Department of the Environment

TECHNICAL SUPPORT DOCUMENT

FOR

COMAR 26.11.24 – Vapor Recovery at Gasoline Dispensing Facilities

AUGUST 27, 2015

PREPARED BY:
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I. Purpose of Amendment

The primary purpose of this action is to allow new gasoline dispensing facilities (GDFs) and GDFs undergoing major modifications the option to choose not to install or decommission existing Stage II vapor recovery equipment. Existing GDFs may decommission Stage II vapor recovery equipment after October 1, 2016. Owners and operators of GDFs that elect to continue with their Stage II equipment can do so, but must continue to test, repair, replace, retrofit, and maintain the Stage II equipment in accordance with Stage II requirements.

Submission to EPA as Revision to Maryland's SIP (or 111(d) Plan, or Title V Program)

The proposed regulation will be submitted to the U.S. EPA for approval as a revision to Maryland's State Implementation Plan (SIP).

II. Facts for Proposal

A. Background

The Clean Air Act (CAA) §182(b)(3) required Stage II vapor recovery for areas classified as moderate, serious, severe, and extreme ozone nonattainment areas. Stage II or Stage II equivalent measures were required statewide because Maryland is part of the Ozone Transport Region. Equivalent measures rather than Stage II were adopted in attainment areas of the state.

Stage II systems transfer by displacement the vapors consisting of fuel air mixture, from the motor vehicle fuel tank fill pipe to the gasoline service station underground storage tank thus preventing volatile organic compounds (VOC) from polluting the air during refueling. The capture of vapors takes place at the interface between the fill pipe and the dispensing nozzle. In the underground tank, the vapors remain in either gaseous or liquid phase as equilibrium between the phases is established.

COMAR 26.11.24, as currently promulgated, requires Stage II Vapor Recovery at all gasoline dispensing facilities built after November 15, 1990 in Baltimore City and Anne Arundel, Baltimore, Calvert, Carroll, Cecil, Charles, Frederick, Harford, Howard, Montgomery, and Prince George's counties. Affected sources have been required to install Stage II systems that meet California Air Resources Board (CARB) standards, with all parts clearly identified as being CARB certified. Over 40 types of Stage II systems have met the rigorous CARB certification standards and carry specific Executive Order numbers. Under existing Maryland requirements, facilities must have at least one person trained to operate and maintain the installed Stage II systems. Facilities required to install and operate Stage II systems are subject to initial and annual testing and inspection requirements, and must maintain records of Stage II maintenance and a malfunction log. COMAR 26.11.24 is currently part of Maryland’s State Implementation Plan (SIP) under the Clean Air Act.

Onboard refueling vapor recovery (ORVR) is a vehicle emission control system required under CAA §202(a)(6) starting with certain 1998 model year gasoline-powered light duty motor vehicles, and covering most vehicles by model year 2006. This system transfers the vapors to a canister in the vehicle filled with activated carbon. The energy content of the captured vapors in the ORVR canister is utilized when the vehicle engine is started. Stage II vapor recovery systems and ORVR each have a projected vapor control efficiency of approximately 95 percent, though actual performance could vary. Over time, non-ORVR vehicles will continue to be replaced with ORVR vehicles. The ORVR control measure is expected to result in a significant decrease in emissions over time until all subject vehicle classes in the highway vehicle fleet are ORVR-equipped.

When ORVR and vacuum assist Stage II systems are operated together, incompatibility due to presence of air instead of vapors from vapor assist systems can result in a 1 to 10 percent decrease in control efficiency over what would be achieved by Stage II or ORVR alone. The decrease in efficiency depends on various factors, including the vacuum assist technology design that draws in air instead of vapors, the gasoline Reid vapor pressure, temperature and throughput. Over time, non-ORVR vehicles will continue to be replaced with ORVR vehicles. Stage II and ORVR emission control systems are redundant, and EPA has determined that ORVR emission reductions are essentially equal to and will soon surpass the emission reductions achieved by Stage II alone.

On May 16, 2012, the U.S. Environmental Protection Agency (EPA) finalized the rule "Widespread Use for Onboard Refueling Vapor Recovery and Stage II Waiver." Section 202(a)(6) of the Clean Air Act allows the EPA to revise or waive certain requirements of the Stage II vapor recovery program in ozone nonattainment areas when the EPA Administrator finds that ORVR systems are in widespread use in the highway vehicle fleet. EPA has determined that the criteria for widespread use of ORVR was met on May 16, 2012, based on national data. Using a gasoline throughput approach, EPA projects that the amount of control that ORVR alone would need to achieve to be equivalent to the amount of control Stage II alone would achieve is 77.4 percent. Given the widespread use of ORVR, Stage II control systems now provide increasingly less air pollution reduction beyond what is provided by ORVR and therefore are increasingly less cost-effective.

Section 182 of the Clean Air Act still requires states in the Ozone Transport Region (OTR), including Maryland, to adopt and implement control measures that are capable of achieving emissions reductions comparable to those achievable by Stage II systems. On August 7, 2012, EPA released their Guidance on Removing Stage II Gasoline Vapor Control Programs from State Implementation Plans and Assessing Comparable Measures, EPA-457/B-12-001. EPA's guidance document provides both technical and policy recommendations to states and local areas on how to develop and submit an approvable SIP revision seeking to remove or phase-out an existing Stage II program. This guidance introduces methods and equations that could be used to calculate the emissions consequences of discontinuing Stage II control programs for purposes of demonstrating compliance with specific CAA provisions in sections 110(ℓ) and 193 governing EPA approval of SIP revisions. This guidance also includes new technical and policy guidance for areas of the OTR on implementing measures capable of achieving emissions reductions comparable to those achievable by ongoing implementation of Stage II controls.

B. Sources Affected and Location

The amendments to this regulation affect new and existing GDFs in Baltimore City and Anne Arundel, Baltimore, Calvert, Carroll, Cecil, Charles, Frederick, Harford, Howard, Montgomery, and Prince George's counties. There are approximately 1,500 existing GDFs subject to Stage II vapor recovery requirements in Maryland. Based on new construction activity records, an average of 20-25 new facilities are built each year in areas of the State subject to this regulation.

C. Requirements

The proposed action provides new and existing GDFs and those undergoing major modifications a regulatory option to either not install or decommission Stage II vapor recovery equipment. Existing GDFs may decommission Stage II vapor recovery equipment after October 1, 2016. The proposed regulation is developed in accordance with EPA's "Guidance on Removing Stage II Gasoline Vapor Control Programs from State Implementation Plans and Assessing Comparable Measures" (Guidance) EPA-457/B-12-001, August 7, 2012.

Maryland is proposing the following amendments to COMAR 26.11.24:

1. Allow GDFs constructed after the effective date of the regulation the option to not install and operate Stage II systems;

2. Allow existing GDFs undergoing major modifications to decommission Stage II systems after the effective date of the regulation;

3. Allow existing GDFs to decommission Stage II systems after October 1, 2016; and

4. An owner or operator of a GDF that decommissions a Stage II vapor recovery system shall perform the decommissioning of the Stage II vapor recovery system in accordance with the "Recommended Practices for Installation and Testing of Vapor Recovery Systems at Vehicle Refueling Sites" of the Petroleum Equipment Institute, Section 14, 2009 and COMAR 26.10.10.

<u>Technology Advancement Considerations</u>

Several emerging technologies have been shown to provide significant reductions in VOC emissions and toxic exposures at GDFs. New technologies such as dripless nozzles and low-permeation hoses have either recently become certified by the California Air Resources Board or are under review. These technologies have been proven to reduce impacts on air, water and land, reduce public health risks and generate energy savings. They provide significant benefit with minimal cost and in some instances are economically cheaper over their life-cycle as compared to traditional equipment. The Department believes these technologies may naturally make their

way into the market. Additional technologies such as pressure monitoring and management further ensure that VOC emissions are minimal at GDFs. The Department will consider future amendments to the regulations requiring new technologies as these items become commercially available and if emission reductions are needed for air quality attainment.

D. Expected Emissions Reductions

Over time, non-ORVR vehicles will continue to be replaced with ORVR vehicles. The ORVR control measure is expected to result in a significant decrease in emissions over time until all subject vehicle classes in the highway vehicle fleet are ORVR-equipped. Stage II and ORVR emission control systems are redundant, and, EPA has determined that ORVR emission reductions are essentially equal to and will soon surpass the emission reductions achieved by Stage II alone. By waiving the Stage II requirement, EPA is reducing regulatory burdens on the gasoline service station industry.

In 2012, the Maryland Department of the Environment contracted for an analysis of the potential impacts associated with the elimination of Stage II requirements in Maryland. The analysis for Maryland has shown that Stage II systems in Maryland will continue to show diminishing VOC benefits in Maryland until the year 2020 when thereafter incompatibility issues with ORVR systems will result in excess VOC emissions being released. Stage II vapor recovery systems total statewide VOC reductions for all refueling operations in 2014 has been calculated to be 1.7 tons/day of VOC and in 2020 to be 0.17 tons/day of VOC.

E. Estimate of Economic Impact

I. Economic Impact on Affected Sources, the Department, other State Agencies, Local Government, other Industries or Trade Groups, the Public

New GDFs of medium model size category would save $14,000-16,000 (off the capital investment) from not having to install Stage II systems. Underground vapor recovery pipes, pumps, Stage II nozzles, coaxial gasoline delivery and vapor recovery hoses, inspections and testing would not be required for facilities that choose not to install or maintain Stage II systems. A vapor recovery nozzle costs approximately $200 more than a standard non-Stage II nozzle. The EPA estimates that for an average size GDF the annual cost to maintain existing Stage II systems is about $3,000 per year, with decommissioning this cost is removed. Maintenance, testing, inspection and recordkeeping costs are also reduced.

Existing GDFs that choose to decommission Stage II systems must perform the decommissioning of the Stage II vapor recovery system in accordance with the "Recommended Practices for Installation and Testing of Vapor Recovery Systems at Vehicle Refueling Sites" of the Petroleum Equipment Institute, Section 14, 2009 and COMAR 26.10.10. There will be a cost to implement the removal of Stage II per the guidelines and the industry estimates that cost to be $10,000 - $15,000. The EPA estimates that for an average size existing GDF the annual cost to maintain existing Stage II systems is about $3,000 per year, with decommissioning this cost is removed.

There will be no expected impact on the Department, other State agencies, or local governments as a result of this action.

II. Economic Impact on Small Businesses

The proposed action has minimal or no economic impact on small businesses.

F. Comparison to Federal Standard

There is a corresponding federal standard to this proposed action, but the proposed action is not more restrictive or stringent.

Title 26
DEPARTMENT OF THE ENVIRONMENT
Subtitle 11 AIR QUALITY
26.11.24 [Stage II] Vapor Recovery at Gasoline Dispensing Facilities

Authority: Environment Article, §§1-404, 2-103, 2-301—2-303, Annotated Code of Maryland

.01 Definitions.

A. (text unchanged)

B. Terms Defined.

(1)—(8) (text unchanged)

(8-1) "Major Modification" means:

(a) Excavation below a shear valve or tank pad in order to repair or replace Stage II system or an underground storage tank;

(b) Installation of a new dispenser system manufactured without a Stage II system; or

(c) A major system modification consisting of the replacement, repair or upgrade of at least 50 percent of a facility's Stage II vapor recovery system.

(9)—(13) (text unchanged)

(14) *Owner.*

(a) "Owner" means the person who owns a gasoline dispensing facility and who is responsible for the installation requirements, initial compliance, and periodic testing of an approved system.

(b) Owner includes a person who:

(i) Owns an oil storage facility or UST system, or both, used for storage, use, or dispensing of regulated substances; or

(ii) Owned the UST system immediately before the discontinuation of its use.

(*14-1) "Stage I vapor balance system" means coaxial or dual piping that creates a closed system between a tank truck and a stationary storage tank and contains the vapors during the transfer of gasoline.*

(15)—(16) (text unchanged)

(16-1) "Tank System" means a storage tank or a set of manifolded storage tanks containing gasoline.

(17)—(20) (text unchanged)

.01-1 Incorporation by Reference.

A. In this chapter, the following CARB approved test methods are incorporated by reference.

B. Test Methods Incorporated.

(1)—(5) (text unchanged)

(6) Leak Rate and Cracking Pressure of Pressure/Vacuum Valves TP-201.1E.

(7) Determination of Vapor Piping Connections to Underground Gasoline Storage Tanks (Tie-Tank Test) TP-201.3C.

(8) "Recommended Practices for Installation and Testing of Vapor Recovery Systems at Vehicle Refueling Sites" of the Petroleum Equipment Institute, Section 14, 2009.

.02 Applicability, Exemptions, and Effective Date.

A. — D. (text unchanged)

[E.**]**—**[**F.**]** (proposed for repeal)

.03 General Requirements.

A. New Gasoline Dispensing Facilities. **[**After May 15, 1993, an**]** *An* owner or operator of a new gasoline dispensing facility may not operate the gasoline dispensing facility unless it is equipped and operated with an approved system.

A-1. Newly Constructed Gasoline Dispensing Facilities. Notwithstanding §A of this regulation, an owner or operator of a gasoline dispensing facility constructed on or after the effective date of this regulation may operate the gasoline dispensing facility without installing and operating a Stage II vapor recovery system.

B. Existing Gasoline Dispensing Facilities. Except as provided in §*§A-1 and* C of this regulation *and Regulation .03-1A of this chapter*, an owner or operator of an existing gasoline dispensing facility may not operate that gasoline dispensing facility after the following dates, unless it is equipped and operated with an approved system:

(1)—(2) (text unchanged)

C.—I. (text unchanged)

J. Stage I Vapor Recovery. An owner or operator of a gasoline tank truck or an owner or operator of a gasoline dispensing facility subject to this regulation may not cause or permit gasoline to be loaded into a stationary tank unless the loading system is equipped with a Stage I vapor balance system that is properly installed, maintained, and operated.

.03-1 Decommissioning of the Stage II Vapor Recovery System.

A. Notwithstanding Regulation .03A of this chapter, an owner or operator of a gasoline dispensing facility or system of gasoline dispensing facilities that installed approved Stage II vapor recovery systems:

(1) May decommission Stage II vapor recovery systems in accordance with §B of this regulation after October1, 2016; or

(2) May decommission Stage II vapor recovery systems in accordance with §B of this regulation where a gasoline dispensing facility undergoes a major modification after the effective date of this regulation.

B. An owner or operator of a gasoline dispensing facility that decommissions a Stage II vapor recovery system shall perform the decommissioning of the Stage II vapor recovery system in accordance with the "Recommended Practices for Installation and Testing of Vapor Recovery Systems at Vehicle Refueling Sites" of the Petroleum Equipment Institute, Section 14, 2009 and COMAR 26.10.10.

.04 Testing Requirements.

A. Testing Requirements for Stage II Stations. Except as provided in §§E and F of this regulation, an *owner or operator of a gasoline dispensing facility* subject to this chapter *which operates Stage II Vapor Recovery systems* shall perform the following CARB-approved tests.

(1) — (5) (text unchanged)

(6) A leak rate and cracking pressure test in accordance with TP-201.1E referenced in Regulation .01-1B(6).

(7) A tie tank test in accordance with TP-201.3C as referenced in Regulation .01-1B(7).

A-1. Testing Requirements for Decommissioned Stations and New Stations Installed after the effective date of this regulation that did not Install Stage II. Except as provided in §§E and F of this regulation, an owner or operator of a gasoline dispensing facility subject to this chapter who does not operate a Stage II Vapor Recovery system shall perform the testing requirements of §A(1), (6), and (7) of this regulation.

B. (text unchanged)

C. Stage II Vapor Recovery System.

(1) (text unchanged)

(2) Test Schedule.

Type of Stage II Vapor Recovery System	Initial Test	Frequency of Retest
(a) Vapor Balance System	Dynamic Back Pressure	12 months
	Leak Test	12 months
	Leak Rate and Cracking Pressure	*12 months*
	Tie-Tank Test	*12 months*
	Liquid Blockage Test	5 years
(b) Vapor Assist System—Type 1	Air to Liquid Ratio Test	12 months
	Leak Test	12 months
	Leak Rate and Cracking Pressure	*12 months*
	Tie-Tank Test	*12 months*
	Liquid Blockage Test	5 years
(c) Vapor Assist System—Type 2 Model 400	Nozzle Regulation Test	12 months
	Vapor Return Leak Tightness Test	12 months
	Leak Rate and Cracking Pressure	*12 months*
	Tie-Tank Test	*12 months*
(d) Vapor Assist System—Type 2 Model 600	Air to Liquid Ratio Test	12 months
	Vapor Return Line Vacuum Integrity Test	12 months
	Leak Rate and Cracking Pressure	*12 months*
	Tie-Tank Test	*12 months*

D.—F. (text unchanged)

.07 Record-Keeping and Reporting Requirements.

A.—D. (text unchanged)

E. The following reporting requirements apply to any test required under this chapter:

(1)—(2) (text unchanged)

(3) Copies of all test results shall be forwarded to the Department within [45] *30* days of the test; and

(4) (text unchanged)

IV. Appendices

Appendix A - Widespread Use

Appendix B - EPA Guidance

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Appendix A

Widespread Use

ENVIRONMENTAL PROTECTION AGENCY

40 CFR Part 51

[EPA–HQ–OAR–2010–1076; FRL–9671–3]

RIN 2060–AQ97

Air Quality: Widespread Use for Onboard Refueling Vapor Recovery and Stage II Waiver

AGENCY: Environmental Protection Agency (EPA).

ACTION: Final rule.

SUMMARY: The EPA has determined that onboard refueling vapor recovery (ORVR) technology is in widespread use throughout the motor vehicle fleet for purposes of controlling motor vehicle refueling emissions, and, therefore, by this action, the EPA is waiving the requirement for states to implement Stage II gasoline vapor recovery systems at gasoline dispensing facilities in nonattainment areas classified as Serious and above for the ozone national ambient air quality standards (NAAQS). This finding will be effective as noted below in the **DATES** section. After the effective date of this notice, a state previously required to implement a Stage II program may take appropriate action to remove the program from its State Implementation Plan (SIP). Phasing out the use of Stage II systems may lead to long-term cost savings for gas station owners and operators while air quality protections are maintained.

DATES: This rule is effective on May 16, 2012.

ADDRESSES: The EPA has established a docket for this rule, identified by Docket ID No. EPA–HQ–OAR–2010–1076. All documents in the docket are listed in *www.regulations.gov*. Although listed in the index, some information is not publicly available, *i.e.*, confidential business information or other information whose disclosure is restricted by statute. Certain other material, such as copyrighted material, is not placed on the Internet and will be publicly available only in hard copy form. Publicly available docket materials are available either electronically in *www.regulations.gov* or in hard copy at the Air and Radiation Docket and Information Center, EPA Headquarters Library, Room Number 3334 in the EPA West Building, located at 1301 Constitution Ave. NW., Washington, DC. The Public Reading Room is open from 8:30 a.m. to 4:30 p.m., Monday through Friday, excluding legal holidays. The telephone number for the Public Reading Room is (202) 566–1744.

FOR FURTHER INFORMATION CONTACT: Mr. Lynn Dail, Office of Air Quality Planning and Standards, Air Quality Policy Division, Mail code C539–01, Research Triangle Park, NC 27711, telephone (919) 541–2363; fax number: 919–541–0824; email address: *dail.lynn@epa.gov*.

SUPPLEMENTARY INFORMATION:

I. Purpose of Regulatory Action

Since 1990, Stage II gasoline vapor recovery systems have been a required emissions control measure in Serious, Severe, and Extreme ozone nonattainment areas. Beginning with model year 1998, ORVR equipment has been phased in for new vehicles, and has been a required control on nearly all new highway vehicles since 2006. Over time, non-ORVR vehicles will continue to be replaced with ORVR vehicles. Stage II and ORVR emission control systems are redundant, and the EPA has determined that emission reductions from ORVR are essentially equal to and will soon surpass the emission reductions achieved by Stage II alone. In this action, the EPA is eliminating the largely redundant Stage II requirement in order to ensure that refueling vapor control regulations are beneficial without being unnecessarily burdensome to American business. This action allows, but does not require, states to discontinue Stage II vapor recovery programs.

II. Summary of the Major Provisions of This Final Rule

Clean Air Act (CAA) section 202(a)(6) provides discretionary authority to the EPA Administrator to, by rule, revise or waive the section 182(b)(3) Stage II requirement for Serious, Severe and Extreme ozone nonattainment areas after the Administrator determines that ORVR is in widespread use throughout the motor vehicle fleet. Based on criteria that the EPA proposed last year (76 FR 41731, July 15, 2011), the EPA is determining that ORVR is in widespread use. As of the effective date of today's action, states that are implementing mandatory Stage II programs under section 182(b)(3) of the CAA may submit revisions to their SIPs to remove this program.

The EPA will also be issuing non-binding guidance on developing and submitting approvable SIP revisions.[1] This guidance will address SIP requirements for states in the Ozone Transport Region (OTR), which are separately required under section 184(b)(2) of the CAA to adopt and implement control measures capable of achieving emissions reductions comparable to those achievable by Stage II. The EPA is updating its guidance for estimating what Stage II comparable emissions reductions could be, in light of the ORVR widespread use determination. The EPA now expects Stage II comparable emissions reductions to be substantially less than what was estimated in the past before ORVR use became widespread. Therefore, the EPA encourages states to consult the updated guidance before submitting a SIP revision removing Stage II controls.

III. Costs and Benefits

The primary purpose of this final rule is to promulgate a determination that ORVR is in widespread use as permitted in section 202(a)(6) of the CAA. In this final rule, EPA is exercising the authority provided by section 202(a)(6) of the CAA to, by rule, revise or waive the section 182(b)(3) Stage II requirement for Serious, Severe, and Extreme ozone nonattainment areas after the Administrator determines that ORVR is in widespread use throughout the motor vehicle fleet. This in turn gives states that were required to implement Stage II vapor recovery under section 182(b)(3) of the CAA the option to submit for the EPA's review and approval revised ozone SIPs that will remove this requirement. The EPA projects that during 2013–2015, gasoline-dispensing facilities (GDFs) in up to 19 states and the District of Columbia could seek to decommission and remove Stage II systems from their dispensers. There are about 30,600 GDFs with Stage II in these 20 areas. If the states submit and EPA approves SIP revisions to remove Stage II systems from these GDFs, the EPA projects savings of about $10.2 million in the first year, $40.5 million in the second year, and $70.9 million in the third year. Long-term savings are projected to be about $91 million per year, compared to the current use of Stage II systems in these areas. No significant emission

[1] "Phasing Out Stage II Gasoline Refueling Vapor Recovery Programs: Guidance on Satisfying Requirements of Clean Air Act Sections 110(ℓ), 193, and 184(b)(2) (tentative title)." U.S. EPA Office of Air and Radiation, forthcoming. This guidance will provide the EPA's recommendations for states to consider when developing SIP revisions following today's rulemaking. Unlike the final rule, the guidance is not final agency action, and is not binding on or enforceable against any person. Consequently, it is subject to possible revision without additional rulemaking. In addition, the approaches suggested in the guidance (or in any changes thereto) will not represent final agency action unless and until the EPA takes a final SIP approval or disapproval action implementing those approaches.

increases or decreases are expected from this action.

IV. General Information

A. Does this action apply to me?

Entities directly affected by this action include states (typically state air pollution control agencies) and, in some cases, local governments that develop air pollution control rules that apply to areas classified as Serious and above for nonattainment of the ozone NAAQS. Individuals and companies that operate gasoline dispensing facilities may be indirectly affected by virtue of state action in SIPs that implement provisions resulting from final rulemaking on this action; many of these sources are in the following groups:

Industry group	SIC [a]	NAICS [b]
Gasoline stations	5541	447110, 447190

[a] Standard Industrial Classification.
[b] North American Industry Classification System.

B. Where can I get a copy of this document and other related information?

In addition to being available in the docket, an electronic copy of this notice will be posted at *http://www.epa.gov/air/ozonepollution/actions.html#impl* under "recent actions."

C. How is this notice organized?

The information presented in this preamble is organized as follows.

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F. Executive Order 13175: Consultation and Coordination With Indian Tribal Governments
G. Executive Order 13045: Protection of Children From Environmental Health and Safety Risks
H. Executive Order 13211: Actions That Significantly Affect Energy Supply, Distribution, or Use
I. National Technology Transfer and Advancement Act
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K. Congressional Review Act
IX. Statutory Authority

V. Background

A. What requirements for Stage II gasoline vapor recovery apply in ozone nonattainment areas?

The requirements in the 1990 CAA Amendments regarding Stage II vapor recovery are contained in Title I: Provisions for Attainment and Maintenance of National Ambient Air Quality Standards. Under CAA section 182(b)(3), Stage II gasoline vapor recovery systems are required to be used at higher throughput GDFs located in Serious, Severe, and Extreme nonattainment areas for ozone.[2] States were required to adopt a Stage II program into their SIPs, and the controls were to be installed according to specified deadlines following state rule adoption.[3] Since the early 1990s, Stage 2 gasoline vapor controls have provided substantial emissions reductions and have contributed to improved air quality over time.

B. Stage II Vapor Recovery Systems

When a gasoline-powered automobile or other vehicle is brought into a GDF to be refueled, the empty portion of the fuel tank on the vehicle contains gasoline vapors. When liquid gasoline is pumped into the partially empty gas tank, gasoline vapors are forced out of the tank and fill pipe as the tank fills with liquid gasoline. Where air pollution control technology is not used, these vapors are emitted into the ambient air. In the atmosphere, these vapors can react with sunlight, nitrogen oxides and other volatile organic compounds to form ozone.

There are two basic technical approaches to Stage II vapor recovery: A "balance" system, and a vacuum assist system. A balance type Stage II control system has a rubber boot around the gasoline nozzle spout that fits snugly up to a vehicle's gasoline fill pipe during refueling of the vehicle. With a balance system, when gasoline in the underground storage tank (UST) is pumped into a vehicle, a positive pressure differential is created between the vehicle tank and the UST. This pressure differential draws the gasoline vapors from the vehicle fill pipe through the rubber boot and the concentric hoses and underground piping into the UST. This is known as a balance system because gasoline vapors from the vehicle tank flow into the UST tank to balance pressures. About 30 percent of Stage II GDFs nationwide use the balance type Stage II system.

The vacuum assist system is the other primary type of Stage II system currently in operation. This type of Stage II system uses a vacuum pump on the vapor return line to help draw vapors from the vehicle fill pipe into the UST. An advantage of this type of system is that the rubber boot around the nozzle can be smaller and lighter (or not used at all) and still draw the vapors into the vapor return hose. This makes for an easier-to-handle nozzle, which is popular with customers. About 70 percent of Stage II GDFs nationwide use the vacuum assist approach.

New Stage II equipment is normally required to achieve 95 percent control effectiveness at certification. However, studies have shown that in-use control efficiency depends on the proper installation, operation, and maintenance of the control equipment at the GDF.[4]

[2] Originally, the section 182(b)(3) Stage II requirement also applied in all Moderate ozone nonattainment areas. However, under section 202(a)(6) of the CAA, 42 U.S.C. 7521(a)(6), the requirements of section 182(b)(3) no longer apply in Moderate ozone nonattainment areas after the EPA promulgated ORVR standards on April 6, 1994, 59 FR 16262, codified at 40 CFR parts 86 (including 86.098–8), 88 and 600. Under implementation rules issued in 2002 for the 1997 8-hour ozone standard, the EPA retained the Stage II-related requirements under section 182(b)(3) as they applied for the now-revoked 1-hour ozone standard, 40 CFR 51.900(f)(5) and 40 CFR 51.916(a).

[3] This requirement only applies to facilities that sell more than a specified number of gallons per month and is set forth in sections 182(b)(3)(A)–(C) and 324(a)–(c). Section 182(b)(3)(B) has the following effective date requirements for implementation of Stage II after the adoption date by a state of a Stage II rule: 6 months after adoption of the state rule, for GDFs built after the enactment date (which for newly designated areas would be the designation date); 1 year after adoption date, for gas stations pumping at least 100,000 gal/month based on average monthly sales over 2-year period before adoption date; 2 years after adoption, for all others.

[4] The Petroleum Equipment Institute has published recommended installation practices (PEI/

Continued

Damaged, missing, or improperly operating components or systems can significantly degrade the control effectiveness of a Stage II system.

In-use effectiveness ultimately depends on the consistency of inspections, follow-up review by state agencies, and actions by operators to perform inspections and field tests and conduct maintenance in a correct and timely manner. The EPA's early guidance for Stage II discussed expected training, inspection, and testing criteria, and most states have adopted and supplemented these criteria as deemed necessary for balance and vacuum assist systems.[5] In some cases, states have strictly followed the EPA guidance but other states have required a lesser level of inspection and enforcement efforts. Past EPA studies have estimated Stage II in-use efficiencies of 92 percent with semi-annual inspections, 86 percent with annual inspections and 62 percent with minimal or less frequent state inspections.[6] The in-use effectiveness of Stage II control systems may vary from state to state, and may vary over time within any state or nonattainment area because the in-use efficiency of Stage II vapor recovery systems depends heavily on the ongoing maintenance and oversight by GDF owners/operators and the state/local agencies.

C. Onboard Refueling Vapor Recovery (ORVR) Systems

In addition to Stage II controls, the 1990 CAA Amendments required another method of controlling emissions from dispensing gasoline. Section 202(a)(6) of the CAA requires an onboard system of capturing vehicle-refueling emissions, commonly referred to as an ORVR system.[7] ORVR consists of an activated carbon canister installed on the vehicle into which vapors are routed from the vehicle fuel tank during refueling. There the vapors are captured by the activated carbon in the canister. To prevent the vapors from escaping through the fill pipe opening, the vehicle employs a seal in the fill pipe which allows liquid gasoline to enter but blocks vapor escape. In most cases, these are "liquid seals" created by the incoming liquid gasoline slightly backing near the bottom of the fill pipe. When the engine is started, the vapors are purged from the activated carbon and into the engine where they are burned as fuel.

The EPA promulgated ORVR standards on April 6, 1994 (59 FR 16262). Section 202(a)(6) of the CAA required that the EPA's ORVR standards apply to light-duty vehicles manufactured beginning in the fourth model year after the model year in which the standards were promulgated, and that ORVR systems provide a minimum evaporative emission capture efficiency of 95 percent.

Automobile manufacturers began installing ORVR on new passenger cars in 1998 when 40 percent of new cars were required to have ORVR. The regulation required the percentage of new cars with ORVR increase to 80 percent in 1999 and 100 percent in 2000. The regulation also required that ORVR for light duty trucks and vans (<6000 pounds (lbs) gross vehicle weight rating (GVWR)) was to be phased-in during 2001 with 40 percent of such new vehicles required to have ORVR in 2001, 80 percent in 2002 and 100 percent in 2003. New heavier light-duty trucks (6001–8500 lbs GVWR) were required to have 40 percent with ORVR by 2004, 80 percent by 2005 and 100 percent by 2006. New trucks up to 10,000 lbs GVWR manufactured as a complete chassis were all required to have ORVR by 2006.[8] Complete vehicle chassis for heavy-duty gasoline vehicles between 10,001 and 14,000 lbs GVWR (Class 3) are very similar to those between 8,501 and 10,000 lbs GVWR. For model consistency purposes, manufacturers began installing ORVR on Class 3 complete chassis in 2006 as well. So, after 2006, essentially all new gasoline-powered vehicles less than 14,000 lbs GVWR are ORVR-equipped.

ORVR does not apply to all vehicles, but those not covered by the ORVR requirement comprise a small percentage of the gasoline-powered highway vehicle fleet (approximately 1.5 percent of gasoline consumption). The EPA estimates that by the end of 2012, more than 71percent of vehicles currently on the road will have ORVR.[9] This percentage will increase over time as older cars and trucks are replaced by new models. However, under the current regulatory construct, motorcycles and heavy-duty gasoline vehicles not manufactured as a complete chassis are not required to install ORVR, so it is likely that there will be some very small percentage of gasoline refueling emissions not captured by ORVR controls.

Even prior to the EPA's adoption of ORVR requirements, in 1993 EPA adopted Onboard Diagnostic (OBD) System requirements for passenger cars and light trucks, and eventually did so for heavy-duty gasoline vehicles up to 14,000 lbs GVWR.[10] These systems are designed to monitor the in-use performance of various vehicle emission control systems and components, including protocols for finding problems in the purge systems and large and small vapor leaks in ORVR/evaporative emission controls.[11] OBD II systems were phased in for these vehicle classes over the period from 1994–1996 for lighter vehicles and 2005–2007 for heavy-duty gasoline vehicles, so, during the same time frame that manufacturers were implementing ORVR into their vehicles, they already had implemented or were implementing OBD II systems.

In 2000, the EPA published a report addressing the effectiveness of OBD II control systems.[12] This study concluded that enhanced evaporative and ORVR emission control systems are durable and low emitting relative to the FTP (Federal Test Procedure) enhanced evaporative emission standards, and that OBD II evaporative emissions checks are a suitable replacement for functional evaporative emission tests in state inspection and maintenance (I/M) programs. OBD system codes are interrogated and evaluated in a 30-vehicle emission I/M program. A recent EPA review of OBD data gathered from I/M programs from five states[13] indicated relatively few vehicles had any evaporative system-related OBD codes that would indicate a potential

RP300–93) and most states require inspection, testing, and evaluation before a system is commissioned for use.

[5] "Enforcement Guidance for Stage II Vehicle Refueling Control Programs," U.S. EPA, Office of Air and Radiation, Office of Mobile Sources, December 1991.

[6] "Technical Guidance—Stage II Vapor Recovery Systems for Control of Vehicle Refueling at Gasoline Dispensing Facilities Volume I: Chapters," EPA–450/3–91–022a, November 1991. This study is a composite of multiple studies.

[7] Unlike Stage II, which is a requirement only in ozone nonattainment areas, ORVR requirements apply to vehicles everywhere. More detail on ORVR is available at *http://www.epa.gov/otaq/orvr.htm*.

[8] The EPA promulgated ORVR standards for light duty vehicles and trucks on April 6, 1994, 59 FR 16262, codified at 40CFR parts 86 (including 86.098–8), 88 and 600.

[9] *See* EPA Memorandum "Onboard Refueling Vapor Recovery Widespread Use Assessment." A copy of this memorandum is located in the docket for this action EPA–HQ–OAR–2010–1076.

[10] *See* **Federal Register** at 58 FR 9468 published February 19, 1993, and subsequent amendments and the latest OBD regulations at 40 CFR part 86.1806–05 for program requirements in various years.

[11] ORVR systems are basically a subset of evaporative emission systems because they share the same vapor lines, purge valves, purge lines, and activated carbon canister.

[12] "Effectiveness of OBD II Evaporative Emission Monitors—30 Vehicle Study," EPA 420–R–00–018, October 2000.

[13] *See* EPA Memorandum, "Review of Frequency of Evaporative System Related OBD Codes for Five State I/M Programs." A copy of this memorandum is located in the docket for this action EPA–HQ–OAR–2010–1076.

problem with the vapor management system.

Based on emissions tests of over 1,100 in-use ORVR-equipped vehicles, EPA concluded that the average in-use efficiency of ORVR is 98 percent. The legal requirement for ORVR is 95 percent efficiency. Thus, the actual reported control achieved in practice is greater than the statutorily required level of control.

D. Compatibility Between Some Vapor Recovery Systems

Even though the per-vehicle vapor recovery efficiency of ORVR exceeds that of Stage II, Stage II vapor recovery systems have provided valuable reductions in ozone precursors and air toxics as ORVR has been phased into the motor vehicle fleet. In fact, overall refueling emissions from vehicle fuel tanks are minimized by having both ORVR and Stage II in place, but the incremental gain from retaining Stage II decreases relatively quickly as ORVR penetration surpasses 75 percent of dispensed gasoline. Please see Table 2 below. This occurs not only because of a decreasing amount of gasoline being dispensed to non-ORVR equipped vehicles, but also because differences in operational design characteristics between ORVR and vacuum assist Stage II systems may in some cases cause a reduction in the overall control system efficiency compared to what could have been achieved relative to the individual control efficiencies of either ORVR or Stage II emissions from the vehicle fuel tank. The problem arises because the ORVR canister captures the gasoline vapor emissions from the motor vehicle fuel tank rather than the vapors being drawn off by the vacuum assist Stage II system. This occurs because the fill pipe seal blocks the vapor from reaching the Stage II nozzle. Thus, instead of drawing vapor-laden air from the vehicle fuel tank into the underground storage tank (UST), the vacuum pump of the Stage II system draws mostly fresh air into the UST. This fresh air causes gasoline in the UST to evaporate inside the UST and creates an internal increase in UST pressure. As the proportion of ORVR vehicles increases, the amount of fresh air, void of gasoline vapors, pumped into the UST also increases. Even with pressure/vacuum valves in place this eventually leads to gasoline vapors being forced out of the UST vent pipe into the ambient air. These new UST vent-stack emissions detract from the overall recovery efficiency at the GDF. As discussed in the proposed rule, the level of these UST vent stack emissions varies based on several factors but can result in a net 1 to 10 percent decrease in overall control efficiency of vehicle fuel tank emissions at any given GDF.[14] The decrease in efficiency varies depending on the vacuum assist technology design (including the use of a mini-boot for the nozzle and the ratio of volume of air drawn into the UST compared to the volume of gasoline dispensed (A/L) ratio), the gasoline Reid vapor pressure, the air and gasoline temperatures, and the fraction of throughput dispensed to ORVR vehicles. There are various technologies that address these UST vent-stack emissions and can extend the utility of Stage II to further minimize the overall control of gasoline vapor emissions at the GDF. These technologies include nozzles that sense when fresh air is being drawn into the UST and stop or reduce the air flow. These ORVR-compatible nozzles are now required in California and Texas. Another solution is the addition of processors on the UST vent pipe that capture or destroy the gasoline vapor emissions from the vent pipe. A number of these systems were presented in comments on the proposed rule. While they may have merit, installing these technologies adds to the expense of the control systems.

E. Proposed Rule To Determine Widespread Use of ORVR

Section 202(a)(6) of the CAA provides discretionary authority to the EPA Administrator to, by rule, revise or waive the section 182(b)(3) Stage II requirement for Serious, Severe, and Extreme ozone nonattainment areas after the Administrator determines that ORVR is in widespread use throughout the motor vehicle fleet. The percentage of non-ORVR vehicles and the percentage of gasoline dispensed to those vehicles grow smaller each year as these older vehicles wear out and are replaced by new ORVR-equipped models. Given the predictable nature of this trend, the EPA proposed a date for ORVR widespread use.

In the Notice of Proposed Rulemaking (NPRM) (76 FR 41731, July 15, 2011), the EPA proposed that ORVR widespread use will occur at the mid-point in the 2013 calendar year, relying upon certain criteria outlined in the proposed rule. This date was also proposed as the effective date for the waiver of the CAA section 182(b)(3) Stage II requirements for Serious, Severe and Extreme ozone nonattainment areas.

The EPA used two basic approaches in determining when ORVR would be in widespread use in the motor vehicle fleet. Both approaches focused on the penetration of ORVR-equipped vehicles in the gasoline-powered highway motor vehicle fleet. The first proposed approach focused on the volume of gasoline that is dispensed into vehicles equipped with ORVR, and compared the emissions reductions achieved by ORVR alone to the reductions that can be achieved by Stage II controls alone. The second approach focused on the fraction of highway motor gasoline dispensed to ORVR-equipped vehicles.

In the proposal, the EPA included Table 1 (republished below). This work was based on outputs from EPA's MOVES 2010 motor vehicle emissions model, which showed information related to the penetration of ORVR in the national motor vehicle fleet projected to 2020. These model outputs have been updated for the final rule to be consistent with the latest public release of the model (MOVES 2010a) since that is the version of the model states would use in any future inventory assessment work related to refueling emissions control. Overall, ORVR efficiency was shown in column 5 of Table 1 and was determined by multiplying the fraction of gasoline dispensed into ORVR-equipped vehicles by ORVR's 98 percent in-use control efficiency.

[14] *See* EPA Memorandum "Onboard Refueling Vapor Recovery Widespread Use Assessment." A copy of this memorandum is located in the docket for this action EPA–HQ–OAR–2010–1076. The level of these UST vent stack emissions varies based on several factors; EPA estimates a 5.4 to 6.4 percentage point decrease in Stage II control efficiency in the 2011–2015 time frame at GDFs employing non-ORVR compatible vacuum assist Stage II nozzles. The decrease in efficiency varies depending on the vacuum assist technology design (including the use of a mini-boot for the nozzle and the ratio of volume of air drawn into the UST compared to the volume of gasoline dispensed (A/L) ratio), the gasoline Reid vapor pressure, the air and gasoline temperatures, and the fraction of throughput dispensed to ORVR vehicles. The values will increase over time as the fraction of total gasoline dispensed to ORVR vehicles at Stage II GDFs increases.

TABLE 1—PROJECTED PENETRATION OF ORVR IN THE NATIONAL VEHICLE FLEET BY YEAR—BASED ON MOVES 2010

Calendar year	Vehicle population percentage	VMT Percentage	Gasoline dispensed percentage	ORVR Efficiency percentage
1	2	3	4	5
2006	39.5	48.7	46.2	45.3
2007	45.3	54.9	52.5	51.5
2008	50.1	60.0	57.6	56.4
2009	54.3	64.5	62.1	60.9
2010	59.0	69.3	66.9	65.6
2011	63.6	73.9	71.5	70.1
2012	67.9	78.0	75.6	74.1
2013	71.7	81.6	79.3	77.7
2014	75.2	84.6	82.6	80.9
2015	78.4	87.2	85.3	83.6
2016	81.2	89.4	87.7	85.9
2017	83.6	91.2	89.7	87.9
2018	85.6	92.7	91.3	89.5
2019	87.5	93.9	92.7	90.8
2020	89.0	94.9	93.9	92.0

See EPA Memorandum "Onboard Refueling Vapor Recovery Widespread Use Assessment" in the docket (number EPA–HQ–OAR–2010–1076) addressing details on issues related to values in this table.

Note: In this table, the columns have the following meaning.

1. Calendar year that corresponds to the percentages in the row associated with the year.
2. Percentage of the gasoline-powered highway vehicle fleet that have ORVR.
3. Percentage of vehicle miles traveled (VMT) by vehicles equipped with ORVR.
4. Amount of gasoline dispensed into ORVR-equipped vehicles as a percentage of all gasoline dispensed to highway motor vehicles.
5. Percentage from the same row in column 4 multiplied by 0.98.

In the proposal, the EPA estimated that ORVR would need to achieve in-use emission reductions of about 77.4 percent to be equivalent to the amount of control Stage II alone would achieve. This estimate was based on the in-use control efficiency of Stage II systems and exemptions for Stage II for lower throughput GDFs. In the NPRM, the EPA assumed that in areas where basic Stage II systems are used the control efficiency of Stage II gasoline vapor control systems is 86 percent. The use of this value depends on the assumption that daily and annual inspections, periodic testing, and appropriate maintenance are conducted in a correct and timely manner. In addressing comments, we have stated that this efficiency could be nearer to 60% if inspections testing and maintenance are not conducted and there is minimal enforcement.[15]

In the NPRM, the EPA estimated that the percentage of gasoline dispensed in an area that is covered by Stage II controls is 90 percent. Multiplying the estimated efficiency of Stage II systems (86 percent) by the estimated fraction of gasoline dispensed in nonattainment areas from Stage II-equipped gasoline pumps yielded an estimate of the area-wide control efficiency of Stage II programs of 77.4 percent (0.90 × 0.86 = 0.774 or 77.4 percent) for emissions displaced from vehicle fuel tanks.[16] [17] Table 1 indicated this level of ORVR control efficiency is expected to be achieved during calendar year 2013.

In the second approach for estimating when ORVR is in widespread use, we also observed from Table 1 that by the end of calendar year 2012 more than 75 percent of gasoline will be dispensed into ORVR-equipped vehicles. As discussed in the NPRM, the EPA believed that this percentage of ORVR coverage (≥75 percent) is substantial enough to inherently be viewed as "widespread" under any ordinary understanding of that term. Furthermore, in Table 1, the percentage of VMT by ORVR-equipped vehicles (column 3) and the amount of gasoline dispensed into ORVR-equipped vehicles (column 4) reached or exceeded 75 percent between the end of year 2011 and end of 2012. The EPA believed this provided further support for establishing a widespread use date after the end of calendar year 2012. Based on the dates derived from these two basic approaches, the EPA proposed to determine that ORVR will be in widespread use by June 30, 2013, or the midpoint of calendar year 2013.

VI. This Action

A. Analytical Rationale for Final Rule

Section 202(a)(6) of the CAA provides discretionary authority to the EPA Administrator to, by rule, revise or waive the section 182(b)(3) Stage II requirement after the Administrator determines that ORVR is in widespread use throughout the motor vehicle fleet. As discussed in the NPRM, the EPA has broad discretion in how it defines widespread use and the manner in which any final determination is implemented. In our review of the public comments received on the proposal, no commenter indicated that a widespread use determination was inappropriate or took issue with the EPA's two-pronged analytical approach. We have integrated responses to many comments throughout the preamble to

[15] *See*, "Determination of Widespread Use of Onboard Refueling Vapor Recovery (ORVR) and Waiver of Stage II Vapor Recovery Requirements: Summary of Public Comments and Responses." March 2012. Document contained in docket EPA–HQ–OAR–2010–1076.

[16] *See* section 4.4.3 (especially Figure 4–14 and Table 4–4) in "Technical Guidance—Stage II Vapor Recovery Systems for Control of Vehicle Refueling Emissions at Gasoline Dispensing Facilities, Volume I: Chapters." EPA–450/3–91–022a, November 1991. A copy of this document is located in the docket for this action EPA–HQ–OAR–2010–1076. This is based on annual enforcement inspections and on allowable exemptions of 10,000/50,000 gallons per month as described in section 324(a) of the CAA. The EPA recognizes that these two values vary by state and that in some cases actual in-use efficiencies, prescribed exemption levels, or both may be either higher or lower.

[17] AP–42. The EPA's emission factors document, identifies three sources of refueling emissions: Displacement, spillage, and breathing losses. In the EPA Memorandum "Onboard Refueling Vapor Recovery Widespread Use Assessment" (available in the public docket), the EPA determined that for separate Stage II and ORVR refueling events, spillage and breathing loss emission rates are similar. Thus, this analysis focuses on differences in controlled displacement emissions. Compatibility effects related to ORVR and Stage II vacuum assist systems are addressed separately.

this final rule. A more detailed set of responses is in a document titled, "Determination of Widespread Use of Onboard Refueling Vapor Recovery (ORVR) and Waiver of Stage II Vapor Recovery, Summary of Public Comments and Responses" that can be found in the docket, EPA–HQ–OAR–2010–1076.

The analytical approaches used by the EPA to determine the widespread use date are influenced by several key input parameters that affect the estimates of the emission reduction benefits of Stage II alone versus the benefits of ORVR alone and the phase-in of ORVR-equipped vehicles. We received several comments on the assumptions and parameters used by the EPA in the NPRM, and in some cases we have updated the information used in calculations that support the final rule, as discussed in the following paragraphs.

1. ORVR Parameters

• *ORVR efficiency.* The EPA used an in-use control efficiency of ORVR of 98 percent in the proposal. This was based on the testing of 1,160 vehicles drawn from the field. EPA has updated its analysis to include an additional 478 refueling emission test results for ORVR-equipped vehicles that were conducted in calendar years 2010 and 2011. The data set, which now includes over 1,600 vehicle tests for vehicles from model years 2000–2010 with mileages ranging from 10,000 to over 100,000, continues to support the conclusion that the 98 percent in-use efficiency values remain appropriate.[18]

• *Modeling program inputs.* The NPRM relied on EPA's MOVES 2010 model for estimating ORVR vehicle fleet penetration, VMT by ORVR vehicles, and gallons of gasoline dispensed to ORVR vehicles. Since the development of the NPRM, the EPA has publicly released MOVES 2010a. The updated model incorporates many improvements. Those relevant here include updates in ORVR vehicle sales, sales projections, scrappage, fleet mix, annual VMT, and fuel efficiency. The EPA believes that the modeling undertaken to determine the widespread use date for the final rule should employ the EPA's latest MOVES modeling program because it contains updated information that bears on the subject of this rulemaking, and because the EPA expects states to also use it in any state-specific demonstrations supporting future SIP revisions, including revisions that seek to remove Stage II programs.

2. Stage II Parameters

• *Stage II efficiency.* The EPA used an in-use control efficiency of 86 percent for Stage II in the proposal. As discussed above, Stage II control efficiency depends on inspection, testing, and maintenance by GDF owner/operators, and inspection and enforcement by state/local agencies. Typical values range from 62 percent to 86 percent. The public comments referred the EPA to additional reported information directly related to in-use effectiveness of Stage II vapor recovery.[19] The reports indicate that for balance and vacuum-assist type Stage II systems in use in many states today, the in-use effectiveness of Stage II is typically near 70 percent. Nonetheless, the EPA has elected to retain the use of an 86 percent efficiency value in the analyses supporting the final rule. This is because many state programs have included the maintenance and inspection provisions recommended by EPA to achieve this level of efficiency in their initial SIPs that originally incorporated Stage II controls.[20] Current in-use efficiency values may well be lower based on the performance of the Stage II technology itself or for other reasons related to maintenance and enforcement. We are not rejecting the additional information from commenters or the possibility that Stage II efficiency may be lower in some states or nonattainment areas. However, the EPA believes these issues are best examined in the SIP review process. If real in-use efficiency across all existing Stage II programs is, in fact, lower than 86 percent, the EPA's final analysis overestimates the length of time required for emissions reductions from ORVR alone to eclipse the reductions that can be achieved by Stage II alone.

• *Stage II exemption rate.* In sections 182(b)(3) and 324 of the CAA, Congress permitted exemptions from Stage II controls for GDFs of less than 10,000 gallons/month (privates) and 50,000 gallons/month (independent small business marketers). The EPA analysis indicated that these GDF throughput values exempted about 10 percent of annual throughput in any given area. Some states included more strict exemption rates, most commonly 10,000 gallons per month (3 percent of throughput) for both privates and independent small business marketers. A few other states' exemption provisions used values that fell within or outside this range.[21] Of the 21 states and the District of Columbia with areas classified as Serious, Severe, or Extreme for ozone and/or within the Ozone Transport Region, the plurality incorporated exemption provisions in their state regulations, which exempted about 10 percent of throughput.[22] Therefore, we believe it remains reasonable to use that value within this analysis.

• *Compatibility factor for vacuum assist Stage II systems.* The EPA discussed the compatibility factor at length in the NPRM and provided relevant materials in the docket. Several commenters asked that the EPA provide guidance on how the compatibility factor should be incorporated into any similar analysis conducted by a state for purposes of future SIP revisions involving Stage II programs. The magnitude of the compatibility factor for any given area varies depending on ORVR penetration, fraction of vacuum assist nozzles relative to balance nozzles, and excess A/L for vacuum assist nozzles. Two states have adopted measures to reduce this effect through the use of ORVR-compatible nozzles and one state prohibits vacuum assist nozzles completely. Due to these significant variables, the EPA is electing not to include the compatibility factor in the widespread use date determination analysis, but will provide the guidance requested by the commenters for use in making future SIP revisions. To the extent that compatibility emissions across all existing Stage II programs as a whole are significant, the EPA's final analysis overestimates the length of time required for emissions reductions from ORVR alone to eclipse the reductions that can be achieved by Stage II alone.

B. Updated Analysis of Widespread Use

As discussed previously, the EPA has used two approaches for determining

[18] *See* the EPA memorandum "Updated ORVR In-Use Efficiency." A copy of this memorandum is located in the docket for this action EPA–HQ–OAR–2010–1076.

[19] *See* "Draft Vapor Recovery Test Report," April 1999 by CARB and CAPCOA (now cleared for public use), and "Performance of Balance Vapor Recovery Systems at Gasoline Dispensing Facilities", prepared by the San Diego Air Pollution Control District, May 18, 2000. Both reports are available in the public docket.

[20] The EPA report, "Enforcement Guidance for Stage II Vehicle Refueling Control Programs," U.S. EPA, Office of Air and Radiation, Office of Mobile Sources, December 1991, provides basic EPA guidance on what a state SIP and accompanying regulations should include to achieve high efficiency.

[21] There are a few states that limit Stage II exemptions to only GDFs with less than 10,000 gpm throughput, which would exempt about three to five percent of area-wide throughput.

[22] *See* the EPA memorandum "Summary of Stage II Exemption Program Values." A copy of this memorandum is located in the docket for this action in EPA–HQ–OAR–2010–1076.

when ORVR is in widespread use on a nationwide basis. After reviewing our methodology and reviewing the related comments on the NPRM, we are retaining three of the four basic analytical input parameters and updating one. The in-use ORVR efficiency, the in-use Stage II efficiency, and the Stage II exemption rate parameters are the same as in the NPRM. However, we have updated the modeling program inputs as discussed previously, and the results are reflected in Table 2.

TABLE 2—PROJECTED PENETRATION OF ORVR IN THE NATIONAL VEHICLE FLEET BY YEAR—BASED ON MOVES 2010(a)

End of calendar year	Vehicle population percentage	VMT Percentage	Gasoline dispensed percentage	ORVR Efficiency percentage
1	2	3	4	5
2006	42.6	51.2	49.2	48.2
2007	48.4	57.3	55.5	54.4
2008	53.3	62.3	60.5	59.2
2009	57.7	66.8	64.8	63.5
2010	62.4	71.6	69.5	68.1
2011	67.1	76.0	73.9	72.4
2012	71.4	80.0	77.7	76.1
2013	75.3	83.4	81.0	79.4
2014	78.7	86.3	84.0	82.3
2015	81.8	88.8	86.5	84.8
2016	84.5	90.9	88.6	86.8
2017	86.8	92.5	90.3	88.5
2018	88.8	93.9	91.9	90.0
2019	90.5	95.0	93.2	91.3
2020	92.0	95.9	94.3	92.4

See EPA Memorandum "Onboard Refueling Vapor Recovery Widespread Use Assessment" in the docket (number EPA–HQ–OAR–2010–1076) addressing details on issues related to values in this table.

Note: In this table, the columns have the following meaning.

1. Calendar year that corresponds to the percentages in the row associated with the year.
2. Percentage of the gasoline-powered highway vehicle fleet that have ORVR.
3. Percentage of vehicle miles traveled (VMT) by vehicles equipped with ORVR.
4. Amount of gasoline dispensed into ORVR-equipped vehicles as a percentage of all gasoline dispensed to highway motor vehicles.
5. Percentage from the same row in column 4 multiplied by 0.98.

The results in Table 2 are applied in the context of the two basic analytical approaches used in the NPRM for supporting the final date associated with the EPA's widespread use determination. First, using the analysis based on equal reductions for Stage II and ORVR, the 77.4 percent in-use emission reduction efficiency for ORVR will occur in May 2013 (See column 5 of Table 2). Second, 75 percent of gasoline will be dispensed to ORVR-equipped vehicles by April 2012 (See column 4 of Table 2).

C. Widespread Use Date

The updated analysis indicates that the two benchmarks will occur about a year apart, and that one benchmark of April 2012 has already passed. At the time of the NPRM, both of the benchmark dates for the ORVR widespread use determination were in the future, many months after the EPA's expected final action. Thus, given the basic merits of both approaches, the EPA believed it was reasonable to propose a date between the dates associated with the two analytical approaches.

The EPA's updated analysis presents a somewhat different picture. The April 2012 benchmark date has already passed, and the May 2013 benchmark date is less than 1 year away. We believe it is reasonable for the EPA Administrator to determine that ORVR is in widespread use in the motor vehicle fleet as of the date this final action is published in the **Federal Register** because this final rule is being promulgated within the window bounded by the two benchmark dates derived from the updated analyses.

As discussed previously in this notice and in the NPRM, the EPA has discretion in setting the widespread use date. It is evident from the public comments on the NPRM from states and members of the regulated industry, and from recent state actions, that there is a desire to curtail Stage II installations at newly constructed GDFs, and to initiate an orderly phase-out of Stage II controls at existing GDFs.[23] Since one of the two analytical benchmark dates (April 2012) has passed, and we expect in most cases the second analytical benchmark date (May 2013) will have passed by the time the EPA is able to complete approvals of SIP revisions removing Stage II programs and pass any revised regulations, then in response to comments asking us to expedite the ORVR widespread use finding, the EPA Administrator is determining that ORVR is in widespread use in the motor vehicle fleet as of May 16, 2012. Accordingly, as of May 16, 2012 the requirement to implement a Stage II emissions control program under section 182(b)(3) of the CAA is waived.

D. Implementation of the Rule Provisions

In this final action, the ORVR widespread use determination and waiver of the section 182(b)(3) requirement applies to the entire country. This includes areas that are now classified as Serious or above for ozone nonattainment, as well as those that may be classified or reclassified as Serious or above in the future.

In the NPRM, we indicated that states could potentially demonstrate that ORVR was in widespread use in specific areas sooner than the general, national date. Such a provision is no longer

[23] For example, in November 2011, New Hampshire put new regulations in place that eliminate the need for new GDFs to install Stage II, allows current GDFs with Stage II to decommission the systems, and requires all systems to be decommissioned by December 22, 2015. In May of 2011, New York issued an enforcement discretion directive which curtailed the need for new stations to install Stage II and permitted current installations to be decommissioned. These actions remain under review of EPA.

needed because today's action provides for a nationwide determination of widespread use effective on May 16, 2012.

As stated in this final action and as pointed out by several commenters, the ORVR widespread use determination and section 182(b)(3) waiver determination does not obligate states to remove any existing Stage II vapor recovery requirements. It is possible that a state would determine it beneficial to continue implementation of a Stage II program. For example, in an area where ORVR-equipped fleet penetration is considerably less than the national average, or where Stage II exemptions are significantly more restrictive than the national assumptions used in this analysis, a state may determine that it would not be appropriate to modify its program immediately, but that it would be more appropriate to do so at a later date. In assessing whether and how to phase out Stage II requirements, states are encouraged to review, and as needed revise the area-specific assumptions about taking into consideration their inspection and enforcement resource commitments as well as ORVR/vacuum-assist Stage II compatibility.

A state that chooses to remove the program must submit a SIP revision requesting EPA to approve such action and provide, as appropriate, a demonstration that the SIP revision is consistent with CAA section 110(1), and in some cases consistent with CAA section 193. The EPA will provide additional guidance on conducting assessments to support Stage II-related SIP revisions.[24] The EPA encourages states to review this guidance and consult with the EPA Regional Offices on developing SIP revisions seeking EPA approval for phasing out existing Stage II programs in a manner that ensures air quality protections are maintained.

Section 110(l) precludes the Administrator from approving a SIP revision if it would interfere with applicable CAA requirements (including, but not limited to, attainment and maintenance of the ozone NAAQS and achieving reasonable further progress). A state may demonstrate through analysis that removing a Stage II program in an area as of a specific date will not result in an emissions increase in the area, or that the small and ever-declining increase is offset by other simultaneous changes in the implementation plan. However, a state may find that by removing Stage II requirements, they are reducing the overall level of emissions reductions they have previously applied toward meeting CAA rate of progress (ROP) or reasonable further progress (RFP) requirements, or demonstrating attainment. If so, the state should explain how removing Stage II controls in the area would not interfere with attaining and maintaining the ozone NAAQS in the area. In such circumstances, it is possible that additional emissions reductions from other measures may be needed to offset the removal of Stage II.

If EPA has approved a state's adoption of Stage II requirements into a SIP before November 15, 1990, section 193 would also apply. Section 193 provides that removal of an emissions control program cannot result in any emissions increase unless the increase is offset. Section 193 only applies if an area is nonattainment for the standard.

State and local agencies should also consider any transportation conformity impacts related to removing Stage II if emissions reductions from Stage II are included in a SIP-approved on-road motor vehicle emissions budget. States may need to adjust conformity budgets or the components of the budget if removing Stage II requirements would alter expected air quality benefits.

In previous memoranda, the EPA provided guidance to states on removing Stage II at refueling facilities dedicated to certain segments of the motor vehicle fleet (e.g., new automobile assembly plants, rental car facilities, E85 dispensing pumps, and corporate fleet facilities). In these specific cases where all or nearly all of the vehicles being refueled are ORVR-equipped, the EPA could conservatively conclude that widespread use of ORVR had occurred in these fleets.[25]

E. Implementation of Rule Provisions in the Ozone Transport Region

States and the District of Columbia in the OTR in the northeastern U.S. are also subject to a separate Stage II-related requirement. Under section 184(b)(2) of the CAA (42 U.S.C. 7511c(b)(2)), all areas in the OTR, both attainment and nonattainment areas, must implement control measures capable of achieving emissions reductions comparable to those achievable through Stage II controls. The CAA does not contain specific provisions giving authority to the EPA Administrator to waive this independent requirement. The section 184(b)(2) requirement does not impose Stage II *per se*, but rather is a requirement that OTR states achieve an amount of emissions reductions comparable to the amount that Stage II would achieve. Moreover, section 202(a)(6), in allowing for a waiver of the section 182(b)(3) Stage II requirement for nonattainment areas, does not refer to the independent section 184(b)(2) requirements. Therefore, the section 184(b)(2) Stage II-related requirement for the OTR will continue to remain in place even after the ORVR widespread use determination and section 182(b)(3) waiver effective date.

In the mid-1990s, the EPA issued guidance on estimating what levels of emissions reductions would be "comparable" to those reductions achieved by Stage II.[26] In response, most OTR states simply adopted Stage II programs rather than identify other measures that got the same degree of emissions reductions. Given the continued penetration of ORVR-equipped vehicles into the overall vehicle fleet, Stage II-comparable emissions are significantly less than in the past, and continue to decline. Accordingly, the EPA is issuing updated guidance on determining "comparable measures." States in the OTR should refer to that guidance if preparing a SIP revision to remove Stage II programs in areas of the OTR.[27]

Commenters on the NPRM urged the EPA to revise its previous interpretation of section 184(b)(2) to permit ORVR to be recognized as a Stage II comparable emission reduction measure. This issue is not within the scope of this rulemaking, and EPS is not taking final agency action implementing section 184(b)(2) or an interpretation thereof. However, for informational purposes, we point out that simply treating the ORVR requirements under section 202(a)(6) as a comparable measure that an OTR SIP must additionally contain would arguably render the 184(b)(2) requirement a nullity, which could be an impermissible statutory interpretation. If commenters wish to further address this issue, we ask that they raise their concerns in any future SIP actions under section 184(b)(2) regarding OTR states that may affect them. In addition, we note that the expected level of emissions reductions

[24] "Phasing Out Stage II Gasoline Refueling Vapor Recovery Programs: Guidance on Satisfying Requirements of Clean Air Act Sections 110(*l*), 193, and 184(b)(2) (tentative title)." U.S. EPA Office of Air and Radiation, forthcoming.

[25] "Removal of Stage II Vapor Recovery in Situation where Widespread Use of Onboard Refueling Vapor Recovery is Demonstrated," from Stephen D. Page and Margo Tsirigotis Oge, EPA, December 12, 2006.

[26] "Stage II Comparability Study for the Northeast Ozone Transport Region," (EPA–452/R–94–011; January 1995).

[27] "Phasing Out Stage II Gasoline Refueling Vapor Recovery Programs: Guidance on Satisfying Requirements of Clean Air Act Sections 110(*l*), 193, and 184(b)(2) (tentative title)." U.S. EPA Office of Air and Radiation, forthcoming.

that Stage II programs can obtain has changed significantly in the past 15 years with ORVR-equipped vehicles phasing in at the rate of 3–4 percent of the fleet each calendar year. Therefore, the EPA is issuing updated guidance on estimating the emissions reductions needed to be comparable to those achievable through Stage II controls. Theoretically, comparable measures could in some areas mean no additional control beyond ORVR is required if Stage II is achieving no additional emission reduction benefit in the area, or has reached a point of providing only a declining *de minimis* benefit.

F. Comments on Other Waiver Implementation Issues

Numerous commenters on the NPRM urged the EPA to adopt provisions in the final rule that would exempt new gasoline dispensing facilities with construction occurring between the final rule publication and the effective Stage II waiver date from installing Stage II equipment. The timing issue is now largely moot since widespread use is deemed to have occurred on the effective date of this action. However, under the CAA, states adopt state-specific or area-specific rules, which are then submitted to the EPA for approval into the SIP. These rules are independently enforceable under state law, and also become federally enforceable when the EPA approves them into the SIP. The EPA cannot unilaterally change legally-adopted state statutes or rules or otherwise revise an approved SIP that was not erroneously approved. The EPA's only authority to establish requirements that would apply in lieu of approved SIPs is its authority under CAA section 110(c) to promulgate a Federal Implementation Plan (FIP). To trigger FIP authority, the EPA must first determine that a state has failed to submit a required SIP or that the state's SIP must be disapproved. The circumstances of this ORVR widespread use finding and waiver of the section 182(b)(3) Stage II requirement to do not present either of those situations. According to requirements established by the CAA that are applicable here, states will need to develop and submit SIP revisions to the EPA in order to change or eliminate SIP-approved state rules that set forth the compliance dates for newly constructed GDFs.

Commenters also urged EPA to simply allow states to eliminate all active Stage II programs from certain nonattainment areas after the widespread use date, without requiring SIP revisions from states. While the EPA has discretion to determine the widespread use date, the EPA cannot simply nullify states' rules that are binding and enforceable under state law. In order to change the federal enforceability of SIPs, states must go through the SIP revision process, and the EPA can approve the SIP revision only if the provisions of section 110(l) and any other applicable requirements, such as the requirements of section 193 and the comparable measures requirement for OTR states, are satisfied. Today's final rule takes no action in implementing CAA sections 110(l), 193, or 184(b)(2), and any future final actions regarding "comparable measures" SIPs will be fact-specific in response to individual state submissions. Also, subsequent to the effective waiver date of the section 182(b)(3) Stage II requirements, areas currently implementing the EPA-approved Stage II programs in their SIPs as a result of obligations under the 1-hour or 1997 8-hour ozone NAAQS, would be required to continue implementing these programs until the EPA approves a SIP revision adopted under state law removing the requirement from the state's ozone implementation plan.

VII. Estimated Cost

As part of the NPRM, the EPA conducted an initial assessment of the costs and savings to gasoline dispensing facility owners related to this proposed action. The report titled, "Draft Regulatory Support Document, Decommissioning Stage II Vapor Recovery, Financial Benefits and Costs," is available in the public docket for this action. The report examines the initial costs and savings to facility owners incurred in the decommissioning of Stage II vapor recovery systems, as well as changes in recurring costs associated with above ground hardware maintenance, operations, and administrative tasks. The EPA received no substantive comment on the draft report, other than a concern that the savings identified therein may not come to pass as quickly as envisioned in the draft report if the EPA does not provide updated guidance on comparable measures for the OTR states. We intend to address this concern by issuing separate guidance for the states.[28] EPA will post this action at the following web site address: *http://www.epa.gov/glo/actions.html.*

As part of the re-analysis following the NPRM, the EPA reviewed the input values used for the proposal draft. Most input values were confirmed as reasonable and representative but it was concluded that two of the values should be updated. These include: (1) The pre-tax price of gasoline used in the foregone vapor recovery savings calculation, which increased from $2.30 in 2010 to $3.04 in 2011 (average price per gallon), and (2) the number of Stage II facilities potentially affected by SIP revisions removing Stage II requirements in non-California Serious, Severe and Extreme ozone nonattainment areas which increased from 26,900 to 30,600 in 19 states and the District of Columbia. As discussed in our final regulatory support document, the EPA estimates recurring cost savings of about $3,000 per year for a typical gasoline dispensing facility, and an annual nationwide savings of up to $91 million if Stage II is phased out of the approximately 30,600 dispensing facilities outside of California that are required to have Stage II vapor recovery systems under section 182(b)(3) of the CAA.[29] This analysis assumes that Stage II is removed from GDFs over a three year time frame in an equal number each year. What actually occurs will depend on actions by the individual states. If the states submit and EPA approves SIP revisions to remove Stage II systems from these GDFs, the EPA projects savings of about $10.2 million in the first year, $40.5 million in the second year, and $70.9 million in the third year. Long term savings are projected to be about $91 million per year, compared to the current use of Stage II systems in these areas.

VIII. Statutory and Executive Order Reviews

A. Executive Orders 12866: Regulatory Planning and Review and Executive Order 13563: Improving Regulation and Regulatory Review

Under Executive Order (EO) 12866 (58 FR 51735, October 4, 1993), this action is a "significant regulatory action" because it raises novel legal or policy issues arising out of legal mandates. Accordingly, the EPA submitted this action to the Office of Management and Budget (OMB) for review under Executive Orders 12866 and 13563 (76 FR 3821, January 21, 2011) and any changes made in response to OMB recommendations have been documented in the docket for this action.

[28] "Phasing Out Stage II Gasoline Refueling Vapor Recovery Programs: Guidance on Satisfying Requirements of Clean Air Act Sections 110(*l*), 193, and 184(b)(2) (tentative title)." U.S. EPA Office of Air and Radiation, forthcoming.

[29] *See* "Final Regulatory Support Document, Decommissioning Stage II Vapor Recovery, Financial Benefits and Costs," available in public docket, EPA–HQ–OAR–2010–1076.

B. Paperwork Reduction Act

This action does not impose an information collection burden under the provisions of the Paperwork Reduction Act, 44 U.S.C. 3501 et seq. Burden is defined at 5 CFR 1320.3(b). It does not contain any recordkeeping or reporting requirements.

C. Regulatory Flexibility Act

The Regulatory Flexibility Act (RFA) generally requires an agency to prepare a regulatory flexibility analysis of any rule subject to notice and comment rulemaking requirements under the Administrative Procedure Act or any other statute unless the agency certifies that the rule will not have a significant economic impact on a substantial number of small entities. Small entities include small businesses, small organizations, and small governmental jurisdictions.

For purposes of assessing the impacts of this action on small entities, small entity is defined as: (1) A small business as defined in the Small Business Administration's (SBA) regulations at 13 CFR 121.201; (2) a small governmental jurisdiction that is a government of a city, county, town, school district or special district with a population of less than 50,000; and (3) a small organization that is any not-for-profit enterprise which is independently owned and operated and is not dominant in its field.

After considering the economic impacts of this action on small entities, I certify that this action will not have a significant economic impact on a substantial number of small entities. This rule will not impose any new requirements on small entities. Rather, it provides criteria for reducing existing regulatory requirements on gasoline dispensing facilities, some of which may qualify as small businesses.

D. Unfunded Mandates Reform Act

This action contains no federal mandates under the provisions of Title II of the Unfunded Mandates Reform Act of 1995 (UMRA), 2 U.S.C. 1531–1538 for state, local, or tribal governments or the private sector. The action imposes no enforceable duty on any state, local or tribal governments, or the private sector. Therefore, this action is not subject to the requirements of sections 202 and 205 of the UMRA.

This action is also not subject to the requirements of section 203 of UMRA because it contains no regulatory requirements that might significantly or uniquely affect small governments. This action addresses the removal of a requirement regarding gasoline vapor recovery equipment, but does not impose any obligations to remove these programs.

E. Executive Order 13132: Federalism

This action does not have federalism implications. It will not have substantial direct effects on the states, on the relationship between the national government and the states, or on the distribution of power and responsibilities among the various levels of government, as specified in Executive Order 13132. This action does not impose any new mandates on state or local governments. Thus, Executive Order 13132 does not apply to this rule.

F. Executive Order 13175: Consultation and Coordination With Indian Tribal Governments

This action does not have tribal implications, as specified in Executive Order 13175 (65 FR 67249, November 9, 2000). It will not have substantial direct effects on tribal governments, on the relationship between the federal government and Indian tribes, or on the distribution of power and responsibilities between the federal government and Indian tribes, as specified in Executive Order 13175. Thus, Executive Order 13175 does not apply to this rule.

G. Executive Order 13045: Protection of Children From Environmental Health and Safety Risks

The EPA interprets Executive Order 13045 (62 FR 19885, April 23, 1997) as applying only to those regulatory actions that concern health or safety risks, such that the analysis required under section 5–501 of the Executive Order has the potential to influence the regulation. This action is not subject to Executive Order 13045 because it does not establish an environmental standard intended to mitigate health or safety risks.

H. Executive Order 13211: Actions Concerning Regulations That Significantly Affect Energy Supply, Distribution, or Use

This action is not a "significant energy action" as defined in Executive Order 13211 (66 FR 28355 (May 22, 2001)), because it is not likely to have a significant adverse effect on the supply, distribution, or use of energy. It does not impose additional costs on gasoline distribution, but rather promises to lower operating and maintenance costs for gasoline dispensing facilities by facilitating removal of redundant gasoline refueling vapor controls.

I. National Technology Transfer and Advancement Act

Section 12(d) of the National Technology Transfer and Advancement Act of 1995 ("NTTAA"), Public Law 104–113, 12(d), (15 U.S.C. 272 note) directs EPA to use voluntary consensus standards in its regulatory activities unless to do so would be inconsistent with applicable law or otherwise impractical. Voluntary consensus standards are technical standards (e.g., materials specifications, test methods, sampling procedures, and business practices) that are developed or adopted by voluntary consensus standards bodies. The NTTAA directs EPA to provide Congress, through OMB, explanations when the Agency decides not to use available and applicable voluntary consensus standards.

This rulemaking does not involve technical standards. Therefore, EPA is not considering the use of any voluntary consensus standards.

J. Executive Order 12898: Federal Actions To Address Environmental Justice in Minority Populations and Low-Income Populations

Executive Order 12898 (59 FR 7629 (Feb. 16, 1994)) establishes federal executive policy on environmental justice. Its main provision directs federal agencies, to the greatest extent practicable and permitted by law, to make environmental justice part of their mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority populations and low-income populations in the United States.

The EPA has determined that this final rule will not have disproportionately high and adverse human health or environmental effects on minority or low-income populations because it does not directly affect the level of protection provided to human health or the environment under the EPA's NAAQS for ozone. This action proposes to waive the requirement for states to adopt largely redundant Stage II programs, based on a determination of widespread use of ORVR in the motor vehicle fleet.

K. Congressional Review Act

The Congressional Review Act, 5 U.S.C. 801 *et seq.*, as added by the Small Business Regulatory Enforcement Fairness Act of 1996, generally provides that before a rule may take effect, the agency promulgating the rule must submit a rule report, which includes a copy of the rule, to each House of the

Congress and to the Comptroller General of the United States. The EPA will submit a report containing this rule and other required information to the U.S. Senate, the U.S. House of Representatives and the Comptroller General of the United States prior to publication of the rule in the **Federal Register**. A major rule cannot take effect until 60 days after it is published in the **Federal Register**. This action is not a "major rule" as defined by 5 U.S.C. 804(2). This rule will be effective upon publication in the **Federal Register**.

IX. Statutory Authority

The statutory authority for this action is provided by the CAA, as amended (42 U.S.C. 7401, et seq.); relevant provisions of the CAA include, but are not limited to sections 182(b)(3), 202(a)(6), 301(a)(1), and 307(b), and 307(d)(42 U.S.C. 7511a(b)(3), 7521(a)(6), 7601(a)(1), 7607(b), and 7607(d)).

List of Subjects in 40 CFR Part 51

Environmental protection, Administrative practice and procedure, Air pollution control, Ozone, Particulate matter, Volatile organic compounds.

Dated: May 9, 2012.

Lisa P. Jackson,

Administrator.

For reasons set forth in the preamble, part 51 of chapter I of title 40 of the Code of Federal Regulations is amended as follows:

PART 51—REQUIREMENTS FOR PREPARATION, ADOPTION, AND SUBMITTAL OF IMPLEMENTATION PLANS.

■ 1. The authority citation for part 51 continues to read as follows:

Authority: 23 U.S.C. 101; 42 U.S.C. 7401–7671q.

Subpart G—[Amended]

■ 2. Section 51.126 is added to read as follows:

§ 51.126 Determination of widespread use of ORVR and waiver of CAA section 182(b)(3) Stage II gasoline vapor recovery requirements.

(a) Pursuant to section 202(a)(6) of the Clean Air Act, the Administrator has determined that, effective May 16, 2012, onboard refueling vapor recovery (ORVR) systems are in widespread use in the motor vehicle fleet within the United States.

(b) Effective May 16, 2012, the Administrator waives the requirement of Clean Air Act section 182(b)(3) for Stage II vapor recovery systems in ozone nonattainment areas regardless of classification. States must submit and receive EPA approval of a revision to their approved State Implementation Plans before removing Stage II requirements that are contained therein.

[FR Doc. 2012–11846 Filed 5–15–12; 8:45 am]

BILLING CODE 6560–50–P

ENVIRONMENTAL PROTECTION AGENCY

40 CFR Part 52

[EPA–R03–OAR–2011–0714; FRL–9670–3]

Approval and Promulgation of Air Quality Implementation Plans; Delaware, New Jersey, and Pennsylvania; Determinations of Attainment of the 1997 Annual Fine Particulate Standard for the Philadelphia-Wilmington Nonattainment Area

AGENCY: Environmental Protection Agency (EPA).

ACTION: Final rule.

SUMMARY: EPA is making two determinations regarding the Philadelphia-Wilmington, PA-NJ-DE fine particulate ($PM_{2.5}$) nonattainment area (the Philadelphia Area). First, EPA is making a determination that the Philadelphia Area has attained the 1997 annual $PM_{2.5}$ national ambient air quality standard (NAAQS) by its attainment date of April 5, 2010. This determination is based upon quality assured and certified ambient air monitoring data that show the area monitored attainment of the 1997 annual $PM_{2.5}$ NAAQS for the 2007–2009 monitoring period. Second, EPA is making a clean data determination, finding that the Philadelphia Area has attained the 1997 $PM_{2.5}$ NAAQS, based on quality assured and certified ambient air monitoring data for the 2007–2009 and 2008–2010 monitoring periods. In accordance with EPA's applicable $PM_{2.5}$ implementation rule, this determination suspends the requirement for the Philadelphia Area to submit an attainment demonstration, reasonably available control measures/reasonably available control technology (RACM/RACT), a reasonable further progress (RFP) plan, and contingency measures related to attainment of the 1997 annual $PM_{2.5}$ NAAQS for so long as the area continues to attain the 1997 annual $PM_{2.5}$ NAAQS. These actions are being taken under the Clean Air Act (CAA).

DATES: This rule is effective on June 15, 2012.

ADDRESSES: EPA has established a docket for this action under Docket ID Number EPA–R03–OAR–2011–0714. All documents in the docket are listed in the *www.regulations.gov* Web site. Although listed in the electronic docket, some information is not publicly available, i.e., confidential business information (CBI) or other information whose disclosure is restricted by statute. Certain other material, such as copyrighted material, is not placed on the Internet and will be publicly available only in hard copy form. Publicly available docket materials are available either electronically through *www.regulations.gov* or in hard copy for public inspection during normal business hours at the Air Protection Division, U.S. Environmental Protection Agency, Region III, 1650 Arch Street, Philadelphia, Pennsylvania 19103.

FOR FURTHER INFORMATION CONTACT: If you have questions concerning EPA's action related to Delaware or Pennsylvania, please contact Maria A. Pino, (215) 814–2181, or by email at *pino.maria@epa.gov*. If you have questions concerning EPA's action related to New Jersey, please contact Henry Feingersh, (212) 637–3382, or by email at *feingersh.henry@epa.gov*.

SUPPLEMENTARY INFORMATION: The following outline is provided to aid in locating information in this action.

I. Background
II. Summary of Actions
III. Summary of Public Comments and EPA Responses
IV. Final Actions
V. Statutory and Executive Order Reviews

I. Background

On January 23, 2012, EPA published a direct final rulemaking (77 FR 3147) and companion notice of proposed rulemaking (NPR) (77 FR 3223) for the States of Delaware and New Jersey and the Commonwealth of Pennsylvania (the States). In the January 23, 2012 rulemaking action, EPA proposed to determine that the Philadelphia Area attained the 1997 $PM_{2.5}$ NAAQS by its attainment date, April 5, 2010. EPA also proposed to make a clean data determination, finding that the Philadelphia Area has attained the 1997 $PM_{2.5}$ NAAQS.

Because EPA received adverse comment, EPA withdrew the direct final rule on March 13, 2012 (77 FR14697), and the direct final rule was converted to a proposed rule.

II. Summary of Actions

These actions do not constitute a redesignation to attainment under section 107(d)(3) of the CAA. The designation status of the Philadelphia Area will remain nonattainment for the 1997 annual $PM_{2.5}$ NAAQS until such

Appendix B

EPA Guidance

United States Environmental Protection Agency

Guidance on Removing Stage II Gasoline Vapor Control Programs from State Implementation Plans and Assessing Comparable Measures

EPA-457/B-12-001
August 7, 2012

Guidance on Removing Stage II Gasoline Vapor Control Programs from State Implementation Plans and Assessing Comparable Measures

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List of Selected Acronyms and Abbreviations

A/L	air to liquid ratio
ARB	Air Resources Board (California)
CAA	Clean Air Act
CAPCOA	California Air Pollution Control Officers Association
CF	Compatibility Factor
EE	Excess Vent Emissions
EPA	Environmental Protection Agency
EVR	California enhanced vapor recovery program
FR	Federal Register
GDF	gasoline dispensing facility
GPM	gallons per month
GVWR	gross vehicle weight rating
IUVP	Input Use Verification Program
MOVES	Motor Vehicle Emissions Simulator
NAAQS	National Ambient Air Quality Standards
NESHAP	National Emissions Standards for Hazardous Air Pollutants
NO_X	nitrogen oxides
OBD	onboard diagnostics
ORVR	onboard refueling vapor recovery
OTR	Ozone Transport Region
RFP	reasonable further progress
RFG	reformulated gasoline
RVP	Reid vapor pressure
SIP	state implementation plan
VOC	volatile organic compound
UST	underground storage tank
VMT	vehicle miles traveled
VRS	vapor recovery systems

Preface

On May 9, 2012, the EPA Administrator signed a notice of final rulemaking determining that onboard refueling vapor recovery (ORVR) systems are in widespread use throughout the motor vehicle fleet which was published in the *Federal Register* on May 16, 2012 (77 FR 28772). In that notice the Administrator also exercised her authority to waive the statutory requirement that Serious, Severe, and Extreme ozone nonattainment areas adopt and implement EPA programs requiring Stage II gasoline vapor recovery systems (VRS) at certain gasoline dispensing facilities (GDFs). Many states and local areas have previously adopted Stage II programs into their state implementation plans (SIPs). This guidance document provides both technical and policy recommendations to states and local areas on how to develop and submit an approvable SIP revision seeking to remove or phase-out an existing Stage II program. This guidance introduces methods and equations that could be used to calculate the emissions consequences of discontinuing Stage II control programs for purposes of demonstrating compliance with specific CAA provisions in sections 110(ℓ) and 193 governing EPA approval of SIP revisions. This document also includes new technical and policy guidance, updating that previously issued by EPA in 1995, for areas of the Ozone Transport Region (OTR) on implementing measures capable of achieving emissions reductions comparable to those achievable by ongoing implementation of Stage II controls.

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1. Introduction

Stage II VRS were adopted by some states beginning in the 1980s to meet the ozone National Ambient Air Quality Standards (NAAQS). Stage II and ORVR are two types of emission control systems that capture fuel vapors from vehicle gas tanks during refueling. Stage II and vehicle ORVR were initially both required by the 1990 Amendments to the CAA under sections 182(b)(3) and 202(a)(6), respectively. In some areas Stage II VRS has been in place for over 25 years, but was not widely implemented by the states until the early to mid-1990s as a result of the CAA requirements for Moderate, Serious, Severe, and Extreme ozone nonattainment areas and for states in the Northeast Ozone Transport Region (OTR) under CAA section 184(b)(2). CAA section 202(a)(6) required EPA to promulgate regulations for ORVR for light-duty vehicles (passenger cars). The EPA adopted these requirements in 1994; at which point Moderate ozone nonattainment areas were no longer subject to the section 182(b)(3) Stage II requirement. However, some Moderate areas retained Stage II VRS requirements to provide a control method to comply with rate-of-progress emission reduction targets.[1] ORVR equipment has been phased in for new passenger vehicles beginning with model year 1998, and starting in 2001 for light-duty trucks and most heavy-duty gasoline-powered vehicles. ORVR equipment has been installed on nearly all (~99%) new gasoline-powered light-duty vehicles, light-duty trucks and heavy-duty vehicles since 2006.

During the phase-in of ORVR controls, which began in 1997, Stage II vapor recovery has provided volatile organic compound (VOC) reductions in ozone nonattainment areas and certain attainment areas of the OTR. Congress recognized that ORVR and Stage II would eventually become largely redundant technologies, and provided authority to the EPA to allow states to remove Stage II from their SIPs after EPA finds that ORVR is in widespread use. Effective May 16, 2012, the date the final rule was published in the Federal Register (77 FR 28772), the EPA determined that ORVR is in widespread nationwide use for control of gasoline emissions during refueling of vehicles at gasoline dispensing facilities (GDFs). Currently, more than 75 percent of gasoline refueling nationwide occurs with ORVR-equipped vehicles, so Stage II programs have become largely redundant control systems and Stage II VRS achieve an ever-declining emissions benefit as more ORVR-equipped vehicles continue to enter the on-road motor vehicle fleet. In fact, in areas where certain types of vacuum-assist Stage II control systems are used, the limited compatibility between ORVR and some configurations of this Stage II hardware may ultimately result in an area-wide emissions disbenefit. Therefore, EPA also exercised its authority under CAA section 202(a)(6) to waive certain federal statutory requirements for Stage II gasoline vapor recovery at GDFs.[2] This decision exempts all new ozone nonattainment areas classified Serious or above from the requirement to adopt Stage II control programs. Similarly, any state currently implementing Stage II programs may decide to seek SIP revisions that, once approved by EPA, would allow them to phase out Stage II control systems. Appendix Table A-5 provides a list of states currently implementing Stage II programs under sections 182(b)(3) and 184(b)(2).

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[1] Kentucky, Tennessee, Michigan, Ohio, Virginia, West Virginia, Nevada, California, Oregon and Washington have implemented Stage II for some areas. If these states/areas included Stage II vapor control programs in their SIPs, they will have to amend their SIPs if Stage II is no longer required, and will have to address the provisions of CAA section 110(ℓ).

[2] 77 FR 28772, May 16, 2012. Widespread Use for Onboard Refueling Vapor Recovery and Stage II Waiver.

Ozone nonattainment areas previously required under the CAA to have Stage II gasoline VRS on GDFs may choose to remove the requirement from their SIPs, but states may also retain their Stage II requirements if they wish. A small fraction of the on-road vehicle fleet is not covered by EPA's ORVR regulations, so Stage II controls would not be redundant for such vehicles refueling in areas subject to existing Stage II programs. Even though Stage II controls are capable of achieving some small level of area-wide benefit for non-ORVR refueling events, they may become a less cost-effective method than other alternatives for addressing area-wide VOC emissions and, as noted above, may ultimately result in a disbenefit to air quality in the areas.

In order to phase out existing Stage II programs in SIPs, states would need to submit SIP revisions to EPA meeting applicable CAA requirements and receive approval from the EPA. States in the OTR remain obligated under CAA section 184(b)(2) to implement either a Stage II program or other measures capable of achieving emissions reductions comparable to those achievable by Stage II. The EPA issued guidance on this latter requirement in 1995, and is now updating that guidance to account for ORVR's widespread use in the motor vehicle fleet and its increasing displacement of Stage II as the primary means of controlling refueling emissions

This guidance document contains the information needed for a state to conduct an emissions inventory analysis related to phasing out an existing Stage II program and is designed to facilitate this assessment. The ORVR phase-in and fuel consumption data presented here are derived from the same core approach as used in EPA's MOVES model and incorporates all major elements of that work. Furthermore, it relies on the latest technical information and data available to EPA on both ORVR and Stage II, and in some cases incorporates information not yet in MOVES models. Given these differences, even though the ORVR phase-in and fuel consumption data presented here are derived from the same core approach as used in MOVES, it is expected that the results from using MOVES to assess the inventory impact would be different than the approach suggested below. This is further discussed in Section 3.

How is this guidance document organized? Section 2 discusses the statutory and regulatory framework governing removal of Stage II control programs from SIPs. Section 3 provides technical information that states may consider using to calculate the impact of phasing out Stage II control programs. Section 4 discusses general strategies and considerations for phasing out Stage II control programs. Section 5 presents information on developing SIP revisions for submission to EPA for review and approval. The appendix contains look up tables associated with the equations presented in this guidance and a chart indicating the specific CAA requirement applicable to each state.

2. When can a state or a GDF stop implementing existing Stage II programs?

The CAA section 182(b)(3) requirements for Stage II have been waived as a result of EPA's exercise of waiver authority under CAA section 202(a)(6). This waiver extends to areas classified as Serious or above for the 1997 or 2008 8-hour ozone NAAQS, and to those that were classified Serious or above for the 1-hour ozone NAAQS at the time that the 1-hour NAAQS was revoked.[3] However, areas where a Stage II program is part of an EPA-approved SIP need to continue implementing Stage II until EPA approves a SIP revision that removes the requirement from the SIP.

The EPA is aware that new GDF construction undertaken prior to the approved phase-out date may incur capital costs for installing Stage II that may only be required for a short time. It is evident from the public comments on the EPA's proposed waiver rule and other materials that states and members of the regulated industry are seeking to curtail Stage II installations at newly constructed GDFs. Changing Stage II applicability requirements contained in state rules that have been approved into SIPs is ultimately an issue that each state would need to address. The EPA cannot unilaterally change existing state regulations or lawfully-adopted SIPs containing Stage II requirements, and the May 16, 2012, waiver does not directly alter those state regulations or revise SIPs.

2.1 What are the CAA requirements that govern EPA approval of a Stage II removal SIP revision?

There are three main CAA provisions that affect EPA's ability to propose approval of any SIP revision seeking to discontinue an existing SIP-approved Stage II control program. Section 110(ℓ) governs EPA approval of all SIP revisions, including SIP revisions involving phase out of Stage II controls. Section 193 applies to any current nonattainment area that adopted a Stage II control program into its SIP prior to November 15, 1990. Section 184(b)(2) applies to any area of the northeast OTR.

2.2 Complying with the "noninterference" clause (CAA section 110(ℓ))

Under CAA section 110(ℓ), the EPA cannot approve a SIP revision if it would interfere with attainment of the NAAQS, reasonable further progress toward attainment, or any other applicable requirement of the Clean Air Act. Therefore, the EPA could propose to approve a SIP revision that removes or modifies Stage II gasoline refueling vapor control measure(s) in the SIP only if there is a basis in the state's submittal for concluding that approval of the revision would

[3] The EPA codified anti-backsliding provisions governing the transition from the revoked 1-hour ozone NAAQS to the 1997 8-hour ozone NAAQS in 40 CFR part 51.905(a). These provisions indicate that some control measures may not be removed from a SIP even if their removal would not interfere with air quality goals. These measures are listed as "applicable requirements" because the CAA requires that they be included in a SIP for an area based on the area's designation status and classification. The authority in CAA section 202(a)(6) makes it possible for EPA to waive Stage II control programs such that they are no longer an "applicable requirement" or a required contingency measure.

not interfere with attainment of the NAAQS, reasonable further progress (RFP) or any other applicable requirement of the CAA.

Specifically, section 110(ℓ) states:

> *Each revision to an implementation plan submitted by a State under this Act shall be adopted by such State after reasonable notice and public hearing. The Administrator shall not approve a revision of a plan if the revision would interfere with any applicable requirement concerning attainment and reasonable further progress (as defined in section 171), or any other applicable requirement of this Act.*

A Federally approved SIP is viewed as the state's blueprint for maintaining clean air, and from time to time a state may choose to revise its SIP and demonstrate that the revision would not interfere with air quality goals. Accordingly, states should explain how the SIP revision that modifies an existing SIP-approved Stage II control program does not interfere with attainment of all applicable ozone NAAQS, including the 2008 NAAQS, and any applicable reasonable further progress requirements. In evaluating whether a given SIP revision would interfere with attainment or maintenance, as required by section 110(ℓ), the EPA generally considers whether the SIP revision will allow for an increase in actual emissions into the air over what is allowed under the existing EPA-approved SIP. The EPA has not required that a state produce a new complete attainment demonstration for every SIP revision, provided that the status quo air quality is preserved. *See, e.g., Kentucky Resources Council, Inc.,* v. *EPA,* 467 F.3d 986 (6th Cir. 2006); *see also,* 61 FR 16,050, 16,051 (April 11, 1996) (actions on which the *Kentucky Resources Council* case were based). Section 3 of this guidance document provides information that states may consider using to develop noninterference demonstrations, including methods to assess the VOC emissions impact in the affected area during the Stage II phase-out period.

As one considers this non-interference assessment, it should be noted that the potential emission control losses from removing Stage II VRS are transitional and relatively small. ORVR-equipped vehicles will continue to phase in to the fleet over the coming years and will exceed 80 percent of all highway gasoline vehicles and 85 percent of all gasoline dispensed during 2015. As the number of these ORVR-equipped vehicles increase, the control attributed to Stage II VRS will decrease even further, and the potential foregone Stage II VOC emission reductions are generally expected to be no more than one percent of the VOC inventory in the area.

***Substituting new control measures*.** The EPA believes that a planned Stage II phase-out that is shown not to result in an increase in area-wide VOC emissions would be consistent with the conditions of CAA section 110(ℓ). A planned Stage II phase-out that would otherwise result in an area-wide VOC emissions increase could also be consistent with the conditions of CAA section 110(ℓ) if the state offsets the increase in emissions by adopting and implementing additional emissions controls into the SIP. One example of substitution is where a state or area may substitute refueling emissions at GDFs with stationary source controls or area source controls, including additional controls on other gasoline vapor emissions points at GDFs (See section 4.4). States have wide latitude to select additional emissions controls to make up for the absence of Stage II VRS, including substituting NO_x controls. The offsetting emissions controls should be generally contemporaneous with the Stage II VRS phase-out period.

Offset of emissions due to excess emission reductions not accounted for in the current SIP. An additional factor that may be relevant in evaluating whether a SIP revision removing Stage II vapor recovery programs is consistent with the provisions of section 110(ℓ) is the consideration of emission reductions not otherwise included in the current SIP. Changes in an area's stationary or area source inventories resulting from changes in industrial population or activity in that area could result in a decrease in VOC emissions compared to that the emissions considered in the SIP. There are too many potential examples to list, but this could include a plant closure or the continued decline in GDF population. Also, there may be changes in the motor vehicle fleet VMT or fleet populations that provide VOC and NO_x emission reductions not accounted for in the SIP. With an increased penetration of newer model year ORVR-equipped vehicles, the amount of additional emission reduction achieved by Stage II over time is smaller in comparison to areas with lower percentages of ORVR penetration into the fleet. In these circumstances it may also be true that the lower exhaust and evaporative emission rates from these newer vehicles in the fleet relative to those being scrapped will offset any transitional VOC emission increases from phasing out Stage II VRS. Furthermore, there may be additional VOC and NO_x emission reductions from non-road sources that could be considered if states have not already sought SIP credit for them.

***Emissions increases that do not interfere with attainment*.** Under the circumstances created by the CAA's widespread use waiver, a planned Stage II phase-out that is shown to result in an area-wide VOC emissions increase may also be consistent with the conditions of CAA section 110(ℓ). A phase-out plan that would result in very small foregone emissions reductions in the near term that continue to diminish rapidly over time as ORVR phase-in continues, may result in temporary increases that are too small to interfere with attainment or progress toward attainment. This may be particularly evident in areas that are already attaining the ozone NAAQS or where emissions and/or air quality projections already demonstrate that an area is likely to maintain the NAAQS into the future. Similarly, in areas where ozone formation is limited by the availability of NO_x emissions, a small (and ever-declining) increase in VOC emissions may have little or no effect on future ozone levels. The EPA would consider any air quality analyses and supporting information provided by a state to show that a proposed SIP revision would not interfere with attainment and maintenance of the NAAQS.

2.3 Complying with the OTR "comparable measures" requirement (CAA section 184(b)(2))

All areas of the Northeast OTR, both attainment and nonattainment, are subject to the requirements of CAA section 184(b)(2), commonly referred to as the "comparable measures requirement."[4] Section 184(b)(2) directs these areas to adopt and implement either Stage II controls meeting the general requirements for Stage II gasoline vapor recovery programs under CAA section 182(b)(3), or "control measures capable of achieving emissions reductions comparable to those achievable" by Stage II. Section 3 of this guidance document provides information that states may consider in developing a comparability analysis that includes an estimate of lost Stage II reductions incremental to ORVR during the Stage II phase out period.

[4] The States of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, Virginia and the District of Columbia are in the OTR and are subject to these provisions.

States in the OTR can conduct comparability analyses on a state-wide basis, or separately for nonattainment and attainment areas within the state.

Demonstrating Comparability. The CAA does not require OTR states to implement measures that would achieve reductions "equivalent" to a Stage II control program; the CAA requires that the reductions be "comparable." Now that ORVR is in widespread use in the motor vehicle fleet, the EPA believes it may be appropriate for states to demonstrate that the comparable measures requirement is satisfied if phasing out a Stage II control program in a particular area is estimated to have no, or a *de minimis*, incremental loss of area-wide emissions control– i.e., when no alternative reductions are needed to achieve reductions comparable to those achievable in the area by the Stage II control program stipulated in CAA section 182(b)(3).

As the fraction of total gasoline dispensed into ORVR-equipped vehicles continues each year to increase in relation to the fraction of total gasoline dispensed into non-ORVR vehicles, the incremental emission reduction benefit achieved by Stage II controls over ORVR controls declines. Accordingly, in the specific context of the comparable measures requirement, EPA believes it is reasonable to conclude that the incremental emissions control that Stage II achieves beyond ORVR is *de minimis* if it is less than 10 percent of the area-wide emissions inventory associated with refueling highway motor vehicles. This is because the Stage II control program stipulated by Congress in CAA section 182(b)(3) exempts some GDFs from Stage II controls, such that even where Stage II was required approximately 10 percent of the gasoline throughput was not subject to the statutory requirement. Specifically, GDFs that sell 10,000 gallons or less per month, and GDFs identified as independent small business marketers that sell 50,000 gallons or less per month, are exempt from the statutory Stage II control requirements. For a typical area implementing the CAA-based exemption program EPA estimates that about 10 percent of highway motor vehicle fleet gasoline consumption was therefore exempted from the statutory requirement for Stage II controls.[5] In light of the Congressional judgement that Stage II controls need only apply to 90 percent of gasoline sales, no new control measure may be necessary to demonstrate comparability to Stage II when the difference between retaining Stage II and removing Stage II affects less than 10 percent of the refueling emissions from area-wide gasoline consumption.

Agencies can consider using the calculations explained in this guidance document to determine the point in time at which *de minimis* incremental benefits are reached in a specific area, based on the area's fleet profile and Stage II control program parameters. The EPA is aware that some states are implementing Stage II control programs that are nominally more stringent than the minimum program requirements in CAA section 182(b)(3). For example, in some states exemptions are provided only for GDFs dispensing 10,000 gallons or less per month. For the purposes of addressing comparability under CAA section 184(b)(2), states only need to consider the reductions achievable by the minimum program required by CAA section 182(b)(3), as section 182(b)(3) defined the scope of applicability of Stage II within the GDF source category – and therefore the scope of expected emissions reductions from Stage II – against which alternative control measures were to be compared under section 184(b)(2).

[5] See "Technical Guidance – Stage II Vapor Recovery Systems for Control of Gasoline Refueling Emissions at Gasoline Dispensing Facilities Vol. 1," EPA-450/3-91-022a, November 1991.

2.4 Complying with the "general savings clause" for pre-1990 Stage II control programs (CAA section 193)

Section 193 prohibits modification of any control requirement in effect before November 15, 1990 in a current nonattainment area, unless modification "insures equivalent or greater emissions reductions." This means that, in areas currently designated nonattainment for ozone, any Stage II control program implemented under a SIP prior to November 15, 1990 could not be removed from the SIP until the ORVR control requirement (or some other requirement or set of requirements) is shown to achieve equal or greater emissions reductions compared to the emissions reductions attributable to Stage II vapor recovery. Alternatively, States can show that removing the area's pre-1990 Stage II control program would have no impact on area-wide emissions reductions. The EPA anticipates that the later showing is inherently more conservative than the former.

Agencies can consider using the assessment method described in Section 3 to determine the point in time the ORVR control requirement achieves equivalent emissions reductions to the reductions credited to the pre-1990 Stage II vapor recovery program. The assessment method is similar to the method the EPA used for establishing the national ORVR widespread use finding and waiver of the section 182(b)(3) requirement, except that here it would be applied on a state or local area level rather than a national level.

3. Assessing Area-Wide Impacts on Vehicle Refueling Emissions

This section covers many of the technical issues states may need to address in developing SIP revisions to phase out existing Stage II programs. Note that the analyses for purposes of section 110(ℓ) and section 193 may not be identical. However, in some cases, an area may be able to show that, due to disbenefits from simultaneous implementation of Stage II and ORVR, phasing out Stage II will result in a net improvement in emissions reductions, satisfying the provisions of both section 110(ℓ) and section 193.

Section 3.1 describes some key terms. Section 3.2 identifies and describes a series of parameters and variables related to the implementation of Stage II and ORVR. Section 3.3 combines these parameters and variables into two equations that states can consider using to evaluate and compare the emission reduction impacts of various combinations of Stage II and ORVR control technologies in the context of the provisions of CAA sections 110(ℓ), 184(b)(2), and 193. Section 3.4 provides guidance on selecting parameter values and ways to determine the variables in the equations. Section 3.5 presents a series of examples of how this information can be used to conduct SIP-related analyses.

States may be accustomed to running the MOVES model in support of SIP revisions. And, while the use of the MOVES model is certainly allowed, without additional analyses and inputs from outside the model, it may not yield outcomes similar to those obtained using Equations 1, 2 and 3 that are presented in this section. For these reasons, and the fact that all previous EPA ORVR/Stage II inventory comparison analyses have been conducted in a similar

manner, EPA believes the approach discussed in this document would be preferable for these assessments.[6]

3.1 Discussion of Terms

The EPA's emission factors document divides vehicle refueling emissions into three broad categories.[7] These include vehicle fuel tank displacement emissions, gasoline spillage, and underground storage tank (UST) breathing and empting losses.[8] In a previous analysis EPA concluded that removing Stage II vapor recovery would potentially impact overall vehicle fuel tank displacement emissions and breathing/emptying losses from UST vent pipes where Stage II vacuum assist technology is used. The analysis further concluded that removing Stage II would neither increase nor decrease gasoline spillage during refueling and that with appropriate measures such as the pressure/vacuum valves now widely employed on UST vent pipes, breathing/emptying losses from non-Stage II nozzles and balance type Stage II nozzles would be similar.[9,10] Thus, this guidance need only address impacts on vehicle fuel tank displacement emissions and impacts on UST vent pipe emission rates from non-ORVR compatible Stage II nozzles.[11]

Described below are key terms used in the calculations and discussions which follow.

Gasoline dispensing facility (GDF): A location which dispenses gasoline to highway motor vehicles and serves as a fueling point for nonroad engines and equipment. It includes all retail outlets such as traditional service stations, convenience stores, truck stops, and hypermarkets (e.g., warehouse clubs and big box stores) as well as private and commercial outlets such as those for centrally-fueled fleets, government operations, and private businesses as well as private outlets such as centrally-fueled fleet and government operations. For these purposes, it generally does not include marinas and general aviation airports dispensing aviation gasoline. Note that some lower throughput GDFs are exempt from Stage II vapor recovery by state regulations.

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[6] In previous publications, (footnote 9 below) EPA concluded that for these purposes factors such as spillage emission rates and traditional breathing/emptying loss emision rates would not be affected by removing Stage II vapor recovery. MOVES runs should not include spillage. Also, it is important to note that the gasoline consumption data in Appendix Table A-1 includes ORVR for Class III HDGVs beginning in 2006. When the last version of the MOVES model was released, EPA was not aware that manufacturers had voluntarily incorporated ORVR on these vehicle models. This guidance document does not include every potential minor emission impact that has been identified for either Stage II or ORVR. For example, vacuum assist Stage II may capture a fraction of the refueling emissions released from an ORVR vehicle fillpipe during a refueling event (~0.05g/gal) and through testing, API has identified that emissions released from the fillpipe immediately after the fuel cap is removed are lower for ORVR vehicles than non-ORVR vehicles. The delta in emissions (about 0.10 g/gal) depends on RVP and fuel tank temperature. These offsetting minor differences are not included in the calculations in this guidance.

[7] AP-42, Fifth Edition, "Compilation of Air Pollutant Emission Factors – Volume 1, Stationary Point and Area Sources" January 1995. The EPA's emission factors document, identifies three sources of refueling emissions: displacement, spillage, and breathing losses..

[8] See Chapter 5 of AP-42, http://www.epa.gov/ttn/chief/ap42/ch05/final/c05s02.pdf

[9] See EPA memorandum, "Onboard Refueling Vapor Recovery Widespread Use Assessment," June 9, 2011.

[10] There would still be breathing and emptying losses from some systems at various times. These could be addressed by one of the post-processor technologies now being marketed for addition to the GDF UST vent pipes

[11] Dispensers using traditional gasoline nozzles, balance-type Stage II nozzles, and specially certified ORVR compatible vacuum-assist type nozzles would not be expected to increase UST vent emissions.

Stage II Vapor Recovery System (VRS): A system designed to capture displaced vapors that emerge from inside a vehicle's fuel tank, when gasoline is dispensed into the tank. There are two basic types of Stage II systems, the balance type and the vacuum assist type.

Balance-type Stage II system: The balance system transfers vapors from the vehicle tank to the GDF UST based on pressure differential. A key feature in the balance system is a hose nozzle that makes a tight connection with the fill pipe on the vehicle fuel tank. The nozzle spout is fitted with an accordion-like bellows that presses snugly against the fill pipe lip. The vapors flow into the port, through the nozzle bellows, through a coaxial hose that connects the nozzle to the dispenser, and finally on through a vapor-return pipe back into the UST.

Vacuum assist-type Stage II system: This system relies on a vacuum source to help move the vapors out of the vehicle tank and into the UST. Current designs do not rely on a tight-fitting seal at the nozzle-fillpipe interface. Traditional vacuum systems are of two types: passive and active. In a passive vacuum-assist system, which is the dominant approach today, an electrically driven vacuum pump, typically in the dispenser cabinet, provides the vacuum power. An active system maintains a vacuum on the entire Stage II vapor recovery system through a central pump (jet pump) to recover vapors from the entire system to the tank. A key feature of vacuum assist system design and operation is the design air/liquid (A/L) volume ratio which is a measure of the volume of air returned to the tank to the volume of liquid dispensed. (When refueling a non-ORVR vehicle this "air" also contains gasoline vapor.) The larger the design A/L ratio the greater the amount of fresh air returned to the UST. Some passive vacuum assist systems employ loose-fitting mini-bellows to help reduce the design A/L ratio. Sometimes these are called hybrid systems. Active vacuum assist systems often have A/L ratios somewhat greater than unity and employ a post-processor to reduce excess vent pipe emissions created by the higher A/L ratio with these systems.

Vent pipe: A pipe from the UST to the atmosphere which allows the tank to "breathe" during normal operation. This allows the tank to bring in fresh air to relieve negative pressure or release vapor to reduce positive pressure in the UST as needed. Vent pipes are generally 12 feet in height and two inches in diameter.

Pressure vacuum vent valve: A device, usually referred to as a "P/V vent valve," installed at the discharge end of a vent pipe connected to a gasoline storage tank, to regulate the pressure at which vapor is allowed to escape from the tank, and the vacuum at which outside air is allowed to enter the tank. The inflow/outflow of air through the vent pipe is controlled at specified pressures. These vent valves generally inhibit vapor release and are used to ensure the proper operation of Stage II balance systems. These P/V vent valves are now widely required as a result of EPA's GDF "Stage I" NESHAP regulation (40 CFR 63 CCCCCC).

Onboard Refueling Vapor Recovery (ORVR): A system employed on gasoline-powered highway motor vehicles to capture gasoline vapors displaced from a vehicle fuel tank during refueling events. These systems are required under section 202(a)(6) of the CAA and implementation of these requirements began in the 1998 model year. Currently they are now used on all gasoline-powered passenger cars, light trucks, and complete heavy trucks of less than 14,000 lbs GVWR. ORVR systems typically employ a liquid fill neck seal to block vapor escape to the atmosphere and otherwise share many components with the vehicle's evaporative emission control system including the onboard diagnostic system (OBD) sensors.

ORVR/Stage II Compatibility: Compatibility problems can result in an increase in emissions from the UST vent pipe and other system fugitive emissions related to the refueling of ORVR vehicles with some types of vacuum assist-type Stage II systems. This occurs during refueling an ORVR vehicle when the vacuum assist system draws fresh air into the UST rather than an air vapor mixture from the vehicle fuel tank. Vapor flow from the vehicle fuel tank is blocked by the liquid seal in the fill pipe which forms at a level deeper in the fill pipe than can be reached by the end of the nozzle spout. The fresh air drawn into the UST enhances gasoline evaporation in the UST which increases pressure in the UST. Unless it is lost as a fugitive emission, any tank pressure in excess of the rating of the pressure/vacuum valve is vented to the atmosphere over the course of a day. The magnitude of these emissions at a specific GDF is primarily a function of the fraction of total gasoline throughput dispensed to the ORVR vehicles and the A/L ratio of the dispensers.

The compatibility factor is an especially important consideration in calculating the emissions impacts of Stage II controls. Even if a state/local area wishes to keep Stage II controls to address non-ORVR equipped vehicles being refueled at Stage II GDFs, for non-ORVR compatible Stage II vacuum assist systems there will come a point where the emissions impact of the compatibility factor surpasses any gain from controlling non-ORVR vehicles. After that point, Stage II would lead to a net area-wide loss in emissions control. The point in time when this occurs depends on the nature of the Stage II program and the rate of ORVR penetration into the fleet.

ORVR-compatible vacuum assist-type Stage II system: A vacuum assist type Stage II system that is designed to sense when an ORVR vehicle is being refueled and reduces the A/L ratio to near zero to avoid compatibility emission effects. Current ORVR compatible nozzles are certified to meet ARB requirements for Stage II enhanced vapor recovery (EVR) efficiency with up to 80 percent ORVR vehicles in the fleet mix. Balance type nozzles are ORVR compatible as well.

3.2 Parameters and Variables Related to Implementing Stage II VRS and ORVR

To conduct analyses of the impact of phasing out Stage II VRS, several key pieces of information and data are needed for the equations used in the assessments, which are presented in section 3.3. Each of these is described below, first for Stage II VRS, and then for ORVR.

3.2.1 Terms for Estimating Area-Wide Stage II VRS Control Efficiency

η_{iuSII} - Stage II VRS in-use control efficiency: This is the current best estimate of the average in-use control efficiency for Stage II VRS in the state/area when applied to vehicles that are not equipped with ORVR. It is expressed as a fraction of 1. This value considers not only vapor capture at the vehicle fillpipe opening but also its transmittal to and storage in the UST. This value likely varies somewhat by state/area depending on how well GDF operators follow the inspection, testing, and maintenance activities specified in the state's implementing regulations and the frequency of inspection and follow-on enforcement actions by state/local authorities in implementing the regulations. This judgment should be informed by test data if available either from within the state/area or from other sources if no local data is available. Publicly available data suggests typical current values are in the range of 60-75 percent (0.60 –

0.75).[12,13,14,15] As a result, it may be appropriate to identify significantly lower Stage II in-use control efficiencies than were identified in EPA's 1991 technical guidance on Stage II systems (see footnote 5).

Q_{SII} - Fraction of highway gasoline throughput covered by Stage II VRS: The fraction of gasoline that is sold through dispensers equipped with Stage II VRS equipment expressed as a fraction of 1. This likely varies somewhat by state/area and can be derived from state data. Typical default values are 0.9 for states/areas that adopted the CAA allowed exemption value of 10,000 gallons per month (gpm) for private GDFs and 50,000 gpm for independent small business marketers and 0.95-0.97 for states/areas that adopted 10,000 gpm exemption criteria for all GDFs.

Q_{SIIva} – Fraction of highway gasoline throughput dispensed through vacuum-assist type Stage II VRS: The fraction of annual gasoline consumption in the state/area dispensed through vacuum assist type Stage II VRS expressed as a fraction of 1. This would not include gasoline dispensed through dispensers with traditional nozzles, balance-type Stage II VRS nozzles, or ORVR-compatible Stage II nozzles. If the fraction dispensed through traditional vacuum assist VRS is not known, then the fraction of GDFs with traditional vacuum assist Stage II VRS may be substituted based on the assumption that throughput is evenly distributed across the various GDFs that are not exempt from Stage II requirements.

VMT_{ORVRi} - ORVR Vehicle Miles Traveled: The fraction of annual area-wide VMT traveled by ORVR-equipped vehicles. The subscript *i* denotes that this term varies by calendar year.

CF_i - Compatibility Factor: This is an increase in UST vent pipe emissions over the normal breathing/emptying loss emissions. As discussed above, this is a function of the fraction of gasoline dispensed to ORVR vehicles in any given year (using VMT of ORVR vehicles as a surrogate), the design features of the traditional vacuum assist Stage II nozzles, and the proportion of vacuum assist Stage II stations with various A/L ratios. This term may be calculated as the product of VMT_{ORVRi} and a constant term 0.07645. It should be noted that for a state/area with all balance systems or with a requirement for ORVR compatible nozzles, the CF term is zero because there is no compatibility problem by definition.

$$\boxed{CF_i = (0.07645)(VMT_{ORVRi})}$$

[12] "Stage II Vapor Recovery Systems Issues Paper," U.S. EPA, Office of Air Quality Planning and Standards, August, 2004.
[13] "Analysis of Future Option's for Connecticut's Gasoline Dispensing Facility Vapor Control Program," Connecticut Department of Energy and Environmental Protection, December 2011.
[14] "Draft Vapor Recovery Test Report," CARB and CAPCOA, April, 1999. This data was used in CARB's analyses of their Enhanced Vapor Recovery rules. See, "Enhanced Vapor Recovery Emissions Reduction Calculations" (available at http://www.arb.ca.gov/regact/march2000evr/march2000evr.htm), Appendix D to "Enhanced Vapor Recovery: Initial Statement of Reasons for Proposed Amendments to the Vapor Recovery Certification and Test Procedures for Gasoline Loading and Motor Vehicle Gasoline Refueling at Service Stations," February 4, 2000; and CARB, "Updated ISD Emission Reductions" (available from http://www.arb.ca.gov/regact/evrtech/isor4d.pdf), Appendix 3 to "Enhanced Vapor Recovery Technology Review", Staff Report, October 2002.
[15] "Performance of Balance Vapor Recovery Systems at Gasoline Dispensing Facilities," San Diego Air Pollution Control District, May 18, 2000.

The constant term 0.07645 is an estimate of the control efficiency loss with vacuum assist systems derived by weighting two technologies tested in a California ARB study.[16] This testing was conducted with the P/V valve in place on the vent pipe and with frequent monitoring of the A/L ratio to be certain that it stayed close to the design values. The technologies are weighted by about 65 percent for the higher A/L ratio dispenser and 35 percent for the lower A/L ratio dispenser.[17,18,19] The results in lbs/1000 gallons are divided by the uncontrolled emission factor for the area where and when this testing occurred (7.6 lbs/1000 gal). The equation yields a term expressed as a fraction of the displacement emission factor (dimensionless) thus allowing it to be used in calculations with the other fractions above.[20] The subscript *i* denotes that this term varies by calendar year.

The compatibility factor can also be calculated as a function of annual gallons of highway motor gasoline dispensed to ORVR-equipped vehicles, where the constant term 0.0777 is derived based on the national average gasoline throughput that corresponds to the ORVR VMT data.

$$CF_i = (0.0777)(Q_{ORVRi}) \quad \text{. . .defined below}$$

For completeness sake, it should be noted that the excess vent emissions (EE) on a lb/1000 gal basis can be estimated using the equations:

$$EE_i = 0.581(VMT_{ORVRi}) \text{ or}$$

$$EE_i = 0.591(Q_{ORVRi})$$

[16] EPA Memorandum "Calculating Stage II Vacuum Assist Stage II VRS and ORVR Excess Emissions," Glenn W. Passavant, May 2012.

[17] California ARB, Preliminary Draft Test Report, Total Hydrocarbon Emissions from Two Phase II Vacuum Assist Vapor Recovery Systems During Baseline Operations and Simulated Refueling of Onboard Refueling Vapor Recovery (ORVR) Equipped Vehicles, Project Number ST-98-XX, June 1999.

[18] See Letter from William Loscutoff, Chief, Monitoring and Laboratory Division ARB to Prentiss Searles, Senior Marketing Issues Associate, American Petroleum Institute, "Comments on Enhanced Vapor Recovery (EVR) Technology Review." August 5, 2002, p.6.

[19] Keeping the in-use A/L ratio close to the design value is very important. A significant variation upward in the A/L ratio would increase CF because more air would be ingested while a significant decrease could decrease capture efficiency and send less vapor to the UST and thus perhaps also increase CF.

[20] This approach gives a different value than that presented in a previous EPA report titled "Stage II Vapor Recovery Systems - Option Paper," February 2006, because this methodology allows for an estimation of the compatibility factor as a function of the fraction of gasoline dispensed to ORVR vehicles rather than at full fleet turnover, and because the results for the two technologies tested in California are weighted by an estimate of their relative fraction of use in the GDF population rather than using only the higher value. Finally, the result is divided by the displacement refueling emission factor in the area of California where and when this testing was conducted to get a factor expressed in the same terms as control efficiency. (see California ARB, Uncontrolled Vapor Emission Factor at Gasoline Dispensing Facilities, January 5, 2000).

3.2.2 Terms for Estimating Area-Wide ORVR Control Efficiency

Q_{ORVRi} - Fraction of annual gallons of highway motor gasoline dispensed to ORVR-equipped vehicles: This is likely to vary by state/area depending on the fleet turnover/scrappage rate, annual VMT, and fuel economy of the vehicles involved in the analysis. The subscript *i* denotes that this term varies by calendar year. Table A-1, column 4 in the Appendix shows national average values that a state could use or adapt by extrapolation or interpolation as appropriate. For example, if the fleet in the state was one year newer than the national average then the analysis would use the data for the next calendar year (e.g., 2014 for 2013). Conversely, for example, if the fleet in the state was on average six months older than the national average then the analysis would interpolate between the current and past year (e.g., halfway between 2012 and 2013). Data on the fleet average age distributions by vehicle class for 2012 used in these calculations is provided in Appendix Table A-9.

η_{ORVR} - In-use control efficiency for ORVR: EPA recommends a value of 0.98.[21] States may use a lower or higher value, if justified. This value is based on testing of over 1,600 in-use vehicles with mileages ranging from about 6,000 – 135,000. This value does not reflect other adjustments found in the MOVES emissions model. The current MOVES model does not fully consider the in-use verification program (IUVP) test results as mentioned above. Other MOVES model efficiency adjustments are based on data from older vintage evaporative emission control systems and do not fully reflect the benefits derived from OBD, I/M, or improved durability resulting from the integrated ORVR/evaporative control systems used in vehicles meeting the progressively more stringent evaporative emission standards which were implemented in the mid-1990s and later.

3.3 Calculating Impacts on the Refueling Emission Inventory

This section presents the two main equations that use the terms discussed in section 3.2 as inputs to calculate area-wide control efficiency impacts of Stage II VRS and ORVR. States can consider using the results of these equations to support SIP actions phasing out Stage II control programs.

3.3.1 Key Equation for Assessing and Demonstrating Compliance with the Noninterference Provisions of CAA Section 110(ℓ) and the Comparable Measures Requirement of CAA Section 184(b)(2)

Overall Stage II-ORVR *increment*: The overall *increment* identifies the annual area-wide emission control gain from Stage II installations at GDFs as ORVR technology phases in. Thus, it also indicates the emission reduction potential loss (in year *i*) from removing Stage II.

Equation 1

$$increment_i = (Q_{SII})(1-Q_{ORVRi})(\eta_{iuSII}) - (Q_{SIIva})(CF_i)$$

[21] EPA Memorandum, "Updated ORVR In-Use Efficiency," Glenn W. Passavant. February, 2012.

Under the current regulatory construct for ORVR, there is a small and declining number of non-ORVR equipped vehicles and thus a small level of future emission reduction achievable from Stage II. However, due to the vacuum assist compatibility factor, this emission reduction will eventually go to zero and become negative for states/areas that do not use properly calibrated ORVR-compatible nozzles because the incompatibility effect will be larger than the Stage II increment. If the value is greater than zero for the year under consideration there is still a remaining emission reduction benefit for Stage II for the year relative to ORVR. If it is zero there is no net difference in the inventory. If it is zero or negative, this would indicate that removing Stage II would not increase the refueling emissions inventory because the higher efficiency from ORVR and the incompatibility emissions offset the increment due to non-ORVR vehicles being refueled at Stage II GDFs. It should be noted that for a state/area with all balance systems or with a requirement for ORVR compatible nozzles, the CF term is zero.

3.3.2 Key Equation for Assessing and Demonstrating Compliance with CAA Section 193

Overall Stage II - ORVR *delta*: The overall *delta* is the comparison between the Stage II efficiency and the ORVR efficiency with both technologies in place.

Equation 2

$$delta_i = (Q_{SII})(\eta_{iuSII}) - (Q_{SIIva})(CF_i) - (Q_{ORVRi})(\eta_{ORVR})$$

This is not the same as the increment calculation in *Equation 1* above because it considers the greater efficiency of ORVR relative to non-ORVR vehicles refueling at Stage II equipped GDFs.

3.3.3 Developing Area-Specific Values for the Terms Used in Equations 1 and 2

To conduct analyses using Equations 1 and 2, a state would first select a base year or date for the analysis. The base year or date would correspond to the date the state is considering for starting to allow decommissioning for affected GDFs. Alternatively, this could be a set of base years/dates if a state is considering phasing-out Stage II in a specific area over a longer time period such as two or more years.

Second, the state would develop the values needed for the equations. The information and values in Table 2 are provided for consideration.

Table 2 Values and Information Sources for Analysis Terms		
Term	**Values/Sources**	**Other Comments**
η_{iuSII} In-use Stage II control efficiency	This refers to the in-use efficiency of the Stage II vapor recovery system when refueling a non-ORVR equipped vehicle. State/area specific value based on best estimate of in-use efficiency when Stage II decommissioning begins. Consider available test data.[22]	Prior EPA guidance links in-use efficiency to the level of inspection, testing, and maintenance by the GDF and follow up by the state.[23] We recommend an efficiency value consistent with field test data and the expected future investment of state inspection and enforcement resources during the base year and any subsequent year if a phase-out is used. We advise against relying solely on prior EPA guidance, new system certification efficiency, or what your state regulations claim regarding efficiency.
Q_{SII} Fraction of gasoline throughput covered by Stage II VRS	Appropriate default values are 0.90 if the state adopted the CAA exemption provisions and 0.95-0.97 if the state used 10,000 gpm for all GDFs	Other values may be justified based on state data. This fraction has the effect of excluding throughput at exempt GDFs.
Q_{SIIva} Fraction of gasoline throughput covered by traditional vacuum assist Stage II VRS	State/area specific value; state could use GDF survey data for throughput or GDF population by dispenser type. Estimated default values are provided in Appendix Table A-6	Zero if all GDFs use the balance type approach or dispenser nozzles are required to be ORVR compatible.
VMT_{ORVR} Fraction of annual VMT of gasoline-powered highway motor vehicles by ORVR equipped vehicles	See Appendix Table A-1, Column 3.	May use state/area specific data or adjust Appendix Table A-1 as appropriate (interpolation) if fleet characteristics are different. Does not include diesels or any off road vehicles.
CF Compatibility factor term	EPA recognizes a value for this constant of 0.07645 associated with the VMT_{ORVR} value, or 0.0777 associated with Q_{ORVR} value. CF is zero by definition for balance and ORVR compatible dispensers.	May calculate using data derived from traditional vacuum assist Stage II dispensers based on knowledge of the distribution of the different types of Stage II vacuum-assisted equipment designs (e.g., high A/L vs. low A/L ratio) and field test data.[24]
Q_{ORVR} Fraction of annual gallons of highway motor gasoline dispensed to ORVR-equipped vehicles	See Appendix Table A-1, Column 4. Note that $Q_{ORVRi} = 0.9826(VMT_{ORVRi})$	May use state/area specific data or adjust Appendix Table A-1 as appropriate (interpolation) if fleet is older or newer, or more or less fuel efficient. Does not include diesels or any off road vehicles.

[22] See reference in footnotes 12-15 above.
[23] EPA report, "Enforcement Guidance for Stage II Vehicle Refueling Control Programs," U.S. EPA, Office of Air and Radiation, Office of Mobile Sources, December 1991.
[24] See reference 16 for an example of how this work could be done.

Table 2 Values and Information Sources for Analysis Terms		
Term	**Values/Sources**	**Other Comments**
η_{ORVR} ORVR in-use control efficiency	EPA recommends 0.98.	May use a locally derived value if state/local authority believes EPA in-use testing data is unrepresentative.

3.4 Example Calculations for Equations 1 and 2

3.4.1 Example Scenario #1

Calculate the increment for a potential deactivation of Stage II requirements in mid-2013 assuming 70 percent in-use Stage II control efficiency, a relatively low Stage II GDF exemption level of 10,000 gpm, a relatively high use of vacuum assist-type dispensers of 90 percent, national fleet ORVR penetration values (interpolated between 2012 and 2013 from columns 3 and 4 of Appendix Table A-1), and EPA's recommended 98 percent ORVR control efficiency. The inputs are as follows:

$\eta_{iuSII} = 0.70$; $Q_{SII} = 0.97$; $Q_{SIIva} = 0.9$; $VMT_{ORVR\,mid2013} = 0.8169$; $Q_{ORVR\,mid2013} = 0.7935$; $\eta_{ORVR} = 0.98$

Compatibility factor calculation:

$$CF_{mid2013} = (0.07645)(VMT_{ORVR\,mid2013}) = (0.07645)(0.8169) = 0.0625$$

Increment calculation using Equation 1:

$$\begin{aligned} Increment_{mid2013} &= (Q_{SII})(1 - Q_{ORVR\,mid2013})(\eta_{iuSII}) - (Q_{SIIva})(CF_{mid2013}) \\ &= (0.97)(1 - 0.7935)(0.70) - (0.9)(0.0625) \\ &= 0.084 \end{aligned}$$

In this example the Stage II - ORVR *increment* is 8.4 percentage points at the midpoint of 2013 and would decrease over time.

For comparison, it is interesting to look at the overall *delta* using the same input values as above in Equation 2:

$$\begin{aligned} Delta_{mid2013} &= (Q_{SII})(\eta_{iuSII}) - (Q_{SIIva})(CF_{mid2013}) - (Q_{ORVR\,mid2013})(\eta_{ORVR}) \\ &= (0.97)(0.70) - (0.9)(0.0625) - (0.7935)(0.98) \\ &= -0.155 \end{aligned}$$

In this case the ORVR control program provides 15.5 percent greater emission reduction benefits than the Stage II control program alone.

3.4.2 Example Scenario #2

Calculate the increment for a potential deactivation of Stage II requirements beginning in 2013 assuming a 75 percent in-use Stage II control efficiency, a relatively low Stage II GDF exemption level of 10,000 gpm, no traditional vacuum assist-type pumps, and ORVR penetration in the fleet lags the national average by one year (using end of 2011 values from columns 3 and 4 of Appendix Table A-1). The inputs are as follows:

$\eta_{iuSII} = 0.75$; $Q_{SII} = 0.97$; $Q_{SIIva} = 0.0$; $VMT_{ORVR2013} = 0.76$; $Q_{ORVR2013} = 0.7385$; $\eta_{ORVR} = 0.98$

Compatibility factor calculation:

$$CF_{2013} = (0.07645)(VMT_{ORVR2013}) = (0.07645)(0.76) = 0.0581$$

Increment calculation using Equation 1:

$$\begin{aligned} Increment_{2013} &= (Q_{SII})(1 - Q_{ORVR2013})(\eta_{iuSII}) - (Q_{SIIva})(CF_{2013}) \\ &= (0.97)(1 - 0.7385)(0.75) - (0)(0.0581) \\ &= 0.1902 \end{aligned}$$

In this example the Stage II - ORVR *increment* is 19.02 percentage points at the beginning of 2013 (end of 2012). For comparison, it is interesting to look at the overall *delta* using the same input values as above in Equation 2:

$$\begin{aligned} Delta_{2013} &= (Q_{SII})(\eta_{iuSII}) - (Q_{SIIva})(CF_{2013}) - (Q_{ORVR2013})(\eta_{ORVR}) \\ &= (0.97)(0.75) - (0.0)(0.0581) - (0.7385)(0.98) \\ &= 0.0038 \end{aligned}$$

In this case the Stage II program provides 0.38 percentage points greater emission reduction benefits than Stage II at the beginning of 2013 (end of 2012). The programs are essentially equivalent.

Using the same scenario for the beginning of 2014, $(Q_{SII})(\eta_{iuSII})$ would stay the same while $(Q_{ORVRi})(\eta_{ORVR})$ would increase from 0.7237 to 0.7611. Thus, $Delta_{2014}$ indicates 3.36 percentage points more reduction from ORVR than Stage II. Similarly, for 2015, $Delta_{2015}$ indicates 6.67 percentage points more reduction from ORVR than Stage II. This difference in effectiveness would be larger if a CF effect from traditional vacuum assist Stage II nozzles was included.

3.4.3 Example Scenario #3

Calculate the increment for a potential deactivation of Stage II requirement beginning in 2013 for GDFs dispensing less than 100,000 gpm, beginning in 2014 for GDFs dispensing between 100,000 and 200,000 gpm, and beginning in 2015 for all larger throughput GDFs. In this scenario, the state/area must also know the fraction of covered throughput in these three segments and conduct the analysis for each of the three years. For the sake of this example, assume that the less than 100,000 gpm segment is 40 percent of throughput, the over 100,000 gpm but less than 200,000 gpm segment is 30 percent of throughput, and the over 200,000 gpm segment is 30 percent of throughput. Thus, beginning in 2013 Stage II would be deactivated at

GDFs representing 40 percent of throughput, beginning in 2014 Stage II would be deactivated at GDFs representing an additional 30 percent of throughput, and beginning in 2015 at the remaining GDFs. In this example, assume the ORVR fleet in the state/area is typical of the national average and 75 percent in-use Stage II control efficiency.

For the beginning of 2013 segment of the analysis use the following values:

$\eta_{iuSII} = 0.75$; $Q_{SII} = 0.97$; $Q_{SIIva} = 0.6$; $VMT_{ORVR2013} = 0.7997$; $Q_{ORVR2013} = 0.7766$; $\eta_{ORVR} = 0.98$

Compatibility factor calculation:

$$CF_{2013} = (0.07645)(VMT_{ORVR2013}) = (0.07645)(0.7997) = 0.0611$$

Increment calculations for 2013 using Equation 1, in two parts:

2013, Part A: Stage II removed in 2013 at GDFs representing 40 percent of consumption:

$$\begin{aligned} Increment_{2013} &= (0.4)[(Q_{SII})(1 - Q_{ORVR2013})(\eta_{iuSII}) - (Q_{SIIva})(CF_{2013})] \\ &= (0.4)[(0.75)(0.97)(1 - 0.7766) - (0.6)(0.0611)] \\ &= (0.40)[(.7275)(0.2234 - 0.0366)] \\ &= 0.054 \end{aligned}$$

2013, Part B: Stage II is not removed in 2013 for GDFs over 100,000 gpm, so the increment would be zero.

In this example the Stage II - ORVR *increment* is 5.4 percentage points for 2013. For comparison, note that the increment would be 12.59 percent if all Stage II VRS were removed in 2013.

For the beginning of 2014 segment of the analysis use the following values:

$\eta_{iuSII} = 0.75$; $Q_{SII} = 0.97$; $Q_{SIIva} = 0.6$; $VMT_{ORVR2014} = 0.8341$; $Q_{ORVR2014} = 0.8104$; $\eta_{ORVR} = 0.98$

Compatibility factor calculation:

$$CF_{2014} = (0.07645)(VMT_{ORVR2014}) = (0.07645)(0.8341) = 0.0638$$

Increment calculations for 2014 using Equation 1, in two parts:

2014, Part A: Stage II removed in 2014 at GDFs representing 70 percent of consumption:

$$\begin{aligned} Increment_{2014} &= (0.7)[(Q_{SII})(1 - Q_{ORVR2014})(\eta_{iuSII}) - (Q_{SIIva})(CF_{2014})] \\ &= (0.7)[(0.75)(0.97)(1 - 0.8104) - (0.6)(0.0638)] \\ &= (0.7)[(0.1379) - (0.0383)] \\ &= 0.070 \end{aligned}$$

2014, Part B: Stage II is not removed in 2014 for GDFs over 200,000 gpm so the increment would be zero.

In this example the Stage II - ORVR *increment* is 7.0 percentage points for 2014.

For the beginning of 2015 segment of the analysis use the following values:

$\eta_{iuSII} = 0.75$; $Q_{SII} = 0.97$; $Q_{SIIva} = 0.6$; $VMT_{ORVR2015} = 0.8633$; $Q_{ORVR2015} = 0.8397$; $\eta_{ORVR} = 0.98$

Compatibility factor calculation:

$$CF_{2015} = (0.07645)(VMT_{ORVR2015}) = (0.07645)(0.8633) = 0.066$$

Increment calculations for 2015 using Equation 1:

$$\begin{aligned} Increment_{2015} &= (Q_{SII})(1 - Q_{ORVR2015})(\eta_{iuSII}) - (Q_{SIIva})(CF_{2015}) \\ &= (0.75)(0.97)(1 - 0.8397) - (0.6)(0.066) \\ &= [(0.1166) - (0.0288)] \\ &= 0.0878 \end{aligned}$$

In this example the Stage II - ORVR *increment* is 8.8 percentage points for 2015 and would continue to decrease over time. To summarize, the increment values for scenario #3 are:

2013 – 0.054 2014 – 0.070 2015 – 0.088

The cumulative Stage II-ORVR *increment* for the three years would be 0.21 for the gradual phase-out scenario which is lower than an increment of 0.30 for the same three year period if the controls were fully removed in 2013.

3.5 Calculating the Impact on the Area-Wide VOC Inventory

Calculating the impact on the VOC inventory is important in the context of assessing a SIP action against the provisions of CAA section 110(ℓ), though the methodology in this section can be applied equally to the outputs of either Equation 1 or Equation 2. The methodology involves multiplying three different terms, which are area/state specific, as well as appropriate unit conversion factors, and is shown in Equation 3.

Equation 3

$$Tons_i = (Increment_i)(GC_i)(EF)$$

3.5.1 Terms for Calculating Tons VOC

Increment: This is the increment percentage impact on the refueling inventory of removing Stage II as discussed above, and is the output from Equation 1. The *delta* percentage from Equation 2 can also be substituted here.

EF: The uncontrolled displacement refueling emission factor (g/gal). This depends on the Reid vapor pressure (RVP), dispensed fuel temperature (T_d), and the difference between tank fuel temperature and the dispensed fuel temperature (ΔT). While there are various forms of equations used to calculate these values we recommend using the equation presented in EPA's

ORVR widespread use determination final rule.[25] This equation reflects a wider variety of vehicle models than used in the data set to develop the equation in AP-42. [26]

$$EF \text{ (g/gal)} = \exp[-1.2798 - 0.0049(\Delta T) + 0.0203(T_d) + 0.1315(RVP)]$$

where RVP is in psi and temperatures are in °F

There are three terms needed for this calculation. These terms vary by region/state by month or season. Values used by the EPA for ΔT and T_d are contained in the Appendix Tables A-2 and A-3.[27] The RVP value is derived from 40 CFR 80.27 unless there are more specific state requirements or lower RVP values such as the 7.0 psi RVP gasoline needed to meet the RFG VOC performance standard. While there is normally some in-use compliance margin for RVP, to be conservative we recommend that modeling of emissions assume that the in-use RVP is at the level of the standard. Information on EPA volatility standards and RFG can be found at the referenced websites.[28] States should refer to and rely on any governing federal and state regulations in lieu of these websites. Default emission factors based on the latest available RVP information from footnote 28 and temperature information in Tables A-2 and A-3 are provided in Table A-7 in the Appendix. These were calculated using the equation provided.

GC: The projected gasoline consumption (gal) for the time period(s) and state/area of interest in gallons. A good publicly available source for information on recent consumption is the Federal Highway Administration.[29] This source provides past gasoline consumption by state and by month. Information may also be available from other authorities within the state. Forecast information may be derived from the U.S. Department of Energy's national annual forecasts of future gasoline consumption in millions of barrels per day, however, this forecast is not disaggregated to the state/area level.[30] (Note that 1 barrel equals 42 gallons.) A simple approach for projecting state/area-level consumption would be to apply the national average growth rate to the latest state-level reported values. States may develop their own approach for disaggregation or use the state/area gasoline consumption breakouts provided in Table A-4 in the Appendix. The values in Appendix Table A-4 are EPA estimates based on the ratio of county-level highway gasoline consumption to national consumption generated from national MOVES 2010b runs based on Department of Energy Annual Energy Outlook 2011 VMT.

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[25] See EPA Memorandum Onboard Refueling Vapor Recovery Widespread Use Assessment, Glenn W. Passavant, June 2011. This equation was also used in EPA's RIA for the original ORVR Final Rule 77 FR 28772, May 16, 2012.

[26] Exp is the root of the natural logarithm *e*, it has a value of 2.71828. In this case it is *e* raised to the power of the term in the brackets.

[27] See pp. 3-16 to 3-18 of, "Technical Guidance – Stage II Vapor Recovery Systems for Control of Vehicle Refueling at Gasoline Dispensing Facilities Volume I: Chapters" EPA-450/3-91-022a, November 1991, for basic information. Additional references are listed in this document.

[28] http://www.epa.gov/otaq/fuels/gasolinefuels/volatility/standards.htm

[29] Use the latest version available of the DoT FHWA Highway Statistics; see the table entitled "Monthly gasoline reported by States – MF33GA." The 2010 version of "Highway Statistics" is found at: http://www.fhwa.dot.gov/policyinformation/statistics/2010/33ga.cfm

[30] Use the motor gasoline projection from the latest version available of the Department of Energy EIA Annual Energy Outlook (AEO); see the table entitled "Liquid Fuels Supply and Distribution - Reference Case." The 2011 AEO is found at: http://www.eia.gov/oiaf/aeo/tablebrowser/#release=AEO2011&subject=0-AEO2011&table=11-AEO2011&region=0-0&cases=ref2011-d020911a

Example 1: Assume we are conducting this calculation for a State in Region 1 of the EPA fuels temperature matrix for the five-month ozone season May-September, and assume we are using the $Increment_{mid2013}$ value from Example Scenario #1 above, which is 8.4 percentage points in mid-2013. Since this is an area in Region 1 of the EPA fuels temperature matrix with an ozone season gasoline RVP of 7.0 psi, the *EF* calculates to 3.0 g/gal (T_d=74°F and ΔT=11.4°F). Using Table MF-33GA from the 2010 Highway Statistics report, determine Massachusetts' annual gasoline consumption (i.e., 2,795,148,000 gallons per year). For the five month ozone season the monthly data in the table indicates that about 43 percent of gasoline is being consumed during May-September. Growth from 2010-2013 is about 3.44 percent. So, $GC_{mid2013}$ = 2,795,148,000 * 0.43 * 1.0344 = 1,243,259,400 gal/ozone season.

For the five month ozone season selected here the overall emissions effect of removing Stage II would be:

$$Tons_{mid2013} = Increment_{mid2013} * GC_{mid2013} * EF * \text{(conversion factors)}$$
$$= (0.084)(1{,}243{,}259{,}400 \text{ gal/season})(3.0 \text{ g/gal})[(1 \text{ lb}/453.59 \text{ g})(1 \text{ ton}/2000 \text{ lbs})]$$
$$= 341.9 \text{ tons/ozone season}$$

In the above equation, in order to obtain an answer in tons per ozone season, we have introduced conversion factors into the equation where 453.59 grams equal 1 pound, and 2,000 pounds equal 1 ton. These conversion factors are also used in the equation below.

On a daily basis this would be about 2.23 tons per day on average for the 153 days in this five-month ozone season. There are approximately 3,200 GDFs in Massachusetts with Stage II VRS. On a daily basis this represents about 1.4 lbs/day per GDF.

States can further disaggregate these calculations to individual ozone nonattainment areas in the state using the estimates in Appendix Table A-4. The effect would be proportional to gasoline consumption.

Example 2: Looking at this same Example Scenario #1 above for $Delta_{mid2013}$, the emissions impact calculation shows a net gain of tons reduction per ozone season for ORVR over Stage II alone:

$$Tons_{mid2013} = (0.155)(1{,}243{,}259{,}400 \text{ gal/season})(2.97 \text{ g/gal})[(1 \text{ lb}/453.59 \text{ g})(1 \text{ ton}/2000 \text{ lbs})]$$
$$= 630.9 \text{ tons/ozone season}$$

On a daily basis this net difference would be about 4.12 tons per day on average for the 153 days in this five-month ozone season.

3.6 States/Areas with Stage II but not Affected by 182(b)(3) or 184(b)(2)

Portions of six states have implemented Stage II for some areas even though they were not required to do so under the CAA to meet a requirement under sections 182(b)(3) or 184(b)(2). These include Kentucky, Tennessee, Nevada, California, Oregon, and Washington. If these states/areas included Stage II-related emission reductions in their SIPs, they will have to amend their SIPs if Stage II is no longer required, and will have to address the provisions of

CAA section 110(ℓ). To facilitate any assessments for SIP revisions (as discussed above), we have included the relevant input parameters in Table A-8 in the Appendix.

4. Strategies and Considerations for Phasing Out Stage II Controls

Even though EPA has determined that ORVR is in widespread use in the motor vehicle fleet, and has waived the statutory requirement to implement Stage II programs in ozone nonattainment areas, states are not obligated to remove the programs. States and local areas may elect to retain Stage II because it provides VOC and hazardous air pollutant emission reductions for non-ORVR equipped vehicles. States that wish to phase out Stage II controls do not necessarily need to wait until the foregone emissions control approaches zero before seeking a SIP revision. There may come a point where retaining Stage II controls is otherwise unattractive for cost and cost-effectiveness reasons and, as discussed above, the foregone emission reductions are small enough that the loss of control would not affect compliance with the NAAQS. This is especially relevant here since the increment in the first year of Stage II removal will not remain constant in the future but will continue to decrease going forward in time. This will provide added assurance that any potential impact on air quality would also diminish. The state would need to maintain its Stage II program until it is fully phased out and until the state has begun implementing any needed new measures to ensure there will not be a harmful gap in area-wide emissions control.

4.1 Gradual Phase-out Strategy

If a state determines that decommissioning all Stage II control in an area all at one time or by a date certain would result in an unacceptable area-wide emissions increase, then states might consider a gradual phase-out strategy. A strategy of this nature is illustrated in Example Scenario #3 above. Using this approach a state might design a phase-out strategy that first exempts new GDFs from Stage II controls starting in 2013, and provides for subsequent decommissioning of existing Stage II-equipped GDFs starting with the lowest throughput stations in 2014 and ending with the highest throughput stations in 2017. An example phase-out strategy might also use some of the original Stage II program phase-in parameters in CAA section 182(b)(3) (e.g., new facilities exempted first, then GDFs that dispense less than 100,000 gallons per month, and then all remaining GDFs).

4.2 Cost Considerations

To support their decision making, states may wish to conduct an economic analysis of their Stage II control program to evaluate the ongoing annualized cost per ton of VOC removed. The EPA conducted this type of assessment to support the final widespread use determination rule.[31] The EPA estimates that for an average size GDF the annual cost to maintain existing Stage II systems is about $3,000per year. These total costs would be incurred by GDF operators each year to cover ever decreasing annual emission reduction benefits as measured by the increment calculation (Equation 1) described above. The EPA also estimates that the additional

[31] See Final Regulatory Support Document - Widespread Use for Onboard Refueling Vapor Recovery and Stage II Waiver: Decommissioning Stage II Vapor Recovery, Financial Benefits and Costs, March 2012.

costs of installing Stage II vapor recovery equipment at new GDFs, which typically include USTs, associated piping, pumps and ancillary equipment, ranges from $20,000 to $60,000. If this cost is amortized over a short period of time as ORVR continues to phase-in (e.g., 3 years) the new control may not be attractive from a cost effectiveness view point.

4.3 Decommissioning Issues

Whatever approach a state decides upon for phasing out Stage II controls, consideration should be given to proper decommissioning of Stage II-related equipment, including the underground vapor piping, and to ensuring that consistent procedures are in place to address liquid and vapor leak issues associated with decommissioning. The EPA recommends that currently available industry association codes and standards be followed (where applicable) to ensure that Stage II systems are properly designed, constructed, installed, and, in this case, dismantled or decommissioned. These codes and standards of practice provide a means for states to monitor methods of Stage II system decommissioning and we encourage state and local agencies to reference these codes. The EPA realizes that industry codes and standards may be updated periodically, and the EPA also recognizes that state and local requirements may supersede industry codes and standards or be inherently more stringent. The EPA regulations do not require the use of a particular issue of code. The Petroleum Equipment Institute (PEI) and at least four states have recommended practices or specific requirements for decommissioning Stage II systems. The PEI guidance, "Recommended Practices for Installation and Testing of Vapor Recovery Systems at Vehicle Fueling Sites, PEI/RP300-09," is especially instructive as it was developed by industry experts with a focus on regulatory compliance and safety. It contains the steps involved in dismantling Stage II hardware and applies to both balance and vacuum assist type systems. Please be aware that there may be other codes or standards not listed here that may also be appropriate to ensure proper Stage II decommissioning.

4.4 Potential Emission Reduction Programs for GDFs

By viewing the GDF in its entirety as a fuel storage and dispensing system, existing GDF emissions control systems can be enhanced to achieve a higher level of in-use efficiency, and to deliver more environmental benefit. Of course, additional system design, maintenance, and enforcement provisions add cost to the installation and ongoing operation of the systems. Examples of extra design and monitoring features include: 1) ORVR compatible Stage II nozzles; 2) systems to help better manage UST pressure and control emissions lost from the UST through vent lines and fugitive leak sources during normal operations; 3) post processors to control or eliminate normal UST breathing/emptying loss emissions; 4) standards for specially designed nozzles that reduce emissions from liquid retention, drips, and spills; and 5) low permeation fuel hoses.

5. Submission, Review and Approval of SIP Revisions

When submitting a SIP revision seeking removal of an existing Stage II vapor recovery program, the SIP revision package should include the information necessary for the EPA to determine that the action complies with all relevant CAA provisions, including, as applicable, sections 110(ℓ), 193, and 184(b)(2). States are encouraged to work closely with EPA Regional Offices to develop SIP revision packages.

5.1 Elements of SIP Revision Package

The state should coordinate with the appropriate EPA Regional Office on the necessary format and procedures for submitting a SIP revision. Submittal and cover letters should be addressed to the EPA Regional Administrator (RA) or the Regional Air Division Director (ADD) if the RA has delegated that authority to the ADD to accept SIP revisions submittals. The SIP revision should clearly identify the portion of the state regulation pertaining to the Stage II regulatory program that the state is requesting to revise. If following this guidance document, the state could include the results of area-wide emissions and emissions control calculations based on Equation 1 (*increment*) and/or Equation 2 (*delta*). The submittal should also include analysis, discussion, and any other relevant materials supporting a request for SIP approval with regards to sections 110(ℓ), 184 (b)(2) and 193, as applicable. If new emissions control regulations are being adopted to offset emissions controls forgone by the phasing out of a Stage II program, an analysis of the expected net area-wide emissions change would be appropriate.

5.2 EPA SIP Review Process

The EPA expects that state submission to revise the SIP should show how the revision satisfies the requirement in section 110(ℓ) not to interfere with attainment or maintenance of the NAAQS or any other applicable requirement. First, the EPA must determine that the submittal is complete within 6 months of the submission date. If deemed complete, the EPA must either approve or disapprove the submittal within one year of the determination of completeness. The EPA will act on SIP revisions through notice and comment rulemaking.

The EPA is not limited to only considering the calculations presented in this memorandum when considering a SIP revision seeking to remove Stage II control requirements. There is no specific value in terms of percentage control or tons of emissions that a state must meet before EPA can propose to approve a SIP revision. Each SIP revision will be reviewed on a case-by-case basis against the criteria of CAA section 110(ℓ), and if applicable, sections 193 and/or 184(b)(2), with due consideration to the basis for the values used in supporting calculations and any related emissions inventory and/or air quality analyses.

Appendix

Table A-1 - Projected Penetration of ORVR in the National Gasoline Fueled Vehicle Fleet by Year
[Based on MOVES 2010(a)]

1	2	3	4
End of Calendar Year	Vehicle Population Percentage	VMT Percentage	Gasoline Dispensed Percentage
2006	42.6%	51.2%	49.2%
2007	48.4%	57.3%	55.5%
2008	53.3%	62.3%	60.5%
2009	57.7%	66.8%	64.8%
2010	62.4%	71.6%	69.5%
2011	67.1%	76.0%	73.9%
2012	71.4%	80.0%	77.7%
2013	75.3%	83.4%	81.0%
2014	78.7%	86.3%	84.0%
2015	81.8%	88.8%	86.5%
2016	84.5%	90.9%	88.6%
2017	86.8%	92.5%	90.3%
2018	88.8%	93.9%	91.9%
2019	90.5%	95.0%	93.2%
2020	92.0%	95.9%	94.3%

See EPA Memorandum "Updated data for ORVR Widespread Use Assessment" February 29, 2012, in docket (number EPA-HQ-OAR-2010-1076) addressing details on values in this table and providing more calendar years.
Note: In this table, the columns have the following meaning.
1. Calendar year that corresponds to the percentages in the row associated with the year.
2. Percentage of the gasoline-powered highway vehicle fleet that have ORVR.
3. Percentage of gasoline-fueled vehicle miles traveled (VMT) by vehicles equipped with ORVR.
4. Amount of gasoline dispensed into ORVR-equipped vehicles as a percentage of all gasoline dispensed to highway motor vehicles.

Table A-2 - Monthly Average Dispensed Liquid Temperature

Dispensed liquid temperature (°F)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Weighted Average		
													Summer (Apr–Sep)	Winter (Oct-Mar)	Annual Average
National Average	51	54	54	58	69	76	82	81	76	70	62	54	74	58	66
Region 1	43	45	48	53	66	74	78	78	72	66	59	46	70	51	61
Region 2	69	74	73	80	84	87	90	91	78	85	83	73	85	76	81
Region 3	54	57	61	67	76	82	83	84	79	76	67	54	79	62	70
Region 4	50	51	41	47	63	74	88	85	83	75	63	52	74	56	65
Region 5	54	NA	NA	NA	72	77	83	83	79	74	67	58	79	63	72
Region 6	NA	48	49	53	59	63	NA	73	71	60	49	42	64	50	57

Regional Boundaries

Region 1: ME, VT, NH, MA, CT, RI, NY, NJ, PA, DE, MD,VA,WV,DC, KY, OH, IN, IL, MI, WI
Region 2: NC, SC, GA, FL, AL, MS, AR, LA, TN
Region 3: OK, TX, NM, AZ
Region 4: MN, IA, MO, ND, SD, NE, KS, MT, WY, CO
Region 5: CA, NV, UT
Region 6: WA, OR, ID

Source: McNally Michael and Dickerman J.C., "Summary and Analysis of Data from Gasoline Temperature Survey," conducted by API, Radian Corporation, May, 1976.

Table A-3 - Seasonal Variation In Temperature Difference Between Vehicle Fuel Tank and Dispensed Fuel
(

Temperature Difference (

	Average Annual	Summer (Apr – Sep)	Winter (Oct – Mar)	5-Month Ozone Season (May – Sep)	2-Month Ozone Season (Jul – Aug)
National Average	4.4	8.8	-0.8	9.44	9.9
Region 1	5.7	10.7	-0.3	11.5	12.5
Region 2	4.0	6.8	0.9	7.5	8.2
Region 3	3.7	7.6	-0.4	7.1	7.0
Region 4	5.5	11.7	-2.4	12.1	13.3
Region 5	0.1	3.9	-4.4	5.1	3.2
Region 6	Use Region 4 data				

Regional Boundaries
Region 1: ME, VT, NH, MA, CT, RI, NY, NJ, PA, DE, MD,VA,WV,DC, KY, OH, IN, IL, MI, WI
Region 2: NC, SC, GA, FL, AL, MS, AR, LA, TN
Region 3: OK, TX, NM, AZ
Region 4: MN, IA, MO, ND, SD, NE, KS, MT, WY, CO
Region 5: CA, NV, UT
Region 6: WA, OR, ID

Source: Rothman, Dale and Johnson, Robert, Technical Report, "Refueling Emissions from Uncontrolled Vehicles," EPA.OMS, EPA-AA-SDSB-85-6. June 1985.

Table A-4 - Percent of 50 State Gasoline Consumption for Areas Covered by CAA Sections 182(b)(3) or 184(b)(2)

State	Counties	Historical Ozone Nonattainment Areas	Area Name	% of 50 State Gasoline Consumption
AZ	3	1	Phoenix	1.079%
CA	21	8	Sacramento	0.7181%
			San Joaquin	1.140%
			East Kern	0.0532%
			LA - South Coast	4.545%
			Southeast Desert	0.6764%
			San Diego	1.096%
			Santa Barbara	0.1270%
			Ventura	0.2201%
CT	8	1	All CT	1.061%
			Greater CT	1.041%
			NY-NJ-CT	0.0196%
DC	1	1	DC	0.1270%
DE	3	2	All DE	0.3079%
			Philadelphia-Wilmington-Trenton	0.2345%
			Sussex	0.0763%
GA	13	1	Atlanta	1.677%
IL	8	1	Chicago-Gary-Lake	1.678%
IN	4	1	Chicago-Gary-Lake	0.2906%
LA	6	1	Baton Rouge	0.2221%
MA	14	2	All MA	1.922%
			Boston (Eastern MA)	1.960%
			Springfield (Western MA)	0.2314%
MD	12	3	Baltimore	0.85859%
			DC/MD/VA	0.7161%
			Philadelphia-Wilmington-Trenton	0.043%
ME	3	0	Portland	0.1943%
MO	5	1	St. Louis	0.7764%
NH	4	1	Portsmouth-Dover-Rochester	0.2950%

State	Counties	Historical Ozone Nonattainment Areas	Area Name	% of 50 State Gasoline Consumption
NJ	21	2	All NJ	2.598%
			New York-New Jersey-Long Island	1.736%
			Philadelphia-Wilmington-Trenton	0.8621%
NY	10	1	New York-New Jersey-Long Island	2.427%
PA	12	2	Philadelphia-Wilmington-Trenton	0.8480%
			Pittsburgh-Beaver Valley	0.652%
RI	5	1	All RI	0.307%
TX	16	4	Houston-Galveston-Brazoria	1.646%
			El Paso	0.1841%
			Dallas-Ft. Worth	1.786%
			Beaumont-Port Arthur	0.1230%
VA	17	2	DC/MD/VA	0.7082%
			Richmond	0.3390%
VT	14	0	All VT	0.362%
WI	6	4	Milwaukee-Racine & Kenosha	0.5779%
	1		Sheboygan	0.0383%
	1		Manitowoc	0.0349%
	1		Kewaunee	0.0084%

Table A-5 - Applicability of Clean Air Act Requirements to Areas Implementing Stage II Gasoline Vapor Recovery Programs for the Ozone NAAQS

State	Nonattainment Areas	§110(ℓ) Only[1]	§184(b)(2) (OTR Comparable Measures)	§193 (Pre-1990 Savings Provision)	Attaining Ozone NAAQS[2]			
					1-hour[3]	1997 8-hour[4]	2011 DV	2008 8-hour[5]
AZ	Phoenix	X			Yes	Yes	0.077	No
CA	LA-South Coast			X	No	No	0.107	No
	LA-San Bernardino Co (West Mojave Desert)[6]			X	No	No	0.097	No
	Sacramento Metro			X	Yes	No	0.095	No
	San Joaquin Valley[6]			X	No	No	0.094	No
	Riverside Co (Coachella Valley)[6]			X	Yes	No	0.093	No
	Ventura Co			X	Yes	Yes	0.083	No
	San Diego			X	Yes	Yes	0.082	No
	Santa Barbara-Santa Maria-Lompoc			X	Yes	Yes	0.076	No
CT	NYC-Long Is., NY-NJ-CT		X		Yes	Yes	0.084	No
	Greater CT Area		X		Yes	Yes	0.076	No
DE	Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE		X		Yes	Yes	0.083	No
	Sussex County, DE OTR Area		X		Yes	Yes	0.077	No
GA	Atlanta	X			Yes	Yes	0.080	No
IL	Chicago-Gary, IL-IN	X			Yes	Yes	0.077	No
	St. Louis, MO-IL	X			Yes	Yes	0.077	No
IN	Chicago-Gary, IL-IN	X			Yes	Yes	0.077	No
LA	Baton Rouge	X			Yes	Yes	0.082	No
ME	ME OTR Area		X		Implementing Stage II in 3 Southern ME Counties.			Yes
MD	Baltimore		X		Yes	No	0.092	No
	Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE		X		Yes	Yes	0.083	No
	Washington DC-MD-VA		X		Yes	Yes	0.082	No
MA[7]	Boston-Lawrence-Worcester (E. MA)		X		Yes	Yes	0.075	Yes
	Springfield (W. MA)		X		Yes	Yes	0.074	Yes
MO	St. Louis, MO-IL			X	Yes	Yes	0.079	No
NH	Boston-Lawrence-Worcester (E. MA)		X		Yes	Yes	0.075	Yes
	Portsmouth-Dover-Rochester		X		Yes	Yes	0.063	Yes
	Rest of NH OTR Area		X		Implementing Stage II and RFG to meet comparable measures.			Yes

State	Nonattainment Areas	§110(ℓ) Only[1]	§184(b)(2) (OTR Comparable Measures)	§193 (Pre-1990 Savings Provision)	Attaining Ozone NAAQS[2]			
					1-hour[3]	1997 8-hour[4]	2011 DV	2008 8-hour[5]
NJ	NYC-Long Is., NY-NJ-CT		X	X	Yes	Yes	0.084	No
	Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE		X		Yes	Yes	0.083	No
	Rest of NJ OTR Areas		X		Implementing Stage II in all counties.			Yes
NY	NYC-Long Is., NY-NJ-CT		X	X	Yes	Yes	0.084	No
PA	Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE		X		Yes	Yes	0.083	No
	Pittsburgh-Beaver Valley, PA (1-hour Moderate area under §182(b)(3))	X			Yes	Yes	0.080	No
RI	Providence and all RI Areas		X		Yes	Yes	0.073	Yes
TX	Houston	X			No	No	0.089	No
	Dallas-Ft. Worth	X			Yes	No	0.090	No
	Beaumont-Port Arthur	X			Yes	Yes	0.074	Yes
	El Paso	X			Yes	Yes	0.071	Yes
VT	All of VT (OTR)		X		Implementing Stage II in all counties.			Yes
VA	Washington DC-MD-VA (Northern VA)		X		Yes	Yes	0.082	No
	Richmond, VA	X			Yes	Yes	0.075	Yes
WI	Milwaukee-Racine	X			Yes	Yes	0.077	No

[1] All states and all areas are required to comply with CAA section 110(ℓ), chart shows states/areas where 110(ℓ) is the only constraint.
[2] Based on air quality data from 2009-2011. [3] The 1-hour ozone NAAQS was promulgated in 1979 and was 0.12 ppm.
[4] The first 8-hour ozone NAAQS was promulgated in 1997 and is 0.08 ppm and is attained if the area design value is less that or equal to 0.084 ppm. Once an area was designated under the 1997 ozone standard, the 1-hour standard was revoked for that area. As of April 15, 2008, all areas were designated under the 1997 ozone standard.
[5] The 2008 8-0hour Ozone NAAQS is 0.075 ppm.
[6] History of redistricting and boundary changes between air districts with pre-1990 requirements. District may have Stage II gasoline dispensing rules in some parts of district prior to 1990.
[7] The MA Stage II program was adopted prior to 11/15/1990 but was not approved into the SIP until 12/14/1992.

Table A-6 - Percent of State/Area GDF Dispensers Using Vacuum Assist Stage II Technology (June 2012)

State	Number Counties	Area name	% GDFs using Vacuum Assist
ARIZONA	3	Phoenix	85%
CALIFORNIA[32]	21	Average Q_{SIIva}	70%
		Sacramento	ORVR Compatible
		San Joaquin	ORVR Compatible
		East Kern	ORVR Compatible
		LA - South Coast	ORVR Compatible
		Southeast Desert	ORVR Compatible
		San Diego	ORVR Compatible
		Santa Barbara	ORVR Compatible
		Ventura	ORVR Compatible
CONNECTICUT	8	All CT	88%
DELAWARE	3	All DE	88%
DC	1	DC	97%
GEORGIA	13	Atlanta	95%
ILLINOIS	8	Chicago metro	92%
INDIANA	4	Chicago-Gary metro	95%
LOUISIANA	6	Baton Rouge	90%
MAINE	3	Portland	95%
MARYLAND	12	Baltimore and Wash DC areas	94%
MASSACHUSETTS	14	All MA	90%
MISSOURI	5	St. Louis	0%
NEW HAMPSHIRE	4	Portsmouth Dover Rochester	93%
NEW JERSEY	21	All NJ	48%
NEW YORK	10	NYC metro	73%
PENNSYLVANIA	12	Philadelphia metro	80%
		Pittsburgh -Beaver Valley	96%
RHODE ISLAND	5	All RI	93%
TEXAS[33]	16	Average Q_{SIIva}	90%
		Houston-Galveston-Brazoria	ORVR Compatible
		El Paso	ORVR Compatible
		Dallas-Fort Worth	ORVR Compatible
		Beaumont -Port Arthur	ORVR Compatible
VIRGINIA	17	Wash DC metro area	93%
		Richmond	85%
VERMONT	14	All VT	95%
WISCONSIN	9	All Counties	85%

[32] Estimates for California provided by state sources, all vacuum assist must be ORVR compatible.
[33] Estimates for Texas provided by state sources, all vacuum assist must be ORVR compatible.

Table A-7 - Five –Month (May-September) Uncontrolled Displacement (non-ORVR) Refueling Emission Factors (g/gal)

State	Number Counties	Area name	RVP (psi)	Emission Factor
ARIZONA	3	Phoenix	7.8	3.5
CALIFORNIA	58	All CA	7.0	3.4
CONNECTICUT	8	All CT	7.0	3.0
DELAWARE	3	All DE	7.0	3.0
DC	1	DC	7.0	3.0
GEORGIA	13	Atlanta	7.0	4.6
ILLINOIS	8	Chicago metro	7.0	3.0
INDIANA	4	Chicago-Gary metro	7.0	3.0
LOUISIANA	6	Baton Rouge	7.8	5.1
MAINE	3	Portland	7.8	3.3
MARYLAND	12	Baltimore and Wash DC areas	7.0	3.0
MASSACHUSETTS	14	All MA	7.0	3.0
MISSOURI	5	St. Louis	7.0	3.3
NEW HAMPSHIRE	4	Portsmouth Dover Rochester	7.0	3.0
NEW JERSEY	21	All NJ	7.0	3.0
NEW YORK	10	NYC metro	7.0	3.0
PENNSYLVANIA	12	Philadelphia metro	7.8	3.0
		Pittsburgh -Beaver Valley	7.0	3.3
RHODE ISLAND	5	All RI	7.0	3.0
TEXAS	16	All TX	7.0	3.5
VIRGINIA	17	All VA	7.0	3.0
VERMONT	14	All VT	9.0	3.9
WISCONSIN	6	Milwaukee-Racine	7.0	3.0
		Sheboygan, Manitowoc, Kewaunee	9.0	3.9

Table A-8 - Input Data for States/Areas with Stage II but not Affected by 182(b)(3) or 184(b)(2) (July 2012)

State	Number Counties	Area name	Percent of 50 State Gasoline Consumption	% GDFs using Vacuum Assist[34]	RVP (psi)	Five – Month (May-September Refueling Emission Factors (g/gal)
CALIFORNIA[35]	37	All AQMDs & APCDs not listed in tables above	2.565%	70% ORVR Compatible	7.0	3.4
KENTUCKY	3	Jefferson	0.2498%	98%	7.0	3.0
		N KY	0.1299%	98%	7.0	3.0
NEVADA	2	Washoe County	0.1087%	40%	7.8	3.9
		Clark County	0.430%	70%	9.0	4.4
OHIO	16	Cleveland-Akron	0.8076%	97%	9.0	3.9
		Cincinnati	0.4775%	96%	7.8	3.4
		Dayton	0.2884%	94%	7.8	3.4
OREGON	3	Portland	0.426%	50%	7.8	3.7
TENNESSEE	1	Davidson	0.2409%	98%	7.8	4.6
	4	Nashville Metro	1.1687%	95%	7.8	4.6
WASHINGTON	5	Seattle	1.088%	80%	9.0	4.3
	2	Vancouver	0.1542%	80%	9.0	4.3

[34] Estimates for California provided by state sources; all vacuum assist must be ORVR compatible.
[35] This data provided by the Petroleum Equipment Institute.

Table A-9 – MOVES 2012 Vehicle Class Age Distribution

Calendar		Model	Gasoline				
Year	**Age**	**Year ID**	**Motorcycle**	**Pass Car**	**LDT1**	**LDT2**	**HDGV**
2012	30	1982	0.001966	0.000668	0.002037	0.002037	0.005699
2012	29	1983	0.001689	0.000718	0.002178	0.002178	0.005426
2012	28	1984	0.002310	0.001094	0.003234	0.003234	0.006327
2012	27	1985	0.002585	0.001559	0.004318	0.004318	0.008814
2012	26	1986	0.003071	0.002170	0.004989	0.004989	0.011413
2012	25	1987	0.003696	0.002585	0.006043	0.006043	0.009350
2012	24	1988	0.003741	0.003538	0.007146	0.007146	0.011049
2012	23	1989	0.004419	0.004355	0.007774	0.007774	0.011843
2012	22	1990	0.005962	0.005407	0.008745	0.008745	0.010388
2012	21	1991	0.007355	0.006255	0.008972	0.008972	0.009462
2012	20	1992	0.009290	0.008232	0.011363	0.011363	0.011102
2012	19	1993	0.011102	0.011132	0.014774	0.014774	0.014453
2012	18	1994	0.013623	0.015221	0.018422	0.018422	0.020989
2012	17	1995	0.011840	0.018786	0.020574	0.020574	0.023061
2012	16	1996	0.015718	0.023545	0.024745	0.024745	0.025302
2012	15	1997	0.017935	0.028620	0.028422	0.028422	0.027497
2012	14	1998	0.018745	0.034619	0.034691	0.034691	0.032089
2012	13	1999	0.021968	0.044520	0.039503	0.039503	0.045460
2012	12	2000	0.029065	0.054649	0.047137	0.047137	0.048348
2012	11	2001	0.036410	0.056862	0.051960	0.051960	0.052218
2012	10	2002	0.042963	0.057388	0.056257	0.056257	0.047379
2012	9	2003	0.048226	0.056194	0.061399	0.061399	0.052367
2012	8	2004	0.056980	0.057747	0.066770	0.066770	0.058223
2012	7	2005	0.067163	0.060876	0.070393	0.070393	0.064607
2012	6	2006	0.076695	0.063183	0.068310	0.068310	0.063641
2012	5	2007	0.080950	0.062722	0.068566	0.068566	0.063843
2012	4	2008	0.089568	0.056968	0.046968	0.046968	0.048232
2012	3	2009	0.047643	0.051356	0.037902	0.037902	0.040547
2012	2	2010	0.067916	0.061669	0.054558	0.054558	0.052774
2012	1	2011	0.089591	0.070362	0.059917	0.059918	0.057786
2012	0	2012	0.109815	0.076999	0.061931	0.061930	0.060313
Total			1.000000	1.000000	1.000000	1.000000	1.000000
Avg Age			6.9	8.0	8.9	8.9	9.6

LDT1: ≤6000 lbs GVWR
LDT2 : >6000 but ≤8500 lbs GVWR
HDGV: > 8500lbs GVWR

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Appendix C

MD Stage II Emission Reduction Benefits

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From: Dan Meszler

Subject: Stage II Emission Reduction Benefits

Date: August 22, 2012

As requested by MDE, MES has performed an analysis of the potential impacts associated with the elimination of Stage II requirements in Maryland. In conducting this analysis, MES has evaluated potential gasoline refueling emissions trends related to both onboard refueling vapor recovery (ORVR) and Stage II control technology over the period 2011 through 2020. MES has also evaluated the potential impact of indirect excess emissions (IEE), caused by a negative interaction between ORVR and some Stage II controls, on gasoline refueling emissions and quantified the potential timeframe in which IEE emissions may lead to a crossover point, following which Stage II emissions controls might actually result in an increase in refueling emissions above levels that would result if Stage II controls were eliminated.[1] As requested, all analysis has been performed at the county level of detail for each of the 12 counties that currently require Stage II controls. Emission estimates are available for each county individually as well as the aggregate Baltimore and Washington, D.C. metropolitan areas and the 12 county Stage II area as a whole.

Before presenting a synopsis of analysis results, it is important to recognize that despite the fact that Stage II control technology has been in use in the U.S. for four decades, there is surprisingly little consensus on the actual in-use effectiveness of such technology, even with regard to reducing vapor displacement emissions. Greater uncertainty exists with regard to whether Stage II offers any spillage-related emission reduction benefit; and there is virtually no information available with regard to the effectiveness of Stage II controls during the refueling of either nonroad equipment and vehicles or portable refueling containers. In fact, most SIP-related Stage II estimates continue to rely on information originally published in EPA guidance documents in the early 1990s, and developed from rather sparse databases.[2] There are some data available for more recent issues such as IEE, but even those data exhibit significant uncertainty – indicating potential emission rates that vary approximately over an order of magnitude. For these reasons, it is not possible to present a single set of conclusive results regarding the impact of eliminating Stage II vapor recovery requirements. Instead, analysis results are presented on in a four-step

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[1] In reviewing the impacts of IEE, it is important to recognize that there are methods to eliminate such emissions, including the installation of ORVR-compatible Stage II equipment and bulk storage tank vent line vapor recovery and processing equipment. *While it is beyond the scope of this analysis, it is important to evaluate the cost effectiveness of IEE reduction technology before any decision-making based on IEE impacts is implemented*.

[2] U.S. EPA, "Technical Guidance - Stage II Vapor Recovery Systems for Control of Vehicle Refueling Emissions at Gasoline Dispensing Facilities," EPA-450/3-91-022a, November 1991.

fashion so that the potential impact (and associated uncertainty) of specific analysis assumptions can be accurately gauged.

The first set of analysis results apply solely to gasoline vapor displacement emissions associated with onroad vehicle refueling. These results indicate the interaction between ORVR and Stage II controls assuming no gasoline spillage benefits (for either technology) and no Stage II control associated with nonroad equipment and vehicles or portable refueling containers. In the context of analysis design, this set of results is consistent with similar analyses that MES has encountered from the EPA and others. A second set of analysis results extends the first set to include potential gasoline spillage impacts for onroad vehicles. Potential impacts related to nonroad equipment and vehicles and portable refueling containers continue to be ignored. A third set of results adds the potential vapor displacement impacts associated with nonroad equipment and vehicles and portable refueling containers to the onroad vehicle vapor displacement (only) estimates (potential spillage impacts on both onroad and nonroad equipment and vehicle emissions are not considered). Finally, a fourth set of analysis results adds the potential spillage impacts for nonroad equipment and vehicles and portable refueling containers to the vapor displacement impacts estimated in the third set of analysis results. Table 1 summarizes this approach and provides a brief description of how each set of results allows for the effects of effectiveness uncertainty to be evaluated.

Each set of analysis results includes estimates for three evaluation scenarios, allowing for a range of control effectiveness values to be investigated (within each results set). In addition, each analysis set also includes impacts with and without IEE, so that the impacts of IEE reductions can also be isolated. Together, the resulting analysis estimates define a wide range of potential impacts and it is, unfortunately, not possible to narrow this range to a single value given the existing state of Stage II (and ORVR) effectiveness data.[3] Ideally existing uncertainty over Stage II effectiveness would be narrowed through the conduct of detailed (and comprehensive)

Table 1. Impacts Included in Analysis Results

Emissions Impact Type	Results Set 1	Results Set 2	Results Set 3	Results Set 4
Onroad Displacement Emissions	Included	Included	Included	Included
Onroad Spillage Emissions	Not Included	Included	Not Included	Included
Nonroad Displacement Emissions	Not Included	Not Included	Included	Included
Nonroad Spillage Emissions	Not Included	Not Included	Not Included	Included
Benefit of Results Set	Isolates onroad displacement effects, allowing effects of spillage uncertainty to be understood.	Isolates onroad effects, allowing nonroad influence on combined effects to be understood.	Isolates combined onroad and nonroad effects of Stage II removal, without spillage effects uncertainty.	Isolates potential maximum onroad and nonroad effects of Stage II removal.

[3] Note that although MES did not alter the ORVR effectiveness assumptions employed by the U.S. EPA, it should be recognized that these assumptions are quite aggressive – assigning a 98 percent in-use effectiveness to ORVR vapor displacement control. Should this level of effectiveness ultimately prove to be overly optimistic, the level of Stage II reductions (relative to those of ORVR) presented in this analysis will be correspondingly underestimated.

in-use field studies, but given the four decade history of such controls and the ever increasing penetration of ORVR technology, it seems unlikely that such studies will be undertaken in the imminent future, if ever. There are valuable information being developed and published by organizations such as the California Air Resources Board and independent developers and marketers of Stage II and IEE control equipment, but those data provide little information with regard to specific conditions in Maryland.

To conduct the requested analysis, MES has constructed a spreadsheet that allows the potential gasoline vapor displacement and spillage impacts for onroad vehicles and nonroad vehicles and equipment to be quantified for any given set of ORVR and Stage II effectiveness assumptions. While readers interested in the specific methodology employed to develop the onroad and nonroad portions of this spreadsheet will find significant additional detail in the sections of this memorandum that follow, fundamental uncontrolled refueling emissions are derived from the EPA's MOVES and NONROAD emissions models for onroad vehicle and nonroad equipment and vehicles respectively.[4,5] ORVR effectiveness data developed by the EPA and Stage II effectiveness data provided by MDE form the backbone of the implemented analysis.

Table 2 presents the various system effectiveness assumptions used to evaluate the impacts of Stage II controls. ORVR spillage and vapor displacement effectiveness estimates are taken (without change) from the databases underlying the EPA MOVES model. For onroad vehicles, Stage II effectiveness assumptions for "nominal" scenario 1 are set at values provided by MDE. Scenarios 2 and 3 reflect a 20 percentage point increase and decrease in vapor displacement effectiveness respectively – with these shifts intended to isolate the effect of in-use effectiveness uncertainty. The magnitude of the MDE-estimated Stage II spillage reduction effectiveness for onroad vehicles is held constant across all three scenarios, but the spreadsheets corrects scenarios 2 and 3 for what MES believes is a flaw in the MOVES emissions estimation algorithm for Stage II spillage impacts. The interested reader is referred to the detailed discussion on onroad vehicle emissions processing below for more information on this perceived flaw, but its net impact is manifested in MOVES as an overestimation of Stage II spillage reduction benefits. The spreadsheet developed by MES for this analysis allows this potential flaw to be eliminated, and that option is selected for scenarios 2 and 3. Conversely, scenario 1 is constructed to produce onroad vehicle impact estimates identical to those estimated by MOVES (and so includes no adjustment for this perceived flaw).

MES has elected to maintain all spillage-related effectiveness assumptions unchanged across all three scenarios in an effort to minimize the influence of alternative spillage assumptions on analysis results. This is exclusively due to the fact that MES does not believe that Stage II provides any reliably demonstrated spillage reduction benefits. The effect of Stage II on spillage is subject to significant uncertainty, with some EPA documents indicating a reduction benefit and others indicating no reduction. Vacuum assist Stage II systems are the overwhelmingly

[4] The MOVES model and associated supporting documentation can be downloaded from www.epa.gov/otaq/models/moves/index.htm.

[5] The NONROAD model and associated supporting documentation can be downloaded from www.epa.gov/otaq/nonrdmdl.htm.

Table 2. Emissions Impact Effectiveness Assumptions

Analysis Parameter	Scenario 1	Scenario 2	Scenario 3
Onroad Vehicle Emissions Impact Parameters			
ORVR Spillage Reduction Factor	50%	50%	50%
ORVR Vapor Displacement Reduction Factor	98%	98%	98%
Stage II Spillage Reduction Factor	70%	70%	70%
Stage II Vapor Displacement Reduction Factor	70%	90%	50%
Use MOVES Stage II Spillage Assumptions	Yes	No	No
Incompatibility Excess Emissions Rate (1)	0.3901 [0.00086]	0.3901 [0.00086]	0.3901 [0.00086]
Nonroad Equipment and Vehicle Emissions Impact Parameters			
Spillage Reduction Factor at a Balance System Pump	70%	70%	70%
Spillage Reduction Factor at a Vacuum Assist Pump	70%	70%	70%
Vapor Displacement Reduction Factor at a Balance System Pump	0%	0%	0%
Vapor Displacement Reduction Factor at a Vacuum Assist Pump	70%	90%	50%
Portable Refueling Container (Pump Refilling) Emissions Impact Parameters			
Spillage Reduction Factor at a Balance System Pump	70%	70%	70%
Spillage Reduction Factor at a Vacuum Assist Pump	70%	70%	70%
Vapor Displacement Reduction Factor at a Balance System Pump	0%	0%	0%
Vapor Displacement Reduction Factor at a Vacuum Assist Pump	56%	72%	40%

Notes: (1) grams [pounds] per gallon dispensed to ORVR-equipped vehicles.

predominant – in fact, nearly universal – Stage II system in Maryland. It is difficult to envision an engineering rationale for spillage emissions control with such systems. Vacuum assist systems are virtually indistinguishable from non-Stage II gasoline delivery systems in both style and function – as perceived by the user. While booted balance-type systems might engender some behavioral caution on the part of users – leading to possible decreases or increases spillage depending on user response thereto – balance systems are associated with far less than one percent of Stage II gasoline throughput in Maryland. This uncertainty is seemingly confirmed by available field studies where some researchers find decreases in spillage with Stage II systems, while others find the opposite.[6]

Nevertheless, even as recently as the 2012 release of the MOVES2010b model, supporting documentation claims that "Stage II controls reduce the amount of fuel spilled due to "spitback"."[7] Based in EPA emission rate calculations, spitback is responsible for approximately 50 percent of uncontrolled spillage emissions, with the remainder due to nozzle drips – both pre and post fill (at about 7 and 10 percent of total spillage respectively) – and overfill (at about 33

[6] See for example, Section 3.4.2 of U.S. EPA, "Technical Guidance - Stage II Vapor Recovery Systems for Control of Vehicle Refueling Emissions at Gasoline Dispensing Facilities," EPA-450/3-91-022a, November 1991.

[7] See for example, Appendix F of U.S. EPA, "Motor Vehicle Emission Simulator (MOVES), User Guide Version, MOVES2010b," EPA-420-B-12-001, March 2012.

percent of total spillage).[8],[9] As mentioned previously, while booted balance-type Stage II systems might indeed reduce spitback emissions, such systems are exceedingly rare in Maryland. Moreover, the introduction of enhanced evaporative emissions testing requirements, beginning in the mid-1990s, was responsible for the virtual elimination of spitback due to the inclusion of an actual vehicle refueling event as an integral component of vehicle evaporative testing – leading to the redesign of vehicle fill pipes and a limit on the delivery rate of gasoline. Whether spitback emission reduction is credited to enhanced evaporative testing, ORVR, or Stage II controls, it is difficult to envision a scenario where one program is more effective than the other. Once spitback is "not spilled," it can't be "not spilled" again. Of course, some residual impact may accrue to Stage II for vehicles without ORVR, but even that requires an assumption that vacuum assist systems somehow control spitback, nozzle leakage, or overfilling (relative to a conventional non-Stage II delivery system). Given our skepticism in this regard, MES has elected to utilize the MDE-provided Stage II spillage reduction credit of 70 percent without change on the premise that the derivation of this level of effectiveness is documented and supported in existing MDE Stage II materials.

Two IEE rates have been assumed in this analysis. Each scenario is evaluated at both a zero IEE rate and a rate of 0.86 pounds per thousand gasoline gallons dispensed to ORVR-equipped vehicles (by definition, the IEE rate is always zero for vehicles without ORVR and for balance-type Stage II systems regardless of ORVR presence). As mentioned above, there are a rather wide range of published IEE rates – and the actual rate in Maryland is dependent on the mix of balance, low V/L vacuum assist, and high V/L vacuum assist systems.[10]

MDE provided data for Stage II system types in Maryland. These data, which are summarized in Table 3, indicate a near negligible fraction of balance-type systems. Healy vacuum assist systems are identified as distinct from other vacuum assist systems, but MES does not believe that one can assume that all existing Healy systems are ORVR compatible, so this analysis treats all vacuum assist systems as a group (of unknown V/L performance). As indicated in Table 3, the identified Healy systems account for less than five percent of all gasoline throughput, so any error associated with this aggregation is small. Nevertheless, the assumed 0.86 pounds per thousand gallon IEE rate is representative of high V/L Stage II systems, and it is virtually certain that some fraction of existing Stage II systems are low V/L (ORVR compatible) systems.[11] Thus the IEE impacts presented in the analysis results should be viewed as "high end" estimates almost certain to overstate the impact of IEE in Maryland. However, the impact of alternative assumptions regarding IEE (e.g., a 50/50 split of ORVR and non-ORVR compatible vacuum

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[8] See for example, Table 4 of U.S. EPA, memorandum from Glenn W. Passavant with subject "Onboard Refueling Vapor Recovery Widespread Use Assessment," June 9, 2011.

[9] Elimination of the 50 percent spitback emissions contribution is undoubtedly the source of EPA's ORVR spillage emissions reduction credit of 50 percent (as shown in Table 2 and encoded in the databases underlying the EPA MOVES model).

[10] V/L is the volumetric ratio of vapor returned to liquid dispensed from the refueling storage tank. Vacuum assist systems with V/L ratios of 1 (±10 percent) exhibit IEE rates that are about an order of magnitude lower than those with V/L ratios of 1.2.

[11] The 0.86 pounds per thousand gallon emission rate is based on California Air Resources Board testing and is representative of a high V/L system emission rate. See U.S. EPA, "Stage II Vapor Recovery Systems, Issues Paper," August 12, 2004.

Table 3. Stage II System Distribution (fraction of Stage II gasoline throughput)

County	Balance System	Vacuum Assist	Healy Vacuum Assist
Anne Arundel	0.3%	94.3%	5.4%
Baltimore	0.5%	95.2%	4.3%
Calvert	0.0%	94.2%	5.8%
Carroll	0.2%	98.4%	1.4%
Cecil	0.3%	96.8%	2.9%
Charles	0.1%	83.8%	16.1%
Frederick	0.3%	96.3%	3.4%
Harford	0.1%	97.8%	2.0%
Howard	0.3%	98.4%	1.4%
Montgomery	0.3%	97.0%	2.8%
Prince George's	0.1%	92.2%	7.7%
Baltimore City	0.3%	98.4%	1.3%
Stage II Area Total	0.3%	95.0%	4.7%

assist systems) can be easily evaluated by interpolating between the zero and non-zero IEE emissions curves in the presented results. Alternatively, MES would be happy to evaluate one or more scenarios with alternative IEE rate assumptions should MDE develop data on the distribution of high and low V/L vacuum assist systems.

Finally MES has estimated the potential Stage II impact on nonroad vehicles and equipment refueled at gasoline dispensing pumps, as well as portable refueling containers refilled at gasoline dispensing pumps. Although the latter are not included in the EPA's NONROAD model, MES has developed a methodology to estimate portable refueling container emissions from other data included with, and estimates produced by, the model. The interested reader will find detailed information on this methodology in the extended nonroad processing discussion that follows.

For nonroad equipment and vehicles refueled at a gasoline dispensing pump, MES has applied the same Stage II spillage effectiveness assumptions provided by MDE for onroad vehicles. Although we have concerns regarding the accuracy of this estimate (as described above), we see no reason that spillage impacts (should such exist) would differ (on a relative basis) across the onroad and nonroad sectors. The relative contributions of onroad vehicle fill pipe redesign and mandated dispensing flow rate caps to spitback emissions reduction is unclear, but the latter certainly influence any equipment subjected to pump refueling, be that equipment used in onroad or nonroad applications. Of course, the primary concern of MES is that neither ORVR nor Stage II controls are the primary drivers of spitback emission reduction. For vapor displacement control, we assume zero effectiveness for balance-type Stage II systems (due to a perceived lack of fill pipe standardization that would allow for a proper balance-type system seal) and vacuum assist system effectiveness identical to that for onroad vehicles (due to the negative pressure operational nature of such systems that should compensate for differing fill pipe characteristics).

For portable refueling containers refilled at a gasoline dispensing pump, MES has also applied the same Stage II spillage effectiveness provided by MDE for onroad vehicles, for the same reasons described in the preceding paragraph. For vapor displacement control, we again assume zero effectiveness for balance-type Stage II systems (due to a perceived lack of a proper balance-type system seal). For vacuum assist systems, we discount the effectiveness values for onroad vehicles by 20 percent, under the assumption that the negative pressure operational nature of such systems will still provide control, but that control will be reduced due to the lack of a defined fill pipe and the likelihood that some vapor will escape above the nozzle intake openings. Given the lack of available data, this discount is not robust and should be subjected to refinement should additional information become available. As described in detail in the extended nonroad processing discussion that follows, there are assumptions associated with portable container refilling emission estimates that should be understood; primarily that (1) such refilling is performed on containers that are properly sealed (before refilling) and thus contain saturated gasoline vapor, and (2) no post-refilling losses are assumed, so that the volume of gasoline dispensed into such containers is the *minimum* required to refuel associated nonroad equipment. Clearly alternative assumptions are possible and MES would be happy to adjust the portable refueling container estimates should MDE wish to investigate alternative assumptions.

Given these assumptions, Figures 1 through 4 present the derived emission impact estimates for results sets 1 through 4. For results set 1 (Figure 1), which addresses onroad vehicle vapor displacement emissions only, the zero impact point for Stage II is mid-2013 for "nominal" input scenario 1. If the IEE rate is altered to reflect a 50 percent ORVR compatible system penetration, the point of zero impact would be extended to 2017. If potential onroad spillage impacts are considered (Figure 2), the "maximum IEE" zero impact point is mid-2015 for "nominal" input scenario 1 – extended to beyond 2020 for a 50 percent ORVR compatible system penetration.[12] Adding nonroad vehicles and equipment to a displacement only evaluation (Figure 3) indicates a "maximum IEE" zero impact point of early 2015 for "nominal" input scenario 1 – extended to beyond 2020 for a 50 percent ORVR compatible system penetration. Finally, including both onroad and nonroad vehicles and equipment and both potential displacement and spillage impacts (Figure 4) indicates a "maximum IEE" zero impact point of beyond 2020 for "nominal" input scenario 1.

Of course, the specific level of emissions "above" or "below" the zero impact point for any given evaluation scenario varies with time, so it is not possible to define a required emissions offset should Stage II control requirements be eliminated – without first specifying an associated time parameter. The specific time-dependent nature of such an offset can be easily viewed in Figures 1 through 4 as the distance between each emissions impact curve and the horizontal zero impact line. Tables 9 through 56, included at the end of this memorandum, present the specific emission impact estimates for each year from 2011 through 2020 by county, metropolitan area, and Stage II region (Tables 9 through 32), as well as hazardous air pollutant emission impact estimates for those same years for the aggregate Stage II region (Tables 33 through 56). The remainder of this memorandum provides additional detail on the methodologies employed to estimate onroad and nonroad equipment and vehicle emissions.

[12] The analysis conducted by MES includes all years from 2011 through 2020, so it is not possible to precisely indicate transition points beyond 2020 without additional analysis beyond the scope of this work.

Figure 1. Results Set 1 – Onroad Only, Displacement Impacts Only (VOC, metric tonnes per day)

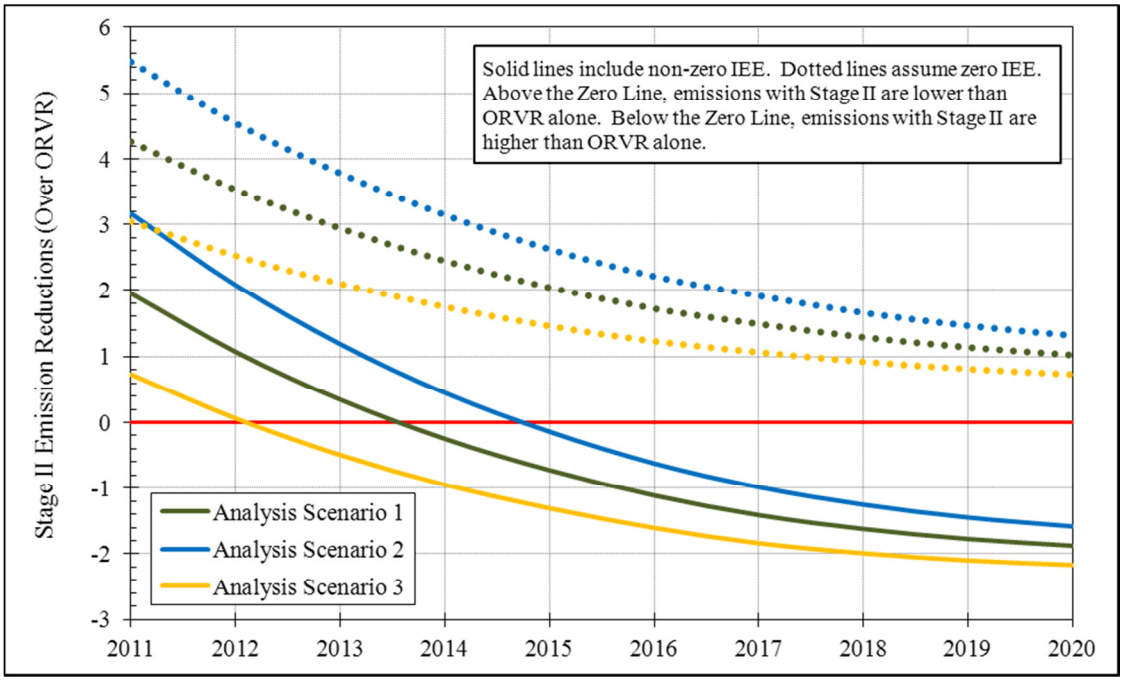


Figure 2. Results Set 2 – Onroad Only, Displacement and Spillage Impacts (VOC, metric tonnes per day)

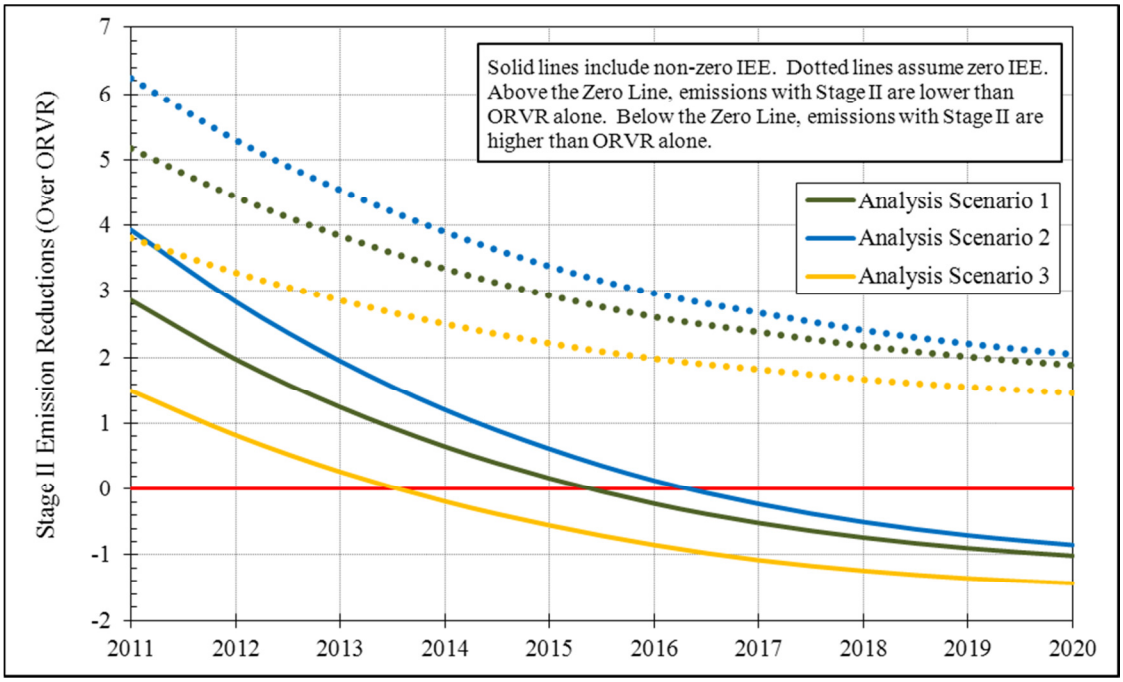


Figure 3. Results Set 3 – Onroad+Nonroad, Displacement Impacts Only (VOC, metric tonnes per day)

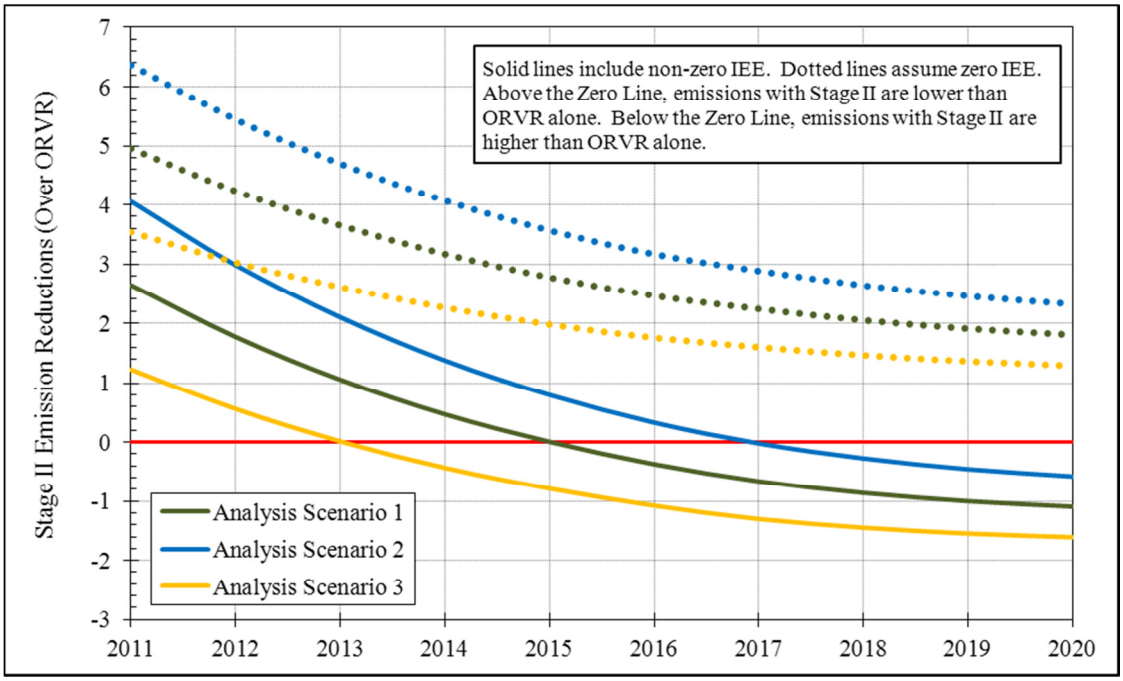
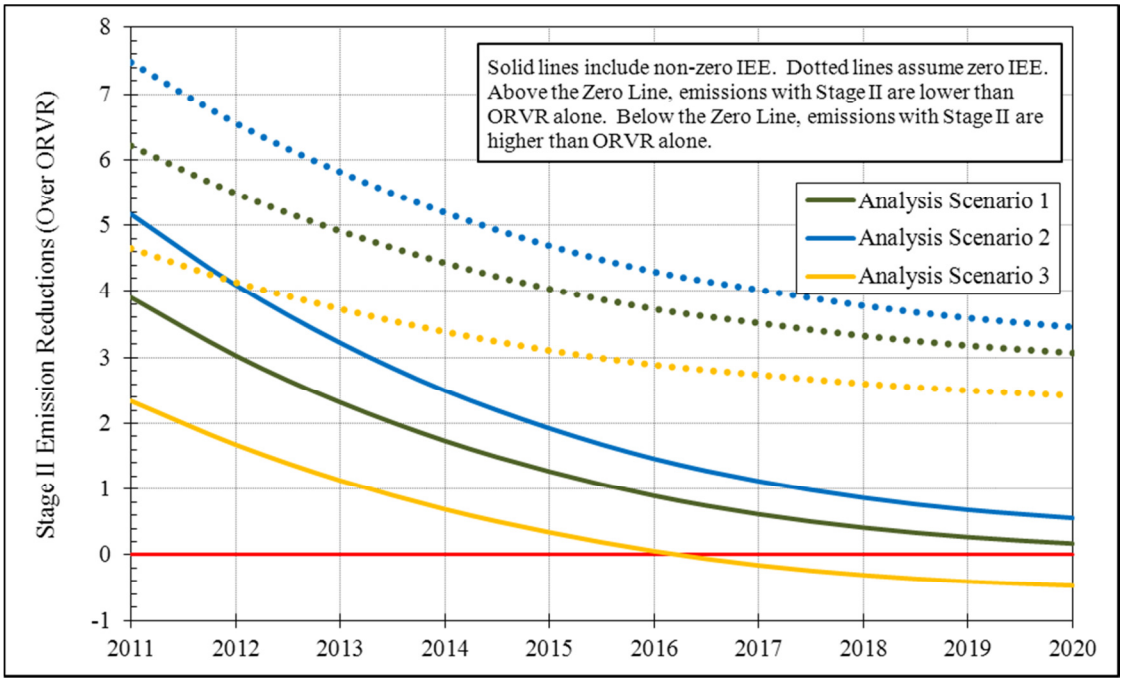


Figure 4. Results Set 4 – Onroad+Nonroad, Displacement and Spillage Impacts (VOC, metric tonnes per day)



Onroad Processing: Generally, all emission estimates for onroad vehicles are based on modeling performed using the U.S. EPA's MOVES2010b model.[13] The MOVES model includes the capability of estimating the impact of Stage II vapor recovery on both displacement and spillage emissions. However, based on an analysis of how MOVES handles the interaction between ORVR and Stage II controls with regard to spillage emissions, MES believes that while the MOVES algorithms are not flawed per se, there are nuances in their implementation that are not discussed in any of the available MOVES-related documentation, and which result in a significant likelihood that users will not properly quantify Stage II modeling inputs. For this reason, as well as to facilitate alternative scenario evaluation, MES developed a stand-alone routine that allows both the ORVR and Stage II emission estimates that would be produced through the execution of detailed MOVES modeling scenarios to be produced quickly and efficiently in a spreadsheet environment (in effect, MES has moved MOVES uncontrolled emissions data and MOVES assumptions and algorithms related to ORVR and Stage II into an independent spreadsheet).

There are several parameters required to implement MOVES ORVR and Stage II algorithms that are not available from MOVES output data. These parameters include: (1) the penetration of ORVR-equipped vehicles into the fleet, which varies both with geography (due to differences in fleet turnover rates) and time, (2) the volume of fuel consumed by vehicles, and (3) the EPA-assumed effectiveness of ORVR controls on vapor displacement and spillage emissions. The first two sets of parameters were *precisely* calculated using other MOVES data as described below. The third set of parameters is reported in supporting documentation associated with MOVES, but also confirmable via examination of the default database underlying the model. Specifically, MOVES assumes that ORVR controls reduce displacement and spillage emissions by 98 and 50 percent respectively.[14]

It is worth noting that while MOVES "assigns" the 50 percent spillage emissions reduction to ORVR controls, the driving force in this reduction is not ORVR per se, but the introduction of enhanced evaporative emissions testing requirements in the mid-1990s. These enhanced requirements include a vehicle refueling event as an integral part of the evaporative emissions testing process, which prompted vehicle manufacturers to redesign fuel tank fill pipes to eliminate gasoline "spitback."[15,16] For reasons that are not clear, EPA assigns the benefit of this emission reduction to ORVR controls. This "mis-assignment" can be easily confirmed through examination of the MOVES default database, wherein "ORVR-induced" spillage reductions begin in model year 1996 (prior to the introduction of ORVR), while ORVR-induced vapor displacement reductions "properly" begin in model year 1998.[17] Although this "accounting discrepancy" is of no real practical importance in this analysis from an emission reduction

[13] The MOVES model and associated supporting documentation can be downloaded from www.epa.gov/otaq/models/moves/index.htm.

[14] See MOVES database table "sourcetypetechadjustment."

[15] In addition, these same requirements limited the maximum flow rate from gasoline dispensing pumps to 10 gallons per minute, which assisted manufacturers in fill pipe redesign.

[16] "Spitback" occurs when gasoline is dispensed into a fuel tank at a rate that exceeds the rate at which evacuating vapor is released, forcing liquid to accumulate in and overflow the fill pipe.

[17] See MOVES database table "sourcetypetechadjustment."

standpoint, it is critical in assessing the fraction of ORVR-equipped vehicles in the fleet at any given point in time (as that assessment cannot be reliably based on spillage emissions changes).

To calculate the fraction of *gasoline use* associated with ORVR-equipped vehicles in the fleet at any given point in time (as assumed by MOVES), one needs to compare MOVES-estimated vapor displacement emissions with ORVR in place to MOVES-estimated vapor displacement emissions in the absence of ORVR.[18],[19] Since MOVES assumes a fixed 98 percent reduction in vapor displacement from ORVR-equipped vehicles, the fraction of fuel consumed by ORVR-equipped vehicles (as assumed within MOVES) can be calculated as follows:

$$\text{FA Emis} = [\text{UC Emis}(1 - \text{ORVRf})] + [\text{UC Emis}(1 - 0.98)(\text{ORVRf})], \text{ or}$$

$$\text{ORVRf} = \frac{\text{FA Emis} - \text{UC Emis}}{[\text{UC Emis}\ (1 - 0.98)] - \text{UC Emis}}$$

where: FA Emis = fleet average emissions
UC Emis = uncontrolled emissions (i.e., emissions with no ORVR)
ORVRf = fraction of emissions generated by ORVR-equipped vehicles[20]

While this calculation is conceptually trivial, it must be performed for each year and each county evaluated (since ORVR penetration changes over time and since the age and relative populations of vehicles across vehicle types will generally vary with geography). Table 4 depicts the calculated ORVR fuel consumption fractions for the 12 counties included in this analysis. These fractions are used in the spreadsheet developed for this analysis to both calculate ORVR emissions impacts as well as distinguish Stage II impacts on vehicles without ORVR from corresponding impacts on vehicles with ORVR.

In order to estimate the impact of IEE, it is necessary to know the absolute volume of gasoline that is associated with *both* ORVR and Stage II controls.[21] The ORVR fuel consumption fraction

[18] A non-ORVR MOVES scenario is run by providing an alternative "sourcetypetechadjustment" database table that replaces all default adjustments with a value of zero.

[19] Note that *all* MOVES runs described in this document (and used for the associated Stage II analysis) include *only* emissions from gasoline vehicles (by instructing MOVES to estimate emissions from all gasoline vehicle types and no others). This is critical for many of the described calculations since parameters such as emission rates, ORVR requirements, and Stage II applicability differ across fueling types. To derive accurate data, calculations must either be limited to gasoline vehicles (as in this analysis) or include appropriate corrections for fuel-related influences.

[20] Since vapor displacement emission factors are expressed in mass per unit volume of fuel dispensed, the fraction of emissions also equals the fraction of gasoline consumed by ORVR-equipped vehicles – which, due to the fact that mileage accumulation rates vary by age and vehicle type, is not the same as the population fraction of ORVR-equipped vehicles.

[21] IEE (incompatibility excess emissions) is the name assigned to incremental refueling station bulk tank losses that result when vacuum assisted Stage II vapor recovery systems deliver ambient air to the refueling tank instead of saturated gasoline vapor. This occurs because the vast majority of saturated vapor displaced during ORVR-equipped vehicle refueling is captured by the ORVR system. There are methods to eliminate these losses, but in the absence of these system "upgrades," the combination of an ORVR-equipped vehicle and a vacuum assist Stage II system has been shown to lead to IEE.

Table 4. Fuel Consumption Fractions of ORVR-Equipped Vehicles

County	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Anne Arundel	77.3%	81.7%	85.2%	88.1%	90.3%	92.2%	93.5%	94.6%	95.4%	96.0%
Baltimore	77.7%	82.0%	85.5%	88.3%	90.5%	92.3%	93.6%	94.6%	95.4%	95.9%
Calvert	74.4%	79.3%	83.4%	86.7%	89.3%	91.5%	93.1%	94.4%	95.3%	96.0%
Carroll	76.5%	81.0%	84.7%	87.7%	90.1%	92.0%	93.5%	94.6%	95.4%	96.1%
Cecil	71.4%	76.5%	80.6%	84.0%	86.8%	89.0%	90.8%	92.1%	93.2%	94.0%
Charles	75.0%	79.8%	83.8%	87.0%	89.6%	91.7%	93.3%	94.5%	95.4%	96.1%
Frederick	75.0%	79.8%	83.7%	87.0%	89.6%	91.6%	93.2%	94.4%	95.3%	96.0%
Harford	76.9%	81.4%	85.0%	87.9%	90.2%	92.0%	93.4%	94.5%	95.3%	95.9%
Howard	77.8%	82.1%	85.6%	88.3%	90.5%	92.3%	93.6%	94.6%	95.4%	96.0%
Montgomery	76.4%	81.0%	84.7%	87.7%	90.2%	92.1%	93.6%	94.7%	95.5%	96.1%
Prince George's	76.1%	80.7%	84.5%	87.6%	90.0%	92.0%	93.5%	94.6%	95.5%	96.1%
Baltimore City	78.5%	82.6%	86.0%	88.7%	90.8%	92.5%	93.8%	94.8%	95.5%	96.1%
Baltimore Region Total	77.6%	81.9%	85.4%	88.2%	90.5%	92.2%	93.6%	94.6%	95.4%	96.0%
Washington Region Total	76.0%	80.6%	84.4%	87.5%	90.0%	92.0%	93.5%	94.6%	95.5%	96.1%
Stage II Area Total	76.7%	81.2%	84.8%	87.8%	90.1%	92.0%	93.5%	94.5%	95.4%	96.0%

provides the fraction of total fuel subject to both controls, but MOVES does not output the actual gasoline consumption estimate calculated within the model. Nevertheless, this gasoline volume can be precisely estimated from other MOVES output and assumptions. For this analysis, the parameters selected for this calculation are the MOVES-estimated uncontrolled (i.e., no ORVR and no Stage II) spillage emissions and the MOVES-assumed uncontrolled spillage emission rate of 0.31 grams per dispensed gallon.[22] Using these parameters, gasoline use in gallons is equal to emissions mass in grams divided by the spillage emissions rate (0.31 grams per dispensed gallon). Table 5 depicts the calculated fuel consumption volumes for a July weekday in the 12 counties included in this analysis. These volumes are used in the spreadsheet developed for this analysis to estimate IEE.[23]

[22] The emission rate is from MOVES database table "refuelingfactors." This combination of parameters results in precise estimates since the spillage emission factor is constant for all gasoline vehicles and all uncontrolled modeling scenarios (unless, of course, the scenario itself involves explicitly altering the factor).

[23] The tabulated volumes are, by definition, consistent with the vehicle miles of travel data provided by MDE as input into MOVES, the MOVES-assumed fuel economy data for modeled vehicles, and the resulting emission estimates upon which this analysis is based. As a result, they are used in this analysis without change. Nevertheless, it is possible to make a *general* assessment of the accuracy of these MOVES-derived estimates though comparisons with reported Maryland fuel use data. The average annual onroad gasoline usage for Maryland between 2007 and 2010 (no data is currently available for 2011), as reported by the Federal Highway Administration (see www.fhwa.dot.gov/policyinformation/statistics.cfm, table MF-21 for each of the four included years) is 2,677,554,500 gallons, which equates to an average daily consumption of 7.34 million gallons. According to Maryland State Highway Administration statistics (see sha.md.gov/index.aspx?pageid=681, Annual Vehicle Miles of Travel Report) for 2011, the 12 county Stage II area is responsible for about 85 percent of statewide miles of travel, so that reported fuel use for the 12 county Stage II area should be on the order of 6.24 million gallons per average annual day (7.34 × 0.85). MOVES data exceed this consumption rate by 24 percent, but there is a summer weekday seasonal factor that must be considered. While MES is uncertain of the aggregate seasonality factor for the 12 county Stage II area, typical factors are in the range of 1.1-1.15, so that the summer

Table 5. Stage II Area Fuel Consumption (million gallons per summer weekday)

County	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Anne Arundel	0.93865	0.94224	0.94905	0.95099	0.94922	0.96174	0.97973	0.96800	0.95589	0.94230
Baltimore	1.32527	1.32405	1.32757	1.32435	1.31606	1.31851	1.32822	1.30927	1.28994	1.26861
Calvert	0.11760	0.12032	0.12324	0.12553	0.12731	0.12823	0.12971	0.13050	0.13116	0.13153
Carroll	0.21650	0.21885	0.22189	0.22380	0.22482	0.23151	0.23968	0.23755	0.23531	0.23271
Cecil	0.19541	0.20031	0.20584	0.21001	0.21337	0.21537	0.21836	0.22005	0.22155	0.22264
Charles	0.20133	0.20595	0.21093	0.21486	0.21793	0.21950	0.22204	0.22342	0.22460	0.22525
Frederick	0.45177	0.46051	0.46998	0.47705	0.48222	0.48406	0.48803	0.48971	0.49095	0.49104
Harford	0.38133	0.38576	0.39142	0.39511	0.39728	0.40977	0.42494	0.42139	0.41764	0.41323
Howard	0.63166	0.63404	0.63862	0.63996	0.63884	0.64694	0.65873	0.65095	0.64294	0.63388
Montgomery	1.25379	1.26384	1.27593	1.28165	1.28262	1.27445	1.27221	1.26580	1.25854	1.24833
Prince George's	1.42185	1.42844	1.43729	1.43885	1.43500	1.42112	1.41394	1.40251	1.39019	1.37474
Baltimore City	0.60671	0.60561	0.60676	0.60488	0.60074	0.60064	0.60388	0.59512	0.58623	0.57638
Baltimore Region Total	4.10012	4.11054	4.13531	4.13910	4.12697	4.16911	4.23518	4.18228	4.12795	4.06710
Washington Region Total	3.44633	3.47907	3.51738	3.53794	3.54509	3.52737	3.52592	3.51194	3.49544	3.47089
Stage II Area Total	7.74186	7.78992	7.85853	7.88704	7.88542	7.91185	7.97946	7.91427	7.84494	7.76063

Finally, as indicated above, the treatment of spillage emission reductions as attributable to ORVR controls is somewhat misleading in MOVES (since these reductions are driven by enhanced evaporative emissions testing requirements rather than ORVR). Nevertheless, since MOVES assumes a 50 percent spillage emissions reduction for such vehicles, it is possible to estimate the fraction of *gasoline use* associated with reduced spillage vehicles in the fleet at any given point in time (as assumed by MOVES). Since both the uncontrolled and controlled spillage emission rates are fixed (at 0.31 and 0.31×(1-0.5) grams per dispensed gallon respectively), the gasoline usage fraction of reduced spillage vehicles (as assumed within MOVES) can be calculated as follows:

$$\frac{\text{FA Emis}}{\text{GC}} = [0.31(1 - \text{RSf})] + [0.31(1 - 0.5)(\text{RSf})], \text{ or}$$

$$\text{RSf} = \frac{\left[\frac{\text{FA Emis}}{\text{GC}}\right] - 0.31}{[0.31\ (1 - 0.5)] - 0.31}$$

where: FA Emis = fleet average spillage emissions (in grams)
GC = fleetwide gasoline consumption (in gallons)
RSf = fraction of emissions generated by reduced spillage vehicles[24]

weekday equivalent of the reported annual average day gasoline consumption rate should be on the order of 7.02 million gallons (6.24 × 1.125). MOVES data exceed this consumption rate by about 10 percent. A more refined comparison may yield even closer agreement, but such analysis is beyond the scope of this work.

[24] Since spillage emission rates are expressed in mass per unit volume of fuel dispensed, the fraction of emissions also equals the fraction of gasoline consumed by reduced spillage vehicles – which, due to the fact that mileage

While this calculation is conceptually trivial, it must be performed for each year and each county evaluated (since reduced spillage vehicle penetration changes over time and since the age and relative populations of vehicles across vehicle types will generally vary with geography). Table 6 depicts the calculated reduced spillage vehicle fuel consumption fractions for the 12 counties included in this analysis. These fractions are not used in the spreadsheet developed for this analysis, but provide a quantitative indication of why spillage emission reduction is not an ORVR-driven phenomena (since the derived fuel consumption fractions are greater than the corresponding ORVR fuel consumption fractions presented in Table 4 above).

Table 6. Fuel Consumption Fractions of Reduced Spillage Vehicles

County	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Anne Arundel	91.6%	93.3%	94.4%	95.2%	95.8%	96.3%	96.7%	97.0%	97.3%	97.5%
Baltimore	91.6%	93.2%	94.4%	95.2%	95.7%	96.3%	96.6%	97.0%	97.2%	97.4%
Calvert	91.0%	92.8%	94.2%	95.1%	95.8%	96.4%	96.8%	97.2%	97.5%	97.7%
Carroll	91.7%	93.3%	94.5%	95.3%	95.9%	96.4%	96.8%	97.2%	97.4%	97.6%
Cecil	88.8%	90.9%	92.2%	93.2%	93.9%	94.6%	95.1%	95.5%	95.8%	96.1%
Charles	91.0%	92.9%	94.2%	95.2%	95.8%	96.4%	96.9%	97.2%	97.5%	97.7%
Frederick	91.0%	92.8%	94.2%	95.1%	95.8%	96.4%	96.8%	97.1%	97.4%	97.6%
Harford	91.6%	93.2%	94.4%	95.2%	95.8%	96.3%	96.7%	97.0%	97.2%	97.4%
Howard	91.6%	93.3%	94.4%	95.2%	95.8%	96.3%	96.7%	97.0%	97.2%	97.4%
Montgomery	91.0%	92.9%	94.2%	95.1%	95.8%	96.4%	96.8%	97.2%	97.4%	97.6%
Prince George's	91.0%	92.9%	94.2%	95.1%	95.8%	96.4%	96.8%	97.2%	97.4%	97.6%
Baltimore City	91.7%	93.3%	94.4%	95.2%	95.8%	96.3%	96.7%	97.0%	97.3%	97.5%
Baltimore Region Total	91.6%	93.3%	94.4%	95.2%	95.8%	96.3%	96.7%	97.0%	97.2%	97.4%
Washington Region Total	91.0%	92.9%	94.2%	95.1%	95.8%	96.4%	96.8%	97.2%	97.4%	97.6%
Stage II Area Total	91.3%	93.0%	94.2%	95.1%	95.7%	96.3%	96.7%	97.0%	97.3%	97.5%

As discussed above, MOVES assumes reduced spillage emissions beginning with the introduction of enhanced evaporative emissions testing in model year 1996 (for 100 percent of all light duty vehicles). MOVES (properly) assumes ORVR-driven vapor displacement reductions track ORVR introduction beginning in model year 1998 (for less than 100 percent of passenger cars due to an associated multi-year phase-in, and with even more extended delays for light duty trucks). Thus, the vapor displacement-derived fuel consumption fractions accurately track ORVR deployment (and lag the spillage-derived fractions by about five years).

MOVES model emission estimates with no ORVR controls, no reduced spillage controls, and no Stage II controls have been incorporated into an analysis spreadsheet for the 12 Maryland counties with Stage II requirements. These emission estimates were developed by executing the

accumulation rates vary by age and vehicle type, is not the same as the population fraction of reduced spillage vehicles.

MOVES model for each county using appropriate input data for each calendar year from 2011 through 2020.[25],[26] The analysis spreadsheet includes ORVR, reduced spillage, and Stage II emission impact algorithms identical to those of the MOVES model. These algorithms can be evaluated by the user for any specified set of ORVR and Stage II effectiveness assumptions (without need to rerun the MOVES model).

In evaluating the MOVES algorithms for Stage II controls, it became apparent that there are nuances in the implementation of spillage-related calculations that result in a significant likelihood that users will not properly quantify Stage II modeling inputs. For this reason, the spreadsheet developed for this analysis includes an option to perform Stage II spillage-related calculations in exactly the same manner as MOVES, or in a slightly modified manner that serves to diminish the likelihood of inaccurate emissions estimation.

The fundamental "problem" is that MOVES assumes that Stage II spillage benefits (if any) accrue "on top of" any ORVR (or more accurately, any enhanced evaporative test-driven) spillage benefits. In principle this is a valid approach and associated emission estimates will be accurate *if the associated input data are properly quantified*, but MOVES guidance documents provide little explanation related to algorithm function and input quantification, and EPA's default effectiveness assumption (specifically, a 50 percent spillage reduction due to Stage II) itself seems to be improperly quantified given the MOVES algorithm design. Basically, MOVES applies an additional reduction to any remaining spillage emissions that are left after (ORVR, or enhanced evaporative test, driven) spillage reductions. This reduction accrues to both ORVR and non-ORVR equipped vehicles, reducing any remaining emissions by the same specified percentage (in the case of the EPA default data, by 50 percent).

Unfortunately, this approach does not seem to recognize that once something is "not spilled," it can't be "not spilled" again. For example, if ORVR (or more accurately enhanced evaporative testing) leads to a 50 percent reduction in spillage due to fill pipe redesign and a flow rate cap that eliminate spitback emissions, then Stage II controls cannot reduce spitback emissions any further on affected vehicles (since the spitback mode of spillage is eliminated). Yet, if both ORVR and Stage II are assigned 50 percent reduction effectiveness values (as they are in the EPA default data), then ORVR-equipped vehicles will actually have spillage emissions reduced by 75 percent when both programs are modeled together (50 percent from ORVR and 50 percent of the remainder from Stage II, or [1-((1-0.5)×(1-0.5))]), while vehicles without ORVR will have emissions reduced by "only" 50 percent. Of course, if Stage II targeted entirely different

[25] The input data used for the MOVES modeling scenarios were provided by MDE to ensure that the estimates generated in this analysis are consistent with other onroad vehicle modeling performed by MDE.

[26] In total, 360 scenarios were processed through the MOVES model, each applicable to one of the 12 Stage II counties. At 12 counties and 10 evaluation years per county, there are 120 MOVES scenarios per scenario "group." A total of three scenario "groups" were modeled. One group of 120 MOVES runs estimated emissions in the absence of ORVR, spillage, and Stage II controls. This group forms the basis of the onroad vehicle portion of the spreadsheet developed for this analysis. A second group of 120 MOVES runs estimated emissions with ORVR and spillage controls in place, as defined by default EPA database tables. A third group of 120 MOVES runs estimated emissions with ORVR and spillage controls in place, as defined by default EPA database tables, and Stage II controls in place as defined by MDE. These latter two groups were analyzed to ensure that the algorithms implemented in the spreadsheet developed for this analysis were identical to those implemented in MOVES (in effect, to ensure that spreadsheet predicted Stage II impacts would exactly match the same impacts that would be estimated by additional tailored MOVES runs).

components of spillage (e.g., nozzle drip or overfilling), it is possible for the dual reductions to be accurate, but it does not appear that this is the intention of the EPA default data. Certainly, no specific guidance is provided to ensure that Stage II spillage impacts are estimated properly given MOVES algorithms.

If both ORVR and Stage II are credited with reducing spitback, then the net Stage II reduction for ORVR-equipped vehicles should be zero (since ORVR has already been credited with the associated spillage reduction). Under MDE's default Stage II assumptions, which ascribe a 70 percent spillage reduction to Stage II, the net spillage reduction due to ORVR and Stage II combined is 85 percent [1-((1-0.5)×(1-0.7))]. If instead, the overall spillage reduction is intended to be 70 percent with Stage II, then non-ORVR vehicles should have a 70 percent reduction applied and ORVR vehicles should be subject to an *additional* spillage reduction of "only" 40 percent [(0.7-0.5)/0.5]. This would produce the desired net 70 percent reduction [1-((1-0.5)×(1-0.4))]. Similarly, if the EPA default Stage II spillage reduction of 50 percent is intended to signify (as expected) that ORVR and Stage II have the same spillage impacts, then the net Stage II reduction for ORVR-equipped vehicles should be zero [(0.5-0.5)/0.5]. This, however, is *not* the way the Stage II algorithms are implemented in MOVES.

As an option, the spreadsheet developed for this analysis allows the user to select a Stage II spillage algorithm that is either: (1) identical to that implemented in MOVES, or (2) implemented as a "net" (ORVR plus Stage II) reduction for ORVR-equipped vehicles and a "full" reduction for non-ORVR vehicles. Under the second option, Stage II is only credited with spillage emission reduction for ORVR-equipped vehicles at a rate based on the extent to which the Stage II spillage reduction effectiveness exceeds that of ORVR alone. Non-ORVR vehicles are always credited with the full Stage II spillage reduction.

Finally, MOVES emissions estimates were also used to develop both hydrocarbon adjustment and speciation factors, the former allowing hydrocarbons to be expressed as either total organic gases (TOG), total hydrocarbons (THC), volatile organic compounds (VOC), non-methane organic gases (NMOG), or non-methane hydrocarbons (NMHC) – the latter allowing for estimation of methane, methyl tertiary butyl ether (MTBE), ethanol, benzene, xylene, toluene, ethyl benzene, hexane, 2,2,4-trimethylpentane, and naphthalene. Table 7 presents the derived factors, which are built into the spreadsheet developed for this analysis and used to estimate hazardous air pollutant emissions as well as tailor hydrocarbon emissions estimates to the basis desired by the user. It is perhaps worth noting that while one would expect the components of evaporated gasoline to be identical whether that evaporation occurs inside or outside of a fueling tank, MOVES estimates slightly different hydrocarbon fractions for displacement and spillage emissions. While the source of this difference is not clear, it has been retained in this analysis to ensure consistency with MOVES emissions estimates. It should also be noted that the factors depicted in Table 7 are used for both onroad and nonroad emission estimates in the spreadsheet developed for this analysis.[27]

[27] The U.S. EPA NONROAD model that was used for nonroad vehicle and equipment emissions estimation in this analysis does not include speciation factors for hazardous air pollutants. It does, however, include hydrocarbon adjustment factors for refueling emissions and these are set to unity (i.e., TOG=THC=VOC=NMOG=NMHC). Since this is not consistent with MOVES adjustment factors and since the same gasoline is assumed for both onroad and nonroad vehicles and equipment, it makes no sense to assume different hydrocarbon adjustment factors for onroad and nonroad vehicles and equipment. Since gasoline in the Stage II counties contains ethanol

Table 7. Emissions Adjustment and Speciation Factors

Emission Species	Vapor Displacement Emissions	Spillage Emissions
Total Organic Gases (TOG)	1.00000	
Total Hydrocarbons (THC)	0.88934	0.91090
Volatile Organic Compounds (VOC)	1.00000	
Methane (CH_4)	0.00000	
Non-Methane Organic Gasses (NMOG)	1.00000	
Non-Methane Hydrocarbons (NMHC)	0.88934	0.91090
Methyl Tertiary Butyl Ether (MTBE)	0.00000	
Ethanol	0.13345	
Benzene	0.00333	
Xylene	0.06423	
Toluene	0.14336	
Ethyl Benzene	0.01721	
Hexane	0.02536	
2,2,4-Trimethylpentane	0.03354	
Naphthalene	0.00040	

All factors are relative to VOC emissions.

Nonroad Processing: Generally, all emission estimates for nonroad vehicles and equipment are based on modeling performed using the U.S. EPA's NONROAD2008a model.[28] While the NONROAD model does include the capability of estimating the impact of Stage II vapor recovery on vapor displacement emissions from gasoline equipment refueled at a gasoline dispensing pump, there are two limitations associated with the way in which Stage II impacts are estimated in the model – limitations that require model emission estimates to be augmented in order to fully gauge the potential impacts of Stage II system removal.

The primary limitation is that the NONROAD model makes no estimate of the emissions associated with filling portable refueling containers. This is a critical issue in evaluating the potential benefits of Stage II on nonroad equipment and vehicle emissions since the overwhelming majority of nonroad gasoline usage in urban areas is associated with portable container refueling.[29] Emission estimates for nonroad equipment refueled from a portable container are generated by the model, but emissions associated with filling up those portable containers are not considered. Since these containers are filled at gasoline dispensing pumps,

in significant volumes, it is believed that the MOVES assumptions are superior to those of the NONROAD model, so the latter have been replaced with the former in this analysis.

[28] The NONROAD model and associated supporting documentation can be downloaded from www.epa.gov/otaq/nonrdmdl.htm.

[29] Although it is not possible to assign a specific value to this majority as it depends on equipment population and usage rates that are dependent on both geography and time (even at the county level), typical urban area portable container refueling fractions in this analysis range from 70-90 percent – but are as low as 40 percent in the more rural affected counties and as high as 95 percent in some urban counties.

emissions associated with the refilling of portable containers can be affected by Stage II systems. A methodology to estimate the emissions associated with the refilling of portable containers was developed, as described below, from data produced by the NONROAD model.

The second limitation associated with the way in which the NONROAD model estimates Stage II impacts is that there is no consideration of potential Stage II impacts on gasoline spillage emissions. Unlike the EPA MOVES model, which considers both displacement and spillage impacts, the NONROAD model includes impact estimates for displacement emissions only. Thus, a methodology was developed, as described below, to estimate potential Stage II spillage emission impacts.[30]

The NONROAD model does not provide an output that describes which equipment are assumed to be refueled at a gasoline dispensing pump and which equipment are assumed to be refueled via portable fuel containers. However, this distinction can be inferred by comparing the model output for a scenario without Stage II vapor recovery to an otherwise identical scenario with Stage II vapor recovery. The specific Stage II effectiveness assumptions are not important to the comparison; any non-zero effectiveness assumption will produce the same results.[31] Equipment for which NONROAD model emission estimates do not vary across the two scenarios must be assumed (in the NONROAD model) to be refueled via a portable fuel container (since the alternative would result in lower emissions under the Stage II non-zero effectiveness scenario). Equipment for which NONROAD model emission estimates do vary across the two scenarios must be assumed (in the NONROAD model) to be refueled at a gasoline dispensing pump.[32]

Since the NONROAD model estimates fuel consumption by equipment type, the fuel consumption associated with the identified gasoline dispensing pump and portable refueling container equipment fractions can be readily calculated from model output. The total fuel consumption supplied through portable refueling containers indicates exactly the volume of fuel that must initially be placed into such containers at gasoline dispensing pumps, and thus exactly that volume of fuel that would be associated with: (1) the displacement of gasoline vapor during the filling of portable containers, (2) potential fuel spillage during those filling events, and (3) potentially affected by Stage II vapor recovery equipment.

To estimate vapor displacement emissions associated with the filling of portable refueling containers at gasoline dispensing pumps, MES applied the same vapor displacement algorithm that NONROAD applies to equipment refueling.[33] This algorithm estimates displacement

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[30] While MES is skeptical of Stage II (and ORVR) spillage emissions benefits, the inclusion of possible benefits in the onroad vehicle sector (as is the case in the EPA MOVES model algorithms) dictates the inclusion of those same possible benefits in the nonroad vehicle and equipment sector.

[31] For this comparison, MES assumed an effectiveness of 100 percent for Stage II in order to maximize comparative emission differentials (which can be helpful for equipment with very low population, and thus emissions, estimates).

[32] The magnitude of the emissions differential in conjunction with the scenario Stage II effectiveness assumption was used to confirm the function of the Stage II impact algorithm coded within the NONROAD model. This serves as an important quality assurance check since these same computations are ultimately reproduced by MES in an external spreadsheet that allows the impacts of alternative Stage II effectiveness assumptions to be evaluated without rerunning the NONROAD model.

[33] U.S. EPA, "Refueling Emissions for Nonroad Engine Modeling, NR-013b," EPA420-P-04-013, April 2004.

emissions mass as a function of dispensed fuel temperature, ambient temperature, and gasoline RVP as follows:

$$gpdg = e^{[-1.2798 - (0.0049 \times (T_d - T_a)) + (0.0203 \times T_d) + (0.1315 \times RVP)]}$$

where: gpdg = grams (of gasoline vapor) per dispensed gallon
T_a = ambient temperature (degrees F)
T_d = dispensed gasoline temperature (degrees F) = $62 + (0.6 \times (T_a - 62))$
RVP = Reid Vapor Pressure (psi)

Ambient temperature and RVP were set at the values provided by MDE as part of the MOVES modeling data for the 12 Stage II counties. For ambient temperature, a daily average temperature was calculated as the arithmetic average of the 24 hourly average temperatures provided by MDE. These data as well as the resulting vapor displacement emission rates are presented in Table 8.

Table 8. Displacement Data for Filling of Portable Refueling Containers

Vapor Displacement Parameter	Baltimore Area Counties	Washington D.C. Area Counties	Cecil County
Average Ambient Temperature (ºF)	81.55	84.12	82.09
RVP (psi)	6.74	6.74	6.74
Dispensed Fuel Temperature (ºF)	73.73	75.272	74.054
Displacement Emission Rate (gpdg)	3.132	3.248	3.156

While there is no question that portable containers must be minimally filled with the same volume of gasoline required to refuel associated nonroad equipment,[34] there is uncertainty related to the vapor saturation status of the empty portable containers at the time of refueling. It is assumed in this analysis that such containers are properly sealed between their last use to refuel nonroad equipment and their subsequent refilling, such that they contain saturated vapor at the time that gasoline is dispensed into the portable container. In cases where the portable container is not properly sealed between the time of last use and subsequent refilling, the actual vapor displacement rate could be substantially lower than assumed in this analysis. Without a detailed analysis of consumer behavior with regard to portable container handling, it is impossible to know the fraction of containers that are not properly sealed with precision (although one might reasonably expect consumers to minimize fugitive vapor loss to avoid inhalation of escaping vapors).

[34] Ignoring post-fill spillage and evaporative losses related to storage, which for conservative estimation purposes are ignored in this analysis.

In addition to vapor displacement, there will also be spillage emissions associated with the refilling of portable fuel containers. As with displacement emissions, MES applied the same spillage algorithm that NONROAD applies to equipment refueling – which assumes that spillage emissions from a gasoline dispensing pump equal 3.6 grams per refueling event.[35] By estimating the average number of gallons dispensed per refueling event, this spillage mass can be converted into an emission rate per gallon of dispensed fuel. Based on data collected by the California Air Resources Board, MES estimated an average portable refueling container size of 2.364 gallons.[36] This results in an average spillage emission rate of 1.523 grams per dispensed gallon (3.6/2.364), which was used in this analysis to estimate spillage emissions during the filling of portable refueling containers.[37]

Using the derived vapor displacement and spillage emission rates, emissions associated with the filling of portable refueling containers can be estimated in a fashion that is entirely consistent with the methodologies employed in the NONROAD model for nonroad equipment refueling. These estimates can then be adjusted in accordance with assumed Stage II effectiveness rates to derive Stage II induced emission reduction estimates. It is important to note that while the NONROAD model calculates Stage II emission impacts solely for displacement emissions, MES extended this calculation to cover both displacement and spillage emissions (based on independent effectiveness inputs for displacement and spillage) for consistency with the Stage II modeling approach employed in both the MOVES and MOBILE6 onroad vehicle emissions models.

As with the onroad emissions analysis approach described above, NONROAD model emission estimates with no Stage II controls have been incorporated into an analysis spreadsheet for the 12 Maryland counties with Stage II requirements. These emission estimates were developed by executing the NONROAD model for each county using appropriate input data for each calendar year from 2011 through 2020.[38,39] The analysis spreadsheet includes Stage II emission impact

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[35] U.S. EPA, "Refueling Emissions for Nonroad Engine Modeling, NR-013b," EPA420-P-04-013, April 2004.

[36] Nguyen, M., "Source Inventory Category # 1434, Portable Fuel Container Spillage," undated. The document, which indicates the fraction of 1, 2, and 5 gallon containers to be 39.2, 35.6, and 25.2 percent respectively, can be downloaded from www.arb.ca.gov/ei/areasrc/districtmeth/BayArea/C1434.pdf.

[37] Note that this assumes that all portable containers are empty when refilled. Since it is likely that some containers will not be empty, this approach almost certainly underestimates the actual volume of gasoline spillage. However, there are no data available to estimate the average liquid volume present at the time of portable container refilling, and since the NONROAD model employs a similar assumption for spillage emissions associated with nonroad equipment, the empty container approach is entirely consistent with other NONROAD model emission estimates.

[38] Generally, the input data are derived from MOVES (onroad vehicle) meteorologic and fuel-related input data provided by MDE.

[39] In total, 90 scenarios were processed through the NONROAD model, each applicable to one of three geographic areas of common meteorology and fuel characteristics as defined by MDE (these areas represent the six county Baltimore area, the five county Washington D.C. area, and Cecil County). Fifty scenarios were evaluated for the Baltimore area: 10 reflecting no Stage II controls, 10 reflecting a 25 percent effective Stage II control efficiency, 10 reflecting a 50 percent effective Stage II control efficiency, 10 reflecting a 75 percent effective Stage II control efficiency, and 10 reflecting a 100 percent effective Stage II control efficiency. Only the 10 "no Stage II" scenarios are used in the final analysis spreadsheet, the remainder were used to identify which equipment were refueled with portable containers and to confirm the methodology through which NONROAD estimates Stage II impacts so that that methodology could be replicated without deviation in the analysis spreadsheet. Twenty

algorithms identical to those of the NONROAD model as well as supplemental equivalent algorithms to estimate Stage II impacts on portable fueling container and spillage emissions. These algorithms can be evaluated by the user for any specified set of Stage II effectiveness assumptions (without need to rerun the NONROAD model).

Potential Impact Tables. Tables 9 through 32 that follow present specific emission impact estimates for each year from 2011 through 2020 by county, metropolitan area, and the aggregate Stage II region. Tables 33 through 56 present associated hazardous air pollutant emission impact estimates for those same years for the aggregate Stage II region.

scenarios were evaluated for each of the Washington D.C. and Cecil County areas: 10 reflecting no Stage II controls and 10 reflecting a 100 percent effective Stage II control efficiency. As with the Baltimore area, only the 10 "no Stage II" scenarios are used in the analysis spreadsheet.

Table 9. Stage II Reductions with Zero IEE Onroad Only, Displacement Impacts Only, Scenario 1 (VOC, metric tonnes per day)

County	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Anne Arundel	0.50	0.41	0.34	0.28	0.24	0.20	0.18	0.15	0.14	0.12
Baltimore	0.69	0.57	0.47	0.39	0.33	0.28	0.24	0.21	0.18	0.17
Calvert	0.07	0.06	0.05	0.04	0.04	0.03	0.03	0.02	0.02	0.02
Carroll	0.12	0.10	0.08	0.07	0.06	0.05	0.04	0.04	0.03	0.03
Cecil	0.13	0.11	0.09	0.08	0.07	0.06	0.05	0.05	0.04	0.04
Charles	0.12	0.10	0.09	0.07	0.06	0.05	0.04	0.04	0.03	0.03
Frederick	0.27	0.23	0.19	0.16	0.13	0.11	0.10	0.08	0.07	0.07
Harford	0.21	0.17	0.14	0.12	0.10	0.09	0.08	0.07	0.06	0.05
Howard	0.33	0.27	0.23	0.19	0.16	0.13	0.12	0.10	0.09	0.08
Montgomery	0.71	0.59	0.49	0.41	0.34	0.28	0.24	0.21	0.18	0.16
Prince George's	0.81	0.67	0.56	0.46	0.38	0.31	0.27	0.23	0.20	0.18
Baltimore City	0.31	0.25	0.21	0.17	0.14	0.12	0.11	0.09	0.08	0.07
Baltimore Region Total	2.15	1.77	1.47	1.23	1.03	0.88	0.77	0.67	0.59	0.53
Washington Region Total	1.98	1.65	1.37	1.14	0.95	0.78	0.67	0.58	0.51	0.46
Stage II Area Total	4.26	3.53	2.94	2.44	2.04	1.72	1.49	1.29	1.14	1.02

Table 10. Stage II Reductions with Non-Zero IEE Onroad Only, Displacement Impacts Only, Scenario 1 (VOC, metric tonnes per day)

County	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Anne Arundel	0.22	0.11	0.03	-0.04	-0.10	-0.14	-0.18	-0.20	-0.22	-0.23
Baltimore	0.29	0.15	0.03	-0.06	-0.14	-0.20	-0.24	-0.27	-0.29	-0.31
Calvert	0.04	0.02	0.01	0.00	-0.01	-0.02	-0.02	-0.03	-0.03	-0.03
Carroll	0.05	0.03	0.01	-0.01	-0.02	-0.03	-0.04	-0.05	-0.05	-0.06
Cecil	0.07	0.05	0.03	0.01	0.00	-0.01	-0.02	-0.03	-0.04	-0.04
Charles	0.06	0.04	0.02	0.00	-0.02	-0.03	-0.04	-0.05	-0.05	-0.05
Frederick	0.14	0.08	0.04	0.00	-0.03	-0.06	-0.08	-0.10	-0.11	-0.12
Harford	0.09	0.05	0.01	-0.02	-0.04	-0.06	-0.08	-0.09	-0.09	-0.10
Howard	0.14	0.07	0.01	-0.03	-0.07	-0.10	-0.12	-0.14	-0.15	-0.15
Montgomery	0.34	0.19	0.07	-0.03	-0.11	-0.18	-0.23	-0.26	-0.29	-0.30
Prince George's	0.39	0.22	0.08	-0.03	-0.12	-0.20	-0.25	-0.29	-0.32	-0.33
Baltimore City	0.12	0.06	0.01	-0.04	-0.07	-0.09	-0.11	-0.13	-0.14	-0.14
Baltimore Region Total	0.91	0.46	0.10	-0.19	-0.43	-0.62	-0.77	-0.87	-0.94	-0.99
Washington Region Total	0.97	0.56	0.22	-0.07	-0.30	-0.48	-0.62	-0.72	-0.79	-0.84
Stage II Area Total	1.95	1.07	0.35	-0.25	-0.72	-1.11	-1.41	-1.62	-1.77	-1.88

Table 11. Stage II Reductions with Zero IEE Onroad Only, Displacement Impacts Only, Scenario 2 (VOC, metric tonnes per day)

County	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Anne Arundel	0.64	0.53	0.44	0.37	0.31	0.26	0.23	0.20	0.18	0.16
Baltimore	0.89	0.73	0.61	0.50	0.42	0.36	0.31	0.27	0.24	0.21
Calvert	0.09	0.08	0.07	0.05	0.05	0.04	0.03	0.03	0.03	0.02
Carroll	0.15	0.13	0.11	0.09	0.07	0.06	0.06	0.05	0.04	0.04
Cecil	0.16	0.14	0.12	0.10	0.09	0.08	0.07	0.06	0.05	0.05
Charles	0.15	0.13	0.11	0.09	0.08	0.06	0.06	0.05	0.04	0.04
Frederick	0.35	0.29	0.24	0.20	0.17	0.14	0.12	0.11	0.09	0.08
Harford	0.26	0.22	0.18	0.15	0.13	0.11	0.10	0.09	0.08	0.07
Howard	0.42	0.35	0.29	0.24	0.20	0.17	0.15	0.13	0.12	0.11
Montgomery	0.91	0.76	0.63	0.52	0.43	0.36	0.31	0.26	0.23	0.21
Prince George's	1.05	0.86	0.72	0.59	0.49	0.40	0.34	0.29	0.26	0.23
Baltimore City	0.39	0.32	0.27	0.22	0.19	0.16	0.14	0.12	0.11	0.09
Baltimore Region Total	2.76	2.28	1.89	1.58	1.32	1.13	0.99	0.86	0.76	0.68
Washington Region Total	2.55	2.12	1.76	1.46	1.22	1.01	0.86	0.74	0.65	0.59
Stage II Area Total	5.48	4.54	3.78	3.14	2.62	2.21	1.91	1.66	1.46	1.31

Table 12. Stage II Reductions with Non-Zero IEE Onroad Only, Displacement Impacts Only, Scenario 2 (VOC, metric tonnes per day)

County	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Anne Arundel	0.36	0.23	0.13	0.04	-0.03	-0.08	-0.13	-0.16	-0.18	-0.19
Baltimore	0.49	0.31	0.17	0.05	-0.04	-0.12	-0.17	-0.21	-0.24	-0.26
Calvert	0.06	0.04	0.03	0.01	0.00	-0.01	-0.01	-0.02	-0.02	-0.03
Carroll	0.09	0.06	0.03	0.01	0.00	-0.02	-0.03	-0.04	-0.04	-0.05
Cecil	0.11	0.08	0.06	0.04	0.02	0.00	-0.01	-0.02	-0.03	-0.03
Charles	0.10	0.07	0.04	0.02	0.00	-0.01	-0.03	-0.03	-0.04	-0.05
Frederick	0.22	0.15	0.09	0.04	0.00	-0.03	-0.05	-0.07	-0.09	-0.10
Harford	0.15	0.10	0.05	0.02	-0.01	-0.03	-0.05	-0.07	-0.08	-0.08
Howard	0.23	0.15	0.08	0.02	-0.02	-0.06	-0.09	-0.11	-0.12	-0.13
Montgomery	0.54	0.36	0.21	0.08	-0.02	-0.10	-0.16	-0.20	-0.23	-0.26
Prince George's	0.62	0.41	0.24	0.10	-0.01	-0.11	-0.17	-0.22	-0.26	-0.28
Baltimore City	0.21	0.13	0.07	0.01	-0.03	-0.06	-0.08	-0.10	-0.11	-0.12
Baltimore Region Total	1.52	0.97	0.52	0.16	-0.13	-0.37	-0.55	-0.68	-0.77	-0.84
Washington Region Total	1.53	1.03	0.61	0.26	-0.03	-0.25	-0.42	-0.55	-0.65	-0.71
Stage II Area Total	3.16	2.08	1.19	0.45	-0.14	-0.62	-0.99	-1.25	-1.45	-1.58

Table 13. Stage II Reductions with Zero IEE Onroad Only, Displacement Impacts Only, Scenario 3 (VOC, metric tonnes per day)

County	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Anne Arundel	0.36	0.29	0.24	0.20	0.17	0.15	0.13	0.11	0.10	0.09
Baltimore	0.49	0.41	0.34	0.28	0.23	0.20	0.17	0.15	0.13	0.12
Calvert	0.05	0.04	0.04	0.03	0.03	0.02	0.02	0.02	0.01	0.01
Carroll	0.08	0.07	0.06	0.05	0.04	0.04	0.03	0.03	0.02	0.02
Cecil	0.09	0.08	0.07	0.06	0.05	0.04	0.04	0.03	0.03	0.03
Charles	0.09	0.07	0.06	0.05	0.04	0.04	0.03	0.03	0.02	0.02
Frederick	0.19	0.16	0.14	0.11	0.09	0.08	0.07	0.06	0.05	0.05
Harford	0.15	0.12	0.10	0.09	0.07	0.06	0.06	0.05	0.04	0.04
Howard	0.23	0.19	0.16	0.13	0.11	0.10	0.08	0.07	0.07	0.06
Montgomery	0.51	0.42	0.35	0.29	0.24	0.20	0.17	0.15	0.13	0.12
Prince George's	0.58	0.48	0.40	0.33	0.27	0.22	0.19	0.16	0.14	0.13
Baltimore City	0.22	0.18	0.15	0.12	0.10	0.09	0.08	0.07	0.06	0.05
Baltimore Region Total	1.53	1.27	1.05	0.88	0.73	0.63	0.55	0.48	0.42	0.38
Washington Region Total	1.42	1.18	0.98	0.81	0.68	0.56	0.48	0.41	0.36	0.33
Stage II Area Total	3.04	2.52	2.10	1.75	1.46	1.23	1.06	0.92	0.81	0.73

Table 14. Stage II Reductions with Non-Zero IEE Onroad Only, Displacement Impacts Only, Scenario 3 (VOC, metric tonnes per day)

County	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Anne Arundel	0.07	-0.01	-0.07	-0.12	-0.16	-0.20	-0.23	-0.25	-0.26	-0.26
Baltimore	0.09	-0.02	-0.10	-0.17	-0.23	-0.27	-0.31	-0.33	-0.35	-0.35
Calvert	0.02	0.01	0.00	-0.01	-0.02	-0.02	-0.03	-0.03	-0.03	-0.04
Carroll	0.02	0.00	-0.01	-0.03	-0.04	-0.05	-0.06	-0.06	-0.06	-0.07
Cecil	0.04	0.02	0.00	-0.01	-0.02	-0.03	-0.04	-0.05	-0.05	-0.05
Charles	0.03	0.01	-0.01	-0.02	-0.03	-0.04	-0.05	-0.06	-0.06	-0.06
Frederick	0.06	0.02	-0.02	-0.05	-0.07	-0.09	-0.11	-0.12	-0.13	-0.14
Harford	0.03	0.00	-0.03	-0.05	-0.07	-0.08	-0.10	-0.11	-0.11	-0.12
Howard	0.04	-0.01	-0.05	-0.09	-0.11	-0.14	-0.16	-0.17	-0.17	-0.18
Montgomery	0.13	0.02	-0.07	-0.15	-0.21	-0.26	-0.29	-0.32	-0.34	-0.35
Prince George's	0.16	0.03	-0.08	-0.16	-0.23	-0.29	-0.32	-0.35	-0.37	-0.39
Baltimore City	0.03	-0.01	-0.05	-0.08	-0.11	-0.13	-0.14	-0.15	-0.16	-0.16
Baltimore Region Total	0.30	-0.04	-0.32	-0.54	-0.72	-0.87	-0.99	-1.06	-1.11	-1.14
Washington Region Total	0.40	0.09	-0.18	-0.39	-0.57	-0.70	-0.81	-0.88	-0.94	-0.97
Stage II Area Total	0.73	0.06	-0.49	-0.95	-1.31	-1.60	-1.84	-1.99	-2.10	-2.17

Table 15. Stage II Reductions with Zero IEE Onroad Only, Displacement Plus Spillage Impacts, Scenario 1 (VOC, metric tonnes per day)

County	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Anne Arundel	0.61	0.52	0.45	0.39	0.35	0.31	0.29	0.26	0.24	0.23
Baltimore	0.85	0.72	0.62	0.54	0.48	0.42	0.39	0.36	0.33	0.31
Calvert	0.09	0.07	0.07	0.06	0.05	0.04	0.04	0.04	0.03	0.03
Carroll	0.14	0.12	0.11	0.09	0.08	0.08	0.07	0.06	0.06	0.06
Cecil	0.15	0.13	0.12	0.11	0.09	0.08	0.08	0.07	0.07	0.06
Charles	0.14	0.13	0.11	0.10	0.08	0.07	0.07	0.06	0.06	0.05
Frederick	0.32	0.28	0.24	0.21	0.19	0.17	0.15	0.14	0.13	0.12
Harford	0.25	0.22	0.19	0.16	0.15	0.13	0.13	0.12	0.11	0.10
Howard	0.40	0.34	0.30	0.26	0.23	0.21	0.19	0.18	0.16	0.15
Montgomery	0.86	0.73	0.64	0.55	0.48	0.42	0.38	0.35	0.32	0.30
Prince George's	0.98	0.84	0.72	0.62	0.54	0.47	0.42	0.39	0.36	0.33
Baltimore City	0.38	0.32	0.28	0.24	0.21	0.19	0.17	0.16	0.15	0.14
Baltimore Region Total	2.63	2.25	1.95	1.70	1.49	1.34	1.24	1.13	1.05	0.98
Washington Region Total	2.39	2.05	1.78	1.54	1.35	1.18	1.06	0.97	0.90	0.84
Stage II Area Total	5.17	4.43	3.84	3.34	2.93	2.61	2.38	2.17	2.01	1.89

Table 16. Stage II Reductions with Non-Zero IEE Onroad Only, Displacement Plus Spillage Impacts, Scenario 1 (VOC, metric tonnes per day)

County	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Anne Arundel	0.33	0.22	0.14	0.07	0.01	-0.03	-0.07	-0.09	-0.11	-0.12
Baltimore	0.45	0.30	0.18	0.09	0.01	-0.05	-0.09	-0.13	-0.15	-0.17
Calvert	0.05	0.04	0.02	0.01	0.01	0.00	-0.01	-0.01	-0.01	-0.02
Carroll	0.08	0.05	0.03	0.02	0.00	-0.01	-0.02	-0.02	-0.03	-0.03
Cecil	0.10	0.07	0.05	0.04	0.02	0.01	0.00	-0.01	-0.01	-0.02
Charles	0.09	0.06	0.04	0.02	0.01	0.00	-0.01	-0.02	-0.03	-0.03
Frederick	0.19	0.14	0.09	0.05	0.02	-0.01	-0.03	-0.04	-0.05	-0.06
Harford	0.14	0.09	0.06	0.03	0.01	-0.01	-0.03	-0.04	-0.05	-0.05
Howard	0.21	0.14	0.09	0.04	0.00	-0.02	-0.05	-0.06	-0.08	-0.08
Montgomery	0.48	0.34	0.21	0.11	0.03	-0.03	-0.08	-0.12	-0.15	-0.17
Prince George's	0.56	0.39	0.25	0.13	0.04	-0.04	-0.09	-0.13	-0.16	-0.18
Baltimore City	0.19	0.13	0.08	0.03	0.00	-0.03	-0.05	-0.06	-0.07	-0.08
Baltimore Region Total	1.39	0.94	0.57	0.28	0.04	-0.15	-0.30	-0.41	-0.48	-0.54
Washington Region Total	1.37	0.96	0.62	0.33	0.10	-0.08	-0.22	-0.33	-0.40	-0.46
Stage II Area Total	2.86	1.97	1.25	0.65	0.17	-0.22	-0.52	-0.74	-0.90	-1.01

Table 17. Stage II Reductions with Zero IEE Onroad Only, Displacement Plus Spillage Impacts, Scenario 2 (VOC, metric tonnes per day)

County	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Anne Arundel	0.73	0.62	0.53	0.46	0.40	0.35	0.32	0.29	0.27	0.25
Baltimore	1.02	0.86	0.73	0.63	0.55	0.48	0.44	0.39	0.36	0.33
Calvert	0.10	0.09	0.08	0.07	0.06	0.05	0.05	0.04	0.04	0.04
Carroll	0.17	0.15	0.13	0.11	0.10	0.09	0.08	0.07	0.07	0.06
Cecil	0.18	0.16	0.14	0.12	0.11	0.10	0.09	0.08	0.08	0.07
Charles	0.17	0.15	0.13	0.11	0.10	0.09	0.08	0.07	0.06	0.06
Frederick	0.39	0.34	0.29	0.25	0.22	0.19	0.17	0.15	0.14	0.13
Harford	0.30	0.26	0.22	0.19	0.17	0.15	0.14	0.13	0.12	0.11
Howard	0.48	0.41	0.35	0.30	0.26	0.24	0.22	0.19	0.18	0.17
Montgomery	1.04	0.88	0.75	0.64	0.56	0.48	0.43	0.38	0.35	0.33
Prince George's	1.19	1.00	0.85	0.73	0.63	0.54	0.48	0.43	0.39	0.36
Baltimore City	0.45	0.38	0.33	0.28	0.24	0.21	0.19	0.18	0.16	0.15
Baltimore Region Total	3.16	2.68	2.29	1.97	1.71	1.52	1.39	1.25	1.15	1.06
Washington Region Total	2.89	2.46	2.10	1.80	1.55	1.34	1.19	1.07	0.98	0.91
Stage II Area Total	6.24	5.30	4.54	3.90	3.38	2.97	2.67	2.41	2.21	2.05

Table 18. Stage II Reductions with Non-Zero IEE Onroad Only, Displacement Plus Spillage Impacts, Scenario 2 (VOC, metric tonnes per day)

County	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Anne Arundel	0.45	0.32	0.22	0.13	0.06	0.01	-0.03	-0.07	-0.09	-0.11
Baltimore	0.62	0.44	0.29	0.18	0.08	0.01	-0.05	-0.09	-0.12	-0.14
Calvert	0.07	0.05	0.04	0.02	0.01	0.00	0.00	-0.01	-0.01	-0.01
Carroll	0.11	0.08	0.05	0.03	0.02	0.00	-0.01	-0.02	-0.02	-0.03
Cecil	0.13	0.10	0.08	0.06	0.04	0.02	0.01	0.00	-0.01	-0.01
Charles	0.12	0.09	0.06	0.04	0.02	0.01	0.00	-0.01	-0.02	-0.02
Frederick	0.26	0.19	0.14	0.09	0.05	0.02	-0.01	-0.03	-0.04	-0.05
Harford	0.19	0.14	0.09	0.06	0.03	0.01	-0.01	-0.03	-0.04	-0.05
Howard	0.29	0.21	0.14	0.08	0.04	0.00	-0.02	-0.05	-0.06	-0.07
Montgomery	0.66	0.48	0.33	0.21	0.11	0.02	-0.04	-0.08	-0.12	-0.14
Prince George's	0.76	0.55	0.38	0.24	0.12	0.03	-0.04	-0.09	-0.13	-0.15
Baltimore City	0.27	0.19	0.12	0.07	0.03	0.00	-0.03	-0.04	-0.06	-0.07
Baltimore Region Total	1.93	1.37	0.92	0.55	0.26	0.03	-0.15	-0.29	-0.38	-0.45
Washington Region Total	1.87	1.37	0.95	0.60	0.31	0.08	-0.09	-0.22	-0.32	-0.38
Stage II Area Total	3.93	2.84	1.95	1.21	0.61	0.13	-0.23	-0.50	-0.70	-0.85

Table 19. Stage II Reductions with Zero IEE Onroad Only, Displacement Plus Spillage Impacts, Scenario 3 (VOC, metric tonnes per day)

County	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Anne Arundel	0.45	0.39	0.34	0.29	0.26	0.24	0.22	0.20	0.19	0.18
Baltimore	0.62	0.53	0.46	0.41	0.36	0.32	0.30	0.27	0.25	0.24
Calvert	0.06	0.05	0.05	0.04	0.04	0.03	0.03	0.03	0.03	0.02
Carroll	0.11	0.09	0.08	0.07	0.06	0.06	0.05	0.05	0.05	0.04
Cecil	0.11	0.10	0.09	0.08	0.07	0.06	0.06	0.05	0.05	0.05
Charles	0.11	0.09	0.08	0.07	0.06	0.06	0.05	0.05	0.04	0.04
Frederick	0.24	0.21	0.18	0.16	0.14	0.13	0.11	0.11	0.10	0.09
Harford	0.18	0.16	0.14	0.12	0.11	0.10	0.10	0.09	0.08	0.08
Howard	0.30	0.26	0.22	0.20	0.17	0.16	0.15	0.14	0.13	0.12
Montgomery	0.63	0.54	0.47	0.41	0.36	0.32	0.29	0.27	0.25	0.23
Prince George's	0.72	0.62	0.54	0.47	0.41	0.36	0.32	0.30	0.28	0.26
Baltimore City	0.28	0.24	0.21	0.18	0.16	0.14	0.13	0.12	0.11	0.11
Baltimore Region Total	1.94	1.67	1.45	1.27	1.13	1.02	0.95	0.87	0.81	0.76
Washington Region Total	1.76	1.52	1.32	1.15	1.01	0.90	0.81	0.74	0.69	0.65
Stage II Area Total	3.81	3.28	2.86	2.50	2.21	1.98	1.82	1.67	1.56	1.46

Table 20. Stage II Reductions with Non-Zero IEE Onroad Only, Displacement Plus Spillage Impacts, Scenario 3 (VOC, metric tonnes per day)

County	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Anne Arundel	0.17	0.09	0.02	-0.03	-0.07	-0.11	-0.14	-0.15	-0.17	-0.18
Baltimore	0.22	0.11	0.02	-0.05	-0.10	-0.15	-0.18	-0.21	-0.22	-0.23
Calvert	0.03	0.02	0.01	0.00	-0.01	-0.01	-0.02	-0.02	-0.02	-0.02
Carroll	0.04	0.02	0.01	-0.01	-0.02	-0.03	-0.03	-0.04	-0.04	-0.04
Cecil	0.06	0.04	0.02	0.01	0.00	-0.01	-0.02	-0.02	-0.03	-0.03
Charles	0.05	0.03	0.01	0.00	-0.01	-0.02	-0.03	-0.03	-0.04	-0.04
Frederick	0.11	0.06	0.03	0.00	-0.03	-0.05	-0.06	-0.07	-0.08	-0.09
Harford	0.07	0.04	0.01	-0.01	-0.03	-0.04	-0.06	-0.07	-0.07	-0.08
Howard	0.11	0.05	0.01	-0.02	-0.05	-0.07	-0.09	-0.10	-0.11	-0.12
Montgomery	0.26	0.15	0.05	-0.02	-0.09	-0.14	-0.17	-0.20	-0.22	-0.23
Prince George's	0.30	0.17	0.06	-0.02	-0.09	-0.15	-0.19	-0.22	-0.24	-0.26
Baltimore City	0.09	0.04	0.01	-0.03	-0.05	-0.07	-0.09	-0.10	-0.10	-0.11
Baltimore Region Total	0.70	0.36	0.08	-0.15	-0.32	-0.47	-0.59	-0.67	-0.72	-0.76
Washington Region Total	0.74	0.43	0.16	-0.05	-0.23	-0.37	-0.47	-0.55	-0.61	-0.65
Stage II Area Total	1.50	0.82	0.27	-0.19	-0.55	-0.85	-1.08	-1.24	-1.35	-1.43

Table 21. Stage II Reductions with Zero IEE Onroad Plus Nonroad, Displacement Only Impacts, Scenario 1 (VOC, metric tonnes per day)

County	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Anne Arundel	0.58	0.50	0.43	0.37	0.33	0.29	0.27	0.25	0.23	0.22
Baltimore	0.79	0.67	0.58	0.50	0.44	0.39	0.35	0.32	0.30	0.28
Calvert	0.09	0.08	0.07	0.06	0.05	0.04	0.04	0.04	0.03	0.03
Carroll	0.15	0.13	0.11	0.10	0.09	0.08	0.07	0.07	0.06	0.06
Cecil	0.15	0.13	0.12	0.10	0.09	0.08	0.07	0.07	0.06	0.06
Charles	0.14	0.12	0.11	0.09	0.08	0.07	0.07	0.06	0.06	0.05
Frederick	0.31	0.27	0.23	0.20	0.18	0.16	0.14	0.13	0.12	0.11
Harford	0.24	0.20	0.18	0.15	0.14	0.12	0.11	0.10	0.10	0.09
Howard	0.38	0.33	0.28	0.24	0.21	0.19	0.18	0.16	0.15	0.14
Montgomery	0.87	0.75	0.65	0.57	0.51	0.45	0.41	0.38	0.36	0.35
Prince George's	0.91	0.77	0.65	0.56	0.48	0.41	0.37	0.33	0.31	0.29
Baltimore City	0.34	0.29	0.25	0.21	0.18	0.16	0.15	0.13	0.12	0.11
Baltimore Region Total	2.48	2.11	1.82	1.58	1.38	1.24	1.13	1.04	0.96	0.91
Washington Region Total	2.32	1.99	1.71	1.49	1.30	1.14	1.03	0.95	0.88	0.83
Stage II Area Total	4.95	4.23	3.65	3.17	2.77	2.46	2.24	2.05	1.91	1.81

Table 22. Stage II Reductions with Non-Zero IEE Onroad Plus Nonroad, Displacement Only Impacts, Scenario 1 (VOC, metric tonnes per day)

County	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Anne Arundel	0.30	0.20	0.12	0.05	-0.01	-0.05	-0.09	-0.11	-0.12	-0.13
Baltimore	0.39	0.25	0.14	0.04	-0.03	-0.08	-0.13	-0.16	-0.18	-0.19
Calvert	0.05	0.04	0.03	0.01	0.01	0.00	-0.01	-0.01	-0.01	-0.02
Carroll	0.08	0.06	0.04	0.02	0.01	0.00	-0.01	-0.02	-0.02	-0.03
Cecil	0.09	0.07	0.05	0.03	0.02	0.01	0.00	-0.01	-0.02	-0.02
Charles	0.08	0.06	0.04	0.02	0.01	0.00	-0.01	-0.02	-0.03	-0.03
Frederick	0.18	0.13	0.08	0.04	0.01	-0.01	-0.03	-0.05	-0.06	-0.07
Harford	0.12	0.08	0.05	0.02	0.00	-0.02	-0.04	-0.05	-0.06	-0.06
Howard	0.19	0.12	0.07	0.02	-0.01	-0.04	-0.06	-0.08	-0.09	-0.09
Montgomery	0.50	0.35	0.23	0.14	0.06	0.00	-0.05	-0.08	-0.11	-0.12
Prince George's	0.48	0.32	0.18	0.07	-0.02	-0.09	-0.15	-0.18	-0.21	-0.23
Baltimore City	0.16	0.09	0.04	0.00	-0.03	-0.06	-0.08	-0.09	-0.10	-0.10
Baltimore Region Total	1.25	0.81	0.45	0.16	-0.07	-0.26	-0.41	-0.50	-0.57	-0.61
Washington Region Total	1.30	0.89	0.56	0.28	0.06	-0.12	-0.25	-0.35	-0.42	-0.46
Stage II Area Total	2.64	1.77	1.06	0.47	0.01	-0.37	-0.66	-0.86	-1.00	-1.09

Table 23. Stage II Reductions with Zero IEE Onroad Plus Nonroad, Displacement Only Impacts, Scenario 2 (VOC, metric tonnes per day)

County	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Anne Arundel	0.75	0.64	0.55	0.48	0.42	0.38	0.35	0.32	0.30	0.28
Baltimore	1.02	0.87	0.74	0.64	0.56	0.50	0.45	0.41	0.39	0.36
Calvert	0.11	0.10	0.08	0.07	0.06	0.06	0.05	0.05	0.04	0.04
Carroll	0.19	0.16	0.14	0.12	0.11	0.10	0.09	0.09	0.08	0.08
Cecil	0.19	0.17	0.15	0.13	0.12	0.10	0.10	0.09	0.08	0.08
Charles	0.18	0.16	0.14	0.12	0.11	0.09	0.09	0.08	0.07	0.07
Frederick	0.40	0.35	0.30	0.26	0.23	0.20	0.18	0.17	0.16	0.15
Harford	0.31	0.26	0.23	0.20	0.17	0.16	0.15	0.13	0.12	0.12
Howard	0.49	0.42	0.36	0.31	0.28	0.25	0.23	0.21	0.20	0.19
Montgomery	1.12	0.97	0.84	0.74	0.65	0.58	0.53	0.49	0.47	0.45
Prince George's	1.17	0.99	0.84	0.72	0.62	0.53	0.47	0.43	0.39	0.37
Baltimore City	0.44	0.37	0.32	0.27	0.23	0.21	0.19	0.17	0.16	0.15
Baltimore Region Total	3.19	2.72	2.34	2.03	1.78	1.59	1.46	1.33	1.24	1.17
Washington Region Total	2.98	2.55	2.20	1.91	1.67	1.47	1.33	1.22	1.13	1.07
Stage II Area Total	6.37	5.44	4.69	4.07	3.56	3.16	2.88	2.64	2.46	2.32

Table 24. Stage II Reductions with Non-Zero IEE Onroad Plus Nonroad, Displacement Only Impacts, Scenario 2 (VOC, metric tonnes per day)

County	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Anne Arundel	0.47	0.34	0.24	0.15	0.09	0.03	-0.01	-0.04	-0.06	-0.07
Baltimore	0.62	0.44	0.30	0.19	0.10	0.03	-0.03	-0.07	-0.09	-0.11
Calvert	0.08	0.06	0.04	0.03	0.02	0.01	0.01	0.00	0.00	-0.01
Carroll	0.12	0.09	0.07	0.05	0.03	0.02	0.01	0.00	-0.01	-0.01
Cecil	0.14	0.11	0.08	0.06	0.05	0.03	0.02	0.01	0.00	0.00
Charles	0.13	0.10	0.07	0.05	0.03	0.02	0.00	0.00	-0.01	-0.02
Frederick	0.27	0.20	0.15	0.10	0.06	0.03	0.01	-0.01	-0.03	-0.04
Harford	0.19	0.14	0.10	0.06	0.04	0.01	-0.01	-0.02	-0.03	-0.04
Howard	0.30	0.22	0.15	0.09	0.05	0.02	-0.01	-0.03	-0.04	-0.05
Montgomery	0.74	0.57	0.42	0.30	0.20	0.12	0.07	0.03	0.00	-0.02
Prince George's	0.74	0.54	0.37	0.23	0.11	0.02	-0.04	-0.09	-0.12	-0.15
Baltimore City	0.25	0.18	0.11	0.06	0.02	-0.01	-0.03	-0.05	-0.06	-0.07
Baltimore Region Total	1.96	1.41	0.97	0.61	0.33	0.09	-0.08	-0.20	-0.29	-0.35
Washington Region Total	1.96	1.46	1.05	0.71	0.43	0.21	0.04	-0.08	-0.17	-0.23
Stage II Area Total	4.05	2.98	2.10	1.38	0.80	0.33	-0.02	-0.27	-0.45	-0.58

Table 25. Stage II Reductions with Zero IEE Onroad Plus Nonroad, Displacement Only Impacts, Scenario 3 (VOC, metric tonnes per day)

County	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Anne Arundel	0.42	0.36	0.31	0.27	0.23	0.21	0.19	0.18	0.16	0.16
Baltimore	0.57	0.48	0.41	0.36	0.31	0.28	0.25	0.23	0.21	0.20
Calvert	0.06	0.05	0.05	0.04	0.04	0.03	0.03	0.03	0.02	0.02
Carroll	0.10	0.09	0.08	0.07	0.06	0.06	0.05	0.05	0.05	0.04
Cecil	0.11	0.09	0.08	0.07	0.07	0.06	0.05	0.05	0.05	0.04
Charles	0.10	0.09	0.08	0.07	0.06	0.05	0.05	0.04	0.04	0.04
Frederick	0.22	0.19	0.17	0.15	0.13	0.11	0.10	0.09	0.09	0.08
Harford	0.17	0.15	0.13	0.11	0.10	0.09	0.08	0.07	0.07	0.06
Howard	0.27	0.23	0.20	0.17	0.15	0.14	0.13	0.12	0.11	0.10
Montgomery	0.62	0.54	0.47	0.41	0.36	0.32	0.30	0.27	0.26	0.25
Prince George's	0.65	0.55	0.47	0.40	0.34	0.30	0.26	0.24	0.22	0.20
Baltimore City	0.24	0.21	0.18	0.15	0.13	0.11	0.10	0.09	0.09	0.08
Baltimore Region Total	1.77	1.51	1.30	1.13	0.99	0.88	0.81	0.74	0.69	0.65
Washington Region Total	1.66	1.42	1.22	1.06	0.93	0.82	0.74	0.68	0.63	0.60
Stage II Area Total	3.54	3.02	2.61	2.26	1.98	1.76	1.60	1.47	1.36	1.29

Table 26. Stage II Reductions with Non-Zero IEE Onroad Plus Nonroad, Displacement Only Impacts, Scenario 3 (VOC, metric tonnes per day)

County	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Anne Arundel	0.13	0.06	-0.01	-0.06	-0.10	-0.13	-0.16	-0.18	-0.19	-0.20
Baltimore	0.17	0.06	-0.03	-0.10	-0.15	-0.20	-0.23	-0.25	-0.26	-0.27
Calvert	0.03	0.02	0.01	0.00	-0.01	-0.01	-0.02	-0.02	-0.02	-0.03
Carroll	0.04	0.02	0.01	-0.01	-0.02	-0.03	-0.03	-0.04	-0.04	-0.04
Cecil	0.05	0.03	0.02	0.00	-0.01	-0.02	-0.02	-0.03	-0.03	-0.04
Charles	0.04	0.02	0.01	-0.01	-0.02	-0.03	-0.03	-0.04	-0.04	-0.05
Frederick	0.09	0.05	0.01	-0.02	-0.04	-0.06	-0.08	-0.09	-0.10	-0.10
Harford	0.06	0.02	0.00	-0.02	-0.04	-0.06	-0.07	-0.08	-0.09	-0.09
Howard	0.08	0.03	-0.01	-0.05	-0.07	-0.09	-0.11	-0.12	-0.13	-0.13
Montgomery	0.25	0.14	0.05	-0.03	-0.09	-0.13	-0.17	-0.19	-0.21	-0.22
Prince George's	0.23	0.10	-0.01	-0.09	-0.16	-0.21	-0.25	-0.28	-0.30	-0.31
Baltimore City	0.06	0.01	-0.03	-0.06	-0.08	-0.10	-0.12	-0.13	-0.13	-0.13
Baltimore Region Total	0.54	0.20	-0.07	-0.29	-0.46	-0.61	-0.73	-0.80	-0.84	-0.87
Washington Region Total	0.64	0.33	0.07	-0.14	-0.31	-0.45	-0.55	-0.62	-0.67	-0.70
Stage II Area Total	1.23	0.56	0.01	-0.43	-0.79	-1.08	-1.30	-1.45	-1.55	-1.61

Table 27. Stage II Reductions with Zero IEE Onroad Plus Nonroad, Displacement Plus Spillage Impacts, Scenario 1 (VOC, metric tonnes per day)

County	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Anne Arundel	0.73	0.65	0.58	0.52	0.48	0.45	0.43	0.40	0.38	0.37
Baltimore	1.00	0.88	0.78	0.70	0.64	0.59	0.56	0.53	0.50	0.48
Calvert	0.10	0.09	0.08	0.08	0.07	0.06	0.06	0.06	0.05	0.05
Carroll	0.19	0.17	0.15	0.14	0.13	0.12	0.12	0.11	0.11	0.10
Cecil	0.18	0.16	0.15	0.13	0.12	0.11	0.11	0.10	0.10	0.09
Charles	0.17	0.15	0.14	0.13	0.11	0.11	0.10	0.09	0.09	0.09
Frederick	0.39	0.35	0.31	0.28	0.26	0.24	0.22	0.21	0.20	0.20
Harford	0.30	0.26	0.24	0.21	0.20	0.19	0.18	0.17	0.16	0.15
Howard	0.49	0.43	0.39	0.35	0.32	0.30	0.28	0.27	0.26	0.25
Montgomery	1.10	0.99	0.89	0.81	0.75	0.69	0.65	0.62	0.60	0.59
Prince George's	1.12	0.98	0.87	0.77	0.69	0.63	0.58	0.54	0.52	0.50
Baltimore City	0.43	0.38	0.33	0.30	0.27	0.25	0.23	0.22	0.21	0.20
Baltimore Region Total	3.14	2.76	2.47	2.23	2.03	1.89	1.80	1.70	1.62	1.56
Washington Region Total	2.90	2.56	2.29	2.07	1.88	1.72	1.61	1.53	1.46	1.42
Stage II Area Total	6.21	5.49	4.91	4.43	4.04	3.73	3.52	3.32	3.18	3.07

Table 28. Stage II Reductions with Non-Zero IEE Onroad Plus Nonroad, Displacement Plus Spillage Impacts, Scenario 1 (VOC, metric tonnes per day)

County	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Anne Arundel	0.45	0.35	0.27	0.20	0.15	0.10	0.07	0.05	0.03	0.02
Baltimore	0.60	0.46	0.34	0.25	0.18	0.12	0.08	0.05	0.03	0.01
Calvert	0.07	0.06	0.04	0.03	0.02	0.02	0.01	0.01	0.00	0.00
Carroll	0.12	0.10	0.08	0.06	0.05	0.04	0.03	0.02	0.02	0.02
Cecil	0.13	0.10	0.08	0.07	0.05	0.04	0.03	0.02	0.02	0.01
Charles	0.11	0.09	0.07	0.05	0.04	0.03	0.02	0.01	0.01	0.00
Frederick	0.26	0.20	0.16	0.12	0.09	0.06	0.05	0.03	0.02	0.01
Harford	0.18	0.14	0.11	0.08	0.06	0.04	0.02	0.01	0.00	0.00
Howard	0.29	0.23	0.17	0.13	0.09	0.07	0.04	0.03	0.02	0.01
Montgomery	0.73	0.59	0.47	0.37	0.30	0.23	0.19	0.16	0.13	0.12
Prince George's	0.70	0.53	0.40	0.28	0.19	0.12	0.07	0.03	0.00	-0.02
Baltimore City	0.25	0.18	0.13	0.09	0.06	0.03	0.01	0.00	-0.01	-0.02
Baltimore Region Total	1.90	1.46	1.10	0.81	0.58	0.40	0.26	0.16	0.09	0.04
Washington Region Total	1.88	1.47	1.14	0.86	0.64	0.46	0.33	0.23	0.16	0.12
Stage II Area Total	3.90	3.03	2.32	1.74	1.27	0.90	0.62	0.41	0.27	0.17

Table 29. Stage II Reductions with Zero IEE Onroad Plus Nonroad, Displacement Plus Spillage Impacts, Scenario 2 (VOC, metric tonnes per day)

County	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Anne Arundel	0.88	0.77	0.69	0.61	0.56	0.51	0.49	0.46	0.43	0.42
Baltimore	1.20	1.05	0.93	0.82	0.74	0.68	0.64	0.60	0.57	0.54
Calvert	0.13	0.11	0.10	0.09	0.08	0.07	0.07	0.06	0.06	0.06
Carroll	0.22	0.20	0.18	0.16	0.15	0.14	0.13	0.13	0.12	0.12
Cecil	0.22	0.20	0.18	0.16	0.15	0.13	0.12	0.12	0.11	0.11
Charles	0.21	0.19	0.17	0.15	0.13	0.12	0.11	0.11	0.10	0.10
Frederick	0.47	0.42	0.37	0.33	0.30	0.27	0.25	0.24	0.23	0.22
Harford	0.36	0.32	0.28	0.25	0.23	0.21	0.20	0.19	0.18	0.17
Howard	0.58	0.51	0.45	0.41	0.37	0.34	0.32	0.31	0.29	0.28
Montgomery	1.33	1.18	1.05	0.95	0.87	0.80	0.75	0.71	0.68	0.66
Prince George's	1.36	1.18	1.03	0.91	0.81	0.72	0.66	0.62	0.58	0.56
Baltimore City	0.52	0.45	0.39	0.35	0.31	0.28	0.26	0.25	0.23	0.22
Baltimore Region Total	3.77	3.29	2.92	2.61	2.35	2.17	2.05	1.92	1.83	1.75
Washington Region Total	3.49	3.07	2.72	2.43	2.19	1.99	1.85	1.74	1.66	1.60
Stage II Area Total	7.48	6.56	5.81	5.19	4.69	4.30	4.02	3.78	3.59	3.46

Table 30. Stage II Reductions with Non-Zero IEE Onroad Plus Nonroad, Displacement Plus Spillage Impacts, Scenario 2 (VOC, metric tonnes per day)

County	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Anne Arundel	0.60	0.47	0.37	0.29	0.22	0.17	0.13	0.10	0.08	0.07
Baltimore	0.80	0.63	0.48	0.37	0.28	0.21	0.16	0.12	0.09	0.07
Calvert	0.09	0.07	0.06	0.05	0.04	0.03	0.02	0.02	0.01	0.01
Carroll	0.16	0.13	0.11	0.09	0.07	0.06	0.05	0.04	0.03	0.03
Cecil	0.16	0.14	0.11	0.09	0.07	0.06	0.05	0.04	0.03	0.03
Charles	0.15	0.12	0.10	0.08	0.06	0.04	0.03	0.02	0.02	0.01
Frederick	0.34	0.27	0.22	0.17	0.13	0.10	0.08	0.06	0.05	0.04
Harford	0.24	0.19	0.15	0.12	0.09	0.07	0.05	0.04	0.03	0.02
Howard	0.39	0.31	0.24	0.19	0.14	0.11	0.08	0.07	0.05	0.04
Montgomery	0.96	0.78	0.63	0.51	0.42	0.34	0.29	0.25	0.22	0.20
Prince George's	0.93	0.73	0.56	0.42	0.30	0.21	0.15	0.10	0.06	0.04
Baltimore City	0.33	0.25	0.19	0.14	0.10	0.07	0.04	0.03	0.01	0.01
Baltimore Region Total	2.53	1.98	1.54	1.19	0.90	0.68	0.51	0.38	0.30	0.24
Washington Region Total	2.47	1.98	1.57	1.22	0.95	0.73	0.57	0.44	0.36	0.30
Stage II Area Total	5.17	4.10	3.22	2.50	1.93	1.46	1.12	0.87	0.68	0.56

Table 31. Stage II Reductions with Zero IEE Onroad Plus Nonroad, Displacement Plus Spillage Impacts, Scenario 3 (VOC, metric tonnes per day)

County	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Anne Arundel	0.55	0.49	0.44	0.40	0.37	0.35	0.33	0.31	0.30	0.29
Baltimore	0.75	0.66	0.60	0.54	0.49	0.46	0.44	0.41	0.40	0.38
Calvert	0.08	0.07	0.06	0.06	0.05	0.05	0.05	0.04	0.04	0.04
Carroll	0.14	0.13	0.12	0.11	0.10	0.09	0.09	0.09	0.08	0.08
Cecil	0.13	0.12	0.11	0.10	0.09	0.09	0.08	0.08	0.07	0.07
Charles	0.13	0.12	0.10	0.10	0.09	0.08	0.08	0.07	0.07	0.07
Frederick	0.29	0.26	0.24	0.22	0.20	0.18	0.17	0.17	0.16	0.15
Harford	0.22	0.20	0.18	0.16	0.15	0.14	0.14	0.13	0.13	0.12
Howard	0.36	0.32	0.29	0.27	0.25	0.23	0.22	0.21	0.20	0.20
Montgomery	0.83	0.75	0.68	0.62	0.58	0.54	0.51	0.49	0.48	0.47
Prince George's	0.84	0.74	0.66	0.59	0.53	0.49	0.45	0.43	0.41	0.39
Baltimore City	0.32	0.28	0.25	0.23	0.21	0.19	0.18	0.17	0.16	0.16
Baltimore Region Total	2.35	2.09	1.88	1.70	1.56	1.47	1.40	1.33	1.27	1.23
Washington Region Total	2.17	1.93	1.74	1.58	1.45	1.34	1.26	1.20	1.15	1.12
Stage II Area Total	4.65	4.14	3.73	3.39	3.11	2.89	2.74	2.61	2.50	2.42

Table 32. Stage II Reductions with Non-Zero IEE Onroad Plus Nonroad, Displacement Plus Spillage Impacts, Scenario 3 (VOC, metric tonnes per day)

County	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Anne Arundel	0.27	0.19	0.13	0.08	0.04	0.00	-0.02	-0.04	-0.05	-0.06
Baltimore	0.35	0.24	0.15	0.09	0.03	-0.01	-0.05	-0.07	-0.08	-0.09
Calvert	0.04	0.03	0.02	0.01	0.01	0.00	0.00	-0.01	-0.01	-0.01
Carroll	0.08	0.06	0.04	0.03	0.02	0.01	0.00	0.00	0.00	0.00
Cecil	0.08	0.06	0.05	0.03	0.02	0.01	0.00	0.00	-0.01	-0.01
Charles	0.07	0.05	0.04	0.02	0.01	0.00	0.00	-0.01	-0.01	-0.02
Frederick	0.16	0.12	0.08	0.05	0.03	0.01	0.00	-0.01	-0.02	-0.03
Harford	0.11	0.08	0.05	0.03	0.01	0.00	-0.02	-0.02	-0.03	-0.03
Howard	0.17	0.12	0.08	0.05	0.02	0.00	-0.02	-0.03	-0.03	-0.04
Montgomery	0.46	0.35	0.26	0.19	0.13	0.08	0.05	0.03	0.01	0.00
Prince George's	0.42	0.29	0.18	0.10	0.03	-0.02	-0.06	-0.09	-0.11	-0.12
Baltimore City	0.14	0.09	0.05	0.02	-0.01	-0.03	-0.04	-0.05	-0.06	-0.06
Baltimore Region Total	1.11	0.78	0.50	0.28	0.11	-0.03	-0.14	-0.21	-0.26	-0.28
Washington Region Total	1.15	0.84	0.59	0.37	0.21	0.07	-0.02	-0.10	-0.15	-0.18
Stage II Area Total	2.34	1.68	1.13	0.69	0.34	0.06	-0.16	-0.31	-0.41	-0.47

Table 33. Stage II HAPs Reductions with Zero IEE Onroad Only, Displacement Impacts Only, Scenario 1 (kilograms per day, entire 12 county Stage II area)

County	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
MTBE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ethanol	568.34	471.10	392.28	326.18	272.31	229.49	198.68	172.04	151.81	136.44
Benzene	14.17	11.75	9.78	8.13	6.79	5.72	4.95	4.29	3.79	3.40
Xylene	273.55	226.75	188.81	156.99	131.06	110.45	95.62	82.80	73.07	65.67
Toluene	610.55	506.09	421.42	350.40	292.53	246.53	213.43	184.81	163.08	146.58
Ethyl Benzene	73.29	60.75	50.59	42.06	35.12	29.60	25.62	22.19	19.58	17.60
Hexane	108.00	89.53	74.55	61.98	51.75	43.61	37.76	32.69	28.85	25.93
2,2,4-Trimethylpentane	142.84	118.40	98.59	81.98	68.44	57.68	49.93	43.24	38.15	34.29
Naphthalene	1.70	1.41	1.18	0.98	0.82	0.69	0.60	0.52	0.46	0.41
Speciated Emissions Total	1792.45	1485.78	1237.20	1028.71	858.82	723.76	626.60	542.58	478.78	430.32
Fraction of Total VOC	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%

Table 34. Stage II HAPs Reductions with Non-Zero IEE Onroad Only, Displacement Impacts Only, Scenario 1 (kilograms per day, entire 12 county Stage II area)

County	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
MTBE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ethanol	259.95	142.76	46.20	-33.25	-96.67	-148.54	-188.44	-216.40	-236.58	-250.23
Benzene	6.48	3.56	1.15	-0.83	-2.41	-3.70	-4.70	-5.40	-5.90	-6.24
Xylene	125.12	68.71	22.24	-16.00	-46.53	-71.50	-90.70	-104.16	-113.87	-120.44
Toluene	279.26	153.37	49.64	-35.71	-103.85	-159.58	-202.44	-232.47	-254.15	-268.81
Ethyl Benzene	33.52	18.41	5.96	-4.29	-12.47	-19.16	-24.30	-27.91	-30.51	-32.27
Hexane	49.40	27.13	8.78	-6.32	-18.37	-28.23	-35.81	-41.12	-44.96	-47.55
2,2,4-Trimethylpentane	65.33	35.88	11.61	-8.36	-24.30	-37.33	-47.36	-54.39	-59.46	-62.89
Naphthalene	0.78	0.43	0.14	-0.10	-0.29	-0.45	-0.56	-0.65	-0.71	-0.75
Speciated Emissions Total	819.84	450.26	145.72	-104.85	-304.87	-468.49	-594.32	-682.49	-746.14	-789.19
Fraction of Total VOC	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%

Table 35. Stage II HAPs Reductions with Zero IEE Onroad Only, Displacement Impacts Only, Scenario 2 (kilograms per day, entire 12 county Stage II area)

County	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
MTBE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ethanol	730.72	605.70	504.36	419.37	350.11	295.05	255.44	221.19	195.18	175.43
Benzene	18.22	15.11	12.58	10.46	8.73	7.36	6.37	5.52	4.87	4.38
Xylene	351.70	291.53	242.76	201.85	168.51	142.01	122.95	106.46	93.94	84.44
Toluene	784.99	650.69	541.82	450.52	376.11	316.97	274.41	237.62	209.68	188.46
Ethyl Benzene	94.24	78.11	65.04	54.08	45.15	38.05	32.94	28.53	25.17	22.62
Hexane	138.86	115.11	95.85	79.69	66.53	56.07	48.54	42.03	37.09	33.34
2,2,4-Trimethylpentane	183.65	152.23	126.76	105.40	87.99	74.16	64.20	55.59	49.06	44.09
Naphthalene	2.19	1.82	1.51	1.26	1.05	0.88	0.77	0.66	0.59	0.53
Speciated Emissions Total	2304.58	1910.29	1590.69	1322.62	1104.19	930.55	805.62	697.60	615.57	553.27
Fraction of Total VOC	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%

Table 36. Stage II HAPs Reductions with Non-Zero IEE Onroad Only, Displacement Impacts Only, Scenario 2 (kilograms per day, entire 12 county Stage II area)

County	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
MTBE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ethanol	422.33	277.36	158.29	59.95	-18.87	-82.98	-131.68	-167.25	-193.21	-211.25
Benzene	10.53	6.92	3.95	1.50	-0.47	-2.07	-3.28	-4.17	-4.82	-5.27
Xylene	203.27	133.50	76.18	28.85	-9.08	-39.94	-63.38	-80.50	-92.99	-101.67
Toluene	453.70	297.96	170.04	64.40	-20.27	-89.14	-141.46	-179.67	-207.56	-226.93
Ethyl Benzene	54.47	35.77	20.41	7.73	-2.43	-10.70	-16.98	-21.57	-24.92	-27.24
Hexane	80.26	52.71	30.08	11.39	-3.59	-15.77	-25.02	-31.78	-36.72	-40.14
2,2,4-Trimethylpentane	106.15	69.71	39.78	15.07	-4.74	-20.85	-33.09	-42.03	-48.56	-53.09
Naphthalene	1.27	0.83	0.47	0.18	-0.06	-0.25	-0.39	-0.50	-0.58	-0.63
Speciated Emissions Total	1331.97	874.77	499.21	189.07	-59.50	-261.70	-415.29	-527.47	-609.35	-666.24
Fraction of Total VOC	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%

Table 37. Stage II HAPs Reductions with Zero IEE Onroad Only, Displacement Impacts Only, Scenario 3 (kilograms per day, entire 12 county Stage II area)

County	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
MTBE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ethanol	405.95	336.50	280.20	232.98	194.51	163.92	141.91	122.88	108.43	97.46
Benzene	10.12	8.39	6.99	5.81	4.85	4.09	3.54	3.06	2.70	2.43
Xylene	195.39	161.96	134.86	112.14	93.62	78.90	68.30	59.15	52.19	46.91
Toluene	436.11	361.49	301.01	250.29	208.95	176.09	152.45	132.01	116.49	104.70
Ethyl Benzene	52.35	43.40	36.14	30.05	25.08	21.14	18.30	15.85	13.98	12.57
Hexane	77.15	63.95	53.25	44.27	36.96	31.15	26.97	23.35	20.61	18.52
2,2,4-Trimethylpentane	102.03	84.57	70.42	58.56	48.89	41.20	35.67	30.88	27.25	24.49
Naphthalene	1.22	1.01	0.84	0.70	0.58	0.49	0.43	0.37	0.33	0.29
Speciated Emissions Total	1280.32	1061.27	883.72	734.79	613.44	516.97	447.57	387.56	341.98	307.37
Fraction of Total VOC	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%

Table 38. Stage II HAPs Reductions with Non-Zero IEE Onroad Only, Displacement Impacts Only, Scenario 3 (kilograms per day, entire 12 county Stage II area)

County	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
MTBE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ethanol	97.57	8.16	-65.88	-126.44	-174.47	-214.11	-245.21	-265.55	-279.95	-289.21
Benzene	2.43	0.20	-1.64	-3.15	-4.35	-5.34	-6.12	-6.62	-6.98	-7.21
Xylene	46.96	3.93	-31.71	-60.86	-83.97	-103.05	-118.02	-127.81	-134.74	-139.20
Toluene	104.82	8.77	-70.77	-135.83	-187.43	-230.01	-263.42	-285.28	-300.75	-310.69
Ethyl Benzene	12.58	1.05	-8.50	-16.31	-22.50	-27.61	-31.62	-34.25	-36.10	-37.30
Hexane	18.54	1.55	-12.52	-24.03	-33.16	-40.69	-46.60	-50.46	-53.20	-54.96
2,2,4-Trimethylpentane	24.52	2.05	-16.56	-31.78	-43.85	-53.81	-61.63	-66.74	-70.36	-72.69
Naphthalene	0.29	0.02	-0.20	-0.38	-0.52	-0.64	-0.73	-0.80	-0.84	-0.87
Speciated Emissions Total	307.72	25.75	-207.77	-398.77	-550.25	-675.28	-773.35	-837.51	-882.93	-912.14
Fraction of Total VOC	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%

Table 39. Stage II HAPs Reductions with Zero IEE Onroad Only, Displacement Plus Spillage Impacts, Scenario 1 (kilograms per day, entire 12 county Stage II area)

County	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
MTBE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ethanol	690.22	591.75	512.61	445.95	391.34	348.29	318.03	290.03	268.48	251.63
Benzene	17.21	14.76	12.78	11.12	9.76	8.69	7.93	7.23	6.70	6.28
Xylene	332.21	284.82	246.72	214.64	188.36	167.64	153.07	139.60	129.22	121.11
Toluene	741.48	635.71	550.68	479.07	420.41	374.16	341.65	311.57	288.42	270.32
Ethyl Benzene	89.01	76.31	66.11	57.51	50.47	44.92	41.01	37.40	34.62	32.45
Hexane	131.17	112.45	97.41	84.75	74.37	66.19	60.44	55.12	51.02	47.82
2,2,4-Trimethylpentane	173.47	148.73	128.84	112.08	98.36	87.54	79.93	72.89	67.48	63.24
Naphthalene	2.07	1.77	1.54	1.34	1.17	1.04	0.95	0.87	0.80	0.75
Speciated Emissions Total	2176.84	1866.30	1616.70	1406.45	1234.23	1098.47	1003.01	914.72	846.73	793.61
Fraction of Total VOC	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%

Table 40. Stage II HAPs Reductions with Non-Zero IEE Onroad Only, Displacement Plus Spillage Impacts, Scenario 1 (kilograms per day, entire 12 county Stage II area)

County	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
MTBE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ethanol	381.83	263.42	166.53	86.52	22.37	-29.74	-69.09	-98.40	-119.91	-135.04
Benzene	9.52	6.57	4.15	2.16	0.56	-0.74	-1.72	-2.45	-2.99	-3.37
Xylene	183.78	126.78	80.15	41.65	10.77	-14.31	-33.25	-47.36	-57.71	-65.00
Toluene	410.19	282.98	178.90	92.95	24.03	-31.95	-74.22	-105.71	-128.82	-145.07
Ethyl Benzene	49.24	33.97	21.48	11.16	2.88	-3.83	-8.91	-12.69	-15.46	-17.42
Hexane	72.56	50.06	31.65	16.44	4.25	-5.65	-13.13	-18.70	-22.79	-25.66
2,2,4-Trimethylpentane	95.97	66.21	41.85	21.75	5.62	-7.47	-17.37	-24.73	-30.14	-33.94
Naphthalene	1.14	0.79	0.50	0.26	0.07	-0.09	-0.21	-0.29	-0.36	-0.40
Speciated Emissions Total	1204.23	830.78	525.22	272.89	70.54	-93.78	-217.91	-310.35	-378.18	-425.90
Fraction of Total VOC	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%

Table 41. Stage II HAPs Reductions with Zero IEE Onroad Only, Displacement Plus Spillage Impacts, Scenario 2 (kilograms per day, entire 12 county Stage II area)

County	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
MTBE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ethanol	832.88	707.19	605.85	520.59	450.87	395.76	356.72	321.42	294.35	273.39
Benzene	20.77	17.64	15.11	12.98	11.24	9.87	8.90	8.02	7.34	6.82
Xylene	400.87	340.38	291.60	250.57	217.01	190.49	171.69	154.70	141.67	131.59
Toluene	894.74	759.71	650.85	559.26	484.36	425.16	383.22	345.29	316.21	293.70
Ethyl Benzene	107.41	91.20	78.13	67.14	58.15	51.04	46.00	41.45	37.96	35.26
Hexane	158.28	134.39	115.13	98.93	85.68	75.21	67.79	61.08	55.94	51.95
2,2,4-Trimethylpentane	209.33	177.74	152.27	130.84	113.32	99.47	89.66	80.78	73.98	68.71
Naphthalene	2.50	2.12	1.82	1.56	1.35	1.19	1.07	0.96	0.88	0.82
Speciated Emissions Total	2626.78	2230.36	1910.76	1641.87	1421.97	1248.18	1125.06	1013.70	928.34	862.25
Fraction of Total VOC	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%

Table 42. Stage II HAPs Reductions with Non-Zero IEE Onroad Only, Displacement Plus Spillage Impacts, Scenario 2 (kilograms per day, entire 12 county Stage II area)

County	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
MTBE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ethanol	524.49	378.85	259.77	161.17	81.89	17.73	-30.39	-67.02	-94.04	-113.28
Benzene	13.08	9.45	6.48	4.02	2.04	0.44	-0.76	-1.67	-2.35	-2.83
Xylene	252.44	182.34	125.03	77.57	39.42	8.54	-14.63	-32.26	-45.26	-54.52
Toluene	563.45	406.99	279.06	173.14	87.98	19.05	-32.65	-72.00	-101.02	-121.69
Ethyl Benzene	67.64	48.86	33.50	20.79	10.56	2.29	-3.92	-8.64	-12.13	-14.61
Hexane	99.67	71.99	49.37	30.63	15.56	3.37	-5.78	-12.74	-17.87	-21.53
2,2,4-Trimethylpentane	131.82	95.22	65.29	40.51	20.58	4.46	-7.64	-16.84	-23.63	-28.47
Naphthalene	1.57	1.14	0.78	0.48	0.25	0.05	-0.09	-0.20	-0.28	-0.34
Speciated Emissions Total	1654.18	1194.83	819.27	508.31	258.28	55.93	-95.86	-211.37	-296.58	-357.26
Fraction of Total VOC	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%

Table 43. Stage II HAPs Reductions with Zero IEE Onroad Only, Displacement Plus Spillage Impacts, Scenario 3 (kilograms per day, entire 12 county Stage II area)

County	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
MTBE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ethanol	508.12	437.99	381.69	334.21	295.26	264.63	243.19	223.11	207.60	195.43
Benzene	12.67	10.92	9.52	8.34	7.36	6.60	6.07	5.56	5.18	4.87
Xylene	244.56	210.81	183.71	160.86	142.11	127.37	117.05	107.38	99.92	94.06
Toluene	545.86	470.52	410.04	359.03	317.19	284.28	261.26	239.68	223.02	209.94
Ethyl Benzene	65.53	56.48	49.22	43.10	38.08	34.13	31.36	28.77	26.77	25.20
Hexane	96.56	83.23	72.53	63.51	56.11	50.29	46.22	42.40	39.45	37.14
2,2,4-Trimethylpentane	127.71	110.08	95.93	84.00	74.21	66.51	61.12	56.07	52.18	49.12
Naphthalene	1.52	1.31	1.14	1.00	0.89	0.79	0.73	0.67	0.62	0.59
Speciated Emissions Total	1602.52	1381.34	1203.78	1054.04	931.22	834.60	767.00	703.65	654.75	616.35
Fraction of Total VOC	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%

Table 44. Stage II HAPs Reductions with Non-Zero IEE Onroad Only, Displacement Plus Spillage Impacts, Scenario 3 (kilograms per day, entire 12 county Stage II area)

County	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
MTBE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ethanol	199.73	109.65	35.61	-25.21	-73.71	-113.40	-143.92	-165.33	-180.78	-191.25
Benzene	4.98	2.73	0.89	-0.63	-1.84	-2.83	-3.59	-4.12	-4.51	-4.77
Xylene	96.13	52.77	17.14	-12.14	-35.48	-54.58	-69.27	-79.57	-87.01	-92.05
Toluene	214.56	117.79	38.25	-27.09	-79.18	-121.82	-154.61	-177.61	-194.21	-205.45
Ethyl Benzene	25.76	14.14	4.59	-3.25	-9.51	-14.62	-18.56	-21.32	-23.31	-24.66
Hexane	37.96	20.84	6.77	-4.79	-14.01	-21.55	-27.35	-31.42	-34.36	-36.34
2,2,4-Trimethylpentane	50.20	27.56	8.95	-6.34	-18.53	-28.50	-36.17	-41.55	-45.44	-48.07
Naphthalene	0.60	0.33	0.11	-0.08	-0.22	-0.34	-0.43	-0.50	-0.54	-0.57
Speciated Emissions Total	629.92	345.81	112.30	-79.52	-232.47	-357.65	-453.92	-521.42	-570.16	-603.16
Fraction of Total VOC	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%

Table 45. Stage II HAPs Reductions with Zero IEE Onroad Plus Nonroad, Displacement Impacts Only, Scenario 1 (kilograms per day, entire 12 county Stage II area)

County	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
MTBE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ethanol	660.69	564.70	487.16	422.37	369.84	328.38	298.95	273.71	254.88	240.93
Benzene	16.48	14.08	12.15	10.53	9.22	8.19	7.46	6.83	6.36	6.01
Xylene	318.00	271.80	234.48	203.29	178.01	158.05	143.89	131.74	122.67	115.96
Toluene	709.76	606.65	523.34	453.74	397.30	352.77	321.16	294.03	273.81	258.82
Ethyl Benzene	85.20	72.83	62.83	54.47	47.70	42.35	38.55	35.30	32.87	31.07
Hexane	125.55	107.31	92.58	80.27	70.28	62.40	56.81	52.01	48.44	45.78
2,2,4-Trimethylpentane	166.05	141.93	122.44	106.16	92.95	82.53	75.14	68.79	64.06	60.55
Naphthalene	1.98	1.69	1.46	1.27	1.11	0.98	0.90	0.82	0.76	0.72
Speciated Emissions Total	2083.71	1780.99	1536.43	1332.10	1166.41	1035.67	942.85	863.23	803.84	759.85
Fraction of Total VOC	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%

Table 46. Stage II HAPs Reductions with Non-Zero IEE Onroad Plus Nonroad, Displacement Impacts Only, Scenario 1 (kilograms per day, entire 12 county Stage II area)

County	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
MTBE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ethanol	352.30	236.37	141.08	62.95	0.86	-49.65	-88.17	-114.73	-133.51	-145.75
Benzene	8.79	5.89	3.52	1.57	0.02	-1.24	-2.20	-2.86	-3.33	-3.63
Xylene	169.57	113.77	67.90	30.30	0.41	-23.90	-42.44	-55.22	-64.26	-70.15
Toluene	378.47	253.92	151.56	67.63	0.93	-53.33	-94.71	-123.25	-143.43	-156.57
Ethyl Benzene	45.43	30.48	18.19	8.12	0.11	-6.40	-11.37	-14.80	-17.22	-18.80
Hexane	66.95	44.92	26.81	11.96	0.16	-9.43	-16.75	-21.80	-25.37	-27.70
2,2,4-Trimethylpentane	88.55	59.41	35.46	15.82	0.22	-12.48	-22.16	-28.84	-33.56	-36.63
Naphthalene	1.06	0.71	0.42	0.19	0.00	-0.15	-0.26	-0.34	-0.40	-0.44
Speciated Emissions Total	1111.11	745.47	444.95	198.54	2.72	-156.58	-278.06	-361.85	-421.07	-459.66
Fraction of Total VOC	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%

Table 47. Stage II HAPs Reductions with Zero IEE Onroad Plus Nonroad, Displacement Impacts Only, Scenario 2 (kilograms per day, entire 12 county Stage II area)

County	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
MTBE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ethanol	849.46	726.05	626.35	543.05	475.50	422.21	384.37	351.91	327.70	309.76
Benzene	21.19	18.11	15.62	13.54	11.86	10.53	9.59	8.78	8.17	7.73
Xylene	408.85	349.45	301.47	261.37	228.86	203.21	185.00	169.38	157.72	149.09
Toluene	912.55	779.97	672.87	583.38	510.82	453.56	412.92	378.04	352.04	332.77
Ethyl Benzene	109.55	93.63	80.78	70.03	61.32	54.45	49.57	45.38	42.26	39.95
Hexane	161.43	137.98	119.03	103.20	90.36	80.23	73.04	66.87	62.27	58.87
2,2,4-Trimethylpentane	213.50	182.48	157.42	136.49	119.51	106.11	96.60	88.45	82.36	77.85
Naphthalene	2.55	2.18	1.88	1.63	1.43	1.27	1.15	1.05	0.98	0.93
Speciated Emissions Total	2679.06	2289.85	1975.41	1712.70	1499.67	1331.57	1212.24	1109.86	1033.51	976.94
Fraction of Total VOC	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%

Table 48. Stage II HAPs Reductions with Non-Zero IEE Onroad Plus Nonroad, Displacement Impacts Only, Scenario 2 (kilograms per day, entire 12 county Stage II area)

County	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
MTBE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ethanol	541.07	397.71	280.27	183.63	106.53	44.18	-2.75	-36.53	-60.69	-76.91
Benzene	13.49	9.92	6.99	4.58	2.66	1.10	-0.07	-0.91	-1.51	-1.92
Xylene	260.42	191.42	134.90	88.38	51.27	21.26	-1.32	-17.58	-29.21	-37.02
Toluene	581.26	427.25	301.09	197.27	114.44	47.46	-2.96	-39.24	-65.20	-82.62
Ethyl Benzene	69.78	51.29	36.14	23.68	13.74	5.70	-0.35	-4.71	-7.83	-9.92
Hexane	102.82	75.58	53.26	34.90	20.24	8.40	-0.52	-6.94	-11.53	-14.62
2,2,4-Trimethylpentane	135.99	99.96	70.44	46.15	26.77	11.10	-0.69	-9.18	-15.25	-19.33
Naphthalene	1.62	1.19	0.84	0.55	0.32	0.13	-0.01	-0.11	-0.18	-0.23
Speciated Emissions Total	1706.45	1254.32	883.93	579.14	335.98	139.33	-8.68	-115.21	-191.41	-242.57
Fraction of Total VOC	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%

Table 49. Stage II HAPs Reductions with Zero IEE Onroad Plus Nonroad, Displacement Impacts Only, Scenario 3 (kilograms per day, entire 12 county Stage II area)

County	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
MTBE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ethanol	471.92	403.36	347.97	301.69	264.17	234.56	213.54	195.50	182.05	172.09
Benzene	11.77	10.06	8.68	7.52	6.59	5.85	5.33	4.88	4.54	4.29
Xylene	227.14	194.14	167.48	145.21	127.15	112.90	102.78	94.10	87.62	82.83
Toluene	506.97	433.32	373.82	324.10	283.79	251.98	229.40	210.02	195.58	184.87
Ethyl Benzene	60.86	52.02	44.88	38.91	34.07	30.25	27.54	25.21	23.48	22.19
Hexane	89.68	76.65	66.13	57.33	50.20	44.57	40.58	37.15	34.60	32.70
2,2,4-Trimethylpentane	118.61	101.38	87.46	75.83	66.39	58.95	53.67	49.14	45.76	43.25
Naphthalene	1.41	1.21	1.04	0.90	0.79	0.70	0.64	0.59	0.55	0.52
Speciated Emissions Total	1488.37	1272.14	1097.45	951.50	833.15	739.76	673.47	616.59	574.17	542.75
Fraction of Total VOC	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%

Table 50. Stage II HAPs Reductions with Non-Zero IEE Onroad Plus Nonroad, Displacement Impacts Only, Scenario 3 (kilograms per day, entire 12 county Stage II area)

County	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
MTBE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ethanol	163.53	75.02	1.89	-57.73	-104.81	-143.47	-173.58	-192.93	-206.33	-214.58
Benzene	4.08	1.87	0.05	-1.44	-2.61	-3.58	-4.33	-4.81	-5.15	-5.35
Xylene	78.71	36.11	0.91	-27.78	-50.44	-69.05	-83.55	-92.86	-99.31	-103.28
Toluene	175.68	80.59	2.03	-62.01	-112.59	-154.13	-186.47	-207.26	-221.66	-230.52
Ethyl Benzene	21.09	9.68	0.24	-7.44	-13.52	-18.50	-22.39	-24.88	-26.61	-27.67
Hexane	31.08	14.26	0.36	-10.97	-19.92	-27.26	-32.99	-36.66	-39.21	-40.78
2,2,4-Trimethylpentane	41.10	18.86	0.48	-14.51	-26.34	-36.06	-43.63	-48.49	-51.86	-53.93
Naphthalene	0.49	0.22	0.01	-0.17	-0.31	-0.43	-0.52	-0.58	-0.62	-0.64
Speciated Emissions Total	515.76	236.61	5.97	-182.06	-330.54	-452.49	-547.45	-608.48	-650.74	-676.76
Fraction of Total VOC	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%

Table 51. Stage II HAPs Reductions with Zero IEE Onroad Plus Nonroad, Displacement Plus Spillage Impacts, Scenario 1 (kilograms per day, entire 12 county Stage II area)

County	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
MTBE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ethanol	829.10	732.65	655.54	590.97	538.48	497.58	469.48	443.66	424.30	409.65
Benzene	20.68	18.27	16.35	14.74	13.43	12.41	11.71	11.06	10.58	10.22
Xylene	399.05	352.63	315.52	284.44	259.17	239.49	225.96	213.54	204.22	197.17
Toluene	890.68	787.06	704.23	634.86	578.47	534.54	504.35	476.61	455.81	440.08
Ethyl Benzene	106.92	94.48	84.54	76.21	69.44	64.17	60.55	57.22	54.72	52.83
Hexane	157.56	139.23	124.58	112.31	102.33	94.56	89.22	84.31	80.63	77.85
2,2,4-Trimethylpentane	208.38	184.14	164.76	148.53	135.34	125.06	118.00	111.51	106.64	102.96
Naphthalene	2.49	2.20	1.96	1.77	1.61	1.49	1.41	1.33	1.27	1.23
Speciated Emissions Total	2614.85	2310.66	2067.47	1863.84	1698.27	1569.29	1480.67	1399.25	1338.17	1291.99
Fraction of Total VOC	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%

Table 52. Stage II HAPs Reductions with Non-Zero IEE Onroad Plus Nonroad, Displacement Plus Spillage Impacts, Scenario 1 (kilograms per day, entire 12 county Stage II area)

County	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
MTBE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ethanol	520.71	404.31	309.46	231.55	169.50	119.55	82.36	55.23	35.91	22.98
Benzene	12.99	10.08	7.72	5.77	4.23	2.98	2.05	1.38	0.90	0.57
Xylene	250.62	194.60	148.95	111.45	81.58	57.54	39.64	26.58	17.28	11.06
Toluene	559.39	434.34	332.44	248.75	182.09	128.43	88.48	59.33	38.58	24.69
Ethyl Benzene	67.15	52.14	39.91	29.86	21.86	15.42	10.62	7.12	4.63	2.96
Hexane	98.95	76.83	58.81	44.00	32.21	22.72	15.65	10.49	6.82	4.37
2,2,4-Trimethylpentane	130.87	101.62	77.78	58.20	42.60	30.05	20.70	13.88	9.03	5.78
Naphthalene	1.56	1.21	0.93	0.69	0.51	0.36	0.25	0.17	0.11	0.07
Speciated Emissions Total	1642.25	1275.13	975.99	730.28	534.58	377.04	259.75	174.17	113.25	72.48
Fraction of Total VOC	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%

Table 53. Stage II HAPs Reductions with Zero IEE Onroad Plus Nonroad, Displacement Plus Spillage Impacts, Scenario 2 (kilograms per day, entire 12 county Stage II area)

County	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
MTBE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ethanol	998.15	874.82	775.89	693.10	625.87	573.31	536.83	504.09	479.62	461.27
Benzene	24.89	21.82	19.35	17.29	15.61	14.30	13.39	12.57	11.96	11.50
Xylene	480.42	421.06	373.44	333.60	301.24	275.94	258.38	242.62	230.84	222.01
Toluene	1072.28	939.80	833.51	744.58	672.35	615.89	576.70	541.53	515.24	495.53
Ethyl Benzene	128.72	112.82	100.06	89.39	80.71	73.94	69.23	65.01	61.85	59.49
Hexane	189.68	166.25	147.45	131.71	118.94	108.95	102.02	95.80	91.14	87.66
2,2,4-Trimethylpentane	250.87	219.87	195.01	174.20	157.30	144.09	134.92	126.70	120.54	115.93
Naphthalene	2.99	2.62	2.33	2.08	1.88	1.72	1.61	1.51	1.44	1.38
Speciated Emissions Total	3148.02	2759.07	2447.03	2185.94	1973.90	1808.12	1693.07	1589.84	1512.65	1454.78
Fraction of Total VOC	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%

Table 54. Stage II HAPs Reductions with Non-Zero IEE Onroad Plus Nonroad, Displacement Plus Spillage Impacts, Scenario 2 (kilograms per day, entire 12 county Stage II area)

County	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
MTBE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ethanol	689.76	546.49	429.81	333.68	256.89	195.28	149.71	115.66	91.23	74.60
Benzene	17.20	13.63	10.72	8.32	6.41	4.87	3.73	2.88	2.28	1.86
Xylene	331.99	263.03	206.87	160.60	123.65	93.99	72.06	55.67	43.91	35.90
Toluene	740.99	587.08	461.73	358.47	275.97	209.78	160.83	124.25	98.01	80.14
Ethyl Benzene	88.95	70.48	55.43	43.03	33.13	25.18	19.31	14.92	11.77	9.62
Hexane	131.08	103.85	81.68	63.41	48.82	37.11	28.45	21.98	17.34	14.18
2,2,4-Trimethylpentane	173.36	137.35	108.02	83.87	64.57	49.08	37.63	29.07	22.93	18.75
Naphthalene	2.07	1.64	1.29	1.00	0.77	0.59	0.45	0.35	0.27	0.22
Speciated Emissions Total	2175.41	1723.54	1355.54	1052.38	810.21	615.88	472.15	364.76	287.73	235.27
Fraction of Total VOC	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%

Table 55. Stage II HAPs Reductions with Zero IEE Onroad Plus Nonroad, Displacement Plus Spillage Impacts, Scenario 3 (kilograms per day, entire 12 county Stage II area)

County	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
MTBE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ethanol	620.61	552.14	497.51	451.75	414.53	385.66	366.00	347.69	333.98	323.60
Benzene	15.48	13.77	12.41	11.27	10.34	9.62	9.13	8.67	8.33	8.07
Xylene	298.71	265.75	239.45	217.43	199.52	185.62	176.16	167.35	160.75	155.75
Toluene	666.71	593.14	534.46	485.30	445.32	414.30	393.18	373.51	358.78	347.63
Ethyl Benzene	80.04	71.21	64.16	58.26	53.46	49.74	47.20	44.84	43.07	41.73
Hexane	117.94	104.93	94.54	85.85	78.78	73.29	69.55	66.07	63.47	61.50
2,2,4-Trimethylpentane	155.98	138.77	125.04	113.54	104.19	96.93	91.99	87.39	83.94	81.33
Naphthalene	1.86	1.65	1.49	1.35	1.24	1.16	1.10	1.04	1.00	0.97
Speciated Emissions Total	1957.32	1741.35	1569.06	1424.74	1307.38	1216.31	1154.30	1096.56	1053.31	1020.58
Fraction of Total VOC	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%

Table 56. Stage II HAPs Reductions with Non-Zero IEE Onroad Plus Nonroad, Displacement Plus Spillage Impacts, Scenario 3 (kilograms per day, entire 12 county Stage II area)

County	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
MTBE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ethanol	312.23	223.80	151.43	92.33	45.56	7.63	-21.12	-40.75	-54.41	-63.08
Benzene	7.79	5.58	3.78	2.30	1.14	0.19	-0.53	-1.02	-1.36	-1.57
Xylene	150.28	107.72	72.88	44.44	21.93	3.67	-10.17	-19.61	-26.19	-30.36
Toluene	335.42	240.42	162.68	99.18	48.94	8.20	-22.69	-43.77	-58.45	-67.76
Ethyl Benzene	40.27	28.86	19.53	11.91	5.88	0.98	-2.72	-5.25	-7.02	-8.13
Hexane	59.33	42.53	28.78	17.55	8.66	1.45	-4.01	-7.74	-10.34	-11.99
2,2,4-Trimethylpentane	78.47	56.25	38.06	23.20	11.45	1.92	-5.31	-10.24	-13.68	-15.85
Naphthalene	0.94	0.67	0.45	0.28	0.14	0.02	-0.06	-0.12	-0.16	-0.19
Speciated Emissions Total	984.72	705.83	477.58	291.19	143.69	24.06	-66.62	-128.51	-171.61	-198.93
Fraction of Total VOC	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%	42.1%

Appendix D

Cost Analysis

Appendix D - Stage II Vapor Recovery Cost Analysis

Cost data on vapor recovery technologies was developed and discussed in detail during the stakeholder process and influenced development of amendments to the proposed regulation.To accurately determine cost impacts and savings from the implementation of technologies, EPA and manufacturer data was reviewed and additional data was gathered from contractors and GDF owners. Operation and maintenance cost of Stage II technology is based on EPA "Guidance on Removing Stage II Gasoline Vapor Control Programs from State Implementation Plans and Assessing Comparable Measures"[i] Stage II technology equipment cost is based on manufacturer data. For new GDFs and decommissioning operations, cost data is based on input from contractors. ORVR technology cost data is from EPA. Since ORVR started in 1998 and will reach 92% utilization level for the fleet in Maryland in 2016, the costs and savings are projected to current values.Cost and impacts and savings from implementation of vapor recovery technologies are provided below.

New GDFs of medium model size category would save $14,000-16,000 (off the capital investment) from not having to install Stage II systems. Underground vapor recovery pipes, pumps, Stage II nozzles, coaxial gasoline delivery and vapor recovery hoses, inspections and testing would not be required for facilities that choose not to install or maintain Stage II systems. A vapor recovery nozzle costs approximately $200 more than a standard non-Stage II nozzle.

Existing GDFs that choose to decommission Stage II systems must perform the decommissioning of the Stage II vapor recovery system in accordance with the "Recommended Practices for Installation and Testing of Vapor Recovery Systems at Vehicle Refueling Sites" of the Petroleum Equipment Institute, Section 14, 2009 and COMAR 26.10.10. There will be a cost to implement the removal of Stage II per the guidelines and the industry estimates that cost to be $10,000 - $15,000. The EPA estimates that for an average size existing GDF the annual cost to maintain existing Stage II systems is about $3,000 per year, with decommissioning this cost is removed.Maintenance, testing, inspection and recordkeeping costs are also reduced. There will be no expected impact on the Department, other State agencies, or local governments as a result of this action.Economic impact on small business with respect to savings would constitute approximately 1-2% of total capital costs for new GDFs. For existing GDFs, the cost savings constitute approximately 0.2% of yearly revenue.

EPA estimates a savings of $3,000 per year in maintenance cost for a typical gasoline dispensing facility. The Department estimates $10,000 - $15,000 in expenditure for existing facility to decommission Stage II system.

Table 1. Cost Comparison of Conventional and Vapor Recovery Components

Component	Conventional-Without Vapor Recovery Stage II	With Vapor Recovery Stage II ORVR Compatible[ii]
Whip Hose	$42	$47
Curb Hose	$82	$165
Nozzle	$175	$370
Reattachable Breakaway	$61	$100
Total Cost of Equipment	$360	$682

Savings Benefit from ORVR Technology

Onboard refueling vapor recovery (ORVR) is a vehicle emission control system required under CAA §202(a)(6) starting with certain 1998 model year gasoline-powered light duty motor vehicles, and covering most vehicles by model year 2006. This system transfers the vapors to a canister in the vehicle filled with activated carbon. The energy content of the captured vapors in the ORVR canister is utilized when the vehicle engine is started.When ORVR and vacuum assist Stage II systems are operated together, incompatibility due to presence of air instead of vapors from vapor assist systems can result in a 1 to 10 percent decrease in control efficiency over what would be achieved by Stage II or ORVR alone.Over time, non-ORVR vehicles will continue to be replaced with ORVR vehicles. Stage II and ORVR emission control systems are redundant, and EPA has determined that ORVR emission reductions are essentially equal to and will soon surpass the emission reductions achieved by Stage II alone.

Implementation of ORVR technology is projected to cover approximately 92% of vehicles in 2016 and 96% of refueling operations in Maryland by 2020. ORVR technology costs are low compared to Stage II vapor recovery systems. ORVR is simple, efficient, cost effective and reliable by virtue of its design. Based on EPA data, ORVR technology adds approximately $15-20 to the cost of a new vehicle and provides an annual gasoline savings of $ 7-10 for owners. The cost of ORVR technology is recovered in the first two years of utilization.ORVR systems provide a 95-98% effectiveness of vapor recovery and are projected to last during the life cycle of the vehicle as there are no moving parts or user interference. This translates into an annual savings of approximately $57 million from all vehicles in Maryland in 2020.

Savings Benefit from Stage II Decommissioning

In the metropolitan areas of Maryland where Stage II systems are required the efficiency of control is approximately 70% covering all the gasoline that is dispensed. Stage II system reliability depends on several components that require regular inspections and testing. EPA has estimated that on an annual basis, the cost per station is $3,000 per year. On an annual basis the

total savings from decommissioning for all affected stations would be approximately $5.7 million.

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[i]EPA-457/B-12-001 August 7, 2012
Guidance on Removing Stage II Gasoline Vapor Control Programs from State Implementation Plans and Assessing Comparable Measures
Prepared By:
H. Lynn Dail, Environmental Scientist State and Local Programs Group Air Quality Policy Division
Glenn W. Passavant, Senior Mechanical Environmental Engineer Assessment and Standards Division Office of Transportation and Air Quality
U. S. Environmental Protection Agency Office of Air Quality Planning and Standards Research Triangle
Section 4.2 has the following:

4.2 Cost Considerations

To support their decision making, states may wish to conduct an economic analysis of their Stage II control program to evaluate the ongoing annualized cost per ton of VOC removed. The EPA conducted this type of assessment to support the final widespread use determination rule.The EPA estimates that for an average size GDF the annual cost to maintain existing Stage II systems is about $3,000per year. These total costs would be incurred by GDF operators each year to cover ever decreasing annual emission reduction benefits.

[ii] Data provided by several manufacturers and averaged

Appendix E

Stakeholder Process

Department of the Environment

Stage II Vapor Recovery

What have we learned?

Stakeholder Meeting
December 17, 2012

Topics

- What is Stage II Vapor Recovery and how are new "on-board" vapor recovery systems affecting the emission reductions from this program?
- Discussion on EPA's policies and guidance
  - EPA's 8-7-12 analysis provides options for States to determine benefits of Stage II and guidance on repealing the program and making up emission offsets.
- MD Analysis results.
- Other State actions.
- What is MDE thinking?
- What are the key issues that need to be resolved?
- What is the proposed stakeholder outreach process and schedule?

What is Stage II Vapor Recovery?

- Equipment that captures gasoline vapors at the pump
- MD has been doing Stage II Vapor Recovery since 1993
- During refueling, Stage II recycles gasoline vapors from the gas tank back into the underground storage tank
- In the late 90s, the Stage II program reduced Volatile Organic Chemical (VOC) emissions by about 8 tons per day
  - This was a relatively large reduction

What is ORVR?

- A gasoline vapor recovery system inside the car
- Started with certain 1998 model year vehicles, and is now included in almost all vehicles as of model year 2006
- ORVR recycles vapors within the vehicle
- Captured vapors are used as fuel when the engine is started

Are Stage II and ORVR Compatible?

- No
  - In Maryland, most Stage II systems are incompatible with ORVR
- When ORVR and the Stage II systems we have in Maryland operate together, a reduction in benefits occurs
- Benefit reduction can be up to a 10 percent decrease (loss of benefit) from what either system would achieve alone

EPA's Stage II Proposal

- On July 8, 2011, EPA released a policy called "Widespread Use for Onboard Refueling Vapor Recovery (ORVR) and Stage II Waiver"
- The Clean Air Act (CAA) allows EPA to waive Stage II Vapor Recovery Programs when these new on-board or "ORVR" systems are in widespread use in the vehicle fleet.
- This EPA action proposes June 30, 2013, as the date that ORVR will be in "widespread use" nationwide

What Has EPA Said?

- EPA Administrator Blog, May 2011
  - "In the past, EPA has required gas stations to incorporate vapor controls on their pumps, but today's generation of vehicles already contain the technology for vapor recovery on the vehicle itself. The requirement for gas pumps has become redundant."
- EPA "Widespread Use" fact sheet
  - "This action also proposes that certain requirements for Stage II gasoline vapor recovery at service stations are waived as of June 30, 2013. This proposed waiver will allow many areas now requiring Stage II equipment at service stations to remove, or decommission, their Stage II systems.
  - EPA regards Stage II vapor recovery system decommissioning to involve equipment replacement and elimination of certain expenses associated with operating Stage II systems. EPA has estimated the national cost savings for facilities decommissioning Stage II vapor recovery systems based on this proposed rule to be over $88 million annually".

EPA's Guidance on Stage II

- EPA's final version of their guidance document was released on August 7, 2012
  - The document entitled "Guidance on Removing Stage II Gasoline Vapor Control Programs from State Implementation Plans and Assessing Comparable Measures" can be viewed on EPA's website at the following link: http://www.epa.gov/airquality/ozonepollution/pdfs/20120807guidance.pdf
- EPA's guidance was never meant to force states to shut down the program immediately.
- State's are required to perform analysis to determine benefit of program and identify further reductions if needed if repealing program.
- The guidance support State policy to maintain the program until the benefits of Stage II are no longer necessary to support attainment plans, or until State's can substitute measures not already claimed in an existing SIP to offset Stage II, or until the reductions from Stage II decline such that the program is no longer needed to support attainment goals.
- The guidance requires states to submit a SIP revision demonstrating the plan is no longer necessary prior to removal of the program.
  - States that shut down Stage II without going through the appropriate analysis and without formally amending their SIP face third party litigation (and at least the threat of an EPA finding of failure to implement).

Maryland Analysis

- Summary of results – add Mesler slides

Other State Actions

- EPA has not yet received a SIP submittal from any other states in Region 3 to formally remove Stage II from their SIPs.
- Region 3 states are still analyzing their program benefits and potential substitute measures, and in some cases are also meeting with stakeholders.
- EPA is not rushing states for decisions on their programs.

Has EPA Approved …

… the Repeal of Stage II in Other States?

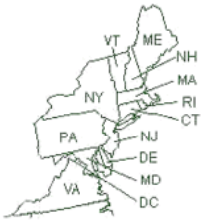
- The following states have adopted regulations or policies to begin the transition away from Stage II
  - Maine
  - New Hampshire
  - New York
  - Vermont
  - Connecticut
  - Pennsylvania
  - Virginia
- EPA has not yet approved any of these regulations or policies

Enforcement Discretion

- Some states have regarded enforcement discretion policies concerning the requirement for Stage II Vapor Recovery at new stations.
- EPA has noted that States that shut down Stage II without going through the appropriate analysis and without formally amending their SIP face third party litigation (and at least the threat of an EPA finding of failure to implement).
- EPA does not have an enforcement discretion policy in effect, so the states that are not enforcing their programs are not shielding the subject facilities from federal enforcement.

Is It Harder to Phase Out Stage II in MD?

- Maryland is part of the 13 state "Ozone Transport Region" (OTR) established in the CAA
- States in the OTR must implement either Stage II or measures that achieve comparable emissions reductions
  - Maryland will have to find new measures to address any loss of emission reductions resulting from the repeal of Stage II
  - States outside of the OTR may not have this issue



So, What is MDE Considering?

- MDE will continue to analyze data and work with the Ozone Transport Commission to develop solutions and determine widespread use.
- Options – Maintaining the program until:
  - the benefits of Stage II are no longer necessary to support attainment plans
  - another measure not already claimed in an existing SIP can be identified to substitute and offset Stage II
  - the reductions from Stage II decline such that the program is no longer needed to support attainment goals

Local Emissions and Toxics

- Pumping gas into non-ORVR equipped vehicles or containers release toxic and harmful pollutants.
  - Benzene and hexane
    - Asthma triggers and cancer risk
- Gasoline related pollutants may contaminate the air up to 300 feet from the station.
  - Airborne organic compounds found to be much higher near gas stations than other urban areas where traffic is the primary source of emissions.

ORVR Does Not Capture All Emissions

- There are other vehicles and equipment that refuel at service stations
  - Large trucks, motorcycles, gas cans, lawn and garden equipment, etc.
  - Stage II would still provide VOC emission reduction benefits during refueling of these vehicles and equipment

- MDE is still evaluating when the net disbenefit begins
  - This happens when the emission reduction disbenefit for cars is larger than the benefit for other vehicles & equipment

What is the Economic Benefit?

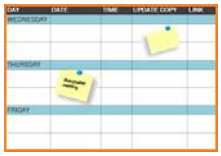
- Considerable savings to service station owners and operators
  - Stage II cost for a medium sized new facility is approximately $14,000-$16,000
  - A vapor recovery nozzle costs approximately $200 more than regular nozzles
  - EPA estimates savings of $3,277 in reduced maintenance, testing, inspection and recordkeeping costs

How Will Stakeholders Be Involved?

- MDE will continue to analyze data and hold stakeholder meetings
  - Open to all interested parties
- Key Issues:
  - When does Stage II/ORVR incompatibility result in negative emission benefits?
  - What will EPA accept for states in the OTR?
  - How will EPA deal with backsliding?
    - If net reductions go negative is there backsliding?
    - If EPA requires new reductions to make up for backsliding, who should MDE regulate?

Stage II Action Schedule

- Stakeholder meetings
  - April 27, 2012
  - June 14, 2012
  - December 17, 2012
  - TBD



- Data Analysis
  - MDE contracted analysis conducted in August 2012
  - Continued review

Questions?

Department of the Environment

Amendments to COMAR 26.11.24

Stage II Vapor Recovery at Gasoline Dispensing Facilities

Tad Aburn, Air Director, MDE

AQCAC Meeting - March 2, 2015

Topics Covered

- Action from last AQCAC meeting
- Brief summary of proposed amendments
- Changes to the regulation resulting from stakeholder input
- Requested action

December 2014 AQCAC Meeting

- MDE briefed AQCAC on proposed amendments
- A few stakeholders spoke at the meeting and asked for a delay in taking action so that they could work with MDE on several issues
- MDE agreed that additional discussions might be useful
- AQCAC charged MDE to continue discussions with stakeholders and work to resolve several issues
- This process took place in late 2014 and early 2015

The Bottom Line

- This regulation fazes out the Stage II Vapor Recovery program as new "On Board" vapor collection technology is about to make the old "Stage II" technology obsolete

Savings to Affected Businesses

- Significant savings from Stage II decommissioning
  - Over 10 year period, large businesses could save up to $9.5 million in avoided operation and maintenance costs
  - At least $1 million in savings for all of the larger networks

# of Stations	# of Dispensers	Annual Throughput	Cost Savings Estimate
156	659	221,016,435	$9,609,600
149	587	176,644,277	$9,178,400
134	615	189,909,287	$8,254,400
121	576	202,908,417	$7,453,600
79	316	90,086,069	$4,866,400
68	375	131,582,541	$4,188,800
62	294	82,361,000	$3,819,200
48	195	72,397,947	$2,956,800
32	241	112,190,000	$1,971,200
22	102	44,053,733	$1,355,200
14	67	30,691,526	$862,400
13	94	36,501,000	$800,800
12	62	28,283,000	$739,200
11	60	37,234,615	$677,600
8	46	73,000,000	$492,800
8	46	41,931,387	$492,800
7	40	9,900,000	$431,200

Background – Transition from Stage II

- Technology for collecting vapors on modern cars has made Stage II systems redundant – *for the most part*
- On July 8, 2011, EPA released a policy called "Widespread Use for Onboard Refueling Vapor Recovery (ORVR) and Stage II Waiver"
- The Clean Air Act (CAA) allows EPA to waive Stage II Vapor Recovery Programs when these new on-board or "ORVR" systems are in widespread use in the vehicle fleet

Technical Analysis – Bottom Line

- In Maryland "Widespread Use" occurs around 2017
- A shortfall (loss of VOC emission reductions) will be created by eliminating Stage II
  - Shortfalls – decrease over time as more ORVR equipped vehicles enter fleet
    - 2014 – 1.74 tons per day (tpd)
    - 2017 – 0.62 tpd
    - 2020 – 0.17 tpd

VOC Shortfall from Eliminating Stage II Requirements (tpd)			
	2014	**2017**	**2020**
All refueling (ORVR & non-ORVR)	1.74	0.62	0.17

Basic Regulatory Approach

- New Gasoline Stations
  - Gasoline Dispensing Facilities (GDFs) constructed after the adoption of the regulation may operate without installing Stage II equipment
- Existing GDFs
  - May decommission Stage II systems after January 1, 2017
- GDFs undergoing Major Modifications
  - May decommission Stage II systems at the modified station after the effective date of the regulation

AQCAC – Stakeholder Process

- MDE has been meeting with stakeholders since early 2012
  - Several briefings to AQCAC
  - Proposed regulation to AQCAC on December 8, 2014
  - Additional stakeholder call held on January 28, 2015 at AQCAC request

Issue 1 – Emerging Technologies

- New "Non-Stage II" emission reduction technologies are soon to be available
- The December draft of the regulation would have required these new technologies after 2020 … if
  - They were certified in California …. and
  - Maryland was designated as Moderate or above nonattainment for the next ozone standard
- Technologies included:
  - Dripless nozzles and low permeation hoses
- Stakeholders urged MDE to not include this requirement in the regulation at this time …
  - But to add it at a later date if the additional reductions are needed
- MDE has agreed to this major change

Issue 2 – Decommission ASAP

- Stakeholders have pushed MDE to allow for decommissioning as early as possible
- Although earlier drafts of the regulation had later dates for decommissioning (2019 when almost all ozone and air toxics benefits are gone) … MDE has agreed to use 2017 as the earliest possible date for full-program decommissioning
- MDE has worked with EPA and followed the EPA guidance and determined that 2017 is the earliest possible date for program-wide decommissioning
  - This is consistent with … or earlier than … other states in the region
  - Several situations where earlier decommissioning can take place

Issue 3 -Voluntary Electric Vehicle Charging Station Option

- The regulation continues to include this voluntary option
  - Some private sector stakeholders have continued to strongly oppose this provision, even with it being **totally voluntary** …
    - … not clear exactly why – expect comments today
  - Other private sector stakeholders support this voluntary option and have already begun to move down this path
  - Environmental advocacy groups support this option
- Basics on how it works … again, totally voluntary:
  - Electric Vehicle (EV) Charging Plan submitted to & approved by MDE
  - EV Charging stations installed by January 1, 2020
  - Number of EV Charging stations linked to the number of stations an owner has in the State
  - Allows for early decommissioning

Adoption Schedule

- Proposed Adoption Schedule
  - AQCAC approval requested – March 30, 2015
  - Notice of Proposed Action published in MD Register – June 26, 2015
  - Public Hearing - July 28, 2015
  - Effective Date – September 14, 2015

Questions?

Appendix F

MD Enforcement Discretion

MARYLAND DEPARTMENT OF THE ENVIRONMENT
1800 Washington Boulevard • Baltimore MD 21230
410-537-3000 • 1-800-633-6101 • www.mde.maryland.gov

Martin O'Malley
Governor

Anthony G. Brown
Lieutenant Governor

Robert M. Summers, Ph.D.
Secretary

MEMORANDUM

TO: Air & Radiation Management Administration (ARMA) – Air Quality Compliance Program
Land Management Administration (LMA) – Oil Control Program

FROM: Tad Aburn, Director, ARMA
Horacio Tablada, Director, LMA

DATE: March 20, 2014

SUBJECT: Stage II Vapor Recovery Systems – Enforcement Discretion Policy

The purpose of this memorandum is to advise compliance staff in the ARMA Air Quality Compliance Program and the LMA Oil Control Program of the Department's enforcement policy as it relates to enforcement of Stage II Vapor Recovery Systems. The Department has adopted a formal enforcement discretion policy regarding requirements for Stage II Vapor Recovery Systems as they apply to newly constructed gasoline dispensing facilities and facilities undergoing significant modification in accordance with this policy. This policy was effective March 6, 2014.

Background

Existing regulations codified in COMAR 26.11.24 require gasoline dispensing facilities in the State to install, certify, maintain, and test Stage II systems. These regulations are a part of Maryland's State Implementation Plan under the federal Clean Air Act. On May 16, 2012, EPA released the final rule that determined vehicle onboard refueling vapor recovery technology (ORVR) would be in widespread use nationally throughout the motor vehicle fleet in June 2013. This EPA action allows states to discontinue the use of Stage II vapor recovery systems at gasoline dispensing facilities, provided that the State is able to demonstrate that the loss of emission reductions associated with the discontinuation of Stage II will be offset through implementation of other strategies.

Exercise of Enforcement Discretion

Because of the cost associated with the installation of new Stage II systems and the diminishing air quality benefits as the percentage of the Maryland fleet of passenger cars and light duty trucks

equipped with ORVR continues to increase, the Department will exercise enforcement discretion to allow *new or modified gasoline dispensing facilities* to be constructed with appropriate new technologies but without Stage II systems. A *new or modified gasoline dispensing facility* is one that on or after March 6, 2014:

1) begins dispensing fuel for the first time;
2) excavates below a shear valve or tank pad in order to repair or replace its Stage II system or an underground storage tank;
3) installs a new dispenser system manufactured without a Stage II system; or
4) undergoes a major system modification consisting of the replacement, repair or upgrade of at least 50% of a facility's Stage II vapor recovery system.

A new or modified gasoline dispensing facility that discontinues all or part of its existing Stage II system is not eligible for enforcement discretion under this policy unless the owner or operator of the facility notifies the Department in writing on the attached form that it intends to act in accordance with this policy prior to removing or discontinuing all or part of its existing Stage II system. The form must be completed as instructed and sent to the appropriate ARMA and LMA programs as indicated.

All existing facilities that are not eligible for enforcement discretion and are currently equipped with Stage II systems must continue to certify, maintain, test, and comply with all Stage II requirements until such time as the Department repeals or otherwise revises existing regulatory requirements through rulemaking.

If you are asked, it is important for the industry to understand that this MDE policy does not protect them from EPA action or citizen lawsuits.

Please direct any questions concerning this Enforcement Discretion Policy to the ARMA Air Quality Compliance Program at 410-537-3231.

MDE

MARYLAND DEPARTMENT OF THE ENVIRONMENT
1800 Washington Boulevard • Baltimore MD 21230
410-537-3000 • 1-800-633-6101 • www.mde.maryland.gov

Notification of Intent to Decommission or to Not Install Stage II Vapor Recovery System on Certain New or Modified Gasoline Dispensing Facilities (GDF)

- **This Notification must be made to MDE at least 30 days prior to the start of construction of a new GDF or decommissioning of an existing GDF.**
- **Within 30 days of completion, provide results of a pressure decay test, pressure vacuum vent cap test, vapor tie-in test, precision tightness test (if required to be performed), and the site assessment (if performed).**
- **Decommissioning of a Stage II Vapor Recovery System shall be performed in accordance with Section 14 of PEI/RP 300-09 and one of the options (A, B, or C) listed on Page 2.**
- **Complete this notification form and submit to both addresses below:**

Maryland Department of the Environment
Air and Radiation Management Administration
Attn: Stage II
1800 Washington Blvd., Suite 715
Baltimore, MD 21230

Maryland Department of the Environment
Oil Control Program
Attn: Stage II
1800 Washington Blvd., Suite 620
Baltimore, MD 21230

OCP Facility ID Number: _____

Site Name: _____

Address: _____

County: _____

Business Phone: _____

Contact Person: _____

Email: _____

New Construction

Date: _____

Decommissioning

Date: _____

Option selected (A, B, or C from page 2): _____

_____	_____	_____
Name of Company Representative	**Signature**	**Date**
_____	_____	_____
Name of Certified Technician	**Signature**	**Date**

Certification No.: MDIC_____

Options for Decommissioning of Stage II Pipes

In accordance with Code of Maryland Regulation 26.10.06.01D, "An underground storage system shall be installed, upgraded, and repaired only in the continuous on-site presence and under the direction of an individual who is a certified underground storage system technician." Additionally, COMAR 26.10.10.02B.(2) requires that, "All lines shall be emptied and removed unless otherwise approved by the Department" when closing part of a UST system.

The Department reserves the right to deny Option C if an active remediation or historical release was associated with the facility.

All test failures related to the Stage II decommissioning including Pressure Decay testing must be reported to the Oil Control Program at 410-537-3442 or after hours to 1-866-633-4686.

Option A – Removal of Pipes:

- Purge pipes of all liquid and vapors.
- Screen the soils directly below the removed pipe at 10 feet intervals using a PID and record the readings on a site map, or conduct an environmental assessment along the pipe run to determine if there is evidence of a release where contamination would most likely be present.
- Upon completion of the pipe removal and backfill of the excavation including final surface cover, precision tightness test the UST system.
- All work to decommission the underground pipe must be performed by the continuous onsite presence and under the direction of a MDE Certified UST System Technician.
- Submit all documentation (assessment report and testing performed) associated with the decommissioning of the Stage II vapor recovery system to the Oil Control Program within 30 days of completion (this is important for tracking HRGUA facilities).

Option B – In-Place Closure of Pipes:

- Submit a work plan for approval to perform an assessment along the Stage II pipe in accordance with COMAR 26.10.10.03. If the pipe location is unknown the site assessment must encompass the UST field, pump-island(s), and area between tank field and dispensers.
- Purge the pipe of all liquid and vapor.
- Permanently cap each end of the pipe (i.e. under dispenser and disconnect and at the tank connection) in accordance with pipe manufacture requirements. If concrete is broken or excavation is required to remove the Stage II piping from the tank, a precision tightness test must be performed prior to placing the tank back into service.
- Conduct a pressure decay and tie-tank test upon completion of the work.
- All work to decommission the underground pipe must be performed by the continuous onsite presence and under the direction of a MDE Certified UST System Technician.
- Submit all documentation (assessment report and testing performed) associated with the decommissioning of the Stage II vapor recovery system to the Oil Control Program within 30 days of completion (this is important for tracking HRGUA facilities).

Option C – Disconnect Stage II Pipe Below the Dispenser Only:

- Stage II pipe will be considered in-use and **must** be maintained.
- Conduct a pressure decay and tie-tank test upon completion of the work.
- Capping, upgrade, and repair of an UST system must be performed by the continuous onsite presence and under the direction of a MDE Certified UST System Technician.
- Submit all documentation (including testing records) associated with the decommissioning of the Stage II vapor recovery system to the Oil Control Program within 30 days of completion (this is important for tracking HRGUA facilities).

Appendix G

Executive Order

Executive Order 01.01.1990.04

Under Executive Order 01.01.1990.04, Maryland State agencies are required to install Stage II Vapor Recovery on all gasoline storage tanks. Since MDE is amending COMAR so that Stage II Vapor Recovery systems are no longer required for GDFs, the Department requested that the Governor repeal the Executive Order allowing Maryland State agencies to decommission or not install Stage II Vapor Recovery at new stations.

Should the Executive Order be repealed, State agencies that have installed Stage II Vapor Recovery may decommission the systems after October 1, 2016, or may decommission Stage II Vapor Recovery systems when a gasoline dispensing facility undergoes a major modification after the effective date of the regulatory amendments. The decommissioning of the Stage II Vapor Recovery system has to be performed in accordance with the "Recommended Practices for Installation and Testing of Vapor Recovery Systems at Vehicle Refueling Sites" of the Petroleum Equipment Institute, Section 14, 2009 and COMAR 26.10.10. New GDFs being constructed at State facilities will not need to install Stage II Vapor Recovery systems after the effective date of the regulatory amendments.

Stage II

The State of Maryland

Executive Department

EXECUTIVE ORDER
01.01.1990.04

Air Pollution - Emission Controls

WHEREAS, Ozone levels in Maryland have exceeded the federal air quality standard and are not expected to improve; and

WHEREAS, Repeated exposure to ozone increases the likelihood of permanent impairment of the lungs; and

WHEREAS, State government must demonstrate its leadership and commitment to clean air and protecting the public health of our citizens;

WHEREAS, Gasoline vapors from motor vehicle refueling contribute significantly to ozone pollution; and

WHEREAS, Stage II vapor controls are the single most effective step remaining that we can take to reduce hydrocarbon emissions; and

WHEREAS, President Bush has proposed amendments to the federal Clean Air Act calling for Stage II vapor controls; and

NOW, THEREFORE, I, WILLIAM DONALD SCHAEFER, GOVERNOR OF THE STATE OF MARYLAND, BY VIRTUE OF THE AUTHORITY VESTED IN ME BY THE CONSTITUTION AND LAWS OF MARYLAND, HEREBY PROCLAIM THE FOLLOWING ORDER:

A. To the greatest extent possible, all State agencies with gasoline dispensing facilities shall install equipment to control emissions from the refueling of motor vehicles.

B. The Department of Environment, in cooperation with other State agencies, shall develop an implementation schedule for the retrofitting of State-owned gasoline dispensing facilities with Stage II vapor controls.

C. (1) The Department of the Environment shall be responsible for monitoring compliance with this order.

(2) The Department of the Environment shall report to the Governor 30 days after the effective date of this order and every 3 months thereafter on the implementation of this order.

GIVEN Under My Hand and the Great Seal of the State of Maryland, in the City of Annapolis, this 22nd day of March, 1990.

William Donald Schaefer
Governor

ATTEST:

Winfield M. Kelly
Secretary of State

Appendix H

MD NOx Limited

The Effectiveness of NOx Reductions When it Comes to Reducing Ozone Concentrations

December 2014

This white paper presents observational evidence of the response of ambient ozone (O_3) to nitrogen oxides (NOx) emissions. In the eastern US, natural biogenic sources usually dominate hydrocarbon reactivity, making NOx the limiting precursor to ozone. NOx emissions from the two major categories, point sources (mostly EGUs) and mobile sources (motor vehicles), have decreased dramatically over the past two decades. Surface concentrations of NOx have decreased correspondingly. Surface ozone concentrations also have decreased, but more irregularly, due the dependence of ozone formation on meteorology as well as to emissions of precursors. From the causal relationships of ambient O_3, NOx concentrations, and NOx emissions, we can estimate the increase in ambient ozone concentrations due to not running NOx controls (i.e., SRCs) during the summer ozone season.

Based on data obtained from the NASA DISCOVER-AQ field campaign over Maryland, it was observed that there was 4 to 8 ppb O_3 produced per ppb NOx consumed, well within the range of 1-20 for other observations over the continental US (Jacob, 2004). This means that for each 100 tons/d increase in NOx emissions we can expect ~0.5 to 1.0 ppb increase in ozone [*He et al.*, 2013a; *He et al.*, 2013b]

Figure 1 indicates that observed ambient ozone and NOx over the Baltimore/Washington area decreased from 1997-2010 (He et al., 2013). Interannual variability responds to a combination of emissions and weather – the greater the number of days with a maximum temperature over 90°F the greater the number of days with an ozone exceedances – but the long-term trend is driven by decreased NOx (and possibly to some degree VOC) emissions. Using estimates for the three most recent years helps strengthen the statistical significance the long-term decrease in ozone. NOx concentrations plummeted after 2003, but have shown little decrease since 2010. In conclusion, the observations verify the predictions from chemical transport models – if NOx emissions revert to levels seen in previous years, ozone concentrations are likely to rise. Other factors held constant, every increase of 100 tons NOx per day will potentially lead to approximately a 1 ppb ozone increase.

Additional UMD research indicates that from the 1970's thru the early 2000's Maryland's air quality responded to both VOC and NOx reductions. This has now changed and it can be seen that since the mid-2000's that Maryland has transitioned into a NOx limited regime, NOx reductions now provide a greater benefit in reducing ozone levels in Maryland (Hosley, et al., 18 January 2013).

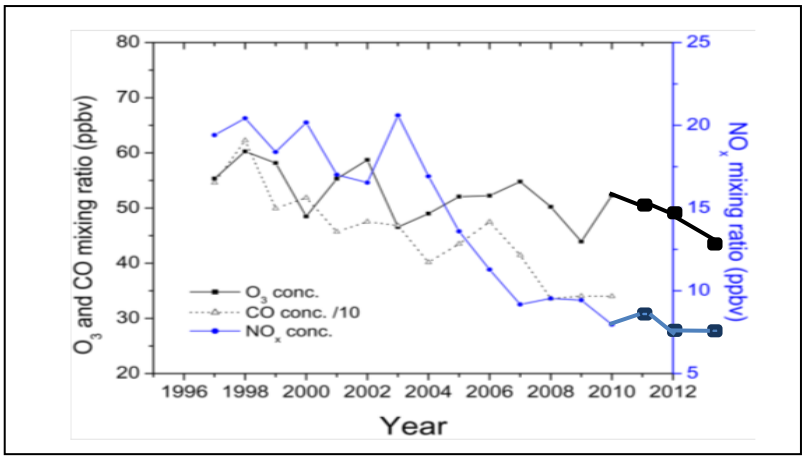


Figure 1, Trends in trace gas concentrations. Taken from He et al., (2013b), these observations show the temporal trends and relationship of O_3, NOx, and CO. Measurements from 1200-1800 LT in the ozone season are shown. Data for 2011-2013 are estimates added for this report, after the original publication in *ACP*. The inter-annual variability, especially for ozone, is subject to changes in the number of hot days, but ozone and oxides of nitrogen have fallen together over the long run.

Based on the UMD research presented it can clearly be determined that Maryland has reached a point where continued NOx reductions will result in greater ozone reductions than has been seen in the past.

References

Jacob, D.J., "Introduction to Atmospheric Chemistry" Princeton Univ. Press, ed. 2004. http://acmg.seas.harvard.edu/people/faculty/djj/book/

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