United States Environmental Protection Agency

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

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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 Park, NC 27711

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).

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[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} - <u>Fraction of highway gasoline throughput covered by Stage II VRS</u>: 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} – <u>Fraction of highway gasoline throughput dispensed through vacuum-assist type Stage II VRS</u>: 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} - <u>ORVR Vehicle Miles Traveled</u>: 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 - <u>Compatibility Factor</u>: 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.

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

[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} - <u>Fraction of annual gallons of highway motor gasoline dispensed to ORVR-equipped vehicles</u>: 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} - <u>In-use control efficiency for ORVR</u>: 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)

<u>Overall Stage II-ORVR *increment*</u>: 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:

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

Compatibility factor calculation:

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

Increment calculation using Equation 1:

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

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:

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

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:

$\eta_{iuSII} = 0.75$; $Q_{SII} = 0.97$; $Q_{SIIva} = 0.0$; $VMT_{ORVR\mathit{2013}} = 0.76$; $Q_{ORVR\mathit{2013}} = 0.7385$; $\eta_{ORVR} = 0.98$

Compatibility factor calculation:

$$CF_{\mathit{2013}} = (0.07645)(VMT_{ORVR\mathit{2013}}) = (0.07645)(0.76) = 0.0581$$

Increment calculation using Equation 1:

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

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:

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

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 $(Q_{ORVR\mathit{i}})(\eta_{ORVR})$ would increase from 0.7237 to 0.7611. Thus, $Delta_{\mathit{2014}}$ indicates 3.36 percentage points more reduction from ORVR than Stage II. Similarly, for 2015, $Delta_{\mathit{2015}}$ 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:

$\eta_{iuSII} = 0.75$; $Q_{SII} = 0.97$; $Q_{SIIva} = 0.6$; $VMT_{ORVR\mathit{2013}} = 0.7997$; $Q_{ORVR\mathit{2013}} = 0.7766$; $\eta_{ORVR} = 0.98$

Compatibility factor calculation:

$$CF_{\mathit{2013}} = (0.07645)(VMT_{ORVR\mathit{2013}}) = (0.07645)(0.7997) = 0.0611$$

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:

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

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:

$\eta_{iuSII} = 0.75$; $Q_{SII} = 0.97$; $Q_{SIIva} = 0.6$; $VMT_{ORVR\mathit{2014}} = 0.8341$; $Q_{ORVR\mathit{2014}} = 0.8104$; $\eta_{ORVR} = 0.98$

Compatibility factor calculation:

$$CF_{\mathit{2014}} = (0.07645)(VMT_{ORVR\mathit{2014}}) = (0.07645)(0.8341) = 0.0638$$

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:

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

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:

η_{iuSII} = 0.75; Q_{SII} = 0.97; Q_{SIIva} = 0.6; $VMT_{ORVR\textit{2015}}$ = 0.8633; $Q_{ORVR\textit{2015}}$= 0.8397; η_{ORVR} = 0.98

Compatibility factor calculation:

$CF_{\textit{2015}}$ = (0.07645)($VMT_{ORVR\textit{2015}}$) = (0.07645)(0.8633) = 0.066

Increment calculations for 2015 using Equation 1:

$Increment_{2015}$ = (Q_{SII})(1 - $Q_{ORVR2015}$)(η_{iuSII}) - (Q_{SIIva})(CF_{2015})
= (0.75)(0.97)(1 - 0.8397) - (0.6)(0.066)
= [(0.1166) - (0.0288)]
= 0.0878

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

$$\text{Tons}_i = (\mathit{Increment}_i)(\mathit{GC}_i)(\mathit{EF})$$

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:

$Tons_{mid2013} = Increment_{mid2013} * GC_{mid2013} * EF$ * (conversion factors)
= (0.084)(1,243,259,400 gal/season)(3.0 g/gal)[(1 lb/453.59 g)(1 ton/2000 lbs)]
= 341.9 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 gal/season)(2.97 g/gal)[(1 lb/453.59 g)(1 ton/2000 lbs)]
= 630.9 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				

<u>Regional Boundaries</u>
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 Year	Age	Model Year ID	Gasoline Motorcycle	Gasoline Pass Car	Gasoline LDT1	Gasoline LDT2	Gasoline 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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