



MEMORANDUM

TO: TPB Technical Committee
FROM: Jane Posey, TPB Transportation Engineer
SUBJECT: Air Quality 101: An introduction to the transportation conformity process and State Implementation Plans in the metropolitan Washington region
DATE: April 30, 2021

This document provides an introduction to the transportation conformity process and State Implementation Plans (SIPs) in the metropolitan Washington region.

BACKGROUND

Under the federal Clean Air Act (CAA) of 1963, as amended in 1970, 1977, and 1990, areas that have not attained National Ambient Air Quality Standards (NAAQS or “Standards”) for one or more of six criteria air pollutants must develop a State Implementation Plan (SIP), which is a collection of regulations and documents used by a state, territory, or local air district to reduce air pollution in areas that do not meet the NAAQS.¹ The Clean Air Act does not allow federal agencies to approve or provide financial support for activities that do not “conform” to the SIP in these “nonattainment” areas.

Before a new long-range transportation plan (LRTP) or transportation improvement program (TIP) can be approved by the Federal Highway Administration (FHWA) and the Federal Transit Administration (FTA), or a new project can receive federal funding in an air quality nonattainment area, a regional “conformity” emissions analysis must generally demonstrate that the projected emissions from the entire transportation system, including any new projects, are consistent with the emissions ceilings (Motor Vehicle Emissions Budgets “MVEBs” or “mobile emissions budgets”) established in the SIP.

The TPB’s current LRTP is a 25-year plan called Visualize 2045. It was adopted in 2018 and amended in 2020. This plan has both a financially constrained element and an aspirational element. The constrained element includes only those transportation projects that have identified funding sources. Per federal regulations, an air quality conformity analysis was conducted on the constrained element of Visualize 2045 and approved by the FHWA and the FTA.

THE CLEAN AIR ACT & NATIONAL AMBIENT AIR QUALITY STANDARDS

The Clean Air Act provides requirements for setting and meeting NAAQS (pronounced “nacks”) for six harmful “criteria” air pollutants: carbon monoxide (CO), lead, nitrogen oxide (NOx), ozone (O₃), particulate matter (PM, also known as particle pollution), and sulfur dioxide (SO₂). The U.S. Environmental Protection Agency (EPA) sets the NAAQS and is required to review them for each

¹ “Basic Information about Air Quality SIPs,” U.S. Environmental Protection Agency, May 11, 2015, <https://www.epa.gov/sips/basic-information-air-quality-sips>.

pollutant every five years to assure that the current Standard protects public health and the environment. Each time a Standard is updated, EPA publishes the new pollution level and outlines the requirements for meeting the revised Standard.

Every state must establish a network of air monitoring stations to monitor and report on pollutant levels. The EPA uses these observed data to designate areas as meeting or not meeting each of the Standards. The EPA nomenclature is “attainment” area or “nonattainment” area. The EPA defines the boundaries of each nonattainment area and expresses the level of severity using the following designations (ordered from worst to best): extreme, severe, serious, moderate, or marginal. Each designation includes specific requirements and an allotted timeframe to attain the Standard, with higher pollution areas receiving a longer time period. If an area does not meet a Standard in the allotted time, the area may be given a time extension, or it may be “bumped-up” to the next level of severity. The EPA has designated the metropolitan Washington region as a marginal nonattainment area for ozone pollution. Based on the current readings from air quality monitors, the region is in attainment of the standards for the remaining five criteria pollutants, having at one time been in nonattainment of the standards for both particulate matter (PM_{2.5}),² also called particle pollution, and wintertime carbon monoxide (CO).

OZONE

Ozone occurs both naturally in the stratosphere (good ozone) to provide a protective layer high above the earth, and at ground-level in the troposphere (bad ozone) as the prime ingredient of smog. Tropospheric ozone is not emitted directly into the air, but is created when its two primary components, volatile organic compounds (VOC) and oxides of nitrogen (NO_x), combine in the presence of sunlight. VOC and NO_x are often referred to as ozone precursors. The NAAQS regulate ground-level ozone.

Since 1979, four progressively tougher ozone standards have been promulgated³ and the region has attained three of these standards. On October 1, 2015, the EPA established the current (fourth) Standard for Ozone, the 2015 Ozone NAAQS, at a level of 70 parts per billion (ppb). Effective August 3, 2018, the EPA designated the Washington, D.C. region as a “marginal” nonattainment area for that Standard. The region faces an August 3, 2021 date to demonstrate attainment of the 2015 Standard.

HOW DO TPB & MWAQC WORK TOGETHER?

In the metropolitan Washington region, the National Capital Region Transportation Planning Board (TPB) and the Metropolitan Washington Air Quality Committee (MWAQC) work together to improve air quality. MWAQC is the entity certified by the mayor of the District of Columbia and the governors of Maryland and Virginia to prepare SIPs for the DC-MD-VA Metropolitan Statistical Area. MWAQC is composed of elected officials from the state and local jurisdictions and of members from the State Air Agencies and State Departments of Transportation. The TPB Chair (or their appointee) is also a member of MWAQC. The TPB provides the information related to the on-road sector (mobile emissions) for the multi-sectoral SIP documents. MWAQC develops the SIPs which include the mobile emissions budgets that the TPB is required to use in air quality conformity analyses of its LRTPs and TIPs. MWAQC also provides some of the input data, such as state fuel and emissions/inspections program specifications for the mobile emissions model used in the air quality conformity analyses. The TPB and MWAQC consult and comment on each other’s processes.

² PM_{2.5} stands for particulate matter with diameters of 2.5 micrometers or smaller. The symbol for the micrometer is “µm” and the micrometer is also commonly known as a “micron.” A micrometer is 10⁻⁶ meters. For comparison, a human hair has a diameter of about 50-70 µm.

³ 1979 1 hour Ozone NAAQS of 120 ppb; 1997 8 hour Ozone NAAQS of 80 ppb; the 2008 8 hour Ozone NAAQS of 75 ppb; and the 2015 Ozone NAAQS of 70 ppb.

WHAT IS A SIP?

A State Implementation Plan (SIP) describes how the state implements and/or enforces actions needed to attain and maintain the NAAQS. A SIP must be submitted to the EPA by any state that has areas designated as being in nonattainment of federal air quality standards. SIPs include emissions from four different sectors: “point sources,” such as power plants; “area sources,” such as lawn mowers and small generators; “non-road sources,” also called “off-road sources,” such as construction equipment, boats, and aircraft; and “mobile sources,” such as cars, trucks, and buses.⁴ Once approved, the SIP is enforceable by the state and the EPA.

Two types of SIPs are of interest to the TPB; Attainment SIPs and Maintenance SIPs. An Attainment SIP describes the measures that a nonattainment area will take to achieve NAAQS. After attaining a Standard, each area must develop a Maintenance SIP to show how the area will maintain that Standard. The Maintenance SIP describes the actions the area will be taking for the next ten years to ensure the area will continue to meet the NAAQS. Attainment and Maintenance SIPs must include enforceable limits on the total amount of air pollution from vehicles and other transportation sources. These limits are called Motor Vehicle Emissions Budgets (“MVEBs” or “Budgets”). Transportation Plans and TIPs must adhere to the MVEBs approved in the SIP. They are a ceiling of total emissions that cannot be exceeded.

MOTOR VEHICLE EMISSIONS BUDGETS (MVEBS)

MWAQC, in consultation with the TPB, develops the MVEBs for our region and submits them to the EPA as part of a SIP. Approved MVEBs set in the SIP for each air pollutant must be used for all air quality conformity analyses until new budgets are set in updated SIPs. Mobile budgets are set based on levels of VOC and NO_x estimated using the tools, planning assumptions, and technical inputs (e.g., travel demand model, MOVES mobile emissions model, LRTP projects, vehicle fleet mix, and land use) in the region’s modeling analysis current at the time when a SIP is developed. Once set, these mobile emissions budgets will be used, perhaps for many years, for determining the conformity of the TPB’s LRTPs and TIPs.

Conformity regulations require the use of the “latest planning assumptions” for each conformity analysis. The latest planning assumptions frequently get updated and therefore will likely result in different tools/inputs than were used for the development of the mobile emissions budgets. This, unfortunately, can cause an inconsistent, or “apples-to-oranges,” comparison of the emissions estimates from the conformity analysis and the MVEBs.

In recognition of the fact that planning assumptions change over time, EPA allows the use of safety margins when setting mobile budgets in the SIP. Many regions around the country use these safety margins. In the metropolitan Washington region, the current VOC and NO_x mobile emissions budgets consist of two tiers: Tier 1 and Tier 2. Tier-1 budgets are set at the level of the mobile emissions inventories when the current SIP was developed. By contrast, Tier-2 budgets provide a safety margin or “conformity buffer” to account for changes in data, models, or planning assumptions that occur between the time that the budgets are set and the time when the conformity analyses are run.

⁴ “Basic Information about the Emission Standards Reference Guide for On-Road and Nonroad Vehicles and Engines,” U.S. Environmental Protection Agency, January 21, 2014, <https://www.epa.gov/emission-standards-reference-guide/basic-information-about-emission-standards-reference-guide-road>.

WHAT IS CONFORMITY?

Transportation conformity is required by the Clean Air Act (CAA) to ensure that federal funding and approval are given to highway and transit projects that are consistent with ("conform to") the air quality goals established in SIPs. It is required in areas that do not meet (nonattainment), or previously have not met (maintenance), air quality standards for any of the criteria pollutants. To receive transportation funding and approvals from the Federal Highway Administration (FHWA) and the Federal Transit Administration (FTA), the conformity analysis is required to demonstrate that a Metropolitan Planning Organization's (MPO) LRTP and TIP conform to the SIP.

The transportation conformity determination includes an assessment of future mobile source emissions for defined analysis years, including the end year of the LRTP. Emissions are estimated using the latest available planning assumptions and available analytical tools, including the region's travel demand model and EPA's mobile sources emissions model, currently called the Motor Vehicle Emission Simulator (MOVES). The conformity determination provides a tabulation of the analysis results for applicable precursor pollutants (VOC and NO_x for the Washington region) showing that the regional mobile source emissions levels are below the MVEBs for each analysis year.

WHY DO EMISSIONS ESTIMATES CHANGE BETWEEN EPA EMISSIONS MODELS?

Mobile emissions estimates for a given future year may change significantly over time. Some of these emissions changes are related to the updated inputs included for each conformity analysis, but the most significant variation is often due to changes in the emissions models. Each update to EPA's mobile emissions model reflects changes related to improved data and more sophisticated modeling techniques. Each update also captures any federal programs affecting mobile emissions that were promulgated since the previous version.

When the EPA updated the MOVES model from MOVES2010 to MOVES2014, for example, it incorporated the impacts of Tier 3 fuel and vehicle standards and the 2012 Corporate Average Fuel Economy (CAFE) standards into the model. Sensitivity tests done at the time of transition from MOVES2010 to MOVES2014 showed that the MOVES2014 model resulted in lower emissions estimates. This was because MOVES2014 contains the effects of the federal programs regulating fuel and vehicle standards that were passed into law between the release of the MOVES2010 and the MOVES2014 models. In 2015, TPB staff conducted some sensitivity tests, for the years 2015 and 2040, where the travel model and its inputs (land use and transportation) were held constant, but the mobile emissions model was varied (MOVES2010 and MOVES2014). As shown in Figure 1 and Figure 2, changing only the mobile emissions model can have a dramatic effect on estimated emissions. And for these tests, there were no changes made to the transportation networks used as inputs to the travel model

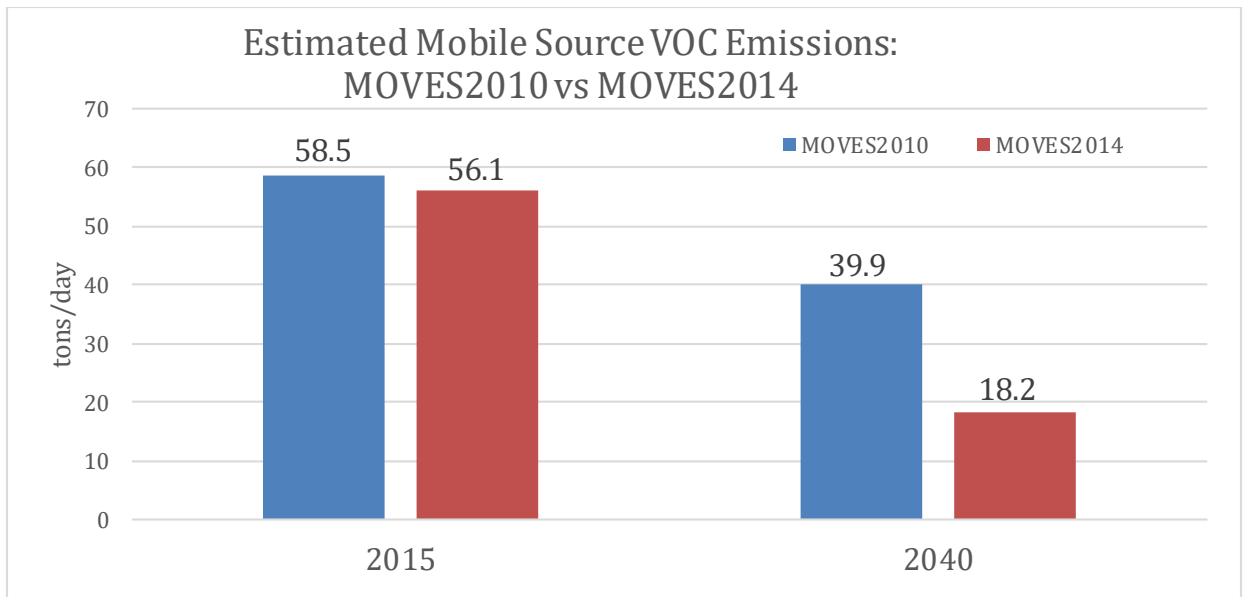


Figure 1 Sensitivity test comparing estimated VOC emissions from both MOVES2010 and MOVES2014

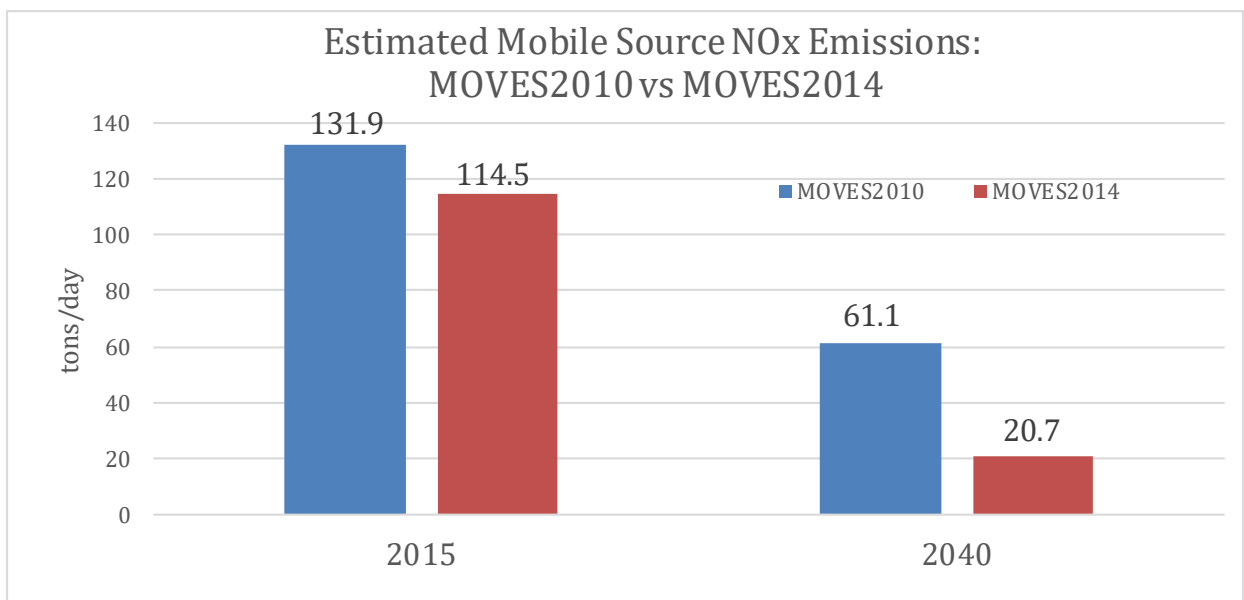


Figure 2 Sensitivity test comparing estimated NO_x emissions from both MOVES2010 and MOVES2014

SOURCE: TPB MOVES2010 vs MOVES2014 sensitivity tests conducted in 2015

In addition to noting the effect of the emissions model, note also that, irrespective of the emissions model, the estimated emissions coming out of the EPA emissions models are predicted to decrease through time.

WHY DO MOBILE SOURCE EMISSIONS DECREASE THROUGH TIME?

The past and predicted decrease in mobile source emissions through time is mostly due to federal requirements for fuel and vehicle standards. These federal standards affect the vehicle fleet characteristics and the implementation of these federal standards is reflected in the various EPA mobile emissions models. Thus, the region's transportation projects, investments, and policies are not the major factor driving the predicted decrease in mobile emissions. While transportation projects, investments, and policies do help decrease mobile emissions, the reality is that most of the decrease in the past couple of decades, and forecast in the future, is mostly related to federal programs. Observed data (as opposed to modeled data) shows that mobile emissions in the Washington region have been decreasing over time, as shown in the graphic below, which shows observed ozone levels from 1999 to 2020.

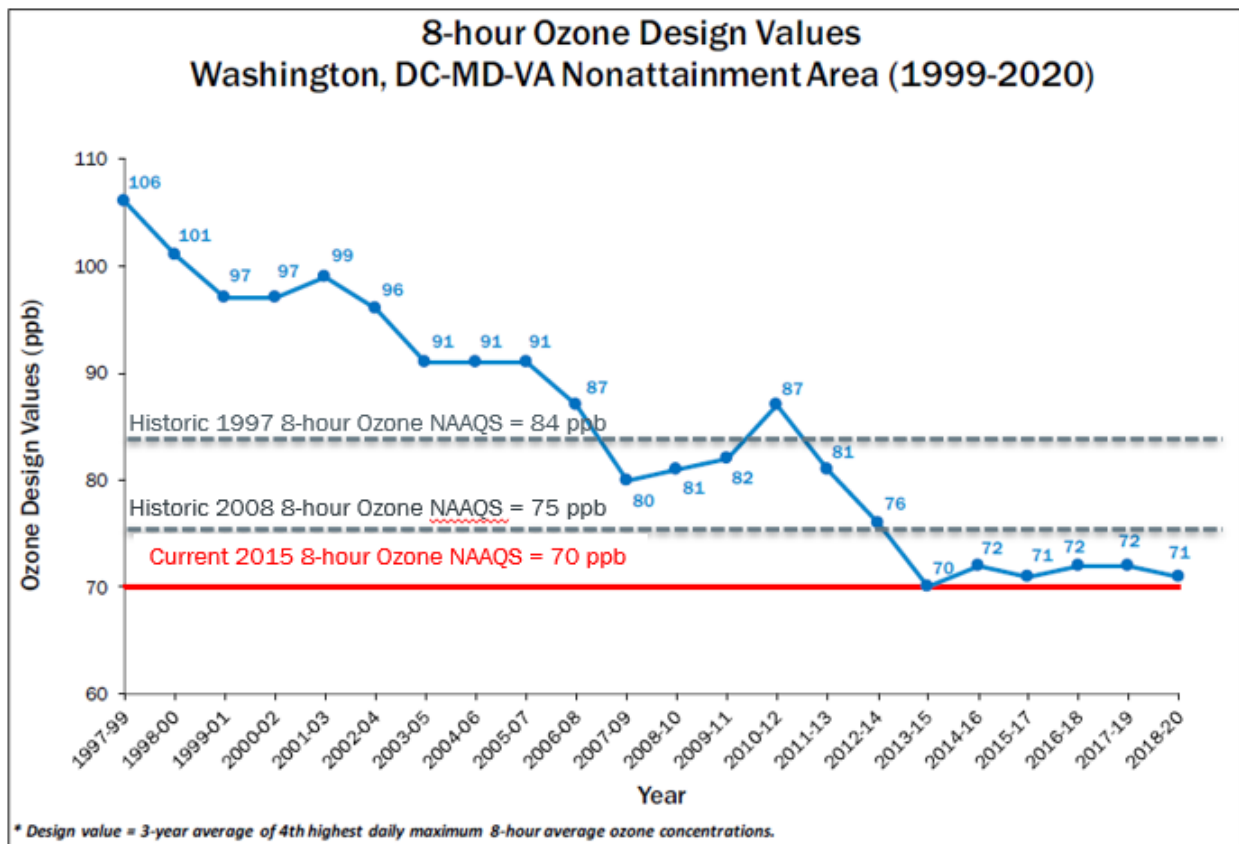


Figure 3 Observed ground-level ozone in the Washington Region: 1999-2020

MOVES3?

The EPA published the release of its newest mobile emissions estimation model, MOVES3, in the January 7, 2021 Federal Register. There is a two-year grace period, until January 9, 2023, before the model is required to be used for air quality conformity analyses. This grace period gives areas time to get any necessary training, prepare local inputs, and test the model before using it in an official capacity. It also gives nonattainment areas time to develop SIPs with new mobile emissions budgets so that conformity inventories will be compared to mobile emissions budgets developed using the same tools. TPB staff is currently developing local inputs and testing the MOVES3 model.

WHAT ABOUT GREENHOUSE GASES?

Greenhouse gases (GHGs) are not included as an official part of air quality conformity analyses. However, TPB staff does estimate GHGs when the other pollutants are analyzed and reports the findings for informational purposes. The TPB and the Metropolitan Washington Council of Governments (MWCOC) strive to mitigate climate change, via adopted policies and actions, including the reduction of GHGs, such as carbon dioxide, through numerous activities both within the region and by coordinating with other areas outside of the region to address this growing challenge. Both the TPB and MWCOC began work to address climate change more than a decade ago. In 2008, the COG Board adopted the National Capital Region Climate Change Report, and, with it, regional greenhouse gas reduction goals. Most recently, in November 2020, officials and local government experts unanimously approved the Metropolitan Washington 2030 Climate and Energy Action Plan, outlining collaborative actions the region should take to meet its shared climate goals, including the newly established resiliency goals and 2030 GHG reduction goals. The plan was developed and approved by the MWCOC Climate, Energy, and Environment Policy Committee (CEEPC), which is the MWCOC's principal policy committee on climate change, energy, and other environmental issues. Most recently, and currently underway with consultant assistance are the TPB Resiliency Study and the TPB Climate Change Mitigation Study of 2021 (CCMS). More information can be found at the MWCOC website at mwcog.org.

WHAT IS HAPPENING NEXT?

TPB staff is preparing to conduct the air quality conformity analysis for the 2022 Update of Visualize 2045 using the MVEBs developed in conjunction with the 2008 Ozone Maintenance Plan, which was found adequate by the EPA in 2018. The analysis of the plan will be completed in spring/summer 2022.

At the same time, on a parallel track, TPB staff will be working closely with MWAQC to develop a new SIP. Namely, MWAQC members are currently considering different planning options in light of the nonattainment of the 2015 ozone NAAQS based on the draft 2018-2020 ozone readings from the air quality monitors ("design value data"). A new SIP with new mobile emissions budgets will be developed and most likely submitted for approval in 2023.