

# AIR QUALITY 101

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## An introduction to transportation conformity

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TPB Technical Committee  
May 7, 2021

Agenda Item #5



National Capital Region  
Transportation Planning Board

# Purpose of Presentation

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- Provide background on air quality planning conducted by Transportation Planning Board (TPB) staff in conjunction with the Long-Range Transportation Plan (LRTP) and Transportation Improvement Program (TIP), including:
  - Clean Air Act
  - National Ambient Air Quality Standards (NAAQS)
  - State Implementation Plans (SIPs)
  - Air Quality Conformity
  - Modeling Tools
  
- Climate change planning activities
  - Estimates of greenhouse gas (GHG) emissions related to the LRTP have been prepared and reported since 2010
  - But GHGs are not part of the conformity process and, thus, are not the focus of this presentation



# Federal Mandates for MPOs

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- Carry out a “continuing, cooperative, comprehensive” (3C) planning process among local, state, regional, and federal transportation partners
- Develop and approve a financially constrained LRTP and TIP
- Develop plans and programs that consider all transportation modes and support metropolitan region and economic development
- In Non-Attainment or Maintenance areas:
  - MPO must coordinate development of the LRTP with the State Implementation Plans (SIPs)
  - Feds approve only those transportation plans or programs that conform with the SIPs and/or develop transportation control measures for the SIPs, as needed



# The Clean Air Act

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- Requires EPA to set National Ambient Air Quality Standards (NAAQS) for 6 common air pollutants: carbon monoxide (CO), lead, nitrogen oxide (NO<sub>x</sub>), ozone (O<sub>3</sub>), particulate matter (PM), and sulfur dioxide (SO<sub>2</sub>)
- Requires EPA to review those standards at least every 5 years, considering new scientific data and public health
- Requires EPA to designate areas as meeting or not meeting the standards (known as “attainment” or “nonattainment”)
- Allows EPA to define boundaries of “nonattainment” areas



# The Clean Air Act

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- Requires states to establish a network of air monitoring stations to monitor and report on pollutant levels
- Requires states to develop State Implementation Plans (SIPs)
  - a specific plan to attain the air quality standards for each area designated as being in nonattainment
- Requires Transportation Conformity in nonattainment areas
  - a process which ensures that transportation plans and programs are consistent with the SIP



# 2015 Ozone NAAQS

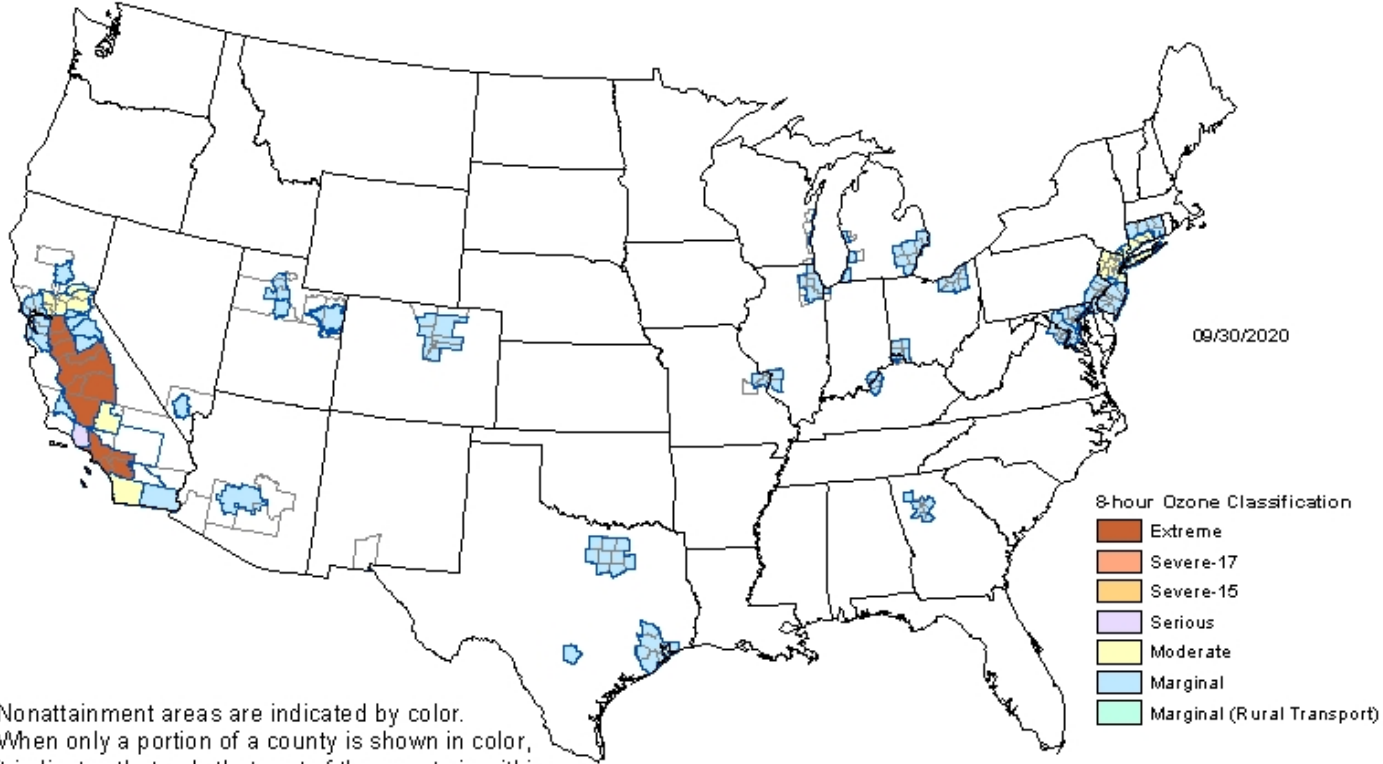
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- The current 2015 Ozone Standard is 70 parts per billion (ppb)
- Based on measured ozone levels, nonattainment areas were designated based on severity of exceedance of the current standard:
  - Extreme
  - Severe
  - Serious
  - Moderate
  - Marginal
- Each designation includes specific requirements and an allotted time to attain the Standard with higher pollution areas receiving a longer time period



# 2015 Ozone NAAQS

## 8-Hour Ozone Nonattainment Areas (2015 Standard)



Nonattainment areas are indicated by color. When only a portion of a county is shown in color, it indicates that only that part of the county is within a nonattainment area boundary.

SOURCE: EPA Greenbook: [https://www3.epa.gov/airquality/greenbook/map8hr\\_2015.html](https://www3.epa.gov/airquality/greenbook/map8hr_2015.html)



# Washington DC-MD-VA Region

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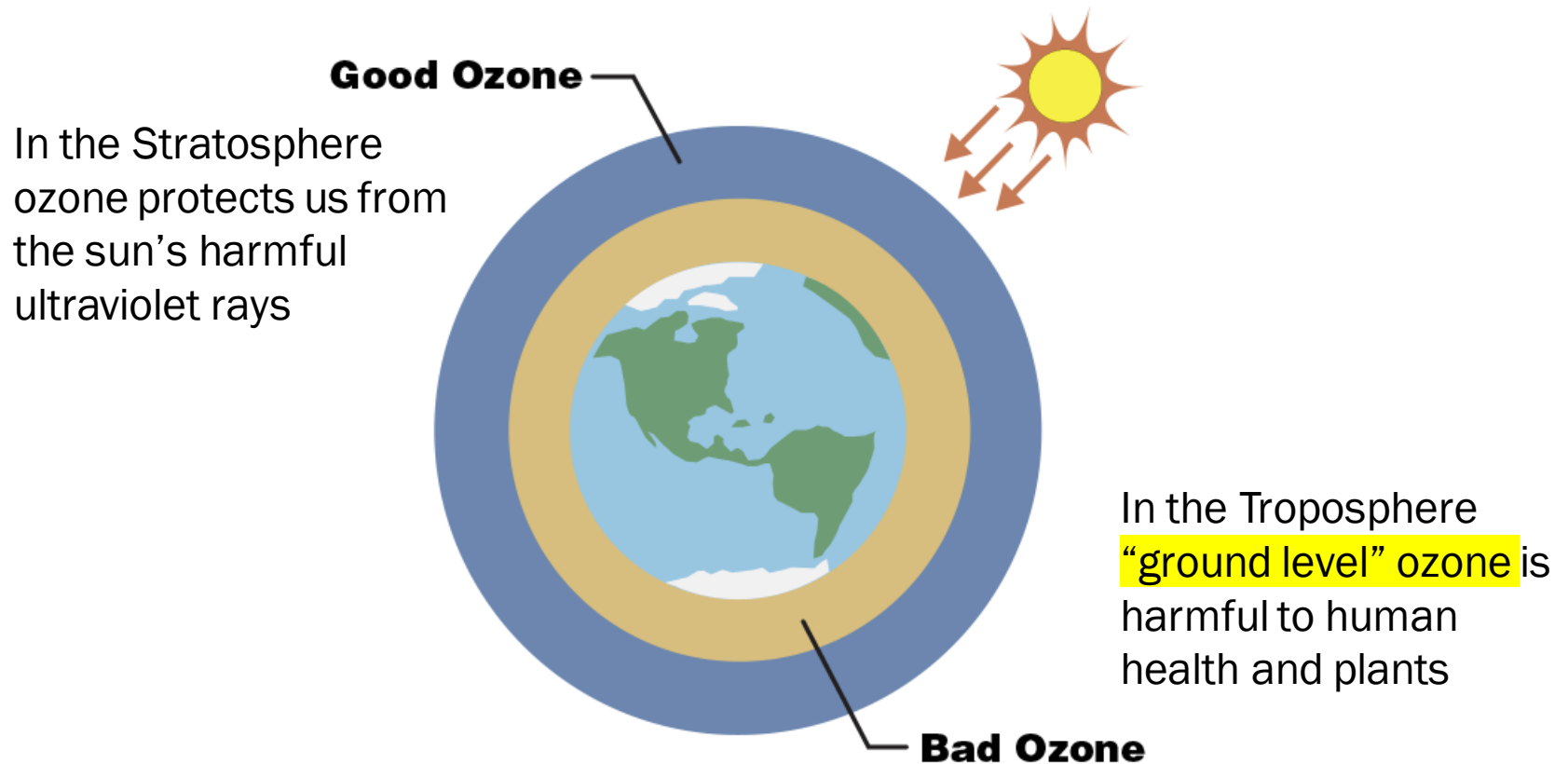
The Washington DC-MD-VA Region:

- Does not meet the EPA's 2015 Ozone NAAQS
- Is classified as a “marginal” nonattainment area for Ozone
- Previously was nonattainment for fine particle pollution (PM<sub>2.5</sub>) and Winter Carbon Monoxide (CO), but has since attained those Standards





# Good Ozone vs. Bad Ozone



*Credit: NASA/JPL-Caltech*



# Ground Level Ozone Formation

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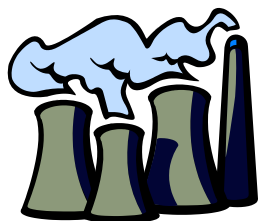


Volatile Organic Compounds (VOCs) and Nitrogen Oxides (NOx) mix with sunlight to form ground-level ozone



# Sources of Ground-Level Ozone Pollution

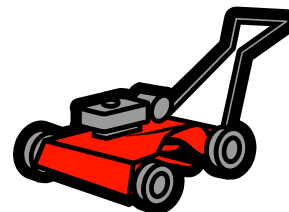
Point, on-road mobile, area, and non-road mobile sources produce Volatile Organic Compounds (VOCs) and Nitrogen Oxides (NOx) emissions



+



+



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Point  
Source

Mobile  
Source

Area  
Source

Non-road  
source

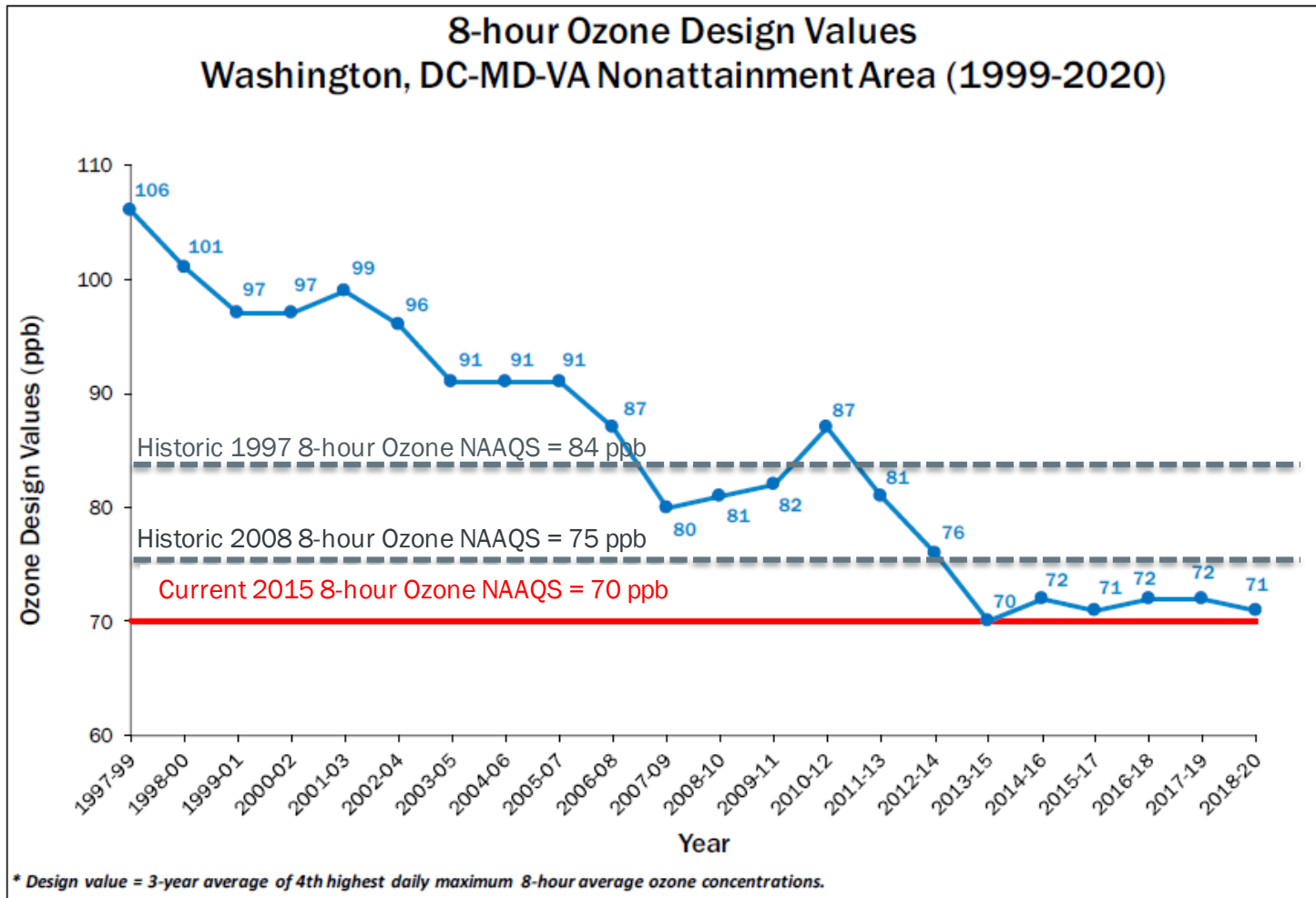


# Ozone Monitors

- Monitors around the region measure the levels of Ozone (as well as other air pollutants)
- Real-time measurements are taken using automated sensing equipment



# Observed Ozone Levels Over Time



## Metropolitan Washington Air Quality Committee (MWAQC)

- Entity certified by the mayor of the District of Columbia and the governors of Maryland and Virginia to prepare State Implementation Plans (SIPs) for the DC-MD-VA Metropolitan Statistical Area

# State Implementation Plans

CONSULTATION

COMMUNICATION

MWAQC

TPB

STATE IMPLEMENTATION  
PLANS\*

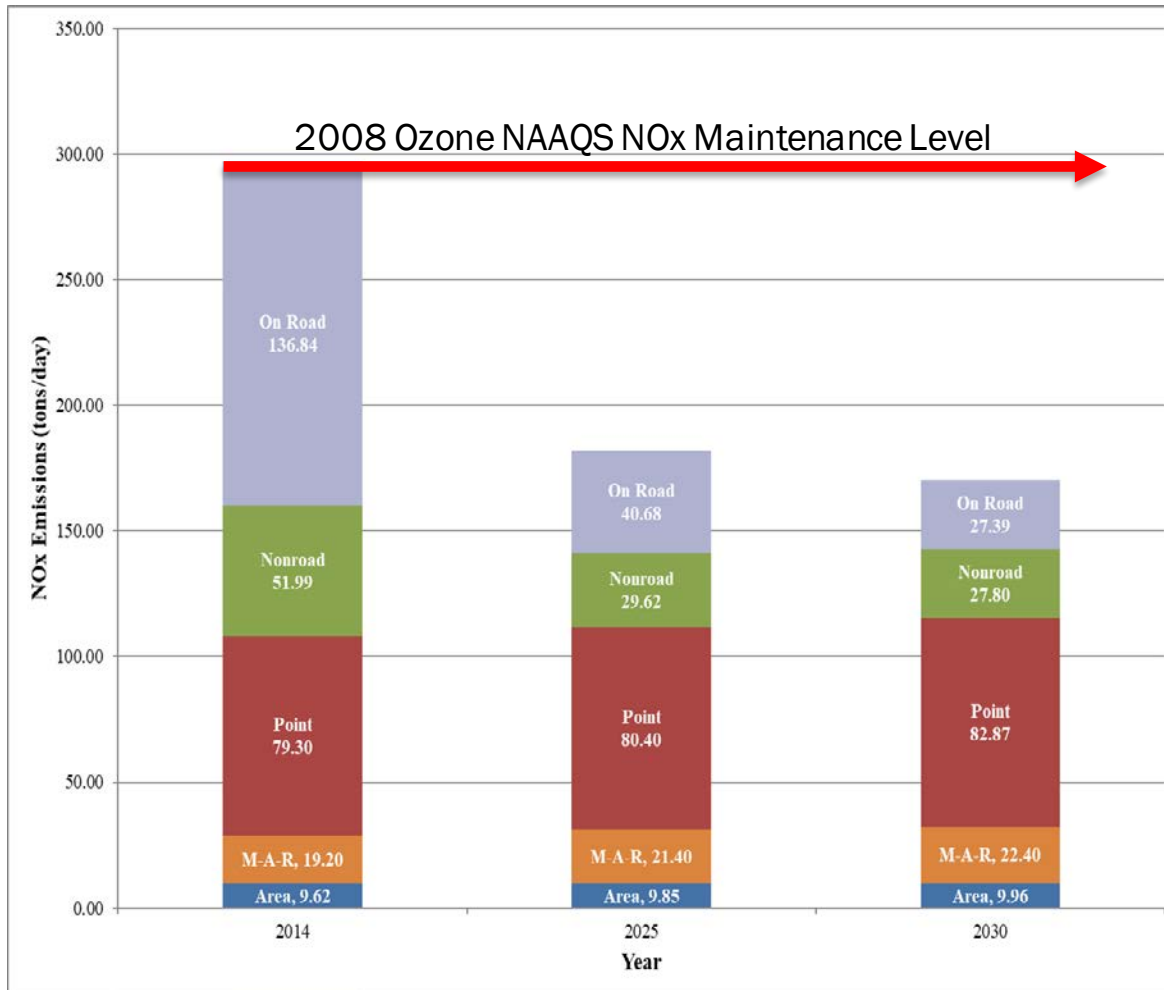
Mobile Emissions Budgets for LRTP and TIP

- Provides Mobile Emissions Inventories
- Comments on Development of Mobile Emissions Budgets

\* Currently for ozone pollutants. The region meets Federal Standards for the remaining five criteria pollutants.



# State Implementation Plans: NOx



Nitrogen oxide (NOx) emissions inventories from all sectors

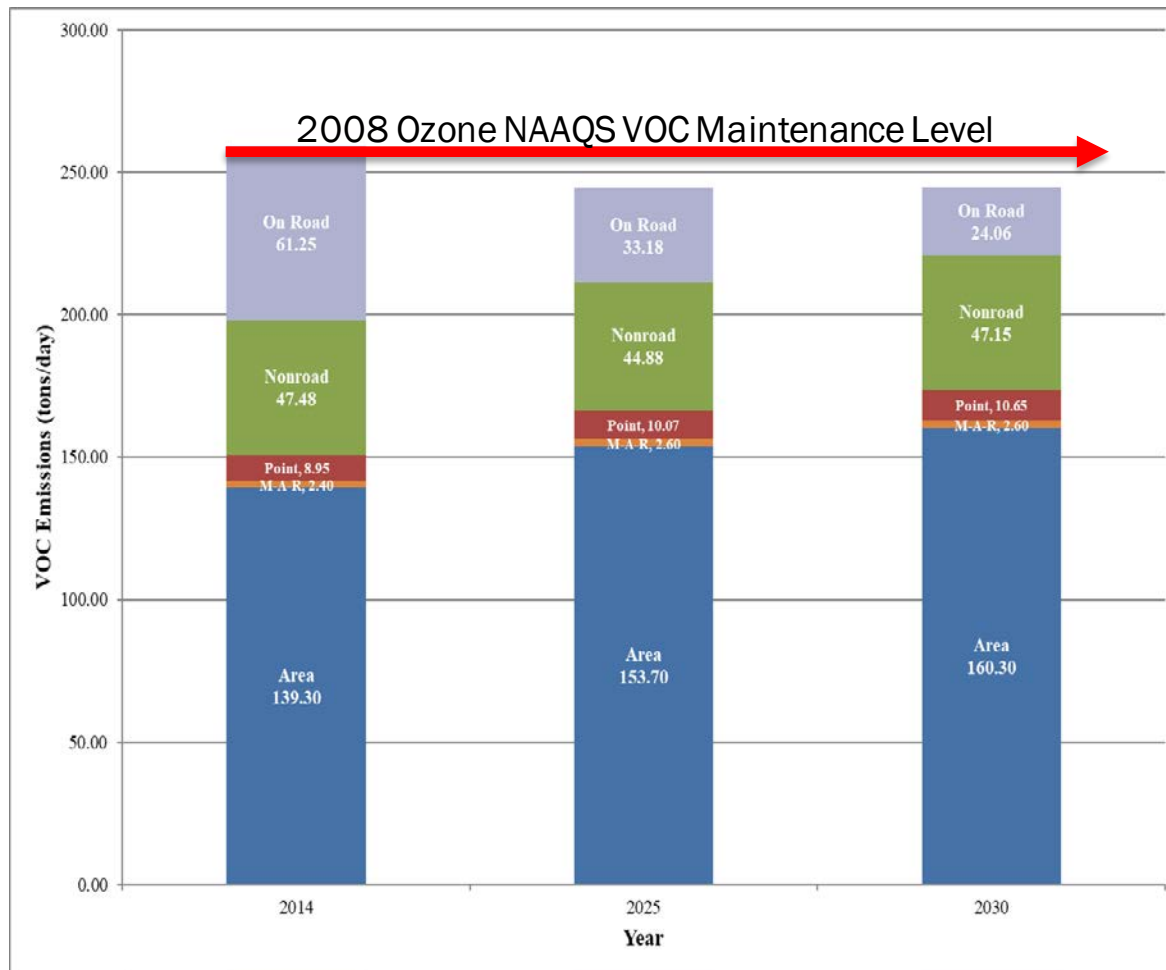
NOTE: M-A-R = marine, air, rail

Source: MWCOG 2008 Ozone NAAQS Maintenance Plan: NOx Emissions for all sectors





# State Implementation Plans: VOC



Volatile Organic Compounds (VOC) emissions inventories from all sectors

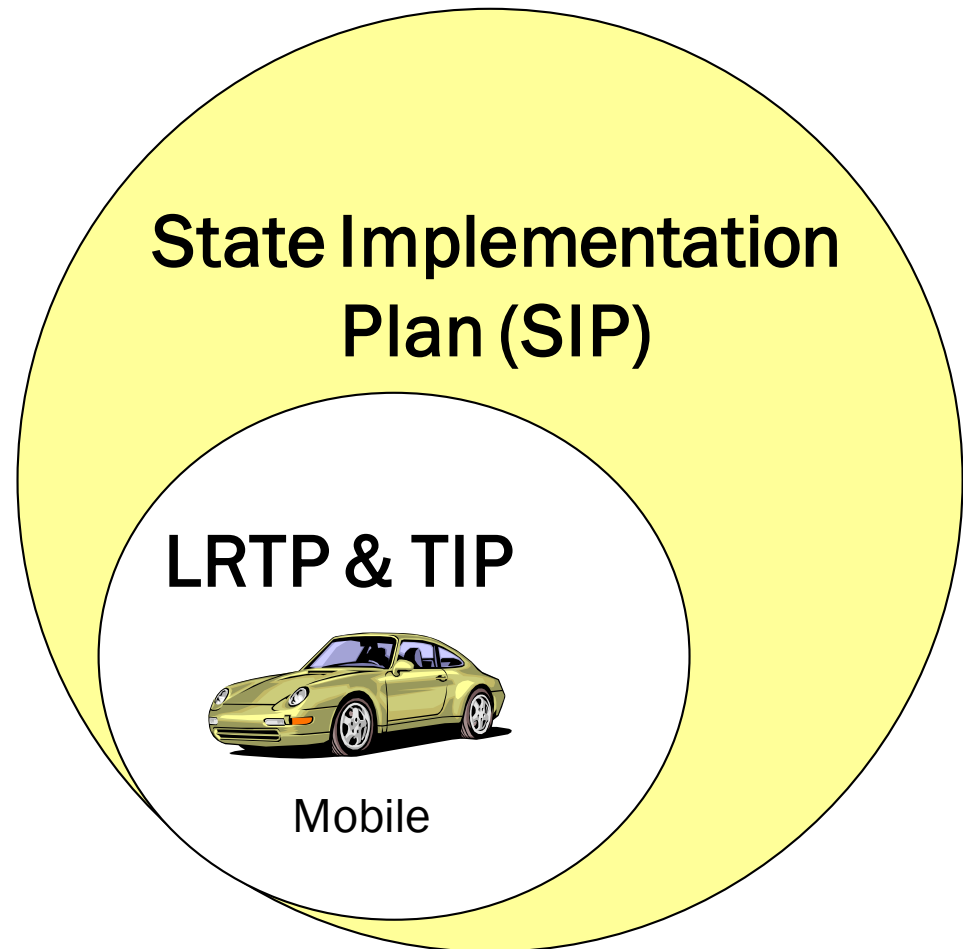
NOTE: M-A-R = marine, air, rail

Source: MWCOG 2008 Ozone NAAQS Maintenance Plan: VOC Emissions for all sectors



# Mobile Emissions Budgets

- The SIP sets the *mobile emissions budget*, the maximum allowable emissions from vehicles
- TPB must ensure that the regional LRTP and TIP do not result in emissions above this level



# SIP Development: Mobile Emissions Budgets

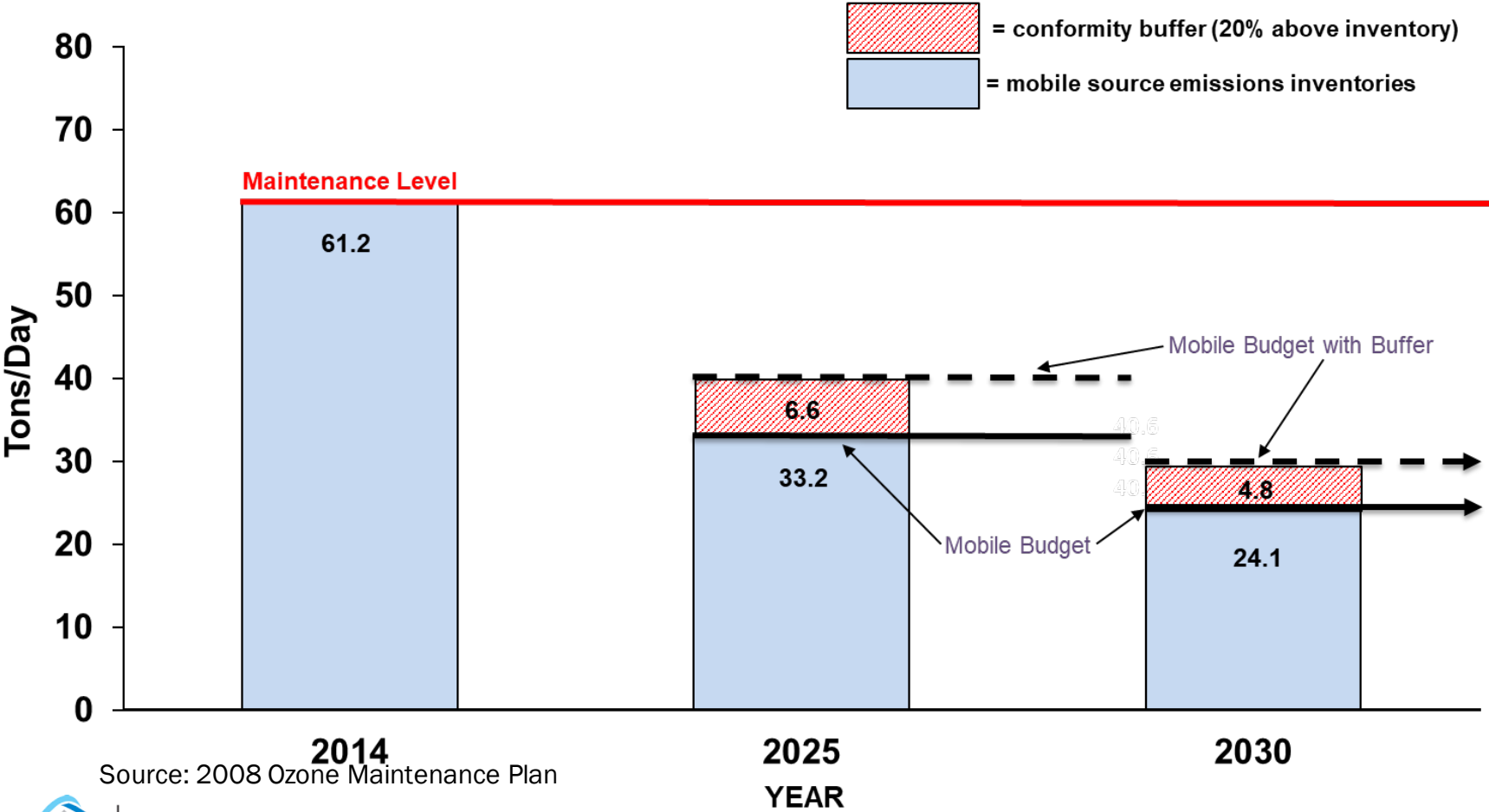
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- Mobile emissions in each conformity analysis must be below mobile emissions budgets in the SIP
- The Washington DC-MD-VA Region's current mobile emissions budgets were developed for the 2008 Ozone Standard Maintenance Plan
- The current mobile emissions budgets consist of two tiers: Tier 1 and Tier 2
  - Tier 1 budgets are set at the level of the mobile emissions inventories
  - Tier 2 budgets provide a “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



# SIP Development: Mobile Emissions Budgets

## Volatile Organic Compounds (VOCs)

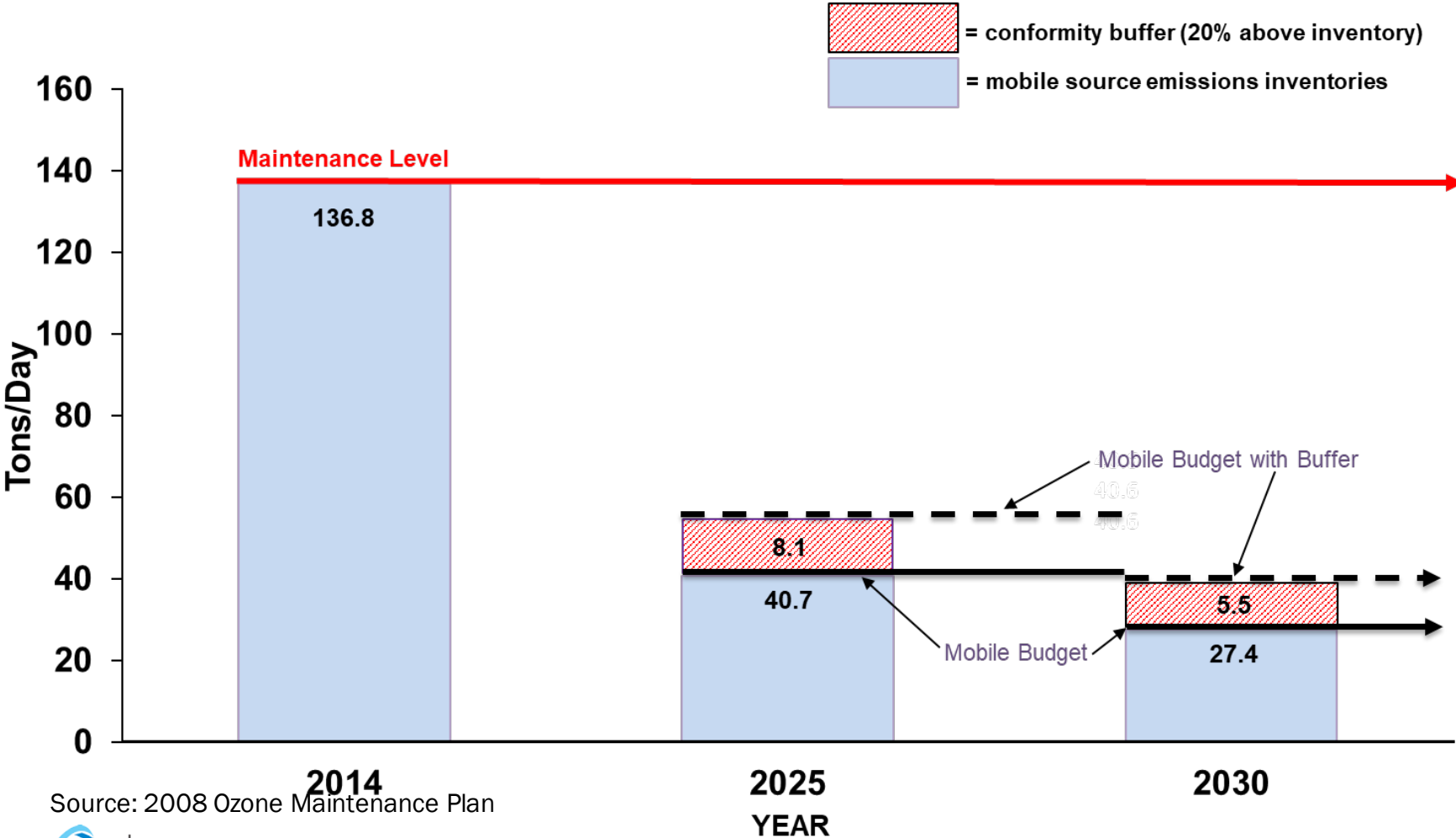


Source: 2008 Ozone Maintenance Plan



# SIP Development: Mobile Emissions Budgets

## Nitrogen Oxides (NOx)



Source: 2008 Ozone Maintenance Plan



# Air Quality Conformity

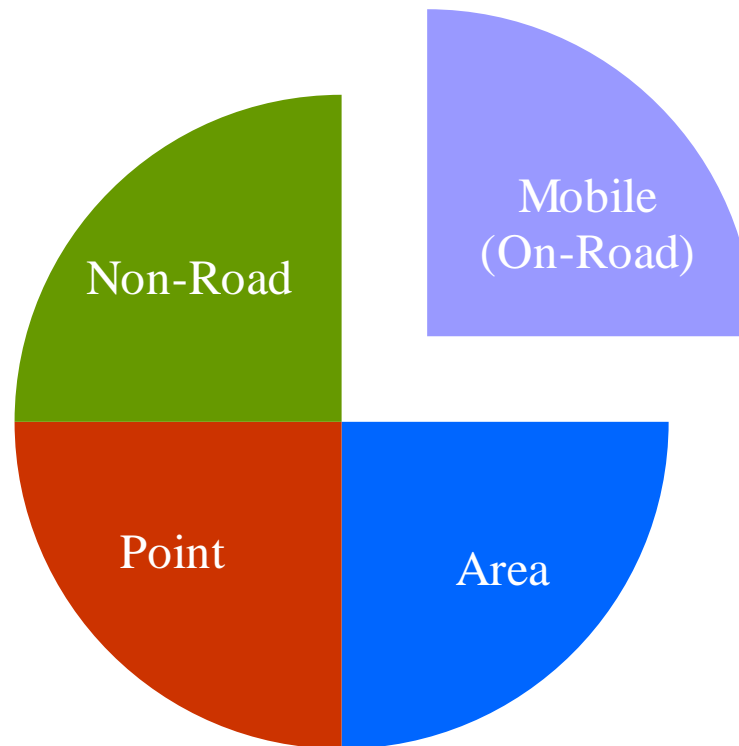
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- Required by Clean Air Act (CAA) Section 176(c)
- Requires evaluation of emissions from fiscally constrained LRTP, TIP, and projects against the emissions budgets set in the SIP before the LRTP, TIP, and projects can be federally funded or approved
- Ensures that Federal (FHWA/FTA) funding and approval are given to transportation (transit/highway) activities that are consistent with air quality plans

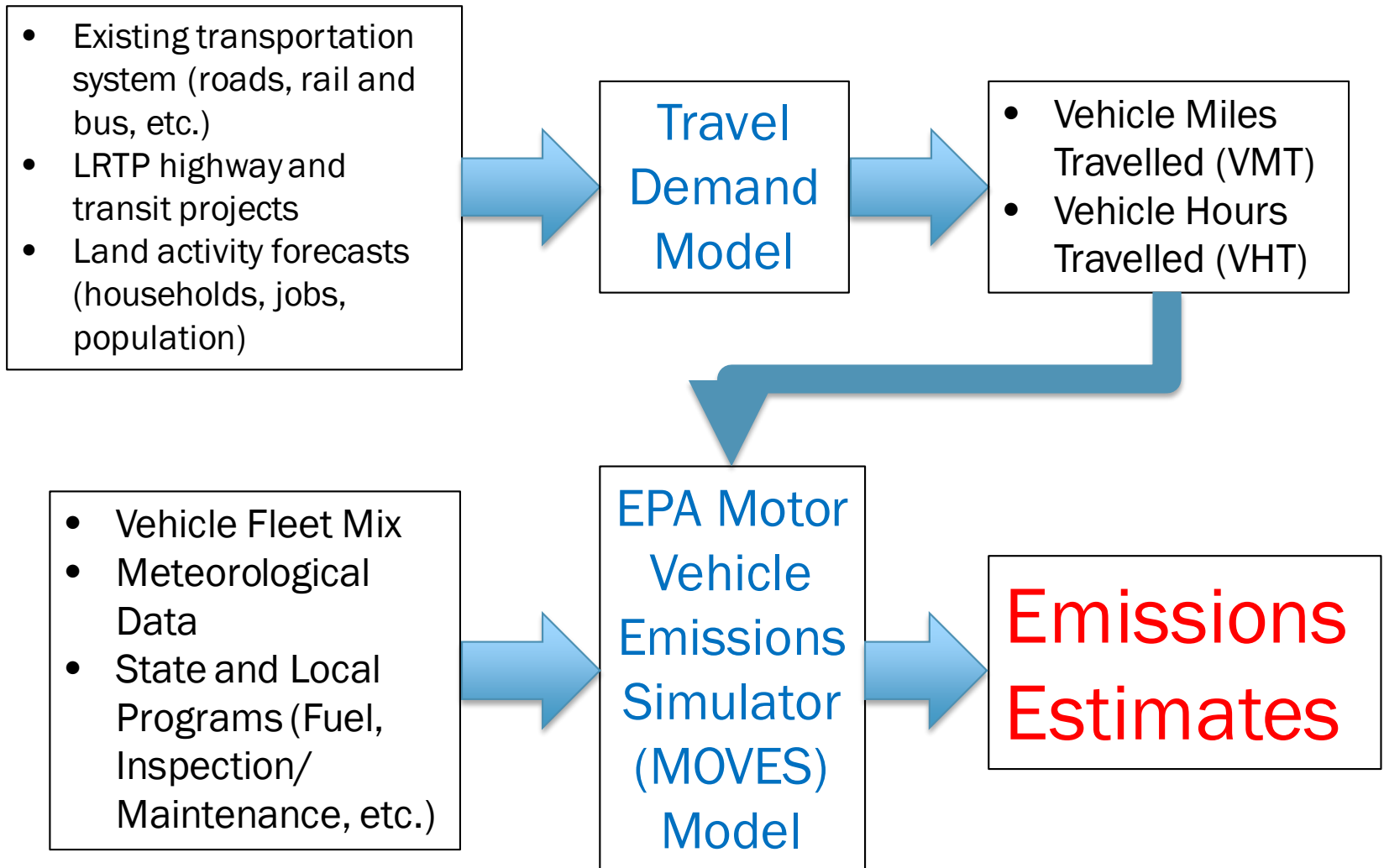


# Transportation Air Quality Conformity

Only On-Road Mobile Source Emissions are Subject to Transportation Conformity Requirements



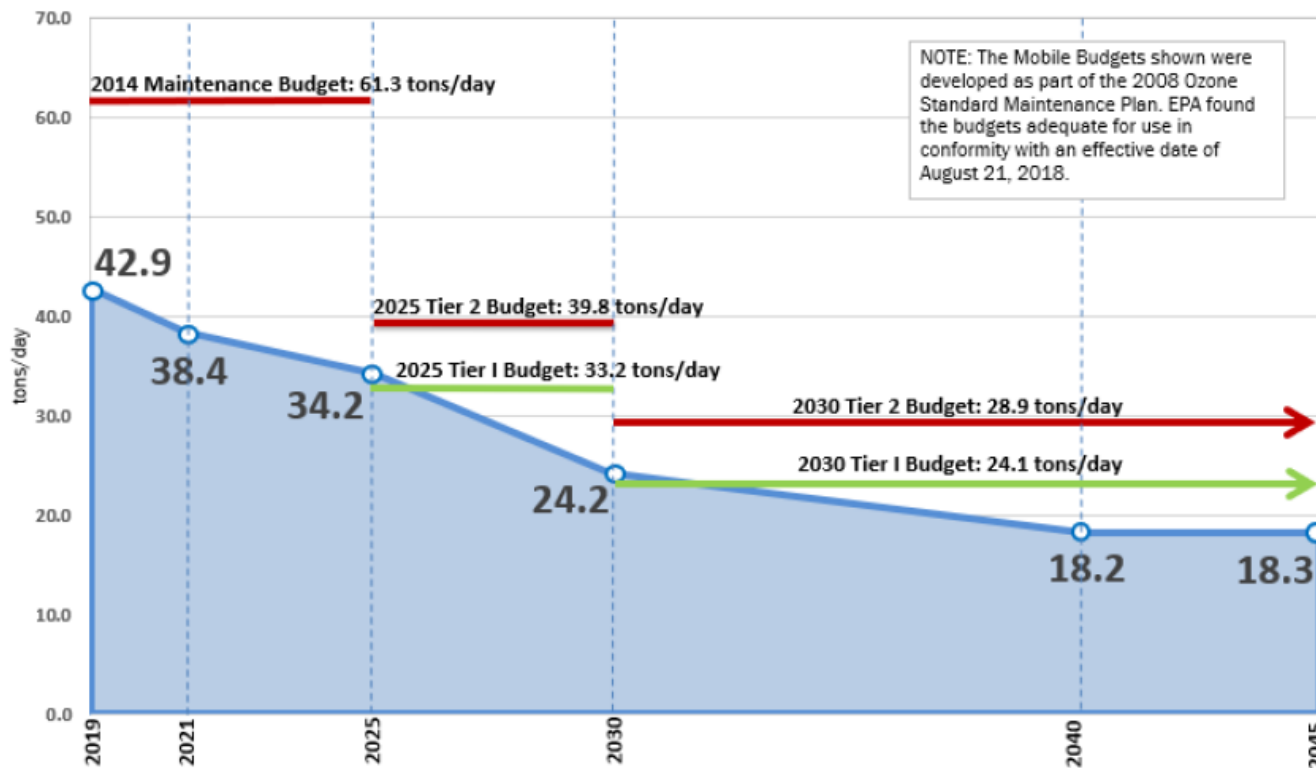
# Transportation Air Quality Conformity





# Air Quality Conformity: LRTP and TIP

Mobile Source Emissions  
OZONE SEASON VOC



TCMs and TERMS are not included in totals.

MWAQC develops mobile emissions budgets during SIP planning

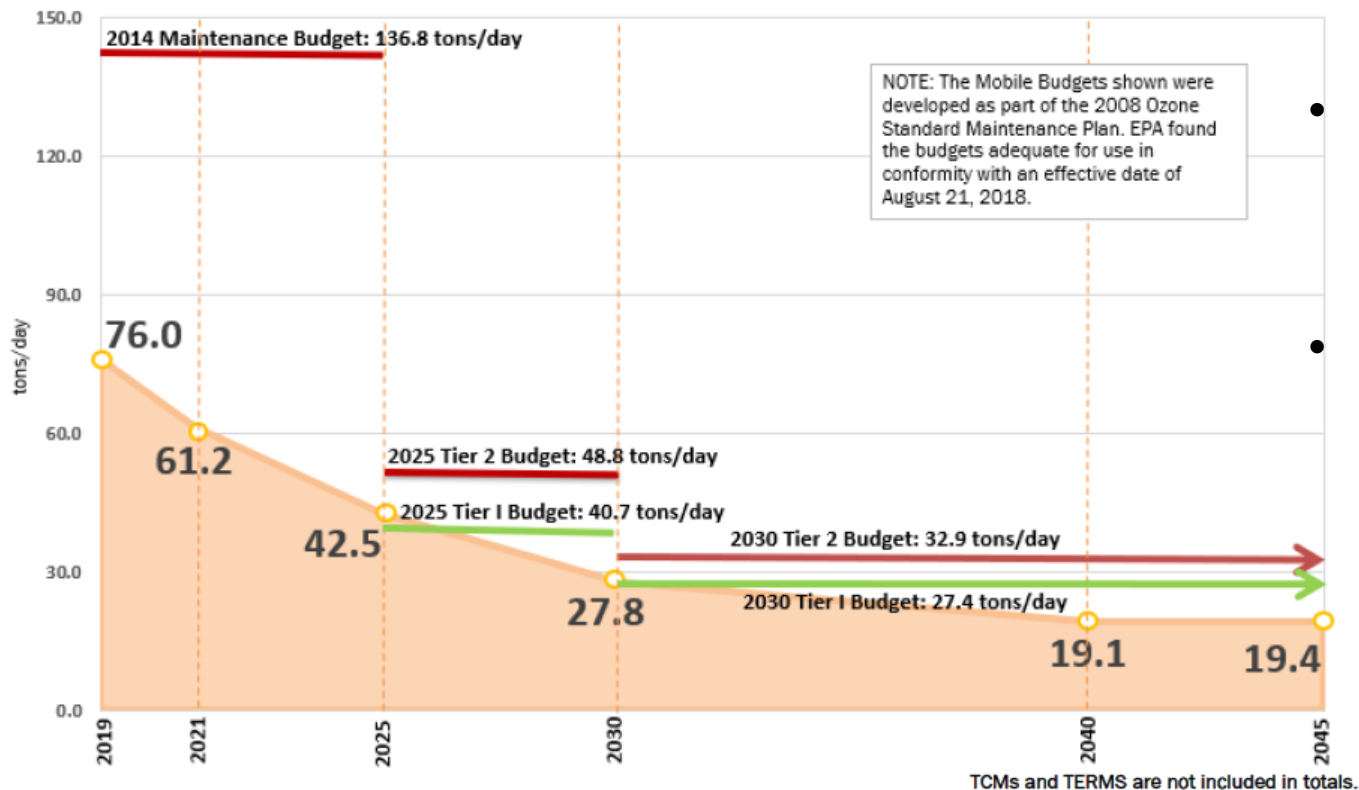
TPB analyzes LRTP and TIP to demonstrate adherence to mobile emissions budgets for air quality conformity

Source: 2020 Amendment to Visualize 2045 Air Quality Conformity Analysis



# Air Quality Conformity: LRTP and TIP

Mobile Source Emissions  
OZONE SEASON NOx



- MWAQC develops mobile emissions budgets during SIP planning
- TPB analyzes LRTP and TIP to demonstrate adherence to mobile emissions budgets for air quality conformity

Source: 2020 Amendment to Visualize 2045 Air Quality Conformity Analysis



# Why Do Mobile Emissions Decrease?

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- Most reductions reflect federal programs such as Tier 1, Tier 2, and Tier 3 Engine Standards, and Corporate Average Fuel Economy (CAFE) Standards
- As people buy new cars, an ever-increasing percentage of the vehicle fleet reflects these more recent federal standards
- Some reductions come from State and Local programs such as Vehicle Inspection/Maintenance requirements, Ozone Transport Rules, and VRE Idling Reductions (limiting the amount of time that the locomotives idle unnecessarily)



# Mobile Emissions Budgets vs. Conformity

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- Mobile emissions budgets are set based on levels of VOC and NOx estimated using the tools, planning assumptions, and technical inputs (travel demand model, MOVES model, LRTP projects, vehicle fleet mix, land use, etc.) in the region’s modeling analysis current at the time when the SIP was developed
- Conformity regulations require the use of “latest planning assumptions” for each conformity analysis, which frequently get updated and therefore will likely result in different tools/inputs than were used for the development of the mobile budgets, causing an “apples-to-oranges” comparison



# EPA Emissions Models

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- Are required for use in air quality conformity analyses
- Reflect only regulations passed into law when the model is released for use
- Are not updated frequently and thus they may lag behind legislation that impacts emissions
  - Mobile1...Mobile6.2 (1978...2004)
  - MOVES2010 (2010)
  - MOVES2014 (2014)
  - MOVES3 (2020)
- As shown in the following slides, which compare MOVES2010 to MOVES2014, changes in emissions models cause changes in estimated/modeled emissions that have nothing to do with TPB inputs (projects/policies)



# MOVES2010 vs. MOVES2014

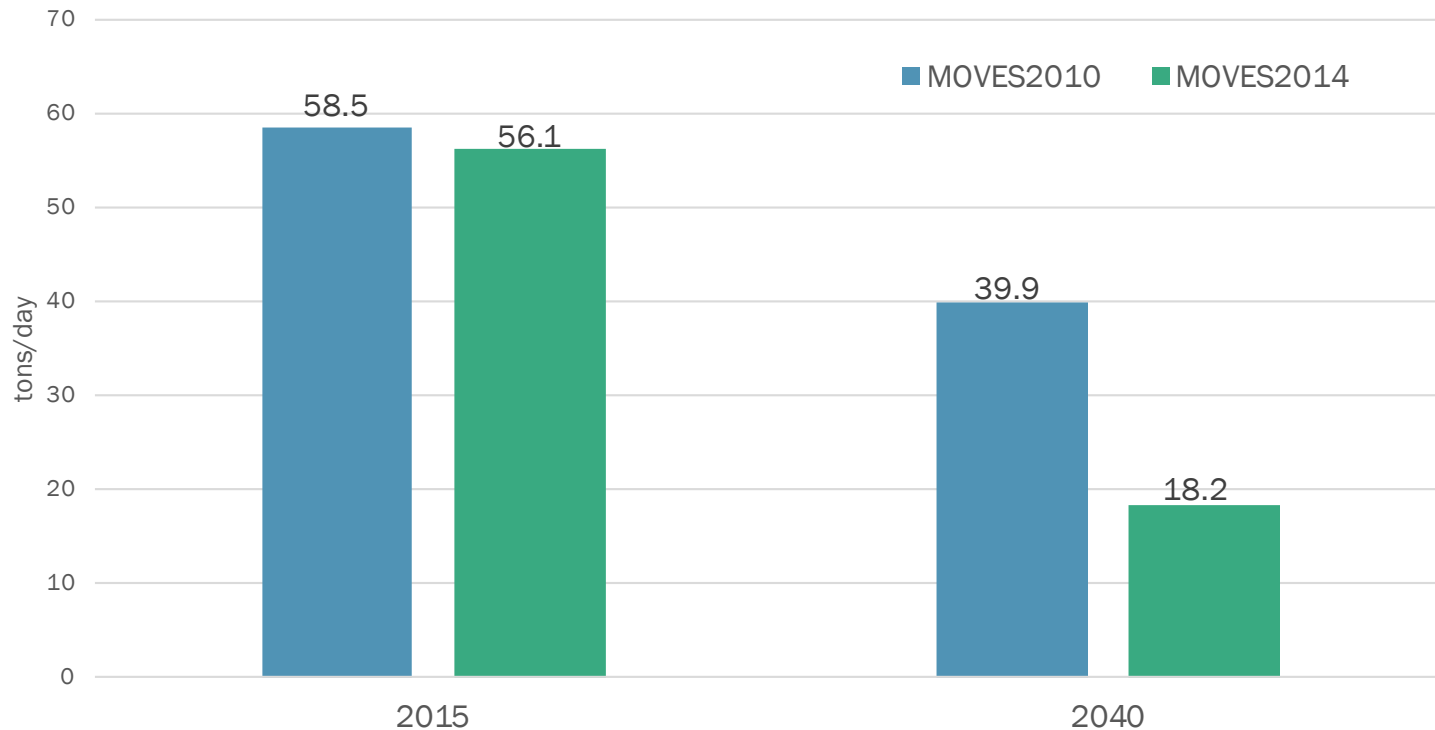
## Select New Features of MOVES2014

- **Federal Programs:**
    - ✓ Tier 3 in 2017 for cars and light/medium/heavy duty vehicles
    - ✓ New CAFE fuel economy standards effective for passenger car/light truck for 2017, and medium/heavy trucks for 2018
    - Heavy duty vehicle GHG regulation for MY 2014-2018
    - Phase 2 light duty vehicle GHG regulation for MY 2017-2025
  - **New Science** based on new test programs & studies:
    - ✓ Improved emission rates for gasoline sulfur and ethanol
    - ✓ Improved temperature effects on emissions
    - ✓ Improved Evaporative & PM emissions calculations methods
  - **Methodological Changes (examples but not limited to):**
    - E85 inclusion in fuel data
    - ✓ Combination long-haul truck 'hoteling' (auxiliary power unit)
    - ✓ Combination long-haul truck start emissions eliminated
- ✓ Applicable for Conformity Analysis;
  - Not applicable for Conformity Analysis



# MOVES2010 vs. MOVES2014

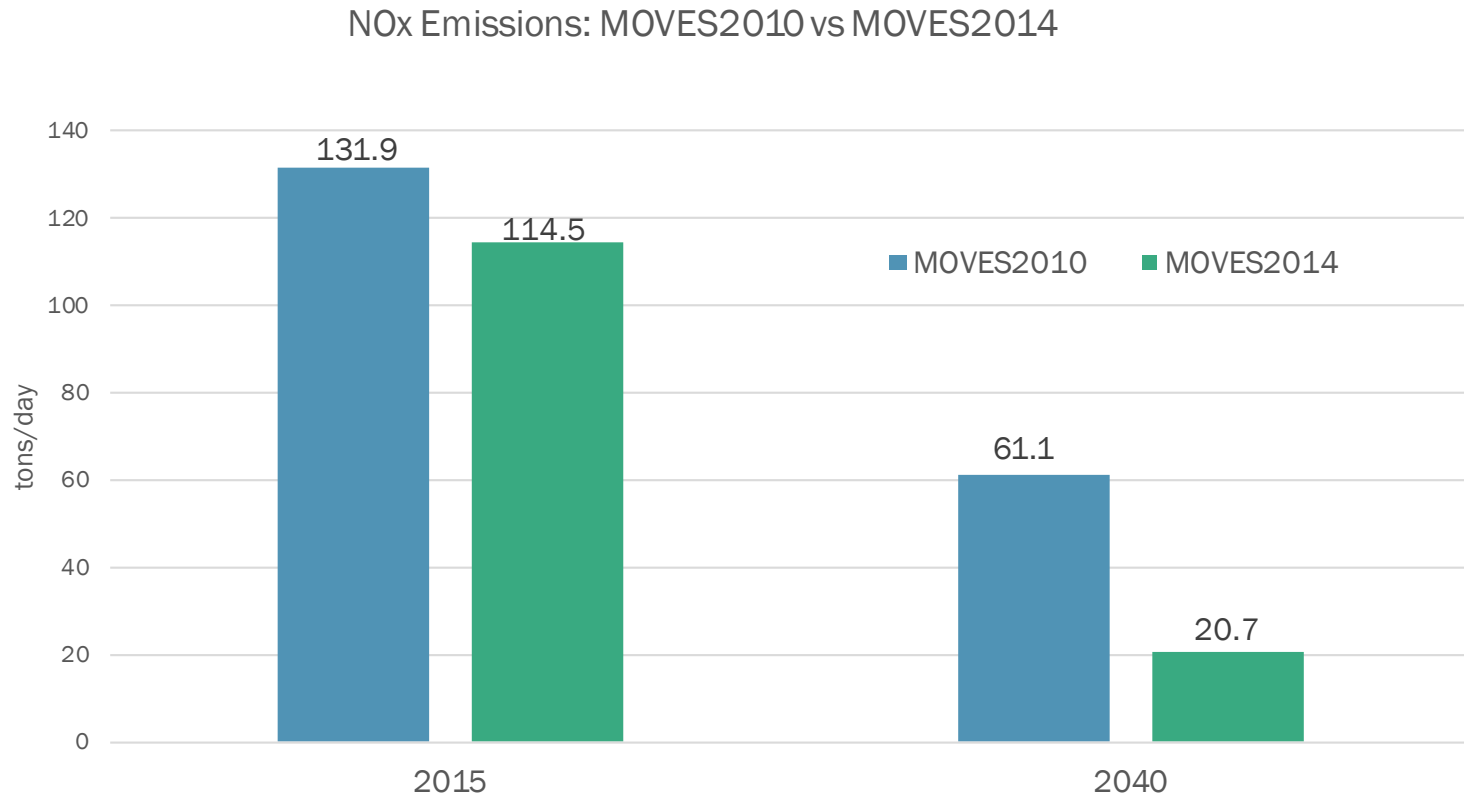
VOC Emissions: MOVES2010 vs MOVES2014



SOURCE: TPB MOVES2010 vs MOVES2014 sensitivity tests conducted in 2015



# MOVES2010 vs. MOVES2014



SOURCE: TPB MOVES2010 vs MOVES2014 sensitivity tests conducted in 2015





# MOVES3

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- Newest EPA emissions model, released November 2020
- Two-year grace period before use is required for conformity
- Staff has begun testing



# MOVES3 Improvements & Updates

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- Incorporates impacts of the Heavy-Duty Greenhouse Gas Phase 2 rule and the Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule
- MOVES3 incorporates the latest data on vehicle populations, travel activity (start and idling activity patterns, updated national VMT, vehicle population), and emission rates (diesel, gasoline, and CNG rates for HD trucks & HC, CO, NOx, and PM rates for LD vehicles) as well as updated fuel supply information at the county level
- Adjusts modeling to better account for vehicle starts, long-haul truck hoteling, and off-network idling

# What about Greenhouse Gases?

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- 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 in support of climate change planning activities
- Both TPB and COG are working to address the challenges of climate change, via both mitigation and resiliency efforts, e.g.,
  - WWIT study (2010, TPB); MSWG study (2016-2017, TPB)
  - LRPTF study (2017, TPB); 2030 CEAP (2020, COG)
  - TPB Resiliency Study; TPB Climate Change Mitigation Study (both currently underway)



# What's Next For Our Region

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- Air quality conformity analysis of the 2022 Update to Visualize 2045 and FY 2022-2026 TIP
- SIP development associated with the 2015 Ozone NAAQS
  - Washington region did not meet deadline to attain 2015 Ozone Standard
    - Region will start working on a new SIP
      - ✓ Attainment Demonstration Plan (in case we attain the Ozone Standard by the end of 2021 ozone season)
      - ✓ 15% Reasonable Further Progress Plan (in case we do not attain the Ozone Standard and get “bumped up” to moderate non-attainment)



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