2015 NATIONAL AMBIENT AIR QUALITY STANDARDS FOR OZONE: REDESIGNATION REQUEST AND MAINTENANCE PLAN INVENTORY

Vehicle Population Projections and Alternative Vehicle Fuel Technology (AVFT) Inputs

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Agenda Item #2

Redesignation Request/Maintenance Plan

- A Redesignation Request (RR) is a formal request to the EPA to designate an area as attaining the Ozone NAAQS, placing the region in "Maintenance" status.
- A Maintenance Plan (MP) outlines how the local air district will maintain its attainment of a federal air quality standard for 10 years into the future.
- MWAQC, in consultation with TPB, develops both the RR and MP. These are then provided to the state air agencies for finalization and submission to the EPA for approval.
- In an Ozone MP, precursor pollutants, Volatile Organic Compounds (VOC) and Nitrogen Oxides (NO_X), are evaluated instead of Ozone directly.

Elements of Redesignation Request and Maintenance Plan

Air Quality Data

- Monitor data to show compliance with the 2015 ozone standard (3-year average: 2021-2023)

Emissions Inventories (Point, Area, Non-road, On-road Mobile Sources)

- 2017 Base Year
- 2022 Attainment Year
- 2032 Intermediate Year
- 2038 Final Maintenance Year (must be at least 10 years beyond EPA's official date of redesignation for an area – likely in 2027)

On-Road Emissions Inventory

- Developed using:
    - Regional travel demand model: Gen2/Ver. 2.4.6
    - EPA MOVES Model: MOVES5

On-Road Emissions Inventory Inputs to MOVES

Travel-Related Data

- Based on the travel demand model and vehicle registration data, such as vehicle miles traveled, vehicle age distribution, and speed data

Non-Travel Data

- Meteorological data, fuel supply and formulation data, and inspection and maintenance program data

On-Road Inventory Input Discussion

- Vehicle Population Projection Data (for "Source Type Population" input)
- Alternative Vehicle and Fuel Technologies (AVFT) Data

Vehicle Population Projections

- Travel-related data used to generate "Source Type Population" input for MOVES runs for all analysis years
- Currently derived using linear regression and vehicle population data points from various sources (vehicle registration data and other) dating back to the 1980s

Vehicle Population Projections: Recommendation

- Use the most recent Cooperative Forecasts and most recent vehicle registration data (or vehicle identification number/VIN data) to create vehicles/household ratio by jurisdiction (in this case, 2023 VIN data along with Round 10.0 Cooperative Forecasts for 2023)

- Apply the observed vehicles-to-household ratio to project future vehicle population for any given year:

$$Rate_{jur}^{2023} = \frac{2023\ VIN\ Vehicle\ Population_{jur}}{2023\ Households_{jur}}$$

$$Projected\ Vehicle\ Population_{y}^{xxxx} = rate_{y}^{2023} X\ Households_{y}^{xxxx}$$

- Assumes that vehicle population per household remains constant*

* USDOT. Summary of Travel Trends. 2022 National Household Travel Survey. January 2024. https://nhts.ornl.gov/assets/2022/pub/2022_NHTS_Summary_Travel_Trends.pdf (Table 2-6 shows that average vehicle population per household has not changed significantly in this century)

Vehicle Population Projections: Implications

- Relative to the current regression method, number of vehicles at the regional level using the proposed method is:
  - Lower by 5% for all years up to 2040 and lower by 9% in 2050
- Relative to the current regression method, emissions at the regional level using the proposed method are:
  - Lower by 2% or less for NOx, depending on the analysis year
  - Lower by 6% or less for VOC, depending on the analysis year
  - Same for greenhouse gases (within 0.2%)
- <u>Good time to make the change - same method used for budget setting now will subsequently be used in future air quality conformity analyses</u>

Alternative Vehicle Fuels and Technologies (AVFT) Data

- Part of the "Non-Travel Data" inputs
- Allows users to modify the fraction of vehicles capable of using different fuels and technologies for each source type and vehicle model year:
    - Gasoline
    - Diesel
    - Ethanol (E-85)
    - Compressed Natural Gas (CNG)
    - Battery electric (BEV)
    - Fuel cell electric (FCEV)
- Recent rapid growth of electric vehicles and how it is reflected in AVFT dataset can impact a region's ability to pass conformity

AVFT Data Sensitivity Tests

- In consultation with MWAQC-TAC members, TPB staff have estimated emissions in 2038 using the following sets of assumptions for AVFT data:
  - Local AVFT: Inputs provided by the state air agencies, developed using MOVES5 tools and guidance for both historic and future data
  - MOVES5 defaults
  - Fixed 2022 AVFT: Assuming today's shares of vehicles by fuel/vehicle technology in the future; 2022 AVFT inputs (or shares), used to represent the today's conditions for the test, supplied by the states are "fixed" and applied in the future years (e.g., in 2038)

AVFT Data Input Assumptions: Passenger Cars

Table 1. Vehicle Shares by Fuel Type for Model Year 2038: Passenger Cars

	Local AVFT			MOVES5	Fixed 2022 AVFT		
Fuel Type	DC	MD	VA	DC/MD/VA	DC	MD	VA
Gasoline	38%	43%	48%	41%	86%	91%	89%
Diesel	0%	0%	0%	0%	0%	0%	0%
E-85	0%	0%	0%	1%	0%	0%	0%
Electricity	**62%**	**56%**	**52%**	**59%**	**14%**	**9%**	**11%**
Total	100%	100%	100%	100%	100%	100%	100%

AVFT Data Input Assumptions: Passenger Trucks

Table 2. Vehicle Shares by Fuel Type for Model Year 2038: Passenger Trucks

	Local AVFT			MOVES5	Fixed 2022 AVFT		
Fuel Type	DC	MD	VA	DC/MD/VA	DC	MD	VA
Gasoline	33%	41%	33%	48%	91%	93%	90%
Diesel	0%	0%	0%	1%	0%	1%	1%
E-85	1%	1%	1%	3%	0%	1%	2%
Electricity	**66%**	**57%**	**65%**	**48%**	**9%**	**6%**	**7%**
Total	100%	100%	100%	100%	100%	100%	100%

AVFT Data Input Assumptions: Combination Short-Haul Trucks

Table 3. Vehicle Shares by Fuel Type for Model Year 2038: Combination Short-Haul Trucks

	Local AVFT			MOVES5	Fixed 2022 AVFT		
Fuel Type	DC	MD	VA	DC/MD/VA	DC	MD	VA
Gasoline	0%	0%	0%	0%	0%	0%	0%
Diesel	56%	56%	70%	56%	99%	99%	99%
E-85	0%	0%	1%	0%	1%	1%	1%
Electricity	**44%**	**44%**	**29%**	**44%**	**0%**	**0%**	**0%**
Total	100%	100%	100%	100%	100%	100%	100%

AVFT Data Input Assumptions: Summary

- Using MOVES5 local input projections means that between 52% and 62% of model year 2038 light-duty passenger cars are assumed to be electric; 2022 data show that this category ranged between 9% and 14%; MOVES5 defaults in 2038 are at 59% for this category for each state.
- Using MOVES5 local input projections means that between 57% and 66% of model year 2038 light-duty passenger trucks are assumed to be electric; 2022 data show that this category ranged between 7% and 9%; MOVES5 defaults in 2038 are at 48% for this category for each state.
- Using MOVES5 local input projections means that between 29% and 44% of model year 2038 combination short-haul trucks (“tractor trailers”) are assumed to be electric; data show that in 2022, this percentage was 0%; MOVES5 defaults in 2038 are at 44% for each state.

AVFT Data Sensitivity Test Findings: Nitrogen Oxides (NOx)

Table 4. 2038 NOx Emissions: AVFT Tests Compared to 2038 Local AVFT/State Air Agency Inputs (in short tons per day)

				MOVES5 Defaults (vs. Local AVFT)		2022 AVFT (vs. Local AVFT)	
Vehicle Category	Local AVFT	MOVES5 Defaults	2022 AVFT	Δ	%Δ	Δ	%Δ
Light-duty Vehicles	3.389	3.902	4.336	0.513	15%	0.946	28%
Heavy-duty Vehicles	7.931	7.992	8.696	0.062	1%	0.766	10%
Buses	1.855	1.794	1.934	-0.061	-3%	0.078	4%
Total	13.175	13.689	14.965	0.514	**4%**	1.790	**14%**

Note:

Light-duty Vehicles = Motorcycles + Passenger Cars + Passenger Trucks + Light Commercial Trucks

Heavy-duty Vehicles = Refuse Trucks + Single Unit Short- and Long-Haul Trucks + Motorhomes + Combination Short- and Long-Haul Trucks

Buses = Other Buses + Transit Buses + School Buses

AVFT Data Sensitivity Test Findings: Volatile Organic Compounds (VOC)

Table 5. 2038 VOC Emissions: AVFT Tests Compared to 2038 Local AVFT/State Air Agency Inputs (in short tons per day)

				MOVES5 Defaults (vs. Local AVFT)		2022 AVFT (vs. Local AVFT)	
Vehicle Category	Local AVFT	MOVES5 Defaults	2022 AVFT	Δ	%Δ	Δ	%Δ
Light-duty Vehicles	14.427	14.844	17.629	0.417	3%	3.201	22%
Heavy-duty Vehicles	0.587	0.520	0.614	-0.067	-11%	0.027	5%
Buses	0.195	0.298	0.165	0.104	53%	-0.030	-15%
Total	15.208	15.662	18.407	0.454	**3%**	3.199	**21%**

Note:

Light-duty Vehicles = Motorcycles + Passenger Cars + Passenger Trucks + Light Commercial Trucks

Heavy-duty Vehicles = Refuse Trucks + Single Unit Short- and Long-Haul Trucks + Motorhomes + Combination Short- and Long-Haul Trucks

Buses = Other Buses + Transit Buses + School Buses

AVFT Data Sensitivity Test Findings

- Using MOVES5 AVFT defaults resulted in increases in estimated NOx emissions by 4% and VOC emissions by 3% percent relative to the local AVFT inputs in 2038.
- However, using "Fixed 2022 Inputs" that match the distribution of various vehicle categories to current conditions (i.e., 2022), resulted in greater estimated increases in NOx emissions (14%) and VOC emissions by (21%) relative to the local AVFT inputs in 2038.
- Data in Table 4 show that the heavy-duty vehicles (or trucks) account for about 60% of NOx emissions.

Considerations for Moving Forward

- Main concern: using locally developed data or MOVES5 defaults, motor vehicle emissions budgets (MVEBs) may be set using relatively optimistic vehicle electrification assumptions that could become outdated if the EPA were to repeal some of the recent regulations embedded in MOVES5 assumptions, for example:
  - EPA's Light- and Medium-Duty Multi-Pollutant Rule with higher projected electric vehicle fractions and more stringent standards for carbon dioxide, particulate matter, non-methane organic gases and oxides of nitrogen
- If these regulations were to be repealed, a new MOVES model, presumably assuming both lower shares of electric vehicles (AVFT inputs) and higher emissions rates in the future (embedded in the model itself), would be released (with state air agency local data also reflecting these trends).

Considerations for Moving Forward (Cont.)

- It may be challenging to pass conformity using a future model if MVEBs were set using the current MOVES5 model, which assumes a cleaner vehicle fleet.
  - If NOx and VOC emissions were to increase by approximately 14-21% only due to a new model (per these tests), the region may need to update the MVEBs and Maintenance Plan to maintain consistency between MVEB setting and conformity assumptions.
- Future MOVES model would presumably not only assume different shares of vehicles by fuel type as specified in AVFT inputs, but it would likely include other updates that would impact emissions rates that are embedded in the model itself, rather than being input by users (e.g., new CAFE Standards).
  - Differences in results documented in these tests resulting in potential 14-21% differences would not be the only changes between the models.

Considerations for Moving Forward (Cont.)

- In addition to the vehicle fleet, other tools/inputs periodically change, including, but not limited to, demographic data and the travel demand model.

Next Steps

- Consider the implications of using different sets of assumptions and determine the optimal way to move forward

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