FY2023 VMT-Mix Update

Emissions and Energy Modeling Group

Texas A&M Transportation Institute

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Outline

- FY23 VMT-Mix Update Overview
  - Updated Python package structure and documentation
  - Methodology Changes w.r.t FY22 VMT-Mix (Used for Trends)
  - Distribution Changes w.r.t FY22 VMT-Mix (Used for Trends)
- Impact of VMT-Mix on On-Road Emission Inventories (EIs) Running Emissions:
  - Statewide for Criteria Air Pollutants (CAPs)
  - Non-attainment counties w.r.t applicable CAPs
  - Counties with Highest and Lowest changes in NOx
  - Sensitivity of NOx to VMT-Mix
- Conclusion and Next Steps

Section 1

FY23 VMT-Mix Update Overview

Updated Python package structure and documentation

Changes:

- Added numpy docstring to all function and classes in the package.
- Added readme to provide an overview of the modules.
- Created Sphinx documentation for the module. It's available here: https://apoorb.github.io/FY23_VMT_Mix.

Reasons:

- Future proofs the VMT-Mix development.
- Allows other team members to be able to pick-up the VMT-Mix development in the future.

Methodology Changes

The following updates are made to the FY23 VMT-Mix:

1. Duplicate stations were removed from the vehicle classification counts.
   - Vehicle classification count had data both by direction and location. Created checks to only use one.
2. Directly using the counts, instead of converting them to annual counts first.
   - The process was adding unnecessary complexity to the methodology.
3. Also using data for 2020 and 2021. FY22 VMT-Mix only uses 2013 to 2019 data.
   - Incorporated the VCC data from the most recent years.
   - Waiting for the 2022 VCC data, which likely would be available in July 2023.

Distribution Changes w.r.t FY22 VMT-Mix

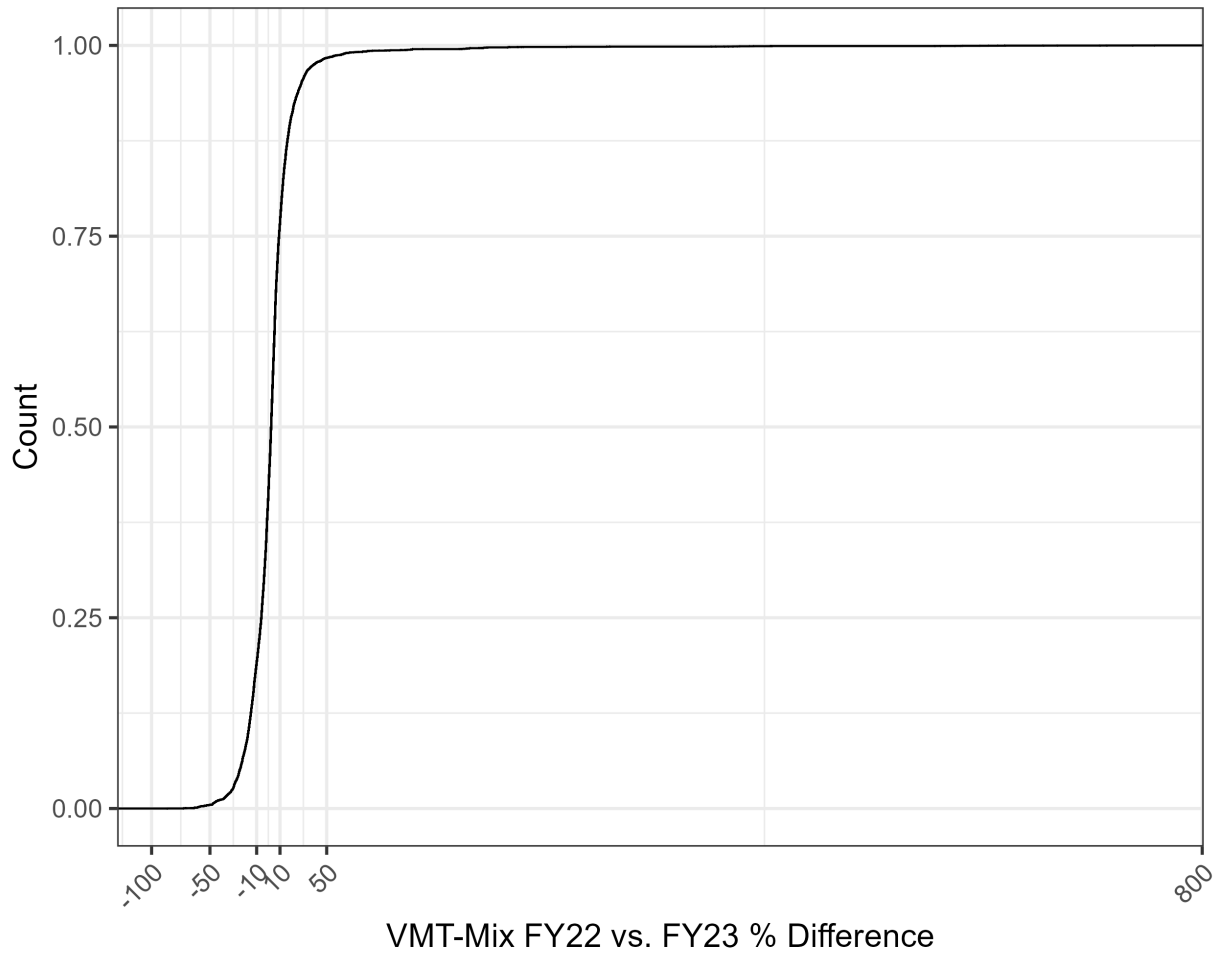
The VMT-Mix table has 60,000 rows (25 * 5 * 5 *4 * 24). It is developed for the following:

- 25 districts,
- four MOVES road type (2, 3, 4, and 5) and no road type (ALL),
- four peak periods (AM, PM, MD, ON) and Entire Day,
- four day types (Wkd, Fri, Sat, Sun),
- 24 SUT+FT combinations.

For 59,400 of the rows the percent difference is under 66%. For 54,000 (90%) of to the rows the percent difference is between -25% and 28%. And, for 50% of the rows the percent difference is between -6% and 9%.

Distribution Changes w.r.t FY22 VMT-Mix (Cont.)

The following figure shows that 25^{th} to 75^{th} percentile values are -6% to 9%. 5th to 95th percentiles are -25% and 28%. Indicating for the majority of the VMT-Mix row's there is little change between FY22 and FY23 VMT-Mix.



Distribution Changes w.r.t FY22 VMT-Mix (Cont.)

The 600 rows with over 66% increase belong to the following districts: San Angelo, Bryan, Corpus Christi, Lubbock, Brownwood, San Antonio, Wichita Falls, Amarillo, Waco, and Dallas. Following shows the breakdown by SUT for these districts:

- Bryan, Waco, San Angelo, San Antonio, Brownwood: CLhT, CShT
- San Angelo: MC
- Amarillo, Lubbock, San Angelo, Dallas, Wichita Falls: OB, TB, SB
- Bryan, Brownwood: RT, MH, SULhT, SUShT

200 rows have over 50% reduction. Waco, Brownwood, Tyler, Paris see reduction in OB, TB, and SB. Tyler and Paris see redution in MC. And, Atlana has redcution in CLhT and CShT.

Section 2

Impact of VMT-Mix on EIs

FY23 VMT-Mix vs. FY22 VMT-Mix Statewide EI Impact

Insignificant percent change in statwide emissions between the FY22 and FY23 VMT-Mix.

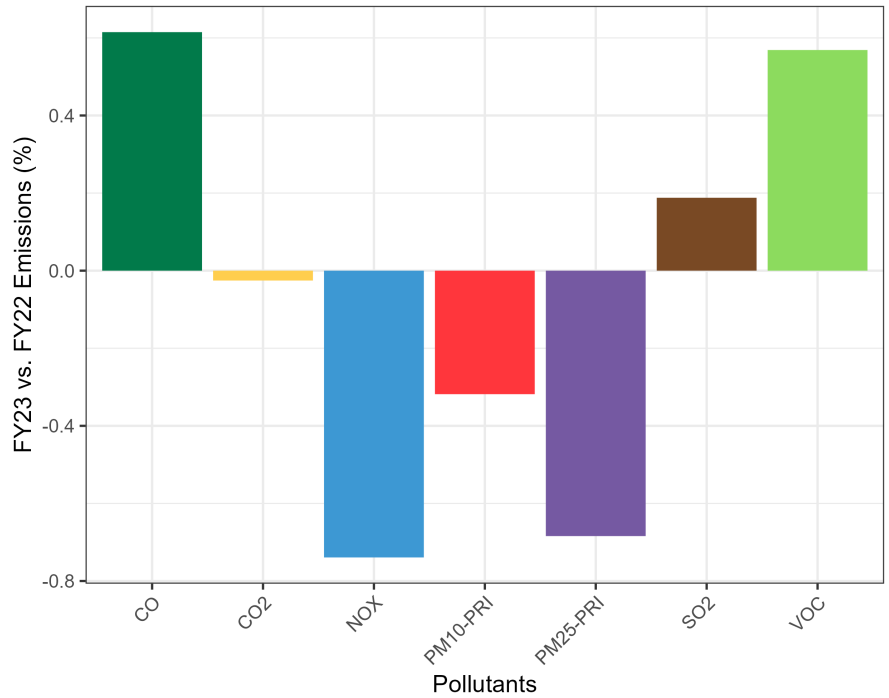


Figure 2: Statewide Change in Emission (FY23 vs. FY22 VMT-Mix)

FY23 VMT-Mix vs. FY22 Ozone Non-Attainment Area NOx EI

COG	County	NOx Emission 2020 + FY22 VMT-Mix	NOx Emission 2020 + FY23 VMT-Mix	FY23 - FY22 NOx	FY23 vs. FY22 NOx (% diff)
HGAC	Harris	36.95	36.5	-0.45	-1.22
NCTCOG	Dallas	23.92	23.97	0.06	0.24
AACOG	Bexar	21.17	22.73	1.56	7.38
NCTCOG	Tarrant	15.77	16.31	0.53	3.39
RIOCOG	El Paso	11.7	11.21	-0.48	-4.12
NCTCOG	Collin	6.8	6.74	-0.06	-0.92
NCTCOG	Denton	6.74	6.63	-0.11	-1.69
HGAC	Montgomery	5.85	5.44	-0.41	-6.94
NCTCOG	Ellis	4.85	4.71	-0.14	-2.95
HGAC	Fort Bend	4.67	4.39	-0.28	-6.01
HGAC	Brazoria	3.75	3.43	-0.32	-8.47
NCTCOG	Parker	3.73	3.43	-0.3	-8
NCTCOG	Kaufman	3.65	3.53	-0.12	-3.26
NCTCOG	Johnson	3.57	3.21	-0.35	-9.93
HGAC	Chambers	3.03	2.99	-0.04	-1.42
HGAC	Galveston	2.06	2	-0.06	-2.79
NCTCOG	Wise	1.89	1.63	-0.26	-13.62
HGAC	Waller	1.77	1.59	-0.18	-10.19
HGAC	Liberty	1.44	1.33	-0.11	-7.91
NCTCOG	Rockwall	1.3	1.26	-0.04	-2.81

This table shows the absolute NOx emissions and the difference and percent difference b/w FY22 and FY23 VMT-Mix. Thing to note for next slide is that even if **counties such as Waller and Liberty have around 10% change**, this likely **will not affect conformity** as their **total emissions are much lower.**

FY23 VMT-Mix vs. FY22 VMT-Mix Ozone Non-Attainment Area NOx EI Impact

Bexar (AACOG) has a ~ 7.4 increase, Tarrant (NCTCOG) has ~ 3.4, and Dallas has ~ 0.25 increase. All other counties have no change or a reduction.

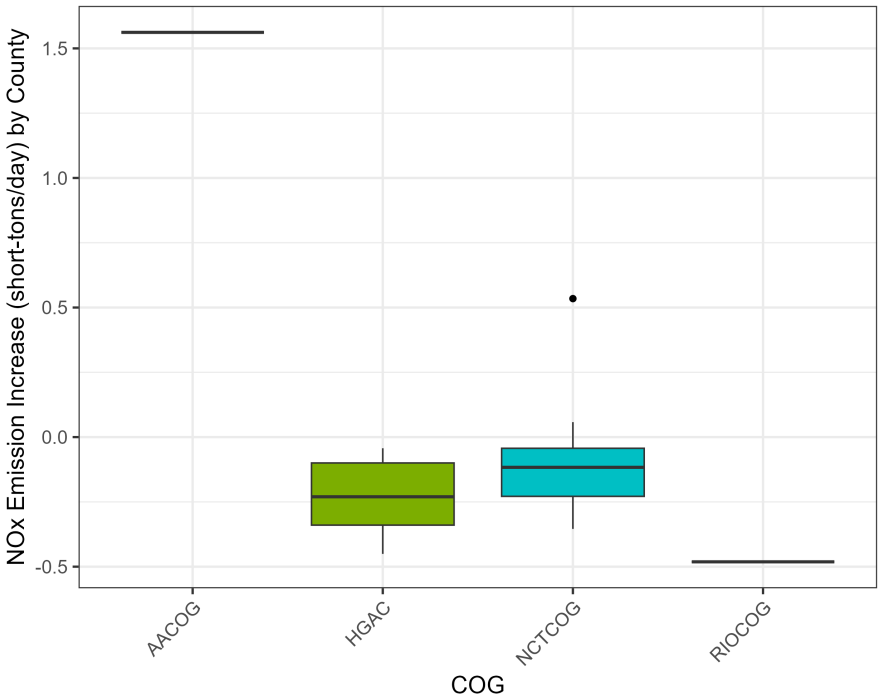


Figure 3: FY23 vs. FY22 VMT-Mix Impact on Ozone Non-Attainment Counties (Absolute)

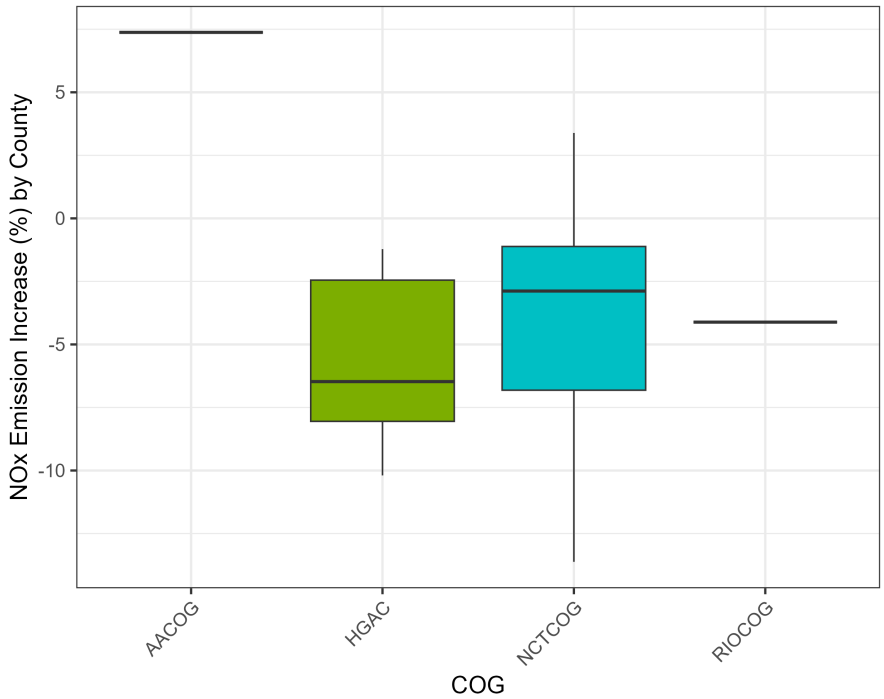


Figure 4: FY23 vs. FY22 VMT-Mix Impact on Ozone Non-Attainment Counties (%)

FY23 VMT-Mix vs. FY22 VMT-Mix PM10 Non-Attainment Area EI Impact

- El Paso county is the only county currently (March 2023) that is in non-conformity for PM10.
- The total PM10 running emissions for El Paso based on FY22 VMT-Mix is 1.13 short-tons/day.
- The emission decrease by 0.03 short-tons/day; a $\sim 2.9\%$ decrease.

Counties with Highest and Lowest changes in NOx

Counties with highest percent change in NOx due to VMT-Mix update.

County	District	NOx Emission 2020 + FY22 VMT-Mix	NOx Emission 2020 + FY23 VMT-Mix	FY23 - FY22 NOx	FY23 vs. FY22 NOx (% diff)
Eastland	Brownwood	1.8	2.28	0.48	26.62
Tom Green	San Angelo	1.72	1.99	0.27	15.85
Frio	San Antonio	1.29	1.49	0.2	15.48
Brazos	Bryan	2.66	3.06	0.4	15.11
Atascosa	San Antonio	1.75	1.99	0.24	13.63

Counties with lowest percent change in NOx due to VMT-Mix update.

County	District	NOx Emission 2020 + FY22 VMT-Mix	NOx Emission 2020 + FY23 VMT-Mix	FY23 - FY22 NOx	FY23 vs. FY22 NOx (% diff)
Archer	Wichita Falls	0.54	0.45	-0.09	-16.72
Jim Hogg	Pharr	0.16	0.14	-0.03	-16.81
Throckmorton	Wichita Falls	0.1	0.08	-0.02	-16.97
Jack	Fort Worth	0.24	0.2	-0.04	-16.99
Somervell	Fort Worth	0.23	0.19	-0.04	-17.01

Potential Reason for changes in NOx Emission

- The largest increase in emission comes from the increase in diesel combination trucks percentages in the Brownwood, San Angelo, San Antonio, and Bryan districts. Diesel combination trucks have emission rates of around 4 gram/mi. In contrast gasoline passenger cars have an emission rate of around 0.1 gram/mi.
- For the counties with most reduction in emission, reduction in the diesel combination trucks was key in reducing the overall emission.
- Diesel combination trucks have ~ 40 times higher emission rate than gasoline passenger cars.

Conclusion and Next Steps

Conclusion

- Not much change in emissions between FY22 and FY23 VMT-Mix.
- Certain pollutants emission rates vary a lot by SUT+FT (diesel CLhT, CShT, RT... for NOx). Any error in VMT-Mix will amplify emissions a lot depending on the SUT+FT being affected.
- From a national perspective, using defaults versus state-specific methodology to get VMTs by SUT+FT can lead to very different emissions. Need to have *uniformity in VMT-Mix estimation across states.*
- Given the high sensitivity to VMT-Mix, there is *need to have a standalone study* for VMT-Mix estimation.

Next Steps

- Work on Memo for Task 5.3 VMT-Mix based on this ppt's structure.
- Finalize literature review on VMT-MIx development methodologies.