5. EMISSIONS FACTOR ESTIMATION

A regional emissions analysis must be conducted for multiple analysis years to satisfy the requirements of 40 CFR Part 93.109 of the conformity rule for ozone nonattainment areas. Specifically, the regional emissions analysis is used to conduct the emission budget test (or interim emission tests) and to determine any contributions to emission reductions. The procedures for determining regional transportation-related emissions are described in 40 CFR Part 93.118 of the conformity rule. The following sections discuss the analysis years, and a description of the modeling processes used to conduct the analysis.

5.1 EMISSIONS FACTOR ESTIMATION MODEL

According to 40 CFR 93.111 of the conformity rule, the determination must be based on the latest emission estimation model. The EPA released the new Motor Vehicle Emission Simulator (MOVES) model, MOVES3.1 that was released in 2021, with an effective date January 7, 2021. The grace period to use MOVES3 for conformity analysis ends on September 12, 2025.

As outlined in the Pre-Analysis Consensus Plan (PACP), included in Appendix F.1 – Approved PACP, the Interagency Consultation Partners approved the use of MOVES3.1 to develop 2026, 2035, 2040, and 2050 vehicle emission factors. Emission factors are one component to determine VOC and NOx emissions from the region's on-road vehicles.

MOVES3.1 input parameters are listed in Table 5-1 through Table 5-9 with the appropriate data source and/or methodology applied. The information listed applies to all counties and analysis years unless otherwise specified.

Table 5-1. MOVES Input Parameters and data source

Input Parameter Name	Description	Source
Source Type Population	Input the number of vehicles in the geographic area, which is to be modeled for each vehicle, and apply the appropriate growth factors for each analysis year.	End-of-year 2021 TxDMV registration data
Source Type Age Distribution	Input that provides the distribution of vehicle counts by age for each calendar year and vehicle type. TxDMV registration data is used to estimate the age distribution of vehicle types up to 31 years. The distribution of Age fractions should sum up to 1.0 for all vehicle types for each analysis year.	End-of-year 2021 TxDMV registration data; MOVES defaults for refuse trucks, motor homes, and buses
Vehicle Type VMT	County specific VMT is distributed to HPMS Vehicle types.	Travel Model Output
Average Speed Distribution	Input average speed data specific to vehicle type, road type, and time of day/type of day into 16 speed bins. The sum of speed distribution to all speed bins for each road type, vehicle type, and time/day type is 1.0.	Travel Model Output
Road Type Distribution (VMT Fractions)	Input County specific VMT by road type. VMT fraction is distributed between the road type and must sum to 1.0 for each source type.	Travel Model Output
Fuel Supply	Input to assign existing fuels to counties, months, and years, and to assign the associated market share for each fuel.	TTI, TCEQ, EPA Fuel Surveys and default MOVES input where local data unavailable
Fuel Formulation	Input county specific fuel properties in the MOVES database.	TTI, TCEQ, EPA Fuel Surveys and default MOVES input where local data unavailable
Meteorology	County specific data on temperature, relative humidity and barometric pressure.	Regional data from TCEQ

Input Parameter Name	Description	Source
Inspection and Maintenance (I/M) Coverage	Input I/M coverage record for each combination of pollutants, process, county, fuel type, regulatory class, and model year are specified using this input.	TCEQ
Fuel Engine Fraction/Diesel Fraction	Input fuel engine fractions (i.e. Gasoline vs. Diesel Engine types in the vehicle population) for all vehicle types.	End-of-year 2021 TxDMV registration data for particular source type diesel fractions; MOVES defaults for other source types (TTI provided the data. The evaluation year-specific local diesel fractions for the MOVES single unit and combination truck source use types were developed using the TxDMV data, for all analysis years, aggregated to the statewide level).

Table 5-2. Fuel Supply

Fuel Formulation ID	Market Share	Market Share CV[7]
2678	1	0
30600	1	0

Table 5-3. Fuel Properties

Fuel Type	Gasoline	Diesel
Fuel Formulation ID	2678	30600
Fuel Subtype ID	12	21
RVP	7.09	0
Sulfur Level	10	6
ETOH Volume	9.56	0
MTBE Volume	0	0
ETBE Volume	0	0
TAME Volume	0	0
Aromatic Content	16.98	0
Olefin Content	10.08	0
Benzene Content	0.37	0
e200	46.96	0
e300	85.00	0
Vol to Wt Percent Oxy	0.3653	0
BioDieselEster Volume	N/A	2.82
Cetane Index	N/A	N/A
PAH Content	N/A	N/A
T50	210.50	0
T90	325.10	0

Note: N/A = not applicable

[7] Market Share CV – the coefficient variation of the market share

Table 5-4. Meteorological Data (2011 Hourly Temperatures)

Hour	Collin	Dallas	Denton	Ellis	Johnson	Kaufman	Parker	Rockwall	Tarrant	Wise
12:00 AM	85.18	85.18	85.18	85.18	85.55	85.18	85.55	85.18	85.55	85.55
1:00 AM	84.01	84.01	84.01	84.01	84.40	84.01	84.40	84.01	84.40	84.40
2:00 AM	82.97	82.97	82.97	82.97	83.06	82.97	83.06	82.97	83.06	83.06
3:00 AM	81.91	81.91	81.91	81.91	81.82	81.91	81.82	81.91	81.82	81.82
4:00 AM	80.79	80.79	80.79	80.79	80.87	80.79	80.87	80.79	80.87	80.87
5:00 AM	79.73	79.73	79.73	79.73	79.56	79.73	79.56	79.73	79.56	79.56
6:00 AM	78.85	78.85	78.85	78.85	78.64	78.85	78.64	78.85	78.64	78.64
7:00 AM	80.01	80.01	80.01	80.01	79.29	80.01	79.29	80.01	79.29	79.29
8:00 AM	82.83	82.83	82.83	82.83	82.76	82.83	82.76	82.83	82.76	82.76
9:00 AM	86.30	86.30	86.30	86.30	86.59	86.30	86.59	86.30	86.59	86.59
10:00 AM	89.61	89.61	89.61	89.61	89.88	89.61	89.88	89.61	89.88	89.88
11:00 AM	92.62	92.62	92.62	92.62	93.30	92.62	93.30	92.62	93.30	93.30
12:00 PM	95.10	95.10	95.10	95.10	95.90	95.10	95.90	95.10	95.90	95.90
1:00 PM	97.02	97.02	97.02	97.02	97.72	97.02	97.72	97.02	97.72	97.72
2:00 PM	98.43	98.43	98.43	98.43	99.34	98.43	99.34	98.43	99.34	99.34
3:00 PM	99.36	99.36	99.36	99.36	100.26	99.36	100.26	99.36	100.26	100.26
4:00 PM	99.83	99.83	99.83	99.83	100.72	99.83	100.72	99.83	100.72	100.72
5:00 PM	99.57	99.57	99.57	99.57	100.42	99.57	100.42	99.57	100.42	100.42
6:00 PM	98.38	98.38	98.38	98.38	99.30	98.38	99.30	98.38	99.30	99.30
7:00 PM	96.03	96.03	96.03	96.03	97.18	96.03	97.18	96.03	97.18	97.18
8:00 PM	92.57	92.57	92.57	92.57	93.54	92.57	93.54	92.57	93.54	93.54
9:00 PM	89.93	89.93	89.93	89.93	90.73	89.93	90.73	89.93	90.73	90.73
10:00 PM	88.10	88.10	88.10	88.10	88.71	88.10	88.71	88.10	88.71	88.71
11:00 PM	86.49	86.49	86.49	86.49	86.90	86.49	86.90	86.49	86.90	86.90

Table 5-5. Meteorological Data (2011 Hourly Relative Humidity Data)

Hour	Collin	Dallas	Denton	Ellis	Johnson	Kaufman	Parker	Rockwall	Tarrant	Wise
12:00 AM	50.15	50.15	50.15	50.15	46.12	50.15	46.12	50.15	46.12	46.12
1:00 AM	52.90	52.90	52.90	52.90	49.02	52.90	49.02	52.90	49.02	49.02
2:00 AM	55.75	55.75	55.75	55.75	52.67	55.75	52.67	55.75	52.67	52.67
3:00 AM	58.76	58.76	58.76	58.76	56.13	58.76	56.13	58.76	56.13	56.13
4:00 AM	61.87	61.87	61.87	61.87	58.63	61.87	58.63	61.87	58.63	58.63
5:00 AM	64.62	64.62	64.62	64.62	61.78	64.62	61.78	64.62	61.78	61.78
6:00 AM	67.70	67.70	67.70	67.70	64.12	67.70	64.12	67.70	64.12	64.12
7:00 AM	66.62	66.62	66.62	66.62	63.75	66.62	63.75	66.62	63.75	63.75
8:00 AM	61.31	61.31	61.31	61.31	57.63	61.31	57.63	61.31	57.63	57.63
9:00 AM	54.11	54.11	54.11	54.11	50.25	54.11	50.25	54.11	50.25	50.25
10:00 AM	47.49	47.49	47.49	47.49	43.90	47.49	43.90	47.49	43.90	43.90
11:00 AM	41.71	41.71	41.71	41.71	37.73	41.71	37.73	41.71	37.73	37.73
12:00 PM	37.19	37.19	37.19	37.19	33.36	37.19	33.36	37.19	33.36	33.36
1:00 PM	33.77	33.77	33.77	33.77	30.55	33.77	30.55	33.77	30.55	30.55
2:00 PM	31.20	31.20	31.20	31.20	27.84	31.20	27.84	31.20	27.84	27.84
3:00 PM	29.42	29.42	29.42	29.42	26.27	29.42	26.27	29.42	26.27	26.27
4:00 PM	28.42	28.42	28.42	28.42	25.32	28.42	25.32	28.42	25.32	25.32
5:00 PM	28.30	28.30	28.30	28.30	25.17	28.30	25.17	28.30	25.17	25.17
6:00 PM	29.47	29.47	29.47	29.47	26.04	29.47	26.04	29.47	26.04	26.04
7:00 PM	32.42	32.42	32.42	32.42	28.45	32.42	28.45	32.42	28.45	28.45
8:00 PM	37.26	37.26	37.26	37.26	32.77	37.26	32.77	37.26	32.77	32.77
9:00 PM	41.36	41.36	41.36	41.36	36.64	41.36	36.64	41.36	36.64	36.64
10:00 PM	44.22	44.22	44.22	44.22	39.91	44.22	39.91	44.22	39.91	39.91
11:00 PM	47.42	47.42	47.42	47.42	43.27	47.42	43.27	47.42	43.27	43.27

Table 5-6. Meteorological Data (2011 Barometric Pressure Data)

County	Barometric Pressure
Collin	29.87
Dallas	29.87
Denton	29.87
Ellis	29.87
Johnson	29.85
Kaufman	29.87
Parker	29.85
Rockwall	29.87
Tarrant	29.85
Wise	29.85

Table 5-7. I/M Descriptive Inputs for Subject Counties

2026			
Collin, Dallas, Denton, Ellis, Johnson, Kaufman, Parker, Rockwall, and Tarrant I/M Data[8]			
I/M Program ID	20	24	Differentiates I/M programs
Pollutant Process ID	101, 102, 201, 202, 301, 302	112	Identifies the pollutant and vehicle process
Source Use Type	21, 31, 32	21, 31, 32	Identifies the vehicle type
Begin Model Year	2002	2002	Model year I/M Program begins
End Model Year	2024	2024	Model year I/M Program ends
Inspection Frequency	1	1	Annual testing; program specifications
Test Standards Description	Exhaust OBD Check	Evaporative Gas Cap and OBD Check	Identifies test type
Test Standards ID	51	45	Identifies test with MOVES3.1 database test standards IDs
I/M Compliance	93.90% for source type 21, 90.25% for source type 31, and 70.67% for source type 32		Expected compliance (%) - MOVES3.1 Default

Note: Begin Model Year and End Model Year define the range of vehicle model years covered by I/M program.

[8] Wise County does not have I/M program.

Table 5-7 (continued): I/M Descriptive Inputs for Subject Counties

2035			
Collin, Dallas, Denton, Ellis, Johnson, Kaufman, Parker, Rockwall, and Tarrant I/M Data			
I/M Program ID	20	24	Differentiates I/M programs
Pollutant Process ID	101, 102, 201, 202, 301, 302	112	Identifies the pollutant and vehicle process
Source Use Type	21, 31, 32	21, 31, 32	Identifies the vehicle type
Begin Model Year	2011	2011	Model year I/M Program begins
End Model Year	2033	2033	Model year I/M Program ends
Inspection Frequency	1	1	Annual testing; program specifications
Test Standards Description	Exhaust OBD Check	Evaporative Gas Cap and OBD Check	Identifies test type
Test Standards ID	51	45	Identifies test with MOVES3.1 database test standards IDs
I/M Compliance	93.90% for source type 21, 90.25% for source type 31, and 70.67% for source type 32		Expected compliance (%) - MOVES3.1 Default

Note: Begin Model Year and End Model Year define the range of vehicle model years covered by I/M program.

Table 5-7 (continued): I/M Descriptive Inputs for Subject Counties

2040			
Collin, Dallas, Denton, Ellis, Johnson, Kaufman, Parker, Rockwall, and Tarrant I/M Data			
I/M Program ID	20	24	Differentiates I/M programs
Pollutant Process ID	101, 102, 201, 202, 301, 302	112	Identifies the pollutant and vehicle process
Source Use Type	21, 31, 32	21, 31, 32	Identifies the vehicle type
Begin Model Year	2016	2016	Model year I/M Program begins
End Model Year	2038	2038	Model year I/M Program ends
Inspection Frequency	1	1	Annual testing; program specifications
Test Standards Description	Exhaust OBD Check	Evaporative Gas Cap and OBD Check	Identifies test type
Test Standards ID	51	45	Identifies test with MOVES3.1 database test standards IDs
I/M Compliance	93.90% for source type 21, 90.25% for source type 31, and 70.67% for source type 32		Expected compliance (%) - MOVES3.1 Default

Note: Begin Model Year and End Model Year define the range of vehicle model years covered by I/M program.

Table 5-7 (continued): I/M Descriptive Inputs for Subject Counties

2050			
Collin, Dallas, Denton, Ellis, Johnson, Kaufman, Parker, Rockwall, and Tarrant I/M Data			
I/M Program ID	20	24	Differentiates I/M programs
Pollutant Process ID	101, 102, 201, 202, 301, 302	112	Identifies the pollutant and vehicle process
Source Use Type	21, 31, 32	21, 31, 32	Identifies the vehicle type
Begin Model Year	2026	2026	Model year I/M Program begins
End Model Year	2048	2048	Model year I/M Program ends
Inspection Frequency	1	1	Annual testing; program specifications
Test Standards Description	Exhaust OBD Check	Evaporative Gas Cap and OBD Check	Identifies test type
Test Standards ID	51	45	Identifies test with MOVES3.1 database test standards IDs
I/M Compliance	93.90% for source type 21, 90.25% for source type 31, and 70.67% for source type 32		Expected compliance (%) - MOVES3.1 Default

Note: Begin Model Year and End Model Year define the range of vehicle model years covered by I/M program

Table 5-8. MOVES Emissions Factor Post-Processing to be Performed by County and Year

Strategy and Post-processing Result	Detail
Texas Low Emission Diesel Fuel (TxLED)	Not Applied[9] to all modeled counties

Table 5-9. Emission Controls Used for Conformity Credit

Emission Reduction Strategy and Years Covered	Modeling or Post-Processing Approach	Analysis Year
Intersection Improvements	Post Processed	2026
Transit Service	Modeled	All
High Occupancy Vehicle/Managed Lanes	Modeled	All
Park-n-Ride Lots	N/A	N/A
Vanpools	N/A	N/A
Grade Separations	Modeled	All
Traffic Signal Improvements	N/A	N/A
Intelligent Transportation Systems	Post Processed	2026
Clean Vehicle Commitments	N/A	N/A
Bicycle/Pedestrian Facilities	Post Processed	2026
Employer Trip Reduction Programs	N/A	N/A
Sustainable Development	N/A	N/A
Public Education/Ozone Season Fare Reduction	N/A	N/A

Note: N/A = not applicable

[9] NCTCOG will not apply TxLED since using EPA's recent guidance will yield negligible benefits

5.2 Modeled Emission Estimates

Modeled emission estimates are calculated using TTI emission inventory estimation utilities using moves: MOVES3Utils, developed by TTI for MOVES. This utility combines vehicle activity and emissions factors to create emission estimates at the link level.

5.2.1 Vehicle Registration Distribution

Vehicle registration (age) distributions were developed using the latest available TxDMV analysis year-specific county vehicle registration data. 2021 data was used for the analysis years 2026, 2035, 2040, and 2050. MOVES defaults were used where the required information was not available in the TxDMV data.

The input values for each vehicle class are 31 age fractions representing the fraction of vehicles by age for that vehicle class as of December of the evaluation year. These age fractions start with the evaluation year as the 1st age fraction and work back in annual increments to end with the 31st fraction, which represents the fraction of vehicles of age 30 years and older. The fractions are calculated as the model-year-specific registrations in a class divided by the total vehicles registered in that class.

5.2.2 Alternative Fuel Vehicle Technology

Alternative Fuel Vehicle Technology (AVFT) fractions were developed using the latest available TxDMV analysis year-specific county vehicle registration data. 2021 data was used for the analysis years 2026, 2035, 2040, and 2050. MOVES defaults were used where the required information was not available in the TxDMV data.

TTI developed the evaluation year-specific local diesel fractions for the MOVES single unit and combination truck source use types using the latest TxDMV data, for all analysis years, aggregated to the statewide level. For all source types, CNG and electricity fractions were set to zero and the gasoline/diesel/flex-fuel fractions were normalized (sum to 1.0) for each source type and model year. Fuel usage for flex-fuel vehicles was set to 100% gasoline (in the fuel usage fraction input table).

5.2.3 VMT Mix

VMT mix (or fractions) is very important to be able to estimate link emissions. The VMT mix is applied to the emission factors in a post-process methodology. The VMT mix enables the assignment of emission factors by vehicle type to VMT to calculate emissions on a specified roadway facility or functional class. VMT mix is estimated for four MOVES roadway types: Rural Restricted (rural freeways), Rural Unrestricted (rural arterials and collectors), Urban Restricted (urban freeways), and Urban Unrestricted (urban arterials and collectors) for daily time periods for each of the modeled counties. Each county's roadway sections are classified as rural or urban by the vehicle activity behavior and the demographics of the county. The VMT

mix methodology utilizes data, assumptions, and procedures from the TxDOT, TTI, and the Dallas Fort Worth region TDM.

Consistent with the prior analysis, the VMT mixes were produced in five-year increments and applied to analysis years as follows:

- 2015 VMT mix – for 2013 through 2017 analysis years,
- 2020 VMT mix – for 2018 through 2022 analysis years,
- 2025 VMT mix – for 2023 through 2027 analysis years, etc.

Using the latest available vehicle classification counts 2013-2021 and MOVES3.1 defaults, TTI estimated the time-of-day (AM Peak, Mid-Day, PM Peak, Overnight) VMT mixes by the four MOVES road types. No seasonal adjustments are made for VMT mix.