Appendix I-Mobile Input Parameters

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ANALYSIS SUMMARY

DATE: 16 March 2020

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SUBJECT: El Paso MPO's Destino 2045 MTP Update Conformity Analysis – Analysis Notes

1. INTRODUCTION - REGIONAL MOBILE SOURCE EMISSION INVENTORIES FOR EL PASO METROPOLITAN PLANNING ORGANIZATION – FY2020

This document provides analysis summaries and notes related to regional transportation emission inventories performed by Texas A&M Transportation Institute (TTI) for the El Paso Metropolitan Planning Organization (EPMPO) and sponsored by Texas Department of Transportation (TXDOT). The emission inventories described in this document are based on the Amended Destino 2045 Metropolitan Transportation Plan (MTP), and are of the quality and scope suitable for demonstrating transportation conformity. The emission inventories were undertaken between February 2020 to March 2020. EPMPO requires three different analyses to satisfy regulatory requirements:

- El Paso County and Dona Ana County (New Mexico) PM-10 Nonattainment Summer and Winter Weekday Emissions Estimates.
- Sunland Park Ozone Nonattainment Area Summer Weekday Emissions Estimates.
- El Paso Carbon Monoxide Maintenance Area Winter Weekday Emissions Estimates.

Each inventory requires different input data, uses different methodologies and estimates different pollutants. To ensure that the methods used in each analysis are clear and precise, TTI have developed three separate analysis notes (methodologies). These analysis notes are documented in subsequent sections of this document, following a summary of the results obtained from all the emission inventories.

2. EMMISSION SUMMARIES – EL PASO DESTINO 2045 METROPOLITAN TRANSPORTATION PLAN AMENDMENT – FY2020

Table 2-1. Summer Weekday Paved Road PM-10 Emissions Summary (tons/day)

Year	Area[1]	VMT	Speed	Direct Vehicle PM-10	Resuspended Dust PM-10	PM-10 Total
2020	El Paso County	19,415,378	35.8	1.45	5.35	6.80
	Dona Ana Zones	724,050	35.9	0.06	0.31	0.37
2030	El Paso County	22,015,123	35.5	1.32	6.07	7.39
	Dona Ana Zones	907,020	35.8	0.06	0.38	0.44
2040	El Paso County	24,297,818	35.3	1.41	6.60	8.01
	Dona Ana Zones	1,026,020	34.9	0.07	0.43	0.50
2045	El Paso County	25,245,745	35.1	1.47	6.83	8.30
	Dona Ana Zones	1,083,812	34.4	0.07	0.46	0.53

[1] Dona Ana zones are the whole of Dona Ana County, NM, within the El Paso regional TDM (including Sunland Park area).

Table 2-2. Winter Weekday Paved Road PM-10 Emissions Summary (tons/day)

Year	Area[1]	VMT	Speed	Direct Vehicle PM-10	Resuspended Dust PM-10	PM-10 Total
2020	El Paso County	20,026,973	35.5	1.56	5.72	7.28
	Dona Ana Zones	746,858	35.9	0.06	0.33	0.39
2030	El Paso County	22,708,612	35.2	1.39	6.49	7.88
	Dona Ana Zones	935,592	35.7	0.06	0.41	0.47
2040	El Paso County	25,063,213	35.0	1.48	7.05	8.54
	Dona Ana Zones	1,058,340	34.7	0.07	0.46	0.53
2045	El Paso County	26,041,000	34.7	1.55	7.30	8.85
	Dona Ana Zones	1,117,953	34.2	0.07	0.49	0.56

[1] Dona Ana zones are the whole part of Dona Ana County, NM, within the El Paso regional TDM (including Sunland Park area).

Table 2-3. Winter Weekday CO Emissions Summary (tons/day)

Year	Area[1]	VMT	Speed	CO
2020	El Paso Carbon Monoxide Maintenance Area	1,311,154	41.7	5.06

[1] El Paso regional TDM zones comprising the CO maintenance area in El Paso County, TX.

Table 2-4. Summer Weekday NOx and VOC Emissions Summary (tons/day)

Year	Area[1]	VMT	Speed	NOx	VOC
2017 baseline	Sunland Park Ozone Nonattainment Area	95,887	31.1	0.10	0.053
2020		105,975	31.1	0.08	0.047
2030		120,830	30.5	0.04	0.028
2040		134,283	29.8	0.03	0.019
2045		140,139	29.6	0.03	0.019

[1] El Paso regional TDM zones comprising the Sunland Park ozone nonattainment area, in Dona Ana County, NM.

3. EL PASO COUNTY AND DONA ANA COUNTY, NM SUMMER AND WINTER WEEKDAY EMISSIONS ANALYSIS

SUMMARY

Under sponsorship of the Texas Department of Transportation (TxDOT), the Texas A&M Transportation Institute (TTI) produced El Paso and Dona Anna area, on-road mobile source emissions estimates in support of the El Paso Metropolitan Planning Organization (EPMPO) transportation planning efforts. This analysis description is for the PM-10 nonattainment area within El Paso County, and the portion of the Dona Ana County New Mexico included in the area travel demand model (TDM). Results are representative of typical summer and winter weekdays for 2020, 2030, 2040 and 2045.

TTI used its on-road inventory methodology to produce emissions estimates of the detail and quality suited for state implementation planning for air quality control and transportation conformity analyses. This is the detailed, disaggregate, TDM link-based rates-per-activity emissions estimation process. It uses MOVES2014a-based county emissions rate look-up tables based on local conditions for external emissions calculations performed at detailed, disaggregate, temporal, and spatial levels, using latest planning assumptions, and latest available data, models, and procedures.[1]

Hourly inventories were estimated by MOVES source use type (SUT) and fuel type (FT) combination (or vehicle type) and TDM roadway class. TDMs were post-processed to estimate hourly, directional, link (roadway segment)-level vehicle miles of travel (VMT) and operational speeds for the roadway-based emissions calculations. Using estimates of vehicle operating hours (VHT), vehicle populations, truck hotelling activity, and other data, TTI estimated hourly off-network activity factors for the parked vehicle-based emissions calculations. Off-network activity types are source-hours-parked (SHP); starts; and source hours extended idling (SHI) and auxiliary power unit (APU) hours (emissions-producing components of combination long-haul truck hotelling hours). Off-network evaporative rates (in mass/SHP form, not directly available from MOVES) were produced by a post-processing procedure and were compiled with other rates produced directly by MOVES to yield look-up tables of all rates in activity terms for the external emissions calculations.[2] The analyses used TTI's MOVES-based inventory development utilities for use with MOVES2014a.[3] EPA's Technical Guidance is the primary reference on appropriate inputs and use of MOVES.[4]

[1] TTI used the November 2016 MOVES2014a release, which produces the latest available on-road mobile source emission rates. All later MOVES updates through MOVES2014b produce the same on-road emissions rates as the November 2016 release.

[2] Although not needed for PM analyses, TTI produces these SHP-based hydrocarbon emission rates in the comprehensive set of emission rates look-up tables, developed as a standard part of the inventory process.

[3] TTI Emissions Inventory Estimation Utilities Using MOVES: MOVES2014aUtl User's Guide, TTI, August 2016.

[4] MOVES2014, MOVES2014a, and MOVES2014b Technical Guidance: Using MOVES to Prepare Emission Inventories for Sate Implementation Plans and Transportation Conformity, EPA, August 2018.

SCOPE OF EMISSIONS ANALYSIS

1. Methodology:

- Exhaust, tire and brake wear emissions: Detailed, hourly, MOVES rates-per-activity, TDM link-based, most recent version of MOVES (for on-road mobile modeling).[5]
- Paved road re-suspended dust: 24-hour, by road type, EPA's AP-42 re-suspended dust model.[6]

2. Analysis Years:

2020, 2030, 2040, and 2045.

3. Seasonal Period:

- Summer: Average June-July-August weekday (average Monday through Friday).
- Winter: Average January-February-December weekday.

4. Geography:

El Paso County and the portion of Dona Ana County within the TDM.

5. Pollutants:

Particulate matter 10 micrometers or less in diameter (PM-10).

6. Sources:

Table 3-5. Vehicle Types Modeled in the Inventory.

MOVES SUT	Gasoline*	Diesel*
Motorcycle	MC_G	-
Passenger Car	PC_G	PC_D
Passenger Truck	PT_G	PT_D
Light Commercial Truck	LCT_G	LCT_D
Intercity Bus	-	IBus_D
Transit Bus	-	TBus_D
School Bus	SBus_G	SBus_D
Refuse Truck	RT_G	RT_D
Single Unit Short-Haul Truck	SUShT_G	SUShT_D
Single Unit Long-Haul Truck	SULhT_G	SULhT_D
Motor Home	MH_G	MH_D
Combination Short-Haul Truck	CShT_G	CShT_D
Combination Long-Haul Truck	-	CLhT_D

These vehicle type (SUT/fuel type) labels are referenced later in the document.

[5] TTI used the November 2016 MOVES2014a release, which produces the latest available on-road mobile source emission rates. All later MOVES updates through MOVES2014b produce the same on-road emission rates as the November 2016 release.

[6] AP-42 paved road re-suspended model provided in "AP-42, Fifth Edition, Volume 1, Chapter 13: Miscellaneous Sources, 13.2.1 Paved Roads" (EPA, January 2011, https://www3.epa.gov/ttn/chief/ap42/ch13/index.html).

7. Link-Based Emissions Estimation Process Components and Utilities:

TTI developed the inventory components and resulting emissions and activity estimates for the analysis using TTI's utilities developed and maintained for this purpose.

a. Inventory Components:

The emissions estimation process required development of the following major components for the emissions calculations:

- Hourly, directional, link-level, on-road fleet VMT, and average speeds;
- SUT/fuel type (i.e., vehicle type) time-of-day VMT mix;
- Vehicle type populations; [7]
- Hourly, vehicle type SHP;
- Hourly, vehicle type starts;
- Hourly, diesel combination long-haul truck hotelling (emissions generating SHI and APU hours components); and
- Hourly vehicle type pollutant and process mass emissions rates: mass per mile, mass per SHP, mass per start, mass per SHI, and mass per APU hour.

b. Utilities:

TTI used its emissions estimation utilities to produce the input components and the emissions estimates in the tab-delimited hourly and 24-hour emissions and activity summary file formats. The TTI utilities include MOVES emission rates input and output processing utilities, TDM network information post-processing utility, vehicle population and off-network activity development utilities, and the link-level emissions calculation utility.[8]

DEVELOPMENT OF ON-ROAD FLEET LINK-VMT AND SPEEDS

8. Travel Demand Models:

TTI received the El Paso MPO's Amended Destino 2045 MTP TDM data sets (i.e., trip matrices and four-time-period, directional, average non-summer weekday [ANSWT] traffic assignments), February 2019.[9] Data sets for this analysis included the 2020, 2030, 2040, and 2045 future analysis years. TTI post-processed the data sets to determine average seasonal (i.e., summer and winter) weekday, county-coded[10], hourly, directional, Highway Performance Monitoring System (HPMS)-consistent, network link VMT and volumes and added intrazonal link VMT estimates. (TDM network ANSWT VMT plus intrazonal ANSWT VMT is referred to herein as "total model VMT".) Method details are found in MOVES2014a-Based Travel Demand Model Link Emissions Estimation Method (TTI, August 2016).

[7] Vehicle populations are an intermediate parameter used in estimating off-network source hours parked and starts activity.
[8] TTI Emissions Inventory Estimation Utilities Using MOVES: MOVES2014aUtl User's Guide, TTI, August 2016.
[9] The EPMPO provided the TDM data sets for 2020 (February 14, 2020), 2030 (February 18, 2020), 2040 and 2045 future years (February 20, 2020).
[10] To facilitate use of these TDM link-data sets in a separate analysis of the Sunland Park area of Dona Ana County, NM the following county (and partial county) coding was applied: "1" for El Paso County and "2" and "3" for the complete portion of Dona Ana County in the TDM, where "2" is the Dona Ana area excluding the Sunland Park ozone nonattainment area (NAA) and "3" is exclusively the Sunland Park NAA in Dona Ana County.

a. Adjustments to TDM VMT:

The ANSWT network link volumes and VMT and added intrazonal link VMT were factored to be consistent with HPMS VMT, to reflect summer and winter weekday activity, to allocate by hour, and to allocate total link volumes by direction of travel. The seasonal weekday and hourly factors were developed using the latest available 10-year aggregate, TxDOT Automatic Traffic Recorder (ATR) traffic count data (2009 – 2018) for El Paso County.

i. Historical Year HPMS Consistency and Seasonal Weekday Adjustments:

HPMS consistency: Not applicable to this analysis.

Seasonal adjustment: Not applicable to this analysis.

ii. Forecast Years HPMS Consistency and Seasonal Weekday Adjustments:

HPMS consistency: TTI applied an HPMS adjustment factor to total model link-level VMT for all county and partial county areas for each analysis year. The validation year HPMS adjustment factor was calculated as 2012 El Paso County HPMS VMT (first adjusted to ANSWT form using the ANSWT/AADT ATR count ratio) divided by 2012 validation year total model VMT for El Paso County[11]. See Table 3-10 in Attachment 3.1,

Seasonal adjustment: Seasonal day-type factors (summer and winter weekday) were produced and used with the 2020, 2030, 2040, and 2045 analysis years. These factors were calculated as the ratio of the seasonal weekday-to-ANSWT counts. See Table 3-11 in Attachment 3.1,

iii. Seasonal Weekday Hourly VMT Distributions:

Summer and winter weekday, hourly travel factors were developed and used to allocate the 24-hour link VMT/volume estimates to each hour of the day – a single set was used for all analysis years. In order to maintain VMT proportions within each of the four time periods, the hourly fractions were normalized within each time period. See Table 3-12 in Attachment 3.1.

iv. Directional Factors:

Directional split factors were applied to total link volumes by functional class and area type. The directional factors were created by aggregating TDM link-level volumes by direction for each functional class/area type. Link-level AB directional volumes were divided by total volumes for each functional class/area type to estimate the direction split. These are the same factors applied in the prior El Paso conformity analysis.

b. Hourly Congested Speeds:

TTI estimated directional, hourly operational link speeds using the TTI speed model, which estimates delay on each link as a function of volume-to-capacity and applies it to the link's estimated free-flow speed. TTI estimated the local streets category average operational link speeds represented by the

[11] The 2012 validation year TDM total model VMT was consistent with the prior Destino 2045 MTP conformity analysis (EPMPO, August 2018).

centroid connector links, as centroid connector TDM input speeds; and represented as added intrazonal links, as the average of the zone's centroid connector input speeds.

DEVELOPMENT OF VEHICLE TYPE VMT MIX

9. VMT Mix:

The VMT mix designates the vehicle categories included in the analysis and specifies the fraction of on-road fleet VMT attributable to each vehicle type.

a. Method:

VMT mixes were estimated using TTI's VMT mix method.[12] The method sets Texas vehicle registration category aggregations for MOVES SUT categories for developing the VMT mixes, as well as for developing other fleet parameters needed elsewhere in the process (e.g., SUT age distributions, vehicle population estimates).

b. Temporal and Spatial Aspects:

The VMT mixes, consistent with the prior analysis, were produced in five-year increments and are 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.

No seasonal adjustments are made for VMT mix. Average weekday vehicle type VMT mixes by MOVES road type and by four time-of-day periods (AM Peak, Mid-Day, PM Peak, Overnight) were estimated for the TxDOT El Paso District for use with the El Paso TDM region.[13]

c. Data Sources:

TTI used the latest available multi-year TxDOT El Paso District vehicle classification counts (2005-2014) and associated Texas Department of Motor Vehicles (TxDMV) year-end registration data (2013), along with MOVES default data, as needed (i.e., appropriate for each analysis year).

d. Vehicle Types:

The vehicle types in the VMT mix are the 22 gasoline and diesel MOVES SUT combinations shown in Table 3-5.

[12] *Developing MOVES Source Use Types and VMT Mix for Conformity Analysis* (TxDOT Air Quality / Conformity IAC-A - TTI Task 409252-0643: Maintain, Update and Enhance Traffic Activity Estimation and Forecasting Methods), Texas Department of Transportation, Austin, TX, August 2016.

[13] Using the same data sets and a similar procedure, aggregate (i.e., 24-hour, all road-types) TxDOT district-level weekday vehicle type VMT mixes were also produced for use in the vehicle population estimation.

DEVELOPMENT OF OFF-NETWORK ACTIVITY BY VEHICLE TYPE

10. County and Partial County Off-Network Activity:

Off-network activity types that produce PM emissions include vehicle engine starts and long-haul truck extended idling and diesel APU operation during hotelling.[14] Off-network estimates of starts, and hotelling activity for El Paso County were first developed using standard county-level procedures. Off-network activity estimates for the adjacent Dona Ana partial county area were then estimated (in two parts), as the product of the El Paso County off-network activity estimates and Dona Ana target area-to-El Paso County VMT ratios, or scaling factors. El Paso County vehicle populations were needed first for estimating county-level vehicle starts.

a. County Vehicle Population Estimates:

Vehicle populations were estimated only at the county-level, not for the partial county areas.[15] The county vehicle population estimates were based on the latest available TxDMV registration data, vehicle population factors derived from the VMT mix, and county-level VMT-based growth estimates for future years where actual registration data were not yet available. Since the latest available registration data for this analysis was mid-year 2014, vehicle population estimates were needed first for the 2014 historical year. The vehicle population estimates don't vary by season.

i. Historical Year Vehicle Population Estimates:

TxDMV registration data: Historical year vehicle population estimates are based on TxDMV mid-year registrations corresponding to the historical year. This registration data is aggregated into vehicle registrations categories (Table 3-6).

Vehicle population factors: Since the TxDMV registration data does not include each SUT/fuel type combination, vehicle population factors are developed using the 24-hour VMT mix for the historical year (as designated per Item 9.b). These factors are applied to the aggregated vehicle registration categories to split them into the SUT/fuel type combinations included in the analysis, creating the base (2014) El Paso County vehicle population estimates.

[14] Off-network SHP activity only produces evaporative hydrocarbon emissions and was not required in this analysis.
[15] No vehicle population estimates were needed for the Dona Ana partial county off-network activity estimation procedure.

Table 3-6. Vehicle Registration Aggregations and Vehicle Types for Estimating Vehicle Populations.

Vehicle Registration[1] Aggregation	Associated Vehicle Type[2]
Motorcycles	MC_G
Passenger Cars (PC)	PC_G; PC_D
Trucks <= 8,500 gross vehicle weight rating (GVWR) (pounds)	PT_G; PT_D; LCT_G; LCT_D
Trucks > 8,500 and <= 19,500 GVWR	RT_G; RT_D SUShT_G; SUShT_D MH_G; MH_D IBus_D TBus_G; TBus_D SBus_G; SBus_D
Trucks >19,500 GVWR	CShT_G; CShT_D
NA[2]	SULhT_G; SULhT_D CLhT_G; CLhT_D

[1] Mid-year TxDMV county registrations data extracts are used, consisting of 1) light-duty cars, trucks, and motorcycles; 2) heavy-duty diesel trucks, and 3) heavy-duty gasoline trucks.

[2] Vehicle population factors are the 24-hour weekday VMT mix fraction for each vehicle type (see Table 3.1 for label definitions) in a category divided by the sum of the VMT mix fractions for all vehicle types in a category, except long-haul trucks. The four long-haul vehicle type populations are estimated using a long-haul-to-short-haul VMT mix ratio applied to the short-haul SUT population estimate.

ii. Future Analysis Year County Vehicle Population Estimates:

TxDMV registration data: As described for historical year vehicle population estimates, the registration data were aggregated by vehicle registration category. Since registration data were not available for future year analyses, the most recent mid-year TxDMV registration data sets (2014) were used.

Vehicle population factors: As described for historical year vehicle population estimates, vehicle population factors developed using the analysis year 24-hour VMT mix were applied to vehicle registrations aggregated by category to split the categories into the SUT/fuel type combinations included in the analysis, creating the base (2014) El Paso County vehicle population estimates.

VMT-based growth estimates: For each analysis year, VMT-based growth estimates were calculated by dividing county, analysis year, summer weekday VMT by county, 2014 summer weekday VMT.[16] These growth estimates were applied to the base vehicle population estimates to scale from the 2014 base to each of the analysis year estimates.

b. SHP Activity:

Not applicable to this analysis. (PM emissions are not produced by SHP.)

[16] Base, summer weekday 2014 VMT for the scaling factors was calculated as the product of El Paso County 2014 AADT VMT (from TxDOT's RIFCREC data set) and the El Paso County ATR-based AADT to summer weekday conversion factor.

c. Starts Activity:

County-level vehicle engine starts were first estimated, followed by estimation of the starts for the partial county areas by scaling the county-level estimates.

i. County Estimates:

El Paso County engine starts were based on the MOVES national default starts per vehicle per hour by vehicle type and the El Paso County vehicle population estimates. MOVES default weekday starts per vehicle were calculated using MOVES national scale inventory mode default run activity output, as weekday day-type vehicle starts divided by vehicle population, for each hour and SUT/fuel type. The El Paso County vehicle starts activity estimates were then calculated in each weekday hour as the product of national default weekday starts/vehicle/hour and the El Paso County vehicle type population estimates.

ii. Partial County Estimates:

This procedure was performed for the two separately coded portions of the TDM Dona Ana area. For each area, the hourly starts by vehicle type were estimated by scaling the El Paso County starts activity using the ratio of the target Dona Ana area VMT to the El Paso County VMT. The aggregate of the two Dona Ana area weekday starts by vehicle type estimates is the estimate for the complete portion of Dona Ana County in the TDM region.

d. SHI and APU Hours as a Function of Hotelling Hours:

During hotelling, the truck's main engine is assumed to be idling, or its diesel APU is in use, or it is using electric power or no power. Hotelling hours were first estimated, followed by the hours attributed to the two emissions-producing hotelling components, SHI and diesel APU hours. County-level hotelling activity estimates were first developed, followed by estimates for the partial county areas, scaled from the county activity estimates using VMT ratios.

i. County Estimates:

County, analysis year, seasonal weekday hotelling hours were first estimated using 24-hour weekday hotelling hour estimates for a 2017 base year (from the recent TCEQ extended idling study); base and analysis year scenario VMT, speeds, and VMT mix; and analysis year scenario SHP estimation data.[17]

The 2017 base year county hotelling hours estimates for a 24-hour winter weekday from the TCEQ study were scaled to each analysis scenario using the ratio of analysis scenario-to-base combination long-haul truck 24-hour VMT (as truck VMT increases, so does the hotelling activity).

[17] Base estimates of hotelling hours are 2017 winter weekday estimates, developed by TTI as part of a truck extended idling study that produced county 24-hour hotelling estimate totals for all Texas counties, sponsored by TCEQ starting in 2017. The base VMT estimates for hotelling scaling factors were developed using 2017 Destino TDM datasets (provided by the EPMPO February 19, 2020) and VMT adjustments, VMT mix, and procedures described in Items 8 and 9.

The 24-hour hotelling estimates were then distributed to each hour using the hotelling hours distribution calculated as the inverse of the hourly distribution of VHT (or SHO, from the SHP calculation process) for combination long-haul trucks. Within each hour, SHP and hotelling hours were compared, and if hotelling hours exceeded SHP, hotelling hours were set equal to SHP.

The SHI and APU hours components of hotelling hours were then estimated for each hour using the hourly hotelling hours estimates, combination long-haul truck travel fractions (calculated from local age distributions, and moves default relative mileage accumulation rates), and hotelling activity distributions for each model year (Table 3-7).

The SHI and APU hours activity distribution fractions were each first multiplied by the travel distribution (model year operating mode activity fraction multiplied by the associated model year travel fraction).

The product of the SHI fractions and travel fractions were then summed to produce the total SHI fraction, and the same process was performed for APU hours to produce total APU hours fraction. (The sum of the SHI and APU hours fractions subtracted from 1.0 results in the remaining fraction of hotelling hours, consisting of the electric power or no power in use modes.)

The total SHI and APU hours fractions were then each multiplied by the hotelling hours for each hour of the day to produce the SHI and APU hours estimates for each hour.

Table 3-7. Hotelling Activity Distributions by Model Year.

Begin Model Year	End Model Year	OpModeFraction for opModelID/opModeName			
		200	201	203	204
		Extend Idling	Diesel Aux	Battery AC	APU Off
1960	2009	0.8	0	0	0.2
2010	2020	0.73	0.07	0	0.2
2021	2023	0.48	0.24	0.08	0.2
2024	2026	0.4	0.32	0.08	0.2
2027	2050	0.36	0.32	0.12	0.2

ii. Partial County Estimates:

For the partial county area estimates for SHI and APU hours as a function of hotelling hours, the procedure of applying a VMT ratio to county-level activity was performed. The SHI and APU hours for each hour for each Dona Ana area were calculated by scaling the El Paso County activity estimates using the ratios by area of the Dona Ana VMT to the El Paso County VMT. The aggregate results of these two areas makes the total of the Dona Ana partial county area in the TDM region.

DEVELOPMENT OF EMISSIONS FACTORS BY VEHICLE TYPE

11. Emission Factors Overview:

TTI developed emissions rates using MOVES and the TTI post-processing utility, RatesCalc, which prepares MOVES2014a-based, direct vehicle emissions rates for input to TTI's external inventory calculation utility, EmsCalc. The paved road re-suspended dust emission rates and emissions, discussed toward the end of this section, were calculated separately using the EPA's AP-42 model. El Paso County seasonal weekday emissions rates were produced for each analysis year for use in estimating emissions for all El Paso regional TDM area analyses.

These on-road emissions rates were developed in terms of mass per activity unit: miles for roadway-based processes; and SHP, starts, SHI, and APU hours for off-network processes. All activity-based rates were directly output by MOVES, except for parked vehicle evaporative emissions rates based in SHP. TTI used the RatesCalc utility to calculate emissions rates in terms of rate/SHP (as a conversion of MOVES rate/vehicle output) using the data in the county (local) input database (CDB) used in the MOVES emissions rates run and the MOVES default database. The RatesCalc utility combined the rate/distance, rate/hour (SHI and APU hours), and rate/start emissions rates tables from MOVES output and the calculated rate/SHP emissions rates table into a database of rates look-up tables.[18] For additional details on the post-processing of MOVES output, see Attachment 3.2.

Table 3-8 lists the emissions processes with associated activity basis and emissions rate units. The emissions factors were developed by pollutant, speed, process, hour, road type, and SUT/FT. The MOVES-based emissions factors include PM from exhaust, tire wear, and brake wear, whereas the paved road re-suspended dust estimates were calculated separately using the EPA's AP-42 model (see Item 11.d).

[18] Although SHP-based rates are for hydrocarbon evaporative emissions only, not required for this PM analysis, these rates were produced in order to have the comprehensive set pollutant emission rates available for other analyses.

Table 3-8. MOVES On-Road Emissions Rates Modeled by Process and Activity Factor.

Emissions Process	Activity[1]	Emissions Factor Units
Running Exhaust Crankcase Running Exhaust	VMT	mass/mile (mass/mi)
Brake Wear	VMT	mass/mi
Tire Wear	VMT	mass/mi
Start Exhaust Crankcase Start Exhaust	starts	mass/start
Extended Idle Exhaust Crankcase Extended Idle Exhaust	SHI	mass/shi
Auxiliary Power Exhaust	APU Hours	mass/APU hour
Evaporative Permeation Evaporative Fuel Vapor Venting Evaporative Fuel Leaks	VMT, SHP	mass/mi, mass/shp

[1] The amount of travel on roads (VMT), SHP, vehicle starts, SHI and APU hours are the basic activity factors. SHI and APU hours are for combination long-haul trucks only. Evaporative (hydrocarbon) permeation, fuel vapor venting, and fuel leaks occur both during operation and while parked.

a. MOVES Model Inputs:

All of the user-specified model settings and inputs for each run were contained in a MOVES run specification (MRS) and a CDB (the MOVES2014a default database used was "MOVESDB20161117"). See Attachment 3.2 for details on the MRS files and CDBs developed for El Paso County and used to estimate the seasonal weekday emission factors for each analysis year for all areas in the El Paso TDM region.

b. Emissions Factor Post-Processing Adjustments:

No emission rate adjustments were applied (e.g., El Paso County is not in the Texas Low Emissions Diesel [TxLED] program so no TxLED NOx adjustments were applied).

c. Emissions Controls Modeling:

Table 3-9 shows the modeling approaches used for the emissions control strategies. Unless otherwise stated, the control strategy was modeled in all years and seasons.

Table 3-9. Emissions Modeling Strategies and Approaches.

Strategy	Approach
Federal Motor Vehicle Control Program Standards	*MOVES defaults.*
Federal Heavy-Duty Diesel Engines Rebuild and 2004 Pull-Ahead Programs to Mitigate NOx Off-Cycle Effects	*MOVES defaults.*
Gasoline Fuel – Tier 2/Tier 3 sulfur standards, Low Summer Reid Vapor Pressure (RVP), Winter Oxygenate	*Locality-specific user inputs to MOVES*. TTI produced summer 2020 and later conventional gasoline inputs consistent with pertinent federal and state rules, based on a combination of El Paso fuel sample data and MOVES defaults or other expected future year values. In the absence of local winter fuel survey data, MOVES default winter gasoline formulations were used for the MOVES fuel region specified for El Paso County. Fuel formulations are provided in Attachment 3.2.
Federal Low Sulfur Diesel Fuel	*Locality-specific user inputs to MOVES*. Diesel sulfur input values were set for consistency with the applicable federal diesel sulfur standards. Diesel formulations are provided in Attachment 3.2.
Inspection and Maintenance (I/M) Program	*Locality-specific user inputs to MOVES*. TTI developed El Paso I/M Program inputs to MOVES using the available MOVES I/M parameters pertaining to the domain of subject I/M vehicles, consistent with current program descriptions and latest I/M modeling protocols. Attachment 3.2 provides a summary of the I/M program input parameters used.

d. Re-Suspended Dust PM-10 Emissions Factors from Paved and Unpaved Roads:

i. Paved Roads:

Re-suspended dust emissions factors from paved roads (i.e., TDM network and intrazonal links) were developed according to equation (2) in AP-42 section 13.2.1 (EPA, January 2011). The input parameters are PM-10 particle size multiplier, road surface silt loading, average vehicle weight, days with at least 0.01 inches precipitation for the seasonal period, and number of days in the seasonal averaging period. The PM-10 particle size multiplier from the referenced EPA AP-42 guidance was used. The road surface silt loading values were consistent with the PM-10 State Implementation Plan (SIP). The average vehicle weight values were consistent with the current VMT mix. Days with at least 0.01 inches precipitation for the seasonal period and number of days in the seasonal averaging period used were consistent with prior El Paso MTP analyses.

Because control programs (i.e., street sweeping) affect the road surface silt loading and controlled silt loading values are not available, as in the prior El Paso MTP analyses, no control programs were included in the development of the re-suspended dust emissions factors and have not been necessary to pass the PM-10 emissions budget test. While the PM-10 nonattainment area was initially determined using the city limits at the time, conformity is

demonstrated at the county-level. Further refinement to include only the emissions within the city limits has not been necessary since the PM-10 emissions at the county-level do not typically exceed the PM-10 emissions budget.

ii. Unpaved Roads:

No unpaved road emissions factor analyses were performed under the assumption that there were no unpaved roads in any of the new TDM networks.

Attachment 3.1
Adjustments to TDM VMT

Table 3-10. HPMS Factor.

2012 HPMS AADT VMT[1]	AADT-to-ANSWT Factor	HPMS-Based ANSWT VMT	2012 TDM VMT[1]	HPMS Factor
15,151,926	1.08814	16,487,417	17,101,944	0.964066834

El Paso County.

Table 3-11. Analysis Year Seasonal Weekday Factors.

Year	Seasonal Factor Type[1]	Factor
2020 and later	ANSWT-to-SWKD	0.96030
	ANSWT-to-WWKD	0.99055

[1] SWKD and WWKD are summer weekday and winter weekday, respectively.

Table 3-12. Hourly VMT Distributions.

Period	Hour	Summer Fractions		Winter Fractions	
		24-Hour-Period	Four-Period[1]	24-Hour-Period	Four-Period[1]
AM Peak	7-8 a.m.	0.062671	0.336480	0.066676	0.347332
	8-9 a.m.	0.066374	0.356360	0.068141	0.354964
	9-10 a.m.	0.057210	0.307160	0.057149	0.297704
Mid-Day	10-11 a.m.	0.053052	0.183839	0.053629	0.182560
	11 a.m-12 p.m.	0.055426	0.192066	0.056343	0.191799
	12-1 p.m.	0.058595	0.203047	0.059402	0.202212
	1-2 p.m.	0.059748	0.207043	0.060959	0.207512
	2-3 p.m.	0.061757	0.214005	0.063428	0.215917
	3-4 p.m.	0.066345	0.242587	0.070123	0.249774
PM Peak	4-5 p.m.	0.071152	0.260163	0.074285	0.264599
	5-6 p.m.	0.073690	0.269443	0.074387	0.264961
	6-7 p.m.	0.062303	0.227807	0.061951	0.220666
	7-8 p.m.	0.062671	0.188006	0.045767	0.195981
Overnight	8-9 p.m.	0.047317	0.149744	0.034912	0.149499
	9-10 p.m.	0.037687	0.128339	0.029520	0.126409
	10-11 p.m.	0.032300	0.103784	0.023014	0.098550
	11 p.m.-12 a.m.	0.026120	0.074707	0.016180	0.069285
	12-1 a.m.	0.018802	0.042106	0.009094	0.038942
	1-2 a.m.	0.010597	0.027281	0.006144	0.026310
	2-3 a.m.	0.006866	0.021770	0.005004	0.021428
	3-4 a.m.	0.005479	0.020117	0.004685	0.020062
	4-5 a.m.	0.005063	0.028620	0.006649	0.028472
	5-6 a.m.	0.007203	0.070519	0.015805	0.067680
	6-7 a.m.	0.017748	0.145007	0.036753	0.157382

[1] To maintain VMT proportions within the four periods, the hourly fractions were normalized within each period.

Attachment 3.2

MOVES Run Specifications (MRS), County Databases (CDB), Outputs, and Post-Processing

MOVES Inputs and Output – El Paso County and the Portion of Dona Ana, NM within the TDM:

MRS input files: One for each season (summer, winter) and analysis year (8).

CDB inputs: One for each analysis year (4).

The MOVES default input database (MOVESDB20161117).

MOVES output databases: One per MOVES run (8).

MOVES run log output text files: One per MOVES run (8).

Table 3-13 describes the MOVES2014a run specification files used. **Table 3-14** describes the CDBs built and used for the rates analysis.

Table 3-13. MOVES Run Specification Selections by GUI Panel.

Navigation Panel	Detail Panel[1]	Selection		
Scale[1]	Model; Domain/Scale; Calculation Type	On-Road; County; Emissions Rates		
Time Spans[1]	Time Aggregation Level; Years – Months – Days – Hours	Hour; <***Year***>[1] - <***Month***> - Weekday - All		
Geographic Bounds[1]	Region; Selections; Domain Input Database	Zone and Link; Texas – El Paso County;[1] <***County Input Database Name***>[1]		
On-Road Vehicle Equipment	SUT/Fuel Combinations	SUT	Gasoline	Diesel
		Motorcycle	X	-
		Passenger Car	X	X
		Passenger Truck	X	X
		Light Commercial Truck	X	X
		Intercity Bus	-	X
		Transit Bus	-	X
		School Bus	X	X
		Refuse Truck	X	X
		Single Unit Short-Haul Truck	X	X
		Single Unit Long-Haul Truck	X	X
		Motor Home	X	X
		Combination Short-Haul Truck	X	X
		Combination Long-Haul Truck	-	X
Road Type	Selected Road Types	Off-Network – Rural Restricted Access – Rural Unrestricted Access – Urban Restricted Access – Urban Unrestricted Access		
Pollutants and Processes[2]	Primary Exhaust PM-10; Primary PM-10 Brakewear; Primary PM-10 Tirewear.	Dependent on pollutant: Running Exhaust, Start Exhaust, Extended Idle Exhaust, Auxiliary Power Exhaust, Crankcase Running Exhaust, Crankcase Start Exhaust, Crankcase Extended Idle Exhaust, Brakewear, Tirewear		
Manage Input Data Sets	Additional Input Database Selections	None		
Strategies	Rate Of Progress	Not Applicable		
General Output	Output Database; Units; Activity	<***MOVES Output Database Name***>[1]; Pounds, KiloJoules, Miles; Hotelling Hours, Population, Starts (not adjustable, pre-selected)		
Output Emissions Detail	Always; For All Vehicles/Equipment; On Road	Time: Hour – Location: Link – Pollutant; Fuel Type, Emissions Process; Source Use Type		
Advanced Performance Measures	Aggregation and Data Handling	All check boxes "un-checked" except "clear BaseRateOutput after rate calculations" box		

[1] County scale allows only one year per run. The years include 2020, 2030,2040, and 2045. Months in runs to represent season, were July for summer and January for winter. El Paso County FIPS code, season, and year were identified in the MRS file names and in the CDB names and output database names.

[2] Only the pollutants retained in the final rates inputs to the emissions calculations are listed. Other pollutant selections were required as pre-requisites for the pollutants needed. These pollutants include the PM-2.5 species required for MOVES PM-10 calculations, and other hydrocarbon species for the MOVES VOC modeling.

Table 3-14. MOVES CDB Input Tables.

Input Table	Category	Notes
year	Time	Designates analysis year as a base year (base year means that local activity inputs will be supplied rather than forecast by the model).
state	Geography	Identifies the state (Texas) for the analysis.
county	Geography/ Meteorology	Identifies county of analysis with local altitude and barometric pressure. Used 2017 summer season barometric pressure input data from the El Paso County 2017 periodic emissions inventory, provided by TCEQ.
zonemonthhour	Meteorology	Summer / winter hourly temperature and relative humidity for the county. 2017 averages: June-July-August; December-January-February, from TCEQ's El Paso County 2017 periodic emissions inventory.
roadtype	Activity	Lists the MOVES road types and associated ramp activity fractions. Road type ramp fractions were set to 0.
Hpmsvtypeyear[1]	Activity (Defaults)	TTI used MOVES default national annual VMT by HPMS vehicle type.
roadtypedistribution[1]		TTI used MOVES default road type VMT fractions.
monthvmtfraction[1]		TTI used MOVES default month VMT fractions.
dayvmtfraction[1]		TTI used MOVES default day VMT fractions.
hourvmtfraction[1]		TTI used MOVES default hour VMT fractions.
avgspeeddistribution[1]		TTI used MOVES default average speed distributions.
sourcetypeyear[1]	Fleet (Defaults)	TTI used MOVES default national SUT populations.
sourcetypeage-distribution	Fleet	TTI estimated SUT age fractions using TxDMV mid-year county vehicle registration data and MOVES defaults (consistent with the registration data year), as needed. The latest available (2014) mid-year registration data were used for all years.
avft	Fleet	TTI estimated SUT fuel fractions using TxDMV vehicle registration data and defaults, where needed. Local data sets used were consistent with sourcetypeagedistribution tables. The avft estimate is also consistent with the analysis VMT mix (i.e., gasoline and diesel).
zone	Activity	Start, hotelling, and SHP zone allocation factors. County = zone, and all factors were set to 1.0 (required for county scale analyses).
zoneroadtype	Activity	SHO zone/roadtype allocation factors. County = zone, and all factors were set to 1.0 (required for county scale analyses).
fuelsupply	Fuel	The fuel supply (marketshares) were set to indicate one gasoline and one diesel fuel formulation (i.e., marketshares = 1.0) for the county.
fuelformulation	Fuel	For summer and winter gasoline formulations, TTI used a combination of MOVES defaults and gasoline properties estimated from local survey data with adjustments where needed for consistency with pertinent fuel regulations (e.g., summer RVP limit and Tier 3 sulfur standard). The diesel fuel formulations were consistent with federal sulfur standards.
countyyear	Stage II	N/A
imcoverage	I/M	TTI used local inputs to represent the I/M program for El Paso County based on current I/M rules, latest modeling protocols, and the available MOVES I/M parameters (in terms of MOVES I/M "teststandards" and associated "imfactors") for the I/M vehicles.
Hotellingactivity-distribution	Activity	Used the updated distribution from TCEQ's 2017 long-haul truck hotelling/idling study.

[1] Use of default activity and population inputs for the MOVES rates mode runs is a basic aspect of the rates-per-activity emissions estimation method, which calculates the emissions inventory estimates via post-processing. The process uses actual, local vehicle activity estimates external to MOVES in the emissions calculations.

Table 3-15 summarizes the meteorological inputs used. **Table 3-16** summarizes the fuel formulation inputs used. Age distribution and fuel fraction inputs are summarized in Attachment 3.3

Table 3-15. Meteorological Inputs to MOVES for El Paso County.

Hour	Summer		Winter	
	Temperature	Relative Humidity	Temperature	Relative Humidity
12:00 a.m.	79.77	42.73	48.57	45.01
1:00 a.m.	78.51	45.05	47.44	46.81
2:00 a.m.	77.31	47.11	46.44	48.65
3:00 a.m.	76.27	49.05	45.46	50.32
4:00 a.m.	75.38	50.63	44.62	51.63
5:00 a.m.	74.47	52.45	43.71	53.29
6:00 a.m.	73.96	53.51	43.08	54.26
7:00 a.m.	75.19	51.26	43.39	52.85
8:00 a.m.	77.54	46.95	45.76	48.11
9:00 a.m.	80.13	42.42	48.91	43.16
10:00 a.m.	82.81	37.98	52.31	38.25
11:00 a.m.	85.38	33.88	55.29	34.22
12:00 p.m.	87.54	30.66	57.39	31.80
1:00 p.m.	89.27	28.03	59.07	29.61
2:00 p.m.	90.68	25.90	60.29	27.94
3:00 p.m.	91.85	24.01	60.83	27.40
4:00 p.m.	92.09	24.18	60.37	28.06
5:00 p.m.	91.62	24.77	58.77	30.20
6:00 p.m.	90.74	25.75	56.88	32.70
7:00 p.m.	89.02	28.24	55.16	35.17
8:00 p.m.	86.68	32.05	53.66	37.07
9:00 p.m.	84.78	34.61	52.16	39.26
10:00 p.m.	82.97	37.00	50.77	41.34
11:00 p.m.	81.28	40.04	49.58	42.97

Average hourly from weather stations within El Paso County—June through August 2017 and Dec, January and February 2017 (provided by TCEQ). Temperatures in °F and percent relative hour (24-hr for pressure).

Table 3-16. MOVES Gasoline and Diesel Fuel Formulation Inputs for El Paso County.

Fuel Type	Gasoline[1]		Diesel[2]
Season	Summer	Winter	Summer and Winter
Year	2020+	2020+	2020+
Fuel Formulation ID	18703	18101	30011
Fuel Subtype ID	12	12	20
RVP	7.00	11.36	0
Sulfur Level	10.00	10.00	11.00
ETOH Volume	9.60	10.00	0
MTBE Volume	0	0	0
ETBE Volume	0	0	0
TAME Volume	0	0	0
Aromatic Content	26.67	21.36	0
Olefin Content	5.50	6.66	0
Benzene Content	0.63	0.63	0
e200	48.74	53.72	0
e300	87.84	87.38	0
Vol to Wt Percent Oxy	0.3653	0.3653	0
BioDieselEster Volume	/N	/N	/N
Cetane Index	/N	/N	/N
PAH Content	/N	/N	/N
T50	206.12	192.22	0
T90	306.72	309.50	0

[1] TTI (June 2018) based the summer season conventional gasoline (CG) formulations on TCEQ's summer 2017 (latest available) fuel survey samples from El Paso County. TTI estimated the summer 2017 actual average CG properties as individual fuel grade averages weighted by relative sales volumes. The future year (2020+) summer CG properties are these latest available 2017 actual estimates except with RVP, average sulfur level, and average benzene content set to the "expected" values (MOVES defaults, consistent with the pertinent regulatory standards). The winter CG formulations are the appropriate, fuel region, season, and year MOVES defaults (used in the absence of available local winter survey data). Fuel subtype ID 12 is 10% ethanol-blend gasoline.

[2] Future Years diesel sulfur was conservatively set to the maximum level of the last three of TCEQ's statewide diesel surveys (2011, 2014, 2017), within the federal ultra-low sulfur diesel 15 ppm average annual standard. Fuel subtype ID 20 is conventional diesel.

Table 3-17. MOVES2014A I/M Descriptive Inputs for Subject Counties

YearID	Begin Model Year[1]	End Model Year[1]	Test Standards ID (Description)	Source Use Type (I/M Compliance)[2]	Other[3]
2007 – 2019	*X*	1995	12 (2500 RMP/Idle)	Passenger Car (93.12 %), Passenger Truck (91.26 %) Light Commercial Truck (85.67 %)	See Note 3
	X	1995	41 (Evp Cap)		
	1996	*Y*	51 (Exh OBD)		
	1996	*Y*	45 (Evp Cap, OBD)		
2020 - 2050	*X*	*Y*	51 (Exh OBD)		
	X	Y	45 (Evp Cap, OBD)		

[1]Begin and end model year (X, Y) define the range of model years covered – where X and Y, respectively, are calculated as YearID – 24, and YearID – 2.

[2] I/M compliance factor estimates were calculated per MOVES Technical Guidance (EPA, November 2015) and Texas modeling protocol (using compliance and waiver rates of 96 % and 3 %, respectively).

[3] Also - the model processes/pollutants affected are start and running exhaust HC, CO, NOx, and tank vapor venting HC; fuel type is gasoline; frequency is annual.

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Post-Processing Output:

Each MOVES output database was post-processed using TTI's MOVES emissions rates post-processing utility, RatesCalc, to produce the final on-road rate tables for subsequent input to the EmsCalc inventory calculation utility.

- RatesCalc Rate Databases: Mass/SHP off-network evaporative process rates were calculated using data from the CDB, the MOVES default database, and the MOVES rateperprofile and ratepervehicle emissions rate output. RatesCalc also copied mass/mile, mass/start, and mass/hour rates along with the units into emissions rate tables. RatesCalc does not perform any unit conversions. The utility created the emission rate look-up tables ttirateperdistance, ttirateperstart, ttirateperhour (for SHI and APU hours), and ttiratepershp in a "ratescalc" output database by county, analysis year, and season. (When the RatesAdj utility is not subsequently applied, RatesCalc produces the final rates inputs to EmsCalc.)

- RatesAdj Final Rate Databases: Not Applicable. The Texas Low Emission Diesel Program (TxLED) is not applicable to El Paso County; thus, the RatesAdj utility was not used. [19]

[19] The TxLED counties list may be found at: https://www.tceq.texas.gov/airquality/mobilesource/txled/txled-affected-counties.

Table 3-8. Estimated TxLED Fuel NOx Reductions and Adjustments.

(The Texas Low Emission Diesel Program (TxLED) is **not applicable** to El Paso County.)

Diesel Fuel Source Use Type	NOx Reduction			NOx Adjustment		
Passenger Car						
Passenger Truck						
Light Commercial Truck						
Intercity Bus						
Transit Bus						
School Bus						
Refuse Truck						
Single Unit Short-Haul Truck						
Single Unit Long-Haul Truck						
Motor Home						
Combination Short-Haul Truck						
Combination Long-Haul Truck						

Attachment 3.3:
Source Type Age and Fuel Engine Fractions Inputs to MOVES

El Paso County (48141) 2014 Age Distribution Inputs to MOVES (used for 2020, 2030, 2040, and 2045)

Age	MC	PC	PT	LCT	IBus	TBus	SBus	RT	SUShT	SULhT	MH	CShT	CLhT
0	0.045935	0.053900	0.026733	0.026733	0.055548	0.055650	0.055556	0.064759	0.062455	0.080736	0.064928	0.009782	0.044007
1	0.079804	0.070772	0.037056	0.037056	0.049844	0.049946	0.049851	0.058272	0.060276	0.097975	0.058445	0.015801	0.048909
2	0.069402	0.060117	0.033846	0.033846	0.046005	0.046100	0.046012	0.053507	0.079702	0.150497	0.053673	0.014296	0.050486
3	0.042856	0.046863	0.035079	0.035079	0.042194	0.055697	0.032610	0.028999	0.066630	0.104892	0.039988	0.006772	0.032874
4	0.031289	0.049364	0.034467	0.034467	0.037253	0.034095	0.035647	0.022977	0.037945	0.036093	0.035305	0.010534	0.017742
5	0.080386	0.040653	0.028561	0.028561	0.031054	0.034678	0.042221	0.030317	0.032680	0.034013	0.029436	0.021068	0.031415
6	0.073146	0.064144	0.058164	0.058164	0.039992	0.048516	0.046183	0.023359	0.109659	0.093698	0.037928	0.029345	0.043640
7	0.096114	0.066662	0.060009	0.060009	0.052280	0.047012	0.047736	0.081433	0.047749	0.057695	0.049441	0.044394	0.094086
8	0.078472	0.061945	0.055914	0.055914	0.053395	0.033713	0.055776	0.060642	0.069535	0.064010	0.050348	0.042889	0.070679
9	0.063826	0.060570	0.053565	0.053565	0.055067	0.052559	0.049572	0.057049	0.069717	0.057569	0.051939	0.049661	0.061342
10	0.045602	0.055428	0.061812	0.061812	0.053502	0.043092	0.048835	0.034170	0.053558	0.040882	0.050306	0.036117	0.041119
11	0.054839	0.053694	0.053524	0.053524	0.049301	0.041983	0.041807	0.033378	0.042484	0.033007	0.046365	0.029345	0.032913
12	0.039694	0.051897	0.055451	0.055451	0.046064	0.042452	0.043802	0.024143	0.034858	0.026419	0.043333	0.033860	0.032437
13	0.031455	0.043310	0.053863	0.053863	0.044038	0.048613	0.039741	0.029530	0.035585	0.027473	0.041306	0.051919	0.043530
14	0.024715	0.042587	0.047742	0.047742	0.041777	0.032808	0.043136	0.040271	0.039034	0.021921	0.039197	0.082769	0.052520
15	0.024049	0.033234	0.039570	0.039570	0.040613	0.031807	0.039913	0.057677	0.032498	0.019697	0.037984	0.078254	0.044225
16	0.017142	0.027351	0.033474	0.033474	0.030598	0.037111	0.031314	0.052718	0.018337	0.009478	0.022205	0.055681	0.037120
17	0.011401	0.021668	0.033913	0.033913	0.024835	0.033826	0.029099	0.025424	0.017974	0.010221	0.034115	0.040632	0.028101
18	0.011401	0.016127	0.022415	0.022415	0.020412	0.030975	0.024947	0.032795	0.009259	0.005665	0.020938	0.033860	0.025898
19	0.008405	0.015798	0.023979	0.023979	0.026464	0.025322	0.031789	0.041995	0.014706	0.006044	0.024651	0.048157	0.032080
20	0.007240	0.011279	0.022920	0.022920	0.020257	0.021952	0.015251	0.029313	0.009622	0.003876	0.023297	0.040632	0.020867
21	0.004660	0.008904	0.016038	0.016038	0.016633	0.018163	0.018167	0.013318	0.007081	0.002748	0.015998	0.029345	0.017990
22	0.003911	0.006789	0.013027	0.013027	0.012252	0.015769	0.014653	0.011855	0.005991	0.001875	0.013989	0.024831	0.012870
23	0.003994	0.005559	0.009793	0.009793	0.013801	0.015855	0.018594	0.018450	0.005991	0.002168	0.010346	0.030098	0.014209
24	0.003162	0.004365	0.009074	0.009074	0.015450	0.023149	0.020950	0.013061	0.004720	0.001735	0.013522	0.024078	0.012572
25	0.001831	0.003615	0.008759	0.008759	0.015324	0.017611	0.011953	0.020123	0.005084	0.001442	0.017413	0.017306	0.009605
26	0.002496	0.002877	0.009512	0.009512	0.014173	0.013781	0.014128	0.011515	0.004720	0.001180	0.015355	0.015049	0.007859
27	0.002164	0.002357	0.005600	0.005600	0.014695	0.012718	0.014276	0.010304	0.001452	0.000678	0.014965	0.015801	0.006202
28	0.003828	0.001917	0.007022	0.007022	0.012327	0.010714	0.012460	0.005268	0.003813	0.000875	0.010998	0.016554	0.006083
29	0.002996	0.001624	0.005782	0.005782	0.010701	0.009139	0.010634	0.005263	0.001997	0.000762	0.011609	0.012039	0.005596
30	0.033785	0.014631	0.043334	0.043334	0.014149	0.015191	0.013386	0.008114	0.014887	0.004677	0.020675	0.039127	0.021026

Texas Statewide 2020 Fuel Engine Fractions Summary[1]

SUT	Fuel Type	Model Year															
		2020	2019	2018	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005
MC	Gas	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
PC	Gas	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.990	0.993	0.999	1.000	0.993	0.995
PC	Diesel	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.010	0.007	0.001	0.000	0.007	0.005
PT	Gas	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.987	0.985	0.977	0.981	0.975	0.979
PT	Diesel	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.013	0.015	0.023	0.019	0.025	0.021
LCT	Gas	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.962	0.955	0.941	0.948	0.938	0.946
LCT	Diesel	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.038	0.045	0.059	0.052	0.062	0.054
IBus	Diesel	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
TBus	Gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TBus	Diesel	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
SBus	Gas	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
SBus	Diesel	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990
RT	Gas	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.002	0.002	0.005	0.001	0.003	0.003
RT	Diesel	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.998	0.998	0.995	0.999	0.997	0.997
SUShT	Gas	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.371	0.219	0.234	0.274	0.351	0.287	0.256	0.238	0.232
SUShT	Diesel	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.629	0.781	0.766	0.726	0.649	0.713	0.744	0.762	0.768
SULhT	Gas	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.371	0.219	0.234	0.274	0.351	0.287	0.256	0.238	0.232
SULhT	Diesel	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.629	0.781	0.766	0.726	0.649	0.713	0.744	0.762	0.768
MH	Gas	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.510	0.530	0.540	0.560
MH	Diesel	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.490	0.470	0.460	0.440
CShT	Gas	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.199	0.110	0.057	0.081	0.052	0.058	0.031	0.050	0.051
CShT	Diesel	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.801	0.890	0.943	0.919	0.948	0.942	0.969	0.950	0.949
CLhT	Diesel	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

[1] Conventional internal combustion engine technology only.

Texas Statewide 2020 Fuel Engine Fractions Summary[1] - (Continued)

SUT	Fuel Type	Model Year														
		2004	2003	2002	2001	2000	1999	1998	1997	1996	1995	1994	1993	1992	1991	1990
MC	Gas	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
PC	Gas	0.997	0.996	0.996	0.997	0.997	0.998	0.998	0.999	0.999	0.999	1.000	0.999	0.999	0.997	0.999
PC	Diesel	0.003	0.004	0.004	0.003	0.003	0.002	0.002	0.001	0.001	0.001	0.000	0.001	0.001	0.003	0.001
PT	Gas	0.982	0.982	0.983	0.989	0.992	0.981	0.993	0.992	0.981	0.995	0.991	0.986	0.985	0.994	0.989
PT	Diesel	0.018	0.018	0.017	0.011	0.008	0.019	0.007	0.008	0.019	0.005	0.009	0.014	0.015	0.006	0.011
LCT	Gas	0.951	0.951	0.956	0.908	0.949	0.929	0.950	0.927	0.971	0.932	0.974	0.974	0.951	0.937	0.984
LCT	Diesel	0.049	0.049	0.044	0.092	0.051	0.071	0.050	0.073	0.029	0.068	0.026	0.026	0.049	0.063	0.016
IBus	Diesel	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
TBus	Gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TBus	Diesel	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
SBus	Gas	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.042	0.114	0.147	0.121	0.010	0.090	0.124
SBus	Diesel	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.958	0.886	0.853	0.879	0.990	0.910	0.876
RT	Gas	0.005	0.004	0.005	0.006	0.002	0.169	0.404	0.019	0.012	0.010	0.105	0.031	0.210	0.101	0.204
RT	Diesel	0.995	0.996	0.995	0.994	0.998	0.831	0.596	0.981	0.988	0.990	0.895	0.969	0.790	0.899	0.796
SUShT	Gas	0.245	0.260	0.268	0.311	0.350	0.348	0.435	0.436	0.427	0.673	0.508	0.519	0.511	0.465	0.539
SUShT	Diesel	0.755	0.740	0.732	0.689	0.650	0.652	0.565	0.564	0.573	0.327	0.492	0.481	0.489	0.535	0.461
SULhT	Gas	0.245	0.260	0.268	0.311	0.350	0.348	0.435	0.436	0.427	0.673	0.508	0.519	0.511	0.465	0.539
SULhT	Diesel	0.755	0.740	0.732	0.689	0.650	0.652	0.565	0.564	0.573	0.327	0.492	0.481	0.489	0.535	0.461
MH	Gas	0.570	0.590	0.600	0.630	0.660	0.680	0.710	0.740	0.770	0.790	0.820	0.850	0.850	0.850	0.850
MH	Diesel	0.430	0.410	0.400	0.370	0.340	0.320	0.290	0.260	0.230	0.210	0.180	0.150	0.150	0.150	0.150
CShT	Gas	0.052	0.055	0.077	0.084	0.090	0.107	0.134	0.147	0.146	0.275	0.117	0.117	0.160	0.161	0.144
CShT	Diesel	0.948	0.945	0.923	0.916	0.910	0.893	0.866	0.853	0.854	0.725	0.883	0.883	0.840	0.839	0.856
CLhT	Diesel	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

[1] Conventional internal combustion engine technology only.

Texas Statewide 2030 Fuel Engine Fractions Summary[1]

SUT	Fuel Type	Model Year															
		2030	2029	2028	2027	2026	2025	2024	2023	2022	2021	2020	2019	2018	2017	2016	2015
MC	Gas	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
PC	Gas	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988
PC	Diesel	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012
PT	Gas	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980
PT	Diesel	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020
LCT	Gas	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947
LCT	Diesel	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053
IBus	Diesel	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
TBus	Gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TBus	Diesel	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
SBus	Gas	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
SBus	Diesel	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990
RT	Gas	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
RT	Diesel	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997
SUShT	Gas	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396
SUShT	Diesel	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604
SULhT	Gas	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396
SULhT	Diesel	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604
MH	Gas	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500
MH	Diesel	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500
CShT	Gas	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094
CShT	Diesel	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906
CLhT	Diesel	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

[1] Conventional internal combustion engine technology only.

Texas Statewide 2030 Fuel Engine Fractions Summary[1] - (Continued)

SUT	Fuel Type	Model Year														
		2014	2013	2012	2011	2010	2009	2008	2007	2006	2005	2004	2003	2002	2001	2000
MC	Gas	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
PC	Gas	0.988	0.988	0.988	0.988	0.990	0.993	0.999	1.000	0.993	0.995	0.997	0.996	0.996	0.997	0.997
PC	Diesel	0.012	0.012	0.012	0.012	0.010	0.007	0.001	0.000	0.007	0.005	0.003	0.004	0.004	0.003	0.003
PT	Gas	0.980	0.980	0.980	0.980	0.987	0.985	0.977	0.981	0.975	0.979	0.982	0.982	0.983	0.989	0.992
PT	Diesel	0.020	0.020	0.020	0.020	0.013	0.015	0.023	0.019	0.025	0.021	0.018	0.018	0.017	0.011	0.008
LCT	Gas	0.947	0.947	0.947	0.947	0.962	0.955	0.941	0.948	0.938	0.946	0.951	0.951	0.956	0.908	0.949
LCT	Diesel	0.053	0.053	0.053	0.053	0.038	0.045	0.059	0.052	0.062	0.054	0.049	0.049	0.044	0.092	0.051
IBus	Diesel	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
TBus	Gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TBus	Diesel	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
SBus	Gas	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
SBus	Diesel	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990
RT	Gas	0.003	0.003	0.003	0.003	0.002	0.002	0.005	0.001	0.003	0.003	0.005	0.004	0.005	0.006	0.002
RT	Diesel	0.997	0.997	0.997	0.997	0.998	0.998	0.995	0.999	0.997	0.997	0.995	0.996	0.995	0.994	0.998
SUShT	Gas	0.396	0.371	0.219	0.234	0.274	0.351	0.287	0.256	0.238	0.232	0.245	0.260	0.268	0.311	0.350
SUShT	Diesel	0.604	0.629	0.781	0.766	0.726	0.649	0.713	0.744	0.762	0.768	0.755	0.740	0.732	0.689	0.650
SULhT	Gas	0.396	0.371	0.219	0.234	0.274	0.351	0.287	0.256	0.238	0.232	0.245	0.260	0.268	0.311	0.350
SULhT	Diesel	0.604	0.629	0.781	0.766	0.726	0.649	0.713	0.744	0.762	0.768	0.755	0.740	0.732	0.689	0.650
MH	Gas	0.500	0.500	0.500	0.500	0.500	0.500	0.510	0.530	0.540	0.560	0.570	0.590	0.600	0.630	0.660
MH	Diesel	0.500	0.500	0.500	0.500	0.500	0.500	0.490	0.470	0.460	0.440	0.430	0.410	0.400	0.370	0.340
CShT	Gas	0.094	0.199	0.110	0.057	0.081	0.052	0.058	0.031	0.050	0.051	0.052	0.055	0.077	0.084	0.090
CShT	Diesel	0.906	0.801	0.890	0.943	0.919	0.948	0.942	0.969	0.950	0.949	0.948	0.945	0.923	0.916	0.910
CLhT	Diesel	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

[1] Conventional internal combustion engine technology only.

Texas Statewide 2040 Fuel Engine Fractions Summary[1]

SUT	Fuel Type	Model Year															
		2040	2039	2038	2037	2036	2035	2034	2033	2032	2031	2030	2029	2028	2027	2026	2025
MC	Gas	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
PC	Gas	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988
PC	Diesel	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012
PT	Gas	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980
PT	Diesel	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020
LCT	Gas	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947
LCT	Diesel	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053
IBus	Diesel	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
TBus	Gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TBus	Diesel	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
SBus	Gas	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
SBus	Diesel	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990
RT	Gas	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
RT	Diesel	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997
SUShT	Gas	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396
SUShT	Diesel	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604
SULhT	Gas	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396
SULhT	Diesel	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604
MH	Gas	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500
MH	Diesel	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500
CShT	Gas	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094
CShT	Diesel	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906
CLhT	Diesel	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

[1] Conventional internal combustion engine technology only.

Texas Statewide 2040 Fuel Engine Fractions Summary[1] - (Continued)

SUT	Fuel Type	Model Year														
		2024	2023	2022	2021	2020	2019	2018	2017	2016	2015	2014	2013	2012	2011	2010
MC	Gas	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
PC	Gas	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.990
PC	Diesel	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.010
PT	Gas	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.987
PT	Diesel	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.013
LCT	Gas	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.962
LCT	Diesel	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.038
IBus	Diesel	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
TBus	Gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TBus	Diesel	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
SBus	Gas	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
SBus	Diesel	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990
RT	Gas	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.002
RT	Diesel	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.998
SUShT	Gas	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.371	0.219	0.234	0.274
SUShT	Diesel	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.629	0.781	0.766	0.726
SULhT	Gas	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.371	0.219	0.234	0.274
SULhT	Diesel	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.629	0.781	0.766	0.726
MH	Gas	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500
MH	Diesel	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500
CShT	Gas	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.199	0.110	0.057	0.081
CShT	Diesel	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.801	0.890	0.943	0.919
CLhT	Diesel	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

[1] Conventional internal combustion engine technology only.

Texas Statewide 2045 Fuel Engine Fractions Summary[1]

SUT	Fuel Type	Model Year															
		2045	2044	2043	2042	2041	2040	2039	2038	2037	2036	2035	2034	2033	2032	2031	2030
MC	Gas	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
PC	Gas	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988
PC	Diesel	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012
PT	Gas	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980
PT	Diesel	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020
LCT	Gas	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947
LCT	Diesel	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053
IBus	Diesel	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
TBus	Gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TBus	Diesel	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
SBus	Gas	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
SBus	Diesel	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990
RT	Gas	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
RT	Diesel	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997
SUShT	Gas	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396
SUShT	Diesel	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604
SULhT	Gas	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396
SULhT	Diesel	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604
MH	Gas	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500
MH	Diesel	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500
CShT	Gas	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094
CShT	Diesel	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906
CLhT	Diesel	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

[1] Conventional internal combustion engine technology only.

Texas Statewide 2045 Fuel Engine Fractions Summary[1] - (Continued)

SUT	Fuel Type	Model Year														
		2029	2028	2027	2026	2025	2024	2023	2022	2021	2020	2019	2018	2017	2016	2015
MC	Gas	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
PC	Gas	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988
PC	Diesel	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012
PT	Gas	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980
PT	Diesel	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020
LCT	Gas	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947
LCT	Diesel	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053
IBus	Diesel	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
TBus	Gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TBus	Diesel	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
SBus	Gas	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
SBus	Diesel	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990
RT	Gas	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
RT	Diesel	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997
SUShT	Gas	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396
SUShT	Diesel	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604
SULhT	Gas	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396
SULhT	Diesel	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604
MH	Gas	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500
MH	Diesel	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500
CShT	Gas	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094
CShT	Diesel	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906
CLhT	Diesel	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

[1] Conventional internal combustion engine technology only.

4. SUNLAND PARK OZONE NONATTAINMENT AREA SUMMER WEEKDAY EMISSIONS ANALYSIS

SUMMARY

Under sponsorship of the Texas Department of Transportation (TxDOT), the Texas A&M Transportation Institute (TTI) produced Sunland Park ozone nonattainment area (NAA), on-road mobile source emissions estimates in support of the El Paso Metropolitan Planning Organization (EPMPO) transportation planning efforts.[20] This analysis description is for the Sunland Park NAA, in the southern portion of Dona Ana County, New Mexico (NM), in the El Paso Amended Destino 2045 regional travel demand model (TDM). Results are representative of typical summer weekday for the years 2017, 2020, 2030, 2040 and 2045.

TTI used its on-road inventory methodology to produce emissions estimates of the detail and quality suited for state implementation planning for air quality control and transportation conformity analyses. This is the detailed, disaggregate, TDM link-based rates-per-activity emissions estimation process. It uses MOVES2014a-based county emissions rate look-up tables based on local conditions for external emissions calculations performed at detailed, disaggregate, temporal, and spatial levels, using latest planning assumptions, and latest available data, models, and procedures.[21]

Hourly inventories were estimated by MOVES source use type (SUT) and fuel type (FT) combination (or vehicle type) and TDM roadway class. TDMs were post-processed to estimate hourly, directional, link (roadway segment)-level vehicle miles of travel (VMT) and operational speeds for the roadway-based emissions calculations. Aspects of the Sunland Park area emissions analysis were dependent on El Paso County inventory parameters, therefore El Paso County was by necessity first in the process. Using estimates of vehicle operating hours (VHT), vehicle populations, truck hotelling activity, and other data, TTI estimated hourly off-network activity factors for the parked vehicle-based emissions calculations. Off-network activity types are source-hours-parked (SHP); starts; and source hours extended idling (SHI) and auxiliary power unit (APU) hours (emissions-producing components of combination long-haul truck hotelling hours). Off-network evaporative rates (in mass/SHP form, not directly available from MOVES) were produced by a post-processing procedure and were compiled with other rates produced directly by MOVES to yield look-up tables of all rates in activity terms for the external emissions calculations. The analyses used TTI's MOVES-based inventory development utilities for use with MOVES2014a.[22] EPA's Technical Guidance is the primary reference on appropriate inputs and use of MOVES.[23]

[20] The Sunland Park NAA is classified as marginal under the 2015 Ozone National Ambient Air Quality Standards (NAAQS).

[21] TTI used the November 2016 MOVES2014a release, which produces the latest available on-road mobile source emission rates. All later MOVES updates through MOVES2014b produce the same on-road emissions rates as the November 2016 release.

[22] TTI Emissions Inventory Estimation Utilities Using MOVES: MOVES2014aUtl User's Guide, TTI, August 2016.

[23] MOVES2014, MOVES2014a, and MOVES2014b Technical Guidance: Using MOVES to Prepare Emission Inventories for Sate Implementation Plans and Transportation Conformity, EPA, August 2018.

SCOPE OF EMISSIONS ANALYSIS

12. Methodology:

Detailed, hourly, MOVES rates-per-activity, TDM link-based, with the most recent version of MOVES (for on-road mobile modeling).[24]

13. Analysis Years:

2017 baseline, 2020, 2030, 2040, and 2045.

14. Seasonal Period:

Summer: Average June-July-August weekday (average Monday through Friday).

15. Geography:

Sunland Park NAA.[25]

16. Pollutants:

Oxides of nitrogen (NOX) and volatile organic compounds (VOC).[26]

17. Sources:

Table 4-17. Vehicle Types Modeled in the Inventory.

MOVES SUT	Gasoline*	Diesel*
Motorcycle	MC_G	-
Passenger Car	PC_G	PC_D
Passenger Truck	PT_G	PT_D
Light Commercial Truck	LCT_G	LCT_D
Intercity Bus	-	IBus_D
Transit Bus	-	TBus_D
School Bus	SBus_G	SBus_D
Refuse Truck	RT_G	RT_D
Single Unit Short-Haul Truck	SUShT_G	SUShT_D
Single Unit Long-Haul Truck	SULhT_G	SULhT_D
Motor Home	MH_G	MH_D
Combination Short-Haul Truck	CShT_G	CShT_D
Combination Long-Haul Truck	-	CLhT_D

These vehicle type (SUT/fuel type) labels are referenced later in the document.

[24] TTI used the November 2016 MOVES2014a release, which produces the latest available on-road mobile source emission rates. All later MOVES updates through MOVES2014b produce the same on-road emission rates as the November 2016 release.

[25] The Sunland Park NAA is included in the southern part of Dona Ana County that is included in the El Paso TDM.

[26] VOC and NOx are the reported pollutants. Additional pollutants were included in MOVES runs and inventory utility output but not reported for this analysis.

18. Link-Based Emissions Estimation Process:

TTI developed the inventory components and resulting emissions and activity estimates for the analysis using TTI's utilities developed and maintained for this purpose.

a. Inventory Components:

The emissions estimation process includes the following major components for the emissions calculations:

- Hourly, directional, link-level, on-road fleet VMT, and average speeds;
- SUT/fuel type (i.e., vehicle type) time-of-day VMT mix;
- Vehicle type populations; [27]
- Hourly, vehicle type SHP;
- Hourly, vehicle type starts;
- Hourly, diesel combination long-haul truck hotelling (emissions generating SHI and APU hours components); and
- Hourly vehicle type pollutant and process mass emissions rates: mass per mile, mass per SHP, mass per start, mass per SHI, and mass per APU hour.

b. Utilities:

The TTI emissions estimation utilities produced the input components and the emissions estimates in the tab-delimited hourly and 24-hour emissions and activity summary file formats easy to use in spreadsheets. The TTI utilities include MOVES emission rates input and output processing utilities, TDM network data sets post-processing utility, vehicle population and off-network activity estimation utilities, and the link-level emissions calculation utility.[28]

DEVELOPMENT OF ON-ROAD FLEET LINK-VMT AND SPEEDS

19. Travel Demand Models:

TTI received the El Paso MPO's Amended Destino 2045 MTP TDM data sets (i.e., trip matrices and four-time-period, directional, average non-summer weekday [ANSWT] traffic assignments), February 2019.[29] Data sets for this analysis included the 2017 baseline, and 2020, 2030, 2040, and 2045 future analysis years. TTI post-processed the data sets to determine average summer weekday, county-coded[30], hourly, directional, Highway Performance Monitoring System (HPMS)-consistent, network link VMT and volumes and added intrazonal link VMT estimates. (TDM network ANSWT VMT plus intrazonal ANSWT VMT is referred to herein as "total model VMT".) Method details are found in MOVES2014a-Based Travel Demand Model Link Emissions Estimation Method (TTI, August 2016).

[27] Vehicle populations are an intermediate parameter used in estimating off-network source hours parked and starts activity.
[28] TTI Emissions Inventory Estimation Utilities Using MOVES: MOVES2014aUtl User's Guide, TTI, August 2016.
[29] The EPMPO provided the TDM data sets for 2017 (February 19, 2020), 2020 (February 14, 2020), 2030 (February 18, 2020), 2040 and 2045 future years (February 20, 2020).
[30] To facilitate use of these TDM link-data in the Sunland Park NAA emissions analysis the following county and partial county coding was used: "1" for El Paso County and "2" and "3" for the complete portion of Dona Ana County in the TDM, where "2" is the Dona Ana area excluding the Sunland Park NAA and "3" is exclusively the Sunland Park NAA of Dona Ana County.

a. Adjustments to TDM VMT:

The ANSWT network link volumes and VMT and added intrazonal link VMT were factored to be consistent with HPMS VMT, to reflect summer and winter weekday activity, to allocate by hour, and to allocate total link volumes by direction of travel. The seasonal weekday and hourly factors were developed using the latest available 10-year aggregate, TxDOT Automatic Traffic Recorder (ATR) traffic count data (2009 – 2018) for El Paso County.

i. Historical Year HPMS Consistency and Seasonal Weekday Adjustments:

HPMS consistency: Not applied for this analysis (see Item 8.a.ii).

Seasonal adjustment: Not applied for this analysis (see Item 8.a.ii).

ii. Forecast Years HPMS Consistency and Seasonal Weekday Adjustments:

HPMS consistency: TTI applied a single HPMS adjustment factor to total model link-level VMT for all county and partial county areas, for the 2017 baseline and for each analysis year. The validation year HPMS adjustment factor was calculated as 2012 El Paso County HPMS VMT (first adjusted to ANSWT form using the ANSWT/AADT ATR count ratio) divided by the 2012 validation year total model VMT for El Paso County[31]. See Table 4-22 in Attachment 4.1.

Seasonal adjustment: Seasonal day-type factors (summer and winter weekday) were produced and used with the 2017 baseline and each analysis year. These factors were calculated as the ratio of the seasonal weekday-to-ANSWT counts. See Table 4-23 in Attachment 4.1

iii. Seasonal Weekday Hourly VMT Distributions:

Summer weekday, hourly travel factors were developed and used to allocate the 24-hour link VMT/volume estimates to each hour of the day – a single set was used for all analysis years. In order to maintain VMT proportions within each of the four time periods, the hourly fractions were normalized within each time period. See Table 4-24 in Attachment 4.1.

iv. Directional Factors:

Directional split factors were applied to total link volumes by functional class and area type. The directional factors were created by aggregating TDM link-level volumes by direction for each functional class/area type. Link-level AB directional volumes were divided by total volumes for each functional class/area type to estimate the direction split. These are the same factors applied in the prior El Paso conformity analysis.

[31] The 2012 validation year TDM total model VMT was consistent with the prior Destino 2045 MTP conformity analysis (EPMPO, August 2018). HPMS VMT is available at the county-level, but not for partial county areas (e.g., Sunland Park). The 2012 TDM validation year HPMS adjustment factor produced using El Paso County data was considered valid and used for the whole TDM region, including the partial NM county areas of the TDM. Seasonal factors were treated analogously, i.e., based on El Paso County data and applied to all areas in the TDM.

b. Hourly Congested Speeds:

1TTI estimated directional, hourly operational link speeds using the TTI speed model, which estimates delay on each link as a function of volume-to-capacity and applies it to the link's estimated free-flow speed. TTI estimated the local streets category average operational link speeds represented by the centroid connector links, as centroid connector TDM input speeds; and represented as added intrazonal links, as the average of the zone's centroid connector input speeds.

DEVELOPMENT OF VEHICLE TYPE VMT MIX

20. VMT Mix:

The VMT mix designates the vehicle categories included in the analysis and specifies the fraction of on-road fleet VMT attributable to each vehicle type.

a. Method:

VMT mixes were estimated using TTI's VMT mix method.[32] The method sets Texas vehicle registration category aggregations for MOVES SUT categories for developing the VMT mixes, as well as for developing other fleet parameters needed elsewhere in the process (e.g., SUT age distributions, vehicle population estimates).

b. Temporal and Spatial Aspects:

The VMT mixes, consistent with the prior conformity analysis, were produced in five-year increments and are 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.

No seasonal adjustments are made for VMT mix. Average weekday vehicle type VMT mixes by MOVES road type and by four time-of-day periods (AM Peak, Mid-Day, PM Peak, Overnight) were estimated for the TxDOT El Paso District for use with the El Paso TDM region.[33]

c. Data Sources:

TTI used the latest available multi-year TxDOT El Paso District vehicle classification counts (2005-2014) and associated Texas Department of Motor Vehicles (TxDMV) year-end registration data (2013) and TxDOT/TxDMV registration data, along with MOVES default data, as needed (i.e., appropriate for each analysis year).

[32] *Developing MOVES Source Use Types and VMT Mix for Conformity Analysis* (TxDOT Air Quality / Conformity IAC-A - TTI Task 409252-0643: Maintain, Update and Enhance Traffic Activity Estimation and Forecasting Methods), Texas Department of Transportation, Austin, TX, August 2016.

[33] Using the same data sets and a similar procedure, aggregate (i.e., 24-hour, all road-types) TxDOT district-level weekday vehicle type VMT mixes were also produced for use in the El Paso County vehicle population estimation.

d. Vehicle Types:

The vehicle types in the VMT mix are the 22 gasoline and diesel MOVES SUT combinations shown in Table 4-17.

DEVELOPMENT OF OFF-NETWORK ACTIVITY BY VEHICLE TYPE

21. County and Partial County Off-Network Activity:

County-level off-network activity estimates are used to estimate off-network activity for partial county areas. The preliminary step of estimating El Paso County starts, SHP, and long-haul truck hotelling activity was performed using standard county-level procedures. Off-network activity for the adjacent Sunland Park NAA was then estimated as a scaling of El Paso County off-network activity estimates using Sunland Park NAA VMT-to-El Paso County VMT ratios for each year as the scaling factors. El Paso County vehicle population estimates were needed first for estimating county-level vehicle starts and SHP.

a. County Vehicle Population Estimates:

Vehicle populations were estimated only at the county-level, not for partial county areas.[34] The county vehicle population estimates were based on the latest available TxDMV registration data, vehicle population factors derived from the VMT mix, and county-level VMT-based growth estimates for future years where actual registration data were not yet available. Since the latest available registration data for this analysis was mid-year 2014, vehicle population estimates were needed first for the 2014 historical year.

i. Historical Year Vehicle Population Estimates:

TxDMV registration data: Historical year vehicle population estimates are based on TxDMV mid-year registrations corresponding to the historical year. This registration data is aggregated into vehicle registrations categories (Table 4-18).

Vehicle population factors: Since the TxDMV registration data does not include each SUT/fuel type combination, vehicle population factors are developed using the 24-hour VMT mix for the year (as designated per Item 9.b). These factors are applied to the aggregated vehicle registration categories to split them into the SUT/fuel type combinations included in the analysis, creating the base (2014) El Paso County vehicle population estimates.

[34] No vehicle population estimates were needed for the Sunland Park partial county area off-network activity procedure.

Table 4-18. Vehicle Registration Aggregations and Vehicle Types for Estimating Vehicle Populations.

Vehicle Registration[1] Aggregation	Associated Vehicle Type[2]
Motorcycles	MC_G
Passenger Cars (PC)	PC_G; PC_D
Trucks <= 8,500 gross vehicle weight rating (GVWR) (pounds)	PT_G; PT_D; LCT_G; LCT_D
Trucks > 8,500 and <= 19,500 GVWR	RT_G; RT_D SUShT_G; SUShT_D MH_G; MH_D IBus_D TBus_G; TBus_D SBus_G; SBus_D
Trucks >19,500 GVWR	CShT_G; CShT_D
NA[2]	SULhT_G; SULhT_D CLhT_G; CLhT_D

[1] Mid-year TxDMV county registrations data extracts are used, consisting of 1) light-duty cars, trucks, and motorcycles; 2) heavy-duty diesel trucks, and 3) heavy-duty gasoline trucks.

[2] Vehicle population factors are the 24-hour weekday VMT mix fraction for each vehicle type (see Table 4.1 for label definitions) in a category divided by the sum of the VMT mix fractions for all vehicle types in a category, except long-haul trucks. The four long-haul vehicle type populations are estimated using a long-haul-to-short-haul VMT mix ratio applied to the short-haul SUT population estimate.

ii. Future Analysis Year County Vehicle Population Estimates:

TxDMV registration data: As described for historical year vehicle population estimates, the registration data were aggregated by vehicle registration category. Since registration data were not available for future year analyses, the most recent mid-year TxDMV registration data sets (2014) were used.

Vehicle population factors: As described for historical year vehicle population estimates, vehicle population factors developed using the analysis year 24-hour VMT mix were applied to vehicle registrations aggregated by category to split the categories into the SUT/fuel type combinations included in the analysis, creating the base (2014) El Paso County vehicle population estimates.

VMT-based growth estimates: For each analysis year, VMT-based growth estimates were calculated by dividing county, analysis year, summer weekday VMT by county, 2014 summer weekday VMT.[35] These growth estimates were applied to the base vehicle population estimates to scale from the 2014 base to each of the analysis year estimates.

[35] Base, summer weekday 2014 VMT for the scaling factors was calculated as the product of El Paso County 2014 AADT VMT (from TxDOT's RIFCREC data set) and the El Paso County ATR-based AADT to summer weekday conversion factor.

b. SHP Activity:

County-level SHP was estimated as the preliminary step for estimating SHP for the partial county area. SHP was estimated for each year and hour of day.

i. County SHP Estimates:

El Paso County SHP was estimated as a function of total hours (hours a vehicle exists) minus its hours of operation on roads (source hours operating, or SHO, which is the same as VHT). The vehicle type SHP estimates were calculated for each hour of the day based on the link VMT and speeds, the VMT mix used in the link-based emissions analysis, and the vehicle population estimates.

The VMT mix was applied to the link VMT to produce VMT estimates by vehicle type. Link VMT was divided by the link speed to produce SHO estimates. SHO was aggregated across links, then subtracted from source hours (equal to vehicle population, since source hours equals the number of hours in the period multiplied by the vehicle population, and each period is one hour) resulting in SHP estimates by vehicle type.

ii. Partial County SHP Estimates:

For each analysis year, the hourly SHP by vehicle type for the Sunland Park NAA was calculated as a scaling of El Paso County activity by multiplying the El Paso County SHP by the total VMT ratio, Sunland Park NAA VMT-to-El Paso County VMT.

c. Starts Activity:

County-level vehicle engine starts were estimated as a preliminary step towards estimating starts for the partial county area. Starts were estimated for each year and hour of day.

i. County Starts Estimates:

El Paso County engine starts were based on the MOVES national default starts per vehicle per hour by vehicle type and the El Paso County vehicle population estimates. MOVES default weekday starts per vehicle were calculated using MOVES national scale inventory mode default run activity output, as weekday day-type vehicle starts divided by vehicle population, for each hour and SUT/fuel type. The El Paso County vehicle starts activity estimates were then calculated in each weekday hour as the product of national default weekday starts/vehicle/hour and the El Paso County vehicle type population estimates.

ii. Partial County Starts Estimates:

Each analysis year, the hourly starts by vehicle type for the Sunland Park NAA were calculated by multiplying the El Paso County starts activity by the total VMT ratio, Sunland Park NAA VMT-to-El Paso County VMT.

d. SHI and APU Hours as a Function of Hotelling Hours:

During hotelling, the truck's main engine is assumed to be idling, or its diesel APU is in use, or it is using electric power or no power. Hotelling hours were first estimated, followed by the hours

attributed to the two emissions-producing hotelling components, SHI and diesel APU hours. County-level hotelling activity estimates were first developed, followed by estimates for the Sunland Park NAA, scaled from the county estimates using VMT ratios.

i. County SHI and APU Hours Estimates:

County, analysis year, summer weekday hotelling hours were first estimated using 24-hour weekday hotelling hour estimates for a 2017 base year (from the recent TCEQ extended idling study); base and analysis year scenario VMT, speeds, and VMT mix; and analysis year scenario SHP estimation data.[36]

The 2017 base year county hotelling hours estimates for a 24-hour winter weekday from the TCEQ study were scaled to each analysis scenario using the ratio of analysis scenario-to-base combination long-haul truck 24-hour VMT (as truck VMT increases, so does the hotelling activity).

The 24-hour hotelling estimates were then distributed to each hour using the hotelling hours distribution calculated as the inverse of the hourly distribution of VHT (or SHO, from the SHP calculation process) for combination long-haul trucks. Within each hour, SHP and hotelling hours were compared, and if hotelling hours exceeded SHP, hotelling hours were set equal to SHP.

The SHI and APU hours components of hotelling hours were then estimated for each hour using the hourly hotelling hours estimates, combination long-haul truck travel fractions (calculated from local age distributions, and MOVES default relative mileage accumulation rates), and hotelling activity distributions for each model year (Table 4-19).

The SHI and APU hours activity distribution fractions were each first multiplied by the travel distribution (model year operating mode activity fraction multiplied by the associated model year travel fraction).

The product of the SHI fractions and travel fractions were then summed to produce the total SHI fraction, and the same process was performed for APU hours to produce total APU hours fraction. (The sum of the SHI and APU hours fractions subtracted from 1.0 results in the remaining fraction of hotelling hours, consisting of the electric power or no power in use modes.)

The total SHI and APU hours fractions were then each multiplied by the hotelling hours for each hour of the day to produce the SHI and APU hours estimates for each hour.

[36] Base estimates of hotelling hours are 2017 winter weekday estimates, developed by TTI as part of a truck extended idling study that produced county 24-hour hotelling estimate totals for all Texas counties, sponsored by TCEQ starting in 2017. The base VMT estimates for hotelling scaling factors were developed using 2017 Destino TDM datasets (provided by the EPMPO February 19, 2020) and VMT adjustments, VMT mix, and procedures described in Items 8 and 9.

Table 4-19. Hotelling Activity Distributions by Model Year.

Begin Model Year	End Model Year	OpModeFraction for opModeID/opModeName			
		200	201	203	204
		Extend Idling	Diesel Aux	Battery AC	APU Off
1960	2009	0.8	0	0	0.2
2010	2020	0.73	0.07	0	0.2
2021	2023	0.48	0.24	0.08	0.2
2024	2026	0.4	0.32	0.08	0.2
2027	2050	0.36	0.32	0.12	0.2

ii. Partial County SHI and APU Hours Estimates:

For the Sunland Park NAA estimates for SHI and APU hours as a function of hotelling hours, the procedure of applying a VMT ratio, or scaling factor, to county-level activity was used. The SHI and APU hours for each hour for the Sunland Park NAA were calculated by scaling the El Paso County activity estimates using the ratios of Sunland Park VMT to the El Paso County VMT, for each year.

DEVELOPMENT OF EMISSIONS FACTORS BY VEHICLE TYPE

22. Emission Factors Overview:

TTI developed emissions rates using MOVES and the TTI post-processing utility, RatesCalc, which prepares MOVES2014a-based, direct vehicle emissions rates for input to TTI's external inventory calculation utility, EmsCalc. El Paso County summer weekday emissions rates were produced for each analysis year for use in estimating emissions for all El Paso regional TDM area analyses.

These on-road emissions rates were developed in terms of mass per activity unit: miles for roadway-based processes; and SHP, starts, SHI, and APU hours for off-network processes. All activity-based rates were directly output by MOVES, except for parked vehicle evaporative emissions rates based in SHP. TTI used the RatesCalc utility to calculate emissions rates in terms of rate/SHP (as a conversion of MOVES rate/vehicle output) using the data in the county (local) input database (CDB) used in the MOVES emissions rates run and the MOVES default database. The RatesCalc utility combined the rate/distance, rate/hour (SHI and APU hours), and rate/start emission rate tables from MOVES output and the calculated rate/SHP emission rate table into a database of rates look-up tables. For additional details on the post-processing of MOVES output, see Attachment 4.2.

Table 4-20 lists the emissions processes with associated activity basis and emissions rate units. The emissions factors were developed by pollutant, speed, process, hour, road type, and SUT/FT.

Table 4-20. MOVES On-Road Emission Rates Modeled by Process and Activity Factor.

Emissions Process	Activity[1]	Emissions Factor Units
Running Exhaust Crankcase Running Exhaust	VMT	mass/mile (mass/mi)
Brake Wear	VMT	mass/mi
Tire Wear	VMT	mass/mi
Start Exhaust Crankcase Start Exhaust	starts	mass/start
Extended Idle Exhaust Crankcase Extended Idle Exhaust	SHI	mass/shi
Auxiliary Power Exhaust	APU Hours	mass/APU hour
Evaporative Permeation Evaporative Fuel Vapor Venting Evaporative Fuel Leaks	VMT, SHP	mass/mi, mass/shp

[1] The amount of travel on roads (VMT), SHP, vehicle starts, SHI and APU hours are the basic activity factors. SHI and APU hours are for combination long-haul trucks only. Evaporative (hydrocarbon) permeation, fuel vapor venting, and fuel leaks occur both during operation and while parked.

a. MOVES Model Inputs:

All user-specified model settings and inputs for each run were contained in a MOVES run specification (MRS) and a CDB (the MOVES2014a default database used was "MOVESDB20161117"). See Attachment 2 for details on the MRS files and CDBs developed for El Paso County and used to estimate the summer weekday emission factors for each analysis year for all areas in the El Paso TDM region.

b. Emissions Factor Post-Processing Adjustments:

No emission rate adjustments were applied (e.g., El Paso County is not in the Texas Low Emissions Diesel [TxLED] program so no TxLED NOx adjustments were applied).

c. Emissions Controls Modeling:

Table 4-21 shows the modeling approaches used for the emissions control strategies. Unless otherwise stated, the control strategy was modeled in all years.

Table 4-21. Emissions Modeling Strategies and Approaches.

Strategy	Approach
Federal Motor Vehicle Control Program Standards	*MOVES defaults.*
Federal Heavy-Duty Diesel Engines Rebuild and 2004 Pull-Ahead Programs to Mitigate NOx Off-Cycle Effects	*MOVES defaults.*
Gasoline Fuel – Tier 2/Tier 3 sulfur standards, Low Summer Reid Vapor Pressure (RVP), Winter Oxygenate	*Locality-specific user inputs to MOVES*. TTI used summer 2017 conventional gasoline inputs based on summer 2017 El Paso gasoline survey data (TCEQ 2017).[1] The 2020 and later conventional gasoline inputs, consistent with pertinent federal and state rules, are based on a combination of the latest available 2017 El Paso fuel sample data and MOVES defaults or other expected future year values. Fuel formulations are provided in Attachment 4.2.
Federal Low Sulfur Diesel Fuel	*Locality-specific user inputs to MOVES*. The 2017 diesel sulfur input values were based on summer 2017 El Paso survey data.[1] For 2020 and later, the sulfur level was set for consistency with the applicable federal diesel sulfur standards. Diesel formulations are provided in Attachment 4.2.
Inspection and Maintenance (I/M) Program	*Locality-specific user inputs to MOVES*. TTI developed El Paso I/M Program inputs to MOVES using the available MOVES I/M parameters pertaining to the domain of subject I/M vehicles, consistent with current program descriptions and latest I/M modeling protocols. Attachment 4.2 provides a summary of the I/M program input parameters used.

[1] The 2017 summer gasoline and diesel formulations are consistent with the local, survey-based inputs applied in the latest El Paso summer weekday periodic emissions inventory as documented in "2017 On-Road Mobile Source Annual, Summer Weekday and Winter Weekday Emissions Inventories: El Paso County" (TTI, August 2019).

Attachment 4.1
Adjustments to TDM VMT

Table 4-22. HPMS Factor.

2012 HPMS AADT VMT[1]	AADT-to-ANSWT Factor	HPMS-Based ANSWT VMT	2012 TDM VMT[1]	HPMS Factor
15,151,926	1.08814	16,487,417	17,101,944	0.964066834

El Paso County.

Table 4-23. Analysis Year Seasonal Weekday Factor.

Year	Seasonal Factor Type[1]	Factor
2017 and later	ANSWT-to-SWKD	0.96030

[1] SWKD is summer weekday.

Table 4-24. Hourly VMT Distributions.

Period	Hour	Summer Fractions	
		24-Hour-Period	Four-Period1
AM Peak	7-8 a.m.	0.062671	0.336480
	8-9 a.m.	0.066374	0.356360
	9-10 a.m.	0.057210	0.307160
Mid-Day	10-11 a.m.	0.053052	0.183839
	11 a.m-12 p.m.	0.055426	0.192066
	12-1 p.m.	0.058595	0.203047
	1-2 p.m.	0.059748	0.207043
	2-3 p.m.	0.061757	0.214005
	3-4 p.m.	0.066345	0.242587
PM Peak	4-5 p.m.	0.071152	0.260163
	5-6 p.m.	0.073690	0.269443
	6-7 p.m.	0.062303	0.227807
	7-8 p.m.	0.062671	0.188006
Overnight	8-9 p.m.	0.047317	0.149744
	9-10 p.m.	0.037687	0.128339
	10-11 p.m.	0.032300	0.103784
	11 p.m.-12 a.m.	0.026120	0.074707
	12-1 a.m.	0.018802	0.042106
	1-2 a.m.	0.010597	0.027281
	2-3 a.m.	0.006866	0.021770
	3-4 a.m.	0.005479	0.020117
	4-5 a.m.	0.005063	0.028620
	5-6 a.m.	0.007203	0.070519
	6-7 a.m.	0.017748	0.145007

[1] To maintain VMT proportions within the four periods, the hourly fractions were normalized within each period.

Attachment 4.2

MOVES Run Specifications (MRS), County Databases (CDB), Outputs, and Post-Processing

MOVES Inputs and Output – El Paso County[37]:

MRS input files: One for each analysis year (5).

CDB inputs: One for each analysis year (5).

The MOVES default input database (MOVESDB20161117).

MOVES output databases: One per MOVES run (5).

MOVES run log output text files: One per MOVES run (5).

Table 4-25 describes the MOVES2014a run specification files used. Table 4-26 describes the CDBs built and used for the rates analysis.

[37] Applicable to all TDM areas, e.g., the Dona Ana County, NM partial County areas in the TDM.

Table 4-25. MOVES Run Specification Selections by GUI Panel.

Navigation Panel	Detail Panel[1]	Selection		
Scale[1]	Model; Domain/Scale; Calculation Type	On-Road; County; Emissions Rates		
Time Spans[1]	Time Aggregation Level; Years – Months – Days – Hours	Hour; <***Year***>[1] - July - Weekday - All		
Geographic Bounds[1]	Region; Selections; Domain Input Database	Zone and Link; Texas – El Paso County;[1] <***County Input Database Name***>[1]		
On-Road Vehicle Equipment	SUT/Fuel Combinations	SUT	Gasoline	Diesel
		Motorcycle	X	-
		Passenger Car	X	X
		Passenger Truck	X	X
		Light Commercial Truck	X	X
		Intercity Bus	-	X
		Transit Bus	-	X
		School Bus	X	X
		Refuse Truck	X	X
		Single Unit Short-Haul Truck	X	X
		Single Unit Long-Haul Truck	X	X
		Motor Home	X	X
		Combination Short-Haul Truck	X	X
		Combination Long-Haul Truck	-	X
Road Type	Selected Road Types	Off-Network – Rural Restricted Access – Rural Unrestricted Access – Urban Restricted Access – Urban Unrestricted Access		
Pollutants and Processes[2]	VOC, NOx	Dependent on pollutant: Running Exhaust, Start Exhaust, Extended Idle Exhaust, Auxiliary Power Exhaust, Crankcase Running Exhaust, Crankcase Start Exhaust, Crankcase Extended Idle Exhaust, Evap Permeation, Fuel Vapor Venting, Fuel Leaks		
Manage Input Data Sets	Additional Input Database Selections	None		
Strategies	Rate Of Progress	Not Applicable		
General Output[1]	Output Database; Units; Activity	<***MOVES Output Database Name***>[1]; Pounds, KiloJoules, Miles; Hotelling Hours, Population, Starts (not adjustable, pre-selected)		
Output Emissions Detail	Always; For All Vehicles/Equipment; On Road	Time: Hour – Location: Link – Pollutant; Fuel Type, Emissions Process; Source Use Type		
Advanced Performance Measures	Aggregation and Data Handling	All check boxes "un-checked" except "clear BaseRateOutput after rate calculations" box		

[1] County scale allows only one year per run. The years include 2017, 2020, 2030,2040, and 2045. The month July represents the summer season. El Paso County FIPS code, season, and year were included in the MRS file names and in the CDB names and output database names.

[2] Only the pollutants required for reporting purposes are listed, although several others were included in the runs (e.g., PM-2.5, PM-10, CO, CO2, etc.).

Table 4-26. MOVES CDB Input Tables.

Input Table	Category	Notes
year	Time	Designates analysis year as a base year (base year means that local activity inputs will be supplied rather than forecast by the model).
state	Geography	Identifies the state (Texas) for the analysis.
county	Geography/ Meteorology	Identifies county, local altitude, barometric pressure. Used summer pressure from TCEQ's El Paso 2017 periodic emissions inventory.
zonemonthhour	Meteorology	Summer hourly temperature and relative humidity for the county. 2017 averages: June-July-August; from TCEQ's El Paso County 2017 periodic emissions inventory.
roadtype	Activity	MOVES road types and ramp activity fractions. Ramp fractions were set to 0.
Hpmsvtypeyear[1]	Activity (Defaults)	TTI used MOVES default national annual VMT by HPMS vehicle type.
roadtypedistribution[1]		TTI used MOVES default road type VMT fractions.
monthvmtfraction[1]		TTI used MOVES default month VMT fractions.
dayvmtfraction[1]		TTI used MOVES default day VMT fractions.
hourvmtfraction[1]		TTI used MOVES default hour VMT fractions.
avgspeeddistribution[1]		TTI used MOVES default average speed distributions.
sourcetypeyear[1]	Fleet (Defaults)	TTI used MOVES default national SUT populations.
sourcetypeage-distribution	Fleet	TTI estimated SUT age fractions using TxDMV mid-year county vehicle registration data and MOVES defaults (consistent with the registration data year), as needed. The latest available (2014) mid-year registration data were used for all years.
avft	Fleet	TTI based SUT fuel fractions using TxDMV vehicle registration data and defaults, as needed. Local data sets used were consistent with sourcetypeagedistribution tables. The avft estimate is consistent with the analysis VMT mix (i.e., gasoline and diesel).
zone	Activity	Start, hotelling, and SHP zone allocation factors. County = zone, and all factors were set to 1.0 (required for county scale analyses).
zoneroadtype	Activity	SHO zone/roadtype allocation factors. County = zone, and all factors were set to 1.0 (required for county scale analyses).
fuelsupply	Fuel	Fuel supply was set to one gasoline and one diesel formulation.
fuelformulation	Fuel	TTI used a combination of MOVES defaults and fuel properties estimated from local (summer 2017) survey data with adjustments where needed for future years for consistency with pertinent fuel regulations (e.g., summer RVP limit and Tier 3 sulfur standard; and ultra-low sulfur diesel sulfur standard).
countyyear	Stage II	N/A
imcoverage	I/M	TTI used local inputs to represent the I/M program design for El Paso County based on applicable I/M rules and the latest modeling protocols.
Hotellingactivity-distribution	Activity	Used the updated distribution from TCEQ's 2017 long-haul truck hotelling/idling study.

[1] Use of default activity and population inputs for the MOVES rates mode runs is a basic aspect of the rates-per-activity emissions estimation method, which calculates the emissions inventory estimates via post-processing. The process uses actual, local vehicle activity estimates external to MOVES in the emissions calculations.

Table 4-27 summarizes the meteorological inputs used. Table 4-28 summarizes the fuel formulation inputs used. Age distribution and fuel fraction inputs are summarized in Attachment 4.3.

Table 4-27. Meteorological Inputs to MOVES for El Paso County.

Hour	Summer	
	Temperature	Relative Humidity
12:00 a.m.	79.77	42.73
1:00 a.m.	78.51	45.05
2:00 a.m.	77.31	47.11
3:00 a.m.	76.27	49.05
4:00 a.m.	75.38	50.63
5:00 a.m.	74.47	52.45
6:00 a.m.	73.96	53.51
7:00 a.m.	75.19	51.26
8:00 a.m.	77.54	46.95
9:00 a.m.	80.13	42.42
10:00 a.m.	82.81	37.98
11:00 a.m.	85.38	33.88
12:00 p.m.	87.54	30.66
1:00 p.m.	89.27	28.03
2:00 p.m.	90.68	25.90
3:00 p.m.	91.85	24.01
4:00 p.m.	92.09	24.18
5:00 p.m.	91.62	24.77
6:00 p.m.	90.74	25.75
7:00 p.m.	89.02	28.24
8:00 p.m.	86.68	32.05
9:00 p.m.	84.78	34.61
10:00 p.m.	82.97	37.00
11:00 p.m.	81.28	40.04

Average hourly from weather stations within El Paso County—June through August 2017 (provided by TCEQ). Temperatures in °F and percent relative hour (24-hr for pressure).

Table 4-28. MOVES Gasoline and Diesel Fuel Formulation Inputs for El Paso County.

Fuel Type	Gasoline[1]		Diesel[2]	
Season	Summer		Summer	
Year	2017	2020+	2017	2020+
Fuel Formulation ID	17703	18703	30637	30011
Fuel Subtype ID	12	12	20	20
RVP	6.94	7.00	0	0
Sulfur Level	19.56	10.00	6.37	11.00
ETOH Volume	9.6	9.60	0	0
MTBE Volume	0	0	0	0
ETBE Volume	0	0	0	0
TAME Volume	0	0	0	0
Aromatic Content	26.67	26.67	0	0
Olefin Content	5.50	5.50	0	0
Benzene Content	1.30	0.63	0	0
e200	48.74	48.74	0	0
e300	87.84	87.84	0	0
Vol to Wt Percent Oxy	0.3653	0.3653	0	0
BioDieselEster Volume	/N	/N	/N	/N
Cetane Index	/N	/N	/N	/N
PAH Content	/N	/N	/N	/N
T50	206.12	206.12	0	0
T90	306.72	306.72	0	0

[1] TTI (June 2018) based the summer season conventional gasoline (CG) formulations on TCEQ's summer 2017 (latest available) fuel survey samples from El Paso County. TTI estimated the summer 2017 actual average CG properties as individual fuel grade averages weighted by relative sales volumes. The future year (2020+) summer CG properties are these latest available 2017 actual estimates except with RVP, average sulfur level, and average benzene content set to the "expected" values (MOVES defaults, consistent with the pertinent regulatory standards). Fuel subtype ID 12 is 10% ethanol-blend gasoline.

[2] Future Years diesel sulfur was conservatively set to the maximum level of the last three of TCEQ's statewide diesel surveys (2011, 2014, 2017), within the federal ultralow sulfur diesel 15 ppm average annual standard. Fuel subtype ID 20 is conventional diesel.

Table 4-30. MOVES2014A I/M Descriptive Inputs for Subject Counties

YearID	Begin Model Year[1]	End Model Year[1]	Test Standards ID (Description)	Source Use Type (I/M Compliance)[2]	Other[3]
2007 – 2019	*X*	1995	12 (2500 RMP/Idle)	Passenger Car (93.12 %), Passenger Truck (91.26 %) Light Commercial Truck (85.67 %)	See Note 3
	X	1995	41 (Evp Cap)		
	1996	*Y*	51 (Exh OBD)		
	1996	*Y*	45 (Evp Cap, OBD)		
2020 - 2050	*X*	*Y*	51 (Exh OBD)		
	X	Y	45 (Evp Cap, OBD)		

[1]Begin and end model year (X, Y) define the range of model years covered – where X and Y, respectively, are calculated as YearID – 24, and YearID – 2.

[2] I/M compliance factor estimates were calculated per MOVES Technical Guidance (EPA, November 2015) and Texas modeling protocol (using compliance and waiver rates of 96 % and 3 %, respectively).

[3] Also - the model processes/pollutants affected are start and running exhaust HC, CO, NOx, and tank vapor venting HC; fuel type is gasoline; frequency is annual.

Post-Processing Output:

Each MOVES output database was post-processed using TTI's MOVES emissions rates post-processing utility, RatesCalc, to produce the final on-road rate tables for subsequent input to the EmsCalc inventory calculation utility.

- RatesCalc Rate Databases: Mass/SHP off-network evaporative process rates were calculated using data from the CDB, the MOVES default database, and the MOVES rateperprofile and ratepervehicle emissions rate output. RatesCalc also copied mass/mile, mass/start, and mass/hour rates along with the units into emissions rate tables. RatesCalc does not perform any unit conversions. The utility created the emission rate look-up tables ttirateperdistance, ttirateperstart, ttirateperhour (for SHI and APU hours), and ttiratepershp in a "ratescalc" output database by county, analysis year, and season. (When the RatesAdj utility is not subsequently applied, RatesCalc produces the final rates inputs to EmsCalc.)
- RatesAdj Final Rate Databases: Not Applicable. The Texas Low Emission Diesel Program (TxLED) is not applicable to El Paso County; thus, the RatesAdj utility was not used. [38]

[38] The TxLED counties list may be found at: https://www.tceq.texas.gov/airquality/mobilesource/txled/txled-affected-counties.

Attachment 4.3:
Source Type Age and Fuel Engine Fractions Inputs to MOVES

El Paso County (48141) 2014 Age Distribution Inputs to MOVES (used for 2017, 2020, 2030, 2040, and 2045)

Age	MC	PC	PT	LCT	IBus	TBus	SBus	RT	SUShT	SULhT	MH	CShT	CLhT
0	0.045935	0.053900	0.026733	0.026733	0.055548	0.055650	0.055556	0.064759	0.062455	0.080736	0.064928	0.009782	0.044007
1	0.079804	0.070772	0.037056	0.037056	0.049844	0.049946	0.049851	0.058272	0.060276	0.097975	0.058445	0.015801	0.048909
2	0.069402	0.060117	0.033846	0.033846	0.046005	0.046100	0.046012	0.053507	0.079702	0.150497	0.053673	0.014296	0.050486
3	0.042856	0.046863	0.035079	0.035079	0.042194	0.055697	0.032610	0.028999	0.066630	0.104892	0.039988	0.006772	0.032874
4	0.031289	0.049364	0.034467	0.034467	0.037253	0.034095	0.035647	0.022977	0.037945	0.036093	0.035305	0.010534	0.017742
5	0.080386	0.040653	0.028561	0.028561	0.031054	0.034678	0.042221	0.030317	0.032680	0.034013	0.029436	0.021068	0.031415
6	0.073146	0.064144	0.058164	0.058164	0.039992	0.048516	0.046183	0.023359	0.109659	0.093698	0.037928	0.029345	0.043640
7	0.096114	0.066662	0.060009	0.060009	0.052280	0.047012	0.047736	0.081433	0.047749	0.057695	0.049441	0.044394	0.094086
8	0.078472	0.061945	0.055914	0.055914	0.053395	0.033713	0.055776	0.060642	0.069535	0.064010	0.050348	0.042889	0.070679
9	0.063826	0.060570	0.053565	0.053565	0.055067	0.052559	0.049572	0.057049	0.069717	0.057569	0.051939	0.049661	0.061342
10	0.045602	0.055428	0.061812	0.061812	0.053502	0.043092	0.048835	0.034170	0.053558	0.040882	0.050306	0.036117	0.041119
11	0.054839	0.053694	0.053524	0.053524	0.049301	0.041983	0.041807	0.033378	0.042484	0.033007	0.046365	0.029345	0.032913
12	0.039694	0.051897	0.055451	0.055451	0.046064	0.042452	0.043802	0.024143	0.034858	0.026419	0.043333	0.033860	0.032437
13	0.031455	0.043310	0.053863	0.053863	0.044038	0.048613	0.039741	0.029530	0.035585	0.027473	0.041306	0.051919	0.043530
14	0.024715	0.042587	0.047742	0.047742	0.041777	0.032808	0.043136	0.040271	0.039034	0.021921	0.039197	0.082769	0.052520
15	0.024049	0.033234	0.039570	0.039570	0.040613	0.031807	0.039913	0.057677	0.032498	0.019697	0.037984	0.078254	0.044225
16	0.017142	0.027351	0.033474	0.033474	0.030598	0.037111	0.031314	0.052718	0.018337	0.009478	0.022205	0.055681	0.037120
17	0.011401	0.021668	0.033913	0.033913	0.024835	0.033826	0.029099	0.025424	0.017974	0.010221	0.034115	0.040632	0.028101
18	0.011401	0.016127	0.022415	0.022415	0.020412	0.030975	0.024947	0.032795	0.009259	0.005665	0.020938	0.033860	0.025898
19	0.008405	0.015798	0.023979	0.023979	0.026464	0.025322	0.031789	0.041995	0.014706	0.006044	0.024651	0.048157	0.032080
20	0.007240	0.011279	0.022920	0.022920	0.020257	0.021952	0.015251	0.029313	0.009622	0.003876	0.023297	0.040632	0.020867
21	0.004660	0.008904	0.016038	0.016038	0.016633	0.018163	0.018167	0.013318	0.007081	0.002748	0.015998	0.029345	0.017990
22	0.003911	0.006789	0.013027	0.013027	0.012252	0.015769	0.014653	0.011855	0.005991	0.001875	0.013989	0.024831	0.012870
23	0.003994	0.005559	0.009793	0.009793	0.013801	0.015855	0.018594	0.018450	0.005991	0.002168	0.010346	0.030098	0.014209
24	0.003162	0.004365	0.009074	0.009074	0.015450	0.023149	0.020950	0.013061	0.004720	0.001735	0.013522	0.024078	0.012572
25	0.001831	0.003615	0.008759	0.008759	0.015324	0.017611	0.011953	0.020123	0.005084	0.001442	0.017413	0.017306	0.009605
26	0.002496	0.002877	0.009512	0.009512	0.014173	0.013781	0.014128	0.011515	0.004720	0.001180	0.015355	0.015049	0.007859
27	0.002164	0.002357	0.005600	0.005600	0.014695	0.012718	0.014276	0.010304	0.001452	0.000678	0.014965	0.015801	0.006202
28	0.003828	0.001917	0.007022	0.007022	0.012327	0.010714	0.012460	0.005268	0.003813	0.000875	0.010998	0.016554	0.006083
29	0.002996	0.001624	0.005782	0.005782	0.010701	0.009139	0.010634	0.005263	0.001997	0.000762	0.011609	0.012039	0.005596
30	0.033785	0.014631	0.043334	0.043334	0.014149	0.015191	0.013386	0.008114	0.014887	0.004677	0.020675	0.039127	0.021026

Texas Statewide 2017 Fuel Engine Fractions Summary[1]

SUT	Fuel Type	Model Year															
		2017	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005	2004	2003	2002
MC	Gas	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
PC	Gas	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.990	0.993	0.999	1.000	0.993	0.995	0.997	0.996	0.996
PC	Diesel	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.010	0.007	0.001	0.000	0.007	0.005	0.003	0.004	0.004
PT	Gas	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.987	0.985	0.977	0.981	0.975	0.979	0.982	0.982	0.983
PT	Diesel	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.013	0.015	0.023	0.019	0.025	0.021	0.018	0.018	0.017
LCT	Gas	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.962	0.955	0.941	0.948	0.938	0.946	0.951	0.951	0.956
LCT	Diesel	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.038	0.045	0.059	0.052	0.062	0.054	0.049	0.049	0.044
IBus	Diesel	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
TBus	Gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TBus	Diesel	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
SBus	Gas	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
SBus	Diesel	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990
RT	Gas	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.002	0.002	0.005	0.001	0.003	0.003	0.005	0.004	0.005
RT	Diesel	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.998	0.998	0.995	0.999	0.997	0.997	0.995	0.996	0.995
SUShT	Gas	0.396	0.396	0.396	0.396	0.371	0.219	0.234	0.274	0.351	0.287	0.256	0.238	0.232	0.245	0.260	0.268
SUShT	Diesel	0.604	0.604	0.604	0.604	0.629	0.781	0.766	0.726	0.649	0.713	0.744	0.762	0.768	0.755	0.740	0.732
SULhT	Gas	0.396	0.396	0.396	0.396	0.371	0.219	0.234	0.274	0.351	0.287	0.256	0.238	0.232	0.245	0.260	0.268
SULhT	Diesel	0.604	0.604	0.604	0.604	0.629	0.781	0.766	0.726	0.649	0.713	0.744	0.762	0.768	0.755	0.740	0.732
MH	Gas	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.510	0.530	0.540	0.560	0.570	0.590	0.600
MH	Diesel	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.490	0.470	0.460	0.440	0.430	0.410	0.400
CShT	Gas	0.094	0.094	0.094	0.094	0.199	0.110	0.057	0.081	0.052	0.058	0.031	0.050	0.051	0.052	0.055	0.077
CShT	Diesel	0.906	0.906	0.906	0.906	0.801	0.890	0.943	0.919	0.948	0.942	0.969	0.950	0.949	0.948	0.945	0.923
CLhT	Diesel	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

[1] Conventional internal combustion engine technology only.

Texas Statewide 2017 Fuel Engine Fractions Summary[1] - (Continued)

SUT	Fuel Type	Model Year														
		2001	2000	1999	1998	1997	1996	1995	1994	1993	1992	1991	1990	1989	1988	1987
MC	Gas	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
PC	Gas	0.997	0.997	0.998	0.998	0.999	0.999	0.999	1.000	0.999	0.999	0.997	0.999	0.999	1.000	0.987
PC	Diesel	0.003	0.003	0.002	0.002	0.001	0.001	0.001	0.000	0.001	0.001	0.003	0.001	0.001	0.000	0.013
PT	Gas	0.989	0.992	0.981	0.993	0.992	0.981	0.995	0.991	0.986	0.985	0.994	0.989	0.992	0.997	0.996
PT	Diesel	0.011	0.008	0.019	0.007	0.008	0.019	0.005	0.009	0.014	0.015	0.006	0.011	0.008	0.003	0.004
LCT	Gas	0.908	0.949	0.929	0.950	0.927	0.971	0.932	0.974	0.974	0.951	0.937	0.984	0.976	0.952	0.986
LCT	Diesel	0.092	0.051	0.071	0.050	0.073	0.029	0.068	0.026	0.026	0.049	0.063	0.016	0.024	0.048	0.014
IBus	Diesel	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
TBus	Gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TBus	Diesel	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
SBus	Gas	0.010	0.010	0.010	0.010	0.010	0.042	0.114	0.147	0.121	0.010	0.090	0.124	0.229	0.250	0.265
SBus	Diesel	0.990	0.990	0.990	0.990	0.990	0.958	0.886	0.853	0.879	0.990	0.910	0.876	0.771	0.750	0.735
RT	Gas	0.006	0.002	0.169	0.404	0.019	0.012	0.010	0.105	0.031	0.210	0.101	0.204	0.029	0.106	0.106
RT	Diesel	0.994	0.998	0.831	0.596	0.981	0.988	0.990	0.895	0.969	0.790	0.899	0.796	0.971	0.894	0.894
SUShT	Gas	0.311	0.350	0.348	0.435	0.436	0.427	0.673	0.508	0.519	0.511	0.465	0.539	0.572	0.640	0.654
SUShT	Diesel	0.689	0.650	0.652	0.565	0.564	0.573	0.327	0.492	0.481	0.489	0.535	0.461	0.428	0.360	0.346
SULhT	Gas	0.311	0.350	0.348	0.435	0.436	0.427	0.673	0.508	0.519	0.511	0.465	0.539	0.572	0.640	0.654
SULhT	Diesel	0.689	0.650	0.652	0.565	0.564	0.573	0.327	0.492	0.481	0.489	0.535	0.461	0.428	0.360	0.346
MH	Gas	0.630	0.660	0.680	0.710	0.740	0.770	0.790	0.820	0.850	0.850	0.850	0.850	0.850	0.850	0.850
MH	Diesel	0.370	0.340	0.320	0.290	0.260	0.230	0.210	0.180	0.150	0.150	0.150	0.150	0.150	0.150	0.150
CShT	Gas	0.084	0.090	0.107	0.134	0.147	0.146	0.275	0.117	0.117	0.160	0.161	0.144	0.114	0.157	0.163
CShT	Diesel	0.916	0.910	0.893	0.866	0.853	0.854	0.725	0.883	0.883	0.840	0.839	0.856	0.886	0.843	0.837
CLhT	Diesel	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

[1] Conventional internal combustion engine technology only.

Texas Statewide 2020 Fuel Engine Fractions Summary[1]

SUT	Fuel Type	Model Year															
		2020	2019	2018	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005
MC	Gas	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
PC	Gas	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.990	0.993	0.999	1.000	0.993	0.995
PC	Diesel	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.010	0.007	0.001	0.000	0.007	0.005
PT	Gas	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.987	0.985	0.977	0.981	0.975	0.979
PT	Diesel	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.013	0.015	0.023	0.019	0.025	0.021
LCT	Gas	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.962	0.955	0.941	0.948	0.938	0.946
LCT	Diesel	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.038	0.045	0.059	0.052	0.062	0.054
IBus	Diesel	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
TBus	Gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TBus	Diesel	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
SBus	Gas	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
SBus	Diesel	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990
RT	Gas	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.002	0.002	0.005	0.001	0.003	0.003
RT	Diesel	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.998	0.998	0.995	0.999	0.997	0.997
SUShT	Gas	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.371	0.219	0.234	0.274	0.351	0.287	0.256	0.238	0.232
SUShT	Diesel	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.629	0.781	0.766	0.726	0.649	0.713	0.744	0.762	0.768
SULhT	Gas	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.371	0.219	0.234	0.274	0.351	0.287	0.256	0.238	0.232
SULhT	Diesel	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.629	0.781	0.766	0.726	0.649	0.713	0.744	0.762	0.768
MH	Gas	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.510	0.530	0.540	0.560
MH	Diesel	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.490	0.470	0.460	0.440
CShT	Gas	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.199	0.110	0.057	0.081	0.052	0.058	0.031	0.050	0.051
CShT	Diesel	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.801	0.890	0.943	0.919	0.948	0.942	0.969	0.950	0.949
CLhT	Diesel	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

[1] Conventional internal combustion engine technology only.

Texas Statewide 2020 Fuel Engine Fractions Summary[1] - (Continued)

SUT	Fuel Type	Model Year														
		2004	2003	2002	2001	2000	1999	1998	1997	1996	1995	1994	1993	1992	1991	1990
MC	Gas	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
PC	Gas	0.997	0.996	0.996	0.997	0.997	0.998	0.998	0.999	0.999	0.999	1.000	0.999	0.999	0.997	0.999
PC	Diesel	0.003	0.004	0.004	0.003	0.003	0.002	0.002	0.001	0.001	0.001	0.000	0.001	0.001	0.003	0.001
PT	Gas	0.982	0.982	0.983	0.989	0.992	0.981	0.993	0.992	0.981	0.995	0.991	0.986	0.985	0.994	0.989
PT	Diesel	0.018	0.018	0.017	0.011	0.008	0.019	0.007	0.008	0.019	0.005	0.009	0.014	0.015	0.006	0.011
LCT	Gas	0.951	0.951	0.956	0.908	0.949	0.929	0.950	0.927	0.971	0.932	0.974	0.974	0.951	0.937	0.984
LCT	Diesel	0.049	0.049	0.044	0.092	0.051	0.071	0.050	0.073	0.029	0.068	0.026	0.026	0.049	0.063	0.016
IBus	Diesel	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
TBus	Gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TBus	Diesel	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
SBus	Gas	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.042	0.114	0.147	0.121	0.010	0.090	0.124
SBus	Diesel	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.958	0.886	0.853	0.879	0.990	0.910	0.876
RT	Gas	0.005	0.004	0.005	0.006	0.002	0.169	0.404	0.019	0.012	0.010	0.105	0.031	0.210	0.101	0.204
RT	Diesel	0.995	0.996	0.995	0.994	0.998	0.831	0.596	0.981	0.988	0.990	0.895	0.969	0.790	0.899	0.796
SUShT	Gas	0.245	0.260	0.268	0.311	0.350	0.348	0.435	0.436	0.427	0.673	0.508	0.519	0.511	0.465	0.539
SUShT	Diesel	0.755	0.740	0.732	0.689	0.650	0.652	0.565	0.564	0.573	0.327	0.492	0.481	0.489	0.535	0.461
SULhT	Gas	0.245	0.260	0.268	0.311	0.350	0.348	0.435	0.436	0.427	0.673	0.508	0.519	0.511	0.465	0.539
SULhT	Diesel	0.755	0.740	0.732	0.689	0.650	0.652	0.565	0.564	0.573	0.327	0.492	0.481	0.489	0.535	0.461
MH	Gas	0.570	0.590	0.600	0.630	0.660	0.680	0.710	0.740	0.770	0.790	0.820	0.850	0.850	0.850	0.850
MH	Diesel	0.430	0.410	0.400	0.370	0.340	0.320	0.290	0.260	0.230	0.210	0.180	0.150	0.150	0.150	0.150
CShT	Gas	0.052	0.055	0.077	0.084	0.090	0.107	0.134	0.147	0.146	0.275	0.117	0.117	0.160	0.161	0.144
CShT	Diesel	0.948	0.945	0.923	0.916	0.910	0.893	0.866	0.853	0.854	0.725	0.883	0.883	0.840	0.839	0.856
CLhT	Diesel	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

[1] Conventional internal combustion engine technology only.

Texas Statewide 2030 Fuel Engine Fractions Summary[1]

SUT	Fuel Type	Model Year															
		2030	2029	2028	2027	2026	2025	2024	2023	2022	2021	2020	2019	2018	2017	2016	2015
MC	Gas	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
PC	Gas	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988
PC	Diesel	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012
PT	Gas	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980
PT	Diesel	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020
LCT	Gas	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947
LCT	Diesel	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053
IBus	Diesel	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
TBus	Gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TBus	Diesel	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
SBus	Gas	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
SBus	Diesel	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990
RT	Gas	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
RT	Diesel	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997
SUShT	Gas	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396
SUShT	Diesel	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604
SULhT	Gas	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396
SULhT	Diesel	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604
MH	Gas	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500
MH	Diesel	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500
CShT	Gas	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094
CShT	Diesel	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906
CLhT	Diesel	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

[1] Conventional internal combustion engine technology only.

Texas Statewide 2030 Fuel Engine Fractions Summary[1] - (Continued)

SUT	Fuel Type	Model Year														
		2014	2013	2012	2011	2010	2009	2008	2007	2006	2005	2004	2003	2002	2001	2000
MC	Gas	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
PC	Gas	0.988	0.988	0.988	0.988	0.990	0.993	0.999	1.000	0.993	0.995	0.997	0.996	0.996	0.997	0.997
PC	Diesel	0.012	0.012	0.012	0.012	0.010	0.007	0.001	0.000	0.007	0.005	0.003	0.004	0.004	0.003	0.003
PT	Gas	0.980	0.980	0.980	0.980	0.987	0.985	0.977	0.981	0.975	0.979	0.982	0.982	0.983	0.989	0.992
PT	Diesel	0.020	0.020	0.020	0.020	0.013	0.015	0.023	0.019	0.025	0.021	0.018	0.018	0.017	0.011	0.008
LCT	Gas	0.947	0.947	0.947	0.947	0.962	0.955	0.941	0.948	0.938	0.946	0.951	0.951	0.956	0.908	0.949
LCT	Diesel	0.053	0.053	0.053	0.053	0.038	0.045	0.059	0.052	0.062	0.054	0.049	0.049	0.044	0.092	0.051
IBus	Diesel	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
TBus	Gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TBus	Diesel	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
SBus	Gas	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
SBus	Diesel	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990
RT	Gas	0.003	0.003	0.003	0.003	0.002	0.002	0.005	0.001	0.003	0.003	0.005	0.004	0.005	0.006	0.002
RT	Diesel	0.997	0.997	0.997	0.997	0.998	0.998	0.995	0.999	0.997	0.997	0.995	0.996	0.995	0.994	0.998
SUShT	Gas	0.396	0.371	0.219	0.234	0.274	0.351	0.287	0.256	0.238	0.232	0.245	0.260	0.268	0.311	0.350
SUShT	Diesel	0.604	0.629	0.781	0.766	0.726	0.649	0.713	0.744	0.762	0.768	0.755	0.740	0.732	0.689	0.650
SULhT	Gas	0.396	0.371	0.219	0.234	0.274	0.351	0.287	0.256	0.238	0.232	0.245	0.260	0.268	0.311	0.350
SULhT	Diesel	0.604	0.629	0.781	0.766	0.726	0.649	0.713	0.744	0.762	0.768	0.755	0.740	0.732	0.689	0.650
MH	Gas	0.500	0.500	0.500	0.500	0.500	0.500	0.510	0.530	0.540	0.560	0.570	0.590	0.600	0.630	0.660
MH	Diesel	0.500	0.500	0.500	0.500	0.500	0.500	0.490	0.470	0.460	0.440	0.430	0.410	0.400	0.370	0.340
CShT	Gas	0.094	0.199	0.110	0.057	0.081	0.052	0.058	0.031	0.050	0.051	0.052	0.055	0.077	0.084	0.090
CShT	Diesel	0.906	0.801	0.890	0.943	0.919	0.948	0.942	0.969	0.950	0.949	0.948	0.945	0.923	0.916	0.910
CLhT	Diesel	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

[1] Conventional internal combustion engine technology only.

Texas Statewide 2040 Fuel Engine Fractions Summary[1]

SUT	Fuel Type	Model Year															
		2040	2039	2038	2037	2036	2035	2034	2033	2032	2031	2030	2029	2028	2027	2026	2025
MC	Gas	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
PC	Gas	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988
PC	Diesel	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012
PT	Gas	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980
PT	Diesel	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020
LCT	Gas	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947
LCT	Diesel	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053
IBus	Diesel	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
TBus	Gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TBus	Diesel	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
SBus	Gas	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
SBus	Diesel	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990
RT	Gas	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
RT	Diesel	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997
SUShT	Gas	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396
SUShT	Diesel	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604
SULhT	Gas	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396
SULhT	Diesel	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604
MH	Gas	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500
MH	Diesel	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500
CShT	Gas	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094
CShT	Diesel	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906
CLhT	Diesel	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

[1] Conventional internal combustion engine technology only.

Texas Statewide 2040 Fuel Engine Fractions Summary[1] - (Continued)

SUT	Fuel Type	Model Year														
		2024	2023	2022	2021	2020	2019	2018	2017	2016	2015	2014	2013	2012	2011	2010
MC	Gas	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
PC	Gas	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.990
PC	Diesel	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.010
PT	Gas	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.987
PT	Diesel	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.013
LCT	Gas	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.962
LCT	Diesel	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.038
IBus	Diesel	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
TBus	Gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TBus	Diesel	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
SBus	Gas	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
SBus	Diesel	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990
RT	Gas	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.002
RT	Diesel	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.998
SUShT	Gas	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.371	0.219	0.234	0.274
SUShT	Diesel	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.629	0.781	0.766	0.726
SULhT	Gas	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.371	0.219	0.234	0.274
SULhT	Diesel	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.629	0.781	0.766	0.726
MH	Gas	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500
MH	Diesel	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500
CShT	Gas	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.199	0.110	0.057	0.081
CShT	Diesel	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.801	0.890	0.943	0.919
CLhT	Diesel	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

[1] Conventional internal combustion engine technology only.

Texas Statewide 2045 Fuel Engine Fractions Summary[1]

SUT	Fuel Type	Model Year															
		2045	2044	2043	2042	2041	2040	2039	2038	2037	2036	2035	2034	2033	2032	2031	2030
MC	Gas	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
PC	Gas	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988
PC	Diesel	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012
PT	Gas	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980
PT	Diesel	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020
LCT	Gas	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947
LCT	Diesel	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053
IBus	Diesel	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
TBus	Gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TBus	Diesel	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
SBus	Gas	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
SBus	Diesel	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990
RT	Gas	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
RT	Diesel	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997
SUShT	Gas	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396
SUShT	Diesel	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604
SULhT	Gas	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396
SULhT	Diesel	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604
MH	Gas	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500
MH	Diesel	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500
CShT	Gas	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094
CShT	Diesel	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906
CLhT	Diesel	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

[1] Conventional internal combustion engine technology only.

Texas Statewide 2045 Fuel Engine Fractions Summary[1] - (Continued)

SUT	Fuel Type	Model Year														
		2029	2028	2027	2026	2025	2024	2023	2022	2021	2020	2019	2018	2017	2016	2015
MC	Gas	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
PC	Gas	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988
PC	Diesel	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012
PT	Gas	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980
PT	Diesel	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020
LCT	Gas	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947
LCT	Diesel	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053
IBus	Diesel	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
TBus	Gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TBus	Diesel	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
SBus	Gas	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
SBus	Diesel	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990
RT	Gas	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
RT	Diesel	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997
SUShT	Gas	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396
SUShT	Diesel	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604
SULhT	Gas	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396
SULhT	Diesel	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.604
MH	Gas	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500
MH	Diesel	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500
CShT	Gas	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094
CShT	Diesel	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906
CLhT	Diesel	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

[1] Conventional internal combustion engine technology only.

5. EL PASO CARBON MONOXIDE MAINTENANCE AREA WINTER WEEKDAY EMISSIONS ANALYSIS

SUMMARY

Under sponsorship of the Texas Department of Transportation (TxDOT), the Texas A&M Transportation Institute (TTI) produced El Paso carbon monoxide (CO) maintenance area, on-road mobile source CO emissions estimates in support of the El Paso Metropolitan Planning Organization (EPMPO) transportation planning efforts. This analysis description is for the CO maintenance area, a portion of the City of El Paso, coded distinctly in the current El Paso travel demand model (TDM). The results are representative of a typical CO season (winter) weekday for the 2020 analysis year.

TTI used its on-road inventory methodology to produce emissions estimates of the detail and quality suited for state implementation planning for air quality control and transportation conformity analyses. This is the detailed, disaggregate, TDM link-based rates-per-activity emissions estimation process. It uses MOVES2014a-based county emissions rate look-up tables based on local conditions for external emissions calculations performed at detailed, disaggregate, temporal, and spatial levels, using latest planning assumptions, and latest available data, models, and procedures.[39]

Hourly inventories were estimated by MOVES source use type (SUT) and fuel type (FT) combination (or vehicle type) and TDM roadway class. The TDMs were post-processed to estimate hourly, directional, link (roadway segment)-level vehicle miles of travel (VMT) and operational speeds for the roadway-based emissions calculations. Using estimates of vehicle operating hours (VHT), vehicle populations, truck hotelling activity, and other data, TTI estimated hourly off-network activity factors for the parked vehicle-based emissions calculations. Off-network activity types are source-hours-parked (SHP); starts; and source hours extended idling (SHI) and auxiliary power unit (APU) hours (emissions-producing components of combination long-haul truck hotelling hours).[40] Off-network evaporative rates (in mass/SHP form, not directly available from MOVES) were produced by a post-processing procedure and were compiled with other rates produced directly by MOVES to yield look-up tables of all rates in activity terms for the external emissions calculations.[41] The analyses used TTI's MOVES-based inventory development utilities for use with MOVES2014a.[42] EPA's Technical Guidance is the primary reference on appropriate inputs and use of MOVES.[43]

[39] TTI used the November 2016 MOVES2014a release, which produces the latest available on-road mobile source emission rates. All later MOVES updates through MOVES2014b produce the same on-road emissions rates as the November 2016 release.

[40] For this specific inventory analysis, the long-haul truck hotelling activity and SHP activity were not applicable. Long-haul truck hotelling is assumed to not occur in the City of El Paso, and SHP activity does not produce CO.

[41] Although not needed for CO analyses, TTI produces the SHP-based hydrocarbon emission rates in the comprehensive set of emission rates look-up tables, developed as a standard part of the inventory process.

[42] TTI Emissions Inventory Estimation Utilities Using MOVES: MOVES2014aUtl User's Guide, TTI, August 2016.

[43] MOVES2014, MOVES2014a, and MOVES2014b Technical Guidance: Using MOVES to Prepare Emission Inventories for Sate Implementation Plans and Transportation Conformity, EPA, August 2018.

SCOPE OF EMISSIONS ANALYSIS

23. Methodology:

Detailed, hourly, MOVES rates-per-activity, TDM link-based, with the most recent version of MOVES (for on-road mobile modeling).[44]

24. Analysis Years:

2020.

25. Seasonal Period:

Winter: Average January-February-December weekday (average Monday through Friday).

26. Geography:

A portion of the City of El Paso originally designated a moderate 8-hr CO NAAQS nonattainment area, currently a CO maintenance area.

27. Pollutants:

CO.

28. Sources:

Table 5-29. Vehicle Types Modeled in the Inventory.

MOVES SUT	Gasoline*	Diesel*
Motorcycle	MC_G	-
Passenger Car	PC_G	PC_D
Passenger Truck	PT_G	PT_D
Light Commercial Truck	LCT_G	LCT_D
Intercity Bus	-	IBus_D
Transit Bus	-	TBus_D
School Bus	SBus_G	SBus_D
Refuse Truck	RT_G	RT_D
Single Unit Short-Haul Truck	SUShT_G	SUShT_D
Single Unit Long-Haul Truck	SULhT_G	SULhT_D
Motor Home	MH_G	MH_D
Combination Short-Haul Truck	CShT_G	CShT_D
Combination Long-Haul Truck	-	CLhT_D

These vehicle type (SUT/fuel type) labels are referenced later in the document.

[44] TTI used the November 2016 MOVES2014a release, which produces the latest available on-road mobile source emission rates. All later MOVES updates through MOVES2014b produce the same on-road emission rates as the November 2016 release.

29. Link-Based Emissions Estimation Process Components and Utilities:

TTI developed the inventory components and resulting emissions and activity estimates for the analysis using TTI's suite of emission analysis utilities.

a. Inventory Components:

The emissions estimation process required development of the following major components for the emissions calculations:

- Hourly, directional, link-level, on-road fleet VMT, and average speeds;
- SUT/fuel type (i.e., vehicle type) time-of-day VMT mix;
- Vehicle type populations; [45]
- Hourly, vehicle type starts;
- Hourly vehicle type pollutant and process mass emissions rates: mass per mile, mass per SHP, mass per start, mass per SHI, and mass per APU hour.

Note that the scope of this analysis does not require SHP, long-haul truck hotelling, or SHP-based hydrocarbon emission rates to be modeled.

b. Utilities:

TTI used its emissions estimation utilities to produce the input components and the emissions estimates in tab-delimited hourly and 24-hour emissions and activity summary file formats. The TTI utilities include MOVES emission rates input and output processing utilities, the TDM network information post-processing utility, vehicle population and off-network activity development utilities, and the link-level emissions calculation utility.[46]

DEVELOPMENT OF ON-ROAD FLEET LINK-VMT AND SPEEDS

30. Travel Demand Models:

TTI received the El Paso MPO's Amended Destino 2045 MTP TDM data sets (i.e., trip matrices and four-time-period, directional, average non-summer weekday [ANSWT] traffic assignments), February 2019.[47] The 2020 analysis year data sets were needed for this analysis. TTI post-processed the data sets to determine average winter weekday, county-coded[48], hourly, directional, Highway Performance Monitoring System (HPMS)-consistent, network link VMT and volumes and added intrazonal link VMT estimates. (TDM network ANSWT VMT plus intrazonal ANSWT VMT is referred to herein as "total model VMT".) Method details are found in MOVES2014a-Based Travel Demand Model Link Emissions Estimation Method (TTI, August 2016).

[45] Vehicle populations are an intermediate parameter used in estimating off-network source hours parked and starts activity.
[46] TTI Emissions Inventory Estimation Utilities Using MOVES: MOVES2014aUtl User's Guide, TTI, August 2016.
[47] The EPMPO provided the TDM data sets for the 2020 analysis year (February 14, 2020).
[48] To estimate activity and emissions for the designated CO maintenance area, the TDM link-data sets were coded specifically for this analysis using "1" for the El Paso CO maintenance area (i.e., the "CO zones"), and "2" for the remainder of El Paso County (i.e., the "Non CO zones").

a. Adjustments to TDM VMT:

The ANSWT network link volumes and VMT and added intrazonal link VMT were factored to be consistent with HPMS VMT, to reflect winter weekday activity, to allocate by hour, and to allocate total link volumes by direction of travel. The seasonal weekday and hourly factors were developed using the latest available 10-year aggregate, TxDOT Automatic Traffic Recorder (ATR) traffic count data (2009 – 2018) for El Paso County.

i. Historical Year HPMS Consistency and Seasonal Weekday Adjustments:

HPMS consistency: Not applicable to this analysis.

Seasonal adjustment: Not applicable to this analysis.

ii. Forecast Years HPMS Consistency and Seasonal Weekday Adjustments:

HPMS consistency: TTI applied an HPMS adjustment factor to total model link-level VMT for all county and sub-county areas for the 2020 analysis year. The validation year HPMS adjustment factor was calculated as 2012 El Paso County HPMS VMT (first adjusted to ANSWT form using the ANSWT/AADT ATR count ratio) divided by 2012 validation year total model VMT for El Paso County[49]. See Table 5-34 in Attachment 5.1.

Seasonal adjustment: The seasonal day-type factor (winter weekday) was produced and used with the 2020 analysis year. The factor was calculated as the ratio of the seasonal weekday-to-ANSWT counts. See Table 5-35 in Attachment 5.1.

iii. Seasonal Weekday Hourly VMT Distributions:

Winter weekday, hourly travel factors were developed and used to allocate the 24-hour link VMT/volume estimates to each hour of the day. In order to maintain VMT proportions within each of the four time periods, the hourly fractions were normalized within each time period. See Table 5-36 in Attachment 5.1.

iv. Directional Factors:

Directional split factors were applied to total link volumes by functional class and area type. The directional factors were created by aggregating TDM link-level volumes by direction for each functional class/area type. Link-level AB directional volumes were divided by total volumes for each functional class/area type to estimate the direction split. These are the same factors applied in the prior El Paso conformity analysis.

b. Hourly Congested Speeds:

2TTI estimated directional, hourly operational link speeds using the TTI speed model, which estimates delay on each link as a function of volume-to-capacity and applies it to the link's estimated free-flow speed. TTI estimated the local streets category average operational link speeds

[49] The 2012 validation year TDM total model VMT was consistent with the prior Destino 2045 MTP conformity analysis (EPMPO, August 2018).

represented by the centroid connector links, as centroid connector TDM input speeds; and represented as added intrazonal links, as the average of the zone's centroid connector input speeds.

DEVELOPMENT OF VEHICLE TYPE VMT MIX

31. VMT Mix:

The VMT mix designates the vehicle categories included in the analysis and specifies the fraction of on-road fleet VMT attributable to each vehicle type.

a. Method:

VMT mixes were estimated using TTI's VMT mix method.[50] The method sets Texas vehicle registration category aggregations for MOVES SUT categories for developing the VMT mixes, as well as for developing other fleet parameters needed elsewhere in the process (e.g., SUT age distributions, vehicle population estimates).

b. Temporal and Spatial Aspects:

The VMT mixes, consistent with the prior analysis, were produced in five-year increments and are 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.

No seasonal adjustments are made for VMT mix. Average weekday vehicle type VMT mixes by MOVES road type and by four time-of-day periods (AM Peak, Mid-Day, PM Peak, Overnight) were estimated for the TxDOT El Paso District for use with the El Paso TDM region.[51]

c. Data Sources:

TTI used the latest available multi-year TxDOT El Paso District vehicle classification counts (2005-2014) and associated Texas Department of Motor Vehicles (TxDMV) year-end registration data (2013) and TxDOT/TxDMV registration data, along with MOVES default data, as needed (i.e., appropriate for the analysis year).

d. Vehicle Types:

The vehicle types in the VMT mix are the 22 gasoline and diesel MOVES SUT combinations shown previously in Table 5-29.

[50] *Developing MOVES Source Use Types and VMT Mix for Conformity Analysis* (TxDOT Air Quality / Conformity IAC-A - TTI Task 409252-0643: Maintain, Update and Enhance Traffic Activity Estimation and Forecasting Methods), Texas Department of Transportation, Austin, TX, August 2016.

[51] Using the same data sets and a similar procedure, aggregate (i.e., 24-hour, all road-types) TxDOT district-level weekday vehicle type VMT mixes were also produced for use in the vehicle population estimation.

DEVELOPMENT OF OFF-NETWORK ACTIVITY BY VEHICLE TYPE

32. County and Partial County Off-Network Activity:

Off-network activity types that produce CO emissions include vehicle engine starts and long-haul truck extended idling and diesel APU operation during hotelling.[52] Only the estimate for starts was needed, since truck hotelling activity is assumed to not occur in the CO maintenance area. Starts activity for El Paso County were needed as a first step in the procedure for estimating starts activity for a sub-county area. The sub-county CO maintenance area starts were then estimated based on the distribution of trips (from the analysis year trip matrices) between the two areas. El Paso County vehicle populations were needed first for estimating county-level vehicle starts.

a. County Vehicle Population Estimates:

Vehicle populations were estimated only at the county-level, not for the sub-county areas.[53] The county vehicle population estimates were based on the latest available TxDMV registration data, vehicle population factors derived from the VMT mix, and county-level VMT-based growth estimates for future years where actual registration data were not yet available. Since the latest available registration data for this analysis was mid-year 2014, vehicle population estimates were needed first for the 2014 historical year. The vehicle population estimates don't vary by season.

i. Historical Analysis Year Vehicle Population Estimates:

TxDMV registration data: Historical year vehicle population estimates are based on TxDMV mid-year registrations corresponding to the historical year. This registration data is aggregated into vehicle registrations categories (Table 5-30).

Vehicle population factors: Since the TxDMV registration data does not include each SUT/fuel type combination, vehicle population factors are developed using the 24-hour VMT mix for the historical year. These factors are applied to the aggregated vehicle registration categories to split them into the SUT/fuel type combination included in the analysis.

[52] Off-network SHP activity only produces evaporative hydrocarbon emissions and was not required in this analysis, and the long-haul truck hotelling activity is assumed to not occur in the City of El Paso where the CO maintenance area is located.

[53] No vehicle population estimates were needed for the sub-county off-network activity estimation procedure.

Table 5-30. Vehicle Registration Aggregations and Vehicle Types for Estimating Vehicle Populations.

Vehicle Registration[1] Aggregation	Associated Vehicle Type[2]
Motorcycles	MC_G
Passenger Cars (PC)	PC_G; PC_D
Trucks <= 8,500 gross vehicle weight rating (GVWR) (pounds)	PT_G; PT_D; LCT_G; LCT_D
Trucks > 8,500 and <= 19,500 GVWR	RT_G; RT_D SUShT_G; SUShT_D MH_G; MH_D IBus_D TBus_G; TBus_D SBus_G; SBus_D
Trucks >19,500 GVWR	CShT_G; CShT_D
NA[2]	SULhT_G; SULhT_D CLhT_G; CLhT_D

[1] Mid-year TxDMV county registrations data extracts are used, consisting of 1) light-duty cars, trucks, and motorcycles; 2) heavy-duty diesel trucks, and 3) heavy-duty gasoline trucks.

[2] Vehicle population factors are the 24-hour weekday VMT mix fraction for each vehicle type (see Table 5.1 for label definitions) in a category divided by the sum of the VMT mix fractions for all vehicle types in a category, except long-haul trucks. The four long-haul vehicle type populations are estimated using a long-haul-to-short-haul VMT mix ratio applied to the short-haul SUT population estimate.

ii. Future Analysis Year County Vehicle Population Estimates:

TxDMV registration data: As described for historical year vehicle population estimates, the registration data were aggregated by vehicle registration category. Since registration data were not available for future year analyses, the most recent mid-year TxDMV registration data sets (2014) were used.

Vehicle population factors: As described for historical year vehicle population estimates, vehicle population factors developed using the analysis year 24-hour VMT mix were applied to vehicle registrations aggregated by category to split each category into each SUT/fuel type combination included in the analysis, creating the base (2014) vehicle population estimates.

VMT-based growth estimates: For the 2020 analysis year, VMT-based growth estimates were calculated by dividing county, 2020 analysis year, summer weekday VMT by county, 2014 summer weekday VMT.[54] These growth estimates were applied to the base vehicle population estimates to scale from the 2014 base to each of the analysis year estimates.

[54] Base, summer weekday 2014 VMT for the scaling factors was calculated as the product of El Paso County 2014 AADT VMT (from TxDOT's RIFCREC data set) and the El Paso County ATR-based AADT to summer weekday conversion factor.

b. SHP Activity:

Not applicable to this analysis. (CO is not produced by SHP).

c. Starts Activity:

County-level vehicle engine starts were first estimated, followed by estimation of the starts for the sub-county areas based on distribution of trips between the "CO zones" (CO maintenance area) and "Non-CO zones" (rest of El Paso County).

i. County Estimates:

El Paso County engine starts were based on the MOVES national default starts per vehicle per hour by vehicle type and the El Paso County vehicle population estimates. MOVES default weekday starts per vehicle were calculated using MOVES national scale inventory mode default run activity output, as weekday day-type vehicle starts divided by vehicle population, for each hour and SUT/fuel type. The El Paso County vehicle starts activity estimates were then calculated in each weekday hour as the product of national default weekday starts/vehicle/hour and the El Paso County vehicle type population estimates.

ii. Partial County Estimates:

For the 2020 analysis year, the county-level winter vehicle starts by SUT/fuel type were distributed to the CO zones and Non-CO zones based on the distribution of vehicle trips (taken from the analysis year trip matrices) between the two areas. For example, if 30 percent of the El Paso County vehicle trips were in the CO zones, then 30 percent of the El Paso County vehicle starts will be in the CO zones and 70 percent of the county-level starts will be in the Non-CO zones.

d. SHI and APU Hours as a Function of Hotelling Hours:

Not applicable to this analysis. (Long-haul truck hotelling activity is assumed to not occur in the CO maintenance area, which is in the City of El Paso.)

DEVELOPMENT OF EMISSIONS FACTORS BY VEHICLE TYPE

33. Emission Factors Overview:

The emission rates produced and used in the prior El Paso Destino 2045 CO conformity analysis (EPMPO, August 2018) are still current (no new inputs are required). TTI used these previously developed emission rates to estimate CO emissions for this analysis. For completeness, the description of the emission rates development process from the previous analysis is included again, here. TTI developed the emissions rates using MOVES and the TTI post-processing utility, RatesCalc, which prepares MOVES2014a-based, direct vehicle emissions rates for input to TTI's external inventory calculation utility, EmsCalc. The El Paso County 2020 winter weekday emissions rates were produced for the estimation of CO emissions for the El Paso CO maintenance area.

These on-road emissions rates were developed in terms of mass per activity unit: miles for roadway-based processes; and SHP, starts, SHI, and APU hours for off-network processes. All activity-based rates

were directly output by MOVES, except for parked vehicle evaporative emission rates based in SHP. TTI used the RatesCalc utility to calculate emissions rates in terms of rate/SHP (as a conversion of MOVES rate/vehicle output) using the data in the county (local) input database (CDB) used in the MOVES emissions rates run and the MOVES default database. The RatesCalc utility combined the rate/distance, rate/hour (SHI and APU hours), and rate/start emissions rates tables from MOVES output and the calculated rate/SHP emissions rates table into a database of rates look-up tables.[55] For additional details on the post-processing of MOVES output, see Attachment 5.2.

Table 5-31 lists the emissions processes with associated activity basis and emissions rate units. The emissions factors were developed by pollutant, speed, process, hour, road type, and SUT/FT.

Table 5-31. MOVES On-Road Emissions Rates Modeled by Process and Activity Factor.

Emissions Process	Activity[1]	Emissions Factor Units
Running Exhaust Crankcase Running Exhaust	VMT	mass/mile (mass/mi)
Brake Wear	VMT	mass/mi
Tire Wear	VMT	mass/mi
Start Exhaust Crankcase Start Exhaust	starts	mass/start
Extended Idle Exhaust Crankcase Extended Idle Exhaust	SHI	mass/shi
Auxiliary Power Exhaust	APU Hours	mass/APU hour
Evaporative Permeation Evaporative Fuel Vapor Venting Evaporative Fuel Leaks	VMT, SHP	mass/mi, mass/shp

[1] The amount of travel on roads (VMT), SHP, vehicle starts, SHI and APU hours are the basic activity factors. SHI and APU hours are for combination long-haul trucks only. Evaporative (hydrocarbon) permeation, fuel vapor venting, and fuel leaks occur both during operation and while parked.

a. MOVES Model Inputs:

All of the user-specified model settings and inputs for each run were contained in a MOVES run specification (MRS) and a CDB (the MOVES2014a default database used was "MOVESDB20161117"). See Attachment 5.2 for details on the MRS files and CDBs developed for El Paso County and used to estimate the 2020 winter weekday emission factors for the El Paso CO maintenance areas emissions analysis.

[55] Although SHP-based rates are for hydrocarbon evaporative emissions only and the long-haul truck hotelling activity-based rates were not required for this CO analysis, both of these types of rates were also produced as part of the standard inventory process which generates a comprehensive set of on-network and off-network activity-based emission rate look-up tables (e.g., for emissions processes and activity types given in **Table** 5-31).

b. Emissions Factor Post-Processing Adjustments:

No emission rate adjustments were applied (e.g., El Paso County is not in the Texas Low Emissions Diesel [TxLED] program so TxLED NOx adjustments do not apply).

c. Emissions Controls Modeling:

Table 5-32 shows the modeling approaches used for the emissions control strategies.

Table 5-32. Emissions Modeling Strategies and Approaches.

Strategy	Approach
Federal Motor Vehicle Control Program Standards	*MOVES defaults.*
Federal Heavy-Duty Diesel Engines Rebuild and 2004 Pull-Ahead Programs to Mitigate NOx Off-Cycle Effects	*MOVES defaults.*
Gasoline Fuel – Tier 2/Tier 3 sulfur standards, Low Summer Reid Vapor Pressure (RVP), Winter Oxygenate	*Locality-specific user inputs to MOVES*. In the absence of local winter fuel survey data, TTI used the MOVES default 2020 winter gasoline (January) formulation for the MOVES fuel region specified for El Paso County. Fuel formulations are provided in Attachment 5.2.
Federal Low Sulfur Diesel Fuel	*Locality-specific user inputs to MOVES*. Diesel sulfur input values were set for consistency with the applicable federal diesel sulfur standards. Diesel formulations are provided in Attachment 5.2.
Inspection and Maintenance (I/M) Program	*Locality-specific user inputs to MOVES*. TTI developed El Paso I/M Program inputs to MOVES using the available MOVES I/M parameters pertaining to the domain of subject I/M vehicles, consistent with current program descriptions and latest I/M modeling protocols. Attachment 5.2 provides a summary of the I/M program input parameters used.

Attachment 5.1
Adjustments to TDM VMT

Table 5-33. HPMS Factor.

2012 HPMS AADT VMT[1]	AADT-to-ANSWT Factor	HPMS-Based ANSWT VMT	2012 TDM VMT[1]	HPMS Factor
15,151,926	1.08814	16,487,417	17,101,944	0.964066834

El Paso County.

Table 5-34. Analysis Year Winter Weekday Factor.

Year	Seasonal Factor Type[1]	Factor
2020	ANSWT-to-WWKD	0.99055

[1] WWKD is winter weekday.

Table 5-35. Hourly VMT Distributions.

Period	Hour	Winter Fractions	
		24-Hour-Period	Four-Period[1]
AM Peak	7-8 a.m.	0.066676	0.347332
	8-9 a.m.	0.068141	0.354964
	9-10 a.m.	0.057149	0.297704
Mid-Day	10-11 a.m.	0.053629	0.182560
	11 a.m-12 p.m.	0.056343	0.191799
	12-1 p.m.	0.059402	0.202212
	1-2 p.m.	0.060959	0.207512
	2-3 p.m.	0.063428	0.215917
	3-4 p.m.	0.070123	0.249774
PM Peak	4-5 p.m.	0.074285	0.264599
	5-6 p.m.	0.074387	0.264961
	6-7 p.m.	0.061951	0.220666
	7-8 p.m.	0.045767	0.195981
Overnight	8-9 p.m.	0.034912	0.149499
	9-10 p.m.	0.029520	0.126409
	10-11 p.m.	0.023014	0.098550
	11 p.m.-12 a.m.	0.016180	0.069285
	12-1 a.m.	0.009094	0.038942
	1-2 a.m.	0.006144	0.026310
	2-3 a.m.	0.005004	0.021428
	3-4 a.m.	0.004685	0.020062
	4-5 a.m.	0.006649	0.028472
	5-6 a.m.	0.015805	0.067680
	6-7 a.m.	0.036753	0.157382

[1] To maintain VMT proportions within the four periods, the hourly fractions were normalized within each period.

Attachment 5.2

MOVES Run Specifications (MRS), County Databases (CDB), Outputs, and Post-Processing

MOVES Inputs and Output – El Paso County and the Portion of Dona Ana, NM within the TDM:

MRS input files: One for each analysis year (1).

CDB inputs: One for each analysis year (1).

The MOVES default input database (MOVESDB20161117).

MOVES output databases: One per MOVES run (1).

MOVES run log output text files: One per MOVES run (1).

Table 5-36 describes the MOVES2014a run specification files used. Table 5-37 describes the CDBs built and used for the rates analysis.

Table 5-36. MOVES Run Specification Selections by GUI Panel.

Navigation Panel	Detail Panel[1]	Selection		
Scale[1]	Model; Domain/Scale; Calculation Type	On-Road; County; Emissions Rates		
Time Spans[1]	Time Aggregation Level; Years – Months – Days – Hours	Hour; 2020 - January - Weekday - All		
Geographic Bounds[1]	Region; Selections; Domain Input Database	Zone and Link; Texas – El Paso County; ***mvs14a_elp18mtp_2020w_er_cdb_in***[1]		
On-Road Vehicle Equipment	SUT/Fuel Combinations	SUT	Gasoline	Diesel
		Motorcycle	X	-
		Passenger Car	X	X
		Passenger Truck	X	X
		Light Commercial Truck	X	X
		Intercity Bus	-	X
		Transit Bus	-	X
		School Bus	X	X
		Refuse Truck	X	X
		Single Unit Short-Haul Truck	X	X
		Single Unit Long-Haul Truck	X	X
		Motor Home	X	X
		Combination Short-Haul Truck	X	X
		Combination Long-Haul Truck	-	X
Road Type	Selected Road Types	Off-Network – Rural Restricted Access – Rural Unrestricted Access – Urban Restricted Access – Urban Unrestricted Access		
Pollutants and Processes[2]	CO	Dependent on pollutant: Running Exhaust, Crankcase Running Exhaust, Start Exhaust, Crankcase Start Exhaust		
Manage Input Data Sets	Additional Input Database Selections	None		
Strategies	Rate Of Progress	Not Applicable		
General Output	Output Database; Units; Activity	***mvs14a_elp18mtp_2020wwkd_er_out***[1]; Grams, KiloJoules, Miles; Hotelling Hours, Population, Starts (not adjustable, pre-selected)		
Output Emissions Detail	Always; For All Vehicles/Equipment; On Road	Time: Hour – Location: Link – Pollutant; Fuel Type, Emissions Process; Source Use Type		
Advanced Performance Measures	Aggregation and Data Handling	All check boxes "un-checked" except "clear BaseRateOutput after rate calculations" box		

[1] Note that this MRS as well as the CDB and output database (i.e., the emission rates) are from the EPMPO's prior Destino 2045 MTP CO conformity analysis (August 2018).

[2] Only the pollutant required for reporting purposes and processes applicable to this specific analysis are listed, although other pollutants and processes are typically included in the run (e.g., VOC, NOx, PM-2.5, PM-10; Extended Idle Exhaust, Auxiliary Power Exhaust, Crankcase Extended Idle Exhaust, Evap Permeation, Fuel Vapor Venting, Fuel Leaks).

Table 5-37. MOVES CDB Input Table (from August 2018 conformity analysis).

Input Table	Category	Notes
year	Time	Designates analysis year as a base year (base year means that local activity inputs will be supplied rather than forecast by the model).
state	Geography	Identifies the state (Texas) for the analysis.
county	Geography/ Meteorology	Identifies county of analysis with local altitude and barometric pressure. TTI used input data consistent with original MOBILE seasonal "min/max" temperature input data (estimates by TTI).
zonemonthhour	Meteorology	Summer and winter hourly temperature and relative humidity for the county. TTI used input data consistent with original (1990 base year) MOBILE "min/max" temperature inputs (estimates by TTI).
roadtype	Activity	Lists the MOVES road types and associated ramp activity fractions. Road type ramp fractions were set to 0.
Hpmsvtypeyear[1]	Activity (Defaults)	TTI used MOVES default national annual VMT by HPMS vehicle type.
roadtypedistribution[1]		TTI used MOVES default road type VMT fractions.
monthvmtfraction[1]		TTI used MOVES default month VMT fractions.
dayvmtfraction[1]		TTI used MOVES default day VMT fractions.
hourvmtfraction[1]		TTI used MOVES default hour VMT fractions.
avgspeeddistribution[1]		TTI used MOVES default average speed distributions.
sourcetypeyear[1]	Fleet (Defaults)	TTI used MOVES default national SUT populations.
sourcetypeage-distribution	Fleet	TTI estimated SUT age fractions using TxDMV mid-year county vehicle registration data and MOVES defaults (consistent with the registration data year), as needed. The latest available (2014) mid-year registration data were used for all years.
avft	Fleet	TTI estimated SUT fuel fractions using TxDMV vehicle registration data and defaults, where needed. Local data sets used were consistent with sourcetypeagedistribution tables. The avft estimate is also consistent with the analysis VMT mix (i.e., gasoline and diesel).
zone	Activity	Start, hotelling, and SHP zone allocation factors. County = zone, and all factors were set to 1.0 (required for county scale analyses).
zoneroadtype	Activity	SHO zone/roadtype allocation factors. County = zone, and all factors were set to 1.0 (required for county scale analyses).
fuelsupply	Fuel	Fuel supply was set to one gasoline and one diesel fuel formulation.
fuelformulation	Fuel	In the absence of appropriate, local winter fuel survey data, TTI used the applicable MOVES default (i.e., January 2020, fuel region for El Paso County, conventional gasoline blend with 10% by volume ethanol). The diesel fuel formulation was consistent with federal sulfur standards.
countyyear	Stage II	N/A
imcoverage	I/M	TTI used local inputs to represent the I/M program design for El Paso County based on applicable I/M rules and the latest modeling protocols.

[1] Use of default activity and population inputs for the MOVES rates mode runs is a basic aspect of the rates-per-activity emissions estimation method, which calculates the emissions inventory estimates via post-processing. The process uses actual, local vehicle activity estimates external to MOVES in the emissions calculations.

Table 5-38 summarizes the meteorological inputs used. Table 3-16 summarizes the fuel formulation inputs used. Age distribution and fuel fraction inputs are summarized in Attachment 5.3.

Table 5-38. Meteorological Inputs to MOVES for El Paso County.

Hour	Winter	
	Temperature	Relative Humidity
12:00 a.m.	34.3	50.1
1:00 a.m.	32.7	53.6
2:00 a.m.	31.0	55.0
3:00 a.m.	29.9	57.4
4:00 a.m.	28.6	58.7
5:00 a.m.	27.9	60.0
6:00 a.m.	26.0	63.9
7:00 a.m.	27.7	62.0
8:00 a.m.	34.5	51.9
9:00 a.m.	42.9	40.7
10:00 a.m.	49.0	33.8
11:00 a.m.	54.6	28.1
12:00 p.m.	58.0	25.3
1:00 p.m.	59.9	23.2
2:00 p.m.	62.0	21.3
3:00 p.m.	63.0	20.4
4:00 p.m.	62.5	21.2
5:00 p.m.	59.1	23.8
6:00 p.m.	52.8	30.5
7:00 p.m.	50.0	33.1
8:00 p.m.	44.2	41.9
9:00 p.m.	40.8	44.3
10:00 p.m.	39.1	46.4
11:00 p.m.	37.3	50.5

Note: Hourly values are consistent with prior MOBILE6 “min/max temperature” command input values used in the original 1990 base year SIP emissions inventories and in prior El Paso MTP regional emissions estimates for conformity. TTI estimated the average hourly temperature values within the original min/max temperature input range (and hourly average relative humidity and barometric pressure values) using hourly weather data from the same dates and location (El Paso International Airport weather station) used for the original min/max temperature estimates. Degrees Fahrenheit and Percent for temperature and humidity, and Inches of Mercury for barometric pressure (which is 26.191).

Table 5-39. MOVES Gasoline and Diesel Fuel Formulation Inputs for El Paso County.

Fuel Type	Gasoline[1]	Diesel[2]
Season	Winter	Winter
Year	2020+	2020
Fuel Formulation ID	18101	30011
Fuel Subtype ID	12	20
RVP	11.36	0
Sulfur Level	10.00	11.00
ETOH Volume	10.00	0
MTBE Volume	0	0
ETBE Volume	0	0
TAME Volume	0	0
Aromatic Content	21.36	0
Olefin Content	6.66	0
Benzene Content	0.63	0
e200	53.72	0
e300	87.38	0
Vol to Wt Percent Oxy	0.3653	0
BioDieselEster Volume	/N	/N
Cetane Index	/N	/N
PAH Content	/N	/N
T50	192.22	0
T90	309.50	0

[1] This winter CG formulation is consistent with the prior CO conformity analysis (August 2018). It is the appropriate MOVES default by fuel region, season and year (January 2020) as applicable to this analysis (used in the absence of available local winter survey data). Fuel subtype ID 12 is 10% ethanol-blend gasoline.

[2] Diesel sulfur was conservatively set to the maximum level of the last three of TCEQ's statewide diesel surveys (2011, 2014, 2017), within the federal ultra-low sulfur diesel 15 ppm average annual standard. Fuel subtype 20 is conventional diesel. This is consistent with the prior CO conformity analysis (August 2018)

Table 5-41. MOVES2014A I/M Descriptive Inputs for Subject Counties

YearID	Begin Model Year[1]	End Model Year[1]	Test Standards ID (Description)	Source Use Type (I/M Compliance)[2]	Other[3]
2007 – 2019	*X*	1995	12 (2500 RMP/Idle)	Passenger Car (93.12 %), Passenger Truck (91.26 %) Light Commercial Truck (85.67 %)	See Note 3
	X	1995	41 (Evp Cap)		
	1996	*Y*	51 (Exh OBD)		
	1996	*Y*	45 (Evp Cap, OBD)		
2020 - 2050	*X*	*Y*	51 (Exh OBD)		
	X	Y	45 (Evp Cap, OBD)		

[1]Begin and end model year (X, Y) define the range of model years covered – where X and Y, respectively, are calculated as YearID – 24, and YearID – 2.

[2] I/M compliance factor estimates were calculated per MOVES Technical Guidance (EPA, November 2015) and Texas modeling protocol (using compliance and waiver rates of 96 % and 3 %, respectively).

[3] Also - the model processes/pollutants affected are start and running exhaust HC, CO, NOx, and tank vapor venting HC; fuel type is gasoline; frequency is annual.

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Post-Processing Output:

The MOVES output database was post-processed using TTI's MOVES emissions rates post-processing utility, RatesCalc, to produce the final on-road rate tables for subsequent input to the EmsCalc inventory calculation utility. These final emissions rates were from the prior CO conformity analysis (EPMPO, August 2018).

- RatesCalc Rate Databases: Mass/SHP off-network evaporative process rates were calculated using data from the CDB, the MOVES default database, and the MOVES rateperprofile and ratepervehicle emissions rate output. RatesCalc also copied mass/mile, mass/start, and mass/hour rates along with the units into emissions rate tables. RatesCalc does not perform any unit conversions. The utility created the emission rate look-up tables ttirateperdistance, ttirateperstart, ttirateperhour (for SHI and APU hours), and ttiratepershp in a "ratescalc" output database by county, analysis year, and season. The output database name (from the prior analysis) is "mvs14a_elp18mtp_2020wwkd_er_outratescalc". (When the RatesAdj utility is not subsequently applied, RatesCalc produces the final rates inputs to EmsCalc.)
- RatesAdj Final Rate Databases: Not Applicable. The Texas Low Emission Diesel Program (TxLED) is not applicable to El Paso County; thus, the RatesAdj utility was not used. [56]

[56] The TxLED counties list may be found at: https://www.tceq.texas.gov/airquality/mobilesource/txled/txled-affected-counties.

Table 5-42. Estimated TxLED Fuel NOx Reductions and Adjustments.

(The Texas Low Emission Diesel Program (TxLED) is **not applicable** to El Paso County.)

Diesel Fuel Source Use Type	NOx Reduction			NOx Adjustment		
Passenger Car						
Passenger Truck						
Light Commercial Truck						
Intercity Bus						
Transit Bus						
School Bus						
Refuse Truck						
Single Unit Short-Haul Truck						
Single Unit Long-Haul Truck						
Motor Home						
Combination Short-Haul Truck						
Combination Long-Haul Truck						

Attachment 5.3:
Source Type Age and Fuel Engine Fractions Inputs to MOVES

El Paso County (48141) 2014 Age Distribution Inputs to MOVES (used for 2020)

Age	MC	PC	PT	LCT	IBus	TBus	SBus	RT	SUShT	SULhT	MH	CShT	CLhT
0	0.045935	0.053900	0.026733	0.026733	0.055548	0.055650	0.055556	0.064759	0.062455	0.080736	0.064928	0.009782	0.044007
1	0.079804	0.070772	0.037056	0.037056	0.049844	0.049946	0.049851	0.058272	0.060276	0.097975	0.058445	0.015801	0.048909
2	0.069402	0.060117	0.033846	0.033846	0.046005	0.046100	0.046012	0.053507	0.079702	0.150497	0.053673	0.014296	0.050486
3	0.042856	0.046863	0.035079	0.035079	0.042194	0.055697	0.032610	0.028999	0.066630	0.104892	0.039988	0.006772	0.032874
4	0.031289	0.049364	0.034467	0.034467	0.037253	0.034095	0.035647	0.022977	0.037945	0.036093	0.035305	0.010534	0.017742
5	0.080386	0.040653	0.028561	0.028561	0.031054	0.034678	0.042221	0.030317	0.032680	0.034013	0.029436	0.021068	0.031415
6	0.073146	0.064144	0.058164	0.058164	0.039992	0.048516	0.046183	0.023359	0.109659	0.093698	0.037928	0.029345	0.043640
7	0.096114	0.066662	0.060009	0.060009	0.052280	0.047012	0.047736	0.081433	0.047749	0.057695	0.049441	0.044394	0.094086
8	0.078472	0.061945	0.055914	0.055914	0.053395	0.033713	0.055776	0.060642	0.069535	0.064010	0.050348	0.042889	0.070679
9	0.063826	0.060570	0.053565	0.053565	0.055067	0.052559	0.049572	0.057049	0.069717	0.057569	0.051939	0.049661	0.061342
10	0.045602	0.055428	0.061812	0.061812	0.053502	0.043092	0.048835	0.034170	0.053558	0.040882	0.050306	0.036117	0.041119
11	0.054839	0.053694	0.053524	0.053524	0.049301	0.041983	0.041807	0.033378	0.042484	0.033007	0.046365	0.029345	0.032913
12	0.039694	0.051897	0.055451	0.055451	0.046064	0.042452	0.043802	0.024143	0.034858	0.026419	0.043333	0.033860	0.032437
13	0.031455	0.043310	0.053863	0.053863	0.044038	0.048613	0.039741	0.029530	0.035585	0.027473	0.041306	0.051919	0.043530
14	0.024715	0.042587	0.047742	0.047742	0.041777	0.032808	0.043136	0.040271	0.039034	0.021921	0.039197	0.082769	0.052520
15	0.024049	0.033234	0.039570	0.039570	0.040613	0.031807	0.039913	0.057677	0.032498	0.019697	0.037984	0.078254	0.044225
16	0.017142	0.027351	0.033474	0.033474	0.030598	0.037111	0.031314	0.052718	0.018337	0.009478	0.022205	0.055681	0.037120
17	0.011401	0.021668	0.033913	0.033913	0.024835	0.033826	0.029099	0.025424	0.017974	0.010221	0.034115	0.040632	0.028101
18	0.011401	0.016127	0.022415	0.022415	0.020412	0.030975	0.024947	0.032795	0.009259	0.005665	0.020938	0.033860	0.025898
19	0.008405	0.015798	0.023979	0.023979	0.026464	0.025322	0.031789	0.041995	0.014706	0.006044	0.024651	0.048157	0.032080
20	0.007240	0.011279	0.022920	0.022920	0.020257	0.021952	0.015251	0.029313	0.009622	0.003876	0.023297	0.040632	0.020867
21	0.004660	0.008904	0.016038	0.016038	0.016633	0.018163	0.018167	0.013318	0.007081	0.002748	0.015998	0.029345	0.017990
22	0.003911	0.006789	0.013027	0.013027	0.012252	0.015769	0.014653	0.011855	0.005991	0.001875	0.013989	0.024831	0.012870
23	0.003994	0.005559	0.009793	0.009793	0.013801	0.015855	0.018594	0.018450	0.005991	0.002168	0.010346	0.030098	0.014209
24	0.003162	0.004365	0.009074	0.009074	0.015450	0.023149	0.020950	0.013061	0.004720	0.001735	0.013522	0.024078	0.012572
25	0.001831	0.003615	0.008759	0.008759	0.015324	0.017611	0.011953	0.020123	0.005084	0.001442	0.017413	0.017306	0.009605
26	0.002496	0.002877	0.009512	0.009512	0.014173	0.013781	0.014128	0.011515	0.004720	0.001180	0.015355	0.015049	0.007859
27	0.002164	0.002357	0.005600	0.005600	0.014695	0.012718	0.014276	0.010304	0.001452	0.000678	0.014965	0.015801	0.006202
28	0.003828	0.001917	0.007022	0.007022	0.012327	0.010714	0.012460	0.005268	0.003813	0.000875	0.010998	0.016554	0.006083
29	0.002996	0.001624	0.005782	0.005782	0.010701	0.009139	0.010634	0.005263	0.001997	0.000762	0.011609	0.012039	0.005596
30	0.033785	0.014631	0.043334	0.043334	0.014149	0.015191	0.013386	0.008114	0.014887	0.004677	0.020675	0.039127	0.021026

Texas Statewide 2020 Fuel Engine Fractions Summary[1]

SUT	Fuel Type	Model Year															
		2020	2019	2018	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005
MC	Gas	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
PC	Gas	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.990	0.993	0.999	1.000	0.993	0.995
PC	Diesel	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.010	0.007	0.001	0.000	0.007	0.005
PT	Gas	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.987	0.985	0.977	0.981	0.975	0.979
PT	Diesel	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.013	0.015	0.023	0.019	0.025	0.021
LCT	Gas	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.962	0.955	0.941	0.948	0.938	0.946
LCT	Diesel	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.038	0.045	0.059	0.052	0.062	0.054
IBus	Diesel	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
TBus	Gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TBus	Diesel	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
SBus	Gas	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
SBus	Diesel	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990
RT	Gas	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.002	0.002	0.005	0.001	0.003	0.003
RT	Diesel	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.998	0.998	0.995	0.999	0.997	0.997
SUShT	Gas	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.371	0.219	0.234	0.274	0.351	0.287	0.256	0.238	0.232
SUShT	Diesel	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.629	0.781	0.766	0.726	0.649	0.713	0.744	0.762	0.768
SULhT	Gas	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.371	0.219	0.234	0.274	0.351	0.287	0.256	0.238	0.232
SULhT	Diesel	0.604	0.604	0.604	0.604	0.604	0.604	0.604	0.629	0.781	0.766	0.726	0.649	0.713	0.744	0.762	0.768
MH	Gas	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.510	0.530	0.540	0.560
MH	Diesel	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.490	0.470	0.460	0.440
CShT	Gas	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.199	0.110	0.057	0.081	0.052	0.058	0.031	0.050	0.051
CShT	Diesel	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.801	0.890	0.943	0.919	0.948	0.942	0.969	0.950	0.949
CLhT	Diesel	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

[1] Conventional internal combustion engine technology only.

Texas Statewide 2020 Fuel Engine Fractions Summary[1] - (Continued)

SUT	Fuel Type	Model Year														
		2004	2003	2002	2001	2000	1999	1998	1997	1996	1995	1994	1993	1992	1991	1990
MC	Gas	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
PC	Gas	0.997	0.996	0.996	0.997	0.997	0.998	0.998	0.999	0.999	0.999	1.000	0.999	0.999	0.997	0.999
PC	Diesel	0.003	0.004	0.004	0.003	0.003	0.002	0.002	0.001	0.001	0.001	0.000	0.001	0.001	0.003	0.001
PT	Gas	0.982	0.982	0.983	0.989	0.992	0.981	0.993	0.992	0.981	0.995	0.991	0.986	0.985	0.994	0.989
PT	Diesel	0.018	0.018	0.017	0.011	0.008	0.019	0.007	0.008	0.019	0.005	0.009	0.014	0.015	0.006	0.011
LCT	Gas	0.951	0.951	0.956	0.908	0.949	0.929	0.950	0.927	0.971	0.932	0.974	0.974	0.951	0.937	0.984
LCT	Diesel	0.049	0.049	0.044	0.092	0.051	0.071	0.050	0.073	0.029	0.068	0.026	0.026	0.049	0.063	0.016
IBus	Diesel	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
TBus	Gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TBus	Diesel	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
SBus	Gas	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.042	0.114	0.147	0.121	0.010	0.090	0.124
SBus	Diesel	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.958	0.886	0.853	0.879	0.990	0.910	0.876
RT	Gas	0.005	0.004	0.005	0.006	0.002	0.169	0.404	0.019	0.012	0.010	0.105	0.031	0.210	0.101	0.204
RT	Diesel	0.995	0.996	0.995	0.994	0.998	0.831	0.596	0.981	0.988	0.990	0.895	0.969	0.790	0.899	0.796
SUShT	Gas	0.245	0.260	0.268	0.311	0.350	0.348	0.435	0.436	0.427	0.673	0.508	0.519	0.511	0.465	0.539
SUShT	Diesel	0.755	0.740	0.732	0.689	0.650	0.652	0.565	0.564	0.573	0.327	0.492	0.481	0.489	0.535	0.461
SULhT	Gas	0.245	0.260	0.268	0.311	0.350	0.348	0.435	0.436	0.427	0.673	0.508	0.519	0.511	0.465	0.539
SULhT	Diesel	0.755	0.740	0.732	0.689	0.650	0.652	0.565	0.564	0.573	0.327	0.492	0.481	0.489	0.535	0.461
MH	Gas	0.570	0.590	0.600	0.630	0.660	0.680	0.710	0.740	0.770	0.790	0.820	0.850	0.850	0.850	0.850
MH	Diesel	0.430	0.410	0.400	0.370	0.340	0.320	0.290	0.260	0.230	0.210	0.180	0.150	0.150	0.150	0.150
CShT	Gas	0.052	0.055	0.077	0.084	0.090	0.107	0.134	0.147	0.146	0.275	0.117	0.117	0.160	0.161	0.144
CShT	Diesel	0.948	0.945	0.923	0.916	0.910	0.893	0.866	0.853	0.854	0.725	0.883	0.883	0.840	0.839	0.856
CLhT	Diesel	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

[1] Conventional internal combustion engine technology only.

APPENDIX B:
EMISSIONS ESTIMATION UTILITIES FOR MOVES-BASED EMISSIONS INVENTORIES

TTI EMISSIONS ESTIMATION UTILITIES FOR MOVES2014A-BASED EMISSIONS INVENTORIES

The following is a summary of utilities developed by TTI (written in the Visual Basic programming language) for producing detailed, link-based, hourly, and 24-hour emissions estimates for on-road mobile sources using the latest version of EPA's MOVES model (MOVES2014a). These utilities produce inputs used with the MOVES model, make special adjustments to the emissions factors (when required), and multiply them with travel model link-based or Highway Performance Monitoring System (HPMS)-based (virtual link) activity estimates to produce emissions at user-specified temporal and spatial scales.

The main utilities for calculating hourly and 24-hour emissions using MOVES are TRANSVMT, VirtualLinkVMT, VehPopulationBuild, OffNetActCalc, MOVESactivityInputBuild, MOVESfleetInputBuild, RatesCalc, RatesAdj, and EmsCalc. The TRANSVMT and VirtualLinkVMT prepare the link VMT and speeds activity input. The VehPopulationBuild utility builds the vehicle population used to calculate the off-network activity. The OffNetActCalc utility builds the SHP, starts, SHI, and APU hours required to estimate emissions using the rate-per-activity emissions rates produced by the RatesCalc or RatesAdj utilities. The MOVESactivityInputBuild and MOVESfleetInputBuild utilities build inputs used in MOVES. The RatesCalc utility assembles the emissions rates from the MOVES output in terms of rate-per-activity, including rate-per-SHP for the evaporative emissions processes. The RatesAdj utility makes special adjustments to the emissions rates when required. The EmsCalc utility calculates emissions by hourly time periods, producing a tab-delimited summary file (including 24-hour totals), hourly link emissions output files (optional), and an optional tab-delimited summary file by MOVES source classification code (SCC).

A process flow diagram follows the utility descriptions.

TRANSVMT

The TRANSVMT utility post-processes travel demand models (TDMs) to produce hourly, on-road vehicle, seasonal and day-of-week specific, directional link VMT, and speed estimates. The TRANSVMT utility processes a TDM traffic assignment by multiplying the link volumes by the appropriate HPMS, seasonal, or other VMT factors. Hourly factors are then used to distribute the link VMT to each hour in the day. The TTI speed model is used to estimate the operational time-of-day link speeds for each direction. Since intrazonal links are not included in the TDM, special intrazonal links are created and the VMT and speeds for these special links are estimated using the intrazonal trips from the trip matrix and the zonal radii. The link VMT and speeds produced by TRANSVMT are subsequently input to the EmsCalc utility for applying the MOVES-based emissions factors (as well as with other utilities to develop off-network activity estimates).

VirtualLinkVMT

The VirtualLinkVMT utility post-processes county HPMS average annual daily traffic (AADT) VMT, centerline miles, and lane miles by functional classification and area type (from the Texas Department of Transportation's [TxDOT's] annual Roadway Inventory Functional Classification Record [RIFCREC]) to produce hourly, on-road vehicle fleet, seasonal and day-of-week specific

actual or projected VMT, and directional operational speed estimates. These estimated VMT and speeds are produced for up to 42 directional HPMS functional classification/area type combinations, or "links." The VirtualLinkVMT utility was developed for use in areas that do not have TDM networks, as well as for inventory applications for which network link-based detail is not required. The main inputs to VirtualLinkVMT are:

- County HPMS data sets, which include AADT VMT, centerline miles, and lane miles by HPMS area type and functional class;
- County-level VMT control totals;
- Hourly VMT distributions; and
- Speed model inputs to include volume/delay equation parameters adapted for HPMS, and free-flow speeds and lane capacities by HPMS functional classification and area type.

VirtualLinkVMT initially scales the county HPMS AADT VMT at the link level to the appropriate VMT (e.g., uses a county-level VMT control total-to-AADT ratio to produce seasonal, day-of-week specific VMT). Hourly factors and directional split factors are applied to the adjusted VMT on each link to estimate the hourly, directional VMT (and volumes) by HPMS link. Congested speed models, each for the high- and low-capacity links, are used to estimate the hourly operational speeds by direction for each link. The operational speeds are based on volume/capacity (v/c)-derived directional delay (minutes/mile) applied to the estimated free-flow speeds for each link. The virtual link VMT and speeds produced using the VirtualLinkVMT utility are an input to the emissions calculation utility, EmsCalc (as well as with other utilities to develop off-network activity estimates).

VehPopulationBuild

The VehPopulationBuild utility builds the sourcetypeyear data files in a format consistent with the MOVES input database table and the SUT/fuel type population input file (can be used with the EmsCalc utility to estimate emissions or the OffNetActCalc utility to estimate starts and SHP) using the VMT mix and the Texas Department of Motor Vehicles (TxDMV) registration data sets. The TxDMV registration data sets are three sets of registration data (an age registration data file, a gas trucks registration data file, and a diesel trucks registration data file) that list 31 years of registration data. The primary inputs to this utility are:

- County ID file, which specifies the county for which the output will be calculated;
- Age registration data file, which lists 31 years of registration data for the Passenger Vehicle, Motorcycles, Trucks <=6000, Trucks >6000 <=8500, Total Trucks <=8500, Gas Trucks >8500, Diesel Trucks >8500, Total Trucks >8500, and Total All Trucks vehicle categories;
- Gas trucks registration data file, which lists 31 years of registration data for the Gas >8500, Gas >10000, Gas >14000, Gas >16000, Gas >19500, Gas >26000, Gas >33000, Gas >60000, and Gas Totals gas truck categories;
- Diesel trucks registration data file, which lists 31 years of registration data for the Diesel >8500, Diesel >10000, Diesel >14000, Diesel >16000, Diesel >19500, Diesel >26000, Diesel >33000, Diesel >60000, and Diesel Totals diesel truck categories;

- VMT mix by TxDOT district, MOVES SUT, and MOVES fuel type;
- TxDOT district name file, which specifies the VMT mix TxDOT district;
- MOVES default database;
- Population factor file (optional); and
- Year ID file (optional, only used if population factors are used), which specifies the year for calculating the output.

For the desired county (from the county ID file), the age registration data (for the Passenger Vehicle, Motorcycles, Trucks <=6000, Trucks >6000 <=8500, and Total Trucks <=8500 vehicle categories) are saved in an age registration data array. The gas truck registration data (for the Gas >8500, Gas >10000, Gas >14000, Gas >16000, Gas >19500, Gas >26000, Gas >33000, and Gas >60000 gas truck categories) are saved in the gas truck section of the diesel/gas registration data array. The diesel truck registration data (for the Diesel >8500, Diesel >10000, Diesel >14000, Diesel >16000, Diesel >19500, Diesel >26000, Diesel >33000, and Diesel >60000 diesel truck categories) are saved in the diesel truck section of the diesel/gas registration data array. The age registration data array and the diesel/gas registration data array are combined to form the registration category data array (seven categories for 31 years of data and the total) using the combinations in Table 1.

Table 1. Registration Categories.

Registration Category	Vehicle Category	Data Location
1	Passenger Vehicle	Age registration data array
2	Motorcycles	
3	Total Trucks <=8500	
4	Diesel >8500, Diesel >10000, Diesel >14000, Diesel >16000	Diesel/gas registration data array
5	Diesel >19500, Diesel >26000, Diesel >33000, Diesel >60000	
6	Gas >8500, Gas >10000, Gas >14000, Gas >16000	
7	Gas >19500, Gas >26000, Gas >33000, Gas >60000	

The registration category data array is used to fill the SUT population array (by SUT and fuel type) for all vehicles except long-haul trucks. Each SUT/fuel type combination is assigned the total registrations from one or more of the registration categories in the registration category data array. Table 2 shows the SUTs and their associated registration category in the registration category data array.

Table 2. SUT/Registration Category Correlation.

SUT	Registration Category
11	2
21	1
31, 32	3
41, 42, 43, 51, 52, 54	4 + 6
61	5 + 7

SUT population factors are calculated by SUT/fuel type using the data from the VMT mix input for all SUTs except motorcycles (SUT 11) and the long-haul trucks (SUTs 53 and 62) and saved in the SUT population factors array. For SUT 21, the fuel type VMT mix is divided by the total VMT mix for SUT 21. For SUT 31, the fuel type VMT mix is divided by the total VMT mix for SUTs 31 and 32. The same process applies to SUT 32. For SUT 41, the fuel type VMT mix is divided by the total VMT mix for SUTs 41, 42, 43, 51, 52, and 54. The same process applies to SUTs 42, 43, 51, 52, and 54. For SUT 61, the fuel type VMT mix is divided by the total VMT mix for SUT 61.

For SUT 11, the SUT population factor for fuel type 1 (gasoline) is set 1 with all other factors set to 0. For SUT 53, the SUT population factors by fuel type are calculated by dividing the fuel type VMT mix for SUT 53 by the fuel type VMT mix for SUT 52. For SUT 62, the SUT population factors by fuel type are calculated by dividing the fuel type VMT mix for SUT 62 by the fuel type VMT mix for SUT 61, therefore creating a ratio of long-haul and short-haul trucks.

The SUT population factors and the population factor (if desired) are applied to the SUT population array for all SUTs except SUT 53 and 62. For SUT 53, the SUT population factors for SUT 53 are applied to the SUT population array for SUT 52. For SUT 62, the SUT population factors for SUT 62 are applied to the SUT population array for SUT 61.

Using the appropriate MySQL code, a new sourcetypeyear database table is created. The data in the SUT population array is aggregated by fuel type and used to fill the sourcetypeyear database table, along with the yearID, salesGrowthFactor, and migrationrate. For the yearID, the year of the registration data is used, unless a population factor is used, in which case the year from the year ID input is used. The salesGrowthFactor and migrationrate for each SUT is set 1. A text format of this database table is written by the utility as well. The SUT/fuel type population input file is written using the SUT population array.

OffNetActCalc

The OffNetActCalc calculates the analysis scenario (i.e., year, season, day type) SHP, starts, SHI, and APU hours by hour, SUT, and fuel type used to estimate emissions using the EmsCalc utility. The SHI and APU hours are only calculated for SUT 62, fuel type 2 (CLhT_Diesel). The SHP is calculated using either the TDM or the virtual link-based link VMT and speeds (same as used in the distance-based emissions estimation), the 24-hour or time period VMT mix (by roadway type and SUT/fuel type), and the SUT/fuel type population (from the

VehiclePopulationBuild utility). The starts activity is calculated using the SUT/fuel type population and the starts per vehicle (typically the MOVES default). The SHI and APU hours are a function of hotelling hours. This utility has two options for calculating the hotelling hours. Using the first option, the analysis scenario 24-hour hotelling hours is calculated using a user-supplied extended idle factor to the source hours operating (SHO). However, this method of estimating the hotelling hours as a direct function of the SHO does not consider the availability of locations where extended idling may occur. The second option (and suggested method) uses base data (24-hour hotelling, link VMT and speeds, and VMT mix), the analysis scenario data used to calculate the SHP, and the analysis scenario SHP to calculate the analysis scenario 24-hour hotelling hours.

For the analysis scenario first hourly VMT and speeds input, the utility applies the appropriate VMT mix (either the 24-hour VMT mix or the appropriate time period VMT mix as assigned by the user) to each link that has the desired county code; thus distributing the link VMT to each SUT/fuel type, which is added to the hourly SUT/fuel type VMT. The link VMT by SUT/fuel type is divided by the link speed to calculate the link VHT (or SHO) by SUT/fuel type, which is added to the SUT fuel/type VHT. This calculation process is repeated for each analysis scenario VMT and speeds input; therefore producing the analysis scenario hourly values for VMT by SUT/fuel type and for VHT by SUT/fuel type.

The analysis scenario hourly SUT/fuel type speed, total hours (or source hours), and SHP are then calculated. For each hour and SUT/fuel type, the hourly SUT/fuel type VMT is divided by the hourly SUT/fuel type VHT to calculate the hourly SUT/fuel type speed. The hourly SUT/fuel type total hours are set equal to the SUT/fuel type population. The hourly SUT/fuel type SHP is calculated by subtracting the hourly SUT/fuel type VHT (or SHO) from the hourly SUT/fuel type total hours. If the calculated SHP is negative (i.e., SHO is greater than the total hours), the SHP is set to 0.

To calculate the analysis scenario 24-hour hotelling hours under option 1 (as a direct function of SHO), the utility multiplies the CLhT_Diesel analysis scenario 24-hour SHO by the user-supplied extended idle factor, which represents the amount of extended idle time that must occur per SHO. For option 2 (as a function of base hotelling data), the utility calculates the base 24-hour CLhT_Diesel VMT using the base VMT and speeds inputs and the base VMT mix with the same procedure used in the analysis scenario SHP calculations. The 24-hour analysis scenario CLhT_Diesel VMT is then divided by the 24-hour base CLhT_Diesel VMT to create a scaling factor, which is then applied to the base 24-hour hotelling hours to calculate the analysis scenario 24-hour hotelling hours.

The utility then calculates the analysis scenario hourly hotelling hours. The analysis scenario hourly CLhT_Diesel SHO (from the SHP calculation process) is converted to hourly VHT fractions. The hourly hotelling fractions are calculated as the inverse of the hourly VHT fractions. The hourly hotelling fractions are then applied to the analysis scenario 24-hour hotelling hours to calculate the hourly hotelling hours. For each hour, the hourly hotelling hours are then compared to the hourly CLhT_Diesel SHP. For those hours where the hotelling hours are greater than the SHP, hotelling hours are set to the SHP for that hour.

The utility then calculates the SHI fraction and the APU fraction using the source type age distribution (same distribution used in the MOVES runs), the relative mileage accumulation rates, and the hotelling activity distribution. Travel fractions for SUT 62 (CLhT) by ageID (0 through 30) are calculated by multiplying the age distribution by the appropriate relative mileage accumulation rate, which is then converted into a distribution by dividing the individual travel fraction (ageID 0 through 30) by the sum of the travel fractions. These travel fractions are then applied to the appropriate operating mode fractions from the hotelling activity distribution (operating mode 200) and summed to calculate the SHI fraction. Using a similar process, the APU fraction is calculated using the operating mode fractions for operating mode 201. For each hour the analysis scenario hotelling hours are multiplied by the SHI fraction to calculate the analysis scenario SHI activity and by the APU fraction to calculate the analysis scenario APU hours.

MOVESactivityInputBuild

The MOVESactivityInputBuild utility builds the roadtypedistribution, hourvmtfraction, avgspeeddistribution, roadtype, hpmsvtypeday, sourcetypedayvmt, year, state, zone, zoneroadtype, monthvmtfraction, and dayvmtfraction data files in a format consistent with the MOVES input database tables using the link-based hourly VMT and speeds developed with the TRANSVMT or VirtualLinkVMT utility, the VMT mix, and the MOVES defaults. The utility also has the option of building the sourcetypeage (adjusted to reflect the 24-hour VMT mix), starts, and hotellinghours data files in a format consistent with the MVOES input database tables using the output from the OffNetActCalc utility, along with inputs from the MOVES runs and the MOVES defaults. The primary inputs to this utility are:

- Link-based hourly VMT and speeds developed with the TRANSVMT or VirtualLinkVMT utility;
- County ID file which specifies the county number in the link-based hourly VMT and speeds for which the output will be calculated;
- VMT roadway type designations, which lists associations of the link roadway types/area type combination to the VMT mix, emissions rate, and MOVES roadway types (same as used with the EmsCalc utility);
- 24-hour or time period VMT mix by roadway type, MOVES source type, and MOVES fuel type (same as used with the EmsCalc utility);
- Day ID, which specifies the MOVES day ID for calculating the output;
- Year ID, which specifies the year for calculating the output;
- Link/Ramp designations, which designates each link roadway type/area type combination to either ramp or non-ramp;
- MOVES default database;
- Month ID, which specifies the month for calculating the output;
- sourcetypeyear, SUT age, and sourcetypeage inputs from the MOVES runs (optional, only if sourcetypeage table output is to be created);

- Starts output from the OffNetActCalc utility (optional, only if starts table output is to be created); and
- Hotelling, extended idle, and APU hours output from the OffNetActCalc utility (optional, only if hotelling table output is to be created).

For each link in the link-based hourly VMT and speeds in which the county number matches the desired county ID, the link VMT is saved in a VMT summary array based on hour, link functional class, and link area type. The link VHT (link VMT/link speed) is saved in a VHT summary array based on hour, link functional class, link area type, and MOVES average speed bin ID (determined using the MOVES average speed bins and the link speed). The link VHT is also saved in a road type VHT array based on link functional class and link area type, and, if the link is specified as ramp by the link/ramp designations specified by the user, the VHT is additionally saved in the ramp segment of the road type VHT array.

A MOVES roadway type array by MOVES roadway type (roadTypeID codes 2 through 5) is also created using the data in the VMT summary array and VMT roadway type designations. For the link road types designated a MOVES road type of 6 or 8, the VMT is added to MOVES road type 2 in the MOVES roadway type array. For the link road types designated a MOVES road type of 7 or 9, the VMT is added to MOVES road type 4 in the MOVES roadway type array. An hourly VMT array (by MOVES SUT, MOVES roadway type, and hour) is formed using the data in the VMT summary array, the VMT roadway type designations, and the VMT mix. If the time period VMT mix is used, each hour is assigned a time period by the user. Otherwise, the same 24-hour VMT mix is used for all hours. An average speed distribution array (by MOVES SUT, MOVES roadway type, hour, and MOVES speed bin) is created using the VHT summary array and the VMT mix. Using the appropriate MySQL code, the MOVES roadtypedistribution, hourvmtfraction, and avgspeeddistribution default values are extracted and saved for later use.

The VMT in the MOVES roadway type array is used to produce the roadway type distribution array by MOVES SUT and MOVES roadway type. This VMT is converted to a distribution by MOVES SUT (i.e., the total for a SUT over the five MOVES roadway types should equal 1), with the distribution value for MOVES roadway type 0 (Off-Network) equal to 0. The utility writes the tab-delimited roadtypedistribution table output (optional).

The VMT in the hourly VMT array is added to the hourly VMT fraction array (by SUT, MOVES roadway type, and hour) and for those roadway types where the VMT for all hours is greater than 0, this VMT is converted to an hourly distribution. For those roadway types where the VMT is equal to 0, a value of 1 is placed in the first hour, followed by 0 in the remaining hours. The utility writes the tab-delimited hourvmtfraction table output (optional). For those SUTs where the VMT mix is greater than 0, the hourly VMT fraction array is used. Otherwise, the MOVES hourvmtfraction default values are used.

The VHT in the average speed distribution array is converted to a distribution by SUT, MOVES roadway type, hour/day (combination of hour and the day ID specified by the user), and MOVES average speed bin. The utility writes the tab-delimited avgspeeddistribution table

output (optional). For those SUTs where the VMT mix is greater than 0, the average speed distribution array is used. Otherwise, the MOVES avgspeeddistribution default values are used.

The VHT in the road type VHT array is converted to a proportion of ramp VHT by dividing the ramp segment of the road type VHT array by the total VHT for the road type in the road type VHT. The utility writes the tab-delimited roadtype table output (optional). If the ramp fraction for roadTypeID 2 is greater than 0, then roadTypeID 6 (with rampFraction equal to 0) and roadTypeID 8 (with rampFraction equal to 1) are also added to the roadtype database table. If the ramp fraction for roadTypeID 4 is greater than 0, then roadTypeID 7 (with rampFraction equal to 0) and roadTypeID 9 (with rampFraction equal to 1) are also added to the roadtype database table.

The VMT in the hourly VMT array is aggregated to create the 24-hour HPMS vehicle type VMT array. Each SUT is assigned an HPMS vehicle type (SUT 11 is HPMS vehicle type 10; SUTs 21, 31 and 32 are HPMS vehicle type 25; SUTs 41, 42, and 43 are HPMS vehicle type 40; SUTs 51, 52, 53, and 54 are HPMS vehicle type 50; and SUTs 61 and 62 are HPMS vehicle type 60). The utility writes the tab-delimited hpmsvtypeday table output (optional).

The VMT in the hourly VMT array is also aggregated by SUT to create the 24-hour SUT VMT array. Using this VMT data, the utility writes the tab-delimited sourcetypedayvmt output table (optional) in a format consistent with the MOVES input.

Using the appropriate MySQL code, the fuel year ID is extracted from the MOVES default year database table for the user-supplied year ID. The tab-delimited year table output is written (optional) using the user-supplied year ID and the extracted fuel year ID. The "isbaseYear" data is written as well (automatically set to "Y").

The utility also produces two tab-delimited summary output files. A tab-delimited VMT summary is output by hour, link road type, and link area type for the user-specified county. A tab-delimited VHT summary is output by hour, link road type, link area type, and MOVES average speed bin for the user-specified county.

The utility creates five other tab-delimited outputs (state, zone, zoneroadtype, monthvmtfraction, and dayvmtfraction tables) using the user-supplied inputs. For the state table (optional), the utility extracts the data from the MOVES default state database table where the state ID is 48 and writes this data to the tab-delimited state table output. For the zone table (optional), the utility extracts the data from the MOVES default zone data for the county ID greater than 48000 and county ID less than 49000 and writes this data to the tab-delimited zone table output with the start allocation factors, idle allocation factors, and SHP allocation factors replaced with values of 1.

For the zoneroadtype table (optional), the utility extracts the MOVES default zoneroadtype data where the zone ID greater than 480000 and zone ID less than 490000 and writes this data to the tab-delimited zoneroadtype table output, with the SHO allocation factors replaced with values of 1. For the monthvmtfraction table (optional), the utility extracts the data from the MOVES default monthvmtfraction table and writes the data to the tab-delimited monthvmtfraction table output with the month VMT fraction set to 1 for the user-supplied month

ID and 0 for all other months. For the dayvmtfraction table (optional), the utility extracts the data from the MOVES default dayvmtfraction table and writes this data to the tab-delimited dayvmtfraction table output with the day VMT fraction is set to 1 for the user-supplied day ID and 0 for all other months.

For the sourcetypeage table output (optional, also needed if the hoteling hours table output is to be created), the utility calculates the adjusted relative mileage accumulation rates (MAR) by multiplying the input relative MAR (categorized by SUT and age from the sourcetypeage input) by the SUT-specific relative MAR adjustment factors (one factor per SUT applied across all age categories). These adjustment factors are calculated using inventory SUT VMT fractions within each HPMS vehicle type and the sum of the SUT-specific normalized travel fractions within each HPMS vehicle type. The inventory SUT VMT fractions within each HPMS vehicle type are calculated by dividing the 24-hour SUT VMT by the 24-hour HPMS vehicle type VMT for the respective SUT.

For the sum of the SUT-specific normalized travel fractions within each HPMS vehicle type, the utility uses the same calculation procedures used by MOVES to calculate the normalized travel fractions. The SUT vehicle population is distributed to each age category using the SUT age distribution input. Using the sum of the vehicle population by HPMS vehicle type, the SUT population fraction for each age category within each HPMS vehicle type is calculated by dividing the SUT vehicle population by age by the sum of the vehicle population by HPMS vehicle type. The utility then calculates the initial travel fractions (by SUT and age) by multiplying the SUT population fraction for each age category within each HPMS vehicle type by the relative MAR input.

These initial travel fractions are then normalized within each HPMS vehicle type to produce the SUT and age-specific normalized travel fractions within each HPMS vehicle type. The utility then calculates the SUT-specific relative MAR adjustment factors by dividing the inventory SUT VMT fractions within each HPMS vehicle type by the sum of the SUT and age-specific normalized travel fractions (i.e., aggregated across the age category for each SUT); resulting in one SUT-specific relative MAR adjustment factor for each SUT.

For the starts table output (optional), the utility aggregates the SUT/fuel type hourly starts input (output from the OffNetActCalc utility) by SUT and multiplies the SUT hourly starts by the SUT age distribution (by SUT) to distribute the hourly SUT starts to each age category. The SUT hourly starts by age are written to the starts table output file, along with the user-supplied monthID, yearID, dayID (used to form the output hourDayID), and zoneID (set using the user-supplied county FIPS code.

For the hoteling hours table output (optional), the utility uses travel fractions specific to SUT 62 to distribute the hourly hoteling hours input (output from the OffNetActCalc utility) to each age category. These travel fractions are calculated by multiplying the SUT 62 age distribution by the calculated relative mileage accumulation rates (MOVES defaults adjusted so to reflect the emissions inventory 24-hour VMT mix) for each age category and dividing by the sum of the product for all the age categories. These travel fractions are multiplied by the hourly hoteling hours input and written to the hoteling hours table output, along with the user-supplied dayID

(used to form the output hourDayID), monthID, yearID, and zoneID (set using the user-supplied county FIPS code.

MOVESfleetInputBuild

The MOVESfleetInputBuild utility builds the sourcetypeagedistribution database table and fuel/engine fraction inputs to MOVES using the TxDOT registration data sets and the MOVES default database tables. The TxDOT registration data sets are three sets of registration data (an age registration data file, a gas trucks registration data file, and a diesel trucks registration data file) that list 31 years of registration data. The primary inputs to this utility are:

- Age registration data file, which lists 31 years of registration data for the Passenger Vehicles, Motorcycles, Trucks <=6000, Trucks >6000 <=8500, Total Trucks <=8500, Gas Trucks >8500, Diesel Trucks >8500, Total Trucks >8500, and Total All Trucks vehicle categories;
- Gas trucks registration data file, which lists 31 years of registration data for the Gas > 8500, Gas > 10000, Gas > 14000, Gas > 16000, Gas > 19500, Gas > 26000, Gas > 33000, Gas > 60000, and Gas Totals gas truck categories;
- Diesel trucks registration data file, which lists 31 years of registration data for the Diesel > 8500, Diesel > 10000, Diesel > 14000, Diesel > 16000, Diesel > 19500, Diesel > 26000, Diesel > 33000, Diesel > 60000, and Diesel Totals diesel truck categories;
- SUT data sources input, which specifies the data source for each SUT to use when building the sourcetypeagedistribution database table;
- Fuel/engine fractions data sources input, which specifies the data source for each SUT to use when building the fuel/engine fractions;
- Default sourcetypeage distribution input;
- MOVES default database; and
- Year ID file (optional, only if year is not the registration data year as in a future year analysis), which specifies the year for calculating the output.

The SUT data sources input lists the data source for each SUT, either a single county, multiple counties, state, or MOVES default. As this input is processed, the utility maintains a list of the input sources. The same applies to the fuel/engine fractions, except data source inputs are only valid for source types 52, 53, and 61 (other are not valid due to data limitations and source type 62 are all considered diesel).

For each county (or state total) in the list of the input sources, the age registration data (for the Passenger Vehicle, Motorcycles, Trucks <=6000, Trucks >6000 <=8500, and Total Trucks <=8500 vehicle categories) are saved in an age registration data array. The gas truck registration data (for the Gas > 8500, Gas > 10000, Gas > 14000, Gas > 16000, Gas > 19500, Gas > 26000, Gas > 33000, and Gas > 60000 gas truck categories) are saved in the gas truck section of the diesel/gas registration data array. The diesel truck registration data (for the Diesel > 8500, Diesel > 10000, Diesel > 14000, Diesel > 16000, Diesel > 19500, Diesel > 26000, Diesel >

33000, and Diesel > 60000 diesel truck categories) are saved in the diesel truck section of the diesel/gas registration data array.

The age registration data array and the diesel/gas registration data array are combined to create the registration category data array (a total of seven categories for 31 years of data and the total) using the combinations in Table 1 (Registration Categories**)**. The county is compared to the data sources for each SUT in the SUT data sources input. If the county is found for a given source type, then the 31 years of registration data from the source type's corresponding category in the registration category data array are added to the SUT age distribution array. Table 3 shows the source types and their corresponding registration categories.

Table 3. SUTs/Registration Categories Correlation for SUT Age Distribution.

SUT	Registration Category
11	2
21	1
31, 32	3
52, 53	4
61, 62	5

A similar process is followed for the fuel/engine fractions array. However, only SUTs 52, 53, 61, and 62 are processed due to data limitations. The registration data are saved in the fuel/engine fractions array based on fuel type. Table 4 shows the SUTs and their corresponding registration categories.

Table 4. SUTs/Registration Categories Correlation for Fuel/Engine Fractions.

SUT	Fuel Type	Registration Category
52, 53	Diesel	4
	Gas	6
61	Diesel	5
	Gas	7
62	Diesel	5 + 7
	Gas	None – all are assumed diesel

After processing all of the counties, the data from the default sourcetypeage distribution input are processed and the data for the registration data year are saved in the default age distribution array. For each source type in which the registration data are to be used for the age distribution, the 31 years of registration data in the SUT age distribution array are converted to a distribution by dividing the source type yearly registration data by the source type total registration data. For

each source type in which the defaults are to be used, the defaults values from the default age distribution array are copied to the SUT age distribution array.

The MOVES default fuel/engine fractions are extracted from the MOVES default database (using the appropriate code for MySQL) and saved in the default fuel/engine fractions array. For source types 52, 53, and 61, the source type yearly registration data in the fuel/engine fractions array are converted to fuel/engine fractions by dividing the yearly source type diesel registration data by the sum of the yearly source type diesel registration data and the yearly source type gas registration data.

If the year ID input is used, then these fuel/engine fractions are adjusted to match the year from the year ID input. If the year from the year ID input is greater than the registration data year, then the first fuel/engine fraction is extended to match the year from the year ID input and the appropriate number of years is dropped from the end of the fuel/engine fractions to maintain the appropriate distribution. If the year from the year ID input is less than the registration data year, then the last fuel/engine fraction is extended to match the year from the year ID input and the appropriate number of years is dropped from the beginning of the fuel/engine fractions to maintain the appropriate distribution. For source type 62, all of the fuel/engine fractions in the fuel/engine fractions array are set to a value of 1.

Using the appropriate MySQL code, a new sourcetypeagedistribution database table is created and the data from the SUT age distribution array, along with the year ID (either from the registration data or the year ID input), are used to fill the new database table. A text format of this database table may be written as well. Using the appropriate MySQL code, a new AVFTfuelengfraction database table is created and the data from the fuel/engine fractions array are used to fill the new database table for SUTs 52, 53, 61, and 62. For all other SUTs, the default fuel/engine fraction array data for the appropriate year (either the registration data year or the year ID input) are used to fill the new database table. A text format of this database table may be written as well.

RatesCalc

The RatesCalc utility calculates emissions rates in terms of rate/SHP for the evaporative emissions processes using the data in the CDB used in the MOVES emissions rates run and the MOVES default database. The utility also creates copies of the rateperdistance, rateperhour, and rateperstartemissions rate tables to include the units for each pollutant. If not specified, emissions rates are assembled for each pollutant and process combination (excluding total energy and the refueling emissions processes) in the MOVES emissions rate tables. The utility also uses the movesrun database table, along with a pollutant energy or mass lookup table (mass, TEQ, or gmole), to determine the units of the emissions rates, which are added to the emissions rate tables, which will allow the user to specify any of the units available in MOVES for the MOVES emissions rate run. The type of activity used for the emissions rate calculation is determined by the process, as Table 5 shows.

Table 5. MOVES2014a Emissions Process and Corresponding Activity for Rate-per-Activity Emissions Rates.

MOVES2014a Emissions Process	Activity	Emissions Rate Units
Running Exhaust	Miles Traveled	Rate/Mile
Crankcase Running Exhaust	Miles Traveled	Rate/Mile
Start Exhaust	Starts	Rate/Start
Crankcase Start Exhaust	Starts	Rate/Start
Extended Idle Exhaust	Extended Idle Hours	Rate/Extended Idle Hour
Crankcase Extended Idle Exhaust	Extended Idle Hours	Rate/Extended Idle Hour
Auxiliary Power Exhaust	APU Hours	Rate/APU Hour
Evaporative Permeation	Miles Traveled Source Hours Parked	Rate/Mile Rate/SHP
Evaporative Fuel Vapor Venting	Miles Traveled Source Hours Parked	Rate/Mile Rate/SHP
Evaporative Fuel Leaks	Miles Traveled Source Hours Parked	Rate/Mile Rate/SHP
Brake Wear	Miles Traveled	Rate/Mile
Tire Wear	Miles Traveled	Rate/Mile

For the rateperdistance (rate/mile emissions rates) emissions rate table, the utility creates a copy of the emissions rates in the specified output database with the table name ttirateperdistance. If specific pollutants are specified, only the emissions rates for those pollutants are copied to the ttirateperdistance table. Otherwise, the entire rateperdistance table is copied to the ttirateperdistance table. The utility also adds a "Units_Per_Activity" field to the ttirateperdistance table and fills that field based on the pollutants energy or mass designation (mass, TEQ, or gmole). For those pollutants designated as mass, the mass units from the movesrun table are added to the "Units_Per_Activity" field. For those pollutants designated as gmole, the mass units from the movesrun table, along with the text "-mole" (i.e., pound-mole or gram-mole) are added to the "Units_Per_Activity" field. For those pollutants designated as TEQ, the text "TEQ" is added to the "Units_Per_Activity" field. No unit conversions are performed in this utility. The rateperstart and rateperhour, emissions rate tables are processed in a similar manner to produce the ttirateperstart and ttirateperhour, emissions rate tables.

For the evaporative emissions rates, the utility uses the CDB from the MOVES run and the MOVES default database to replicate the MOVES vehicle population and SHP calculation process. Using the emissions rates from the rateperprofile and ratepervehicle emissions rate tables, the utility calculates the rate-per-SHP emissions rates by multiplying the emissions rate by the appropriate vehicle population and dividing by the appropriate SHP value. These rate-

per-SHP emissions rates are then saved in the ttiratepershp emissions rate table. Similar to the previous RatesCalc emissions rate tables, the "Units_Per_Activity" field is added to the ttiratepershp table and filled based on the pollutants energy or mass designation.

RatesAdj

The RatesAdj utility applies emissions rate adjustments to an emissions rate database table produced by RatesCalc utility (ttirateperdistance, ttirateperstart, ttirateperhour, or ttiratepershp) or by this utility to produce a new emissions rate database table in the same format as the input emissions rate database table. The emissions rate adjustments can be linear adjustments that are applied to all emissions rates or can be applied by SUT, fuel type, pollutant, and process (adjustments may also include roadway type, average speed bin, and hour). The user has the option of selecting which pollutants will be in the new emissions rate database table, along with the output units of the emissions rates. This allows the user to perform any unit conversions between mass units (i.e., pounds to grams or pound-mole to gram-mole) without providing any addition adjustment factors. Unit conversions between unit types (i.e., gram-moles to grams or TEQ to grams) are not performed internally by the utility. These types of conversions must be made using the emissions rate adjustment factors. The utility also has the option for combining multiple emissions rate database tables into one new emissions rate database table, if the input emissions rate database tables are in the same format.

For the first input emissions rate database table, the utility extracts the emissions rates for the specified pollutants (or all the pollutants if not specified) from the input database emissions rate table, applies the emissions rate adjustments (if necessary) and any unit conversion adjustments, and saves these adjusted emissions rates. If more than one emissions rate database table is input, then the utility performs a similar calculation process to the first input emissions rate database table for each input emissions rate database table. If pollutants are found in more than one input emissions rate database table, the adjusted emissions rates are summed to produce one emissions rate.

After processing all of the input emissions rate database tables, the utility creates a new emissions rate database table in the same format as the first input emissions rate database table and writes the adjusted emissions rates to this new emissions rate database table. Using MySQL code, the utility also creates a minimum and maximum emissions rate summary for each input emissions rate table and the output emissions rate table by pollutant, process, and source type/fuel type, which is written to a tab-delimited file specified by the user.

EmsCalc

The EmsCalc utility estimates the hourly link emissions for one user-specified county using the emissions factors (either from RatesCalc or RatesAdj), the 24-hour or time period VMT mix, the hourly link VMT and speeds activity estimates (either from TRANSVMT or VirtualLinkVMT), and the off-network activity (SHP, starts, and SHI). This utility produces a tab-delimited output summary (including hourly and 24-hour totals) and hourly link emissions output files (optional). The primary inputs to EmsCalcare:

- Emissions factors from RatesCalc or RatesAdj;

- Link-based hourly VMT and speeds developed with the TRANSVMT or VirtualLinkVMT utility. For each link, the following information is input to EmsCalc: link start node, link end node, link county number, link roadway type number, link area type number, link VMT, and link operational speed estimate;
- 24-hour or time period VMT mix by roadway type, MOVES SUT, and MOVES fuel type;
- Off-network activity (SHP, starts, SHI, and APU hours) by hour and SUT/fuel type;
- VMT roadway type designations, which lists associations of the link roadway types/area type combination to the VMT mix, emissions rate, and MOVES roadway types;
- Pollutants input file, which specifies which pollutant/process combinations for which the emissions calculations will be performed and their respective units in the tab-delimited output;
- SCC input file (optional, only if the activity and emissions by SCC are to be created); and
- SCC pollutants input file (optional, only if the activity and emissions by SCC are to be created).

The emissions estimation can be categorized by two basic types based on the type of emissions factors: the roadway-based emissions and the off-network-based emissions. For the roadway-based emissions (ttirateperdistance emissions factors), the VMT for each link is distributed to each of the SUT/fuel type combinations listed in the VMT mix by roadway type (as designated in the VMT roadway type designations). If the time period VMT mix is input, each hour is assigned a time period by the user. Otherwise, the 24-hour VMT mix is used for all hours. For each pollutant/process combination in the pollutants input file, the emissions factors are selected based on the emissions rate roadway type (as designated in the VMT roadway type designations) and the link speed for each SUT/fuel type combinations listed in the VMT mix. For link speeds greater than 75 mph, the emissions factors for 75 mph are used. For link speeds less than 2.5 mph, the emissions factors for 2.5 mph are used. For those link speeds that fall between the 16 MOVES speeds, the emissions factors are interpolated using the emissions factor interpolation methodology in the following section. These SUT/fuel type combination-specific emissions factors are multiplied by the SUT/fuel type combination-specific VMT to estimate the mobile source emissions for that link by SUT/fuel type combination. If the activity and emissions by SCC are to be created, the activity and emissions are also aggregated by SCC using the SCC input file and by SCC pollutant using the SCC pollutants input file (thus allowing the user the option to combine multiple MOVES pollutants into one more aggregate pollutant).

For the off-network emissions , the ttirateperstart, ttirateperhour, and ttiratepershp emissions rates(by SUT/fuel type) are multiplied by the appropriate activity, which is determined by the emissions process (see Table 5). If the activity and emissions by SCC are to be created, the activity and emissions are also aggregated by SCC using the SCC input file and by SCC pollutant using the SCC pollutants input file (thus allowing the user the option to combine multiple MOVES pollutants into one more aggregate pollutant).

The emissions estimates are output in a tab-delimited file (including all of the SUT/fuel type combinations listed in the VMT mix on a single line, separated by a tab character) for the

specified county by pollutant, link roadway type, and SUT/fuel type combination for each of the specified episode time periods. A 24-hour (or total if all 24 hours are not specified) output is also included in the tab-delimited file. Only those pollutant/process combinations in the pollutants input file with tab-delimited output units other than "NONE" will appear in the tab-delimited output file. Prior to output, any unit conversions between mass units (i.e., pounds to grams or pound-mole to gram-mole) are performed by the utility. Unit conversions between unit types (i.e., gram-moles to grams or TEQ to grams) are not performed internally by the utility (these type of unit conversions must be done using the RatesAdj utility). This tab-delimited file also includes hourly and 24-hour summaries of the off-network activity and VMT, VHT, and speed by link road type. Link emissions may also be output by county, pollutant, process, and each SUT/fuel type combination. If specified, the tab-delimited activity and emissions by SCC output file is also created, which lists the activity and emissions for each SCC pollutant by SCC.

Emissions Factor Interpolation Methodology

To calculate emissions factors for link speeds that fall between two of the 16 MOVES speed bin speeds, an interpolation methodology similar to the methodology used with MOBILE6 is used. This methodology interpolates each emissions factor using a factor developed from the inverse link speed and the inverse high and low bounding speed bin speeds. The following is an example for a link speed of 41.2 mph.

The interpolated emissions factor (EF_{Interp}) is expressed as:

$$EF_{Interp} = EF_{LowSpeed} - FAC_{Interp} \text{ H } (EF_{LowSpeed} - EF_{HighSpeed})$$

Where:

$EF_{LowSpeed}$ = emissions factor (EF) corresponding to the speed below the link speed;

$EF_{HighSpeed}$ = EF corresponding to the speed above the link speed; and

$$FAC_{Interp} = \left(\frac{1}{Speed_{link}} - \frac{1}{Speed_{low}} \right) \Big/ \left(\frac{1}{Speed_{high}} - \frac{1}{Speed_{low}} \right)$$

Given that:

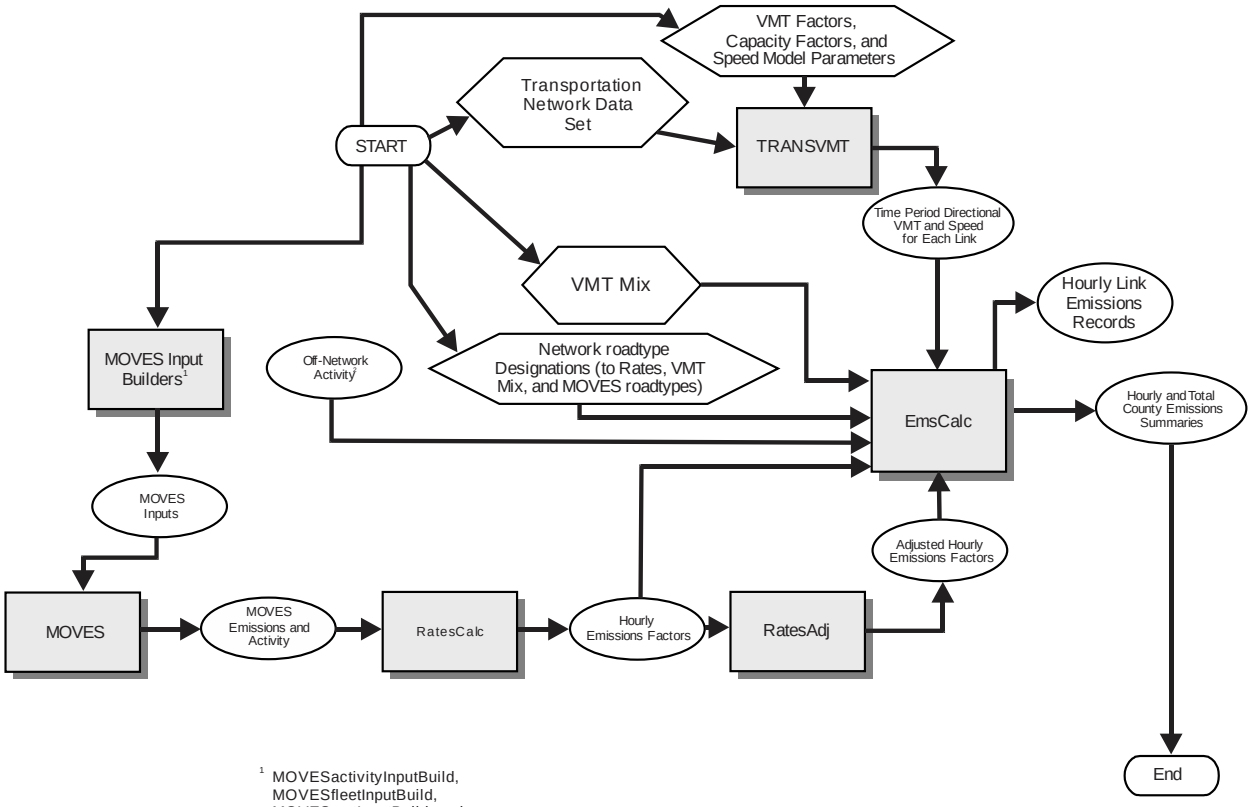
$EF_{LowSpeed}$ = 0.7413 g/mi;
$EF_{HighSpeed}$ = 0.7274 g/mi;
$Speed_{lnk}$ = 41.2 mph;
$Speed_{low}$ = 40 mph; and
$Speed_{high}$ = 45 mph.

$$FAC_{Interp} = \left(\frac{1}{41.2mph} - \frac{1}{40mph} \right) \Big/ \left(\frac{1}{45mph} - \frac{1}{40mph} \right) = \frac{-0.00073}{-0.00278} = 0.26214;$$

EF_{Interp} = 0.7413 g/mi - (0.26214) H (0.7413 g/mi - 0.7274 g/mi);

= 0.7377 g/mi.

Travel Demand Model Network Link-Based Hourly MOVES Emissions Estimates



[1] MOVESactivityInputBuild, MOVESfleetInputBuild, MOVESmetInputBuild, and VehPopulationBuild.

[2] VehPopulationBuild, and OffNetActCalc.