Los Angeles International Airport (LAX)

Air Quality Improvement Measures - 2017, 2023, and 2031 Emissions Inventories With AQIM Potential Emission Reductions Draft

Los Angeles World Airports

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Section 1
Introduction

Los Angeles World Airports (LAWA) is completing the Los Angeles International Airport (LAX) Air Quality Improvement Measures (AQIM) that are designed to reduce air pollutant emissions from various airport sources. Most of the individual elements of the AQIM have been implemented at LAX for a decade or more and are being consolidated into the AQIM to more efficiently track progress towards achieving multiple air quality improvement goals and align with the larger LAX Sustainability Action Plan. Therefore, emissions of the criteria pollutants carbon monoxide (CO); volatile organic compounds (VOC); oxides of nitrogen (NO_x); sulfur oxides (SO_x), respirable particulate matter (PM_{10}); and fine particulate matter, ($PM_{2.5}$); as well as the major greenhouse gas pollutant carbon dioxide (CO_2) are presented in this report.

Several elements of the AQIM will be incorporated into a Memorandum of Understanding (MOU) with the South Coast Air Quality Management District (SCAQMD) to provide voluntary emission reductions of the ozone precursors (NO_x and VOC). The MOU negotiated between LAWA and SCAQMD will be similar to MOUs that SCAQMD is negotiating with each of the commercial passenger airports in the South Coast Air Basin, including Orange County John Wayne Airport, Ontario International Airport, Hollywood Burbank Airport, and Long Beach Airport. The intent of the MOUs is to provide voluntary emissions reductions that can be applied to the South Coast Ozone State Implementation Plan (SIP), as updated with the 2016 South Coast Air Quality Management Plan (2016 AQMP).

The emissions inventories are provided for calendar years 2023, and 2031, per SCAQMD's request to match various attainment dates for the ozone National Ambient Air Quality Standards (NAAQS). The Baseline year (2017) was selected as the most recent, complete year for developing inventories for the airports. The inventories for 2023 and 2031 are each provided in the report for two scenarios: (i) Business-As-Usual (BAU Scenario), and (ii) With Implementation of the AQIM (AQIM Scenario). The BAU scenario assumes that existing air quality programs at LAX will be maintained at current (2017) level of implementation. The AQIM scenario includes enhancements and additions to the current programs that are captured in the AQIM.

The remaining portions of this report include the following: Section 2 provides the 2017 Baseline emissions inventory and assumptions; Section 3 provides the 2023 BAU emissions inventory and assumptions; Section 4 outlines the assumptions used to develop estimates of the 2023 AQIM emission reduction benefits and provides resulting emission benefits; Section 5 provides the 2031 BAU emissions inventory and assumptions; and Section 6 outlines the assumptions used to develop estimates of the 2031 AQIM emission reduction benefits and provides resulting emission benefits.

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Section 2

LAX 2017 Baseline Emissions Inventory and Assumptions

2.1 Summary of 2017 Baseline Emissions Inventory

A summary of the LAX 2017 Baseline emissions inventory is presented in **Table 2-1**. The emissions by major source categories are shown graphically on **Figure 2-1**. The remainder of this section provides an overview of the input parameters and assumptions used to develop this inventory.

Table 2-1. LAX 2017 Baseline Emissions Inventory

Airport Emission Source	Pollutant Emissions, tons per year						CO_2 (MT/yr)
	CO	VOC	NO_x	SO_x	PM_{10}	$PM_{2.5}$	
Ground Support Equipment Total	**1,141.40**	**25.93**	**184.93**	**0.23**	**4.83**	**4.27**	**23,369**
Traffic & Parking							
Regional Traffic	6,333.96	661.83	1,319.59	13.65	201.71	95.14	1,258,667
On-Airport Traffic & Parking	316.39	33.47	83.04	0.71	11.02	5.46	65,832
Paved Road Dust	---	---	---	---	332.26	83.07	---
Traffic & Parking Total	**6,650.35**	**695.30**	**1,402.63**	**14.36**	**545.00**	**183.67**	**1,324,499**
GRAND TOTAL	**7,791.75**	**725.23**	**1,587.56**	**14.59**	**549.83**	**187.94**	**1,347,868**

Source: CDM Smith 2019

2.2 LAX 2017 Baseline Ground Support Equipment Emissions

2.2.1 GSE Inventory, Activity, and Emissions Modeling

Ground support equipment (GSE) at airports includes the vehicles and equipment that service aircraft at the gates, as well as certain equipment used to maintain the airfield. In 2013, LAWA conducted a survey of the GSE operating at LAX. The results of that survey allowed the development of airport wide GSE inventory by equipment type, equipment age, and fuel type. In 2015, LAWA developed and implemented the LAX GSE Policy, which requires GSE operators at LAX to annually report information on each piece of equipment in their respective fleets including the GSE type, fuel type, model year, and horsepower. The data collected for 2017 was used to develop the GSE inventory (equipment counts) summarized in **Table 2-2**. Over 52 percent of the GSE at LAX is either electric powered or runs on alternative fuels (mostly liquefied petroleum gas/propane).

Table 2-2. LAX 2017 Baseline - GSE Inventory of Equipment by Fuel Type

	Fuel Type				
Equipment Type	**Diesel**	**Gasoline**	**LPG/Propane**	**Electric**	**Totals**
Air Conditioner	27	0	0	14	41
Air Start	29	0	0	0	29
Aircraft Tractor	125	3	5	52	185
Baggage Tractor	65	185	163	331	744
Belt Loader	38	46	21	193	298
Bobtail	5	34	1	0	40
Cargo Loader	124	0	0	3	127
Cargo Tractor	3	47	7	111	168
Cart	0	14	0	183	197
Catering Truck	34	56	0	1	91
Fork Lift	15	2	150	51	218
Fuel Truck	29	4	0	0	33
Generator	3	1	0	0	4
Ground Power Unit	108	1	0	29	138
Hydrant Truck	4	5	0	0	9
Lavatory Cart	0	2	0	0	2
Lavatory Truck	2	24	0	0	26
Lift	34	27	16	61	138
Other	17	25	2	2	46
Other ORE	9	42	23	1	75
Passenger Stand	8	16	0	17	41
Service Truck	1	46	0	0	47
Sweeper	2	7	4	3	16
Water Truck	0	4	0	0	4
Totals	**682**	**591**	**392**	**1,052**	**2,717**

Source: CDM Smith, 2019

The California Air Resources Board (ARB) OFFROAD2017[1] model was used to obtain GSE emission factors, deterioration factors, load factors, and activity levels (hours/year/unit). These data were obtained from OFFROAD2017 by using the following model option: Los Angeles Sub Area of the South Coast Air Basin; 2017 Calendar Year; Adopted Rules – Exhaust Scenario; All Equipment Types; All Model Years; All Horsepower Bins; and All Fuel Types. The GSE annual survey conducted for the 2017 calendar year obtained sufficient manufactured date for equipment that equipment ages could be determined. The aged emission factors were determined for each piece of equipment in the inventory, the load factors and activity levels were applied to create the emission inventory.

Each GSE was matched to OFFROAD2017 equipment types based on the designated Fuel Types and Equipment Types. LPG/Propane GSE was assumed to be equivalent to Natural Gas equipment as listed in the OFFROAD database. When possible, the Equipment Categories AirGrSupp and OFF–AirGrSupp were utilized to pair non-diesel equipment, although Portable Equipment, Light

[1] California Air Resources Board. 2017. OFFROAD2017 Web Database. Available at: https://www.arb.ca.gov/orion/ (accessed February 13, 2019); and California Air Resources Board. 2017. 2017 Off-Road Diesel Emission Factor Update for NOx and PM. Available a: https://www.arb.ca.gov/msei/ordiesel/ordas_ef_fcf_2017.pdf (accessed February 13, 2019).

Commercial, or other OFFROAD categories were necessary pairings for Pumps or Generator Sets. The full pairing is listed below in **Table 2-3**.

Table 2-3. LAX GSE Type Pairing with OFFROAD2017 Equipment and Fuel Types

GSE Category	OFFROAD Category (Diesel)	OFFROAD Category (Gasoline & Nat Gas)
Air Conditioner	Portable Equipment - Non-Rental Generator	OFF - AirGrSupp - Air Conditioner
Air Start	Portable Equipment - Non-Rental Generator	OFF - AirGrSupp - Air Start Unit
Aircraft Tug	AirGrSupp - A/C Tug Narrow Body	OFF - AirGrSupp - A/C Tug Narrow Body
Backhoe	ConstMin - Tractors/Loaders/Backhoes	ConstMin - Tractors/Loaders/Backhoes
Bag Tug	AirGrSupp - Baggage Tug	OFF - AirGrSupp - Baggage Tug
Belt Loader	AirGrSupp - Belt Loader	OFF - AirGrSupp - Belt Loader
Cargo Loader	AirGrSupp - Cargo Loader	OFF - AirGrSupp - Cargo Loader
Cargo Tractor	AirGrSupp - Cargo Tractor	OFF - AirGrSupp - Cargo Tractor
Fork Lift	AirGrSupp - Forklift	OFF - AirGrSupp - Forklift
Fuel Truck	AirGrSupp - Other GSE	OFF - AirGrSupp - Fuel Truck
Generator	Portable Equipment - Non-Rental Generator	OFF - AirGrSupp - Generator
Golf Cart	Portable Equipment - Non-Rental Generator	OFF - AirGrSupp - Cart
GPU	AirGrSupp - Other GSE	OFF - AirGrSupp - Ground Power Unit
Lavatory Cart	AirGrSupp - Other GSE	OFF - AirGrSupp - Lav Cart
Lavatory Truck	AirGrSupp - Other GSE	OFF - AirGrSupp - Lav Truck
Lift	AirGrSupp - Lift	OFF - AirGrSupp - Lift
Other GSE	AirGrSupp - Other GSE	OFF - AirGrSupp - Other GSE
Passenger Stairs	AirGrSupp - Passenger Stand	OFF - AirGrSupp - Passenger Stand
Push Back	AirGrSupp - A/C Tug Narrow Body	OFF - AirGrSupp - A/C Tug Narrow Body
Service Truck	AirGrSupp - Other GSE	OFF - AirGrSupp - Service Truck
Skid Steer Loader	ConstMin - Skid Steer Loaders	ConstMin - Skid Steer Loaders
Sweeper	ConstMin - Sweepers/Scrubbers	OFF - AirGrSupp - Sweeper

Source: CDM Smith 2019

Based on its category and fuel type, each piece of equipment was matched to the nearest model year and horsepower pairings available in the OFFROAD database. When matching horsepower, the lowest horsepower bin that was greater than the identified horsepower was utilized. When no such horsepower bin existed for the specific category / fuel type pairing, the highest horsepower bin that was smaller than the identified horsepower was utilized. Model year was matched in a similar manner if an exact match did not exist in the database. For GSE that was indicated to have an on-road equivalent engine, the EMFAC 2017 emission factors were used.

In airport-provided equipment lists, some GSE lacked identifying model years and/or engine horsepower ratings. In this case, equipment was conservatively paired to the oldest model year equipment for the category / fuel type pairing identified in the OFFROAD database. Horsepower ratings were somewhat more subjective, utilizing either a horsepower-hours per year-weighted average horsepower for the equipment type /fuel type pairing or an estimated horsepower rating based high conformity of horsepower ratings for other GSE of the same category used on the airfield.

2.2.2 GSE Emissions Modeling Results

The emission calculation results for the LAX 2017 Baseline GSE by equipment type are presented in Table 2-4. Table 2-5 summarizes the emissions for GSE by fuel type.

Table 2-4. GSE Emissions by Equipment Type at LAX in 2017

GSE Type	Equipment Count	Pollutant Emissions, tons per year						CO2
		CO	VOC	NOx	SO_2	PM_{10}	$PM_{2.5}$	Tonnes/yr
Air Conditioner	41	3.97	0.53	5.39	0.01	0.22	0.20	564
Air Start	29	0.33	0.04	0.63	0.00	0.02	0.02	63
Aircraft Tractor	185	20.23	1.43	16.74	0.02	0.73	0.67	1,233
Baggage Tractor	744	565.48	5.56	64.61	0.06	1.36	1.19	7,668
Belt Loader	298	69.95	0.99	8.41	0.01	0.23	0.20	1,357
Bobtail	40	15.85	0.18	1.32	0.01	0.03	0.02	694
Cargo Loader	127	7.09	0.88	8.56	0.01	0.59	0.54	710
Cargo Tractor	168	151.92	8.54	18.65	0.01	0.13	0.10	1,628
Cart	197	19.44	0.29	0.24	0.00	0.01	0.01	127
Catering Truck	91	67.47	1.31	11.49	0.02	0.23	0.18	2,338
Fork Lift	218	16.17	0.12	4.41	0.00	0.04	0.04	194
Fuel Truck	33	1.07	0.08	0.78	0.00	0.02	0.02	75
Generator	4	5.26	0.06	0.43	0.00	0.01	0.01	92
Ground Power Unit	138	10.10	1.41	14.27	0.02	0.64	0.59	1,286
Hydrant Truck	9	48.68	0.58	5.57	0.01	0.13	0.10	1,540
Lavatory Cart	2	0.19	0.00	0.00	0.00	0.00	0.00	1
Lavatory Truck	26	21.56	0.46	3.52	0.01	0.05	0.03	757
Lift	138	37.19	1.58	9.63	0.01	0.19	0.17	863
Other	46	48.12	0.91	3.76	0.01	0.12	0.11	1,109
Other ORE	75	0.20	0.02	0.03	0.00	0.00	0.00	19
Passenger Stand	41	1.16	0.07	0.53	0.00	0.01	0.01	47
Service Truck	47	26.54	0.73	5.11	0.01	0.05	0.04	916
Sweeper	16	3.10	0.15	0.70	0.00	0.01	0.01	72
Water Truck	4	0.31	0.02	0.16	0.00	0.00	0.00	14
TOTALS	**2,717**	**1,141.40**	**25.93**	**184.93**	**0.23**	**4.83**	**4.27**	**23,369**

Source: CDM Smith 2019

Table 2-5. GSE Emissions by Fuel Type at LAX in 2017

Fuel Type	Equipment Count	Pollutant Emissions, tons per year						CO2
		CO	VOC	NOx	SO_2	PM_{10}	$PM_{2.5}$	Tonnes/yr
Diesel	682	45.77	6.67	71.02	0.10	3.87	3.55	5,092
Gasoline	591	843.76	19.16	71.96	0.13	0.94	0.70	16,986
LPG/Propane	392	251.87	0.10	41.94	0.00	0.02	0.01	1,292
Electric	1,052	0.00	0.00	0.00	0.00	0.00	0.00	0
TOTALS	**2,717**	**1141.40**	**25.93**	**184.93**	**0.23**	**4.83**	**4.27**	**23,369**

Source: CDM Smith 2019

2.3 LAX 2017 Baseline Traffic & Parking Emissions

2.3.1 Regional Airport-Related Trips and Miles Traveled

Ground vehicles trips, including passenger cars, taxis, limos, shuttles, buses, and cargo trucks, traveling to or from LAX were estimated for 2017. The basis for the trip estimates and vehicle miles traveled was the LAX Landside Access Modernization Project (LAMP) Environmental Impact Report (EIR).[2] Specifically, the traffic data provided for the air quality impacts analysis for the 2015 Existing Conditions was used as the initial basis. The trip volume was provided for various trip end points at the airport including the Central Terminal Area (CTA), rent-a-car (RAC) facilities located around LAX, cargo ramps at LAX, airport and tenant employee parking lots, and other passenger parking lots (both airport-owned and private lots).

To generate annual vehicle trips associated with traffic to and from LAX, average daily trip volumes from the 2015 LAMP baseline scenario were summed across the roadway segments detailed in **Table 2-6** based on consolidated vehicle category (Light-Duty, Light-Heavy-Duty, Medium-Heavy-Duty, and Heavy-Heavy-Duty). Roadway segments representing structures that did not exist in the baseline scenario, such as the CONRAC, provided zero traffic volumes for the baseline scenario as detailed in the LAMP EIR.

Table 2-6. Traffic Segments used to Identify Trips to/from LAX

LAWA Facility	Trip End-Point Category
Lot C - 96th Street Entrance	Airport Public Parking
Lot C - Existing driveway on Jenny / Employee Lot South Dwy on Jenny	Airport Public Parking
Lot C - Entrace driveway on Westchester Pkwy	Airport Public Parking
Lot E	Employee Parking
Lot D - Employee Lot East & West	Employee Parking
World Way West - WAMA	World Way West
Cargo - Aviation & 104th St	Cargo Facilities
Cargo - Aviation & 111th St	Cargo Facilities
Cargo - Century Blvd. & Avion Dr	Cargo Facilities
Cargo - Century & Airport Blvd	Cargo Facilities
Cargo - Century & Postal Road	Cargo Facilities
Rental Car - Enterprise	Rental Car Facilities
Cargo - Imperial Hwy & Imperial Terminal	Cargo Facilities
Cargo - Imperial Hwy & California St	Cargo Facilities
Cargo - Imperial Hwy & Hughes Way	Cargo Facilities
Cargo - Imperial Hwy & Unsignalized Entrance e/o Hughes	Cargo Facilities
Cargo - Imperial Hwy & Kilroy Center Dr	Cargo Facilities
Cargo - Imperial Hwy & Douglass St	Cargo Facilities
Cargo - Imperial Hwy & Driveway west of Aviation Blvd	Cargo Facilities
Rental Car - Advantage	Rental Car Facilities
Rental Car - Alamo & National	Rental Car Facilities
Rental Car - Avis	Rental Car Facilities

[2] City of Los Angeles, 2017. Final Environmental Impact Report for Los Angeles International Airport (LAX) Landside Access Modernization Program. State Clearinghouse No. 2015021014. February.

Table 2-6. Traffic Segments used to Identify Trips to/from LAX

LAWA Facility	Trip End-Point Category
Rental Car - Budget	Rental Car Facilities
ITF West & Parking Structure	Airport Public Parking
ITF East & Parking Structure	Airport Public Parking
CONRAC	Rental Car Facilities
Rental Car - Dollar	Rental Car Facilities
Central Terminal Area	Central Terminal Area
Rental Car - Fox & Payless	Rental Car Facilities
Rental Car - Hertz	Rental Car Facilities
Rental Car - Thrifty	Rental Car Facilities
The Parking Spot	Off-Airport Private Parking
Park One	Off-Airport Private Parking
Valet Air & Park	Off-Airport Private Parking
Wally Park	Off-Airport Private Parking
Westchester Parking Spot	Off-Airport Private Parking

Source: CDM Smith 2019

The annual Trip General Reports[3,4] published by LAWA for 2015 and 2017 were used to adjust the 2015 traffic estimates in the LAMP EIR to 2017 levels. The total number of trips for vehicles traveling to and from LAX in 2017 is presented in **Table 2-7**.

Table 2-7. Estimated Total Vehicle Trips to LAX in 2017

	Vehicle Trips to or from LAX				Grand
Airport Destination	Light Duty	LHD	MHD	HHD	Total
Central Terminal Area	64,892,265	0	1,711,120	0	66,603,385
Airport Public Parking	1,249,670	0	263,250	735	1,513,655
Off-Airport Private Parking	1,535,838	0	1,535,581	0	3,071,419
Employee Parking	2,639,893	0	0	279	2,640,172
World Way West	3,080,401	0	0	309	3,080,710
Rental Car Facilities	10,475,623	0	126,481	2,149	10,604,253
Cargo Facilities	12,824,506	2,514,034	2,748,083	521,881	18,608,505
TOTALS	**96,698,198**	**2,514,034**	**6,384,515**	**525,354**	**106,122,101**

Source: CDM Smith 2019

[3] Los Angeles World Airports. 2015. Traffic Generation Report [Los Angeles International Airport / August 2015]. (December). Available at: https://lawamediastorage.blob.core.windows.net/lawa-media-files/media-files/lawa-web/lawa-our-lax/studies-and-reports/traffic-generation-report/traffic-generation-report---2015.pdf (accessed February 8, 2019).

[4] Los Angeles World Airports. 2017. Traffic Generation Report [Los Angeles International Airport / August 2017]. (November). Available at: https://lawamediastorage.blob.core.windows.net/lawa-media-files/media-files/lawa-web/lawa-our-lax/studies-and-reports/traffic-generation-report/traffic-generation-report-2017.pdf (accessed February 8, 2019).

The average miles traveled to each of the trip end points by vehicle type were obtained from the traffic study conducted for the LAX Specific Plan Amendment Study EIR.[5] The trip volumes to each end point were multiplied by the average distance traveled for each end point and each vehicle type traveling to that end point to get total vehicle miles traveled (VMT) in 2017. A breakdown of miles-per-trip by end-point and by consolidated vehicle category is provided in **Table 2-8**. The resulting VMT are presented in **Table 2-9**.

Table 2-8. 2017 Miles-per-Trip by LAX End-Point

SPAS Trip End-Point Category	LDAT	LHD	MHD	HHD	Trip End-Point Category
Parking	30.9	1.9	1.9	1.9	Off-Airport Private Parking
Employee Parking	29.4	3.1	3.1	3.1	Employee Parking, World Way West, & Airport Public Parking
Cargo	28.0	36.0	36.0	36.0	Cargo Facilities
RAC	28.9	2.0	2.0	2.0	Rental Car Facilities
CTA	31.9	2.2	2.2	2.2	Central Terminal Area

Source: CDM Smith 2019

Table 2-9. Regional Miles Traveled for All Trips To or From LAX in 2017

	Vehicle Trips to or from LAX				Grand
Airport Destination	Light Duty	LHD	MHD	HHD	Total
Central Terminal Area	2,070,063,269	0	3,764,463	0	2,073,827,732
Airport Public Parking	36,740,286	0	816,076	2,280	37,558,642
Off-Airport Private Parking	47,457,395	0	2,917,605	0	50,375,000
Employee Parking	77,612,860	0	0	865	77,613,725
World Way West	90,563,803	0	0	958	90,564,761
Rental Car Facilities	302,745,519	0	252,962	4,298	303,002,779
Cargo Facilities	359,086,178	90,505,238	98,930,986	18,787,721	567,310,123
TOTALS	2,984,269,311	90,505,238	106,682,091	18,796,121	3,200,252,761

Source: CDM Smith 2019

The types of vehicles traveling to and from each trip end-point were segregated into light-duty vehicle (LDA, LDT1, and LDT2); light-heavy duty (LHD) truck; medium-heavy duty (MHD) truck; and heavy-heavy-duty (HHD) truck technology categories in the CARB EMFAC model.

2.3.2 On-Airport Roadways and Parking Lots

Using the trip volumes in Table 4, distances traveled on airport roadways and in airport parking lots was estimated to be approximately 1.5 miles per one-way trip. This estimated distance was developed from reviewing airport roadways and parking lots in Google Earth Pro. The resulting total distance traveled is summarized in **Table 2-10**.

[5] City of Los Angeles, 2013. Final Environmental Impact Report for Los Angeles International Airport (LAX) Specific Plan Amendment Study. State Clearinghouse No. 1997061047. January. Trip lengths based on LAX SPAS Alternative 4.

Table 2-10. On-Airport Roadway and Parking Lot Travel Distances at LAX in 2017

	Vehicle Trips to or from LAX				Grand
Airport Destination	Light Duty	LHD	MHD	HHD	Total
Central Terminal Area	97,338,398	0	2,566,679	0	99,905,078
Airport Public Parking	1,874,504	0	394,876	1,103	2,270,483
Off-Airport Private Parking	2,303,757	0	2,303,372	0	4,607,129
Employee Parking	3,959,840	0	0	418	3,960,258
World Way West	4,620,602	0	0	463	4,621,066
Rental Car Facilities	15,713,435	0	189,721	3,224	15,906,380
Cargo Facilities	19,236,760	3,771,052	4,122,124	782,822	27,912,757
TOTALS	145,047,296	3,771,052	9,576,773	788,030	159,183,151

Source: CDM Smith 2019

2.3.3 LAX Traffic and Parking Emissions

Emission factors from the ARB EMFAC2017 model were used to estimate traffic and parking lot emissions. Emission factors were aggregated by speed and by model years were obtained for all technology categories. The light duty vehicle factors were developed from distance traveled (VMT)-weighted averages of the LDA, LDT1 and LDT2 vehicle types. Medium heavy-duty truck (MHD) factors were used for all shuttles and buses entering the airport. Cargo trucks factors were split among the light heavy duty (LDH), MDH, and heavy heavy duty (HHD) truck factors based on the VMT for each category entering the cargo ramps. were used for all cargo trucks entering the airport.

The emission factors were developed from EMFAC2017 emission inventories for the South Coast Air Basin portion of Los Angeles County for calendar year 2017. Other EMFAC2017 model options selected included: EMFAC2011 Vehicle Categories; All Vehicle Categories; Aggregated Model Years; Aggregated Speeds; and All Fuel Types. The total pollutant emission inventories (in tons per day) for each of the vehicle technology categories noted above (LDA, LDT1, LDT2, LHD, MDH, and HHD) were divided by the EMFAC VMT data for the corresponding vehicle technology category. The final 2017 emission factors, in grams per mile, for each pollutant are summarized in **Table 2-11** In addition, re-entrained road dust was estimated the method described in Chapter 13.2.1 Paved Roads in U.S. EPA's Compilation of Air Pollutant Emission Factors (AP-42).

The LAX 2017 total traffic emission inventories are summarized in **Table 2-12**.

Table 2-11. 2017 Emission Factors from EMFAC2017

Vehicle Category	2017 Calendar Year Emission Factors, grams/mile						
	CO	VOC	NOx	SOx	PM10[e]	PM2.5[e]	CO2e
LDAT[a]	1.781	0.173	0.161	0.003	0.047	0.020	344
LHD[b]	1.971	0.461	1.458	0.007	0.098	0.045	761
MHD[c]	2.089	0.344	4.305	0.012	0.272	0.183	1,219
HHD[d]	1.525	0.308	6.748	0.016	0.208	0.141	1,741
Paved Road Dust	--	--	--	--	0.090	0.022	--

Source: CDM Smith 2019

a. LDAT = Light Duty Autos and Trucks. Emission factors developed from LDA, LDT1, and LDT2 total emissions (South Coast portion of Los Angeles County in 2017).
b. LHD = Light-Heavy Duty vehicles. Emission factors developed from LDHT1 and LDHT2 total emissions (South Coast portion of Los Angeles County in 2017).
c. MHD = Medium Heavy-Duty vehicles. Emission factors developed from MDHT total emissions (South Coast portion of Los Angeles County in 2017).
d. HHD = Heavy-Heavy Duty vehicles. Emission factors developed from HHDT total emissions (South Coast portion of Los Angeles County in 2017).
e. PM10 and PM2.5 vehicle emission factors include exhaust, tire wear and brake wear.

Table 2-12. Grand Total – LAX Traffic Emissions

Airport Destination	Pollutant Emissions, tpy						CO2e MT/yr
	CO	VOC	Nox	SO2	PM10*	PM2.5*	
Regional Emissions	6,333.96	661.83	1,319.59	13.65	201.71	95.14	1,258,677
On-Airport Emissions	316.39	33.47	83.04	0.71	11.02	5.46	65,832
Paved Road Dust	--	--	--	--	332.26	83.07	--
TOTAL Traffic-Related Emissions	6,650.35	695.30	1,402.63	14.36	545.00	183.67	1,324,510

Source: CDM Smith 2019

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Section 3

LAX 2023 Business-As-Usual Emissions Inventory and Assumptions

3.1 Summary of 2023 Business-As-Usual Emissions Inventory

A summary of the LAX 2023 business-as-usual emissions inventory is presented in **Table 3-1**.[6] The emissions by major source categories are shown graphically on **Figure 3-1**. The remainder of this section provides an overview of the input parameters and assumptions used to develop this inventory.

Table 3-1. LAX 2023 Business-As-Usual Emissions Inventory

Airport Emission Source	Pollutant Emissions, tons per year						CO_2 (MT/yr)
	CO	VOC	NO_x	SO_x	PM_{10}	$PM_{2.5}$	
Ground Support Equipment Total	**1,307.15**	**20.62**	**150.69**	**0.25**	**3.58**	**3.11**	**25,222**
Traffic & Parking							
Regional Traffic	4,004.85	420.93	472.51	11.85	190.89	80.52	1,104,735
On-Airport Traffic & Parking	194.61	20.34	25.29	0.59	9.50	4.01	55,153
Paved Road Dust	---	---	---	---	361.39	90.35	---
Traffic & Parking Total	**4,199.46**	**441.27**	**497.80**	**12.44**	**561.78**	**174.88**	**1,159,888**
GRAND TOTAL	**5,506.61**	**461.89**	**648.49**	**12.69**	**565.36**	**177.99**	**1,185,110**

Source: CDM Smith 2019

3.2 LAX 2023 BAU Ground Support Equipment Emissions

3.2.1 GSE Inventory, Activity, and Emissions Modeling

As noted in Section 2.2.1 above, GSE data collected under the LAX GSE Policy was used to develop the GSE equipment counts and emissions for the 2017 Baseline inventory. The same GSE equipment and fuel mix (see Table 2-2) was used as the starting point for developing the 2023 BAU GSE emissions.

The California Air Resources Board (ARB) OFFROAD2017[7] model was used to obtain GSE emission factors, deterioration factors, load factors, and activity levels (hours/year/unit). These data were obtained from OFFROAD2017 by using the following model option: Los Angeles Sub

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[6] Emissions of criteria pollutants (carbon monoxide, CO; volatile organic compounds, VOC, oxides of nitrogen, NOx, sulfur oxides, SOx, respirable particulate matter, PM-10; and fine particulate matter, PM-2.5) and the major greenhouse gas pollutant carbon dioxide (CO_2) are presented in this report. Criteria pollutant emissions are presented in short tons per year, while CO_2 emissions are presented in metric tons (tonnes) per year.

[7] California Air Resources Board. 2017. OFFROAD2017 Web Database. Available at: https://www.arb.ca.gov/orion/ (accessed February 13, 2019); and California Air Resources Board. 2017. 2017 Off-Road Diesel Emission Factor Update for NOx and PM. Available a: https://www.arb.ca.gov/msei/ordiesel/ordas_ef_fcf_2017.pdf (accessed February 13, 2019).

Area of the South Coast Air Basin; 2023 Calendar Year; Adopted Rules – Exhaust Scenario; All Equipment Types; All Model Years; All Horsepower Bins; and All Fuel Types.

To estimate the model year for each piece of GSE, the 2023 average fleet age was assumed to be the same as the LAX 2017 GSE fleet age used in the 2017 LAX AQIM Emission Inventory. This was accomplished by increasing the model year for each GSE in the 2017 database by six (6) years (i.e., 2023 minus 2017).

Growth in GSE activity level (hours/year/unit) was developed utilizing the default OFFROAD per-equipment activities for each year. The model includes built-in factors for each equipment type detailing the total hours of operation per year per piece of equipment. Except for air start units, the model showed increasing or flat (no) growth across most equipment categories for each future scenario. This growth is used to account for growth expected at the airfield. GSE activity assumptions are listed in **Table 3-2**.

Table 3-2. OFFROAD GSE Activity per Unit of Equipment per Year

GSE Category	2017 Activity (hrs/yr)	2023 Activity (hrs/yr)[a]	Change Relative to 2017[a]
Air Conditioner	1,272	1,432	13%
Air Start	80	85	6%
Aircraft Tractor	320	348	9%
Backhoe	559	651	16%
Baggage Tractor	714	776	9%
Belt Loader	499	542	9%
Bobtail	429	466	9%
Cargo Loader	459	499	9%
Cargo Tractor	651	707	9%
Cart (Utility)	152	167	10%
Catering Truck	928	1,027	11%
Fork Lift	368	400	9%
Fuel Truck	83	92	11%
Generator	900	999	11%
Ground Power Unit	798	883	11%
Hydrant Truck	1,529	1,693	11%
Lavatory Cart	151	166	10%
Lavatory Truck	1,158	1,282	11%
Lift	404	439	9%
Other GSE	464	505	9%
Passenger Stand	47	51	9%
Push Back	320	348	9%
Service Truck	883	977	11%
Skid Steer Loader	325	379	16%
Sweeper	339	373	10%
Water Truck	311	344	11%

Sources: California Air Resources Board. OFFROAD 2017; CDM Smith 2019.
a. Change in activity from 2017 to 2023 includes both increases in equipment population and increases in activity per unit.

3.2.2 GSE Emission Modeling Results

The emission calculation results for LAX 2023 GSE by equipment type are presented in **Table 3-3**. **Table 3-4** summarizes the emissions for GSE by fuel type.

Table 3-3. GSE Emissions by Equipment Type at LAX in 2023 – BAU Scenario

GSE Type	Equipment Count	Pollutant Emissions, tons per year						CO2
		CO	VOC	NOx	SO_2	PM_{10}	$PM_{2.5}$	Tonnes/yr
Air Conditioner	41	4.86	0.56	2.55	0.02	0.12	0.11	617
Air Start	29	0.46	0.03	0.27	0.00	0.01	0.01	63
Aircraft Tractor	185	21.95	1.32	12.24	0.03	0.62	0.57	1,386
Baggage Tractor	744	615.89	5.06	57.62	0.06	1.04	0.90	8,321
Belt Loader	298	76.23	0.79	7.32	0.01	0.18	0.16	1,410
Bobtail	40	16.67	0.17	1.29	0.01	0.03	0.02	677
Cargo Loader	127	7.72	0.55	5.90	0.01	0.30	0.28	782
Cargo Tractor	168	220.77	4.84	15.59	0.01	0.12	0.09	1,786
Cart	197	21.72	0.32	0.27	0.00	0.02	0.01	142
Catering Truck	91	75.50	1.61	11.21	0.02	0.24	0.19	2,509
Fork Lift	218	17.36	0.15	4.00	0.00	0.05	0.05	211
Fuel Truck	33	1.16	0.06	0.55	0.00	0.01	0.01	80
Generator	4	5.87	0.06	0.40	0.00	0.01	0.00	103
Ground Power Unit	138	13.35	1.25	8.34	0.03	0.36	0.33	1,374
Hydrant Truck	9	54.55	0.63	5.43	0.01	0.11	0.08	1,687
Lavatory Cart	2	0.20	0.00	0.00	0.00	0.00	0.00	1
Lavatory Truck	26	23.80	0.45	2.61	0.01	0.05	0.03	827
Lift	138	42.29	1.15	7.46	0.01	0.13	0.11	914
Other	46	52.18	0.82	2.82	0.01	0.12	0.10	1,148
Other ORE	75	0.08	0.01	0.01	0.00	0.00	0.00	17
Passenger Stand	41	1.34	0.05	0.46	0.00	0.01	0.01	51
Service Truck	47	29.56	0.67	3.94	0.01	0.05	0.04	1,003
Sweeper	16	3.29	0.08	0.39	0.00	0.00	0.00	98
Water Truck	4	0.34	0.01	0.05	0.00	0.00	0.00	15
TOTALS	**2,717**	**1,307.15**	**20.62**	**150.69**	**0.25**	**3.58**	**3.10**	**25,222**

Source: CDM Smith 2019

Table 3-4. GSE Emissions by Fuel Type at LAX in 2023 – BAU Scenario

Fuel Type	Equipment Count	Pollutant Emissions, tons per year						CO2
		CO	VOC	NOx	SO_2	PM_{10}	$PM_{2.5}$	Tonnes/yr
Diesel	682	56.45	5.86	46.65	0.11	2.53	2.32	5,427
Gasoline	591	977.01	14.65	68.49	0.14	1.03	0.76	18,396
LPG/Propane	392	273.69	0.11	35.56	0.00	0.02	0.02	1,399
Electric	1,052	0.00	0.00	0.00	0.00	0.00	0.00	0
TOTALS	**2,717**	**1,307.15**	**20.62**	**150.69**	**0.25**	**3.58**	**3.10**	**25,222**

Source: CDM Smith 2019

3.3 LAX 2023 BAU Traffic and Parking Emissions

3.3.1 Regional Airport-Related Trips and Miles Traveled

Ground vehicles trips, including passenger cars, taxis, limos, shuttles, buses, and cargo trucks, traveling to or from LAX were estimated for 2023. The basis for the trip estimates and vehicle miles traveled was the LAX Landside Access Modernization Project (LAMP) Environmental Impact Report (EIR).[8] Specifically, the traffic data provided for the air quality impacts analysis for the 2024 Without Project scenario was used as the initial basis. The trip volume was provided for various trip end points at the airport including the Central Terminal Area (CTA), rent-a-car (RAC) facilities located around LAX, cargo ramps at LAX, airport and tenant employee parking lots, and other passenger parking lots (both airport-owned and private lots). The roadway segments/endpoints presented in **Table 3-5** from the LAMP EIR Without Project scenario to determine LAX trip volumes.

Table 3-5. BAU Traffic Segments used to Identify Trips to/from LAX

LAWA Facility	Trip End-Point Category
Central Terminal Area	Central Terminal Area
Lot C - 96th Street Entrance	Airport Public Parking
Lot C - Existing driveway on Jenny / Employee Lot South Dwy on Jenny	Airport Public Parking
Lot C - Entrace driveway on Westchester Pkwy	Airport Public Parking
Lot E	Employee Parking
Lot D - Employee Lot East & West	Employee Parking
World Way West - WAMA	World Way West
Cargo - Aviation & 104th St	Cargo Facilities
Cargo - Aviation & 111th St	Cargo Facilities
Cargo - Century Blvd. & Avion Dr	Cargo Facilities
Cargo - Century & Airport Blvd	Cargo Facilities
Cargo - Century & Postal Road	Cargo Facilities
Cargo - Imperial Hwy & Imperial Terminal	Cargo Facilities
Cargo - Imperial Hwy & California St	Cargo Facilities
Cargo - Imperial Hwy & Hughes Way	Cargo Facilities
Cargo - Imperial Hwy & Unsignalized Entrance e/o Hughes	Cargo Facilities
Cargo - Imperial Hwy & Kilroy Center Dr	Cargo Facilities
Cargo - Imperial Hwy & Douglass St	Cargo Facilities
Cargo - Imperial Hwy & Driveway west of Aviation Blvd	Cargo Facilities
Rental Car - Advantage	Rental Car Facilities
Rental Car - Alamo & National	Rental Car Facilities
Rental Car - Avis	Rental Car Facilities
Rental Car - Budget	Rental Car Facilities
Rental Car - Dollar	Rental Car Facilities
Rental Car - Enterprise	Rental Car Facilities

[8] City of Los Angeles, 2017. Final Environmental Impact Report for Los Angeles International Airport (LAX) Landside Access Modernization Program. State Clearinghouse No. 2015021014. February.

Table 3-5. BAU Traffic Segments used to Identify Trips to/from LAX

LAWA Facility	Trip End-Point Category
Rental Car - Fox & Payless	Rental Car Facilities
Rental Car - Hertz	Rental Car Facilities
Rental Car - Thrifty	Rental Car Facilities
The Parking Spot	Off-Airport Private Parking
Park One	Off-Airport Private Parking
Valet Air & Park	Off-Airport Private Parking
Wally Park	Off-Airport Private Parking
Westchester Parking Spot	Off-Airport Private Parking

Source: CDM Smith 2019.

The FAA's Terminal Area Forecast (TAF), dated February 2019, was used to scale trip volumes from the 2024 LAMP EIR Without Project scenario to the 2023 scenario utilized in this inventory. The total trip volumes for each end point were scaled proportionally to the enplanements projected in the TAF for 2024 to the enplanements projected in the TAF for 2023.

The types of vehicles traveling to and from each trip end-point were segregated into light-duty vehicle (LDA, LDT1, and LDT2); light-heavy duty (LHD) truck; medium-heavy duty (MHD) truck; and heavy-heavy-duty (HHD) truck technology categories in the CARB EMFAC model). The total number of trips for vehicles traveling to and from LAX in 2023 is presented in **Table 3-6**.

Table 3-6. Estimated Total Vehicle Trips to LAX in 2023 – BAU Scenario

	Vehicle Trips to or from LAX				Grand
Airport Destination	**Light Duty**	**LHD**	**MHD**	**HHD**	**Total**
Central Terminal Area	76,193,470	0	948,698	0	77,142,168
Airport Public Parking	991,472	0	117,073	633	1,109,178
Off-Airport Private Parking	841,011	0	500,417	0	1,341,428
Employee Parking	2,729,011	0	0	316	2,729,328
World Way West	3,342,237	0	0	316	3,342,553
Rental Car Facilities	11,087,058	0	96,109	1,581	11,184,748
Cargo Facilities	12,487,583	2,411,336	1,255,340	387,869	16,542,129
TOTALS	**107,671,842**	**2,411,336**	**2,917,637**	**390,716**	**113,391,531**

Source: CDM Smith 2019.

The average miles traveled to each of the trip end points by vehicle type were obtained from the traffic study conducted for the LAX Specific Plan Amendment Study EIR.[9] The trip volumes to each end point were multiplied by the average distance traveled for each end point and each vehicle type traveling to that end point to get total vehicle miles traveled (VMT) in 2023. The resulting VMT is presented in **Table 3-7**.

[9] City of Los Angeles, 2013. Final Environmental Impact Report for Los Angeles International Airport (LAX) Specific Plan Amendment Study. State Clearinghouse No. 1997061047. January.

Table 3-7. Regional Miles Traveled for All Trips To or From LAX in 2023 – BAU Scenario

	Vehicle Trips to or from LAX				Grand
Airport Destination	Light Duty	LHD	MHD	HHD	Total
Central Terminal Area	2,430,571,685	0	2,087,135	0	2,432,658,820
Airport Public Parking	29,149,282	0	362,926	1,961	29,514,169
Off-Airport Private Parking	25,987,239	0	950,792	0	26,938,031
Employee Parking	80,232,936	0	0	980	80,233,917
World Way West	98,261,763	0	0	981	98,262,744
Rental Car Facilities	320,415,966	0	192,219	3,163	320,611,348
Cargo Facilities	349,652,337	86,808,098	45,192,239	13,963,286	495,615,960
TOTALS	**3,334,271,208**	**86,808,098**	**48,785,310**	**13,970,371**	**3,483,834,988**

Source: CDM Smith 2019.

3.3.2 On-Airport Roadways and Parking Lots

Using the trip volumes in Table 5, distances traveled on airport roadways and in airport parking lots was estimated to be approximately 1.5 miles per one-way trip. This estimated distance was developed from reviewing airport roadways and parking lots in Google Earth Pro. The resulting total distance traveled is summarized in **Table 3-8**.

Table 3-8. On-Airport Roadway and Parking Lot Travel Distances at LAX in 2023 – BAU Scenario

	Vehicle Trips to or from LAX				Grand
Airport Destination	Light Duty	LHD	MHD	HHD	Total
Central Terminal Area	114,290,205	0	1,423,047	0	115,713,251
Airport Public Parking	1,487,208	0	175,609	949	1,663,766
Off-Airport Private Parking	1,261,516	0	750,625	0	2,012,142
Employee Parking	4,093,517	0	0	474	4,093,992
World Way West	5,013,355	0	0	474	5,013,830
Rental Car Facilities	16,630,586	0	144,164	2,372	16,777,123
Cargo Facilities	18,731,375	3,617,004	1,883,010	581,804	24,813,193
TOTALS	**161,507,763**	**3,617,004**	**4,376,455**	**586,074**	**170,087,296**

Source: CDM Smith 2019.

3.3.3 LAX 2023 BAU Traffic and Parking Emissions

Emission factors from the ARB EMFAC2017 model were used to estimate traffic and parking lot emissions. Emission factors were aggregated by speed and by model years were obtained for all technology categories. The light duty vehicle factors were developed from distance traveled (VMT)-weighted averages of the LDA, LDT1 and LDT2 vehicle types. Medium heavy-duty truck (MHD) factors were used for all shuttles and buses entering the airport. Cargo trucks factors were split among the light heavy duty (LDH), MDH, and heavy heavy duty (HHD) truck factors based on the VMT for each category entering the cargo ramps. were used for all cargo trucks entering the airport.

The emission factors were developed from EMFAC2017 emission inventories for the South Coast Air Basin portion of Los Angeles County for calendar year 2023. The total pollutant emission inventories (in tons per day) for each of the vehicle technology categories noted above (LDA, LDT1, LDT2, LHD, MDH, and HHD) were divided by the EMFAC VMT data for the corresponding vehicle technology category. The final 2023 emission factors, in grams per mile, for each pollutant

are summarized in **Table 3-9**. In addition, re-entrained road dust was estimated the method described in Chapter 13.2.1 Paved Roads in U.S. EPA's Compilation of Air Pollutant Emission Factors (AP-42).

Table 3-9. 2023 Emission Factors from EMFAC2017

Vehicle Category	2023 Calendar Year Emission Factors, grams/mile						
	CO	VOC	NOx	SOx	PM10[e]	PM2.5[e]	CO2e
LDAT[a]	1.052	0.106	0.075	0.003	0.047	0.020	291
LHD[b]	0.959	0.275	0.711	0.006	0.096	0.043	676
MHD[c]	0.606	0.061	1.440	0.010	0.149	0.065	1,083
HHD[d]	1.022	0.063	3.372	0.014	0.117	0.054	1,559
Paved Road Dust	--	--	--	--	0.090	0.022	--

Source: CDM Smith 2019

a. LDAT = Light Duty Autos and Trucks. Emission factors developed from LDA, LDT1, and LDT2 total emissions (South Coast portion of Los Angeles County in 2023).

b. LHD = Light-Heavy Duty vehicles. Emission factors developed from LDHT1 and LDHT2 total emissions (South Coast portion of Los Angeles County in 2023).

c. MHD = Medium Heavy-Duty vehicles. Emission factors developed from MDHT total emissions (South Coast portion of Los Angeles County in 2023).

d. HHD = Heavy-Heavy Duty vehicles. Emission factors developed from HHDT total emissions (South Coast portion of Los Angeles County in 2023).

e. PM10 and PM2.5 vehicle emission factors include exhaust, tire wear and brake wear.

The LAX 2023 total traffic emission inventories under the BAU scenario are summarized in **Table 3-10**.

Table 3-10. Grand Total - LAX 2023 BAU Traffic Emissions

Airport Destination	Pollutant Emissions, tpy						CO2e
	CO	VOC	NOx	SO2	PM10*	PM2.5*	MT/yr
Regional Emissions	4,004.85	420.93	472.51	11.85	190.89	80.52	1,104,735
On-Airport Emissions	194.61	20.34	25.29	0.59	9.50	4.01	55,153
Paved Road Dust	--	--	--	--	361.39	90.35	--
TOTAL Traffic-Related Emissions	**4,199.46**	**441.27**	**497.80**	**12.45**	**561.78**	**174.88**	**1,159,889**

Source: CDM Smith 2019.

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Section 4

LAX 2023 AQIM Potential Emission Reductions and Assumptions

4.1 Summary of 2023 AQIM Potential Emissions Reductions

A summary of the LAX 2023 AQIM emissions inventory as compared to the 2023 Business-As-Usual emissions inventory is presented in **Table 4-1**. The remainder of this section provides an overview of the input parameters and assumptions used to develop this inventory.

Table 4-1. LAX 2023 AQIM Potential Emission Reductions Compared to 2023 BAU Emissions

Airport Emission Source	Pollutant Emissions, tons per year						CO_2 (MT/yr)
	CO	VOC	NO_x	SO_x	PM_{10}	$PM_{2.5}$	
GSE BAU Emissions	1,307.15	20.62	150.69	0.25	3.58	3.11	25,222
GSE AQIM Emissions[a]	707.96	11.53	94.32	0.18	2.53	2.20	17.256
GSE AQIM Reductions	**599.19**	**9.09**	**56.17**	**0.07**	**1.04**	**0.90**	**7,966**
Traffic & Parking Under Business-As-Usual							
Regional Traffic	4,004.85	420.93	472.51	11.85	190.89	80.52	1,104,735
On-Airport Traffic & Parking	194.61	20.34	25.29	0.59	9.50	4.01	55,153
Paved Road Dust	---	---	---	---	361.39	90.35	---
Traffic & Parking Under AQIM (w Lamp)							
Regional Traffic	3,874.54	407.76	466.55	11.52	185.38	78.22	1,073,953
On-Airport Traffic & Parking	191.70	20.05	27.26	0.60	9.56	4.04	55,721
Paved Road Dust	---	---	---	---	350.17	87.54	---
Traffic & Parking Reductions w LAMP	**133.21**	**13.46**	**3.99**	**0.33**	**16.66**	**5.08**	**30,215**
Additional AQIM Traffic Emission Reductions	**131.14**	**6.64**	**7.58**	**0.02**	**0.25**	**0.10**	**3,078**
TOTAL AQIM Emission Reductions Relative to BAU Scenario	**863.54**	**29.19**	**67.74**	**0.42**	**17.95**	**6.08**	**41,259**

Source: CDM Smith 2019

f. Although emission estimates were calculated assuming an increase in electrification of GSE, operators would have the option of achieving airport-wide g/bhp-hr NOx+HC emission factor goals through other means, such as the implementation of ultra-low Nox or alternative fueled non-electric equipment.

4.2 LAX 2023 AQIM Ground Support Emissions

4.2.1 GSE Inventory, Activity, and Emissions Modeling

As noted in Section 2.2.1 above, GSE data collected under the LAX GSE Policy was used to develop the GSE equipment counts and emissions for the 2017 Baseline inventory. The same GSE equipment and fuel mix (see Table 2-2) was used as the starting point for developing the 2023 AQIM GSE emissions.

The California Air Resources Board (ARB) OFFROAD2017[10] model was used to obtain GSE emission factors, deterioration factors, load factors, and activity levels (hours/year/unit). These data were obtained from OFFROAD2017 by using the following model option: Los Angeles Sub Area of the South Coast Air Basin; 2023 Calendar Year; Adopted Rules – Exhaust Scenario; All Equipment Types; All Model Years; All Horsepower Bins; and All Fuel Types.

To estimate the model year for each piece of GSE, the 2023 average fleet age was assumed to be the same as the LAX 2017 GSE fleet age used in the 2017 LAX AQIM Emission Inventory. This was accomplished by increasing the model year for each GSE in the 2017 database by six (6) years (i.e., 2023 minus 2017).

Growth in GSE activity level (hours/year/unit) was developed utilizing the default OFFROAD per-equipment activities for each year. The model includes built-in factors for each equipment type detailing the total hours of operation per year per piece of equipment. Except for air start units, the model showed increasing or flat (no) growth across most equipment categories for each future scenario. This growth is used to account for growth expected at the airfield. GSE activity assumptions are listed in **Table 4-2**.

Table 4-2. OFFROAD GSE Activity per Unit of Equipment per Year

GSE Category	2017 Activity (hrs/yr)	2023 Activity (hrs/yr)[a]	Change Relative to 2017[a]
Air Conditioner	1,272	1,432	13%
Air Start	80	85	6%
Aircraft Tractor	320	348	9%
Backhoe	559	651	16%
Baggage Tractor	714	776	9%
Belt Loader	499	542	9%
Bobtail	429	466	9%
Cargo Loader	459	499	9%
Cargo Tractor	651	707	9%
Cart (Utility)	152	167	10%
Catering Truck	928	1,027	11%
Fork Lift	368	400	9%
Fuel Truck	83	92	11%
Generator	900	999	11%
Ground Power Unit	798	883	11%

[10] California Air Resources Board. 2017. OFFROAD2017 Web Database. Available at: https://www.arb.ca.gov/orion/ (accessed February 13, 2019); and California Air Resources Board. 2017. 2017 Off-Road Diesel Emission Factor Update for NOx and PM. Available a: https://www.arb.ca.gov/msei/ordiesel/ordas_ef_fcf_2017.pdf (accessed February 13, 2019).

Table 4-2. OFFROAD GSE Activity per Unit of Equipment per Year

GSE Category	2017 Activity (hrs/yr)	2023 Activity (hrs/yr)[a]	Change Relative to 2017[a]
Hydrant Truck	1,529	1,693	11%
Lavatory Cart	151	166	10%
Lavatory Truck	1,158	1,282	11%
Lift	404	439	9%
Other GSE	464	505	9%
Passenger Stand	47	51	9%
Push Back	320	348	9%
Service Truck	883	977	11%
Skid Steer Loader	325	379	16%
Sweeper	339	373	10%
Water Truck	311	344	11%

Sources: California Air Resources Board. OFFROAD 2017; CDM Smith 2019.

g. Change in activity from 2017 to 2023 includes both increases in equipment population and increases in activity per unit.

For the 2023 AQIM scenario, a practically achievable fleet-wide horsepower-weighted Nox +HC emission factor goal, in g/bhp-hr, was determined. Determination of this factor was based on historical precedent, current fleet makeup, current fleet-wide factor, and input pertaining to practical and economic feasibility from GSE stakeholders. The fleet-wide Nox+HC g/bhp-hr emission factor for the 2017 baseline inventory was calculated to be 2.24 g/bhp-hr Nox+HC. The fleet-wide emission factor goal for 2023 was determined to be 1.80 g/bhp-hr Nox+HC.

To determine the realistic fleet composition which would achieve the fleet-wide emission factor goal, the following procedure was followed. For each equipment type, the percent of that equipment which was electrified in the baseline was calculated and then normalized across all equipment types. For each equipment type, the count of electrified equipment was scaled up relative to the normalized baseline electrification value for that equipment type. This method of determining an effective future electrification of equipment allowed for equipment which was already heavily electrified under baseline conditions, such as baggage tractors, belt loaders, and carts, to be electrified more rapidly under the future conditions. Assumed effective electrification of equipment under the 2023 AQIM scenario, as compared to the 2017 Baseline, is presented in **Table 4-3**. ***Although emission estimates were calculated assuming an increase in electrification of GSE, operators would have the option of achieving airport-wide g/bhp-hr Nox+HC emission factor goals through other means, such as the implementation of ultra-low Nox or alternative fueled non-electric equipment.***

Table 4-3. Assumed Effective Electrification of Equipment

GSE Category	Total Count of Equipment	Baseline Count of Electrified Equipment	AQIM Effective Count of Electrified Equipment
Air Conditioner	41	14	21
Air Start	29	0	0
Aircraft Tractor	185	52	80
Baggage Tractor	744	331	508
Belt Loader	298	193	296
Bobtail	40	0	0
Cargo Loader	127	3	5
Cargo Tractor	168	111	168
Cart (Utility)	197	183	188
Catering Truck	91	1	2
Fork Lift	0	0	0
Fuel Truck	218	51	78
Generator	33	0	0
Ground Power Unit	4	0	0
Hydrant Truck	138	29	45
Lavatory Cart	9	0	0
Lavatory Truck	2	0	0
Lift	26	0	0
Other GSE	138	61	94
Passenger Stand	46	2	3
Push Back	75	1	2
Service Truck	41	17	26
Skid Steer Loader	47	0	0
Sweeper	16	3	5
Water Truck	4	0	0

Source: CDM Smith 2019

4.2.2 GSE Emission Modeling Results

The emission calculation results for LAX 2023 GSE by equipment type are presented in **Table 4-4**. **Table 4-5** summarizes the emissions for GSE by fuel type.

Table 4-4. GSE Emissions by Equipment Type at LAX in 2023 – AQIM Scenario[a]

GSE Type	Equipment Count	Pollutant Emissions, tons per year						CO2
		CO	VOC	Nox	SO_2	PM_{10}	$PM_{2.5}$	Tonnes/yr
Air Conditioner	41	3.60	0.41	1.89	0.01	0.09	0.08	457
Air Start	29	0.46	0.03	0.27	0.00	0.01	0.01	63
Aircraft Tractor	185	17.33	1.04	9.66	0.02	0.49	0.45	1,094
Baggage Tractor	744	351.93	2.89	32.92	0.04	0.60	0.51	4,755
Belt Loader	298	1.45	0.01	0.14	0.00	0.00	0.00	27
Bobtail	40	16.67	0.17	1.29	0.01	0.03	0.02	677
Cargo Loader	127	7.60	0.55	5.80	0.01	0.30	0.27	769
Cargo Tractor	168	0.00	0.00	0.00	0.00	0.00	0.00	0
Cart	197	13.96	0.21	0.18	0.00	0.01	0.01	91
Catering Truck	91	74.66	1.59	11.09	0.02	0.24	0.19	2,481
Fork Lift	218	14.55	0.12	3.35	0.00	0.04	0.04	177
Fuel Truck	33	1.16	0.06	0.55	0.00	0.01	0.01	80
Generator	4	5.87	0.06	0.40	0.00	0.01	0.00	103
Ground Power Unit	138	11.39	1.07	7.11	0.03	0.31	0.28	1,172
Hydrant Truck	9	54.55	0.63	5.43	0.01	0.11	0.08	1,687
Lavatory Cart	2	0.20	0.00	0.00	0.00	0.00	0.00	1
Lavatory Truck	26	23.80	0.45	2.61	0.01	0.05	0.03	827
Lift	138	24.17	0.66	4.26	0.00	0.07	0.06	523
Other	46	51.00	0.80	2.75	0.01	0.11	0.10	1,122
Other ORE	75	0.08	0.01	0.01	0.00	0.00	0.00	16
Passenger Stand	41	0.84	0.03	0.28	0.00	0.00	0.00	32
Service Truck	47	29.56	0.67	3.94	0.01	0.05	0.04	1,003
Sweeper	16	2.78	0.07	0.33	0.00	0.00	0.00	83
Water Truck	4	0.34	0.01	0.05	0.00	0.00	0.00	15
TOTALS	**2,717**	**707.96**	**11.53**	**94.32**	**0.18**	**2.53**	**2.20**	**17,256**

Source: CDM Smith 2019

h. Although emission estimates were calculated assuming an increase in electrification of GSE, operators would have the option of achieving airport-wide g/bhp-hr Nox+HC emission factor goals through other means, such as the implementation of ultra-low Nox or alternative fueled non-electric equipment.

Table 4-5. GSE Emissions by Fuel Type at LAX in 2023 – AQIM Scenario[a]

Fuel Type	Equipment Count	Pollutant Emissions, tons per year						CO2
		CO	VOC	Nox	SO_2	PM_{10}	$PM_{2.5}$	Tonnes/yr
Diesel	682	43.48	4.47	34.91	0.09	1.84	1.69	4,340
Gasoline	591	513.46	6.97	39.75	0.09	0.68	0.50	12,150
LPG/Propane	392	151.01	0.09	19.67	0.00	0.02	0.01	766
Electric	1,052	0.00	0.00	0.00	0.00	0.00	0.00	0
TOTALS	**2,717**	**707.96**	**11.53**	**94.32**	**0.18**	**2.53**	**2.20**	**17,256**

Source: CDM Smith 2019

a. Although emission estimates were calculated assuming an increase in electrification of GSE, operators would have the option of achieving airport-wide g/bhp-hr Nox+HC emission factor goals through other means, such as the implementation of ultra-low Nox or alternative fueled non-electric equipment.

4.3 LAX 2023 AQIM Traffic and Parking Emissions

The potential emission reductions for several key elements in the AQIM that address traffic emissions on analyzed in this subsection.

4.3.1 Potential Traffic and Parking Emissions with LAMP

4.3.1.1 Regional Airport-Related Trips and Miles Traveled with LAMP

Ground vehicles trips, including passenger cars, taxis, limos, shuttles, buses, and cargo trucks, traveling to or from LAX were estimated for 2023. The basis for the trip estimates and vehicle miles traveled was the LAX Landside Access Modernization Project (LAMP) Environmental Impact Report (EIR).[11] Specifically, the traffic data provided for the air quality impacts analysis for the 2024 With Project scenario was used as the initial basis. The trip volume was provided for various trip end points at the airport including the Central Terminal Area (CTA), rent-a-car (RAC) facilities located around LAX, cargo ramps at LAX, airport and tenant employee parking lots, and other passenger parking lots (both airport-owned and private lots). The roadway segments/endpoints presented in **Table 4-6** from the LAMP EIR With Project scenario to determine LAX trip volumes.

Table 4-6. AQIM Traffic Segments used to Identify Trips to/from LAX

LAWA Facility	Trip End-Point Category
Central Terminal Area	Central Terminal Area
Lot C – 96th Street Entrance	Airport Public Parking
Lot C – Entrace driveway on Westchester Pkwy	Airport Public Parking
Lot D – Employee Lot East & West	Employee Parking
World Way West – WAMA	World Way West
Cargo – Aviation & 104th St	Cargo Facilities
Cargo – Aviation & 111th St	Cargo Facilities
Cargo – Century Blvd. & Avion Dr	Cargo Facilities
Cargo – Century & Airport Blvd	Cargo Facilities
Cargo – Century & Postal Road	Cargo Facilities
Cargo – Imperial Hwy & Imperial Terminal	Cargo Facilities
Cargo – Imperial Hwy & California St	Cargo Facilities
Cargo – Imperial Hwy & Hughes Way	Cargo Facilities
Cargo – Imperial Hwy & Kilroy Center Dr	Cargo Facilities
Cargo – Imperial Hwy & Douglass St	Cargo Facilities
Cargo – Imperial Hwy & Driveway west of Aviation Blvd	Cargo Facilities
ITF West & Parking Structure	Airport Public Parking
ITF East & Parking Structure	Airport Public Parking
CONRAC	Rental Car Facilities
The Parking Spot	Off-Airport Private Parking
Valet Air & Park	Off-Airport Private Parking

[11] City of Los Angeles, 2017. Final Environmental Impact Report for Los Angeles International Airport (LAX) Landside Access Modernization Program. State Clearinghouse No. 2015021014. February.

Table 4-6. AQIM Traffic Segments used to Identify Trips to/from LAX

LAWA Facility	Trip End-Point Category
Wally Park	Off-Airport Private Parking
Westchester Parking Spot	Off-Airport Private Parking

Source: CDM Smith 2019.

The FAA's Terminal Area Forecast (TAF), dated February 2019, was used to scale trip volumes from the 2024 LAMP EIR With Project scenario to the 2023 scenario utilized in this inventory. The total trip volumes for each end point were scaled proportionally to the enplanements projected in the TAF for 2024 to the enplanements projected in the TAF for 2023.

The types of vehicles traveling to and from each trip end-point were segregated into light-duty vehicle (LDA, LDT1, and LDT2); light-heavy duty (LHD) truck; medium-heavy duty (MHD) truck; and heavy-heavy-duty (HHD) truck technology categories in the CARB EMFAC model). The total number of trips for vehicles traveling to and from LAX in 2023 is presented in **Table 4-7**.

Table 4-7. Estimated Total Vehicle Trips to LAX in 2023 – AQIM Scenario

	Vehicle Trips to or from LAX				Grand
Airport Destination	Light Duty	LHD	MHD	HHD	Total
Central Terminal Area	56,887,524	0	1,088,422	0	57,975,946
Airport Public Parking	18,086,520	0	333,545	633	18,420,698
Off-Airport Private Parking	492,875	0	997,530	0	1,490,405
Employee Parking	3,658,426	0	194,239	949	3,853,614
World Way West	3,342,399	0	0	316	3,342,716
Rental Car Facilities	10,501,142	0	0	316	10,501,459
Cargo Facilities	12,486,199	2,411,336	1,250,439	387,869	16,535,844
TOTALS	**105,455,086**	**2,411,336**	**3,864,176**	**390,083**	**112,120,681**

Source: CDM Smith 2019.

The average miles traveled to each of the trip end points by vehicle type were obtained from the traffic study conducted for the LAX Specific Plan Amendment Study EIR.[12] The trip volumes to each end point were multiplied by the average distance traveled for each end point and each vehicle type traveling to that end point to get total vehicle miles traveled (VMT) in 2023. The resulting VMT is presented in **Table 4-8**.

Table 4-8. Regional Miles Traveled for All Trips To or From LAX in 2023 – AQIM Scenario

	Vehicle Trips to or from LAX				Grand
Airport Destination	Light Duty	LHD	MHD	HHD	Total
Central Terminal Area	1,814,712,019	0	2,394,529	0	1,817,106,548
Airport Public Parking	531,743,682	0	1,033,990	1,961	532,779,633
Off-Airport Private Parking	15,229,838	0	1,895,308	0	17,125,145
Employee Parking	107,557,722	0	602,141	2,942	108,162,805
World Way West	98,266,544	0	0	981	98,267,525
Rental Car Facilities	303,483,011	0	0	633	303,483,644
Cargo Facilities	349,613,582	86,808,098	45,015,813	13,963,286	495,400,779
TOTALS	**3,220,606,399**	**86,808,098**	**50,941,780**	**13,969,802**	**3,372,326,079**

Source: CDM Smith 2019.

[12] City of Los Angeles, 2013. Final Environmental Impact Report for Los Angeles International Airport (LAX) Specific Plan Amendment Study. State Clearinghouse No. 1997061047. January.

4.3.1.2 On-Airport Roadways and Parking Lots with LAMP

Using the trip volumes in Table 5, distances traveled on airport roadways and in airport parking lots was estimated to be approximately 1.5 miles per one-way trip. This estimated distance was developed from reviewing airport roadways and parking lots in Google Earth Pro. The resulting total distance traveled is summarized in **Table 4-9**.

Table 4-9. On-Airport Roadway and Parking Lot Travel Distances at LAX in 2023 – AQIM Scenario

	Vehicle Trips to or from LAX				Grand
Airport Destination	**Light Duty**	**LHD**	**MHD**	**HHD**	**Total**
Central Terminal Area	85,331,286	0	1,632,633	0	86,963,920
Airport Public Parking	27,129,780	0	500,318	949	27,631,046
Off-Airport Private Parking	739,313	0	1,496,296	0	2,235,608
Employee Parking	5,487,639	0	291,358	1,423	5,780,421
World Way West	5,013,599	0	0	474	5,014,074
Rental Car Facilities	15,751,713	0	0	474	15,752,188
Cargo Facilities	18,729,299	3,617,004	1,875,659	581,804	24,803,766
TOTALS	**158,182,629**	**3,617,004**	**5,796,264**	**585,125**	**168,181,022**

Source: CDM Smith 2019.

4.3.1.3 LAX Traffic and Parking Emissions with LAMP

Emission factors from the ARB EMFAC2017 model were used to estimate traffic and parking lot emissions. Emission factors were aggregated by speed and by model years were obtained for all technology categories. The light duty vehicle factors were developed from distance traveled (VMT)-weighted averages of the LDA, LDT1 and LDT2 vehicle types. Medium heavy-duty truck (MHD) factors were used for all shuttles and buses entering the airport. Cargo trucks factors were split among the light heavy duty (LDH), MDH, and heavy heavy duty (HHD) truck factors based on the VMT for each category entering the cargo ramps. Were used for all cargo trucks entering the airport.

The emission factors were developed from EMFAC2017 emission inventories for the South Coast Air Basin portion of Los Angeles County for calendar year 2023. The total pollutant emission inventories (in tons per day) for each of the vehicle technology categories noted above (LDA, LDT1, LDT2, LHD, MDH, and HHD) were divided by the EMFAC VMT data for the corresponding vehicle technology category. The final 2023 emission factors, in grams per mile, for each pollutant are summarized in **Table 4-10**. In addition, re-entrained road dust was estimated the method described in Chapter 13.2.1 Paved Roads in U.S. EPA's Compilation of Air Pollutant Emission Factors (AP-42).

Table 4-10. 2023 Emission Factors from EMFAC2017

Vehicle	2023 Calendar Year Emission Factors, grams/mile						
Category	**CO**	**VOC**	**Nox**	**SOx**	**PM10[e]**	**PM2.5[e]**	**CO2e**
LDAT[a]	1.052	0.106	0.075	0.003	0.047	0.020	291
LHD[b]	0.959	0.275	0.711	0.006	0.096	0.043	676
MHD[c]	0.606	0.061	1.440	0.010	0.149	0.065	1,083
HHD[d]	1.022	0.063	3.372	0.014	0.117	0.054	1,559
Paved Road Dust	--	--	--	--	0.090	0.022	--

Source: CDM Smith 2019

a. LDAT = Light Duty Autos and Trucks. Emission factors developed from LDA, LDT1, and LDT2 total emissions (South Coast portion of Los Angeles County in 2023).

b. LHD = Light-Heavy Duty vehicles. Emission factors developed from LDHT1 and LDHT2 total emissions (South Coast portion of Los Angeles County in 2023).
c. MHD = Medium Heavy-Duty vehicles. Emission factors developed from MDHT total emissions (South Coast portion of Los Angeles County in 2023).
d. HHD = Heavy-Heavy Duty vehicles. Emission factors developed from HHDT total emissions (South Coast portion of Los Angeles County in 2023).
e. PM10 and PM2.5 vehicle emission factors include exhaust, tire wear and brake wear.

The LAX 2023 total traffic emission inventories under "with LAMP" AQIM scenario are summarized in **Table 4-11**.

Table 4-11. Grand Total – LAX 2023 AQIM Traffic Emissions (With LAMP)

	Pollutant Emissions, tpy						CO2e
Airport Destination	**CO**	**VOC**	**NOx**	**SO2**	**PM10***	**PM2.5***	**MT/yr**
Regional Emissions	3,874.54	407.76	466.55	11.52	185.38	78.22	1,073,953
On-Airport Emissions	191.70	20.05	27.26	0.60	9.56	4.04	55,721
Paved Road Dust					350.17	87.54	
TOTAL Traffic-Related Emissions	**4,066.25**	**427.81**	**493.81**	**12.12**	**545.12**	**169.80**	**1,129,674**
Reductions from 2023 BAU	**133.21**	**13.46**	**3.99**	**0.33**	**16.66**	**5.08**	**30,215**

Source: CDM Smith 2019.

4.3.2 Potential Traffic Emission Reductions from Other AQIM Programs

The existing LAX FlyAway, Employee Rideshare, and Alternative Fuels Policy as well as AQIM LAWA clean fleet and smart parking policies are expected to generate additional emission reductions from use of cleaner vehicles and reduced vehicle miles traveled and idling time. The specific measures discussed in this section below are those for which emission reductions were quantified.

4.3.2.1 Alternative Fuel Vehicle Programs

The LAX Alternative Fuel Vehicle Policy and Incentive will require operators of medium- and heavy-duty vehicles over 8,500 lbs gross vehicle weight rating (GVRW) to utilize clean fueled vehicles which meet CARB's LEV III or Optional Low-NOx standards and use engines that are no older than thirteen (13) model years. Vehicle data, such as GVRW, vehicle description, engine model year, vehicle use designations, and current vehicle compliance, was collected under the LAX Alternative Fuel Vehicle Policy which was used as a basis to develop vehicle emissions based on grams per mile factors corresponding to a vehicle's CARB EMFAC technology category or specific engine data where available.[13]

To estimate the model year for each reported vehicle, the 2023 average fleet age was assumed to be the same as the 2017 LAX Alternative Fuel Vehicle Surveyed fleet age. This was accomplished by increasing the model year for each vehicle engine in the 2017 survey database by six (6) years (i.e., 2023 minus 2017).

[13] CARB maintains a database of on-road certified engines for Passenger Cars, Light-Duty Trucks, Medium-Duty Vehicles, Heavy-Duty Engines, and other vehicle types which includes certified pollutant emission rates. Where identifying engine data was included in the Alternative Fuel Vehicle Policy survey, engines were matched to corresponding CARB certified engines for the purpose of determining emission rates. The database is available at: https://ww3.arb.ca.gov/msprog/onroad/cert/cert.php.

For the purposes of calculating emissions, vehicles were assigned daily VMT based on EMFAC default mileage. Vehicles designated for use by airlines, catering services, LAWA, maintenance, passenger vans, and scheduled services were assumed to travel an average of five (5) miles per day.

Based on the AQIM targets, by 2023 all vehicles under the Alternative Fuel Vehicle Programs will be in compliance with the program. Thus, vehicles which would otherwise have emission rates exceeding CARB's LEV III standards would be required to, at a minimum, meet these standards. An estimate of the benefits (reductions) in emissions was calculated as the difference between the fleet emissions without this requirement, versus the fleet emissions with this requirement and is presented in **Table 4-12**.

4.3.2.1 Alternative Fuel Vehicle Incentive Program

The LAX Alternative Fuel Vehicle Incentive Program will implement one-time incentive opportunity to replace conventionally fueled heavy-duty vehicles with zero or near-zero emission vehicles at LAX. The program will distribute $500,000 in funding to applicants based on the "incremental cost" of the zero or near-zero emission vehicles as compared to conventionally-fueled equivalents. This program is anticipated to replace up to 20 conventionally fueled vehicles to zero or near-zero emission alternatives by December 31, 2021.

Benefits associated with this measure were calculated as the emissions benefits of the zero or near-zero emission equipment beyond those benefits already achieved by the Alternative Fuel Vehicle Program. Emissions without the program were calculated assuming compliance with the Alternative Fuel Vehicle Program-required LEV III SULEV200 emission standards. Emissions with the program were calculated assuming, as minimum, compliance with CARB's optional low-NOx standard of 0.02 g/bhp-hr. Vehicle VMT and additional criteria pollutant emission rates were based on CARB-certified engine specifications committed for purchase by program applicants. An estimate of the benefits (reductions) in emissions is presented in **Table 4-12**.

4.3.2.2 Light-Duty Vehicle Program

The LAX Clean Fleet Light-Duty Vehicle Program would achieve 25 percent light-duty LAWA-owned vehicle fleet electrification by 2023. CARB's EMFAC LDA technology category emission rates were used as a basis for emission calculations. LAWA-owned light-duty vehicles were assumed to travel and average of five (5) miles per day. Emission reductions associated with this measure were calculated as a reduction in annual emissions associated with 25 percent of LAWA's light-duty vehicle fleet. An estimate of the benefits (reductions) in emissions is presented in **Table 4-12**.

4.3.2.3 Zero-Emission Bus Program

The LAX Clean Fleet Zero-Emission Bus Program would achieve 20 percent LAWA-owned bus fleet electrification by 2023. CARB's EMFAC UBUS technology category aggregated VMT and emission rates were used as a basis for emission calculations. Emission reductions associated with this measure were calculated as a reduction in annual emissions associated with 20 percent of LAWA's bus fleet. An estimate of the benefits (reductions) in emissions is presented in **Table 4-12**.

4.3.2.4 Smart Parking Systems at LAX

The AQIM targets for smart parking include installation of smart parking systems in all new parking garages and developing an implementation schedule for future installation of smart parking systems in the existing parking garages. By 2023, it is anticipated that all new public parking garages and 50 percent of CTA public parking will benefit from smart parking. Benefits associated with this measure were calculated assuming emissions low speed (5 miles per hour) emission factors for the aggregated light-duty vehicle (LDA, LDT1, and LDT2) technology categories in the CARB EMFAC model. Smart parking was assumed to reduce an average of one (1) minute of low speed parking time per vehicle park. An estimate of the benefits (reductions) in emissions is presented in **Table 4-12**.

Table 4-12. Additional Emission Reductions

	Pollutant Emissions, tpy						CO2e
	CO	VOC	NOx	SO2	PM10*	PM2.5*	MT/yr
Alternative Fuel Vehicle Program	94.92	6.46	6.87	NA	0.09	0.01	NA
Alternative Fuel Vehicle Incentive Program	-2.59	-0.08	0.11	NA	0.04	0.04	NA
Light-Duty Vehicle Program	0.16	0.01	0.01	<0.01	0.01	<0.01	42
Zero-Emission Bus Program	35.05	0.06	0.35	<0.01	0.08	0.03	1,476
Smart Parking Systems	3.60	0.19	0.24	0.02	0.03	0.02	1,560
Reductions from 2023 BAU	**131.14**	**6.64**	**7.58**	**0.02**	**0.25**	**0.1**	**3,078**

Source: CDM Smith 2019.

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Section 5

LAX 2031 Business-As-Usual Emissions Inventory and Assumptions

5.1 Summary of 2031 Business-As-Usual Emissions Inventory

A summary of the LAX 2031 business-as-usual emissions inventory is presented in **Table 5-1**.[14] The emissions by major source categories are shown graphically on **Figure 5-1**. The remainder of this section provides an overview of the input parameters and assumptions used to develop this inventory.

Table 5-1. LAX 2031 Business-As-Usual Emissions Inventory

Airport Emission Source	Pollutant Emissions, tons per year						CO_2 (MT/yr)
	CO	VOC	NO_x	SO_x	PM_{10}	$PM_{2.5}$	
Ground Support Equipment Total	**1,436.51**	**16.41**	**121.31**	**0.31**	**2.31**	**1.91**	**27,671**
Traffic & Parking							
Regional Traffic	3,348.36	332.48	368.39	11.39	221.28	91.72	1,061,253
On-Airport Traffic & Parking	162.61	16.07	21.11	0.57	11.02	4.57	53,103
Paved Road Dust	---	---	---	---	424.91	106.23	---
Traffic & Parking Total	**3,510.97**	**348.55**	**389.50**	**11.96**	**657.21**	**202.52**	**1,114,356**
GRAND TOTAL	**4,947.48**	**364.96**	**510.81**	**12.27**	**659.52**	**204.43**	**1,142,027**

Source: CDM Smith 2019

5.2 LAX 2031 BAU Ground Support Emissions

5.2.1 GSE Inventory, Activity, and Emissions Modeling

As noted in Section 2.2.1 above, GSE data collected under the LAX GSE Policy was used to develop the GSE equipment counts and emissions for the 2017 Baseline inventory. The same GSE equipment and fuel mix (see Table 2-2) was used as the starting point for developing the 2031 BAU GSE emissions.

The California Air Resources Board (ARB) OFFROAD2017[15] model was used to obtain GSE emission factors, deterioration factors, load factors, and activity levels (hours/year/unit). These data were obtained from OFFROAD2017 by using the following model option: Los Angeles Sub

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[14] Emissions of criteria pollutants (carbon monoxide, CO; volatile organic compounds, VOC, oxides of nitrogen, NOx, sulfur oxides, SOx, respirable particulate matter, PM-10; and fine particulate matter, PM-2.5) and the major greenhouse gas pollutant carbon dioxide (CO_2) are presented in this report. Criteria pollutant emissions are presented in short tons per year, while CO_2 emissions are presented in metric tons (tonnes) per year.

[15] California Air Resources Board. 2017. OFFROAD2017 Web Database. Available at: https://www.arb.ca.gov/orion/ (accessed February 13, 2019); and California Air Resources Board. 2017. 2017 Off-Road Diesel Emission Factor Update for NOx and PM. Available a: https://www.arb.ca.gov/msei/ordiesel/ordas_ef_fcf_2017.pdf (accessed February 13, 2019).

Area of the South Coast Air Basin; 2031 Calendar Year; Adopted Rules – Exhaust Scenario; All Equipment Types; All Model Years; All Horsepower Bins; and All Fuel Types.

To estimate the model year for each piece of GSE, the 2031 average fleet age was assumed to be the same as the LAX 2017 GSE fleet age used in the 2017 LAX AQIM Emission Inventory. This was accomplished by increasing the model year for each GSE in the 2017 database by fourteen (14) years (i.e., 2031 minus 2017).

Growth in GSE activity level (hours/year/unit) was developed utilizing the default OFFROAD per-equipment activities for each year. The model includes built-in factors for each equipment type detailing the total hours of operation per year per piece of equipment. Except for air start units, the model showed increasing or flat (no) growth across most equipment categories for each future scenario. This growth is used to account for growth expected at the airfield. GSE activity assumptions are listed in **Table 5-2**.

Table 5-2. OFFROAD GSE Activity per Unit of Equipment per Year

GSE Category	2017 Activity (hrs/yr)	2031 Activity (hrs/yr)[a]	Change Relative to 2017[a]
Air Conditioner	1,272	1,678	32%
Air Start	80	85	6%
Aircraft Tractor	320	385	20%
Backhoe	559	703	26%
Baggage Tractor	714	858	20%
Belt Loader	499	600	20%
Bobtail	429	515	20%
Cargo Loader	459	552	20%
Cargo Tractor	651	782	20%
Cart (Utility)	152	182	20%
Catering Truck	928	1,123	21%
Fork Lift	368	443	20%
Fuel Truck	83	101	21%
Generator	900	1,089	21%
Ground Power Unit	798	965	21%
Hydrant Truck	1,529	1,851	21%
Lavatory Cart	151	182	21%
Lavatory Truck	1,158	1,401	21%
Lift	404	485	20%
Other GSE	464	558	20%
Passenger Stand	47	56	20%
Push Back	320	385	20%
Service Truck	883	1,068	21%
Skid Steer Loader	325	409	26%
Sweeper	339	411	21%
Water Truck	311	376	21%

Sources: California Air Resources Board. OFFROAD 2017; CDM Smith 2019.
a. Change in activity from 2017 to 2031 includes both increases in equipment population and increases in activity per unit.

5.2.2 GSE Emission Modeling Results

The emission calculation results for LAX 2031 GSE by equipment type are presented in **Table 5-3**. **Table 5-4** summarizes the emissions for GSE by fuel type.

Table 5-3. GSE Emissions by Equipment Type at LAX in 2031 – BAU Scenario

GSE Type	Equipment Count	Pollutant Emissions, tons per year						CO2
		CO	VOC	NOx	SO_2	PM_{10}	$PM_{2.5}$	Tonnes/yr
Air Conditioner	41	5.88	0.44	0.92	0.02	0.06	0.05	741
Air Start	29	0.37	0.03	0.12	0.00	0.00	0.00	61
Aircraft Tractor	185	24.18	1.53	6.93	0.03	0.46	0.42	1,433
Baggage Tractor	744	678.18	4.89	53.99	0.07	0.57	0.46	9,221
Belt Loader	298	83.78	0.78	6.75	0.01	0.09	0.07	1,600
Bobtail	40	18.26	0.19	1.40	0.00	0.03	0.02	670
Cargo Loader	127	8.42	0.38	3.10	0.01	0.15	0.14	849
Cargo Tractor	168	244.52	2.03	10.42	0.01	0.12	0.09	1,962
Cart	197	24.73	0.37	0.31	0.00	0.02	0.01	161
Catering Truck	91	81.07	1.35	10.53	0.02	0.18	0.13	2,747
Fork Lift	218	18.93	0.10	4.32	0.00	0.04	0.04	217
Fuel Truck	33	1.39	0.06	0.35	0.00	0.01	0.00	85
Generator	4	6.39	0.07	0.44	0.00	0.01	0.00	109
Ground Power Unit	138	14.70	1.00	3.03	0.04	0.15	0.14	1,571
Hydrant Truck	9	59.64	0.66	5.19	0.02	0.12	0.09	1,848
Lavatory Cart	2	0.20	0.00	0.00	0.00	0.00	0.00	1
Lavatory Truck	26	25.93	0.34	2.25	0.01	0.05	0.04	895
Lift	138	45.01	0.83	4.93	0.01	0.09	0.08	948
Other	46	57.23	0.72	2.19	0.01	0.06	0.04	1,276
Other ORE	75	0.06	0.01	0.00	0.00	0.00	0.00	13
Passenger Stand	41	1.51	0.04	0.36	0.00	0.00	0.00	57
Service Truck	47	32.59	0.57	3.41	0.01	0.06	0.04	1,088
Sweeper	16	3.12	0.04	0.29	0.00	0.00	0.00	101
Water Truck	4	0.37	0.00	0.03	0.00	0.00	0.00	15
TOTALS	**2,717**	**1,436.47**	**16.41**	**121.26**	**0.28**	**2.27**	**1.88**	**27,671**

Source: CDM Smith 2019

Table 5-4. GSE Emissions by Fuel Type at LAX in 2031 – BAU Scenario

Fuel Type	Equipment Count	Pollutant Emissions, tons per year						CO2
		CO	VOC	NOx	SO_2	PM_{10}	$PM_{2.5}$	Tonnes/yr
Diesel	682	58.35	4.43	22.66	0.13	1.12	1.03	6,086
Gasoline	591	1,075.42	11.86	65.44	0.15	1.13	0.84	20,047
LPG/Propane	392	302.70	0.12	33.16	0.00	0.02	0.02	1,539
Electric	1,052	0.00	0.00	0.00	0.00	0.00	0.00	0
TOTALS	**2,717**	**1,436.47**	**16.41**	**121.26**	**0.28**	**2.27**	**1.88**	**27,671**

Source: CDM Smith 2019

5.3 LAX 2031 BAU Traffic and Parking Emissions

5.3.1 Regional Airport-Related Trips and Miles Traveled

Ground vehicles trips, including passenger cars, taxis, limos, shuttles, buses, and cargo trucks, traveling to or from LAX were estimated for 2031. The basis for the trip estimates and vehicle miles traveled was the LAX Landside Access Modernization Project (LAMP) Environmental Impact Report (EIR).[16] Specifically, the traffic data provided for the air quality impacts analysis for the 2024 Without Project scenario was used as the initial basis. The trip volume was provided for various trip end points at the airport including the Central Terminal Area (CTA), rent-a-car (RAC) facilities located around LAX, cargo ramps at LAX, airport and tenant employee parking lots, and other passenger parking lots (both airport-owned and private lots). The roadway segments/endpoints presented in **Table 5-5** from the LAMP EIR Without Project scenario to determine LAX trip volumes.

Table 5-5. BAU Traffic Segments used to Identify Trips to/from LAX

LAWA Facility	Trip End-Point Category
Central Terminal Area	Central Terminal Area
Lot C - 96th Street Entrance	Airport Public Parking
Lot C - Existing driveway on Jenny / Employee Lot South Dwy on Jenny	Airport Public Parking
Lot C - Entrace driveway on Westchester Pkwy	Airport Public Parking
Lot E	Employee Parking
Lot D - Employee Lot East & West	Employee Parking
World Way West - WAMA	World Way West
Cargo - Aviation & 104th St	Cargo Facilities
Cargo - Aviation & 111th St	Cargo Facilities
Cargo - Century Blvd. & Avion Dr	Cargo Facilities
Cargo - Century & Airport Blvd	Cargo Facilities
Cargo - Century & Postal Road	Cargo Facilities
Cargo - Imperial Hwy & Imperial Terminal	Cargo Facilities
Cargo - Imperial Hwy & California St	Cargo Facilities
Cargo - Imperial Hwy & Hughes Way	Cargo Facilities
Cargo - Imperial Hwy & Unsignalized Entrance e/o Hughes	Cargo Facilities
Cargo - Imperial Hwy & Kilroy Center Dr	Cargo Facilities
Cargo - Imperial Hwy & Douglass St	Cargo Facilities
Cargo - Imperial Hwy & Driveway west of Aviation Blvd	Cargo Facilities
Rental Car - Advantage	Rental Car Facilities
Rental Car - Alamo & National	Rental Car Facilities
Rental Car - Avis	Rental Car Facilities
Rental Car - Budget	Rental Car Facilities
Rental Car - Dollar	Rental Car Facilities
Rental Car - Enterprise	Rental Car Facilities

[16] City of Los Angeles, 2017. Final Environmental Impact Report for Los Angeles International Airport (LAX) Landside Access Modernization Program. State Clearinghouse No. 2015021014. February.

Table 5-5. BAU Traffic Segments used to Identify Trips to/from LAX

LAWA Facility	Trip End-Point Category
Rental Car - Fox & Payless	Rental Car Facilities
Rental Car - Hertz	Rental Car Facilities
Rental Car - Thrifty	Rental Car Facilities
The Parking Spot	Off-Airport Private Parking
Park One	Off-Airport Private Parking
Valet Air & Park	Off-Airport Private Parking
Wally Park	Off-Airport Private Parking
Westchester Parking Spot	Off-Airport Private Parking

Source: CDM Smith 2019.

The FAA's Terminal Area Forecast (TAF), dated February 2019, was used to scale trip volumes from the 2024 LAMP EIR Without Project scenario to the 2031 scenario utilized in this inventory. The total trip volumes for each end point were scaled proportionally to the enplanements projected in the TAF for 2024 to the enplanements projected in the TAF for 2031.

The types of vehicles traveling to and from each trip end-point were segregated into light-duty vehicle (LDA, LDT1, and LDT2); light-heavy duty (LHD) truck; medium-heavy duty (MHD) truck; and heavy-heavy-duty (HHD) truck technology categories in the CARB EMFAC model). The total number of trips for vehicles traveling to and from LAX in 2031 is presented in **Table 5-6**.

Table 5-6. Estimated Total Vehicle Trips to LAX in 2031 – BAU Scenario

	Vehicle Trips to or from LAX				Grand
Airport Destination	**Light Duty**	**LHD**	**MHD**	**HHD**	**Total**
Central Terminal Area	89,584,847	0	1,115,436	0	90,700,283
Airport Public Parking	1,165,728	0	137,649	744	1,304,121
Off-Airport Private Parking	988,823	0	588,367	0	1,577,190
Employee Parking	3,208,649	0	0	372	3,209,020
World Way West	3,929,651	0	0	372	3,930,023
Rental Car Facilities	13,035,663	0	113,001	1,859	13,150,523
Cargo Facilities	14,682,338	2,835,140	1,475,972	456,039	19,449,489
TOTALS	**126,595,699**	**2,835,140**	**3,430,426**	**459,386**	**133,320,651**

Source: CDM Smith 2019.

The average miles traveled to each of the trip end points by vehicle type were obtained from the traffic study conducted for the LAX Specific Plan Amendment Study EIR.[17] The trip volumes to each end point were multiplied by the average distance traveled for each end point and each vehicle type traveling to that end point to get total vehicle miles traveled (VMT) in 2031. The resulting VMT is presented in **Table 5-7**.

[17] City of Los Angeles, 2013. Final Environmental Impact Report for Los Angeles International Airport (LAX) Specific Plan Amendment Study. State Clearinghouse No. 1997061047. January.

Table 5-7. Regional Miles Traveled for All Trips To or From LAX in 2031 – BAU Scenario

	Vehicle Trips to or from LAX				Grand
Airport Destination	Light Duty	LHD	MHD	HHD	Total
Central Terminal Area	2,857,756,627	0	2,453,960	0	2,860,210,587
Airport Public Parking	34,272,412	0	426,712	2,306	34,701,429
Off-Airport Private Parking	30,554,625	0	1,117,898	0	31,672,523
Employee Parking	94,334,270	0	0	1,153	94,335,423
World Way West	115,531,752	0	0	1,153	115,532,905
Rental Car Facilities	376,730,650	0	226,002	3,719	376,960,371
Cargo Facilities	411,105,457	102,065,049	53,134,997	16,417,402	582,722,905
TOTALS	**3,920,285,792**	**102,065,049**	**57,359,569**	**16,425,732**	**4,096,136,142**

Source: CDM Smith 2019.

5.3.2 On-Airport Roadways and Parking Lots

Using the trip volumes in Table 5, distances traveled on airport roadways and in airport parking lots was estimated to be approximately 1.5 miles per one-way trip. This estimated distance was developed from reviewing airport roadways and parking lots in Google Earth Pro. The resulting total distance traveled is summarized in **Table 5-8**.

Table 5-8. On-Airport Roadway and Parking Lot Travel Distances at LAX in 2031 – BAU Scenario

	Vehicle Trips to or from LAX				Grand
Airport Destination	Light Duty	LHD	MHD	HHD	Total
Central Terminal Area	134,377,271	0	1,673,154	0	136,050,425
Airport Public Parking	1,748,592	0	206,473	1,116	1,956,182
Off-Airport Private Parking	1,483,234	0	882,551	0	2,365,785
Employee Parking	4,812,973	0	0	558	4,813,531
World Way West	5,894,477	0	0	558	5,895,035
Rental Car Facilities	19,553,494	0	169,502	2,789	19,725,785
Cargo Facilities	22,023,507	4,252,710	2,213,958	684,058	29,174,234
TOTALS	**189,893,548**	**4,252,710**	**5,145,639**	**689,079**	**199,980,976**

Source: CDM Smith 2019.

5.3.3 LAX Traffic and Parking Emissions

Emission factors from the ARB EMFAC2017 model were used to estimate traffic and parking lot emissions. Emission factors were aggregated by speed and by model years were obtained for all technology categories. The light duty vehicle factors were developed from distance traveled (VMT)-weighted averages of the LDA, LDT1 and LDT2 vehicle types. Medium heavy-duty truck (MHD) factors were used for all shuttles and buses entering the airport. Cargo trucks factors were split among the light heavy duty (LDH), MDH, and heavy heavy duty (HHD) truck factors based on the VMT for each category entering the cargo ramps. were used for all cargo trucks entering the airport.

The emission factors were developed from EMFAC2017 emission inventories for the South Coast Air Basin portion of Los Angeles County for calendar year 2031. The total pollutant emission inventories (in tons per day) for each of the vehicle technology categories noted above (LDA, LDT1, LDT2, LHD, MDH, and HHD) were divided by the EMFAC VMT data for the corresponding vehicle technology category. The final 2031 emission factors, in grams per mile, for each pollutant are summarized in **Table 5-9**. In addition, re-entrained road dust was estimated the method

described in Chapter 13.2.1 Paved Roads in U.S. EPA's Compilation of Air Pollutant Emission Factors (AP-42).

Table 5-9. 2031 Emission Factors from EMFAC2017

Vehicle Category	2031 Calendar Year Emission Factors, grams/mile						
	CO	VOC	NOx	SOx	PM10[e]	PM2.5[e]	CO2e
LDAT[a]	0.071	0.750	0.043	0.002	0.046	0.019	236
LHD[b]	0.183	0.579	0.297	0.006	0.095	0.042	583
MHD[c]	0.042	0.381	1.479	0.009	0.149	0.065	947
HHD[d]	0.059	1.085	3.153	0.011	0.116	0.053	1,336
Paved Road Dust	--	--	--	--	0.090	0.022	--

Source: CDM Smith 2019

a. LDAT = Light Duty Autos and Trucks. Emission factors developed from LDA, LDT1, and LDT2 total emissions (South Coast portion of Los Angeles County in 2031).

b. LHD = Light-Heavy Duty vehicles. Emission factors developed from LDHT1 and LDHT2 total emissions (South Coast portion of Los Angeles County in 2031).

c. MHD = Medium Heavy-Duty vehicles. Emission factors developed from MDHT total emissions (South Coast portion of Los Angeles County in 2031).

d. HHD = Heavy-Heavy Duty vehicles. Emission factors developed from HHDT total emissions (South Coast portion of Los Angeles County in 2031).

e. PM10 and PM2.5 vehicle emission factors include exhaust, tire wear and brake wear.

The LAX 2031 total traffic emission inventories under the BAU scenario are summarized in **Table 5-10**.

Table 5-10. Grand Total - LAX 2031 BAU Traffic Emissions

Airport Destination	Pollutant Emissions, tpy						CO2e
	CO	VOC	NOx	SO2	PM10*	PM2.5*	MT/yr
Regional Emissions	3,348.36	332.48	368.39	11.39	221.28	91.72	1,061,253
On-Airport Emissions	162.61	16.07	21.11	0.57	11.02	4.57	53,103
Paved Road Dust	--	--	--	--	361.39	90.35	--
TOTAL Traffic-Related Emissions	**3,510.98**	**348.55**	**389.50**	**11.96**	**657.20**	**202.52**	**1,114,356**

Source: CDM Smith 2019.

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Section 6

LAX 2031 AQIM Potential Emission Reductions and Assumptions

6.1 Summary of 2031 AQIM Potential Emissions Reductions

A summary of the LAX 2031 AQIM emissions inventory as compared to the 2031 Business-As-Usual emissions inventory is presented in **Table 6-1**. The remainder of this section provides an overview of the input parameters and assumptions used to develop this inventory.

Table 6-1. LAX 2031 AQIM Potential Emission Reductions Compared to 2031 BAU Emissions

Airport Emission Source	Pollutant Emissions, tons per year						CO_2 (MT/yr)
	CO	VOC	NO_x	SO_x	PM_{10}	$PM_{2.5}$	
GSE BAU Emissions	1,436.51	16.41	121.31	0.31	2.31	1.91	27,671
GSE AQIM Emissions[a]	352.70	5.29	35.15	0.10	0.80	0.64	10,642
GSE Benefits	**1,083.81**	**11.12**	**86.16**	**0.21**	**1.51**	**1.27**	**17,029**
AQIM Traffic-Related Emission Reductions	**480.3**	**9.01**	**11.15**	**0.02**	**2.83**	**1.23**	**8,871**
TOTAL PROGRAM BENEFITS	**1,564.11**	**20.13**	**97.31**	**0.23**	**4.34**	**2.50**	**25,900**

Source: CDM Smith 2019

a. Although emission estimates were calculated assuming an increase in electrification of GSE, operators would have the option of achieving airport-wide g/bhp-hr NOx+HC emission factor goals through other means, such as the implementation of ultra-low NOx or alternative fueled non-electric equipment.

6.2 LAX 2031 AQIM Ground Support Emissions

6.2.1 GSE Inventory, Activity, and Emissions Modeling

As noted in Section 2.2.1 above, GSE data collected under the LAX GSE Policy was used to develop the GSE equipment counts and emissions for the 2017 Baseline inventory. The same GSE equipment and fuel mix (see Table 2-2) was used as the starting point for developing the 2031 AQIM GSE emissions.

The California Air Resources Board (ARB) OFFROAD2017[18] model was used to obtain GSE emission factors, deterioration factors, load factors, and activity levels (hours/year/unit). These data were obtained from OFFROAD2017 by using the following model option: Los Angeles Sub Area of the South Coast Air Basin; 2031 Calendar Year; Adopted Rules – Exhaust Scenario; All Equipment Types; All Model Years; All Horsepower Bins; and All Fuel Types.

To estimate the model year for each piece of GSE, the 2031 average fleet age was assumed to be the same as the LAX 2017 GSE fleet age used in the 2017 LAX AQIM Emission Inventory. This was

[18] California Air Resources Board. 2017. OFFROAD2017 Web Database. Available at: https://www.arb.ca.gov/orion/ (accessed February 13, 2019); and California Air Resources Board. 2017. 2017 Off-Road Diesel Emission Factor Update for NOx and PM. Available a: https://www.arb.ca.gov/msei/ordiesel/ordas_ef_fcf_2017.pdf (accessed February 13, 2019).

accomplished by increasing the model year for each GSE in the 2017 database by fourteen (14) years (i.e., 2031 minus 2017).

Growth in GSE activity level (hours/year/unit) was developed utilizing the default OFFROAD per-equipment activities for each year. The model includes built-in factors for each equipment type detailing the total hours of operation per year per piece of equipment. Except for air start units, the model showed increasing or flat (no) growth across most equipment categories for each future scenario. This growth is used to account for growth expected at the airfield. GSE activity assumptions are listed in **Table 6-2**.

Table 6-2. OFFROAD GSE Activity per Unit of Equipment per Year

GSE Category	2017 Activity (hrs/yr)	2031 Activity (hrs/yr)[a]	Change Relative to 2017[a]
Air Conditioner	1,272	1,678	32%
Air Start	80	85	6%
Aircraft Tractor	320	385	20%
Backhoe	559	703	26%
Baggage Tractor	714	858	20%
Belt Loader	499	600	20%
Bobtail	429	515	20%
Cargo Loader	459	552	20%
Cargo Tractor	651	782	20%
Cart (Utility)	152	182	20%
Catering Truck	928	1,123	21%
Fork Lift	368	443	20%
Fuel Truck	83	101	21%
Generator	900	1,089	21%
Ground Power Unit	798	965	21%
Hydrant Truck	1,529	1,851	21%
Lavatory Cart	151	182	21%
Lavatory Truck	1,158	1,401	21%
Lift	404	485	20%
Other GSE	464	558	20%
Passenger Stand	47	56	20%
Push Back	320	385	20%
Service Truck	883	1,068	21%
Skid Steer Loader	325	409	26%
Sweeper	339	411	21%
Water Truck	311	376	21%

Sources: California Air Resources Board. OFFROAD 2017; CDM Smith 2019.
a. Change in activity from 2017 to 2031 includes both increases in equipment population and increases in activity per unit.

For the 2031 AQIM scenario, a practically achievable fleet-wide horsepower-weighted NOx +HC emission factor goal, in g/bhp-hr, was determined. Determination of this factor was based on historical precedent, current fleet makeup, current fleet-wide factor, and input pertaining to practical and economic feasibility from GSE stakeholders. The fleet-wide NOx+HC g/bhp-hr emission factor for the 2017 baseline inventory was calculated to be 2.24 g/bhp-hr NOx+HC. The fleet-wide emission factor goal for 2031 was determined to be 0.80 g/bhp-hr NOx+HC.

To determine the realistic fleet composition which would achieve the fleet-wide emission factor goal, the following procedure was followed. For each equipment type, the percent of that equipment which was electrified in the baseline was calculated and then normalized across all equipment types. For each equipment type, the count of electrified equipment was scaled up relative to the normalized baseline electrification value for that equipment type. This method of determining an effective future electrification of equipment allowed for equipment which was already heavily electrified under baseline conditions, such as baggage tractors, belt loaders, and carts, to be electrified more rapidly under the future conditions. Assumed effective electrification of equipment under the 2031 AQIM scenario, as compared to the 2017 Baseline, is presented in **Table 6-3**. ***Although emission estimates were calculated assuming an increase in electrification of GSE, operators would have the option of achieving airport-wide g/bhp-hr NOx+HC emission factor goals through other means, such as the implementation of ultra-low NOx or alternative fueled non-electric equipment.***

Table 6-3. Assumed Effective Electrification of Equipment

GSE Category	Total Count of Equipment	Baseline Count of Electrified Equipment	AQIM Effective Count of Electrified Equipment
Air Conditioner	41	14	40
Air Start	29	0	0
Aircraft Tractor	185	52	162
Baggage Tractor	744	331	728
Belt Loader	298	193	297
Bobtail	40	0	0
Cargo Loader	127	3	9
Cargo Tractor	168	111	168
Cart (Utility)	197	183	188
Catering Truck	91	1	3
Fork Lift	0	0	0
Fuel Truck	218	51	159
Generator	33	0	0
Ground Power Unit	4	0	0
Hydrant Truck	138	29	90
Lavatory Cart	9	0	0
Lavatory Truck	2	0	0
Lift	26	0	0
Other GSE	138	61	118
Passenger Stand	46	2	6

Table 6-3. Assumed Effective Electrification of Equipment

GSE Category	Total Count of Equipment	Baseline Count of Electrified Equipment	AQIM Effective Count of Electrified Equipment
Push Back	75	1	3
Service Truck	41	17	39
Skid Steer Loader	47	0	0
Sweeper	16	3	9
Water Truck	4	0	0

Source: CDM Smith 2019

6.2.2 GSE Emission Modeling Results

The emission calculation results for LAX 2031 GSE by equipment type are presented in **Table 6-4**. **Table 6-5** summarizes the emissions for GSE by fuel type.

Table 6-4. GSE Emissions by Equipment Type at LAX in 2031 – AQIM Scenario[a]

GSE Type	Equipment Count	Pollutant Emissions, tons per year						CO2
		CO	VOC	NOx	SO_2	PM_{10}	$PM_{2.5}$	Tonnes/yr
Air Conditioner	41	0.22	0.02	0.03	0.00	0.00	0.00	27
Air Start	29	0.37	0.03	0.12	0.00	0.00	0.00	61
Aircraft Tractor	185	4.18	0.26	1.20	0.01	0.08	0.07	248
Baggage Tractor	744	26.27	0.19	2.09	0.00	0.02	0.02	357
Belt Loader	298	0.80	0.01	0.06	0.00	0.00	0.00	15
Bobtail	40	18.26	0.19	1.40	0.00	0.03	0.02	670
Cargo Loader	127	8.01	0.36	2.95	0.01	0.14	0.13	808
Cargo Tractor	168	0.00	0.00	0.00	0.00	0.00	0.00	0
Cart	197	15.90	0.24	0.20	0.00	0.01	0.01	104
Catering Truck	91	79.27	1.32	10.30	0.02	0.17	0.13	2,686
Fork Lift	218	6.69	0.04	1.52	0.00	0.01	0.01	77
Fuel Truck	33	1.39	0.06	0.35	0.00	0.01	0.00	85
Generator	4	6.39	0.07	0.44	0.00	0.01	0.00	109
Ground Power Unit[b]	138	0.65	0.04	0.13	0.00	0.01	0.01	69
Hydrant Truck	9	59.64	0.66	5.19	0.02	0.12	0.09	1,848
Lavatory Cart	2	0.20	0.00	0.00	0.00	0.00	0.00	1
Lavatory Truck	26	25.93	0.34	2.25	0.01	0.05	0.04	895
Lift	138	11.69	0.22	1.28	0.00	0.02	0.02	246
Other	46	52.03	0.65	1.99	0.01	0.05	0.04	1,160
Other ORE	75	0.05	0.01	0.00	0.00	0.00	0.00	13
Passenger Stand	41	0.13	0.00	0.03	0.00	0.00	0.00	5
Service Truck	47	32.59	0.57	3.41	0.01	0.06	0.04	1,088
Sweeper	16	1.68	0.02	0.15	0.00	0.00	0.00	55
Water Truck	4	0.37	0.00	0.03	0.00	0.00	0.00	15
TOTALS	**2,717**	**352.70**	**5.29**	**35.15**	**0.10**	**0.80**	**0.64**	**10,642**

Source: CDM Smith 2019

a. Although emission estimates were calculated assuming an increase in electrification of GSE, operators would have the option of achieving airport-wide g/bhp-hr NOx+HC emission factor goals through other means, such as the

implementation of ultra-low NOx or alternative fueled non-electric equipment.
b. Emissions associated with ground power units would be further reduced through the implementation of the LAX Gate Electrification Program. By 2031, 100% of all permanent cargo and maintenance aircraft parking positions would be electrified, resulting in an approximate 90 percent reduction in Ground Power Unit emissions (incorporated in Tables 6-4 and 6-5).

Table 6-5. GSE Emissions by Fuel Type at LAX in 2031 – AQIM Scenario[a]

Fuel Type	Equipment Count	Pollutant Emissions, tons per year						CO2
		CO	VOC	NOx	SO_2	PM_{10}	$PM_{2.5}$	Tonnes/yr
Diesel	682	15.80	1.00	6.43	0.03	0.31	0.28	1,938
Gasoline	591	314.09	4.23	25.79	0.06	0.49	0.36	8,555
LPG/Propane	392	22.81	0.06	2.93	0.00	0.01	0.01	148
Electric	1,052	0.00	0.00	0.00	0.00	0.00	0.00	0
TOTALS	**2,717**	**352.70**	**5.29**	**35.15**	**0.10**	**0.80**	**0.64**	**10,642**

Source: CDM Smith 2019
a. Although emission estimates were calculated assuming an increase in electrification of GSE, operators would have the option of achieving airport-wide g/bhp-hr NOx+HC emission factor goals through other means, such as the implementation of ultra-low NOx or alternative fueled non-electric equipment.

6.3 LAX 2031 AQIM Traffic and Parking Emission Reductions

The potential emission reductions for several key elements in the AQIM that address traffic emissions on analyzed in this subsection.

The existing LAX FlyAway, Employee Rideshare, and Alternative Fuels Policy as well as AQIM LAWA clean fleet and smart parking policies are expected to generate additional emission reductions from use of cleaner vehicles and reduced vehicle miles traveled and idling time. The LAX LAMP project is also expected to reduce regional vehicles miles traveled. However, potential benefits were not assessed due to lack of specific traffic data for the With LAMP scenario in 2031. The specific measures discussed below are those for which emission reductions were quantified.

6.3.1 Alternative Fuel Vehicle Programs

The LAX Alternative Fuel Vehicle Policy and Incentive will require operators of medium- and heavy-duty vehicles over 8,500 lbs gross vehicle weight rating (GVRW) to utilize clean fueled vehicles which meet CARB's LEV III or Optional Low-NOx standards and use engines that are no older than thirteen (13) model years. Vehicle data, such as GVRW, vehicle description, engine model year, vehicle use designations, and current vehicle compliance, was collected under the LAX Alternative Fuel Vehicle Policy which was used as a basis to develop vehicle emissions based on grams per mile factors corresponding to a vehicle's CARB EMFAC technology category or specific engine data where available.[19]

To estimate the model year for each reported vehicle, the 2031 average fleet age was assumed to be the same as the 2017 LAX Alternative Fuel Vehicle Surveyed fleet age. This was accomplished

[19] CARB maintains a database of on-road certified engines for Passenger Cars, Light-Duty Trucks, Medium-Duty Vehicles, Heavy-Duty Engines, and other vehicle types which includes certified pollutant emission rates. Where identifying engine data was included in the Alternative Fuel Vehicle Policy survey, engines were matched to corresponding CARB certified engines for the purpose of determining emission rates. The database is available at: https://ww3.arb.ca.gov/msprog/onroad/cert/cert.php.

by increasing the model year for each vehicle engine in the 2017 survey database by fourteen (14) years (i.e., 2031 minus 2017).

For the purposes of calculating emissions, vehicles were assigned daily VMT based on EMFAC default mileage. Vehicles designated for use by airlines, catering services, LAWA, maintenance, passenger vans, and scheduled services were assumed to travel an average of five (5) miles per day.

Based on the AQIM targets, by 2031 all vehicles under the Alternative Fuel Vehicle Programs will be in compliance with the program. Thus, vehicles which would otherwise have emission rates exceeding CARB's LEV III standards would be required to, at a minimum, meet these standards. An estimate of the benefits (reductions) in emissions was calculated as the difference between the fleet emissions without this requirement, versus the fleet emissions with this requirement and is presented in **Table 6-12**.

6.3.2 Light-Duty Vehicle Program

The LAX Clean Fleet Light-Duty Vehicle Program would achieve 100 percent light-duty LAWA-owned vehicle fleet electrification by 2031. CARB's EMFAC LDA technology category emission rates were used as a basis for emission calculations. LAWA-owned light-duty vehicles were assumed to travel and average of five (5) miles per day. Emission reductions associated with this measure were calculated as a reduction in annual emissions associated with 100 percent of LAWA's light-duty vehicle fleet. An estimate of the benefits (reductions) in emissions is presented in **Table 6-12**.

6.3.3 Zero-Emission Bus Program

The LAX Clean Fleet Zero-Emission Bus Program would achieve 100 percent LAWA-owned bus fleet electrification by 2031. CARB's EMFAC UBUS technology category aggregated VMT and emission rates were used as a basis for emission calculations. Emission reductions associated with this measure were calculated as a reduction in annual emissions associated with 100 percent of LAWA's bus fleet. An estimate of the benefits (reductions) in emissions is presented in **Table 6-12**.

6.3.4 Smart Parking Systems at LAX

The AQIM targets for smart parking include installation of smart parking systems in all new parking garages and developing an implementation schedule for future installation of smart parking systems in the existing parking garages. By 2031, it is anticipated that 100 percent of public parking garages will benefit from smart parking. Benefits associated with this measure were calculated assuming emissions low speed (5 miles per hour) emission factors for the aggregated light-duty vehicle (LDA, LDT1, and LDT2) technology categories in the CARB EMFAC model. Smart parking was assumed to reduce an average of one (1) minute of low speed parking time per vehicle park. An estimate of the benefits (reductions) in emissions is presented in **Table 6-12**.

Table 6-6. Additional Emission Reductions

	Pollutant Emissions, tpy						CO2e
	CO	VOC	NOx	SO2	PM10*	PM2.5*	MT/yr
Alternative Fuel Vehicle Programs	300.36	8.50	9.18	NA	2.39	1.04	NA
LAMP	NA	NA	NA	NA	NA	NA	NA
Light-Duty Vehicle Program	0.48	0.04	0.03	<0.01	0.03	0.01	141
Zero-Emission Bus Program	175.18	0.32	1.73	<0.01	0.38	0.15	6,470
Smart Parking Systems	4.28	0.15	0.21	0.02	0.03	0.03	2,260
Reductions from 2031 BAU	**480.3**	**9.01**	**11.15**	**0.02**	**2.83**	**1.23**	**8,871**

Source: CDM Smith 2019

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