

MISCELLANEOUS PROCESS METHODOLOGY 4.10

Gas Dispensing Facilities

Revised and updated, April 2018

EMISSION INVENTORY SOURCE CATEGORY

Petroleum Production and Marketing / Petroleum Marketing

EMISSION INVENTORY CODES (CES CODES) AND DESCRIPTION

330-374-1100-0000 (46532) Gasoline Dispensing Tanks - Working Losses

330-376-1100-0000 (46557) Gasoline Dispensing Tanks - Breathing Losses

330-378-1100-0000 (46540) Vehicle Refueling - Vapor Displacement

330-380-1100-0000 (46565) Vehicle Refueling – Spillage

330-381-1100-0000 (93583) Hose Permeation

BACKGROUND

ARB's enhanced vapor recovery (EVR) regulations initially became law in 2001. EVR Phase I system components reduce emissions associated with gasoline deliveries to underground storage tanks. EVR Phase II systems control emissions from vehicle fueling, including standards for on board vapor recovery (ORVR) compatibility, more stringent spillage and "dripless nozzle" requirements, in-station diagnostics and storage tank pressure limits. Areas not meeting state ozone standards (nonattainment areas) are required to meet EVR standards. Existing facilities in districts where all areas meet state ozone standards (attainment areas) are exempt from EVR standards, except for ORVR compatibility, and may continue to use pre-EVR systems. However, new gas dispensing facilities (GDFs) and existing GDFs undergoing a major modification in attainment areas must comply with applicable EVR requirements.

METHODS AND SOURCES

This category reports emissions from gasoline storage and transfer at facilities with underground storage tanks. Emissions include working and breathing losses from storage tanks, vapor displaced in vehicle refueling, spillage, and hose permeation. GDF's consist of retail gas stations, private facilities used by fleet operators, gas pumps at marinas, and airport facilities dispensing aviation gasoline.

OVERVIEW OF EMISSION METHODOLOGY

Emissions for the 2012 base year were estimated by taking statewide gasoline sales from Board of Equalization data, distributing this figure to county/air basin/air district (COABDIS) regions with ARB data and then estimating the percentage of gasoline pumped from facilities with underground tanks. Emissions were estimated from this throughput by applying emission factors developed by ARB's Monitoring and Laboratory Division in December 2013. Updated emissions, growth, and temporal profiles were incorporated into ARB's 2016 SIP ozone inventory, Version 1.02, in October 2015.

Gasoline throughput

Statewide gasoline deliveries were taken from the California Board of Equalization's fuel tax statistics and reports. Figures from *Taxable Gasoline Gallons 10 Year Report* and *Taxable Aviation Gasoline Gallons 10 Year Report* were used to estimate 2012 deliveries of aviation gasoline and other gasoline.

Statewide aviation gasoline deliveries were allocated to COABDIS regions proportional to 2012 NOx emissions from piston-engine aircraft in ARB's 2016 Ozone SIP v1.0 forecast. Statewide deliveries of other gasoline were allocated to COABDIS regions proportional to 2012 gasoline use from ARB's EMFAC 2014 model.

Gasoline used in boats was taken from ARB's Pleasure Craft 2014 model (EMFAC, Off-Road Gasoline Fueled Equipment). These figures were deducted from the COABDIS region figures to give an estimate of on-land gasoline use by road vehicles and other equipment.

These steps gave estimates of 2012 gasoline deliveries by COABDIS region for three fueling types: road vehicles and other equipment, boats, and aviation gasoline.

Percentage of deliveries from underground tanks

Estimates of the percentage of deliveries pumped from facilities with underground tanks were developed based on information provided by air districts. Default percentages for the three fueling types are:

Road vehicles and other equipment	99%
Boats	95%
Aircraft, aviation gasoline	100%

When air districts provided specific figures, these were used instead of the statewide defaults.

Emission factors

The previous steps gave estimates of 2012 gasoline deliveries by COABDIS region and fueling type from facilities with underground tanks. The per-gallon emission factors applied to these figures (see Table 1 below) were taken from the 2013 report by ARB's Monitoring and Laboratory Division previously cited. The factors are based on tests at a sample of operating gas stations and reflect failure and noncompliance rates.

Table 1. Emission factors for gasoline deliveries from facilities with underground tanks

Source	Emissions, total organic gases		
	Enhanced vapor recovery	Pre-EVR	Uncontrolled
pounds/million gallons			
Phase I Working losses	150	380	7,700
Tank breathing	24	92	760
Phase II Fueling, non-ORVR vehicles	420	2,400	8,400
Fueling, ORVR vehicles	21	120	420
Customer spillage	240	420	610
Hose permeation	62	62	62

EVR – Enhanced vapor recovery

ORVR – Onboard refueling vapor recovery

100% of emissions are reactive organic gases

Factors from Air Resources Board, Monitoring and Laboratory Division. *Revised Emission Factors for Gasoline Marketing Operations at California Gasoline Dispensing Facilities*. December 23, 2013. Table I-1, page 2.

EMISSION ESTIMATION METHODOLOGY

COABDIS-specific emissions were estimated by applying emission factors to deliveries in each COABDIS region. The EVR factors were generally used in areas not in attainment of the state ozone standard in 2013, because these areas are required to meet EVR standards. Pre-EVR factors were applied in attainment areas.

A small percentage of deliveries are from facilities that are exempt from controls. Discussions with district staff indicated that this is minimal for facilities with underground tanks. Emissions for Phase I were estimated assuming that 0.1% of deliveries is pumped from uncontrolled tanks and the remaining 99.9% is pumped from tanks with the appropriate controls for the area.

For Phase II, it was assumed that all deliveries are from facilities with the appropriate control level for the area. The factor for fueling losses depended on the fueling type. For road vehicles and other equipment, emissions were estimated assuming that 68% of deliveries were to ORVR vehicles, based on an estimate of fleet composition from the EMFAC 2014 model. The non-ORVR factors were used for the remaining 32% of deliveries. This accounts for fueling non-ORVR vehicles and trailered equipment, and filling gas cans. The non-ORVR factors were used for boat and aircraft fueling.

This step gave emissions by loss source, fueling type, control level, and COABDIS region. Statewide totals are shown in Table 2 below.

Table 2. Statewide TOG emissions, 2012, facilities with underground tanks

Fueling type and control level	Gasoline deliveries	Working losses	Tank breathing	Fueling, non-ORVR	Fueling, ORVR	Customer spillage	Hose permeation	Total emissions
	<i>million gallons</i>				<i>tons/day</i>			
Total emissions	14,595.9	3.244	0.518	3.091	0.306	4.865	1.240	13.26
Road vehicles, equipment								
Enhanced	14,121.2	2.902	0.464	2.600	0.276	4.643	1.199	12.08
Regular	220.3	0.115	0.028	0.232	0.025	0.127	0.019	0.55
Uncontrolled	14.0	0.148	0.015	0.052	0.005	0.012	0.001	0.23
Boats								
Enhanced	32.7	0.007	0.001	0.019	<i>n</i>	0.011	0.003	0.04
Regular	0.1	<i>r</i>	<i>r</i>	<i>r</i>	<i>n</i>	<i>r</i>	<i>r</i>	0.00
Uncontrolled	0.3	0.003	<i>r</i>	0.003	<i>n</i>	<i>r</i>	<i>r</i>	0.01
Aircraft								
Enhanced	189.8	0.039	0.006	0.109	<i>n</i>	0.062	0.016	0.23
Regular	15.3	0.008	0.002	0.050	<i>n</i>	0.009	0.001	0.07
Uncontrolled	2.2	0.023	0.002	0.025	<i>n</i>	0.002	<i>r</i>	0.05

n – no emissions in this category *r* – not zero, but rounds to zero
Hose permeation is a new category for this version of the inventory

Emission Inventory Code Summary:

	<u>Emissions (Tons/Day)</u>
330-374-1100-0000 Gasoline Dispensing Tanks - Working Losses	3.244
330-376-1100-0000 Gasoline Dispensing Tanks - Breathing Losses	0.518
330-378-1100-0000 Vehicle Refueling - Vapor Displacement**	3.397
330-380-1100-0000 Vehicle Refueling – Spillage	4.865
330-381-1100-0000 Hose Permeation	1.240
Total	13.264

** Vehicle Refueling – Vapor Displacement combines the emissions from non-ORVR and ORVR fueling.

TEMPORAL ACTIVITY

Monthly factors for all sources were calculated from average monthly sales 2004–2012 from the California Board of Equalization (*Taxable Gasoline Gallons 10 Year Report* and *Taxable Aviation Gasoline Gallons 10 Year Report*). Annual activity is nearly uniform throughout the year, with slightly higher activity during the summer months and holiday periods. The weekly activity is nearly uniform, with slightly lower activity on the weekend. Daily activity follows a pattern which is uniform during the day, peaks during the after-work hours in the evening, and is lowest between midnight and 6 AM.

GROWTH FORECASTING

The primary growth surrogate for gasoline dispensing facility categories is fuel consumption from ARB's EMFAC 2014 mobile sources emission factors model. For some regions, additional surrogates are used in conjunction with the EMFAC model, including forecasts from Regional Economic Models, Inc. (REMI) and the California Energy Commission (CEC).

CHANGES IN THE METHODOLOGY

Emission estimates were updated based on 2012 gasoline sales data from the California Board of Equalization and new per-gallon emission factors for gasoline dispensing facility categories developed by ARB's Monitoring and Laboratory Division. With this update, emissions are also estimated for a new category, Hose Permeation. Emissions for gas dispensing facilities for base year 2012 were incorporated into the California Emission Projection Analysis Model (CEPAM), 2016 SIP Baseline Emission Projections, Version 1.02, in October 2015.

The current estimates are generally lower than the numbers formerly in the inventory. The prior estimates were based on the assumption that 2% of deliveries were from uncontrolled facilities. Because losses from uncontrolled tanks are about 20 times larger than losses from tanks with vapor recovery systems, the estimates are highly sensitive to the assumption made on deliveries from uncontrolled tanks. The 2% figure was based on the assumption that all gasoline used in offroad equipment is from uncontrolled tanks and an estimate of offroad gasoline use by the Federal Highway Administration. Discussions with district staff indicated that this overestimates uncontrolled deliveries because gasoline used in boats, lawnmowers, and many other types of offroad equipment is typically delivered from controlled facilities.

In addition, the prior estimates included deliveries from facilities with above-ground tanks, which are no longer included in the source category. Other differences result from using lower emission factors for enhanced vapor recovery, compared to the factors used previously, and updated figures for statewide gasoline deliveries.

PREPARED BY

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October 2015

Methodology revised to reflect revised emission factors and a new emissions category for hose permeation. Emissions, growth profiles, and temporal profiles were updated statewide for 2012 activity and incorporated into the CEPAM 2016 SIP ozone inventory, Version 1.02, in October, 2015.

Table 2 Revised by Martin Johnson
April 2018

REFERENCES

1. California Air Resources Board, Vapor Recovery – Executive Orders (last modified September 13, 2015). <https://www.arb.ca.gov/vapor/eo.htm>
2. California Air Resources Board, Monitoring and Laboratory Division. Revised Emission Factors for Gasoline Marketing Operations at California Gas Dispensing Facilities. December 23, 2013. <https://www.arb.ca.gov/vapor/gdf-emisfactor/gdf%20umbrella%20document%20-%202020%20nov%202013.pdf>
3. California Board of Equalization. *Taxable Gasoline Gallons 10 Year Report and Taxable Aviation Gasoline Gallons 10 Year Report*. <http://www.boe.ca.gov/sptaxprog/spftrpts.htm>
4. California Air Resources Board. Area Designations Maps, State and National. Last updated May 5, 2016. <https://www.arb.ca.gov/desig/adm/adm.htm>
5. California Air Resources Board. EMFAC 2014 Model. <https://www.arb.ca.gov/msei/categories.htm>
6. Regional Economic Models, Inc. <http://www.remi.com/>
7. California Energy Commission. <http://www.energy.ca.gov/>