AREA SOURCE EMISSIONS FOR CALENDAR YEAR 2023
METHODOLOGY DOCUMENTATION
COMMERCIAL AND INDUSTRIAL COMBUSTION OF LPG

DESCRIPTION OF CATEGORY:

This analysis provides an estimate of emissions from external & internal combustion of propane or liquefied petroleum gas (LPG) from industrial and commercial sector facilities with non-permitted equipment and emissions that are not reported through the South Coast AQMD Annual Emission Reporting (AER) Program. LPG combustion can occur in equipment such as boilers, ovens, heaters (external), or internal combustion engines (internal). Emissions consist of combustion contaminants, i.e. PM, CO, SOx, NOx, and ROG. Emissions estimates include all air basins in the South Coast AQMD (i.e., South Coast Air Basin (SCAB), Salton Sea Air Basin (SSAB), Mojave Desert Air Basin (MDSB)).

CES	EIC	Description
58727	60-995-0120-0000	Commercial LPG Combustion
66795	50-995-0120-0000	Industrial LPG Combustion

METHODOLOGY AND ASSUMPTIONS:

The total LPG consumed in California for both the industrial and commercial sectors is obtained from the Energy Information Administration (EIA) of the U.S. Department of Energy. Previously, EIA reported LPG as propane but now uses the term hydrocarbon gaseous liquid (HGL).[1] EIA however still considers HGL to be propane for reporting purposes. This report uses the terms propane, LPG and HGL interchangeably. Additionally, consumption and throughput are assumed to be the same and are used interchangeably in this document. EIA provides HGL consumption data for industrial and commercial sectors in the state of California for base year 2023[2]. Reported 2023 CA state HGL consumption for the commercial sector is 3,783,000 barrels (158,886,000 gallons) and CA state HGL industrial sector consumption is 5,371,000 barrels (225,582,000 gallons).

EIA defines industrial activities by North American Industrial Classification System (NAICS) code. Commercial activities are also described below. However, the EIA industrial sector consumption also includes agricultural sector consumption (NAICS Code 11) and use of HGL in forklifts in industrial sectors. Therefore, the calculations and this methodology document focus are on the non-agricultural and non-forklift component of EIA-reported HGL industrial consumption.

[1] Propane is used as a proxy for LPG. https://www.eia.gov/energyexplained/hydrocarbon-gas-liquids/

[2] https://www.eia.gov/state/seds/sep_use/ind/pdf/use_ind_CA.pdf (CY 2023).

Industrial	An energy-consuming sector that consists of all facilities and equipment used for producing, processing, or assembling goods The industrial sector encompasses the following types of activity: manufacturing (NAICS codes 31-33); agriculture, forestry, fishing and hunting (NAICS code 11); mining, including oil and gas extraction (NAICS code 21); natural gas distribution (NAICS code 2212); and construction (NAICS code 23). Overall energy use in this sector is largely for process heat and cooling and powering machinery, with lesser amounts used for facility heating, air conditioning, and lighting. Fossil fuels are also used as raw material inputs to manufactured products. Note: This sector includes generators that produce electricity and/or useful thermal output primarily to support the above-mentioned industrial activities.
Commercial	An energy-consuming sector that consists of service-providing facilities and equipment of businesses; Federal, State, and local governments; and other private and public organizations, such as religious, social, or fraternal groups. The commercial sector includes institutional living quarters. It also includes sewage treatment facilities. Common uses of energy associated with this sector include space heating, water heating, air conditioning, lighting, refrigeration, cooking, and running a wide variety of other equipment. Note: This sector includes generators that produce electricity and/or useful thermal output primarily to support the activities of the above-mentioned commercial establishments.

Previous emissions inventory efforts in 2020 for 2018 base year data utilized manufacturing employment to scale down CA to SCAQMD. However, for this methodology, the 2023 California Air Resources Board's (CARB) Mandatory Greenhouse Gas Reporting – Reported Emissions data[3] was used to determine a scale down factor to estimate the percentage of industrial and commercial emissions in the District. CARB's previous mandatory GHG reporting data was used for the 2016 AQMP – Industrial Combustion emission inventory. NAICS codes in the CARB dataset were used to categorize commercial or industrial emissions based on the above definitions and agricultural emissions were excluded if found. The industrial and commercial emissions were totaled for California state, then filtered by SCAQMD zip codes[4] to get the District portion of those emissions. SCAQMD emissions totals were then divided by the CA total to get the CARB scale down factor for both industrial and commercial emissions. The percentage of SCAQMD industrial emissions to CA state industrial emissions is 33.985% and SCAQMD commercial emissions to CA state commercial emissions is 40.928%. There were a few records of out of state emissions, which were excluded from the total. These percentages were applied to the EIA CA state consumption to estimate SCAQMD consumption.

Since the EIA reported Industrial consumption includes agricultural consumption and forklifts, it is necessary to further adjust this figure to determine the non-agricultural portion. In order to determine the portion of non-agriculture industrial consumption reported by EIA, staff looked into sales data

[3] CARB, Mandatory GHG Reporting – Reported Emissions, https://ww2.arb.ca.gov/mrr-data.

[4] https://www.aqmd.gov/nav/about/jurisdiction

reporting in the 2023 Propane Education & Research Council (PERC) report[5]. PERC is a national propane industry group that periodically publishes detailed sales studies that summarize industrial and agricultural sector sales. To adjust EIA industrial sector consumption to exclude agriculture in California, the percentage of PERC reported industrial sector sales to agricultural and industrial sector propane sales was calculated. The PERC reported industrial sales was 16 million gallons and sales for agriculture and forklifts was 44 million gallons and 56 million gallons, respectively. The portion of industrial HGL from EIA data excluding agriculture and forklifts consumption in California was determined to be 13.79%. The assumption is that the consumption of industrial and agricultural propane is proportional to the sales.

Both the EIA commercial consumption and industrial consumption is further categorized by external or internal combustion. The EIA data does not have the combustion type, but AER reporting data can be utilized to estimate the proportions of external and internal combustion. Like the CARB data, the AER data was further refined by using the same NAICS codes outlined above to categorize by commercial or industrial sectors, and it specifies external or internal combustion. There were no agricultural sources (NAICS code 11) in the 2023 AER database, so all non-industrial sector sources are assumed to be commercial sector sources. If agricultural emissions are found, then it is excluded from our analysis. Staff applied 2020-2023 averaged percentages of external to internal combustion for both EIA CA state reported Commercial and Industrial categories to estimate:

- SCAQMD portion of 2023 EIA CA Reported commercial consumption
    - external combustion
    - internal combustion
- SCAQMD portion of 2023 EIA CA Reported industrial consumption
    - external combustion
    - internal combustion

See table below for percentage of external and internal combustion for both commercial and industrial sectors from 2020 through 2023, with a four-year average of the percentages.

[5] Propane Education & Research Council, *Annual Retail Propane Sales Report - U.S. Odorized Propane Sales by State and End-Use Sector - Reporting Year: 2023*, 2024.

Ratio of External to Internal Combustion by Year, 2020-2023				
	Commercial		Industrial	
Year	External	Internal	External	Internal
2020	70.05%	29.95%	60.37%	39.63%
2021	71.77%	28.23%	45.70%	54.30%
2022	57.23%	42.77%	56.28%	43.72%
2023	69.92%	30.08%	37.00%	63.00%
Average	**67.24%**	**32.76%**	**49.84%**	**50.16%**

Additionally, the AER-reported propane throughputs can be subtracted from the SCAQMD estimated portion of the EIA California consumption. It is assumed that the total unreported/un-permitted area source emissions for both the industrial and commercial sectors are estimated by subtracting the corresponding 2023 AER reported propane throughput data from the estimated SCAQMD portions of EIA California consumption for each sector (industrial or commercial), and type of combustion (external or internal). See below for calculations:

- Unreported Commercial (external combustion) = Estimated EIA SCAQMD Commercial (External) - AER (Commercial – External)
- Unreported Commercial (internal combustion) = Estimated EIA SCAQMD Commercial (Internal) - AER (Commercial – Internal)
- Unreported Industrial (external combustion) = Estimated EIA SCAQMD Industrial (External) - AER (Industrial – External)
- Unreported Industrial (internal combustion) = Estimated EIA SCAQMD Industrial (Internal) - AER (Industrial – Internal)

After the unreported consumption is determined, it is multiplied by corresponding external combustion and internal combustion emission factors. Emission factors are from either EPA AP-42 or CARB.

LPG Combustion Emission Factors (lbs/1000 gal)						
Type of LPG Combustion	**VOC**	**NOx**	**SOx**	**CO**	**PM**	**NH3**
External Combustion	0.26	12.80	4.60	3.20	0.28	0.00
Internal Combustion	83.00	139.00	0.35	129.00	5.00	0.24

Emissions totals are obtained separately for each sector (industrial or commercial), by applying the appropriate (external/internal combustion) pollutant emissions factors to the corresponding estimated external or internal combustion throughputs. The sums of the resulting net emission amounts are used

for total emission inventory. Totals for each category were distributed among counties based on the 2023 SCAQMD population ratios provided by Southern California Association of Governments (SCAG).

The sections below outline step-by-step methodology and calculations using the above percentages and factors for estimating emission inventory for the commercial and industrial combustion of LPG, starting from EIA reported CA state level consumption and resulting in the South Coast AQMD emission inventory for these categories.

Commercial Combustion

Using reported data as stated above (EIA, CARB, AER), the non-reported commercial sector LPG throughput is calculated as below:

Non-Reported Commercial LPG Throughput Calculations		
Description	**Estimates (1,000 gallons)**	
EIA - CA Commercial HGL Consumption	158,886	
SCAQMD Fraction of EIA CA Commercial Consumption (40.928%)	65,029	
2020-2023 AER Average Commercial External and Internal Combustion Percentage	**External (67.243%)**	**Internal (32.757%)**
Estimated SCAQMD EIA Commercial LPG External/Internal Consumption	43,727.358	21,301.504
2023 AER Reported Commercial Propane Throughput	1,074.161	408.159
Non-Reported Subtotal (Estimated SCAQMD EIA Consumption minus AER Throughput)	42,653.197	20,893.345
Non-Reported Total, External + Internal (SCAQMD minus AER)	63,546.542	

Total emissions are calculated by applying the external or internal combustion emission factors to the corresponding non-reported subtotal throughputs of external or internal throughput. The estimated emission inventory for SCAQMD is calculated by dividing the sum of the external combustion emissions and internal combustion emissions by total non-reported throughput.

Calculation for Emissions of Commercial Combustion of LPG						
Total Non-Reported Commercial Combustion of LPG: 63,546,542 gal	**Pollutant**					
Description	**VOC**	**NOx**	**SOx**	**CO**	**PM**	**NH3**
External Combustion Emission Factors (lbs/1000 gal)	0.26	12.80	4.60	3.20	0.28	0
External Combustion Emissions (lbs/year) (42,653,197 gal)	11,090	545,961	196,205	136,490	11,943	0
Internal Combustion Emission Factors (lbs/1000 gal)	83.00	139.00	0.35	129.00	5.00	0.24
Internal Combustion Emissions (lbs/year) (20,892,345 gal)	1,734,148	2,904,175	7,313	2,695,242	104,467	5,110
Total External and Internal Combustion Emissions (lbs/year)	1,745,238	3,450,136	203,517	2,831,732	116,410	5,110
SCAQMD Commercial LPG Combustion Emissions Inventory (tpd)	2.3907	4.7262	0.2788	3.8791	0.1595	0.01

Industrial Combustion

Using reported data as stated above (EIA, PERC, CARB, AER), the non-reported industrial sector LPG throughput is calculated below. The industrial combustion calculations only differ by one step, adjusting for the non-agriculture industrial sector consumption of the EIA California state data.

Non-Reported Industrial LPG Throughput Calculations		
Description	**Estimates (1,000 gallons)**	
EIA - CA Industrial HGL Consumption	225,582	
Industrial Fraction excluding Agriculture and Forklifts (13.793%)	31,115	
SCAQMD Fraction of EIA CA Industrial Consumption (33.985%)	10,574	
2020-2023 AER Average Industrial External and Internal Combustion Percentage	**External (49.838%)**	**Internal (50.162%)**
Estimated SCAQMD EIA Industrial LPG External/Internal Consumption	5,270	5,304
2023 AER Reported Industrial Propane Throughput	22	38
Non-Reported Subtotal (Estimated SCAQMD EIA Consumption minus AER Throughput)	5,248	5,267
Non-Reported Total, External + Internal (SCAQMD minus AER)	10,515	

Like the section above, total emissions are calculated by applying the external or internal combustion emission factors to the corresponding non-reported subtotal throughputs of external or internal throughput. The estimated emission inventory for SCAQMD is calculated by dividing the sum of the external combustion emissions and internal combustion emissions by total non-reported throughput.

Total Non-Reported Industrial Combustion of LPG: 10,514,621 gal	Calculation for Emissions of Industrial Combustion of LPG					
	Pollutant					
Description	**VOC**	**NOx**	**SOx**	**CO**	**PM**	**NH3**
External Combustion Emission Factors (lbs/1000 gal)	0.26	12.80	4.60	3.20	0.28	0.00
External Combustion Emissions (lbs/year) (5,247,944 gallons)	1,364	67,174	24,141	16,793	1,469	0
Internal Combustion Emission Factors (lbs/1000 gal)	83.00	139.00	0.35	129.00	5.00	0.24
Internal Combustion Emissions (lbs/year) (5,266,677 gallons)	437,134	732,068	1,843	679,401	26,333	1,288
Total External and Internal Combustion Emissions (lbs/year)	438,499	799,242	25,984	696,195	27,803	1,288
SCAQMD Industrial LPG Combustion Emissions Inventory (tpd)	0.60	1.09	0.04	0.95	0.04	0.00

SUMMARY AND NEW EMISSIONS

Emissions for base year 2023 are summarized below for SCAB and SSAB.

Commercial LPG Combustion (tpd)			
Pollutant	**2022 AQMP**	**Prospective SIP/AQMP (SCAB)**	**Prospective SIP/AQMP (SSAB)**
VOC	1.001	2.324	0.066
NOx	3.085	4.595	0.131
CO	2.338	3.771	0.108
SOx	0.328	0.271	0.008
PM10	0.100	0.154	0.004
PM2.5	0.01	0.154	0.004
NH3	0	0.007	0.000

Industrial LPG Combustion (tpd)			
Pollutant	**2022 AQMP**	**Prospective SIP/AQMP (SCAB)**	**Prospective SIP/AQMP (SSAB)**
VOC	0.016	0.584	0.017
NOx	0.041	1.064	0.030
CO	0.036	0.927	0.026
SOx	0.003	0.035	0.001
PM10	0.001	0.037	0.001
PM2.5	0.001	0.037	0.001
NH3	0	0.002	0.000