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M E M O R A N D U M

Date:	January 29, 2025
To:	Garrett Wong Climate Program Manager County of Santa Barbara gwong@co.santa-barbara.ca.us
Via:	Email
From:	Ryan Garder Climate Planning Director rgardner@rinconconsultants.com
Subject:	**Santa Barbara County Petroleum Production Activity GHG Emissions Analysis**
Project Number:	20-09336

Preliminary Santa Barbara County Petroleum Production Activities Greenhouse Gas Emissions Inventory and CAP Impact Analysis

This technical memorandum presents the preliminary results of an investigation into the available data and resulting inventory of greenhouse gas (GHG) emissions produced by oil and gas activities in Santa Barbara County (the County). The scope for this analysis included a review of the available datasets and resulting emissions over time resulting from the processes of extraction, transportation and refining of petroleum products. This analysis includes both onshore and offshore oil extraction activities within the County and the Santa Barbara Channel. Oil production activities have occurred in the area of Santa Barbara County for well over 100 years. However, production in the County has been in decline since the 1980s and much of the region has been transitioning away from the oil production past. Today, oil production is a small fraction of the overall economy in Santa Barbara County.[1]

For the County oil and gas GHG emissions inventory, Rincon collected and analyzed data from the following publicly available regulatory data sources:

- California Air Resources Board (CARB)
- California's Department of Conservation Geologic Energy Management Division (CalGEM) WellSTAR database.
- CARB Low Carbon Fuel Standard Carbon Intensity Scores by Oil Field

Rincon collected and collated available data for historic calendar years between 2005 and 2023 as available. One of the challenges for quantifying GHG emissions related to the petroleum industry is the aggregation of various data sources and the distribution of available data for each stage of the extraction, transportation, and refining processes across multiple government agencies. Furthermore,

[1] https://www.govinfo.gov/content/pkg/GOVPUB-I-2cda7e2ddea58e6ed2d24c68f6b77cc4/pdf/GOVPUB-I-2cda7e2ddea58e6ed2d24c68f6b77cc4.pdf

no single dataset exists that provides a complete picture of all oil and gas related emissions within the County. This analysis investigated two different approaches to quantify GHG emissions within the County in a repeatable and transparent manner.

California Air Resources Board (CARB) Regulation for the Mandatory Reporting of Greenhouse Gas Emissions (MRR) database Analysis

The first approach Rincon explored was to leverage the CARB MRR emissions database. The County of Santa Barbara has been using MRR data to track oil and gas emissions historically and, therefore, it was the starting point for this analysis. Leveraging the MRR data is considered a top-down analysis since it provides emissions at a facility level and aggregates multiple emissions sources occurring at each facility. The MRR data provides a broad analysis of the overall emissions generated by facilities that emit over 10,000 MT CO_2e (metric tons of carbon dioxide equivalent) per year. To utilize this data for oil and gas inventory purposes Rincon first identified all facilities reporting to the MRR and filtered for facilities with zip codes located within Santa Barbara County.

Rincon also completed this analysis for historic years (as far back as 2008, the first year that MRR data were available) to help identify the trend in emissions over time using the MRR top-down data collection approach. These results and corresponding discussion are presented in Attachment 1. However, due to the MRR data limitations, discussed below, Rincon pursued a bottom-up analytical approach using alternative oil and gas production databases in conjunction with MRR refinery data, as described in the following sections.

Data Limitations

While the MRR dataset provides data on a wide range of oil and gas related activities including oil and gas production as well as refining, it does have several limitations. The primary limitations include:

- Only provides total GHG emissions data by facility;
- Does not provide barrels of oil extracted;
- Does not differentiate GHG emissions from different oil fields; and
- Only captures facilities above 10,000 MT CO_2e, so small producers are not captured.

As oil and gas production continues to decline, additional facilities may fall under the 10,000 MT CO_2e threshold. Therefore, Rincon investigated additional datasets in order to provide a more comprehensive look at oil and gas activities within the County.

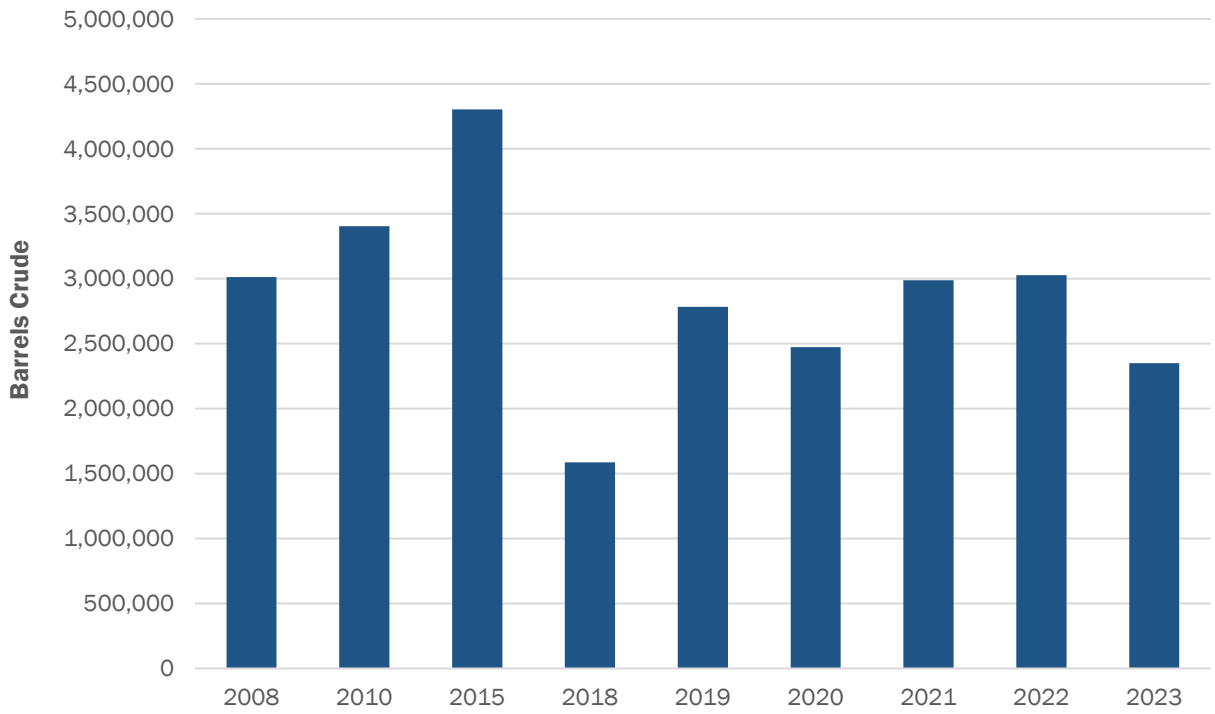
CalGEM WellSTAR Database Analysis

Due to the limitations of the MRR data as a single source of oil and gas emissions data, Rincon also conducted a review of other oil and gas emissions data that are publicly available, consistent, and transparent. Based on these criteria, Rincon identified the CalGEM WellSTAR database and the CARB low carbon fuel standard (LCFS) crude average carbon intensity (CI) values. These data provide a summary of every barrel of oil produced within the County as well as the carbon intensity of each oil field. When combined, these data provide a bottom-up analysis of oil and gas production from individual wells in Santa Barbara County. Total barrels of oil condensate produced were summed for each oil field located in the County. To estimate GHG emissions occurring due to oil and gas extraction, the CARB LCFS program CI scores were then applied to production from each oil field. The LCFS program carbon intensities include emissions from oil extraction and transportation (but not refining) for each specific oil field. The data are for all oil fields in the County, regardless of total production or

emissions, providing a more comprehensive picture of oil and gas production in the County than the MRR data. While the CI score is in MT CO_2e per barrel of oil, this score would also include the extraction of natural gas, which is a byproduct of oil production in the County. The calculated total GHG emissions for the bottom-up analysis were 98,868 MT CO_2e in 2018 and 132,355 MT CO_2e in 2023 (Table 1 and Table 2).

WellSTAR production data were available back to reporting year 2008. WellSTAR production data show a large increase in production from 2008 through 2015, with a sharp decline in production reflected by 2018, and then a smaller increase and variable production through 2023 (Figure 1). The reduced output seen after 2015 likely reflects the impacts of the 2015 Refugio oil spill, which caused the shutdown of offshore oil production through the Gaviota Offshore field. Since the oil spill, offshore production has been significantly lower and had zero production in both 2018 and 2023.

Figure 1 Oil Production from Santa Barbara County Over Time (WellSTAR Database)



The methods outlined above were applied to both the 2018 and 2023 WellSTAR production numbers to calculate total GHG emissions from oil and gas extraction processes in the County. The bottom-up analysis estimated total GHG emissions for 2018 at 98,868.39 MT CO2e (Table 1), compared to 132,355.90 MT CO2e in 2023 (Table 2). While oil production increased by 48% between 2018 and 2023, emissions only increased by 34%. The discrepancy between the reduction in crude oil production and the decrease in GHG emissions is attributed to a higher average CI per barrel in 2018 (11.12 g CO_2e/M) compared to 2023 (9.27 g CO_2e/MJ).

Table 1 Bottom-up 2018 Petroleum Industry GHG Emissions Inventory

Field Name	Oil Condensate Produced (barrels)	Carbon Intensity (g CO_2e/MJ)[1]	MT CO_2e
Barham Ranch	26,877	4.15	680.39
Capitan	17,549	11.12[2]	1,190.38
Careaga Canyon	2,796	11.12	189.66
Casmalia	63,672	10.26	3,984.98
Cat Canyon	689,718	7.83	32,943.00
Cuyama South	107,909	14.70	9,676.20
Elwood	2,742	11.12	186.00
Four Deer	764	11.12	51.82
Gaviota Offshore	0	11.12	0
Goleta	0	11.12	0
Guadalupe	0	11.12	0
Harris Canyon Northwest	0	11.12	0
Jesus Maria	2,908	11.12	197.26
La Goleta Gas	2,104	11.12	142.72
Lompoc	60,822	28.45	10,555.35
Los Alamos	1,254	11.12	85.06
Orcutt	450,083	11.76	32,287.15
Point Conception	0	11.12	0
Refugio Cove Gas	2,494	11.12	169.17
Russell Ranch	11,412	8.58	597.28
Santa Maria Valley	94,362	4.80	2,762.92
Zaca	13,141	9.53	763.93
Unknown Field	35,457	11.12	2,405.12
Total	**1,586,064**		**98,868.39**

[1] grams of CO_2 equivalent per megajoule

[2] Average carbon intensity value for Santa Barbara County oils fields in 2018

Source: https://wellstar-public.conservation.ca.gov/

Table 2 Bottom-up 2023 Petroleum Industry GHG Emissions Inventory

Field Name	Oil Condensate Produced (barrels)	Carbon Intensity (g CO_2e/MJ)[1]	MT CO_2e
Barham Ranch	26,383	4.15	667.89
Capitan	21,433	9.27[2]	1,211.97
Careaga Canyon	2,991	9.27	169.13
Casmalia	72,460	10.26	4,534.98
Cat Canyon	1,120,996	7.83	53,542.13
Cuyama South	145,375	14.7	13,035.78
Elwood	2,130	9.27	120.45
Four Deer	4,333	9.27	245.02
Gaviota Offshore	0	9.27	0
Goleta	0	9.27	0
Guadalupe	440	9.27	24.88
Harris Canyon Northwest	0	9.27	0
Jesus Maria	1,648	9.27	93.19
La Goleta Gas	2,945	9.27	166.53
Lompoc	48,992	9.27	2,770.35
Los Alamos	12,092	11.78	868.91
Orcutt	626,683	11.76	44,955.73
Point Conception	2,695	9.27	152.39
Refugio Cove Gas	1,282	9.27	72.49
Russell Ranch	18,821	8.58	985.05
Santa Maria Valley	177,938	4.8	5,210.02
Zaca	31,937	9.27	1,805.94
Unknown Field	29,640	9.53	1,723.06
Total	**2,351,214**		**132,355.90**

[1] grams of CO_2 equivalent per megajoule

[2] Average carbon intensity value for oil fields in Santa Barbara County in 2023

Source: https://wellstar-public.conservation.ca.gov/

Data Limitations

While the WellSTAR data in combination with the LCFS data provides a finer grain look at the oil and gas production emissions in the County of Santa Barbara, it also has several deficiencies that must be addressed.

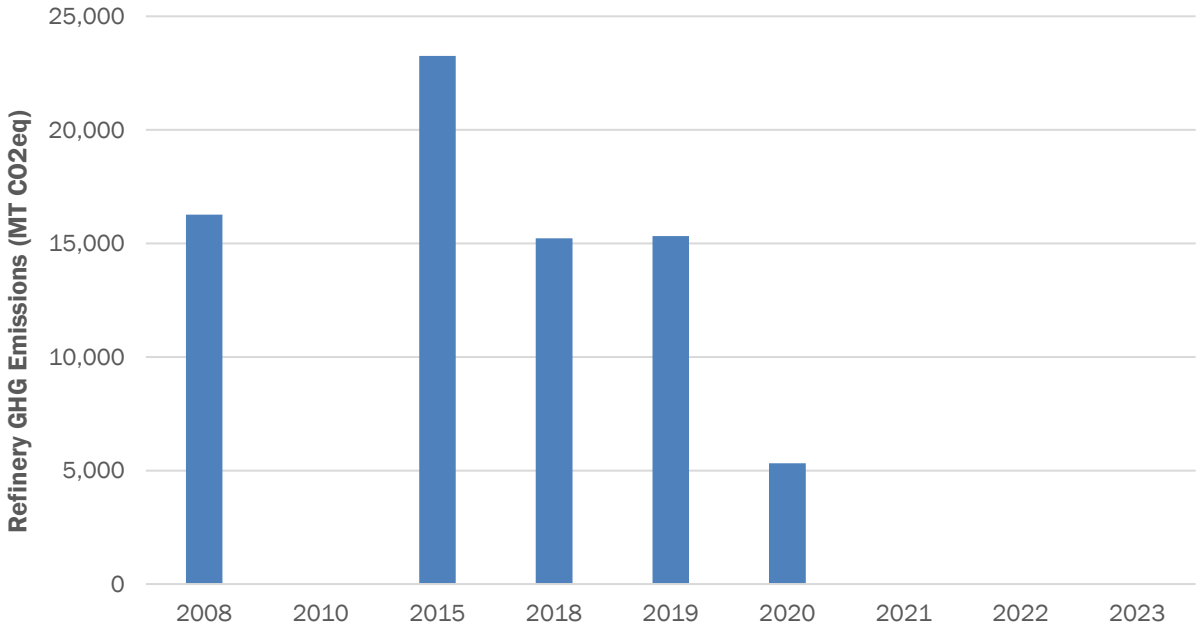
- Only 9 of the 23 County oil fields have CARB-verified CI values
  - For the remaining 14 oil fields, it was necessary to use an average oil field CI for Santa Barbara County;
- Historic CARB LCFS CI data are not available prior to 2014;
- LCFS emission factors only include emissions from oil and gas production and transportation (no refining, if applicable in a given year); and
- Natural Gas extraction emissions are likely included (as a biproduct of oil extraction) but transportation is not.

Final Approach

To address some of the limitations of the WellSTAR data Rincon created a hybrid methodology that will be transparent and repeatable into the future. To address one of the largest issues, the lack of oil refining emissions data, a hybrid approach can be employed. Adding refining emissions data from the MRR with emissions information with the bottom-up production data provides the most complete picture of oil and gas emissions in the County.

MRR refinery emissions data are available as far back as reporting year 2008. Figure 2 provides historical refinery emissions in Santa Barbara County. Similar to the trend in overall County oil production, refinery emissions peaked in 2015 and fell until 2020. Due to refinery closures in the County, GHG emissions due to refining have been nonexistent (0 MT CO2e per year) since 2021.

Figure 2 Annual GHG Emissions Due to Refinery Operations in Santa Barbara County



Based on the MRR and WellSTAR data, Rincon completed a detailed emissions analysis for 2018 (baseline year for the County's Climate Action Plan) and 2023 (most current year). The final emissions from this approach are shown below in Table 3. It should be noted that the refining emissions are from the Greka Santa Maria Asphalt Refinery, which utilizes waste product from oil extraction. The operation of the refinery or the extraction of oil are not directly related in a way that the cessation of one would cease the other.

Table 3 Hybrid Emissions Approach Results

Year	WellSTAR Production Emissions	MRR Refining Emissions (MT CO_2e)	Total Emissions (MT CO_2e)
2018	98,868	15,218	114,086
2023	132,356	0.0	132,356

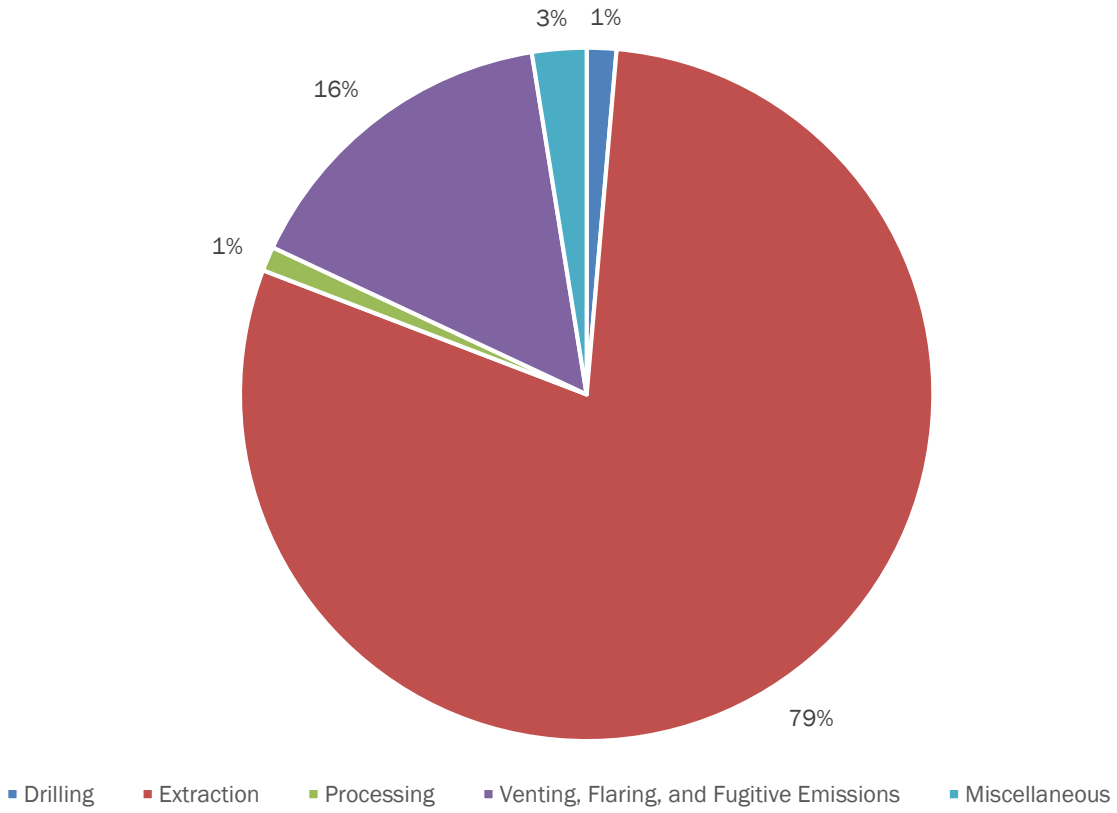
Sources of Emissions within Oil and Gas Extraction

Santa Barbara County oil fields are characterized by a long history of extraction causing depletion in the oil fields and the necessity to utilize increasingly energy intensive extraction techniques to continue production. The Cat Canyon oil field is a good case study in the evolution of oil extraction in the County. The Cat Canyon oil field is located in the Santa Maria Basin, overlying the Monterey and Sisquoc formations. Oil in Cat Canyon was initially discovered in 1908, and by 1938 typical daily production was approximately 700 barrels.[2] Today there are over 500 wells in the Cat Canyon oil field, and many wells lie dormant or plugged. Continuing extraction there requires tertiary oil recovery techniques such as thermal injection, gas injection, and/or chemical injection, as at many fields across the County.[3] Consequently, oil production at Cat Canyon is carbon and energy intensive, requiring a combination of cyclic steam injection and acidizing techniques to access the remaining heavy, viscous crude oil reserves that were unrecoverable using less energy intensive primary and secondary[4] extraction methods.[5] In 2023, CARB reported that the CI value for oil extracted from Cat Canyon was 7.83 g CO_2e/MJ, and that 175,529 barrels were produced. The trend is similar in other major oil fields in the County: in 2023 the greatest number of barrels were extracted from Orcutt oil field, which has a CI value of 11.76 g CO_2e/MJ.

Rincon used data from the Oil-Climate Index to further breakdown the oil production process and provide emissions by activity.[6] Most emissions resulting from oil and gas production in Santa Barbara County come from the extraction process, which includes generating steam or other methods for loosening and removing oil from the basin. The other large source is flaring, which includes combusting gases like methane that are released by the extraction process. The emissions by activity for oil and gas production are included in Figure 3.

[2] Roehl and Weinbrandt 1985. Geology and Production Characteristics of Fractured Reservoirs in the Miocene Monterey Formation, West Cat Canyon Oilfield, Santa Maria Valley, California.
[3] Tennyson, M.E., 2005. Growth History of Oil Reserves in Major California Oil Fields During the Twentieth Century. Bulletin 2172-H. US Geological Survey.
[4] Primary extraction relies on the natural pressure within the reservoir to bring oil or gas to the surface, while secondary extraction methods are employed when natural pressure is insufficient and consist of water and/or gas injection to displace crude oil
[5] Partridge, T., Barandiaran, J., Walsh, C., Bakardzhieva, K., Bronstein, L. and Hernandez, M., 2020. California oil: bridging the gaps between local decision-making and state-level climate action. *The Extractive Industries and Society*, *7*(4), pp.1354-1359.
[6] https://oci.carnegieendowment.org/

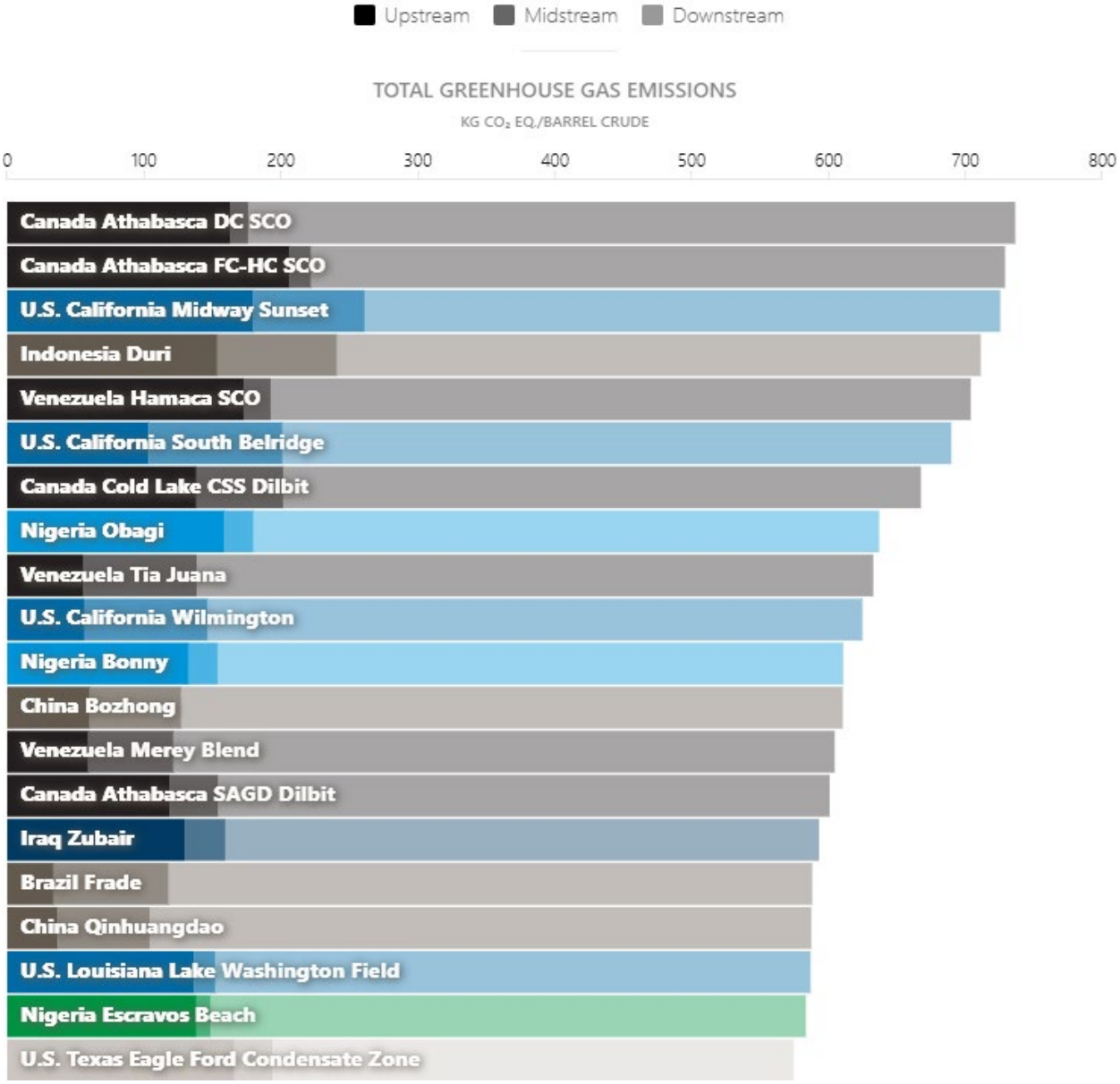
Figure 3 Emissions from Oil Production by Activity



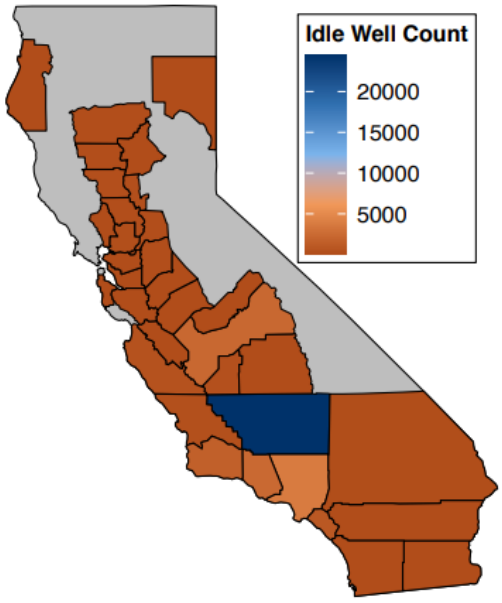
Due to the depletion of the County oil fields and relatively high GHG emissions necessary for extraction compared to global oil fields (Figure 4), extracting crude oil from Santa Barbara County oil fields is becoming increasingly unsustainable. California state crude oil production has declined steadily since 1985.[7] Similarly, oil production in the County has decreased in recent years, from its peak in 2015 (Figure 1). As crude production has decreased, the number of idle wells in the County has increased (Figure 5). Idle wells are both an environmental concern and an end-of-life cost to well operators (and potentially to the County). The State and County's active wells will change to idle status as crude oil production naturally declines and the State and County shift away from fossil fuels and toward renewables. The County could focus their efforts on removing idle wells and limiting new extraction processes while the remaining operating wells phase out over time.

[7] California Energy Commission, 2022. Petroleum Watch, March 2022.

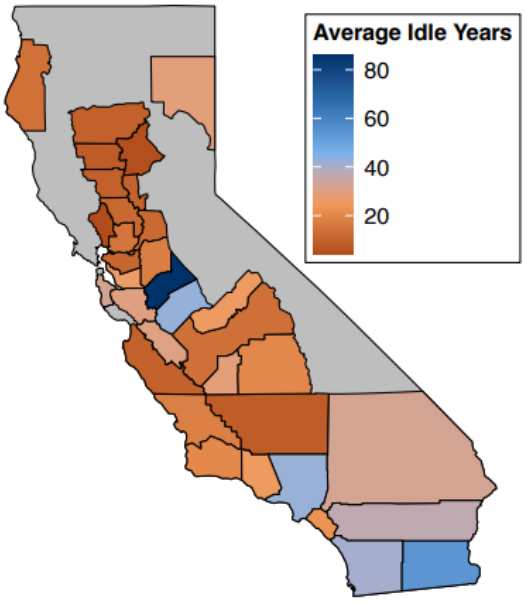
Figure 4 Total GHG Emissions per Barrel Crude for 20 Global Test Oils (Oil-Climate Index)



IDLE WELL COUNTS



AVERAGE YEARS IDLE



Source: CEC analysis of California Geologic Energy Management (CalGEM) data
Notes: Offshore Idle Wells included for the following counties: Los Angeles, Orange, Santa Barbara, Ventura

Discussion of Results

Based on Rincon's analysis, the use of WellSTAR oil production data in conjunction with refinery data from the MRR provides both a wide range of emissions sources as well as more detail into areas of oil production and overall production trends.

In general, both MRR emissions and WellSTAR production values have declined over time. Based on the data available, it appears that a decrease in offshore oil extraction as well as the end of refining operations caused the largest decline in overall emissions while oil and gas extraction peaked in 2015 and has since been decreasing. However, 2018 was an unusually low oil production and GHG emissions year for the County of Santa Barbara. Using the recommended approach of combining WellSTAR production data with refinery emissions from the MRR the total 2018 GHG emissions were 114,086 MT CO_2e. In 2023 emissions increased to 132,356 MT CO_2e due to an overall increase in production (despite a decrease in refinery emissions with the closure of Santa Maria Refinery).

Therefore, when solely looking at the CAP baseline year of 2018 and the most recent year (2023), it appears that oil and gas emissions have increased in the County. When taking a longer view (using 2008 or 2015 for example) emissions have generally been trending down due to a decrease in production and the closure of refining operations.

Expected Impacts from Adding Oil and Gas Emissions on Communitywide Inventory, Targets, and CEQA Streamlining

Expected Impacts to Communitywide Inventory, Forecast and Targets

Adding oil and gas emissions to the County's community inventory would have several impacts. The primary impacts would be increasing the baseline and current inventory emissions, forecast, and targets. Furthermore, Including oil and gas would make achieving the target more difficult because both the County's stretch target and SB32-consistent target are based on 2018 GHG emissions baselines. As shown in Figure 1, between 2008 and 2023, oil and gas production were lowest in 2018, and when compared to 2023, oil and gas GHG emissions have increased by 18,269 MT CO_2e (Table 3). Figure 6 shows the impact adding oil and gas emissions has on the inventory, forecast and targets for Santa Barbara County. This forecast assumes oil and gas emissions stay the same as they are in 2023. This variability in oil and gas production and emissions is one reason why including oil and gas in the Climate Action Plan (CAP) poses a challenge to the County's ability to achieve their GHG reduction targets.

As shown in Table 4, when County oil and gas GHG emissions are included, the existing CAP targets dictated by SB32, and self-imposed by the County, increase by 70,581 and 57,043 MT CO_2e, respectively. The GHG emissions gap in Table 4 is calculated by taking the difference between the 2030 legislation-based target or the County 2030 target and their respective baseline year emissions. The 2030 target gaps are the amount of GHG emissions reduction that must be achieved using local action, As shown in Table 4, both the state legislative and County determined 2030 target gaps increase when oil and gas emissions are included in the County inventory.

Figure 6 Effect of Oil and Gas Emissions on the GHG Inventory and Forecast (SB 32 Target)

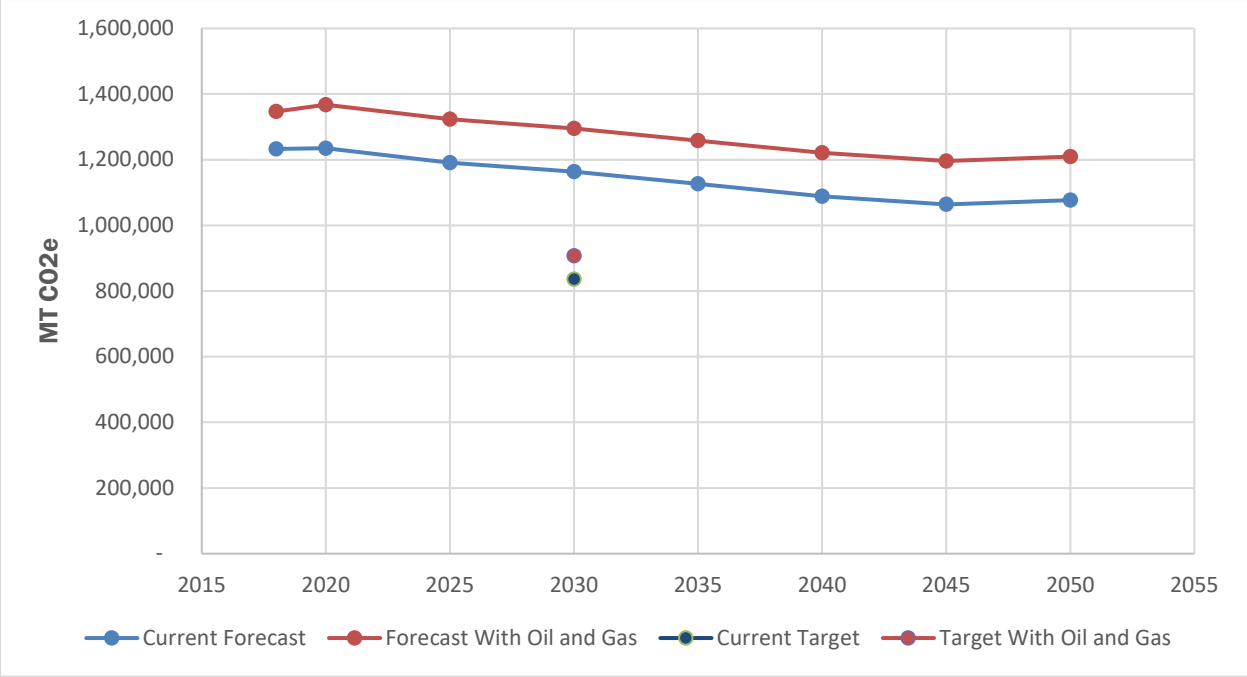


Table 4 Effects of Adding Oil and Gas GHG Emissions to County Inventories and Targets

Parameter	SB32: 40% below 1990 (MT CO_2e)	Santa Barbara County: 50% below 2018 (MT CO_2e)
Existing CAP Target	836,239	616,313
Existing Emissions Gap	326,945	546,871
New Emissions Target with O&G	906,820	673,356
New Emissions Gap with O&G	388,720	622,184
Target Emissions Gap Increase	61,775	75,313

To calculate the updated SB32 target, Rincon conducted a backcast to 1990 from 2018 using the change in emissions from the state inventory, the same methodology utilized in the CAP. However, for this backcast, Rincon included the Oil and Gas sector from the state inventory.

Expected Impacts to County Climate Action Plan

After the GHG inventory and targets are updated, Rincon would need to re-evaluate the measures and actions within the CAP to ensure that substantial evidence would be available to demonstrate the County would meet the targets. Additional GHG reductions would be needed to reduce an additional 61,775 MT CO_2e as demonstrated in Table 4. These emissions reductions would either need to come from the oil and gas industry itself, or from more aggressive reductions from the transportation and building sectors.

Expected Impacts to the CEQA Analysis

Due to the substantial changes to inventory, forecast, targets, and measures and actions, the CEQA analysis would need to be updated and recirculated for the standard 30-day public review period.

In summary, including oil and gas emissions in the existing Climate Action Plan would require revisions to inventory, forecast, targets, and GHG reduction measures. It would also require the County to increase GHG emission reductions from the oil and gas sector or another major sector such as transportation and buildings. In turn this would require updates to the CEQA analysis as well as another 30-day comment period. For any questions on this analysis, please reach out to Ryan Gardner or Lily Momper for more information.

Sincerely,
Rincon Consultants, Inc.

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Attachments

Attachment 1 MRR Top-Down GHG Emissions Analysis from 2008 to 2023

Attachment 1

MRR Top-Down GHG Emissions Analysis from 2008 to 2023

MRR Top-Down GHG Emissions Analysis from 2008 to 2023

The California Air Resources Board (CARB) requires mandatory reporting of greenhouse gas emissions (MRR) for any entity in the state of California that emits more than 10,000 MT CO_2e (metric tons of carbon dioxide equivalent) per year. The County of Santa Barbara has been using MRR data to track oil and gas emission historically and, therefore, it is included here for reference. This is considered a top-down analysis since it provides emissions at a facility level and aggregates multiple emissions sources occurring at each facility. The MRR data provides a broad analysis of the overall emissions generated by facilities that emit over 10,000 MT CO_2e (metric tons of carbon dioxide equivalent) per year. The MRR data was collected by downloading the complete list of facilities reporting to the MRR and filtering for facilities with zip codes located within Santa Barbara County.

Rincon also completed this analysis for historic years (as far back as 2008, the first year that MRR data were available) to help identify the trend in emissions over time using the MRR top-down data collection approach.

The oil and gas related facilities (production and refining) located in the County and total GHG emissions for 2018 and 2023 can be found in Table 1A and Table 2A, respectively. These tables only include facilities (including oil fields) that emit over 10,000 MT CO_2e (the reporting threshold) and therefore, these data are not exhaustive of oil and gas activities in the County.

Table 1A Top-down 2018 Petroleum Industry GHG Emissions Inventory

ARB ID[1]	Facility Name	MT CO_2e
104458	ERG Operating Company, LLC. 750 Santa Maria Basin	38,292
104459	ExxonMobil POPCO Facility	0
101674	Pacific Coast Energy Company LP	34,993
104381	Santa Maria Energy, LLC, Careaga Lease	13,139
104766	Sierra Resources Santa Barbara Basin	14,408
104783	Vaquero Energy - Santa Barbara County	22,154
104460	ExxonMobil LFC Facility	1
101155	Greka Santa Maria Asphalt Refinery	15,218
Total		**138,205**

[1]Air Resources Board Identification
Source: https://ww2.arb.ca.gov/mrr-data

Table 2A Top-down 2023 Petroleum Industry GHG Emissions Inventory

ARB ID[1]	Facility Name	MT CO_2e
104458	Cat Canyon Resources 750 Santa Maria Basin	56,761.25
101674	Pacific Coast Energy Company LP	38,339.15
104460	Sable LFC Facility	0.15
104766	Sierra Resources Santa Barbara Basin	8.12
104783	Vaquero Energy - Santa Barbara County	11,683.27
Total		**106,791.95**

[1]Air Resources Board Identification
Source: https://ww2.arb.ca.gov/mrr-data

Between 2008 and 2023, oil and gas emissions from facilities reporting to the MRR have decreased by 74% from 403,791 MT CO_2e down to 106,792 MT CO_2e. During this time multiple oil and gas extraction and refining operations have come offline or reduced their emissions to below the 10,000 MT CO_2e reporting threshold, including operations run by Aera, Exxon, and others. These facilities may still produce oil and gas but are not captured by the MRR. Figure 1A shows the changes in GHG emissions from the oil and gas sector based on the MRR data between 2008 and 2023.

Figure 1A Oil and Gas Emissions in Santa Barbara County over Time (MRR)

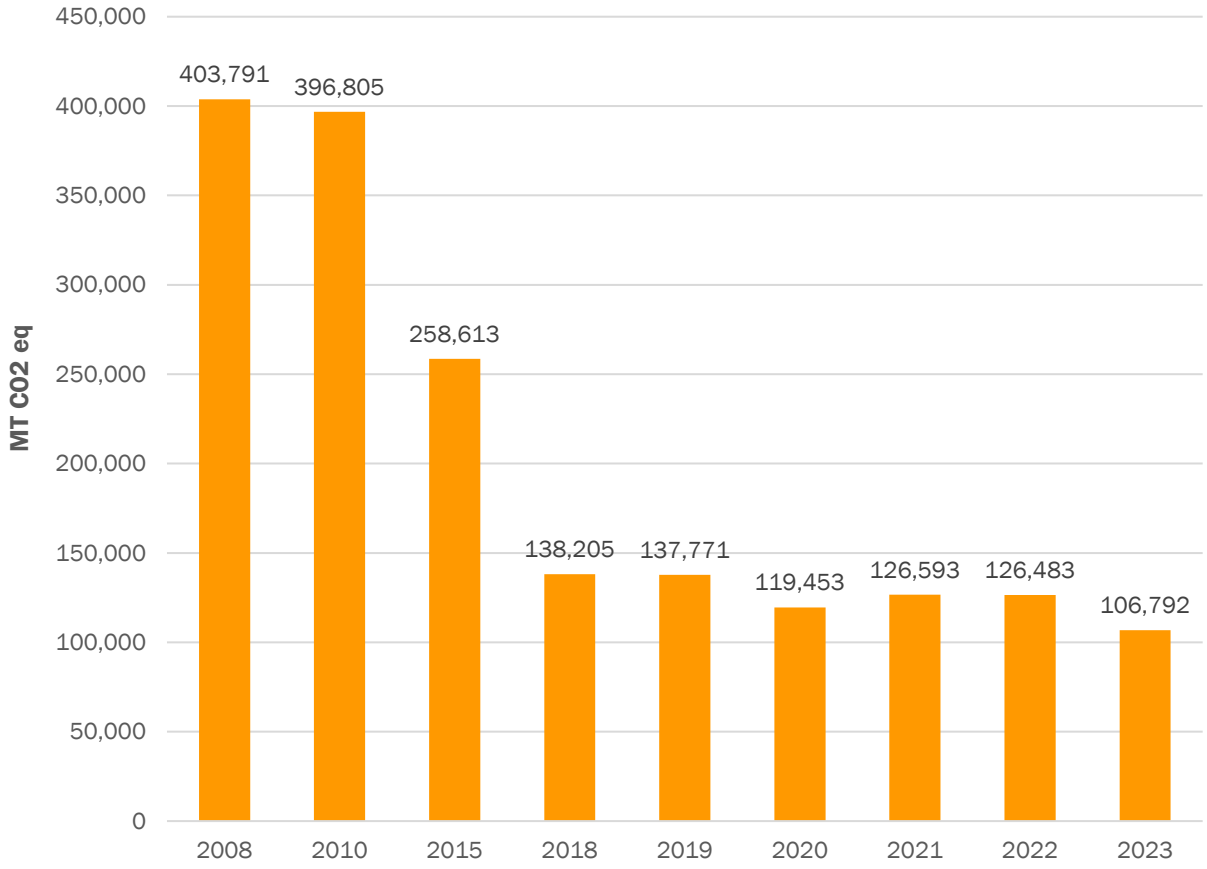

Figure 2A further breaks down the MRR data by facility type: oil and gas production, versus refinery related GHG emissions. As shown in Figure 2A and Table 3A, according to the available MRR data, refinery emissions in the County peaked in 2015, and fell to 0 MT CO_2e per year by 2021, due to closure of refinery facilities in the County.

Figure 2A Annual MRR Emissions Data from Oil and Gas Production and Refinery Operations

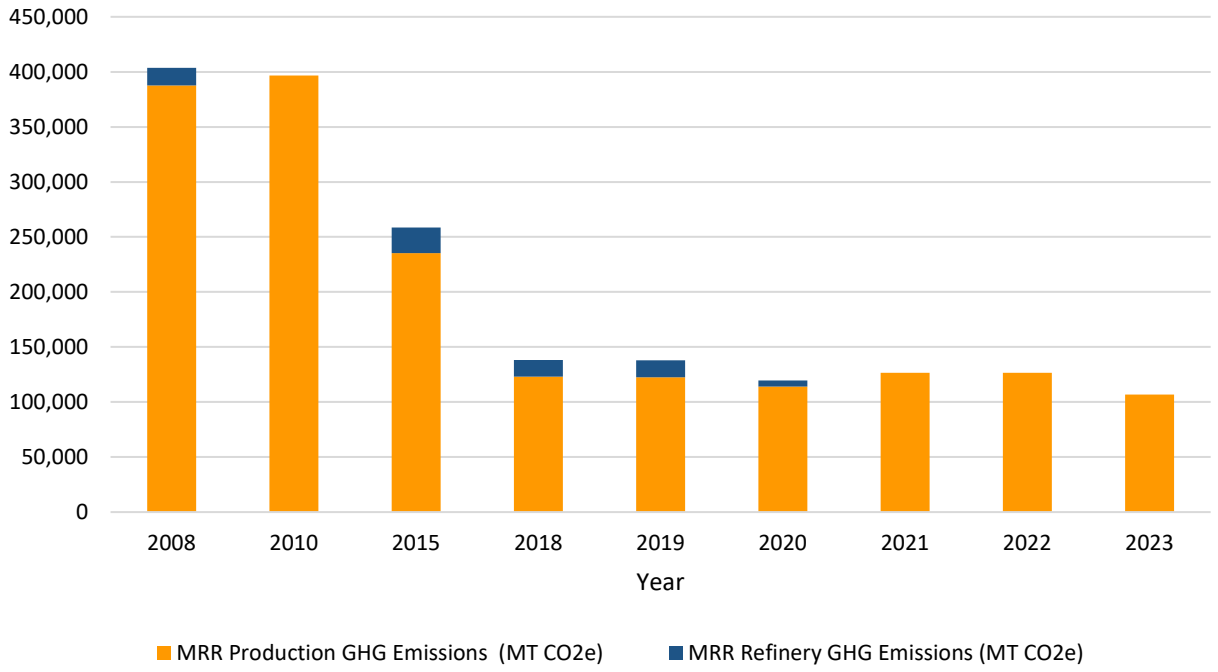

Table 3A Annual GHG Emissions due to Refinery Operations in Santa Barbara County

Year[1]	Facility Name	MT CO_2e
2008	Santa Maria Asphalt Refining Company	16,266
2010	NA	0
2015	Greka Santa Maria Asphalt Refinery	23,250
2018	Greka Santa Maria Asphalt Refinery	15,218
2019	Greka Santa Maria Asphalt Refinery	15,326
2020	Greka Santa Maria Asphalt Refinery	5,311
2021	NA	0
2022	NA	0
2023	NA	0

[1]Air Resources Board Identification

Source: https://ww2.arb.ca.gov/mrr-data