SAN FRANCISCO BAY AREA GREENHOUSE GAS TRENDS FOR YEARS 2014 - 2019

AUGUST 2021

the climate center

SAN FRANCISCO BAY AREA GREENHOUSE GAS EMISSION TRENDS FOR YEARS 2014 – 2019

By Jock Gilchrist, Ken Wells, and Ann Hancock
The Climate Center, August 2021

Executive Summary – 3.6% Overall Decrease

Between 2014 and 2019, the Bay Area reduced its greenhouse gas (GHG) emissions by 3.6% total across the four sectors that produce most of the Bay Area's climate pollution – transportation, electricity, natural gas, and solid waste. The electricity sector led with GHG emission reductions of 52% during this period.

Figure 1 shows the changes in emissions in these four sectors. Although the region's progress is trending in a positive direction, it is not nearly enough compared with scientific requirements for a life-sustaining climate. To avoid crossing the 1.5C global warming threshold set by scientists, the state must do its part by reducing its emissions about 7.7% every year between 2020 and 2030. This would put us on track for ~80% below 1990 levels of GHG emissions and, when coupled with nature-based sequestration at scale during this decade, net-negative emissions by 2030. (Read more here.) Our aim in reporting these trends is to call attention to the Bay Area's climate status and to build support for accelerated action. The longer action is delayed, the more challenging it will be to achieve needed reductions.

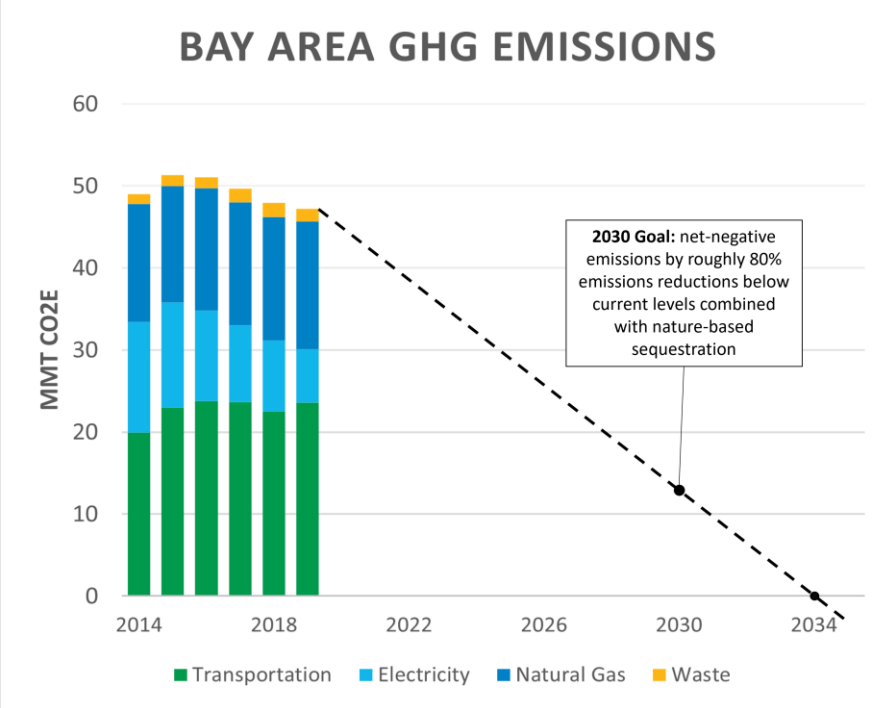

Figure 1. The Bay Area's emissions in 4 key sectors across the Bay Area between 2014 and 2019. The dashed line indicates emissions reductions required by science for this region to do its part in the global effort to maintain a life-sustaining climate.

For this report, we used a simple and replicable method based on publicly available data to show GHG emission trends and compared them with the required emissions reductions for a safe climate. The methodology section of this report provides descriptions of the approach and data sources we used. A spreadsheet of data on which this report is based is available here.

Contents

Key Findings by Sector

Transportation – 18.6% Increase

Transportation emissions increased 18.6% from 2014 to 2019 in the Bay Area. The transportation sector continues to produce the most emissions and provides the greatest opportunity for GHG reductions.

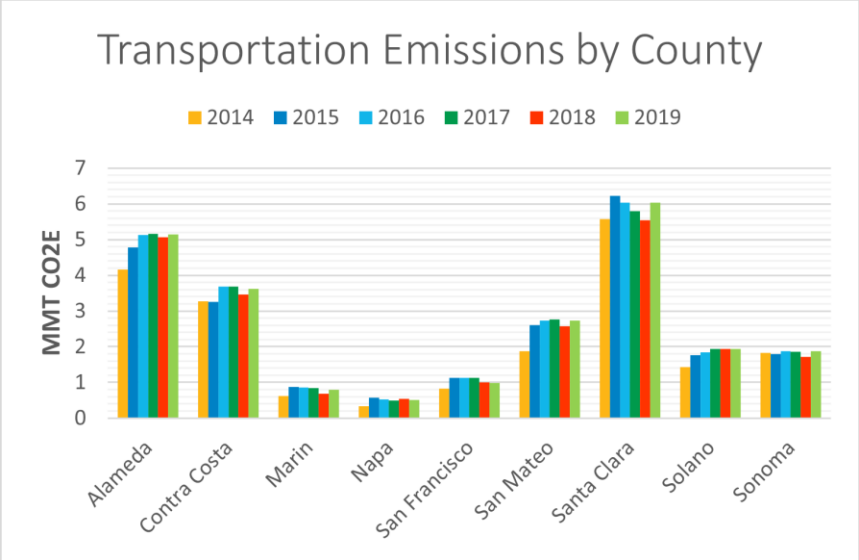

Figure 1. Transportation emissions in each Bay Area county between 2014 and 2019.

Electricity – 52% Decrease

Electricity sector emissions dropped 52% in the Bay Area from 2014 to 2019, with a significant 25% reduction between 2018 and 2019 alone. The major decrease in carbon intensity of electricity is driving net emissions reductions across the Bay Area (Figure 3). Some counties even increased total electricity usage while still dropping their electricity emissions, demonstrating that emissions intensity reductions are outpacing generation growth in those locales.[1]

The primary driver of reductions in this sector has been Community Choice Energy. Starting in 2010, Community Choice Energy agencies offered an alternative to PG&E with lower-GHG electricity. As the customer load shifted from PG&E to Community Choice, PG&E was able to shed its electricity contracts from higher-GHG sources and consequently deliver a higher proportion of nuclear-generated electricity to its remaining customers. (Community Choice agencies declined to purchase nuclear-generated electricity.) Nuclear has a lower GHG profile per kilowatt hour than other conventional electricity sources. The most precipitous decrease in PG&E's GHGs occurred in 2019 when its electricity sources were primarily nuclear and large hydroelectric facilities. When the Diablo Canyon nuclear generation station closes in 2025, PG&E will need to replace nuclear power with renewable energy to remain a low-carbon electricity provider.

Another factor that could be impacting emissions from electricity is precipitation. Rainfall was low in early years and higher in later years of the report timeframe. More precipitation results in greater amounts of emissions-free hydroelectric power generation. This factor likely influenced electricity emissions in recent years, leading to a favorable but temporary impact (assuming present drought conditions persist) on GHG emissions.

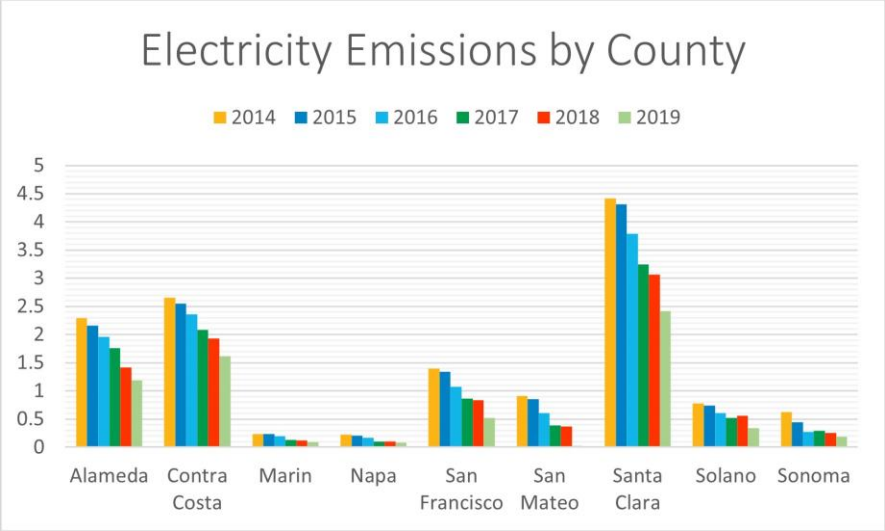

Figure 2. Electricity emissions in each Bay Area county between 2014 and 2019.

[1] Accuracy of electricity GHG emissions is impacted by underlying issues relating to the accounting protocols used. More information about these issues is provided in the spreadsheet accompanying this report and in the Methodology section.

Natural Gas – 8.9% Increase

In recent years, as the electricity sector's emissions have decreased, the carbon footprint of the natural gas sector has surpassed that of electricity. Natural gas use increased nearly 9% in the Bay Area from 2014 to 2019. This trend is concerning because methane gas, released during natural gas production and use, is about 80 times more powerful than carbon dioxide as a planet-warming greenhouse gas on a 20-year timespan. Contra Costa's disproportionately high natural gas use is caused by its petroleum processing industry. This sector's increase in emissions underscores the need for more incentives for switching from natural gas to electricity and for natural gas use to become more efficient.

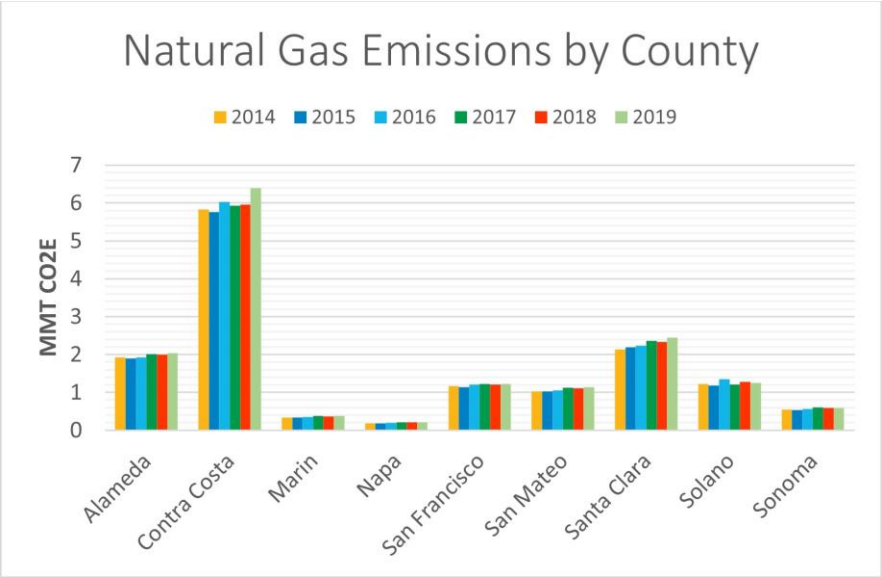

Figure 3. Natural gas emissions in each Bay Area county between 2014 and 2019.

Solid Waste – 25.8% Increase

The overall 6-year trend for solid waste emissions is an increase of about 26%. Although solid waste emissions rose significantly, they comprise a small portion of overall Bay Area emissions. The dramatic increase in Sonoma and Napa's solid waste emissions in 2017 and 2018 reflects the disposal of large amounts of wildfire debris. A similar spike in solid waste emissions due to more wildfires in 2020 is expected for these North Bay counties.

Our use of established emissions accounting protocols for the solid waste sector may overestimate emissions for two reasons. First, it is unlikely the increased landfill disposal of wildfire-related debris generated the GHG emissions attributed to it because the debris is inert, having already released the embedded GHGs during the combustion of homes and other structures. Second, the increasing diversion of organic, methane-generating waste from landfills has likely reduced actual GHG emissions from the remaining waste going to landfill on which data for this report is based.

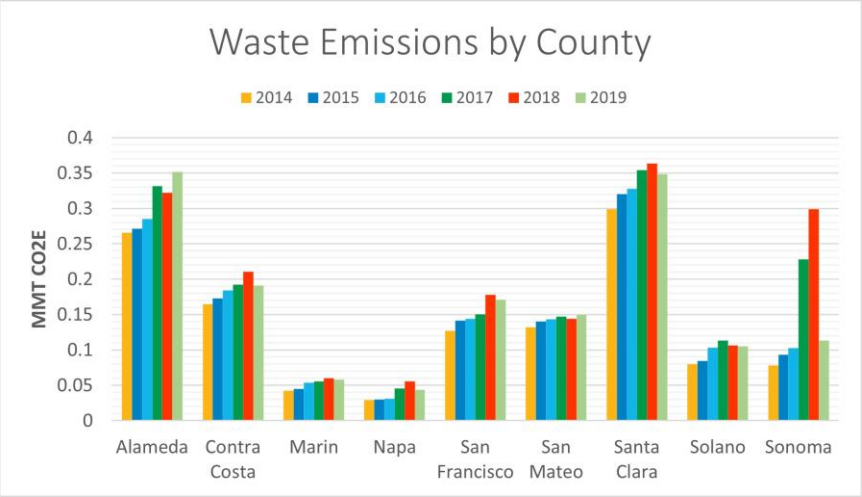

FIGURE 4. WASTE EMISSIONS IN EACH BAY AREA COUNTY BETWEEN 2014 AND 2019.

FINDINGS AND DISCUSSION

Between 2014 and 2019, the Bay Area reduced its emissions by about 3.6% (Table 1). The region made meaningful progress in reducing its electricity emissions, dropping them 52% between 2014 and 2019. This has largely been driven by Community Choice agencies coming online that deliver low-carbon electricity and by a nearly decarbonized PG&E electricity supply in 2019 (due to Community Choice impacts).

Year	Total GHGs (MMT CO2e)	Total GHGs (Metric Tons/capita)	GHG change compared to previous year	GHG change, 2014-2019
2014	49.01	6.49	-	-3.61%
2015	51.33	6.72	5.05%	
2016	51.09	6.63	-0.28%	
2017	49.64	6.42	-2.61%	
2018	47.95	6.19	-3.26%	
2019	47.24	6.11	-0.86%	

TABLE 1. BAY AREA-WIDE EMISSIONS TRENDS DATA IN 4 KEY SECTORS FOR 2014 THROUGH 2019.

A lack of progress in other sectors – emissions increased in the other three – diluted the benefits of electricity decarbonization. **To match a global emissions reductions pathway that avoids 1.5C of warming, all sectors should be shrinking their GHG footprints at the same rate as the electricity sector** instead of holding steady or growing.

To provide context to these emission figures, 2020 wildfires in California emitted more than 110 MMT CO_2e,[2] the worst ever measured and far exceeding the state's and Bay Area's modest emissions reductions. Regular, low- to moderate-intensity wildfires are a part of earth's natural carbon cycle. But following a

[2] https://ww3.arb.ca.gov/cc/inventory/pubs/ca_ghg_wildfire_forestmanagement.pdf

century of fire suppression coupled with more severe drought and heat from climate change, forests are in poor health with fuel loading conditions prone to high severity wildfires. The emission impacts of catastrophic wildfires underscore the urgency of economy-wide decarbonization.

California outperformed the Bay Area for GHG emissions reductions for the 2014-2019 time period, according to statewide 2019 emissions data from the California Air Resources Board (Table 2). One explanation is that economic activity in the Bay Area likely outperformed California as a whole.[3] GHG emissions tend to be directly correlated with economic activity. California has proven that decoupling GHG emissions from economic activity is possible, although concerted efforts, including policy changes, are required to ensure such decoupling.[4]

	2014 (MMT CO_2e)	2018 (MMT CO_2e)	2019 (MMT CO_2e)	2014 – 2019 Emissions Change (%)	2018 – 2019 Emissions Change (%)
U.S.[5]	6825	6671	6558	-3.9	-1.7
California[6]	443.0	425.2	418.2	-5.6	-1.7
Bay Area	49.0	48.0	47.3	-3.6	-1.5

TABLE 2. COMPARISON OF EMISSIONS IN THE U.S., CALIFORNIA, AND BAY AREA IN 3 SELECT YEARS, AND CALCULATION OF EMISSIONS CHANGES OVER SELECT TIMEFRAMES.

As discussed below, emissions reductions at Bay Area, state, and national levels are not keeping pace with reductions required for a 1.5C-or-less warming pathway.

Variations among the nine counties are evident based on data generated for this report. The City and County of San Francisco, the top-performing jurisdiction, reduced its overall emissions by about 18% from 2014 to 2019. At the same time using the same metrics, Napa County's emissions increased by about 9%. Both counties' emissions in the electricity sector decreased by 37%. Emissions in the other three sectors increased for both counties. The factor that made the big difference was transportation. For San Francisco, emissions in this sector increased 19% while in Napa County they increased 51%. Analysis beyond the scope of this report is needed to determine the cause of performance variations among the nine Bay Area counties.

Businesses must closely track their financial bottom line to operate profitably and avoid bankruptcy. Similarly, governments from local to global must track their GHG emissions as part of the worldwide effort to sustain a habitable planet.

Challenges currently exist in local GHG tracking. The process generally entails a substantial investment of time and funds from local governments. Inconsistencies in methodology make apples-to-apples comparisons across jurisdictions difficult. Recent research shows that cities nationwide underreport their GHG emissions by an average of 18%.[7]

---

[3] https://www.vitalsigns.mtc.ca.gov/economic-output
[4] https://ww3.arb.ca.gov/cc/inventory/pubs/reports/2000_2019/ghg_inventory_trends_00-19.pdf
[5] https://cfpub.epa.gov/ghgdata/inventoryexplorer/#allsectors/allsectors/allgas/econsect/all
[6] https://ww2.arb.ca.gov/ghg-inventory-data
[7] https://www.nature.com/articles/s41467-020-20871-0

Rather than a piecemeal approach where local governments spend their limited resources to produce an occasional inventory, policymakers should consider having the California Air Resources Board produce regular GHG inventories for all cities and counties in the state using a standardized methodology. **Centralization of GHG inventories would vastly increase the efficiency, cost effectiveness, accessibility, and reliability of local GHG tracking**. Also, such reporting would likely garner heightened public attention for the results.

Emission Reductions for a Life-Sustaining Climate

California's Fourth Climate Change Assessment predicts severe impacts to the Bay Area under warming scenarios. Effects are expected to include longer and deeper droughts; less frequent but more intense storms; sea level rise of 0.74m to 1.37m (or more if Antarctic ice sheet tipping points are reached); damage to ecosystems and natural coastal buffers; greater energy demand; and extensive damage to infrastructure like wastewater treatment facilities, roads, and gas and electricity grid components.[8]

To avoid crossing the 1.5C global threshold of dangerous warming set by climate scientists, the state must do its part by reducing its emissions by roughly 7.7% every year between 2020 and 2030 (Figure 1). The largest emissions drop seen in the Bay Area between 2014 and 2019 was between 2017 and 2018, when emissions decreased by 3.3%. **For a climate-safe pathway, the Bay Area as well as California must do better and decrease its emissions 7.7% every year for the next decade.**

A recent study by world-renowned climate scientists and other experts validates the urgency of California's climate action, including the goal of net-negative emissions by 2030.[9] The study includes a model scenario for California to reach this 2030 goal.

Solutions exist to realize these reductions in the necessary timeframe. What is currently missing is the political will to enact the needed economy-wide shifts, unprecedented resource mobilization, and coordinated state policies. Even so, **the costs of inaction far outweigh the costs of action**. The Climate Center's Climate-Safe California Campaign is designed to deliver the just, ambitious, and innovative policies for these emissions reductions.[10]

[8] https://barc.ca.gov/sites/default/files/documents/2020-12/20190116-sanfranciscobayarea.pdf

[9] https://arxiv.org/abs/2103.07801

[10] https://theclimatecenter.org/climatesafeca/

METHODOLOGY

We used a simple, transparent approach to quantify GHG trends, focusing on four sectors that can be monitored with relative ease while still capturing between 70% and 90% of Bay Area emissions (excluding consumption-based emissions). This methodology is based on publicly available data that are collected using a consistent approach, thus allowing emissions trends to be observed and updated regularly to monitor progress. Our approach avoids much of the complexity involved in widely used GHG accounting protocols.[11]

TRANSPORTATION

Vehicle transportation emissions were calculated using the California Energy Commission's retail sales for gasoline and diesel for each Bay Area county during the 6 years analyzed. Gallons were converted into GHG emissions using standardized Energy Information Administration rates for E10 fuel (gasoline with 10% ethanol) and standard diesel. The percentages if ethanol and biodiesel blended into gasoline and diesel respectively were taken into consideration in accordance with CARB guidelines.[12]

GREENHOUSE GAS ACCOUNTING IS NOT PRECISE.

The accuracy of GHG emission calculations varies from sector to sector. For example, electricity and natural gas calculations are more accurate, and transportation less. For transportation, there is no way at present to accurately and cost-effectively measure the tailpipe GHG emissions of vehicles as they travel within the Bay Area. We must rely on proxy measures and make estimates.

By using a consistent methodology to calculate GHG emissions we can detect trends, and **by focusing on overall trends and order-of-magnitude differences in the four major sectors that produce GHG emissions, we can determine the most effective pathway to reduce emissions.**

Retail gasoline sales represent most of the gasoline consumed for surface transportation. In contrast, retail diesel sales are a small portion of total diesel consumed for surface transportation. For example, they do not include commercial trucking operations. For purposes of tracking trends in the transportation sector, gasoline and diesel retail sales provide consistent year-to-year data.

ELECTRICITY

For GHG emissions from electricity consumption, the data for the nine Bay Area counties is drawn from several sources. The California Energy Commission (CEC) reports electricity consumption for each county. Within each county, electricity is provided to business and residential customers from a variety of sources, segregated into three categories for this analysis:

(1) PG&E, the local Investor-Owned Utility,

[11] https://ceq.doe.gov/guidance/ghg-accounting-tools.html

[12] One uncertainty in calculating GHGs from gasoline and diesel fuel demand is that both are blended with non-petroleum-based fuels. Gasoline has up to 10% ethanol, derived from corn fermentation. If, in the emissions intensity factor, the corn ethanol is considered "renewable" with only biogenic carbon, it ignores the fossil fuels used to farm the corn and to ferment, distill, and transport the ethanol. Overall, it may be no more "biogenic" than gasoline from petroleum. Similarly, the State now claims diesel contains 27% biodiesel. This equates to about 800 million gallons per year of biodiesel. We do not currently know how this vast volume is produced, and if the GHGs needed to produce it are fairly accounted for in the emission intensity factor.

(2) Community Choice Aggregation agencies, and
(3) Unspecified, which includes Direct Access customers and municipal electricity providers.

To calculate the GHG emissions from electricity, two factors are used: the quantity of electricity consumed and the emissions intensity of the electricity consumed. Each generation source, such as natural gas, hydroelectricity, nuclear, geothermal, solar, and wind, has its own emissions factor, which expresses the carbon intensity of each source in pounds of CO_2/MWh. Emissions intensity for an electricity provider is determined by the power mix from the provider's generation sources.

The mix and quantity of electricity purchased from each generation source for every Load Serving Entity (LSE) is reported to the California Energy Commission each year in the Power Source Disclosure report.[13] The Community Choice Aggregation (CCA) emission factors came from the CCA itself or from an estimate based on the Power Source Disclosure report. Unspecified were assigned the emissions factor of "Unspecified Sources" provided by the California Air Resources Board, representing the average GHG emission factor for electricity used in California.

Each LSE and CCA procured electricity for their customers from some mix of sources, such as geothermal, natural gas, wind, and solar. By combining the percentage of electricity that came from a particular source with each source's emissions factor, we arrived at a total emissions factor for each electricity provider for a given year. For example, in 2019, Sonoma Clean Power generated its CleanStart electricity from geothermal (18%), solar (8%), wind (25%), large hydropower (46%), and unspecified sources (3%). These sources have emissions factors, respectively, of 53, 0, 0, 0, and 944 lbs/MWh, leading to a 2019 emissions factor for Sonoma Clean Power electricity of 39 lbs/MWh. (For reference, coal-derived electricity has the highest emissions factor at 2,190 lbs/MWh.) This emissions factor is converted to metric tons and multiplied by total generation to determine Sonoma Clean Power's 2019 GHG footprint.[14]

Natural Gas

For natural gas consumption, the dataset is based on the Natural Gas Consumption reports for the nine Bay Area counties collected by the California Energy Commission.

Unlike electricity, the emissions intensity of natural gas is generally consistent, although gas from tar sands and other similar sources may have a higher emissions intensity.

---

[13] The accuracy of these GHG emissions is impacted by underlying issues relating to the accounting protocols used. PG&E purchased massive amounts of excess energy in 2019 including natural gas. But it reported none of the natural gas power it delivered to the grid because California Energy Commission rules require that electric providers such as PG&E report only 100% of the energy it buys to serve the load (not the excess power purchased), and that RPS (Renewable Portfolio Standard) eligible renewable energy, hydro and nuclear be reported first before natural gas or coal. Additionally, PG&E (like most load-serving entities) reports its geothermal and biomass sources as having zero GHGs rather than reporting their actual emissions. This discrepancy may lead to an underestimation of the carbon intensity of PG&E's electricity and an overestimation of the climate progress in the electricity sector in the Bay Area. With the passage of AB 1110, new GHG reporting protocols will soon rectify some of the issues regarding the accuracy of GHG emission accounting for electricity. The data used for this report are from the Power Source Disclosure Report available from the California Energy Commission as the best available data.

[14] To view data for all entities, see the Excel dataset available at theclimatecenter.org.

Weather fluctuations impact natural gas GHG emissions because weather alters the amount of energy used for heating and cooling. Natural gas usage reflects this most clearly with milder winters showing reduced GHG emissions from natural gas, while cold and wet winters exhibit increases.

Solid Waste

The amount of organic material buried in the landfill, and the management of the methane from decomposing landfilled organic waste determine the amount of GHG emissions produced from solid waste. For this analysis, the estimated GHG emissions from landfilled solid waste from each county were determined using the CalRecycle Disposal Reporting System data and the USEPA WARM Version 14 GHG from Landfill Waste emission factor.

Not Included in This Report

By limiting this report to the four sectors described above, it excludes other GHG sources such as agricultural emissions and consumption-based emissions, the latter of which are thoroughly addressed in an inventory developed by the Bay Area Air Quality Management District (BAAQMD) in collaboration with researchers at UC Berkeley.[15]

Given the methodology used for this report, emissions sectors are categorized differently from breakdowns used by other agencies such as the California Air Resources Board (CARB). CARB's statewide inventories include categories such as Commercial & Residential, Electricity Generation, and Industry. Although our report does not categorize emissions using the same breakdown as CARB's, our report nonetheless captures most of the emissions from these sectors. For example, CARB's Commercial & Residential sector emissions largely come from building electricity and natural gas use. Our report captures these emissions in our Electricity and Natural Gas categories. Similarly, CARB's Industry category produces emissions from electricity and natural gas, which are mostly captured in our Electricity and Natural Gas categories. Our report does not capture all transportation emissions, for example air travel, nor does it capture emissions from sources such as hydrofluorocarbons.

Population

We used population figures to calculate per capita emissions, shown in the spreadsheet accompanying this report. Between 2018 and 2019, the population of 6 of the 9 Bay Area counties began decreasing based on 2010 US Census projections. This results in an overall net Bay Area population decrease of 0.3% between 2018 and 2019, a reversal of the consistent growth observed in prior years.

Other Bay Area GHG Emissions Tracking

Other efforts to track Bay Area emissions include the Metropolitan Transportation Commission's Vital Signs report,[16] the BAAQMD's Consumption-Based Inventory (reference 8) as well as the inventory in the BAAQMD's 2017 Clean Air Plan which is based on 2011 data.[17]

The Climate Center has issued occasional GHG reports for Sonoma County and the Bay Area since 2004. To our knowledge, this report of Bay Area GHG Trends 2014-2019 is the most up to date for the region.

---

[15] https://www.baaqmd.gov/about-air-quality/research-and-data/emission-inventory/consumption-based-ghg-emissions-inventory

[16] https://www.vitalsigns.mtc.ca.gov/greenhouse-gas-emissions#chart-0

[17] https://www.baaqmd.gov/about-air-quality/research-and-data/emission-inventory/climate-forcing-pollutants

SOURCES

A spreadsheet with data used for this report, along with a discussion of the factors and methodology used to calculate emissions, are available at https://theclimatecenter.org/san-francisco-bay-area-greenhouse-gas-emission-trends-for-2014-2019/.

California Energy Commission: Retail Fuel Outlet Annual Reporting
https://ww2.energy.ca.gov/almanac/transportation_data/gasoline/piira_retail_survey.html

The Climate Registry (electricity emissions coefficient data)—to access this data, go to www.climateregistry.org, public reports, view public reports, access public reports, Pacific Gas and Electric.

California Energy Commission: Electricity Consumption by County
http://www.ecdms.energy.ca.gov/elecbycounty.aspx

California Energy Commission: Natural Gas Consumption by County (1990-2015)
http://www.ecdms.energy.ca.gov/gasbycounty.aspx

ACKNOWLEDGMENT

Special thanks to MTC and Dave Vautin for the MTC's Vital Signs work. It provided a model and invaluable source information for this report. BAY AREA METRO | BayAreaMetro.gov Association of Bay Area Governments, Metropolitan Transportation Commission http://www.vitalsigns.mtc.ca.gov/greenhouse-gas-emissions

Thank you to Julianne Alontave and Cam-Giang Nguyen, California Energy Commission; to Rebecca Simonson, Sonoma Clean Power; Amanda Begley, former staff member at The Climate Center; and Ed Myers, consultant; for their support for this report.

AUTHOR BIOGRAPHIES

Jock Gilchrist is the Research and Initiative Manager at The Climate Center, and holds an M.S. in Environmental Science and Policy, with a concentration in climate change policy, from Johns Hopkins University. In 2020, Jock was an E2 1 Hotels Fellow and received a grant to research policy and market mechanisms to scale the adoption of regenerative agriculture. His previous research has focused on electric vehicles, ecological rationality, and wolf reintroductions. He is an avid musician and outdoorsman and lives in Seattle, Washington.

Ken Wells is a sustainability consultant with expertise in recycling, composting, solid waste management, greenhouse gas emissions and renewable energy production. He was the Executive Director of the Sonoma County Waste Management Agency and, concurrently, Integrated Waste Manager for the Sonoma County Department of Transportation and Public Works for 16 years. Ken has a B.S. in Environmental Resources Engineering and a B.A. in Environmental Economics, both from Humboldt State University.

Ann Hancock in 2001 co-founded The Climate Center and was its Executive Director until 2019 when she recruited a new CEO and became Chief Strategist. Ann holds a master's degree in Public Health Administration and Planning from the University of California, Berkeley.