City of Palo Alto (ID # 14174)

City Council Staff Report

Meeting Date: 4/11/2022

Council Priority: Climate/Sustainability and Climate Action Plan

Title: Annual Earth Day Report Study Session

From: City Manager

Lead Department: Public Works

Recommendation

This report is intended to support discussion and no action is requested.

Executive Summary

Consistent with Council's adoption of "Climate Change – Protection and Adaptation" as one of the four priorities for calendar year 2022, staff is updating the Sustainability and Climate Action Plan (S/CAP) to help the City meet its sustainability goals, including its goal of reducing greenhouse gas (GHG) emissions 80 percent below 1990 levels by 2030 (the "80 x 30" goal). The S/CAP Ad Hoc Working Group Teams are pursuing a deeper dive into four areas that will advance our residential building electrification goals: Engagement, Technology, Finance, and Community Scale.

Cities represent the single greatest opportunity for tackling climate change, as they are responsible for 75 percent of global energy-related carbon dioxide emissions[1]. In 2020, Palo Alto emitted an estimated 387,287metric tons (MT) of carbon dioxide equivalent (CO_2e) from the residential, commercial, industrial, transportation, waste, water, and municipal sectors.[2] In comparison to the 1990 base year emissions (which were about 780,000 metric tons), that is a 50.4 percent decrease in total community emissions, despite a population increase of 21.8 percent during that same time period. The 2020 GHG inventory includes pandemic impacts - such as reduced vehicular traffic - resulting in emissions reductions that may be temporary.

[1] https://www.unep.org/explore-topics/resource-efficiency/what-we-do/cities/cities-and-climate-change

[2] Carbon dioxide equivalent is a unit of measure that normalizes the varying climate warming potencies of all six GHG emissions, which are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). For example, one metric ton of nitrous oxide is 210 metric tons of CO_2e.

The full 2020 GHG inventory can be found in Attachment A: 2020 Greenhouse Gas Inventory. A full comparison between the 1990 and 2020 inventories can be found in Attachment B: 1990 vs. 2020 Greenhouse Gas Emissions by Sector and Subsector.

Background

In April 2016, City Council adopted the ambitious goal of reducing GHG emissions to 80 percent below 1990 levels by 2030[3] (the "80 x 30" goal) - 20 years ahead of the State of California 80 x 50 target, and an interim step towards California's new statewide goal of achieving carbon neutrality by 2045[4]. In November 2016 the Council adopted the S/CAP Framework[5], which has served as the road map for achieving Palo Alto's sustainability goals. In December 2017, Council accepted the 2018-2020 Sustainability Implementation Plan "Key Actions" as a summary of the City's work program[6].

In early 2020, the City launched an S/CAP update to determine the goals and key actions needed to meet its sustainability goals, including the 80 x 30 goal. While GHG emissions reduction is not the only goal of the S/CAP, it is the major one. As a result of various City-led initiatives, programs, and activities focused on climate change and sustainability, by the end of 2020 Palo Alto reduced GHG emissions an estimated 50.4 percent from the 1990 baseline, despite a population increase of 21.8 percent during that same time period.

Discussion

The City is fully committed to a sustainable future. The City owns, operates, and maintains a full-service utilities portfolio that provides electric, natural gas, fiber, water, and wastewater services to residents and businesses in Palo Alto. Palo Alto's continued leadership in advancing sustainability commitments has succeeded mainly because of the continued collaboration of community stakeholders, City departments, and the leadership of the City Council.

Staff presented a Progress Report on the Sustainability and Climate Action Plan Update and S/CAP Ad Hoc Committee Work[7] to Council on December 13, 2021. Council and the Utilities Advisory Commission (UAC) held a joint study session[8] to discuss sustainability and utility related items on March 7, 2022.

[3] https://www.cityofpaloalto.org/news/displaynews.asp?NewsID=3534&TargetID=268

[4] In September 2018, Governor Brown signed California Executive Order B-55-18, setting the goal of achieving carbon neutrality as soon as possible, and no later than 2045. The state is to maintain net negative net emissions after 2045, meaning that GHG sinks must exceed GHG sources. The Executive Order explains that the carbon neutrality goal is layered on top of the state's existing commitments to reduce greenhouse gas emissions 40% below 1990 levels by 2030 (as codified in SB 32), and 80% below 1990 levels by 2050.

[5] https://www.cityofpaloalto.org/civicax/filebank/documents/60858

[6] https://www.cityofpaloalto.org/civicax/filebank/documents/63141

[7] https://www.cityofpaloalto.org/files/assets/public/agendas-minutes-reports/reports/city-manager-reports-cmrs/2021/id.-13765-s-cap-update.pdf

[8] https://www.cityofpaloalto.org/files/assets/public/agendas-minutes-reports/agendas-minutes/city-council-agendas-minutes/2022/20220307/20220307pccsmamendedfinal-linked.pdf

S/CAP and Residential Building Electrification

As the work of the S/CAP Ad Hoc Committee has progressed, it has become clearer that residential building electrification is a key area of focus if the City is to meet the 80 x 30 goal. Relative to the transition to Electric Vehicles already in process largely due to market forces, Palo Alto is in the very early stages of residential building electrification. Moreover, recent discussions have emphasized the importance of planning and implementing the improvements to the electrical grid necessary to support widespread electrification. The Utilities Department is working to address the grid infrastructure challenge, but it is critical for this work to occur in parallel with electrification efforts that are part of the strategy for the 80 x 30 goal. Additionally, the City's permitting and inspection processes for electrification projects must be able to scale efficiently for broader implementation.

The S/CAP Ad Hoc Working Group Teams are pursuing a deeper dive into four areas that will advance our residential building electrification goals:

- *Engagement.* The goals of this team include fine-tuning messaging on residential building electrification and developing a strategy and timeline for engagement.
- *Technology.* The goals of this team include reviewing current and emerging technologies and their feasibility for meeting the demands of a typical home and developing a strategy. The team will also consider the influence of electrification technologies that are implemented on the electrical grid improvements that are needed.
- *Finance.* The goals of this team include prioritizing the most feasible funding strategies and developing a strategy for financing S/CAP Implementation.
- *Community Scale.* The goals of this group include developing a strategy for piloting residential building electrification before full-scale implementation, with an emphasis on ensuring that the strategy begins to build significant momentum while also acknowledging electrical grid improvement needs. The team will also evaluate the full-scale implementation plan.

This work will be incorporated into the S/CAP Goals and Key Actions and Three-Year Work Plan. Grid modernization will be an important part of the teams' discussions, particularly the Technology team. The teams will be exploring different available policy options and technologies for managing electric system capacity while making it possible to move forward with residential electrification as rapidly as possible.

Recognizing the importance of the Working Group Team discussions, and acknowledging prior discussions with Council and UAC, the Ad Hoc Committee and staff developed a revised S/CAP timeline and a new residential building electrification timeline. Once the Council identifies a complete set of proposed S/CAP Goals and Key Actions, California Environmental Quality Act (CEQA) evaluation can commence.

The key milestones of the S/CAP and Residential Building Electrification Timeline include:

- April 2022: Launch Climate Pledge
- May 2022: Identify complete set of S/CAP Sustainability area Goals and Key Actions

- June 2022: Working Group Teams wrap-up recommendations
- July 2022: Refine proposed S/CAP Goals & Key Actions and revise Three-Year Work Plan with Working Group recommendations, draft S/CAP Report
- Mid-August 2022: Palo Alto Climate Action Summit, Climate Day of Action
- Late September 2022: Council Approval of Proposed S/CAP Goals and Key Actions and revised Three-Year Work Plan, Council review of draft S/CAP Report
- Late September 2022: Council Approval of Building Electrification Pilot and Long-Term Plan
- Late September 2022: Start California Environmental Quality Act (CEQA) evaluation of S/CAP
- March 2023: CEQA review completed
- April 2023: Council certification of CEQA and adoption of S/CAP

Palo Alto's 2020 Greenhouse Gas Emissions Inventory

Cities represent the single greatest opportunity for tackling climate change, as they are responsible for 75 percent of global energy-related carbon dioxide emissions, mostly from transportation and buildings. The first step for cities to realize their potential is to identify and measure where their emissions come from.

Staff recognizes that these are unprecedented times created by the coronavirus pandemic. COVID-19 has brought disruption to cities and communities across the globe. On March 16, 2020, six Bay Area Counties - including Santa Clara – issued coordinated shelter-in place orders that were not phased out until more than two months later. The shelter-in place order, as well as changes in how and where people worked, greatly impacted energy use, vehicle miles traveled, and carbon dioxide emissions. The 2020 GHG inventory includes these pandemic impacts, resulting in emissions reductions that may be temporary.

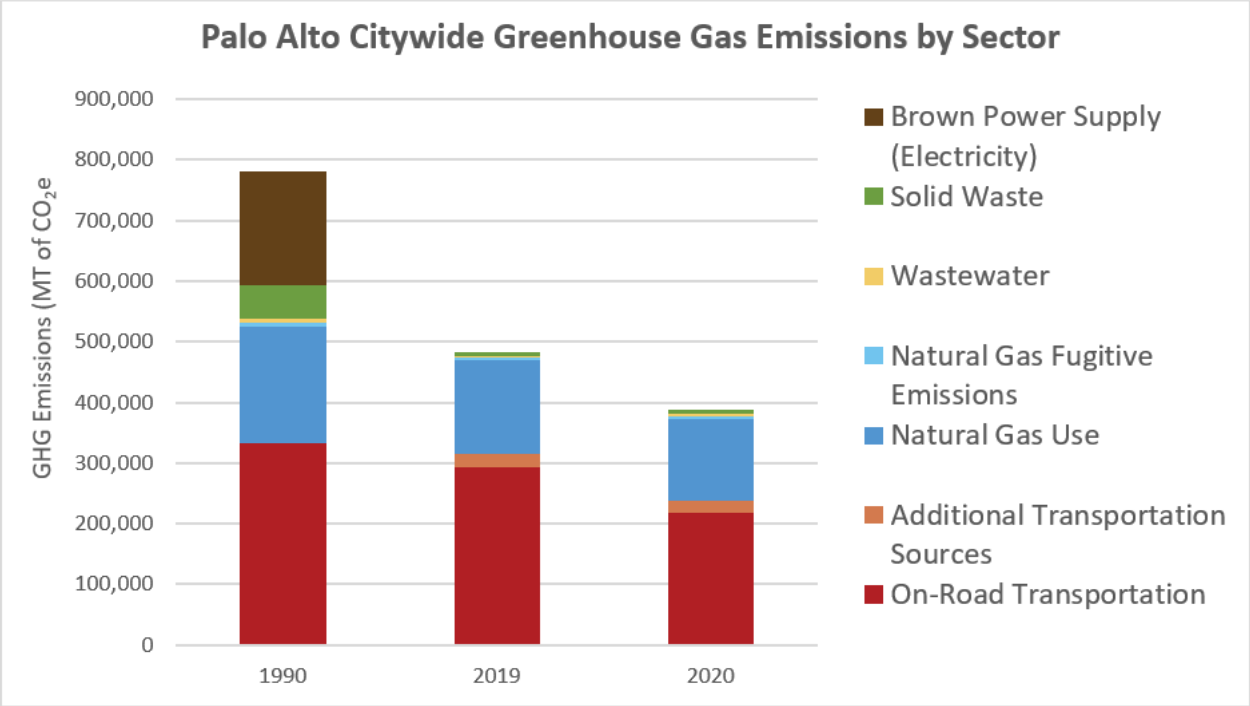
In 2020, Palo Alto emitted an estimated 387,287metric tons (MT) of carbon dioxide equivalent (CO_2e) from the residential, commercial, industrial, transportation, waste, water, and municipal sectors.[9] In comparison to the 1990 base year emissions (which were about 780,000 metric tons), that is a 50.4 percent decrease in total community emissions, despite a population increase of 21.8 percent during that same time period. Of that 50.4 percent reduction to-date, 47.3 percent of the total reduction came from achieving carbon neutrality for the City's electricity portfolio, 15.2 percent from reduction in natural gas consumption, 12.3 percent from declines in solid waste emissions, 23.8 percent from declines in transportation emissions, and the remaining reductions from other sources. In comparison to 2019, that is a 19.7 percent decrease in total community emissions. Staff recognizes that COVID-19 has brought disruption to cities and communities across the globe and greatly impacted daily life. The 2020 GHG inventory includes pandemic impacts - such as reduced vehicular traffic - resulting in emissions

[9] Carbon dioxide equivalent is a unit of measure that normalizes the varying climate warming potencies of all six GHG emissions, which are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). For example, one metric ton of nitrous oxide is 210 metric tons of CO_2e.

reductions that may be temporary. Without the effects of the pandemic, emissions reductions from the 1990 base year would be closer to 41.5 percent versus the 50.4 percent figure.

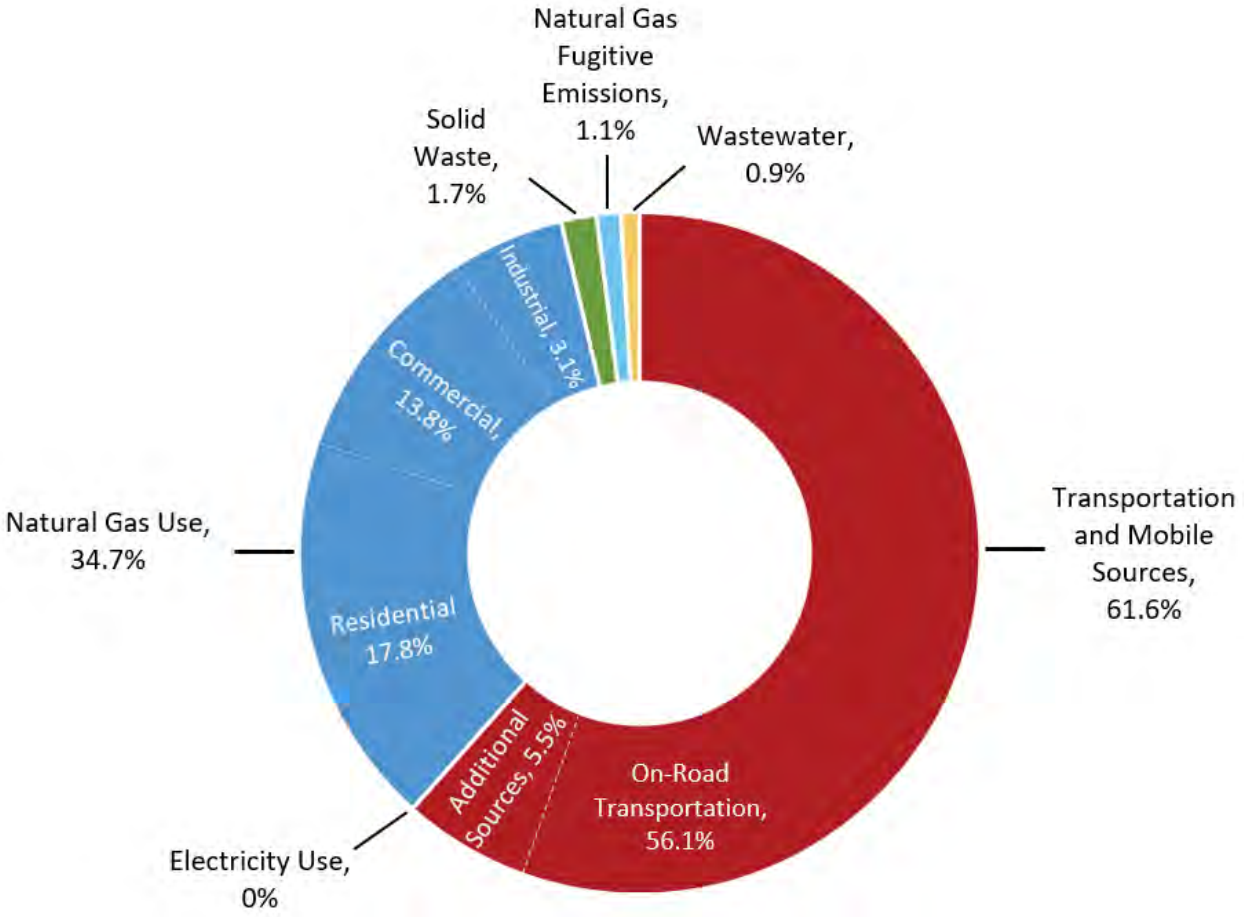
A comparison of 1990, 2019, and 2020 GHG emissions is shown in Figure 1. The full 2020 GHG inventory can be found in Attachment A: 2020 Greenhouse Gas Inventory. A full comparison between the 1990 and 2020 inventories can be found in Attachment B: 1990 vs. 2020 Greenhouse Gas Emissions by Sector and Subsector.

Figure 1: 1990 vs 2020 GHG Emissions by Sector



As shown in Figure 2, the two largest categories of emissions are transportation and mobile sources (including on-road transportation, airport emissions, off-road vehicles, and Caltrain commuter rail) and natural gas use (including residential, commercial, and industrial). Of the remaining emissions sources as of 2020, roughly 56.1 percent are from on-road transportation, 34.7 percent are from natural gas use, and the remainder are from other sources.

Figure 2: 2020 GHG Emissions by Sector



Timeline

The S/CAP update timeline is provided in detail in this report's Discussion section. Community engagement and S/CAP Ad Hoc Committee and Council reviews are scheduled through September 2022, with Council adoption of the of the updated S/CAP expected in April 2023.

Resource Impact

Initiatives will be managed and funded across various departments and funds. Resources for some of the S/CAP initiatives are funded in current budgets; however it is anticipated that significant investments will be needed to pursue the expansion of S/CAP work across the City.

Additional resources were approved by the City Council during the FY 2022 Mid-Year Budget Review. These investments reflect the highest impact resource requests related to S/CAP communications, beginning to address the impact of electric system infrastructure upgrades, and beginning to address non-residential building electrification. A net addition of 6.25 positions were approved as well as the reclassification of existing resources.

- Public Works Office of Sustainability adjustments (1.25 FTE) included reclassifying a 0.75

FTE Management Analyst position to a 1.00 FTE Manager Environmental Control Program and adds a 1.00 FTE Environmental Specialist position. This work will be supported by the General Fund and various Enterprise Funds.

- The Utilities Department adjustments (5.00 FTE) included 1.00 FTE Electric Project Coordinator and 3.00 FTE Electric Project Engineers for increasing workload capacity in the Electric engineering and operations project management work functions; 1.00 FTE Utilities Programs Services Manager to focus on commercial energy efficiency and electrification; and 1.00 FTE Senior Engineer for technical oversight and scaling up the electrification program. The elimination of 1.00 FTE Metering Tech resulted in the addition of 5.0 positions to support S/CAP initiatives.

Staff is working with the Office of Management and Budget and the City Manager's Office to bring forward recommendations related to S/CAP needs as part of the Fiscal Year 2023 Proposed Budget, but most will need to be prioritized in consideration of competing priorities.

Funding and resources will be discussed in greater detail with the S/CAP Ad Hoc Committee.

Policy Implications

The Earth Day Report aligns with one of the top four Council Priorities for CY 2022: "Climate Change – Protection and Adaptation".

Stakeholder Engagement

Stakeholder engagement on the S/CAP Update is wide-reaching and coordinated with multiple Departments. Efforts include direct engagement, webinars, social media outreach, website updates, Ad Hoc meeting participation, leveraging the City Manager's communication platforms, and more. Staff developed, and is implementing, an S/CAP Engagement Plan which identifies relevant stakeholders, proposed materials, and desired meeting milestones and outcomes. Stakeholder engagement is an integral part of the S/CAP Ad Hoc Committee's mission and one of the four areas of focus of the Working Group Teams.

Environmental Review

Council's review of this report is not a project under Section 21065 for purposes of the California Environmental Quality Act (CEQA). The final S/CAP Report will be evaluated consistent with CEQA prior to approval by the City.

Attachments:

- Attachment A: 2020 GHG Inventory
- Attachment B: 1990 vs 2020 GHG Emissions by Sector and Subsector

Attachment A: Palo Alto's 2020 Greenhouse Gas Emissions Inventory

1.a. Overview of Methodology for Quantifying Greenhouse Gas Emissions

Cities represent the single greatest opportunity for tackling climate change, as they are responsible for 75 percent of global energy-related carbon dioxide emissions, mostly from transportation and buildings. The first step for cities to realize their potential is to identify and measure where their emissions come from. There are two types of Greenhouse Gas (GHG) emissions inventories:

1. **Generation-based GHG inventory** – This measurement method helps a community understand its level of emissions based on community energy use. It includes 1) direct consumption of energy, 2) consumption of energy via the electrical grid, and 3) emissions from the treatment/decomposition of waste. This is the industry-accepted methodology for quantifying community GHG emissions, with emissions reported by emission source category[1].

2. **Consumption-based GHG inventory** – This measurement method helps a community understand its level of emissions based on consumption. It offers an alternative, more holistic, approach for quantifying emissions within a community, quantifying consumption of goods and services (including food, clothing, electronic equipment, etc.) by residents of a city, with emissions reported by consumption category.

Staff did not complete a consumption-based GHG inventory, though staff believes there would be value in completing one eventually. The California Air Resources Board (CARB) has been tasked with developing an implementation framework and accounting to track consumption-based emissions over time.[2] In particular, this framework needs to address how to account for the embodied emissions in the food, goods, and services the community purchases that are not covered by generation-based GHG inventories. While Palo Alto will await State guidance on how to account for these consumption-based emissions reductions, the community can work to reduce these emissions in the meantime.

In 2014, World Resources Institute, C40 Cities Climate Leadership Group (C40) and ICLEI – Local Governments for Sustainability (ICLEI)[3] partnered to create global standard protocol for GHG inventories. The official GHG Protocol standard for Cities,[4] also known as GPC, provides a robust framework for accounting and reporting city-wide GHG emissions. AECOM utilized this framework when developing our 2020 GHG inventory. It seeks to:

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[1] There are two reporting frameworks commonly used by cities: the U.S. Community Protocol and the Global Protocol for Communities (GPC). Palo Alto uses the GPC framework.

[2] Executive Department State of California. (2019). Executive Order B-55-18 to Achieve Carbon Neutrality. https://www.ca.gov/archive/gov39/wp-content/uploads/2018/09/9.10.18-Executive-Order.pdf.

[3] Formerly the International Council for Local Environmental Initiatives, renamed in 2003 to ICLEI – Local Governments for Sustainability.

[4] The GPC is the official protocol specified by the Global Covenant of Mayors and defines what emissions must be reported and how.

- Help cities develop a comprehensive and robust GHG inventory to support climate action planning
- Help cities establish a base year emissions inventory, set reduction targets, and track their performance
- Ensure consistent and transparent measurement and reporting of GHG emissions between cities, following internationally recognized GHG accounting and reporting principles
- Enable city inventories to be aggregated at subnational and national levels
- Demonstrate the important role that cities play in tackling climate change, and facilitate insight through benchmarking – and aggregation – of comparable data

Palo Alto's first generation-based inventory was completed for 2005 and then extrapolated for 1990 (the baseline year). Beginning in 2010, new community GHG inventories were completed annually, enabling Palo Alto to track progress over time.

The 2020 Palo Alto GHG inventory uses the approach and methods provided by the GPC and was completed by AECOM. Inventory calculations were performed using the ClearPath[5] tool. The City's GHG inventory conforms to the GPC Basic protocol.

The GPC Basic protocol describes three emissions scopes for community emissions:

- **Scope 1:** GHG emissions from sources located within the city boundary, such as stationary fuel consumption.
- **Scope 2:** GHG emissions occurring because of the use of grid-supplied electricity, heat, steam, and/or cooling within the city boundary
- **Scope 3:** All other GHG emissions that occur outside the city boundary as a result of activities taking place within the city boundary

This inventory follows the city-inducted framework in the GPC, which totals GHG emissions attributable to activities taking place within the geographic boundary of the city[6]. Under the BASIC reporting level as defined by GPC, the inventory requirements cover scope 1 and scope 2 emissions from stationary energy and transportation, as well as all emissions resulting from waste generating within the city boundary.

1.b. Palo Alto's 2020 GHG Emissions

We recognize that these are unprecedented times created by the coronavirus pandemic. COVID-19 has brought disruption to cities and communities across the globe. On March 16, 2020, six Bay Area Counties - including Santa Clara – issued coordinated shelter-in place orders that were not phased out until more than two months later. The shelter-in place order, as well as changes in how and where people worked, greatly impacted energy use, vehicle miles

[5] https://icleiusa.org/clearpath/
[6] https://ghgprotocol.org/sites/default/files/standards/GHGP_GPC_0.pdf

traveled, and carbon dioxide emissions. The 2020 inventory includes these pandemic impacts, resulting in emissions reductions that may be temporary.

In 2020, Palo Alto emitted an estimated 387,287 metric tons (MT) of carbon dioxide equivalent (CO_2e) from the residential, commercial, industrial, transportation, waste, water, and municipal sectors.[7] In comparison to the 1990 base year, that is a 50.4 percent decrease in total community emissions, despite a population increase of 21.8 percent during that same time period. Of that 50.4 percent reduction to-date, 47.3 percent came from achieving carbon neutrality for the City's electricity portfolio, 15.2 percent from reduction in natural gas consumption, 12.3 percent from declines in solid waste emissions, 23.8 percent from declines in transportation emissions, and the remaining reductions from other sources. In comparison to 2019, that is a 19.7 decrease in total community emissions. Without the effects of the pandemic, emissions reductions would be closer to 41.5 percent.

Of the remaining emissions sources as of 2020, roughly 56.1 percent are from on-road transportation, 34.7 percent are from natural gas use, and the remainder are from other sources. A comparison of 1990, 2019, and 2020 GHG emissions is shown in Figure 1 and Table 1. The full comparison between the inventories can be found in Attachment A: 1990 vs. 2020 Greenhouse Gas Emissions by Sector and Subsector. Additional existing emissions sources that were missing from the 1990 GHG inventory were included in the 2020 GHG inventory to comply with the GPC Basic protocol (Airport Emissions, Off-road Vehicles, Caltrain Commuter Rail, Composting, and Palo Alto Landfill Gas Flaring). As shown in Attachment A, a total of 25,150 MT CO_2e was added from GHG emissions sources that were not included previously, accounting for 6.5 percent of total emissions.

Figure 1: 1990 vs 2020 GHG Emissions by Sector

[7] Carbon dioxide equivalent is a unit of measure that normalizes the varying climate warming potencies of all six GHG emissions, which are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). For example, one metric ton of nitrous oxide is 210 metric tons of CO_2e.

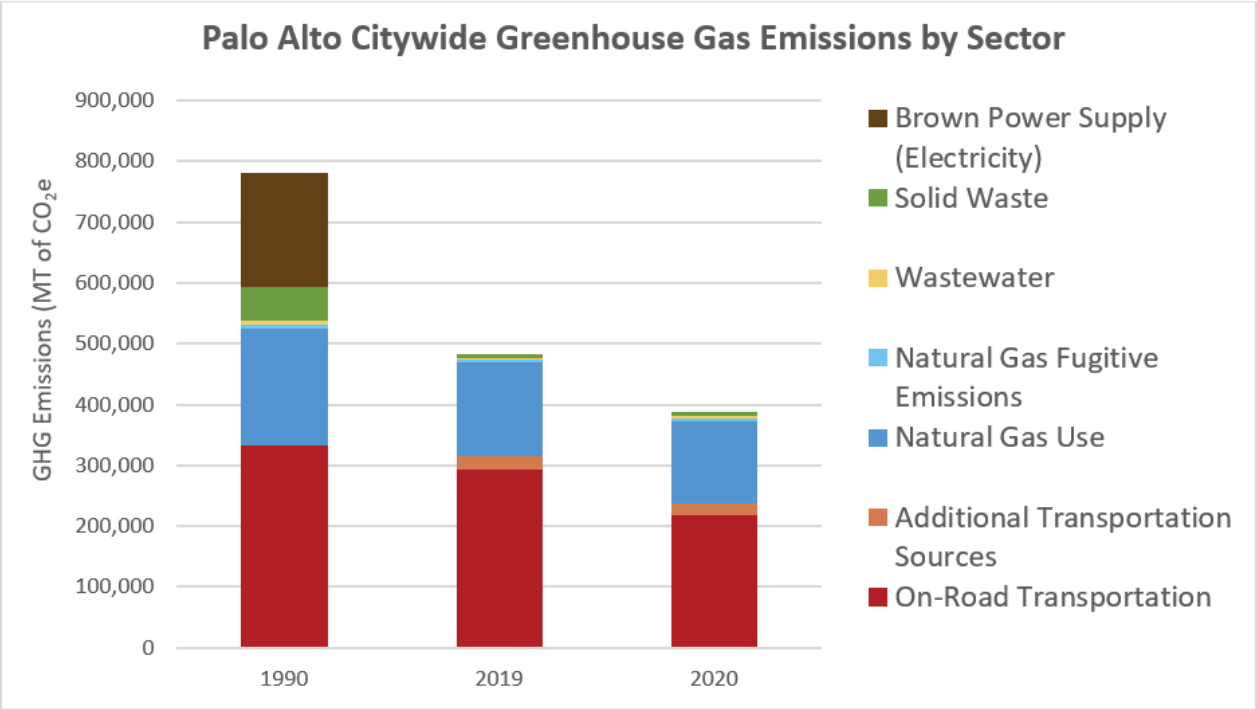
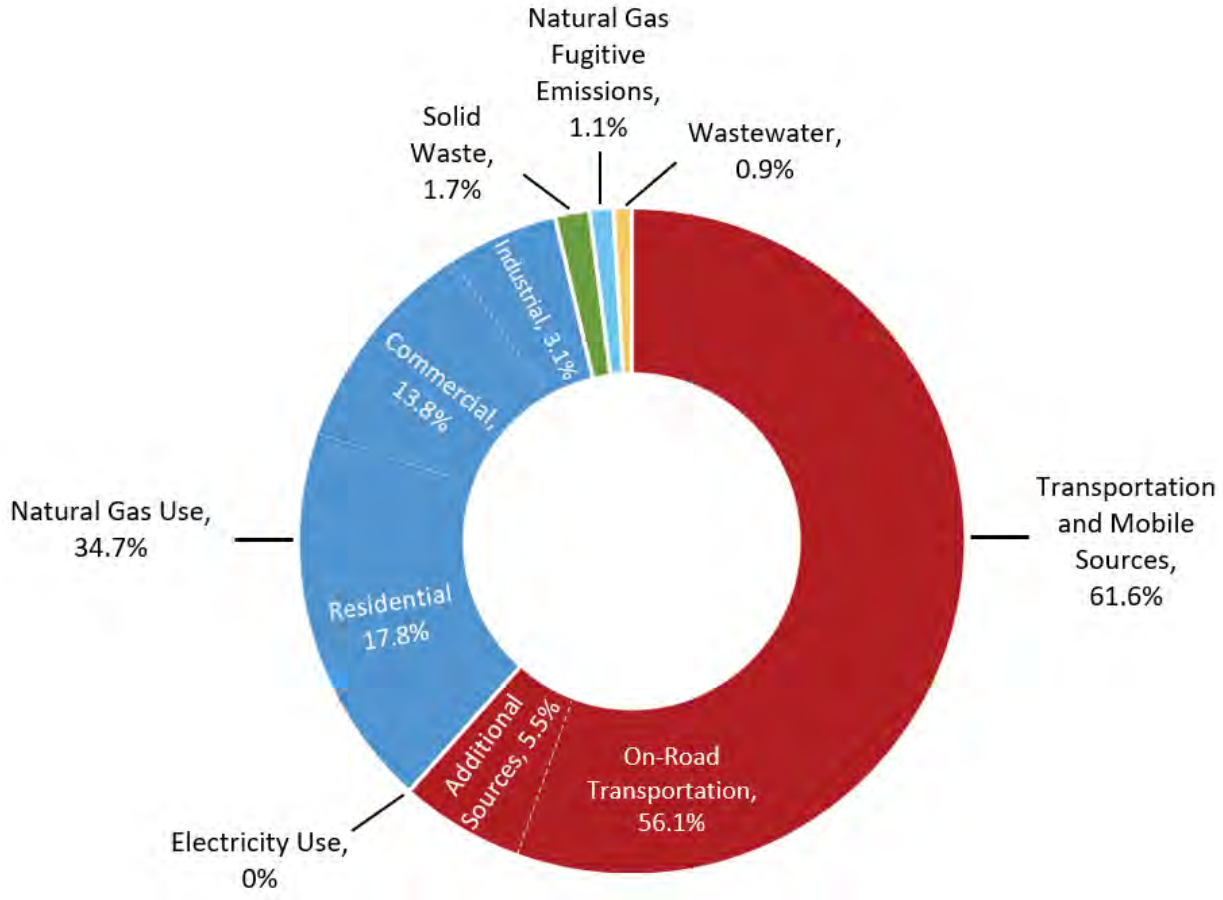


Table 1: 1990 vs 2020 GHG Emissions by Sector

Sector	1990 GHG emissions (MT CO_2e)	2019 GHG emissions (MT CO_2e)	2020 GHG emissions (MT CO_2e)	Percent Change in 2020 from 1990
On-Road Transportation	331,840	293,413	217,279	-34.5%
Additional Transportation Sources		21,668	21,244	n/a
Natural Gas Use	194,000	153,509	134,365	- 30.7%
Natural Gas Fugitive Emissions	4,718	5,009	4,384	- 7.1%
Wastewater	8,504	2,197	3,355	- 60.5%
Solid Waste	55,057	6,531	6,660	- 87.9%
Brown Power Supply (Electricity)	186,000			- 100%
Total GHG Emissions (MT CO_2e)	**780,119**	**482,237**	**387,287**	**- 50.4%**

As shown in Figure 2, the two largest categories of emissions are transportation and mobile sources (including on-road transportation, airport emissions, off-road vehicles, and Caltrain commuter rail) and natural gas use (including residential, commercial, and industrial).

Figure 2: 2020 GHG Emissions by Sector



Transportation and mobile sources include emissions from private, commercial, and fleet vehicles driven within the City's geographical boundaries, as well as the emissions from public transit vehicles and the City-owned fleet. Off-road vehicles include airport ground support, construction and mining, industrial, light commercial, portable equipment, and transportation refrigeration.

Natural gas use includes emissions that result from natural gas consumption in both private and public sector buildings and facilities, and residential, commercial, and industrial sources. Fugitive Emissions related to natural gas consumption are calculated separately and are discussed in Section 1.d. The City's electricity supply has been carbon neutral since 2013, when Council approved a Carbon Neutral Electric Resource Plan, committing Palo Alto to pursuing only carbon-neutral electric resources and effectively eliminating all GHG emissions from the City's electric portfolio.

1.c. Transportation and Mobile Sources

In 2020, transportation and mobile sources accounted for roughly 61.6 percent of total 2020 GHG emissions in Palo Alto. As shown in Table 2, transportation and mobile sources consist of:

- On-Road Transportation – This includes all daily vehicular trips made entirely within the Palo Alto city limits, one-half of daily vehicular trips with an origin within Palo Alto city limits and a destination outside of Palo Alto city limits (this assumes that Palo Alto shares half the responsibility for trips traveling from other jurisdictions), and one-half of daily vehicular trips with an origin outside Palo Alto city limits and a destination within Palo Alto city limits (this assumes that Palo Alto shares the responsibility of trips traveling to other jurisdictions). Vehicular trips through Palo Alto are not included because Palo Alto cannot solely implement policies that influence the trip-making behavior. Rather, through trips are assigned to other jurisdictions that can influence either the origin or destination side of the trip-making behavior.
- Airport Emissions – This includes emissions from take-offs and landings from trips that start and end at Palo Alto Airport. This includes emergency services helicopters, sightseeing helicopters, and training flights. Flights that take-off from Palo Alto Airport but land elsewhere, and flights that land in Palo Alto Airport but take-off from elsewhere are not included per GPC Basic.
- Off-road Vehicles - This includes airport ground support (based on take-offs and landings), construction and mining, industrial (based on employment data), light commercial (based on employment data), portable equipment (e.g. back-pack leaf blower, based on service population), and transportation refrigeration units (based on service population).
- Caltrain Commuter Rail – This includes emissions from Caltrain travel within Palo Alto.

Table 2: 2020 Transportation and Mobile Sources

Subsector	2019 GHG emissions (MT CO_2e)	2020 GHG emissions (MT CO_2e)	Percent of Total 2020 Emissions (%)
On-Road Transportation	293,413	217,279	56.1%
Airport Emissions	2,192	1,664	0.4%
Off-road Vehicles	14,634	15,029	3.9%
Caltrain Commuter Rail	4,842	4,552	1.2%
Total Transportation & Mobile Sources	**315,081**	**238,523**	**61.6%**

Estimating vehicles miles traveled (VMT) is a complicated process and is one of the few emissions sources that the City does not estimate annually. Forecasts of on-road transportation emissions are typically based on outputs from a travel forecasting model, other accounting-type method (sketch models), or Big Data (vehicle navigation data from built-in GPS and location-based services data from cell-phones). Previously, Fehr & Peers provided VMT estimates for 2019, 2030, and 2040. Per the current Santa Clara Valley Transportation Authority (VTA) transportation model, in 2019 Palo Alto's annual VMT was roughly 952,584,400. However, the model that Fehr & Peers used to provide VMT estimates was based on pre-pandemic travel patterns. The temporary Shelter-in Place order, combined with more people working from home, resulted in a decrease in VMT throughout the Bay Area. Comparing California

Department of Transportation traffic count data[8] during the same two-week period starting the Tuesday after Thanksgiving, the data shows that in Santa Clara County, VMT dropped 23.4 percent in 2020 compared to 2019. While the traffic count data is for all of Santa Clara County and not exclusive to Palo Alto, the 23.4 percent reduction in VMT was used to estimate Palo Alto's 2020 annual VMT. The VTA model used to calculate Palo Alto's 2019 annual VMT is only updated every few years, so until the model is updated to better reflect changes in VMT due to the pandemic, we are limited in our options for modeling our VMT annually.

If we include the effects of the pandemic on VMT, on-road transportation accounts for approximately 56.1 percent of Palo Alto's total emissions, with a 25.9 percent decrease from 2019 and a 34.5 percent decrease from 1990. However, these reductions are largely because of the pandemic and may be temporary. If we don't adjust Palo Alto's annual VMT to better reflect the effects of the pandemic on transportation, then on-road transportation would account for approximately 62.5 percent of Palo Alto's total emissions, with a 2.9 percent decrease from 2019 and a 14.1 percent decrease from 1990.

Off-road transportation accounts for approximately 3.9 percent of Palo Alto's total emissions, with a 2.7 percent increase from 2019. Off-road transportation emissions were not calculated in 1990. It is important to note that most of the off-road transportation emissions are based on models at the County level that were not adjusted to reflect any pandemic-induced activity changes.

Caltrain electrification is a key component of the Caltrain Modernization program[9], with Caltrain scheduled to be electrified in 2023. Once the Caltrain Modernization program is complete, most of the Caltrain commuter rail emissions will be eliminated.

1.d Natural Gas Use

In 2020, natural gas emissions accounted for 34.7 percent of total 2020 GHG emissions in Palo Alto, with a 12.5 percent decrease from 2019 and a 30.7 percent decrease from 1990. As shown in Table 3, Palo Alto's total natural consumption in 2020 was 25,267,739 therms. Residential energy accounts for 17.8 percent of total emissions, commercial energy accounts for 13.8 percent of total emissions, and industrial energy accounts for 3.1 percent of total emissions. The pandemic drastically affected natural gas consumption. The temporary shelter-in place order, as well as changes in how and where people worked, resulted in major changes in the commercial and industrial sectors, with fewer people staying in hotels, going to restaurants, and going to retail establishments. Natural gas emissions decreased by 19,763 MT CO_2e between 2019 to 2020, representing 20.1 percent of total emissions reductions.

City Council unanimously approved Palo Alto's Carbon Neutral Natural Gas Plan on December 5, 2016. The Natural Gas Plan, implemented on July 1, 2017, achieves carbon neutrality for the gas supply portfolio by 1) purchasing high-quality carbon offsets equivalent to our City and

[8] https://dot.ca.gov/programs/traffic-operations/census
[9] https://calmod.org/

community natural gas emissions; 2) pursuing efficiency strategies to reduce natural gas use, and 3) seeking opportunities to fund local offsets that finance actual emissions reductions in Palo Alto and the surrounding region. As a bridging strategy, carbon offsets are being purchased in an amount equal to the GHG emissions caused by natural gas use within the City. However, offsets are not included in this GHG inventory.

Table 3: 2020 Natural Gas Use

Subsector	2019 Consumption (Therms)	2019 GHG emissions (MT CO_2e)	2020 Consumption (Therms)	2020 GHG emissions (MT CO_2e)	Percent of Total 2020 Emissions (%)
Residential Energy	13,565,360	72,149	12,952,262	68,889	17.8%
Industrial Energy	2,707,034	14,373	2,253,635	11,961	3.1%
Commercial Energy	12,954,768	66,987	10,061,842	53,515	13.8%
Total Natural Gas Use	**28,867,162**	**153,509**	**25,267,739**	**134,365**	**34.7%**

Natural Gas Fugitive Emissions

Natural gas is mainly methane (CH_4), some of which escapes during the drilling, extraction, and transportation processes. Such releases are known as fugitive emissions. The primary sources of these emissions may include equipment leaks, evaporation losses, venting, flaring and accidental releases. Methane is a potent greenhouse gas – approximately 25 times more powerful than carbon dioxide over a 100-year timescale.

In 2020, natural gas fugitive emissions accounted for 1.1 percent of total 2020 GHG emissions in Palo Alto, which is decrease of 12.5 percent from 2019 and a decrease of 7.1 percent from 1990. Per the GPC, fugitive emissions from natural gas are based on overall community consumption and a leakage rate of 0.03 percent.

As mentioned in Section 1.a., the GPC Basic methodology includes GHG emissions attributable to activities taking place within the geographic boundary of the city. As such, the 2020 GHG inventory does not include a category of emissions that are called “upstream emissions”.

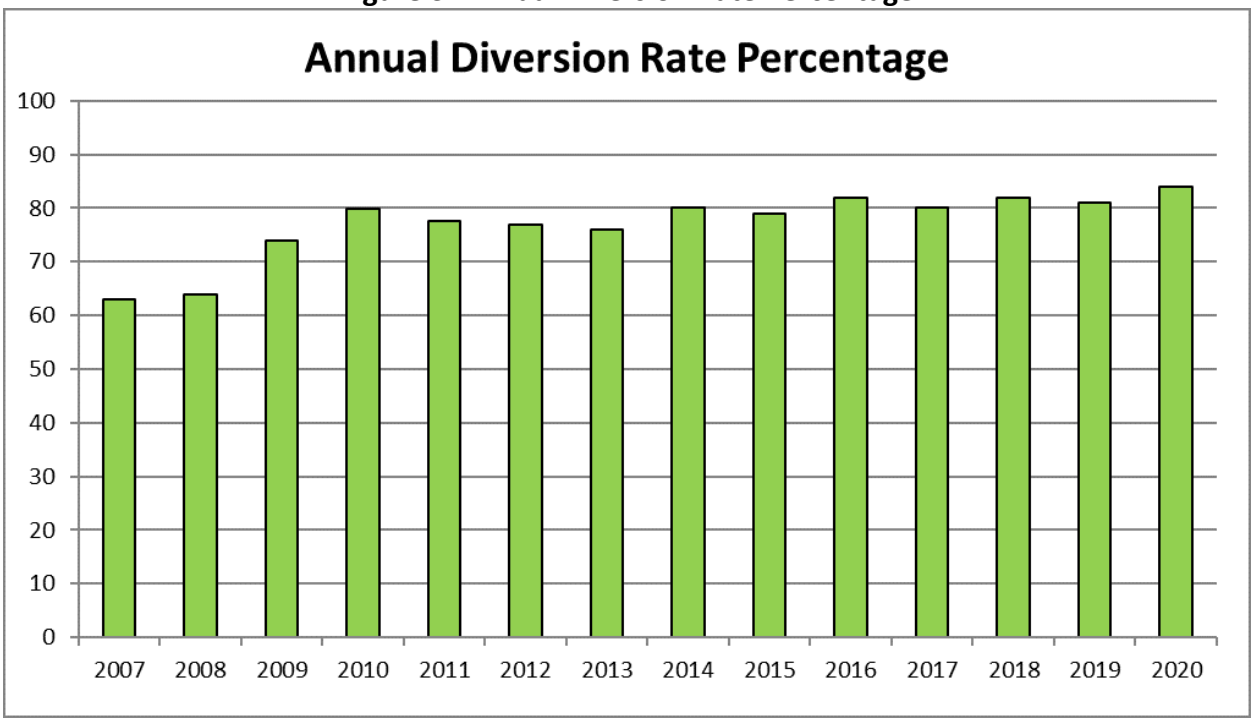
1.e. Solid Waste

In 2020, Palo Alto's solid waste diversion rate was 84 percent. “Diversion” includes all waste prevention, reuse, recycling, and composting activities that “divert” materials from landfills. In 2015, the national average of landfill diversion was 34.7 percent. In 2017, California’s statewide diversion rate was 58 percent, which continues to outpace the 50 percent diversion mandate set for local jurisdictions.[10] The City uses the diversion rate to measure progress on waste reduction and resource conservation goals. As shown in Figure 3**: Annual Diversion Rate Percentage**, the diversion rate of 84 percent is an improvement from the rate of 62 percent in

[10] https://www.calrecycle.ca.gov/lgcentral/goalmeasure/disposalrate/graphs/estdiversion

2007 but has remained relatively flat the last few years. As part of the 2016 S/CAP Framework, Council adopted a goal of 95 percent diversion of materials from landfills by 2030[11].

Figure 3: Annual Diversion Rate Percentage



Solid waste emissions accounted for 1.7 percent of total 2020 GHG emissions in Palo Alto, which is an increase of 2 percent from 2019 and a decrease of 87.9 percent from 1990. It must be noted that solid waste emissions were calculated using a different methodology than 1990 for the 2020 GHG inventory.[12] In addition, as shown in Table **4**, the 1990 inventory included Palo Alto Landfill Gas Fugitive emissions, whereas the 2020 inventory did not, and the 2020 inventory included composting emissions at the ZeroWaste Energy Development Company's (ZWED) Dry Fermentation Anaerobic Digestion (AD) Facility in San Jose, CA, composting emissions at the Synagro El Nido Central Valley Composting (CVC) facility in Dos Palos, as well as Palo Alto Landfill Gas Flaring Emissions while the 1990 inventory did not. The increase in solid waste emissions from 2019 is due largely to the increase in composting emissions. The 2019 data source for ZWED compost feedstock is no longer available. The new data source shows an undercount of 2019 ZWED compost by more than double what was previously reported. In addition, compost emissions from wastewater sludge at Synargo was not included in previous GHG emissions inventories, since the wastewater sludge is a new source of emissions related to the decommissioning of the sewage

[11] https://www.cityofpaloalto.org/civicax/filebank/documents/64814

[12] The 1990 Solid Waste emissions were calculated using the EPA WARM methodology, which includes lifecycle emissions and emissions from landfilling recyclable material; waste was landfilled inside and outside Palo Alto. The 2020 Solid Waste emissions were calculated using the ICLEI (Local Governments for Sustainability) ClearPath tool, which includes composting and Palo Alto landfill gas flaring emissions; waste is landfilled and composted outside of Palo Alto and methane flared in closed landfill.

sludge incinerators, as described in further detail in section 1.f. We are not updating the 2019 GHG inventory but recognize that the new data source and new source of emissions for composting related emission results in an overly inflated increase in composting emissions relative to 2019.

In 2020, emissions from landfills located within the community accounted for 1.2 percent of total waste emissions.

Table 4: 1990 vs 2020 Solid Waste Emissions by Subsector

Subsector	1990 GHG emissions (MT CO_2e)	2019 GHG emissions (MT CO_2e)	2020 GHG emissions (MT CO_2e)	Percent of Total 2020 Emissions (%)
Composting	Not included	731	1,623	0.4%
Palo Alto Landfill Gas Flaring	Not included	281	316	0.1%
Palo Alto Landfill Gas Fugitive	24,325	n/a[13]	n/a	n/a
Landfill Waste	30,732	5,519	4,721	1.2%
Total	**55,057**	**6,531**	**6,660**	**1.7%**

Waste emissions result from organic material decomposing in the anaerobic conditions present in a landfill and releasing methane (CH_4) – a greenhouse gas much more potent than CO_2. Organic materials (e.g., paper, plant debris, food waste, etc.) generate methane within the anaerobic environment of a landfill while non-organic materials (e.g., metal, glass, etc.) do not.

1.f. Wastewater

In 2020, wastewater emissions accounted for 0.9 percent of total 2020 GHG emissions in Palo Alto, which is an increase of 52.7 percent from 2019 and a decrease of 60.5 percent from 1990. These emissions include wastewater biosolid treatment (which includes biosolid composing, anaerobic digestion, and incineration) and wastewater treatment and effluent. As shown in Table 5, the increase in wastewater emissions from 2019 is due to a new emissions source - wastewater biosolid treatment. In March 2019, the City of Palo Alto's Regional Water Quality Control Plant (RWQCP) replaced the City facility with the largest energy use - the sewage sludge incinerators - with a more environmentally friendly Sludge Dewatering and Truck Loadout Facility. The updated treatment process will reduce climate-warming GHG emissions by approximately 15,000 MT of CO_2e per year – this approximates the carbon dioxide emissions of 3,000 passenger cars. The replacement technologies dewater the sludge and send it to farm areas to produce agricultural soil supplements. While the addition of wastewater biosolid treatment increased wastewater emissions compared to 2019, as shown in Figure 4**: RWQCP Historical Total Greenhouse Gas Emissions**, the elimination of energy use related emissions

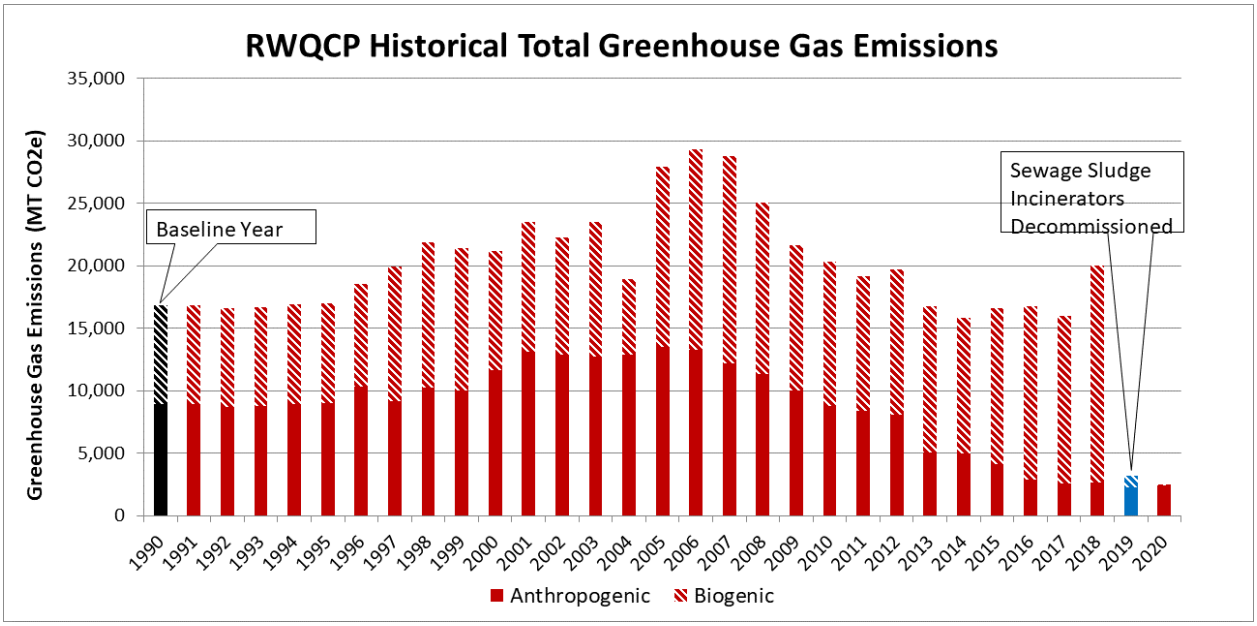
[13] Not included because the landfill was closed

from the decommissioned sewage sludge incinerators far exceeds the additional emissions from wastewater biosolid treatment.

Table 5: 1990 vs 2020 Wastewater Emissions by Subsector

Subsector	1990 GHG emissions (MT CO_2e)	2019 GHG emissions (MT CO_2e)	2020 GHG emissions (MT CO_2e)	Percent of Total 2020 Emissions (%)
Wastewater Biosolid Treatment[14]	n/a	812 (new)	1,967	0.5%
Wastewater Treatment and Effluent	8,504	1,385	1,388	0.4%
Total	**8,504**	**2,197**	**3,355**	**0.9%**

Figure 4: RWQCP Historical Total Greenhouse Gas Emissions



[14] Includes biosolid composting, anaerobic digestion, and incineration

Attachment B: 1990 vs. 2020 Greenhouse Gas Emissions by Sector and Subsector

Sector and Subsector	1990 GHG emissions (MT CO_2e)[1]	2019 GHG emissions (MT CO_2e)	2020 GHG emissions (MT CO_2e)	Percent Change in 2020 from 1990 (%)	Percent of Total 2020 Emissions (%)
Total Transportation and Mobile Sources	**331,840**	**315,081**	**238,523**	**-28.1%**	**61.6%**
- On-Road Transportation	331,840	293,413	217,279	-34.5%	56.1%
- Airport Emissions	Not Included	2,192	1,664	n/a	0.4%
- Off-road Vehicles	Not Included	14,634	15,029	n/a	3.9%
- Caltrain Commuter Rail	Not Included	4,842	4,552	n/a	1.2%
Total Natural Gas Use	**194,000**	**153,509**	**134,365**	**-30.7%**	**34.7%**
- Commercial Energy	Not calculated	66,987	53,515	n/a	13.8%
- Industrial Energy	Not calculated	14,373	11,961	n/a	3.1%
- Residential Energy	Not calculated	72,149	68,889	n/a	17.8%
Natural Gas Fugitive Emissions	**4,718**	**5,009**	**4,384**	**-7.1%**	**1.1%**
Total Wastewater	**8,504**	**2,197**	**3,355**	**-60.5%**	**0.9%**
- Wastewater Biosolid Treatment[2]	n/a	812 (new)	1,967	n/a	0.5%
- Wastewater Treatment and Effluent	8,504	1,385	1,388	-83.7%	0.4%
Total Solid Waste	**55,057**	**6,531**	**6,660**	**-87.9%**	**1.7%**
- Composting	Not Included	731	1,623	n/a	0.4%
- Palo Alto Landfill Gas Flaring[3]	Not Included	281	316	n/a	0.1%
- Palo Alto Landfill Gas Fugitive	24,325	n/a[4]	n/a	n/a	n/a
- Landfill Waste	30,732	5,519	4,721	-84.6%	1.2%
Brown Power Supply (Electricity)	186,000	n/a	n/a	**-100.0%**	n/a
Total GHG Emissions (MT CO_2e)	**780,119**	**482,237**	**387,287**	**-50.4%**	100%
- Total Additional Emissions Sources		23,493			6.5%

[1] Source: 2016 S/CAP Framework and 2016 Earth Day Report
[2] Includes biosolid composting, anaerobic digestion, and incineration
[3] 2016 Earth Day Report labeled these emissions as biogenic
[4] Not included because the landfill was closed