



City of Palo Alto

City Council Staff Report

(ID # 12009)

Report Type: Action Items

Meeting Date: 4/19/2021

Council Priority: Climate/Sustainability and Climate Action Plan, Transportation and Traffic

Summary Title: S/CAP Report

Title: City Council Review of the Sustainability and Climate Action Plan (S/CAP) Update Report, Provide Feedback on Policy Tools, and Direction to Staff to Implement an S/CAP Engagement Strategy for three S/CAP engagement tracks that includes outreach to Council, Commissions, and the community.

From: City Manager

Lead Department: Public Works

Recommendation

Staff recommends that City Council

1. Discuss and provide feedback to staff on policy tools that could be implemented in S/CAP analysis (Attachment A) that would be included in the S/CAP engagement strategy for further refinement and eventual adoption of a revised Sustainability and Climate Action Plan, and
2. Provide direction on stakeholder engagement for the Sustainability and Climate Action Plan (S/CAP) Update, and direct staff to develop and implement an S/CAP engagement strategy for S/CAP engagement tracks that includes outreach City Board, Commissions and Committees, key stakeholders, and the community at large.

Executive Summary

Consistent with Council's adoption of "Climate Change – Protection and Adaptation" as one of the four priorities for calendar year 2021, staff is developing a 2021 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). Staff presented the [Major Goals and Key Actions related to greenhouse gas emissions reduction](#)¹ to Council on June 16, 2020. Amidst the backdrop of a global pandemic, an economic downturn, and other challenging events, Council directed staff to continue with its work on

¹ <https://www.cityofpaloalto.org/civicax/filebank/blobdload.aspx?t=59513.75&BlobID=77028>

finding strategies to achieve the 80 x 30 goal. Staff has devoted extensive analytical and research efforts to estimating the GHG reduction potential of proposed strategies, estimated costs, and additional sustainability co-benefits (such as improved local air quality or reduced cost of living). The status of the 2021 S/CAP was detailed at the [February 3, 2021 Utilities Advisory Commission Meeting](#)² and the [February 22, 2021 Council Meeting](#)³.

While extensive discussion of the preliminary results of the S/CAP impact analysis is presented in this report, staff's primary goal with this report is to request Council's

- feedback to staff on examples of policy tools that could be implemented in S/CAP analysis (Attachment A), and
- direction on next steps for reviewing this information with the Council, Commissions, and the community, leading to stakeholder engagement and adoption of a revised S/CAP

Essentially, staff's analysis and preliminary results reflect one scenario for achieving the 80 x 30 goal. While this scenario represents staff's best professional judgement, it is important to vet this analysis through community review and feedback. Many of these proposals and financing measures represent novel applications of local government authority. As such, another key component is additional in-depth legal analysis as staff develops more detail about individual program proposals. Staff has included community engagement options as part of this report. Details of the preliminary impact analysis are included in this report in Attachment B. A recorded webinar providing an overview can be found [at this link](#)⁴.

In parallel with the S/CAP process, staff is working on development of the Sea Level Rise Adaptation Policy. Engagement around S/CAP development and sea level rise will be closely coordinated.

AECOM, the City's consultant, has prepared a 2019 greenhouse gas (GHG) emissions inventory. Palo Alto's 2019 emissions were roughly 482,000 metric tons, approximately 38.2 percent below 1990 emissions (which were about 780,000 metric tons). Of that 38.2 percent reduction to-date, 24 percent came from achieving carbon neutrality for the City's electricity portfolio, and the remaining 14 percent reductions were due to declines in the City's natural gas emissions, transportation emissions, and emissions from other sources. Of the remaining emissions sources as of 2019, roughly 61 percent are from on-road transportation, 32 percent are from natural gas use, and the remainder are from other sources.

AECOM has also prepared a forecast of emissions under "business as usual" (BAU) conditions to show how much GHG reduction will be achieved if the City only implements policies and plans that Council has already adopted and follows California-wide goals and regulations. AECOM's BAU Forecast showed emissions at 47.4 percent below 1990 levels in 2030 and 49.4 percent

² <https://www.cityofpaloalto.org/civicax/filebank/documents/80035>

³ <https://www.cityofpaloalto.org/civicax/filebank/documents/80219>

⁴ <https://www.youtube.com/playlist?list=PLJ0x6PDuVXIPJ2o1qIIEIXINb8rQ8HNMid>

below 1990 levels in 2040 without additional City actions. Staff adjusted the AECOM BAU forecast to account for higher expected EV adoption for Palo Alto due to the Governor's recent executive order setting a goal of eliminating new gasoline vehicle sales in California by 2035, as well as post-pandemic telecommuting trends. The Adjusted BAU Forecast predicts emissions at 52.1 percent below 1990 levels in 2030 and 59.6 percent below 1990 levels in 2040 without additional City actions.

In addition, staff has completed the preliminary Impact Analysis. In order to meet its 80 x 30 goal, the City will need to decide on a policy framework that takes into account updated climate science describing what actions are needed to combat global warming, and reinforce community awareness leading to actions that aggressively reduce vehicle miles traveled and vehicle emissions, and electrify existing buildings. The overall scenario described in staff's preliminary analysis achieves 72 percent reduction below 1990 levels by 2030, leaving 8 percent remaining. The analysis also identifies a number of policies that could be pursued, if legally feasible, while continuing analysis to identify the remaining 8 percent needed.

Based on staff and consultant modeling, and depending on what strategies Council chooses to pursue, the cost to implement the goals and key actions analyzed is roughly \$740 million. If debt financing is available⁵, staff estimated the annual cost in 2030 would be roughly \$53 million per year. Fortunately, there are ongoing savings associated with these emissions reductions⁶ estimated at \$43 million per year, for a net cost of \$10 million per year. For comparison, the total of all community electric and gas bills is roughly \$175 million per year. This means the net cost to implement would be 5 percent to 6 percent of total community energy spending. The actual costs and benefits accrue differently across the community, however. Section 4.b. of Attachment B discusses this issue and potential solutions. While the costs may seem high and the scale of action large, the cost of inaction is also high. Section 4.c. of Attachment B discusses the potential impacts of slowing achievement of the goals.

Background

In April 2016, City Council adopted the ambitious goal of [reducing GHG emissions to 80 percent below 1990 levels by 2030](#)⁷ (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 2045⁸. In November 2016 the Council adopted the [S/CAP Framework](#)⁹, which has served as the road map for achieving Palo Alto's sustainability goals. In December 2017, Council

⁵ Staff assumed financing over the life of each electrified appliance at municipal bond rates for the purposes of this analysis.

⁶ Savings in vehicle fuel, vehicle maintenance, and decreased natural gas bills net of increased electric bills.

⁷ <https://www.cityofpaloalto.org/news/displaynews.asp?NewsID=3534&TargetID=268>

⁸ 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.

⁹ <https://www.cityofpaloalto.org/civicax/filebank/documents/60858>

accepted the [2018-2020 Sustainability Implementation Plan “Key Actions” as a summary of the City’s work program](#)¹⁰.

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. Over the next nine years, if the City only implements City Council approved plans, policies, and ordinances that were approved on or before 2019, and considering demographic changes, Palo Alto’s emissions are projected to be 47.4 percent below 1990 levels in 2030 (410,435 MTCO₂e) – a “business-as-usual” (BAU) scenario. To achieve the 80 x 30 goal, Palo Alto must meet a GHG emissions target of 156,024 MT CO₂e. Palo Alto will need to reduce total emissions by about 326,303 MT CO₂e, or an additional 254,411 MT CO₂e beyond “Business-as-usual” projections, at a rate of 3.8 percent per year, significantly increasing the scale and speed of reductions.

As a result of various City-led initiatives, programs, and activities focused on climate change and sustainability, by the end of 2019 Palo Alto reduced GHG emissions an estimated 38.2 percent from the 1990 baseline, despite a population increase of 23.6 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, 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.

Consistent with Council’s adoption of “Climate Change – Protection and Adaptation” as one of the four priorities for CY 2021, staff has prepared a 2019 greenhouse gas (GHG) emissions inventory and a Business as Usual (BAU) Forecast to show how much GHG reduction will be achieved if the City only implements policies and plans that Council has already adopted and follow California-wide goals and regulations. In addition, staff, with technical assistance from AECOM, has completed the preliminary Impact Analysis. In order to meet the 80 x 30 goal, the City will need to decide on a policy framework that takes into account updated climate science describing what actions are needed to combat global warming, and reinforce community awareness leading to actions that aggressively reduce vehicle miles traveled and vehicle emissions, and electrify existing buildings.

AECOM has reviewed the preliminary Impact Analysis and is drafting a memo that includes a summary of the results of the preliminary Impact Analysis, their assessment of the modeling work, and recommendations for next steps. AECOM’s review of the preliminary Impact Analysis is not part of this report and will be shared at a future council meeting.

¹⁰ <https://www.cityofpaloalto.org/civicax/filebank/documents/63141>

This staff report includes a potential list of policy tools that could be implemented as part of the SCAP adoption to further the City's 80x30 goals, a summary of the 2019 GHG inventory and the changes from previous inventories, the Business as Usual forecast and an adjusted Business as Usual forecast, the preliminary Impact analysis, and a financial analysis and community and stakeholder options for the Council to consider. A potential list of shorter term, near term and longer term policy tools can be found in Attachment A. The full Sustainability and Climate Action Plan update report with detailed analysis can be found in Attachment B.

Policy Tools and Actions to Consider As Part of SCAP Development

Attachment A lists a variety of preliminary proposed measures which involve different levels of government intervention and community programs designed to make it easy for early adopters to electrify. Low intervention policy tools include outreach efforts or voluntary programs. Medium intervention actions could include ordinances requiring electrification of appliances at end of life and low-level carbon pricing. Higher intervention actions include mandating electrification by a date certain or imposing carbon pricing on private property, and other actions which could present legal challenges and/or where the City must either comply with or secure changes to state and federal laws that would otherwise constrain some promising approaches. Local community support and voter approval may be an important next step on several of these actions. Direct advocacy at the state level, for some if not all of the medium and high intervention actions, may also be necessary.

Staff expects that high-intervention, mandatory actions will be needed to achieve the outcomes required to achieve the city's 80 x 30 goals. With that said, the outreach efforts and voluntary programs can make a big difference in conjunction with other city actions. Direct local community action will be needed to make a global impact on sustainability at the local level and move us further towards the city's 80x30 vision.

The final recommendations contained in the revised SCAP for Council consideration will include a series of low, medium and high interventions to help the city achieve its 80x30 goals and much of the community and stakeholder engagement planned will involve gaining further input on these and other items to inform Council consideration and eventual adoption of the revised SCAP later in 2021. It would be helpful for staff to hear from Council on the potential low, medium or high interventions. Some examples of potential actions include:

Voluntary and outreach programs that could have a short-term impact include:

- Expand electrification incentives to cover space heating and cooking equipment for residential and nonresidential customers
- Expand program services targeting multi-family buildings and low-income households to include electrification projects
- Expand program services to non-residential facilities to electrify water and space heating system
- Targeted outreach to multifamily residential (MFR) and lower income residents, including assistance with charger installation for MFR buildings.
- Continue to provide rebates and technical assistance for workplace charging.

Mid-term actions could include:

- Launch direct-install program for EV charging with on-bill financing
- Allocate funding for charger installation for low income residents
- Mandate non-residential new construction projects to meet all-electric requirements ideally via Reach Code
- Adopt mandate to require end-of-life replacement of mixed-fuel rooftop packaged HVAC systems with electric heat pump systems starting in 2023
- Launch direct-install program for EV charging with on-bill financing
- Allocate funding for charger installation for low income residents
- Residential EV credit – electric bill discount for registered EVs
- Institute project to build 30 miles of Bicycle Boulevard /Traffic Calming facilities over next 20 years
- Explore ballot measures to further infrastructure focused on impacts to the City’s sustainability goals
- Traffic signal related equipment improvement to improve traffic flow, reducing idling time and associated GHG emissions

For the full list of potential actions for further Council input, see Attachment A.

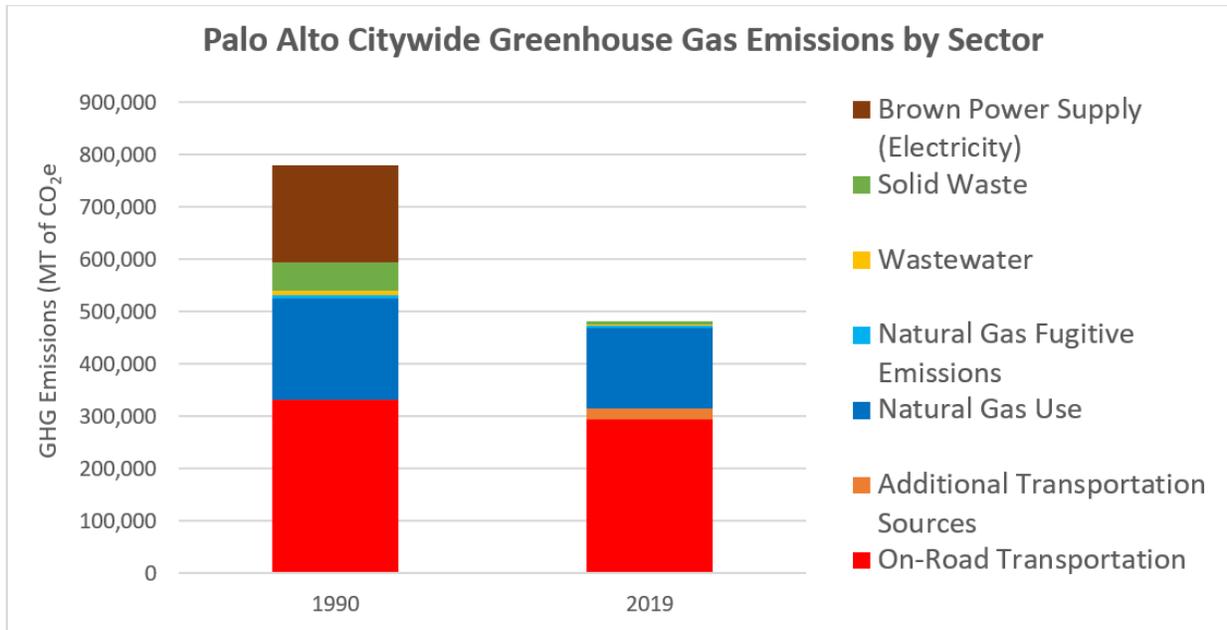
Summary of the Sustainability and Climate Action Plan Update Report

The attached Sustainability and Climate Action Plan update report is organized by a series of sections that provide greater depth and information on several elements of the 2019 GHG inventory and other analysis. The following summary is a high-level overview of the details contained in Attachment B.

Palo Alto’s 2019 Greenhouse Gas Emissions Inventory - Cities represent the single greatest opportunity for tackling climate change, as they are responsible for more than 70 percent of global energy-related carbon dioxide emissions. The first step for cities to realize their potential is to identify and measure where their emissions come from. In 2019, Palo Alto emitted an estimated 482,327 metric tons (MT) of carbon dioxide equivalent (CO₂e) from the residential, commercial, industrial, transportation, waste, water, and municipal sectors.¹¹ In comparison to the 1990 base year, that is a 38.2 percent decrease in total community emissions, despite a population increase of 23.6 percent during that same time period. Of that 38.2 percent reduction to-date, 24 percent came from achieving carbon neutrality for the City’s electricity portfolio, and the remaining 14 percent reductions were due to declines in the City’s natural gas emissions, transportation emissions, and emissions from other sources. Of the remaining emissions sources as of 2019, roughly 61 percent are from on-road transportation, 32 percent are from natural gas use, and the remainder are from other sources. The full comparison between the 1990 and 2019 GHG inventories can be found in Attachment C: 1990 vs. 2019 Greenhouse Gas Emissions by Sector and Subsector.

¹¹ Carbon dioxide equivalent is a unit of measure that normalizes the varying climate warming potencies of all six GHG emissions, which are carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF₆). For example, one metric ton of nitrous oxide is 210 metric tons of CO₂e.

Figure 1: 1990 vs 2019 GHG Emissions by Sector



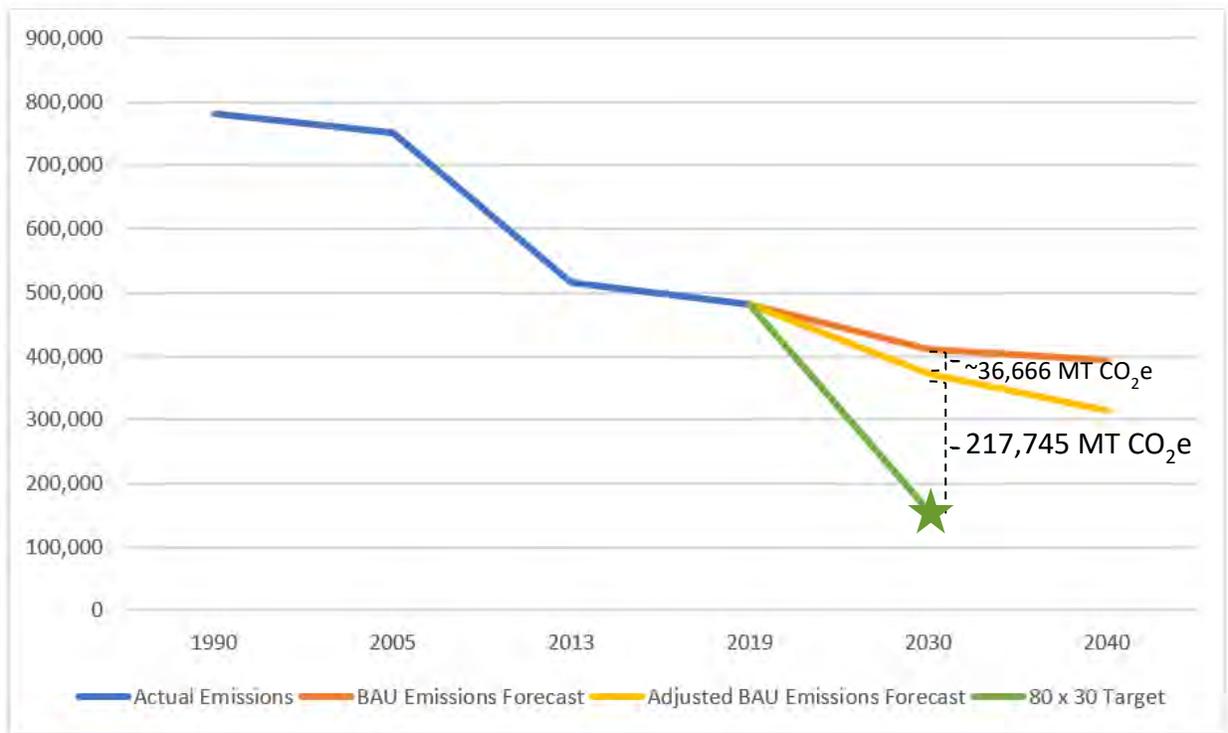
Business As Usual (BAU) Forecast - AECOM developed a forecast of future emissions to understand what reduction measures are needed to meet the 80 x 30 goal. This BAU projection represents the emissions expected if the 2019 patterns of travel, energy and water consumption, and waste generation/disposal persist. It includes emissions reductions as a result of implementation of all the City Council approved plans, policies, and ordinances that were approved on or before 2019. This projection factors in the expected rate of county population and job growth and is considered in the absence of any statewide measures, policies, or actions that would reduce emissions, including state legislation and/or any other policies or procedures adopted after 2019. Under a BAU scenario, Palo Alto emissions are projected to be 47.4 percent below 1990 levels in 2030 (410,435 MT CO₂e) and 49.4 percent below 1990 levels in 2040 (394,451 MT CO₂e).

The BAU forecast developed by AECOM is based on 2019 trends, and therefore leaves out the impacts of the COVID-19 pandemic and the increase in remote work as well as the market shifts from Governor Newsom’s September 2020 Executive Order N-79-20, which directs California to require that, by 2035, all new cars and passenger trucks sold in the state be zero-emission vehicles. Staff adjusted AECOM’s BAU forecast to include these factors, using data and assumptions specific to Palo Alto. Assuming that 50 percent of employees are eligible for remote work and that (if supported by city policies and programs) they opt for 2 days a week of remote work, then commute Vehicle Miles Traveled (VMT) could be reduced by 8 percent to 11 percent¹² compared to 2019 levels. On-road transportation emissions in the 2030 BAU forecast

¹² While permanent increases in work-from-home behavior will lead to decreased commute VMT, this reduction is off-set by additional travel for non-commute reasons, such as increased VMT from driving to run errands and

could be reduced an additional 3.8 percent from remote work. This translates into a 3 percent reduction in on-road transportation emissions relative to 2019 levels, or a 2.8 percent reduction of on-road transportation emissions relative to 1990 levels and slightly more than 1 percent of total 1990 emissions. In addition, Palo Alto currently has one of the highest electric vehicle (EV) adoption rates in the country. The models used to calculate AECOM’s BAU forecast do not include Palo Alto specific EV adoption rates – they use Santa Clara County EV adoption rates. For EVs, market share is projected to increase from the current 30% to 50% in 2030, based on a CA-specific EV sales forecast¹³. Assuming that 31 percent of all Palo Alto registered vehicles will be EVs by 2030 without additional City action, on-road transportation emissions in the 2030 BAU forecast could be reduced an additional 11.3 percent through EV adoption. This translates into a 9 percent reduction of on-road transportation emissions relative to 2019 levels or an 8 percent reduction of on-road transportation emissions relative to 1990 levels and 4 percent of total 1990 emissions. Under staff’s adjusted BAU scenario, Palo Alto emissions are projected to be 52.1 percent below 1990 levels in 2030 (373,769 MTCO₂e) and 59.6 percent below 1990 levels in 2040 (314,968 MTCO₂e).

Figure 2: Adjusted “Business as Usual” GHG Emissions Projection and Reduction Target



getting more deliveries at home. Studies show that the degree of this added non-commute VMT ranges from 15% of the total saved, to more than 100% of the total saved.

¹³ UBS Investment Bank, March 2021. “EVs Shifting into Overdrive: How will electric cars re-shape the auto industry?”. <https://neo.ubs.com/static/login.html?origin=/shared/d24liDrju8G4f>

Impact Analysis – Staff and AECOM modeled the outcomes needed to achieve the 80 x 30 goal, keeping in mind updated climate science and the global impacts of climate change, as well as the increased community awareness needed. While there are multiple strategies to reduce Palo Alto’s emissions, the scenario described below represents the most technically feasible and cost-effective pathway staff and its consultant could identify. While legal analysis of these preliminary measures is underway, additional in-depth review will be needed as implementation details emerge. The full details of the preliminary Impact Analysis can be found in Attachment B, Section 4, and the Supplemental Charts can be found in Attachment D.

Staff and AECOM have identified the following outcomes in 2030 as necessary to achieve the 80 percent reduction:

- Commute travel is reduced 10 percent via telecommuting
- Vehicle Miles Traveled (VMT) are reduced 8 to 11 percent
- 85 percent of all Palo Alto new vehicle purchases are EVs, up from 30 percent now, which results in a vehicle fleet that is 44 percent EVs (50 percent in single-family households, 33 percent in multi-family)
- 40 percent of commuter trips into Palo Alto and 30 percent of visitor trips are made in EVs (35 percent overall). This is up from 3 percent right now.
- Virtually all single-family gas appliances and virtually all commercial rooftop HVAC units are electrified
- Significant additional multi-family and commercial building electrification and other emissions reductions to be determined
- An additional 65,0000 MT CO_{2e} of emissions reductions are achieved through other measures. Staff’s preliminary analysis only achieves 72 percent reductions below 1990 levels, leaving an 8% gap to be closed.

More detail on the key actions modeled to achieve the above outcomes can be found in Attachment A.

Based on staff and consultant modeling, and depending on what strategies Council chooses to pursue, staff estimates the total cost to implement the goals and key actions analyzed is roughly \$740 million in 2021 dollars (note that there would be an additional cost to achieving the remaining 8% GHG emissions reductions, but this cost is unknown at this time). This investment would take place through 2030. This is the up-front capital cost for the necessary vehicle and mobility investments, investments in charging infrastructure, and investments in appliances and building infrastructure. It includes utility improvements needed to support the transformation. It does not include operational savings to customers from eliminating natural gas bills, gasoline expenditures, and the value of reduced vehicle maintenance. If debt financing is available¹⁴, staff estimated the annual cost in 2030 would be roughly \$53 million per year.

¹⁴ Staff assumed financing over the life of each electrified appliance at municipal bond rates for the purposes of this analysis.

There are also significant annual operational savings to customers from these measures. These annual operational savings are expected to be roughly \$43 million per year in 2030, for a net cost of \$10 million per year. For comparison, the total of all community electric and gas bills is roughly \$175 million per year. This means the net cost to implement would be 5 percent to 6 percent of total community energy spending. The actual costs and benefits accrue differently across the community, however. Section 4.b. of Attachment B discusses this issue and potential solutions. By 2033, benefits are estimated to match costs and from then forward electrification would represent a net benefit to the community as a whole. This means achieving the S/CAP goals would likely result in *lower* household and business expenses throughout the community in the long term, which could make residents and businesses open to funding other community investments such as undergrounding utilities or fiber to the home. While the costs may seem high and the scale of action needed may seem large, the cost of inaction is also high. The analysis of the estimated costs to achieve 80 x 30 and the cost of delaying action can be found in Attachment B, Section 4.b. and 4.c.

Council and Stakeholder Engagement

Staff developed, and is implementing, a 2021 S/CAP Engagement Plan which identifies relevant stakeholders, proposed materials, and desired meeting milestones and outcomes. Key steps to date have been a March 31 – April 14, 2020 Community Engagement Virtual Workshop; Council Study Sessions on April 13, 2020 and June 16, 2020; a Utilities Advisory Commission Study Session on May 20, 2020; June 2020 Study sessions with the Utilities Advisory Commission, Planning and Transportation Commission, and Parks and Recreation Commission; and a Fall 2020 S/CAP Webinar series to highlight various topics addressed in the 2021 S/CAP. Topics covered in the Fall 2020 S/CAP Webinar series included: an overview of the Sustainability and Climate Action Plan, Sea Level Rise, All-Electric Homes, Transportation, and the Natural Environment. The webinar recordings, PowerPoint presentations, and questions and answers can be found on the [S/CAP Website](#)¹⁵. The webinars were generally well received, with an average of 90 participants at each webinar. Many participants responded to the webinar surveys. The following are some examples of ideas supported by survey respondents:

- Further exploration of a carbon fund, carbon “savings account”, or vehicle miles travelled (VMT) bank to reduce greenhouse gas emissions
- A ballot measure at some point in the future that raises funds from the community in order to reduce greenhouse gas emissions
- Rebates for electric panel upgrade and electric conduit installation, and a special electric rate for all-electric homes
- A special electricity rate for EVs that would help their decision to switch to an EV
- Participants indicated that working from home; better access, efficiency, and reliability of public transit; closer proximity to amenities (e.g. grocery stores); and safer bike routes would motivate them to drive less.

¹⁵

https://www.cityofpaloalto.org/services/sustainability/sustainability_and_climate_action_plan/community_engagement/default.asp

For the next phase of S/CAP development, staff proposes focusing on three themes of work that would proceed concurrently:

1. **Technical Analysis:** Climate action technical analysis review and comments, including legal review of key actions as details become available
2. **Policy Development:** Review and feedback on S/CAP climate policies analyzed
3. **Near-Term Programs:** Development of proposals for programs to be implemented in 2021 to 2024

An additional body of work involves outreach and engagement, which while necessarily integrated with the tracks above, could be considered a discrete effort with specific stakeholders, strategies, and tactics. In either case, outreach and engagement would be an aspect of all three tracks above including technical analysis, policy development, and near-term programs. Recommended options for Council consideration include:

Council Involvement Options

1. Continue to bring items directly to the City Council
2. Create an Ad Hoc Committee to assist staff as work is underway
3. Provide status reports on S/CAP work to the Finance Committee (acknowledging the technical analysis and costs the overall S/CAP elements will require)

Community Engagement Options

1. **Utilize City's Board, Commission and Committee (BCC) Structure.** Staff is recommending using the City's existing Boards, Commission and Committee structure to gain input on specific topic areas that the BCC's focus on including:
 - Utilities Advisory Commission
 - Technical Analysis – Energy (Building Electrification), Mobility, EVs
 - Policy Development – Energy (Building Electrification), Mobility, EVs, Climate Adaptation and Sea Level Rise
 - Near-Term Programs – Energy (Building Electrification), Mobility, EVs
 - Planning and Transportation Commission
 - Technical Analysis - Mobility, EVs
 - Policy Development - Mobility, EVs, Climate Adaptation and Sea Level Rise
 - Near-Term Programs - Mobility, EVs
 - Parks and Recreation Commission
 - Policy Development - Water, Climate Adaptation and Sea Level Rise, Natural Environment, Zero Waste
 - Near-Term Programs - Water, Climate Adaptation and Sea Level Rise, Natural Environment, Zero Waste
 - Human Relations Commission
 - Policies with provisions for income-qualified residents
2. **Industry-Specific Roundtable discussions.** These engagement opportunities will provide initial input on technical analysis, policy development, and near-term programs by

bringing together industry specific stakeholders and advocates. These smaller group sessions will help inform and gain input as further work is completed.

3. **Community Meetings.** As work is further developed in these three focus areas, staff could use community meetings as a venue to continue engage several stakeholder groups and community members on milestones in the work, provide progress updates and gain input as recommendation are being finalized.
4. **Online Survey.** Staff plans to use an online survey or surveys to gain input from a broad range of the community when the draft S/CAP recommendations are finalized to help inform Council consideration/adoption.
5. **Community Summit Series.** A series of summits by distinct topic areas will be used to share final draft recommendations before Council adoption. The summits will be split into topic areas including: Energy; Mobility/EV; Sea Level Rise; and Water, Natural Environment, and Zero Waste.

As noted above, staff is working on development of the Sea Level Rise Adaptation Policy in parallel with the S/CAP. In addition to S/CAP engagement options above, staff continues to develop community engagement planning specific to sea level rise. The next public meeting for the Sea Level Rise Adaptation Policy is scheduled for May 2021¹⁶.

Timeline

The timeline is dependent upon Council's approval of council governance and community engagement. If Council approves the community engagement options above, the following would be a general timeline of staff work ahead:

- May: Sea Level Rise Adaptation Policy Public Meeting
- June-August: Industry specific Roundtable Discussions on S/CAP tracks
- Early Fall 2021: Commission meetings on the S/CAP tracks, potential select community meetings
- Early Winter 2021: Online survey and Summit Series
- December 2021: Final Draft S/CAP presented to Council for adoption
- Spring 2022: California Environmental Quality Act (CEQA) evaluation completed
- Spring 2022: S/CAP with CEQA Review presented to Council for approval

Policy Implications

The Sustainability and Climate Action Plan Update Report aligns with one of the top four Council Priorities for CY 2021: "Climate Change – Protection and Adaptation"

Resource Impact

Initiatives are across departments and funds. Some are funded in current budgets, others will be recommended as part of the FY 2022 Proposed Budget, while most will need to be prioritized in consideration of competing priorities. Unfortunately, this significant comes at a

¹⁶ More information about the Sea Level Rise Adaptation Policy process can be found at <http://cityofpalto.org/sealevelrise>.

time of an acute awareness of resource limitations associated with pandemic recovery.

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 2021 S/CAP will be evaluated consistent with CEQA prior to approval by the City.

Attachments:

- Attachment A: Examples of Policy Tools That Could be Implemented in S/CAP Analysis, by Year
- Attachment B: Sustainability and Climate Action Plan Update Report
- Attachment C: 1990 vs 2019 GHG Emissions by Sector and Subsector
- Attachment D: Supplemental Charts and Tables

Attachment A:

Examples of Policy Tools That Could be Implemented in S/CAP Analysis, by Year

This table shows a variety of preliminary proposed measures which involve different levels of government intervention. Low intervention policy tools include outreach efforts or voluntary programs designed to make it easy for early adopters to electrify. Medium intervention actions include ordinances requiring electrification of appliances at end of life and low-level carbon pricing. Higher intervention actions include mandating electrification by a date certain or imposing carbon pricing on private property.

Staff expects that high-intervention, mandatory actions will be needed to achieve the outcomes required to achieve the 80 x 30 goals. As a chartered city that operates both an electric and a gas utility, Palo Alto has possession of tools to lower carbon emissions that many communities lack. One challenge is that medium and high intervention actions, in particular those involving mandates or gas bans, present a variety of legal issues. The City must either comply with or secure changes to a myriad of state and federal laws that would otherwise constrain some promising approaches. Local community support and voter approval may be an important step. Direct advocacy at the state level, for some if not all of the medium and high intervention actions, may also be necessary.

	Electric Vehicles	Mobility	Buildings
2021 to 2022	<ul style="list-style-type: none"> Targeted outreach to MFR and lower income residents, including assistance with charger installation for MFR buildings. Continue to provide rebates and technical assistance for workplace charging. 	<ul style="list-style-type: none"> Implement shared micro-mobility service to provide last-mile connection Allocate funding for on-demand transit service Allocate funding for TMA, expand geographic scope of TMA to entire City Initiate Bike Plan update Start implementing smart parking infrastructure in public garages 	<ul style="list-style-type: none"> Raise awareness on GHG, health and safety benefits of all-electric appliances Expand electrification incentives to cover space heating and cooking equipment for residential and nonresidential customers Expand program services targeting MF buildings and low-income households to include electrification projects Expand program services to non-residential facilities to electrify water and space heating systems
	<ul style="list-style-type: none"> Develop extensive Citywide promotion of walking, bicycles, and small electric vehicles like e-bikes and scooters, and other alternative transportation modes for all types of trips. Raise awareness of emissions savings and other benefits of EVs and available incentives for those who cannot use alternative modes. Create incentives for e-bikes and light EVs. 		
2022 to 2023	<ul style="list-style-type: none"> Launch direct-install program for EV charging with on-bill financing Funding for charger installation for low income residents Residential EV credit – electric bill discount for registered EVs 	<ul style="list-style-type: none"> Update and strengthen public and private TDM programs Adopt telecommuting policy for local employers to align with regional targets. Complete Bike Plan Update Designate vehicle-free streets to encourage economic activity and recreational uses. Identify additional funding sources for 2023-2030 Mobility measures. Revise employee parking permit fees to make transit a competitively priced commute mode 	<ul style="list-style-type: none"> Offer on-bill financing for electrification projects Mandate major alterations of SFRs to meet all-electric requirements, ideally via Reach Code Mandate non-residential new construction projects to meet all-electric requirements ideally via Reach Code Adopt mandate to require end-of-life replacement of mixed-fuel rooftop packaged HVAC systems with electric heat pump systems starting in 2023
	<ul style="list-style-type: none"> Non-binding ballot measure to indicate community interest in adopting carbon pricing in 2024. 		

	Electric Vehicles	Mobility	Buildings
2023	<ul style="list-style-type: none"> Explore adopting a mandate that all MFR buildings and employers must provide at least some EV charging capacity by a date certain (TBD, but prior to 2030) – or equivalent program to deliver EV charging capacity to MFR residents. 	<ul style="list-style-type: none"> Institute Safe Routes for Adults program Install short-term on-street bicycle parking in business districts and major retail centers Expand e-bike and e-scooter infrastructure throughout Palo Alto, especially at transit stations and stops, job centers, community centers, and other destinations. Institute paid parking on-street and in public garages in Downtown and California Ave area 	<ul style="list-style-type: none"> Aggressively implement adopted programs and drive high levels of participation. Continue public outreach.
2024	<ul style="list-style-type: none"> Alternative commute mandate – explore limiting workplace parking for single occupancy ICE vehicles 	<ul style="list-style-type: none"> Institute project to build 30 miles of Bicycle Boulevard /Traffic Calming facilities over next 20 years Revise minimum parking requirement standards to reduce number of trips and VMT 	
	<ul style="list-style-type: none"> Explore ballot measure to adopt carbon pricing for commuter and visitor parking. Explore ballot measure to authorize disconnection of gas service to single-family residential areas while greatly reducing multi-family and non-residential natural gas use. 		
2025	<ul style="list-style-type: none"> Work with employers to provide incentives for employees using EVs or alternate commute 	<ul style="list-style-type: none"> Install speed limit signage and markings to make streets more bicyclist and pedestrian friendly and safe. 	<ul style="list-style-type: none"> Mandate end-of-life replacement of gas furnaces in multifamily units with heat pump systems starting in 2026, ideally via Reach Code Mandate the replacement of gas cooktop in multifamily units with electric alternatives starting in 2026, ideally via Reach Code
2026	<ul style="list-style-type: none"> Carbon pricing gradually increases and City continues to provide programs to ease EV adoption and charger installation 	<ul style="list-style-type: none"> Initiate program to install 50 miles of protected class-4 bike lanes over the next 20 years 	<ul style="list-style-type: none"> If approved, begin gas main disconnection to single family residences Aggressively implement adopted programs and drive high levels of participation. Continue public outreach.
2027		<ul style="list-style-type: none"> Initiate program to install 10 miles of multi-use paths over the next 20 years 	
2028		<ul style="list-style-type: none"> Initiate program to install transit signal priority equipment Traffic signal related equipment improvement to improve traffic flow, reducing idling time and associated GHG emissions 	
2029		<ul style="list-style-type: none"> Initiate program to install 10 miles of bicycle highways program for next 20 years Construct 8 protected intersections for biking and walking 	

	Electric Vehicles	Mobility	Buildings
2030		<ul style="list-style-type: none">• Construction of bus rapid transit lanes and queue jump lanes to speed bus travel	

Attachment B: Sustainability and Climate Action Plan Update Report

Table of Contents

1. Palo Alto's 2019 Greenhouse Gas Emissions Inventory
 - 1.a. Overview of Methodology for Quantifying Greenhouse Gas Emissions
 - 1.b. Palo Alto's 2019 GHG Emissions
 - 1.c. Transportation and Mobile Sources
 - 1.d. Natural Gas Use
 - 1.e. Solid Waste
 - 1.f. Wastewater
2. Business as Usual Forecast
 - 2.a. "Business-as-usual" (BAU) emissions
 - 2.b. Additional Emissions Reductions Needed to Achieve 80% Reduction
3. Adjusted Business as Usual Forecast
 - 3.a. The Impact of Remote Work
 - 3.b. Electric Vehicle Adoption Trends
 - 3.c. Adjusted Business as Usual Forecast
4. Impact Analysis
 - 4.a. Outcomes needed to achieve 80% Reduction from 1990 Levels
 - 4.b. Estimated Costs to Achieve 80% Reduction from 1990 Levels
 - 4.c. Cost of Delaying Action
5. Carbon Neutrality

1. Palo Alto's 2019 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 more than 70 percent of global energy-related carbon dioxide emissions. 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 category¹.
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

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.

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 GHG Protocol standard for Cities, also known as GPC, provides a robust framework for accounting and reporting city-wide greenhouse gas emissions. The GPC is the official protocol specified by the Global Covenant of Mayors and defines what emissions must be reported and how. In addition, this inventory draws on methods from the U.S. Community Protocol⁴, which provides more detailed methodology specific to U.S. communities. It seeks to:

- 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 2019 Palo Alto GHG inventory uses the approach and methods provided by the GPC and was completed by AECOM. Inventory calculations were performed using the ClearPath⁵ tool. The City's GHG inventory conforms to the GPC Basic protocol.

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 <https://icleiusa.org/us-community-protocol/>

⁵ <https://icleiusa.org/clearpath/>

For the 2019 GHG inventory to comply with the GPC Basic protocol, additional existing emissions sources were included for the first time: Airport Emissions, Off-road Vehicles, Caltrain Commuter Rail, Composting, and Palo Alto Landfill Gas Flaring. Wastewater biosolids treatment is a new emissions source that was added due to the closure of the sewage sludge incinerators (more information can be found in section 1.f). Palo Alto Landfill Gas Fugitive Emissions are also no longer included since the landfill has since been capped. In addition, natural gas use is now separated into three categories: Commercial Energy, Industrial Energy, and Residential Energy.

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 city⁶. 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 2019 GHG Emissions

In 2019, Palo Alto emitted an estimated 482,327 metric tons (MT) of carbon dioxide equivalent (CO₂e) from the residential, commercial, industrial, transportation, waste, water, and municipal sectors.⁷ In comparison to the 1990 base year, that is a 38.2 percent decrease in total community emissions, despite a population increase of 23.6 percent during that same time period. A comparison of 1990 and 2019 GHG emissions is shown in Figure 1 and Table 1. The full comparison between the two inventories can be found in Attachment C: 1990 vs. 2019 Greenhouse Gas Emissions by Sector and Subsector. As mentioned in section 1.a., additional existing emissions sources were included in the 2019 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 C, a total of 23,493 MT CO₂e was added from GHG emissions sources that were not included previously, accounting for 4.9 percent of total emissions. As a result of these additions, it is no longer possible to make a direct comparison with previous inventories. We can still compare to the 1990 baseline, but with the understanding that total GHG emissions would be 458,834 MT CO₂e for a 41.2 percent

⁶ https://ghgprotocol.org/sites/default/files/standards/GHGP_GPC_0.pdf

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 (CO₂), methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF₆). For example, one metric ton of nitrous oxide is 210 metric tons of CO₂e.

reduction from 1990 levels, rather than a 38.2 percent reduction below 1990 levels. At this time, staff does not recommend adjusting previous inventories or the 1990 baseline to include the additional emissions sources. The amount of GHG emissions from additional sources is relatively small, at 4.9 percent of total emissions. Palo Alto completes a GHG inventory on an annual basis. Future inventories will all need to comply with the GPC Basic Protocol, and as such, will need to include the same additional emissions sources that were included in the 2019 GHG inventory. In order to compare the 2019 GHG inventory and future GHG inventories to the 1990 baseline, we could either remove the additional emissions sources for comparison purposes, or acknowledge that methodologies for calculating GHG emissions are constantly improving and evolving and that we will strive to use the most accurate method for calculating GHG emissions instead of trying to duplicate the methodology used in 1990.

Figure 1: 1990 vs 2019 GHG Emissions by Sector

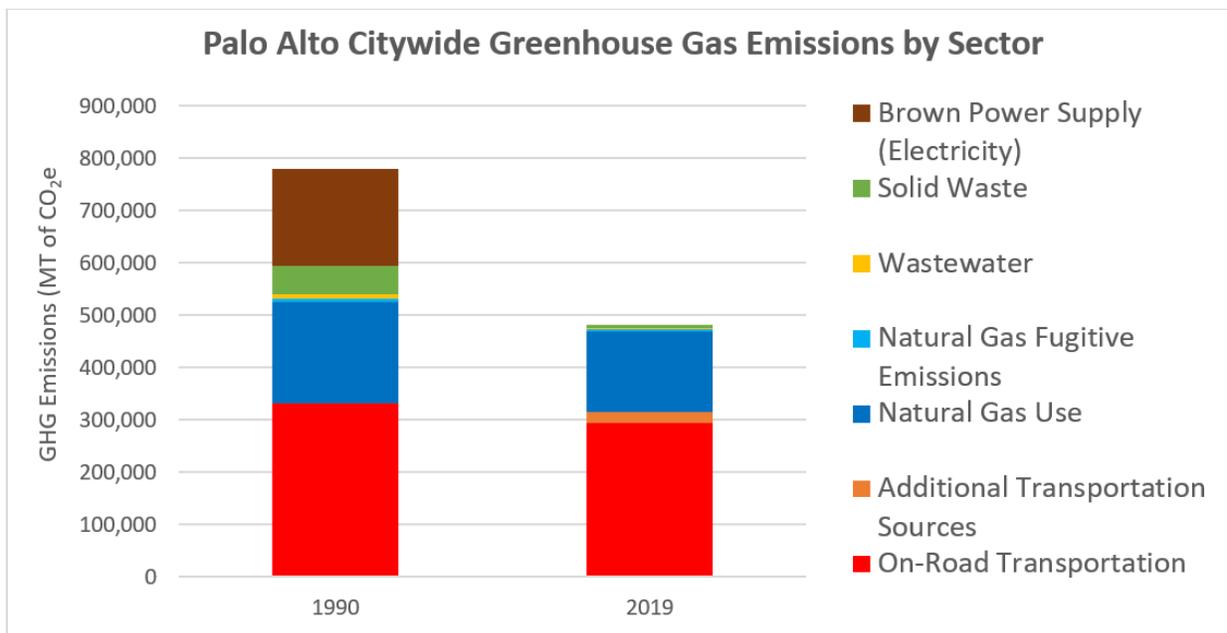
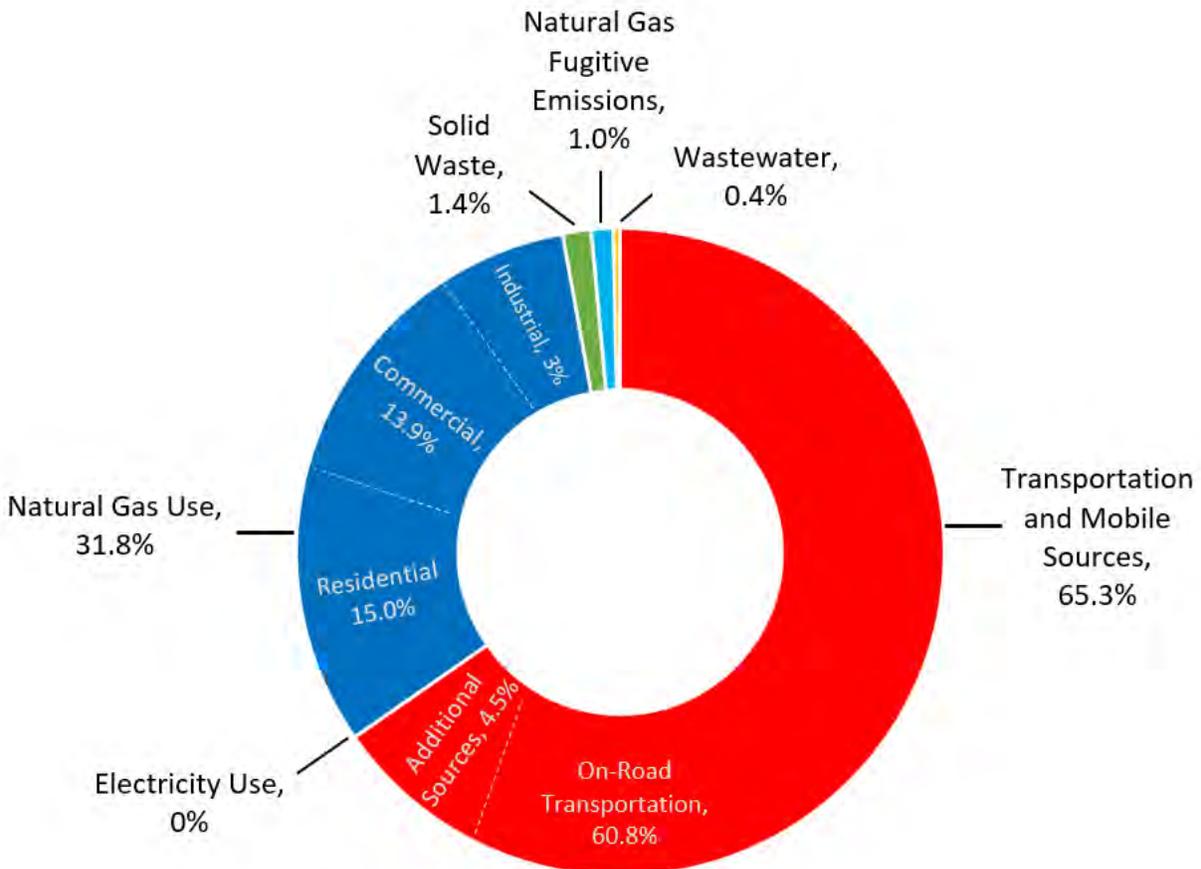


Table 1: 1990 vs 2019 GHG Emissions by Sector

Sector	1990 GHG emissions (MT CO ₂ e)	2019 GHG emissions (MT CO ₂ e)	Percent Change in Emissions (%)
On-Road Transportation	331,840	293,413	- 11.6%
Additional Transportation Sources		21,668	n/a
Natural Gas Use	194,000	153,509	- 20.9%
Natural Gas Fugitive Emissions	4,718	5,009	+ 6.2%
Wastewater	8,504	2,197	- 74.2%
Solid Waste	55,057	6,531	- 88.1%
Brown Power Supply (Electricity)	186,000		- 100%
Total GHG Emissions (MT CO₂e)	780,119	482,237	- 38.2%

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: 2019 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 2019, transportation and mobile sources accounted for roughly 65 percent of total 2019 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: 2019 Transportation and Mobile Sources

Subsector	2019 GHG emissions (MT CO ₂ e)	Percent of Total Emissions (%)
On-Road Transportation	293,413	60.8%
Airport Emissions	2,192	0.5%
Off-road Vehicles	14,634	3.0%
Caltrain Commuter Rail	4,842	1.0%
Total Transportation & Mobile Sources	315,081	65.3%

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). The last time VMT was estimated was in 2016. However, due to different methodologies used, one cannot directly compare the 2016 and 2019 estimates. One can, however, compare the 2019 estimate with the 2015 estimate generated from the same model run. Per the current Santa Clara Valley Transportation Authority

transportation model, in 2015 Palo Alto's annual VMT was roughly 930,313,940 compared to 952,584,400 in 2019. While the overall annual VMT increased, the daily VMT per service population (residents plus employees) decreased slightly from 16.5 in 2015 to 16.4 in 2019. On-road transportation accounts for approximately 60.8 percent of Palo Alto's total emissions, which is a 4.2 percent decrease from 2018 and an 11.6 percent decrease from 1990. Transportation emissions in all of California have increased since 2013.⁸

As mentioned previously, this is the first year that airport emissions, off-road vehicles, and Caltrain commuter rail are included in the GHG inventory. Due to the lack of prior data, there are no Key Actions related to reducing airport emissions or off-road vehicles emissions in this S/CAP. However, these emissions could be included in future work plans or updates to the S/CAP. Caltrain electrification is a key component of the Caltrain Modernization program⁹, with Caltrain scheduled to be electrified in 2022. Once the Caltrain Modernization program is complete, most of the Caltrain commuter rail emissions will be eliminated.

1.d Natural Gas Use

In 2019, natural gas emissions accounted for 31.8 percent of total 2019 GHG emissions in Palo Alto, which is a 1.6 percent increase from 2018 and a 20.9 percent decrease from 1990. As shown in Table 3, Palo Alto's total natural consumption was 28,867,162 therms. Residential energy accounts for 15 percent of total emissions, commercial energy accounts for 13.9 percent of total emissions, and industrial energy – which include 6 MT CO₂e from the COBUG natural gas generator for emergency use – accounts for 3 percent of total emissions.

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 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: 2019 Natural Gas Use

Subsector	Consumption (Therms)	2019 GHG emissions (MT CO ₂ e)	Percent of Total Emissions (%)
Residential Energy	13,565,360	72,149	15.0%
Industrial Energy	2,707,034	14,373	3.0%
Commercial Energy	12,954,768	66,987	13.9%
Total Natural Gas Use	28,867,162	153,509	31.8%

⁸ California Air Resources Board. (2021). Improved Program Measurement Would Help California Work More Strategically to Meet Its Climate Change Goals. <http://auditor.ca.gov/pdfs/reports/2020-114.pdf>.

⁹ <https://calmod.org/>

Natural Gas Fugitive Emissions

Natural gas is mainly methane (CH₄), 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 2019, natural gas fugitive emissions accounted for 1 percent of total 2019 GHG emissions in Palo Alto, which is an increase of 4.8 percent from 2018 and 6.2 percent from 1990. Per the GPC, fugitive emissions from natural gas are based on overall community consumption and a leakage rate of 0.03%.

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 2019 GHG inventory does not include a category of emissions that are called “upstream emissions”. Upstream emissions are discussed in further detail in section 4.a.

1.e. Solid Waste

Palo Alto's current solid waste diversion rate is 81 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. The diversion rate of 81% is an improvement from the rate of 62% in 2007 but has remained relatively flat the last few years. As part of the 2016 S/CAP Framework, Council adopted a goal of 95% diversion of materials from landfills by 2030¹¹.

Waste sector emissions accounted for 1.4 percent of total 2019 GHG emissions in Palo Alto, which is a decrease of 88.1 percent from 1990. However, it must be noted that solid waste emissions were calculated using a different methodology for the 2019 GHG inventory.¹² In addition, as shown in Table 4, the 1990 inventory included Palo Alto Landfill Gas Fugitive emissions, whereas the 2019 inventory did not, and the 2019 inventory included composting emissions at the ZeroWaste Energy Development Company’s (ZWED) Dry Fermentation Anaerobic Digestion (AD) Facility in San Jose, CA as well as Palo Alto Landfill Gas Flaring Emissions while the 1990 inventory did not. In 2019, emissions from landfills located within the community accounted for 79.5 percent of total waste emissions.

¹⁰ <https://www.calrecycle.ca.gov/lgcentral/goalmeasure/disposalrate/graphs/estdiversion>

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 2019 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.

Table 4: 1990 vs 2019 Solid Waste Emissions by Subsector

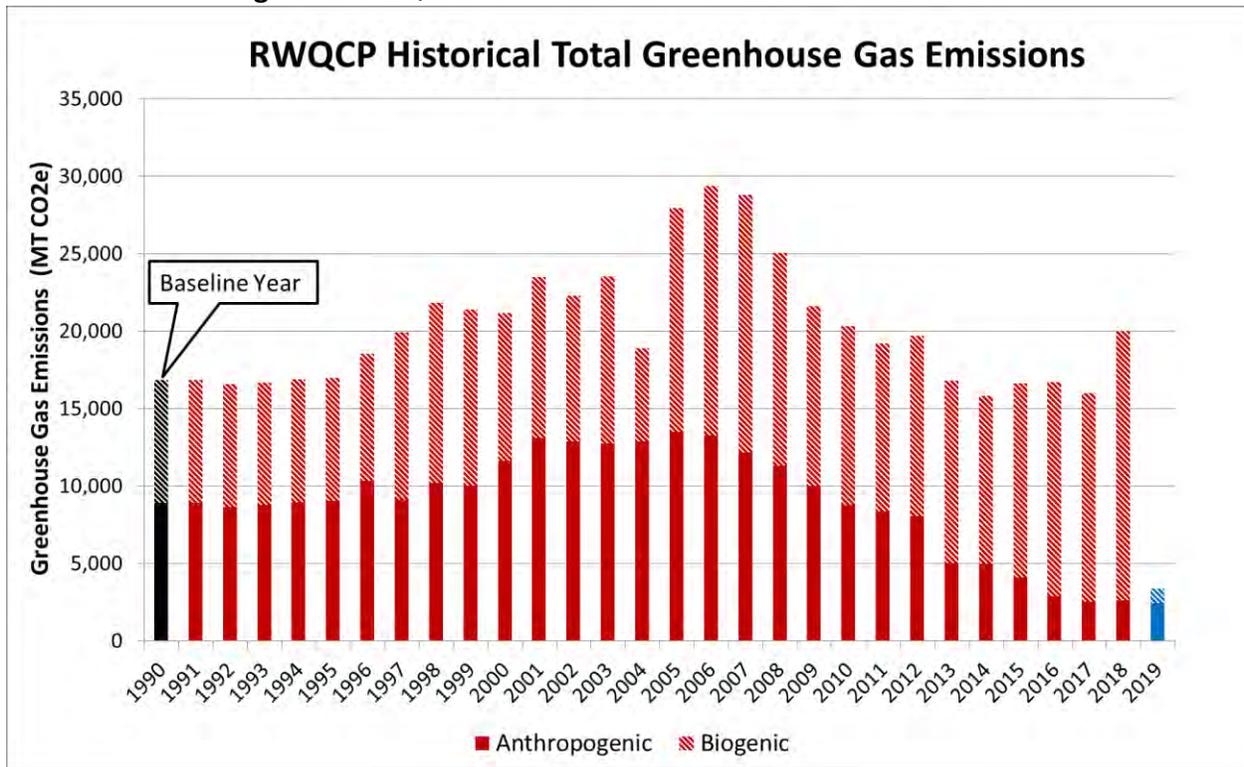
Subsector	1990 GHG emissions (MT CO ₂ e)	2019 GHG emissions (MT CO ₂ e)	Percent Change in Emissions (%)
Composting (ZWED)	Not included	731	n/a
Palo Alto Landfill Gas Flaring	Not included	281	n/a
Palo Alto Landfill Gas Fugitive	24,325	Not included	n/a
Landfill Waste	30,732	5,519	- 82.0%
Total	55,057	6,531	- 88.1%

Waste emissions result from organic material decomposing in the anaerobic conditions present in a landfill and releasing methane (CH₄) – a greenhouse gas much more potent than CO₂. 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 2019, wastewater emissions accounted for 0.4 percent of total 2019 GHG emissions in Palo Alto, which is a decrease of 29.7 percent from 2018 and 79 percent from 1990. These emissions include wastewater biosolid treatment (which includes biosolid composting, anaerobic digestion, and incineration) and wastewater treatment and effluent. Wastewater biosolid treatment is a new emissions source. In 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 CO₂e 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.

Figure 3: RWQCP Historical Total Greenhouse Gas Emissions



2. Business as Usual Forecast

AECOM developed a forecast of future emissions to understand what reduction measures are needed to meet the 80 x 30 goal.

2.a. “Business-as-usual” (BAU) emissions

This projection represents the emissions expected if the 2019 patterns of travel, energy and water consumption, and waste generation/disposal persist. It includes emissions reductions as a result of implementation of all the City Council approved plans, policies, and ordinances that were approved on or before 2019. This projection factors in the expected rate of county population and job growth and is considered in the absence of any statewide measures, policies, or actions that would reduce emissions, including state legislation and/or any other policies or procedures adopted after 2019. The projection also includes additional existing emissions sources to comply with the GPC Basic protocol (Airport Emissions, Off-road Vehicles, Caltrain Commuter Rail, Composting, and Palo Alto Landfill Gas Flaring). The Forecasting Growth Indicators used for the BAU forecast are shown in Table 5.

Table 5: Forecasting Growth Indicators

Subsector	Growth Indicator	Source
On-Road Transportation	Emission Factor: EMFAC VMT: Fehr & Peers	CARB EMFAC model Fehr & Peers
Airport Emissions	Assumed no growth	NA
Off-Road Vehicles	EMFAC-ORION	CARB EMFAC-ORION model
Caltrain Commuter Rail (will be electrified in 2022)	Caltrain Ridership Projections + 2022 Rail Electrification	Caltrain
Residential Energy	City Provided Forecasts	City of Palo Alto
Commercial Energy	City Provided Forecasts	City of Palo Alto
Industrial Energy	City Provided Forecasts	City of Palo Alto
COBUG Generator	Assumed no growth	NA
Natural Gas Fugitive Emissions	Natural gas growth rate	City of Palo Alto
Landfill Waste	Service Population	City of Palo Alto
Composting (ZWED)	Service Population	City of Palo Alto
Closed Landfill Gas Flaring	Assumed no growth	NA
Wastewater Treatment and Effluent	Service Population	City of Palo Alto
Wastewater Biosolid Treatment*	Service Population	City of Palo Alto

*Includes composting, anaerobic digestion, and incineration. Incineration not forecasted as discontinued in 2019.

The BAU emissions forecast is shown in Figure 4 and Table 6.

Figure 4: "Business as Usual" Greenhouse Gas Emissions Forecast

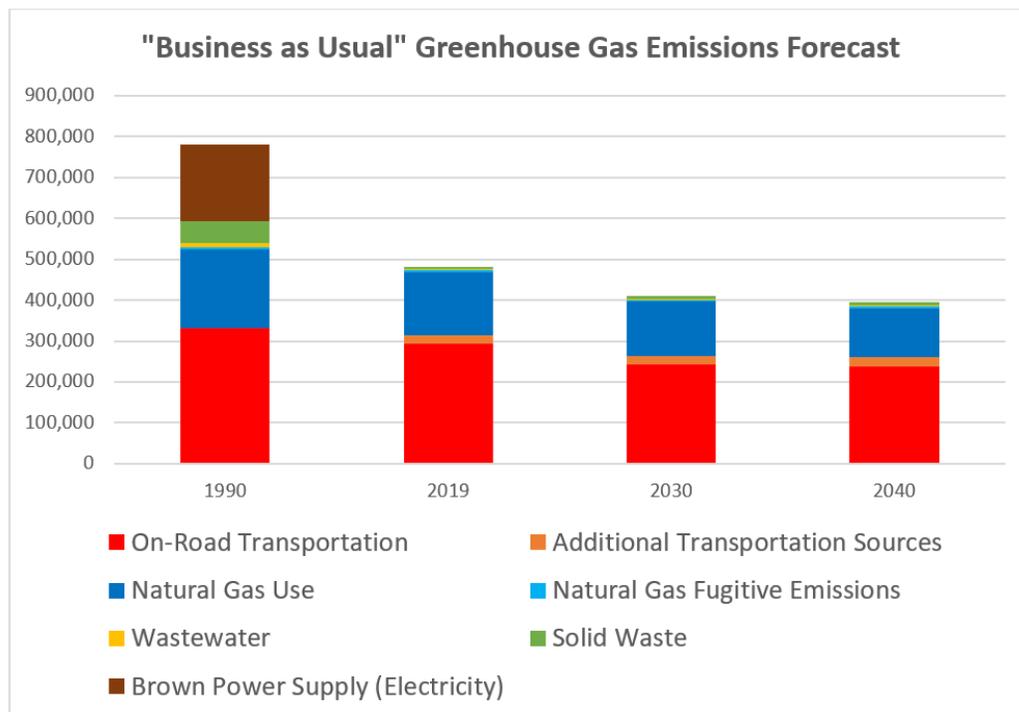


Table 6: "Business as Usual" Greenhouse Gas Emissions Forecast

GHG emissions (MT CO ₂ e)				
Sector	1990	2019	2030	2040
On-Road Transportation	331,840	293,413	243,851	239,110
Additional Transportation Sources		21,668	19,929	22,575
Natural Gas Use	194,000	153,509	133,393	119,426
Natural Gas Fugitive Emissions	4,718	5,009	4,346	3,891
Wastewater	8,504	2,197	1,927	2,046
Solid Waste	55,057	6,531	6,989	7,403
Brown Power Supply (Electricity)	186,000			
Total GHG Emissions (MT CO₂e)	780,119	482,237	410,435	394,451

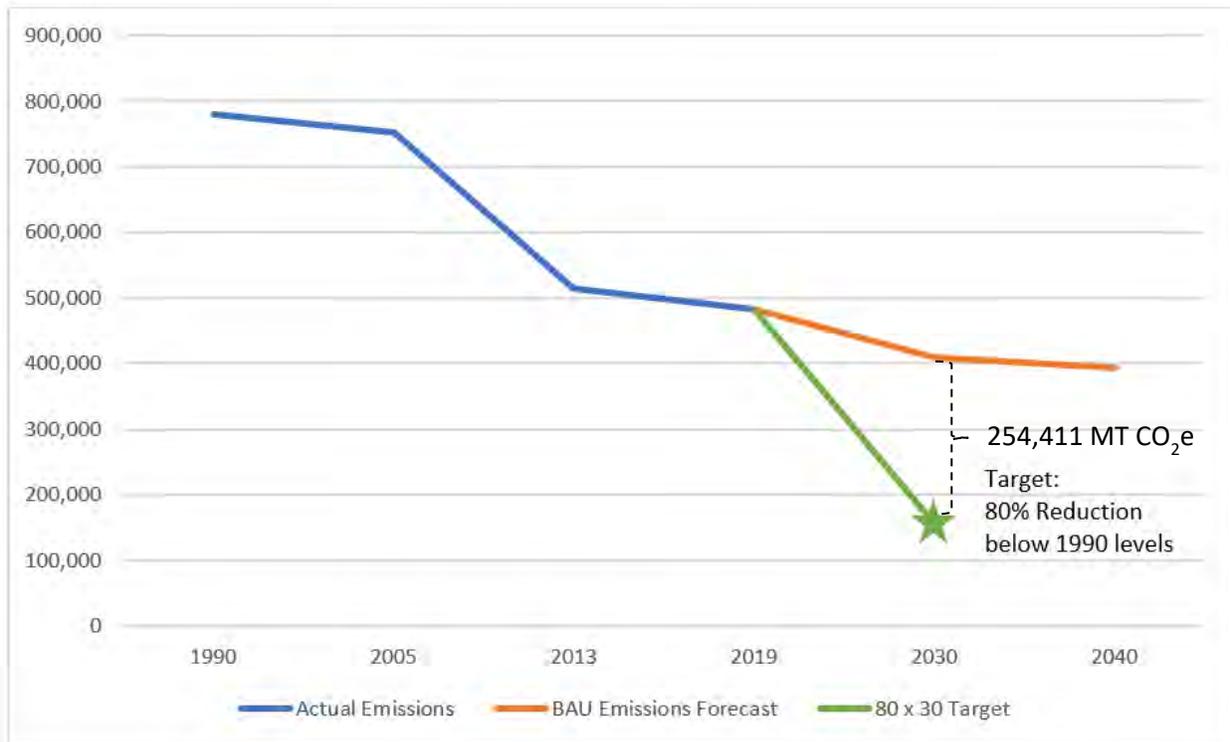
2.b. Additional Emissions Reductions Needed to Achieve 80% Reduction

Palo Alto City Council committed to an 80 percent reduction in emissions below 1990 levels by 2030. Through this commitment, Palo Alto will be doing its part in helping California achieve the statewide target of a 40 percent reduction below 1990 levels by 2030 and will place Palo Alto on the path to achieving the statewide target of carbon neutrality before 2045. Under a BAU scenario, Palo Alto emissions are projected to be 47.4 percent below 1990 levels in 2030 (410,435 MT CO₂e) and 49.4 percent below 1990 levels in 2040 (394,451 MT CO₂e). Therefore, more aggressive actions will be needed to achieve the 80 percent reduction.

Between 1990 and 2019, Palo Alto reduced its emissions by 297,792 metric tons (MT) of carbon dioxide equivalents (MT CO₂e) to achieve 38.2 percent below 1990 levels at a rate of 1.3 percent per year. To achieve the 80 x 30 goal, Palo Alto must meet a GHG emissions target of 156,024 MT CO₂e. Palo Alto will need to reduce total emissions by about 326,303 MT CO₂e, or an additional 254,411 MT CO₂e beyond "Business-as-usual" projections, at a rate of 3.8 percent per year, significantly increasing the scale and speed of reductions. As shown in Table 7, the emissions reduction required by 2030 on top of business-as-usual projected emissions, 254,411 MT CO₂e, is the equivalent of taking 54,964 passenger vehicles off the road for an entire year.

Table 7: GHG Emissions Projection and Reduction Target

	1990	2019	2030	2040
Emissions (MT CO₂e)	780,119	482,327	410,435	394,451
Percent change from 1990 baseline	-	~38.2%	~47.4%	~49.4%
Emissions Target - % below 1990 baseline	-	-	80%	-
Emissions needed on top of BAU projections	-	-	254,411	-

Figure 5: “Business as Usual” GHG Emissions Projection and Reduction Target

3. Adjusted Business as Usual Forecast

The BAU forecast developed by AECOM is based on 2019 trends, and therefore leaves out the impacts of the COVID-19 pandemic and the increase in remote work as well as the market shifts from Governor Newsom’s September 2020 Executive Order N-79-20, which directs California to require that, by 2035, all new cars and passenger trucks sold in the state be zero-emission vehicles. Staff adjusted AECOM’s BAU forecast to include these factors, using data and assumptions specific to Palo Alto.

3.a. The Impact of Remote Work

The pandemic has created the need for people who can work from home to do so. It has also shown that remote work or telework - working either full- or part-time from home, from a 'telecenter' located close to home, or from other locations – is possible. In December 2020, the Bay Area Council Economic Institute, in partnership with the Bay Area Regional Collaborative, released a study on Remote Work in the Bay Area¹³. The study does not represent the number of people working remotely today, or that have in the past or will in the future. It instead focuses on the occupations that could be completed remotely, offering an upper bound for potential remote work adoption. The analysis revealed several key findings, including:

- It is impossible to disaggregate remote work effects from COVID-19 effects, and this is especially true when it comes to housing markets.
- In the Bay Area, the share of people who reported primarily working from home grew

¹³ http://www.bayareaeconomy.org/wp-content/uploads/2020/12/BACEI_RemoteWork_12.21.20.pdf

from 3.4 percent in 1990 to 6.4 percent in 2018.

- 51% (569,941) of the jobs in Santa Clara County are eligible for remote work.
- Among remote eligible workers in Santa Clara County, 6 percent (or 34,196 of all remote eligible workers) take transit to work, while 75 percent (or 427,456 workers) drive alone. The remaining 19% (or 108,289 remote eligible workers) commute via carpool, on bike, walking, or they already work from home.
- Reduced demand for commute trips will ease congestion for those that do travel, creating emissions benefits.
- Remote work could also reduce transit ridership.
- The overall impact of remote work on GHG emissions is inconclusive. Some studies that account for factors such as increased non-work travel and home energy use have found remote work to have a neutral or negative impact on overall energy use.
- If households relocate to more dispersed locations in the region because they only need to be in the office a few days per week, more drivers could take to the roads for longer commutes between locations that are not currently connected by transit.
- If many households relocate to less transit and pedestrian-friendly locations, there could be a localized impact on the environment as people become more reliant on cars as a primary mode. Shifting travel behavior could also call for a re-prioritization of transportation investments away from commute trips to urban centers and toward local transit, bicycle, and pedestrian infrastructure.
- Remote work has equity considerations, as eligibility rises as average income increases
- With the daytime population much lower in many commercial districts across the region and higher in many suburbs, there will be fiscal impacts for cities that collect business taxes based on employee counts.

In Palo Alto, assuming that 50 percent of employees are eligible for remote work and that (if supported by city policies and programs) they opt for 2 days a week of remote work, then commute VMT could be reduced by 8 percent to 11 percent¹⁴ compared to 2019 levels. On-road transportation emissions in the 2030 BAU forecast could be reduced an additional 3.8 percent from remote work. This translates into a 3 percent reduction in on-road transportation emissions relative to 2019 levels, or a 2.8 percent reduction of on-road transportation emissions relative to 1990 levels and slightly more than 1 percent of total 1990 emissions. Palo Alto staff has adjusted the business as usual forecast to incorporate this trend.

3.b. Electric Vehicle Adoption Trends

Palo Alto currently has one of the highest electric vehicle (EV) adoption rates in the country. In the US, approximately 2.3 percent of new car sales were EVs in 2019. In California, 8.1 percent

¹⁴ While permanent increases in work-from-home behavior will lead to decreased commute VMT, this reduction is off-set by additional travel for non-commute reasons, such as increased VMT from driving to run errands and getting more deliveries at home. Studies show that the degree of this added non-commute VMT ranges from 15% of the total saved, to more than 100% of the total saved.

of new car sales were EVs¹⁵, and in Palo Alto that number was about 30 percent. The models used to calculate AECOM’s BAU forecast do not include Palo Alto specific EV adoption rates – they use Santa Clara County EV adoption rates. In addition, the AECOM BAU forecast for EV adoption uses the CARB EMFAC model, which utilizes consumer survey data from 2015-2017 as the core of its consumer choice model. Since the data was collected before the widespread availability of mass market EVs, the EMFAC forecast for EV market share is likely too low.

Auto analysts and economists do not agree on future US auto sales, however, in CA, some analysts have predicted that EV sales could reach 50% of new car sales by 2030.¹⁶ And, starting in 2035, Executive Order N-79-20 will go into effect, which directs California to require all new cars and passenger trucks sold in the state be zero-emission vehicles.¹⁷ Furthermore, many automakers have committed to going fully electric or pivoting heavily towards electric vehicles within the next two decades, with a large number of new EV models becoming available in the next few years. This will undoubtedly accelerate the rate of EV adoption in Palo Alto.

For EVs, market share is projected to increase from the current 30% to 50% in 2030, based on a CA-specific EV sales forecast¹⁸. Based on these sales trends and a fleet evolution and attrition model, 31 percent of all Palo Alto registered vehicles are estimated to be EVs by 2030 under the BAU scenario. It is important to note that the BAU scenario excludes any impact from local policies, but will still benefit from regional, state, and federal policies, as well as industry and societal trends. Palo Alto is particularly challenging to forecast because its EV market share is one of the highest in the nation and well above even the CA average, and this can either result in continued strong growth or an eventual plateau in demand.

Assuming that 31 percent of all Palo Alto registered vehicles will be EVs by 2030 without additional City action, on-road transportation emissions in the 2030 BAU forecast could be reduced an additional 11.3 percent through EV adoption. This translates into a 9 percent reduction of on-road transportation emissions relative to 2019 levels or an 8 percent reduction of on-road transportation emissions relative to 1990 levels and 4 percent of total 1990 emissions.

3.c. Adjusted Business as Usual Forecast

As mentioned previously, the AECOM BAU forecast is based on 2019 trends, and therefore leaves out the increase in remote work as well as EV market shifts. Therefore, staff incorporated remote work trends and EV adoption trends to create an adjusted BAU forecast. As explained above, remote work is estimated to result in a 2.8 percent reduction of on-road transportation emissions relative to 1990 levels, and EV adoption is estimated to result in an 8

¹⁵ <https://evadoption.com/ev-sales/ev-sales-forecasts/>

¹⁶ UBS Investment Bank, March 2021. “EVs Shifting into Overdrive: How will electric cars re-shape the auto industry?”. <https://neo.ubs.com/static/login.html?origin=/shared/d24liDrju8G4f>

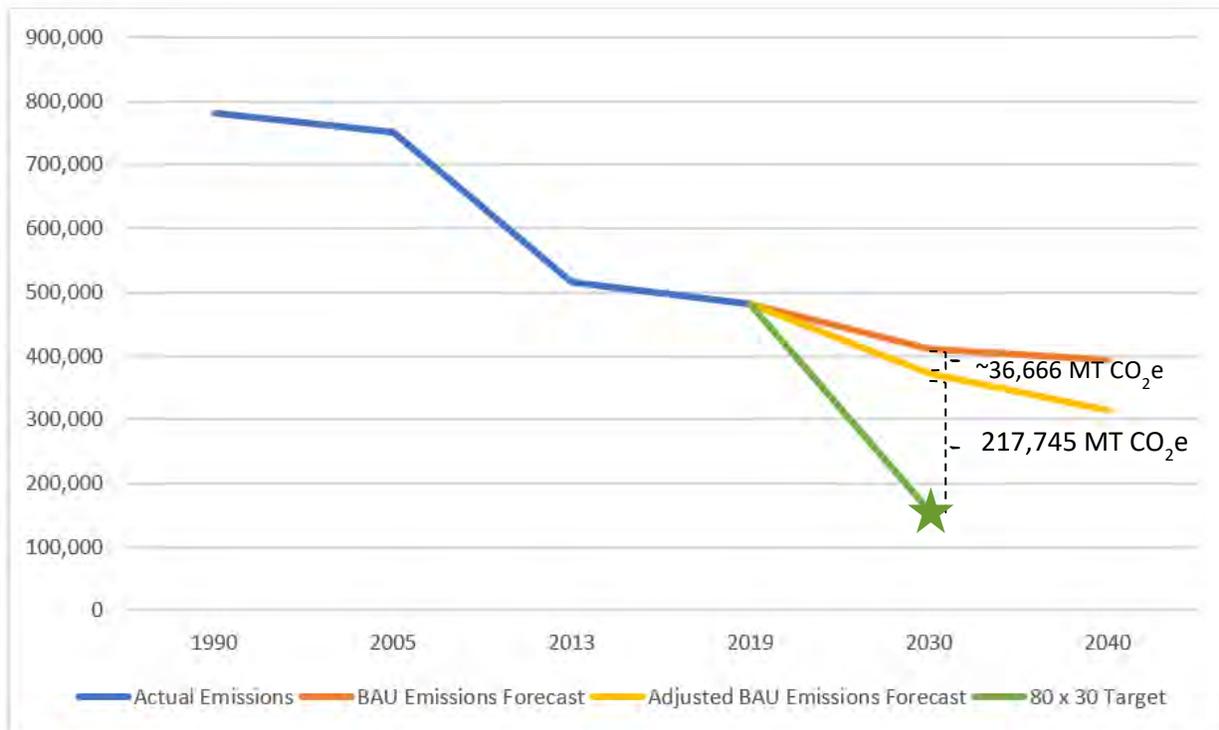
¹⁷ <https://www.energy.ca.gov/data-reports/reports/integrated-energy-policy-report/2020-integrated-energy-policy-report-update>

¹⁸ UBS Investment Bank, March 2021. “EVs Shifting into Overdrive: How will electric cars re-shape the auto industry?”. <https://neo.ubs.com/static/login.html?origin=/shared/d24liDrju8G4f>

percent reduction in on-road transportation emissions relative to 1990 levels.

Under staff’s adjusted BAU scenario, Palo Alto emissions are projected to be 52.1 percent below 1990 levels in 2030 (373,769 MTCO₂e) and 59.6 percent below 1990 levels in 2040 (314,968 MTCO₂e).

Figure 6: Adjusted “Business as Usual” GHG Emissions Projection and Reduction Target



4. Impact Analysis

Although these are unprecedented times, with a global pandemic, an economic downturn, and other challenging events, Council directed staff to continue with its work on developing strategies to achieve the ambitious 80 x 30 goal. Staff modeled the outcomes needed to achieve the 80 x 30 goal, keeping in mind updated climate science and the global impacts of climate change, as well as the increased community awareness needed. While there are multiple strategies to reduce Palo Alto’s emissions, the scenario described below represents the most technically feasible and cost-effective pathway staff and its consultant could identify. As noted above, while legal analysis of these preliminary measures is underway, additional in-depth review will be needed as implementation details emerge.

4.a. Outcomes needed to achieve 80% Reduction from 1990 Levels

Table 8 and Figure 7 below show more detail on the sources of the City’s various types of emissions. Table 8 shows the 1990, 2019, and 2030 target emissions for each source. The table breaks down transportation and building emissions among various sectors that contribute to total emissions. Transportation emissions from residential and fleet vehicles registered in Palo

Alto as well as commuter and visitor vehicle emissions are included. In the buildings category, emissions are broken down between single-family residential, multi-family residential, and non-residential emissions.

There are different challenges associated with reducing emissions among each of these sectors. Some are more expensive than others to electrify and some are technically more challenging. Reducing transportation emissions is the lowest cost emissions reduction alternative, but in the short term¹⁹, the City has fewer policy levers to affect reductions in transportation emissions, particularly for visitors. As a result, the City is unable to rely solely on vehicle electrification to achieve its goals and must focus efforts in the buildings sector as well. In this area emissions-reducing technologies are readily available to electrify all gas appliances and systems in single-family homes and to electrify some gas appliances in multi-family and commercial buildings, but electrification of multi-family and commercial may be more expensive because it is more technically complicated. For some types of end uses, staff and its consultant did not have the time or resources to do as thorough a study as they would have liked, but with the time allotted, were unable to identify electric heat pump alternatives to gas equipment in existing buildings. With more time and research, staff may be able to identify alternatives. As a result, staff has had to rely heavily on single-family building electrification to get close to achieving the 80 x 30 goal. Still, staff's preliminary analysis only achieves 72 percent reductions below 1990 levels, leaving an 8% gap to be closed through some combination of deeper vehicle electrification, multi-family and commercial building electrification, carbon dioxide removal, and funding emissions reductions outside of Palo Alto.

Table 8: Emissions by Source and Milestone

Source	1990 Levels	2019 Emissions	2030 Target Emissions	% Reduction from 1990 levels
Residential / Fleet Transportation	331,840	84,100	19,200	65%
Commuter Transportation		101,600	11,000	
Visitor Transportation		107,700	85,000	
Single-Family Building Gas Use	194,000	49,500	0	61%
Multi-Family Building Gas Use		22,600	18,400	
Non-Residential Building Gas Use		81,400	57,100	
Electricity	186,000	0	0	100%
Other emissions sources	68,279	35,400	30,700	55%
SUBTOTAL, Key Actions Analyzed To-Date	780,119	482,300	221,300	-72%
Additional Emissions Reductions TBD			65,300	-8%
TOTAL	780,119	482,300	156,000	80%

¹⁹ Land use changes can reduce driving significantly over the long term by locating housing closer to services and employment. The land use assumptions in the BAU analysis reflect the 2017 Comprehensive Plan. Different land use scenarios were not modeled as part of this analysis due to budget constraints. Future S/CAP work should include resources to model how growth can be accommodated in a way that does not increase GHG emissions.

Figure 7: Contributions of Various Emissions Reduction Measures to Achieving Emissions Goals

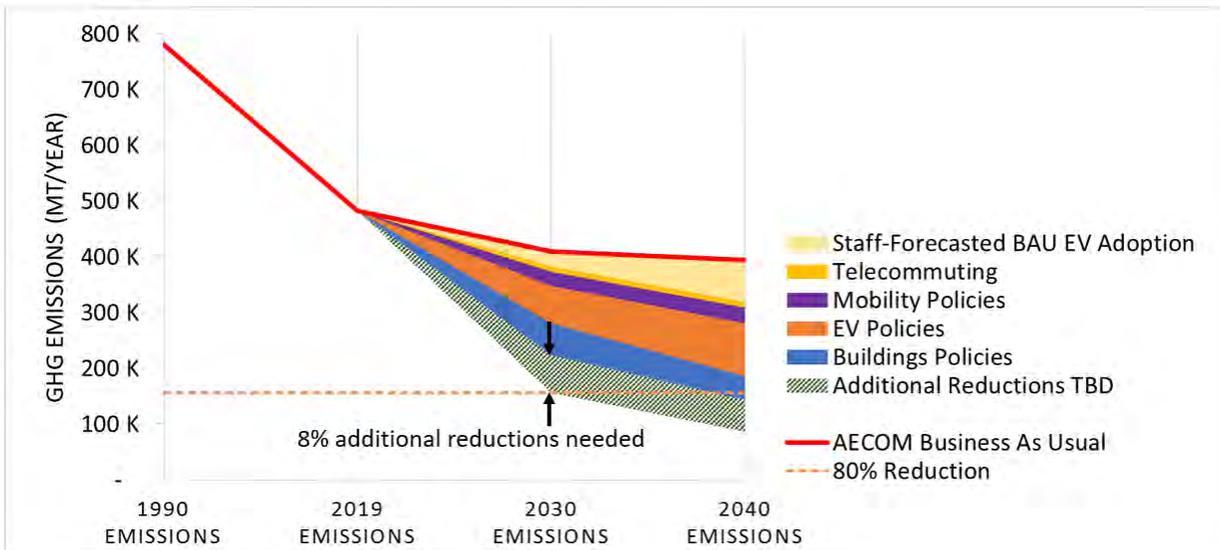
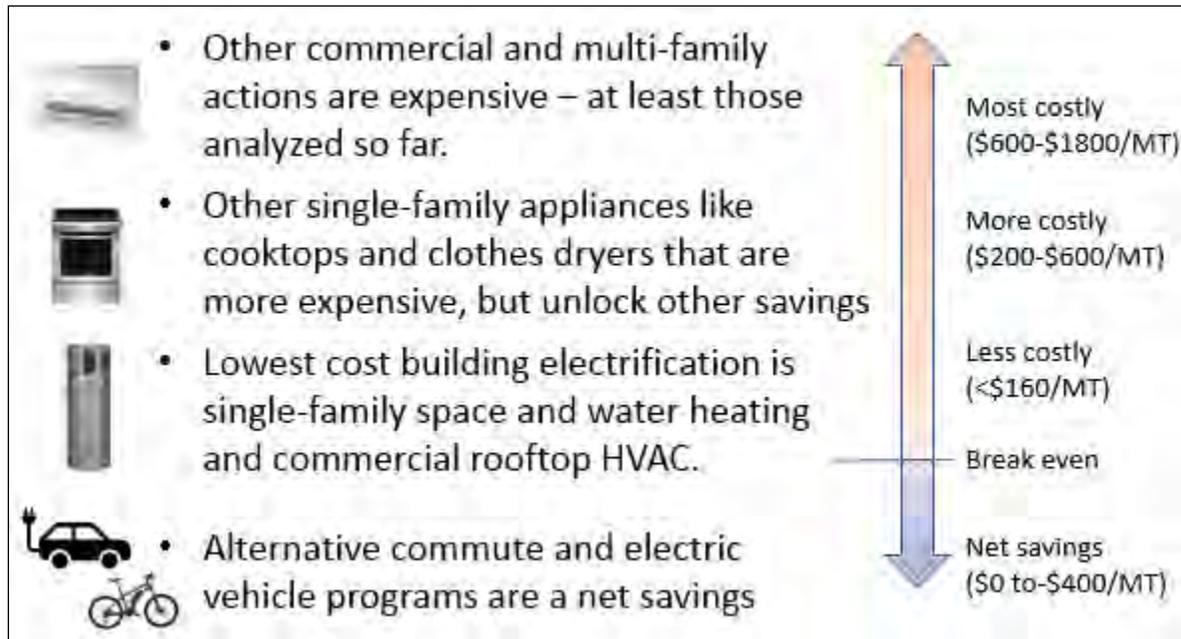


Figure 8 summarizes the cost per metric ton of carbon dioxide equivalent (MT CO₂e) reduced for various emissions reductions technologies, while Attachment D, Chart D-3 shows the costs in more detail. To provide some context for the costs in the chart, the current cost of building renewable energy in California as a way to reduce carbon is \$30 per MT CO₂-e to \$60 per MT CO₂-e,²⁰ though the CPUC projects that will rise to around \$200 per MT CO₂-e by 2030.²¹ The cost of renewable natural gas is \$270 per MT CO₂-e to \$450 per MT CO₂-e.²²

²⁰ Calculated based on current Renewable Energy Credit prices (\$/MWh) converted to \$/ton CO₂-e

²¹ Extracted from CPUC RESOLVE model by a City consultant, E3

²² Forecast by E3 using PATHWAYS models developed for forecasting RNG prices in California Energy Commission study titled [Deep Decarbonization in a High Renewables Future](#).

Figure 8: Cost per Metric Ton for Various Types of Emissions Reduction Actions

In summary, staff and AECOM have identified the following outcomes in 2030 as necessary to achieve the 80 percent reduction:

- Commute travel is reduced 10 percent via telecommuting
- Vehicle Miles Traveled (VMT) are reduced 8 to 11 percent
- 85 percent of all Palo Alto new vehicle purchases are EVs, up from 30 percent now, which results in a vehicle fleet that is 44 percent EVs (50 percent in single-family households, 33 percent in multi-family)
- 40 percent of commuter trips into Palo Alto and 30 percent of visitor trips are made in EVs (35 percent overall). This is up from 3 percent right now.
- Virtually all single-family gas appliances and virtually all commercial rooftop HVAC units are electrified
- Significant additional multi-family and commercial building electrification and other emissions reductions to be determined
- An additional 65,000 MT CO₂e of emissions reductions are achieved through other measures.

More detail on the key actions modeled to achieve the above outcomes can be found in Attachment A.

Table 8 and Figure 7 only represent the direct emissions reductions associated with electrifying vehicles and buildings; that is, the emissions reductions associated with burning fuel in a gas tank or natural gas appliance. However, there are also emissions associated with producing and transporting gasoline or natural gas to the home, gas pump, or commercial building due to leakage that occurs during transportation. These fuels, when released directly to the

atmosphere, have significantly higher global warming potentials than the carbon dioxide released when they are burned. Attachment D, Table D-1 shows what the emissions reductions look like when these “upstream emissions” from transportation are taken into account. Even more significantly, natural gas has a very high short-term global warming potential. Attachment D, Table D-2 shows emissions when looking at warming occurring over the next 20 years rather than a full 100 years. Consideration of these upstream emissions further emphasizes the importance of reducing natural gas use in buildings, rather than pursuing strategies with even greater emphasis on vehicle electrification. While these upstream emissions are worth examining to understand the additional potential impacts of fossil fuel use, they are not included in industry-standard GHG inventories and are just included for informational purposes. The true impact of upstream emissions outside of Palo Alto city boundaries would be more accurately reflected in a consumption-based GHG inventory.

The momentum created by these strategies will continue past 2030, and staff forecasts achieving 78 percent reductions by 2035 and 80 percent by 2036 or 2037, even without an additional 65,000 MT CO₂e of emissions reductions through other measures. It is also worth noting that some of the effects of these proposed strategies will generate emissions reductions that are not counted in the City’s GHG inventory. For example, if a Palo Alto resident converts to an EV as part of one of our programs, only their driving within Palo Alto counts towards reducing emissions counted in the City’s GHG inventory. If they commute out of Palo Alto, for example, the community can only count part of that vehicle trip towards its emissions savings, but of course they are reducing emissions for the entire journey. Those unclaimed emissions are very large, equal to another 6% to 7% reduction in emissions if they could be claimed.

4.b. Estimated Costs to Achieve 80% Reduction from 1990 Levels

Based on staff and consultant modeling, and depending on what strategies Council chooses to pursue, staff estimates the total cost to implement the goals and key actions analyzed is roughly \$740 million in 2021 dollars (note that there would be an additional cost to achieving the remaining 8% GHG emissions reductions, but this cost is unknown at this time). This investment would take place through 2030. This is the up-front capital cost for the necessary vehicle and mobility investments, investments in charging infrastructure, and investments in appliances and building infrastructure. It includes utility improvements needed to support the transformation. It does not include operational savings to customers from eliminating natural gas bills, gasoline expenditures, and the value of reduced vehicle maintenance.

If municipal bond financing is available, it might be possible to spread the cost of these measures over time, thus making the cost more manageable. The viability of this approach, however, is uncertain. Municipal debt is typically issued to fund public improvements, rather than improvements to private property. Further analysis will be required to assess which S/CAP program elements may be supported by bond financing. Furthermore, if the City sells debt to create a large pool of up-front funding for programs, the City will need to pledge acceptable security for the debt, and identify a source of funds for debt service.

Another means of spreading costs over time would involve the creation of an “on-bill financing” program, by which customers are charged on their utility bill for a financing obligation they voluntarily incur. The Bay Area’s Water Upgrades Save Program is a local example.²³ Administration challenges associated with on-bill financing can vary widely, depending on repayment details such as loan security, whether the loan runs with the property and can be transferred upon resale, and the cost of defaults. Potential bond financing of the cost of an on-bill financing program raises additional legal and feasibility questions.

For purposes of this analysis, however, financing is assumed, and the cost in 2030 is roughly \$53 million per year (in 2021 dollars), which is equivalent to about 30 percent of the entire community’s total annual gas and electricity bills (CY 2019). In its analysis, staff assumed financing of all eligible property-related measures over the life of the measure.

There are also significant annual operational savings to customers from these measures. These annual operational savings are expected to be roughly \$43 million per year in 2030, making achievement of the S/CAP goals nearly a net benefit to the community. By 2033, benefits are estimated to match costs and from then forward electrification would represent a net benefit to the community as a whole. This means achieving the S/CAP goals would likely result in *lower* household and business expenses throughout the community in the long term, which could make residents and businesses open to funding other community investments such as undergrounding utilities or fiber to the home.

However, the costs and the operational savings are not spread evenly across the community, and this creates a variety of issues. For example, in 2030, a homeowner who owns an EV is projected to experience, over time and on average, a \$116/month decrease in household expenses. This is due to vehicle fuel and maintenance savings. A homeowner who electrifies their home is projected to see a \$107/month increase. On balance, the savings due to the electric vehicle are similar to the cost of the building electrification work, making these emissions reductions roughly offset each other in cost. But it also means that residents who electrify their vehicles but do not electrify their homes see a large net savings in their monthly household expenses when compared to residents who do both. This creates a disincentive to building electrification. Figure 9 shows the costs associated with electrification for single-family residents and multi-family residents with and without electrified buildings, illustrating this issue.

There are other issues. Without incentives or taxes, the community’s more vulnerable members will face steep costs to electrify (not shown in Figure 9). They may still be able to take advantage of the cost savings of vehicle electrification if they have access to vehicle charging. But building electrification will be out of their reach. And if gas rates start to rise because others in the community are electrifying, that could negatively impact their ability to manage household expenses. This is another reason income-qualified incentives are a critical need for

²³ <https://www.bayren.org/waterupgradessave>

this program. Similar issues are faced by vulnerable businesses, such as neighborhood-serving businesses that face tighter margins than larger businesses, or nonprofits.

Businesses, because they do not have as many vehicle-related emissions, will not see a net savings from emissions reductions, just a cost, as shown in Figure 9. This leads to a disincentive to electrify. And, of course, because staff was unable to identify as many emissions reductions for businesses, residents end up bearing most of the cost impacts.

Since emissions reduction is a community goal, it may be viable to have some sectors of the community that have more difficulty electrifying fund incentives for other sectors of the community that can do so at lower cost. That way, the lowest cost emissions reductions measures in the community are implemented, but the cost is shared by the entire community. The same principle applies to funding electrification for members of the community that may have trouble affording electrification. This includes low-income members of the community, neighborhood businesses, and non-profits.

Non-rate-based funding for this type of financial support would be needed, absent a change to current law, since California constitutional provisions governing municipal fees and charges (Propositions 26 and 218, for example) require utility rates to be cost based absent voter approval. A variety of taxation approaches are being explored by staff, including parcel taxes and carbon taxes. Many of these taxation ideas represent novel and expanded uses of municipal taxing power, mainly because they would use restricted revenues in new ways. For example, while a parcel tax is one legal option, applying the revenue raised from that tax to fund improvements on private property is unprecedented. While voters might, in theory, approve this type of electrification funding as a component of utility rates or as a parcel tax, this approach is likely to invite challenge from taxpayer advocacy groups. It is difficult to predict how a court might rule if a measure such as this were challenged, and legal challenges, even if successfully opposed, would likely delay or disrupt implementation and raise costs. Advocacy for state-level support, both in the legislature and at key regulatory agencies such as CARB, the CEC and CPUC, could provide important support for novel approaches and reduce legal risk.

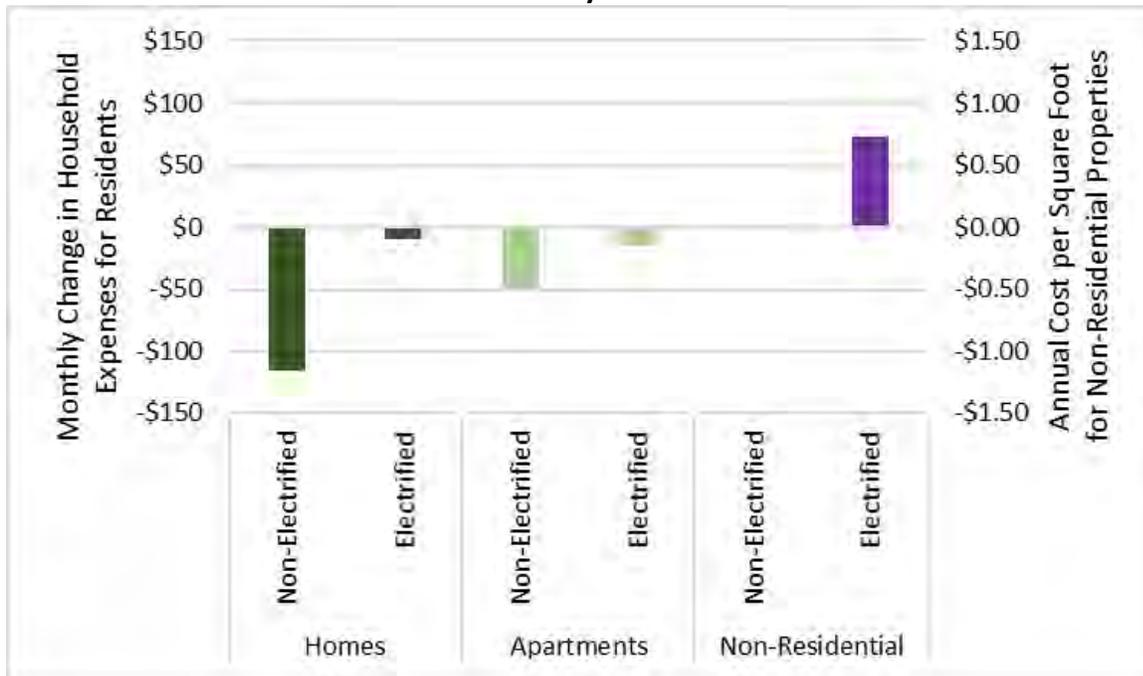
Setting aside these concerns for purposes of this analysis, staff evaluated one hypothetical scenario to see what the potential impact might be on different sectors if costs were spread across the community using some form of tax, to be determined. Figure 10 shows the results.

In this hypothetical scenario, segments of the community needing protection from cost increases were assumed to be exempted from the tax. In addition, 100 percent of building improvements²⁴ required to support electrification would be paid for by the City using tax revenues. Bond financing is assumed to spread the costs out over a longer period. For this hypothetical scenario the segments requiring an exemption from the tax and/or additional

²⁴ All single-family gas appliances, multi-family gas wall heaters, non-residential rooftop packaged HVAC systems, major facility gas efficiency measures, and all residential and non-residential vehicle charging.

funding were assumed to be income-qualified residents, small businesses, and non-profits. The analysis showed that a combination of a parcel tax and utilization of non-rate-based funding sources²⁵ enabled costs to be spread more broadly across the community. Such a scenario would require customer groups that are less able to electrify, such as large commercial customers, agreeing to tax themselves to fund electrification for other groups of customers. In this scenario the annual tax averages to roughly \$300 per year per non-exempt single-family household (\$25 per month), \$120 per non-exempt multi-family household (\$10 per month), and \$1.35 per square foot of commercial space for those segments that pay the tax (this scenario assumes several segments do not pay).

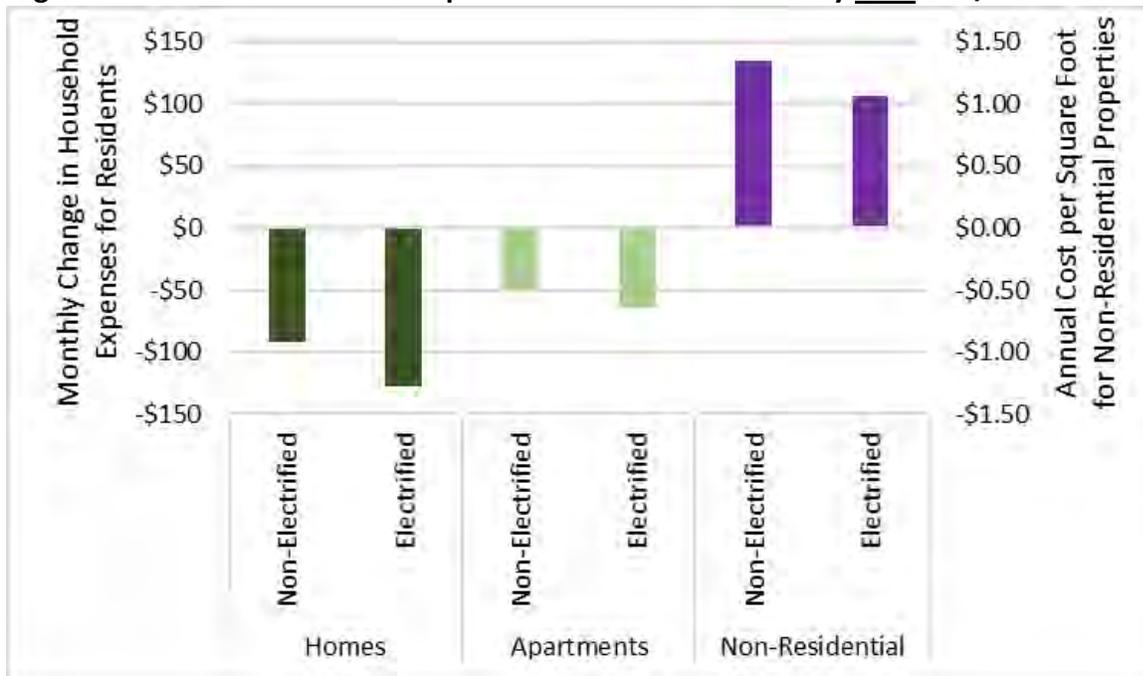
Figure 9: Costs for Various Groups in the Palo Alto Community without Tax / Incentive System²⁶



²⁵ For example, the City is allocated allowances under the State’s Cap and Trade program that is required to auction, and it is required to use the revenue for local decarbonization or return it to ratepayers. The City realizes similar revenues through its participation in the State’s Low Carbon Fuel Standard program.

²⁶ This chart does not include a separate estimate of the costs to low-income customers, neighborhood businesses, or other vulnerable customers, but costs for these customers are the same as the costs cited for homes, apartments, and businesses in the absence of taxes and incentives.

Figure 10: Costs for Various Groups in the Palo Alto Community with Tax / Incentive System²⁷



These are all preliminary results, but they give some early indications of what might be possible with this system of taxes and incentives.

4.c. Cost of Delaying Action

Achieving the 80 percent reduction target over a longer period of time could reduce the total cost to electrify because more appliance replacement takes place at end of life and more new all-electric construction and major renovation, which is cheaper than retrofits, will take place. In addition, the slower pace of implementation would reduce the maximum annual financing cost incurred by the community.

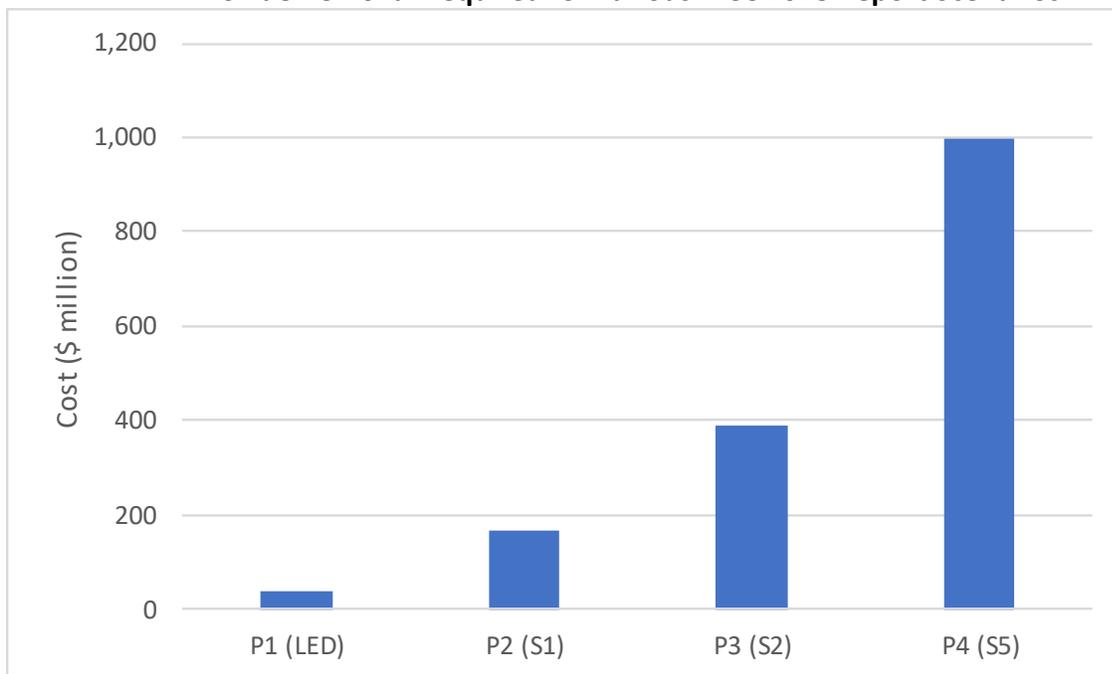
However, the cost of delaying emissions reductions is high. While carbon offsets can mitigate carbon emissions impacts, they cannot be considered a replacement for direct emissions reductions. The IPCC 2018 Special Report stated that deep emissions reductions, carbon neutrality, and negative emissions are all required to keep global warming to 1.5°C. Achieving carbon neutrality and negative emissions both require the removal of carbon dioxide from the atmosphere through new forest growth and processes to remove carbon dioxide from the air and store it underground. The faster the direct emissions reductions achieved, the less carbon dioxide removal is required.

²⁷ This chart does not include a separate estimate of the costs to low-income customers, neighborhood businesses, or other vulnerable customers, but costs for low-income residential customers are slightly lower than the costs cited for homes or apartments because they are exempt from the tax. For neighborhood businesses, there is little or no impact on their costs due to exemption from the tax and the availability of City-funded electrification.

The IPCC 2018 Special Report identified several example pathways involving slower and faster rates of emissions reduction and the carbon dioxide removal associated with each pathway. These pathways were labeled P1 through P4 in the Special Report’s Summary for Policymakers. The P1 scenario involved the most rapid global emissions reductions and required little carbon dioxide removal beyond new forest growth. The P4 scenario involved continued emissions growth through 2030 followed by rapid decarbonization and achievement of carbon neutrality by mid-century, but it required massive investments in carbon dioxide removal using expensive industrial methods and underground storage.

Staff estimated Palo Alto’s share of global carbon dioxide removal based on global and local 2010 emissions under each scenario. As shown in Figure 11 below, the cost of the additional carbon dioxide increases very significantly the slower emissions are reduced. This is both because much more carbon must be removed from the atmosphere in the P4 scenario, but also because much more of that carbon dioxide removal takes place using expensive industrial processes, since there is limited potential for new forest growth globally.²⁸

Figure 11: Cost of Estimated Palo Alto Share of Carbon Dioxide Removal Based on Carbon Dioxide Removal Required for various IPCC 2018 Report Scenarios



²⁸ For this estimate staff used \$12.50/metric ton for the cost of carbon dioxide removal through new forest growth, based on quotes from offset brokers. This price is likely to rise over the next decade as demand increases due to the increasing cost of allowances in the California Cap and Trade Program (offsets can be used to fulfill a portion of allowance obligations). This is likely a low-end estimate of forestry costs. For industrial carbon dioxide removal staff used a price of \$65/metric ton based on the 2020 Lawrence Livermore Laboratories “Getting to Neutral” study of the cost of carbon dioxide removal in California (This is also likely a low-end estimate, given that the cost estimates in the study were based on a coordinated statewide rollout of these technologies. The study can be found at:

https://www-gs.llnl.gov/content/assets/docs/energy/Getting_to_Neutral_Executive_Summary.pdf

5. Carbon Neutrality

When the 80 x 30 goal was adopted by Council in 2016, California’s emissions reduction goal was to reduce greenhouse gas emissions 80% below 1990 levels by 2050. In September 2018, Governor Brown issued California Executive Order B-55-18, setting the goal of achieving carbon neutrality as soon as possible (by 2045 at the latest), and maintaining net negative net emissions from that point forward. The Executive Order explains that the carbon neutrality goal is layered on top of the state’s existing commitments to reduce GHG emissions 40% below 1990 levels by 2030 (as codified in SB 32), and 80% below 1990 levels by 2050.

The basic definition of carbon neutrality is taking action towards the goal of achieving net zero emissions – reducing the amount of greenhouse gas put into the atmosphere and then “offsetting” an equivalent amount of any remaining emissions using carbon removal methods like new forest growth and removing carbon from the air and storing it underground. This carbon neutrality target is based on the Paris Agreement²⁹ which calls for preventing average global temperature from rising more than 2°C (3.6°F) above pre-industrial levels and pursuing efforts to keep warming below 1.5°C (2.7°F). According to the Intergovernmental Panel on Climate Change (IPCC), holding temperature rise below 1.5°C will mean global emissions of CO₂ will need to decline 45 percent from 2010 levels by 2030 and reach net zero by 2050.

²⁹ Paris Agreement,
https://unfccc.int/files/essential_background/convention/application/pdf/english_paris_agreement.pdf

Attachment C: 1990 vs. 2019 Greenhouse Gas Emissions by Sector and Subsector

Sector and Subsector	1990 GHG emissions (MT CO ₂ e) ¹	2019 GHG emissions (MT CO ₂ e)	Percent Change in Emissions (%)	Percent of Total Emissions (%)
Total Transportation and Mobile Sources	331,840	315,081	-5.1%	65.3%
- On-Road Transportation	331,840	293,413	- 11.6%	60.8%
- Airport Emissions	Not Included	2,192	n/a	0.5%
- Off-road Vehicles	Not Included	14,634	n/a	3.0%
- Caltrain Commuter Rail	Not Included	4,842	n/a	1.0%
Total Natural Gas Use	194,000	153,509	- 20.9%	31.8%
- Commercial Energy	Not calculated	66,987	n/a	13.9%
- Industrial Energy	Not calculated	14,373	n/a	3.0%
- Residential Energy	Not calculated	72,149	n/a	15.0%
Natural Gas Fugitive Emissions	4,718	5,009	+ 6.2%	1.0%
Total Wastewater	8,504	2,197	- 74.2%	0.5%
- Wastewater Biosolid Treatment ²	n/a	812 (new)	n/a	0.2%
- Wastewater Treatment and Effluent	8,504	1,385	-83.7%	0.3%
Total Solid Waste	55,057	6,531	- 88.1%	1.4%
- Composting (ZWED)	Not Included	731	n/a	0.2%
- Palo Alto Landfill Gas Flaring ³	Not Included	281	n/a	0.1%
- Palo Alto Landfill Gas Fugitive	24,325	n/a ⁴	n/a	n/a
- Landfill Waste	30,732	5,519	- 82%	1.1%
Brown Power Supply (Electricity)	186,000	n/a	- 100%	n/a
Total GHG Emissions (MT CO₂e)	780,119	482,237	- 38.2%	
- Total Additional Emissions Sources		23,493		4.9%
- Total Emissions Excluding Additional Sources		458,834	-41.2%	

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

ATTACHMENT D: SUPPLEMENTAL TABLES AND CHARTS

Chart D-1: Emissions by Source and Milestone

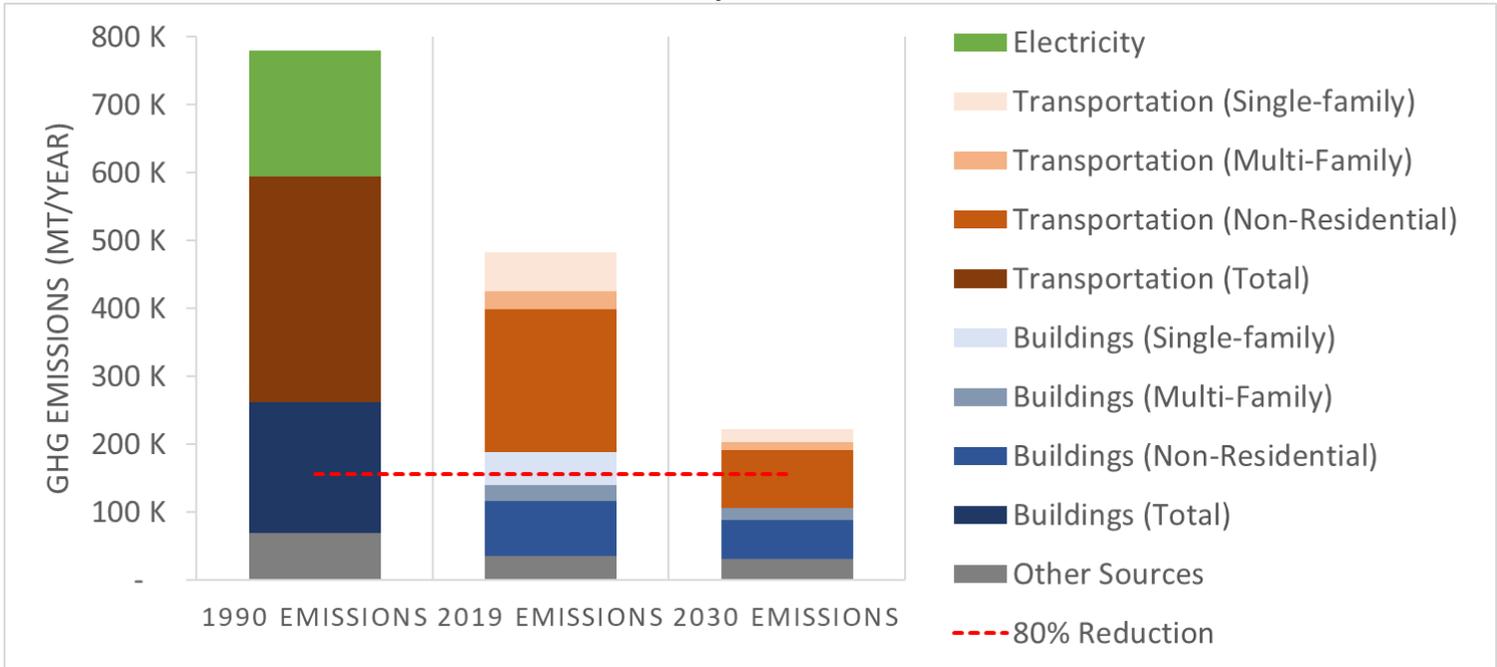
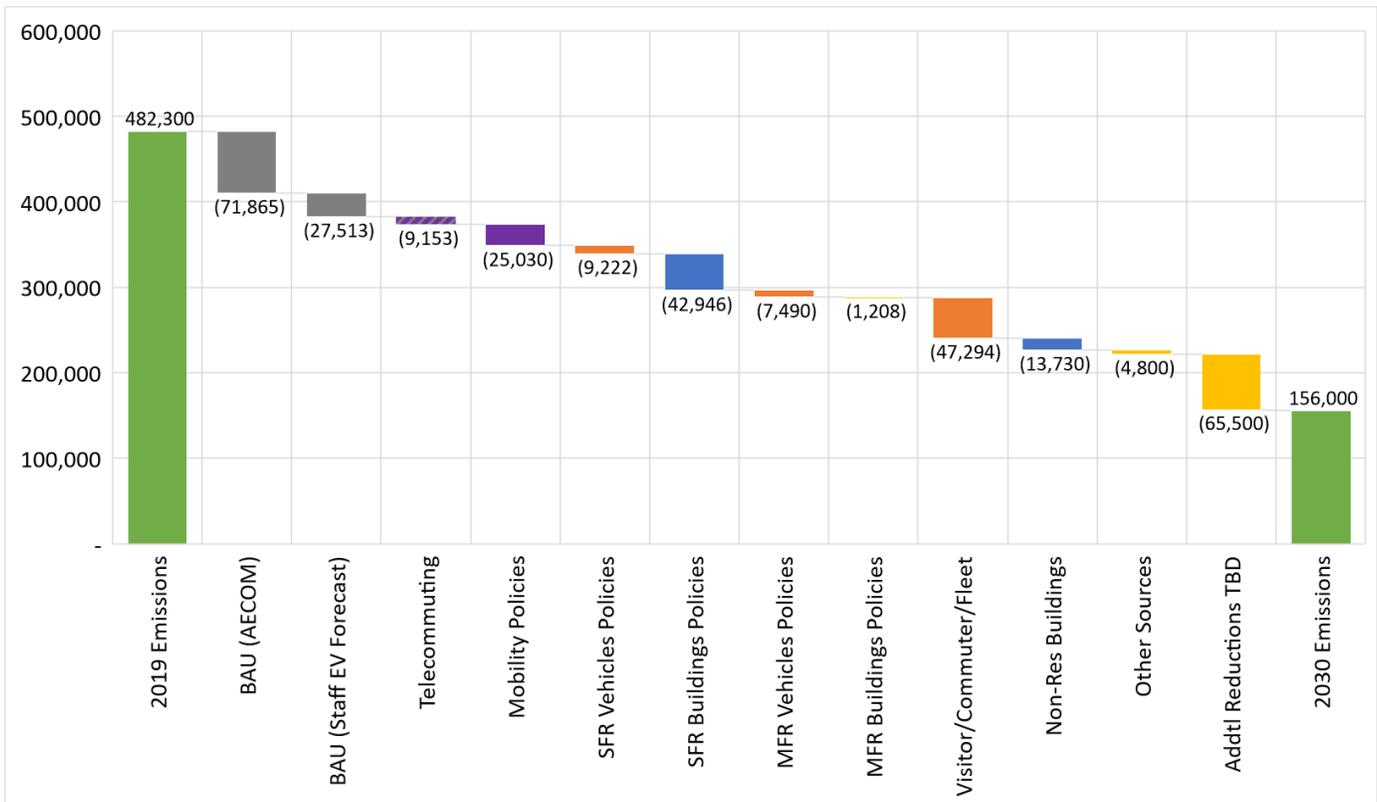
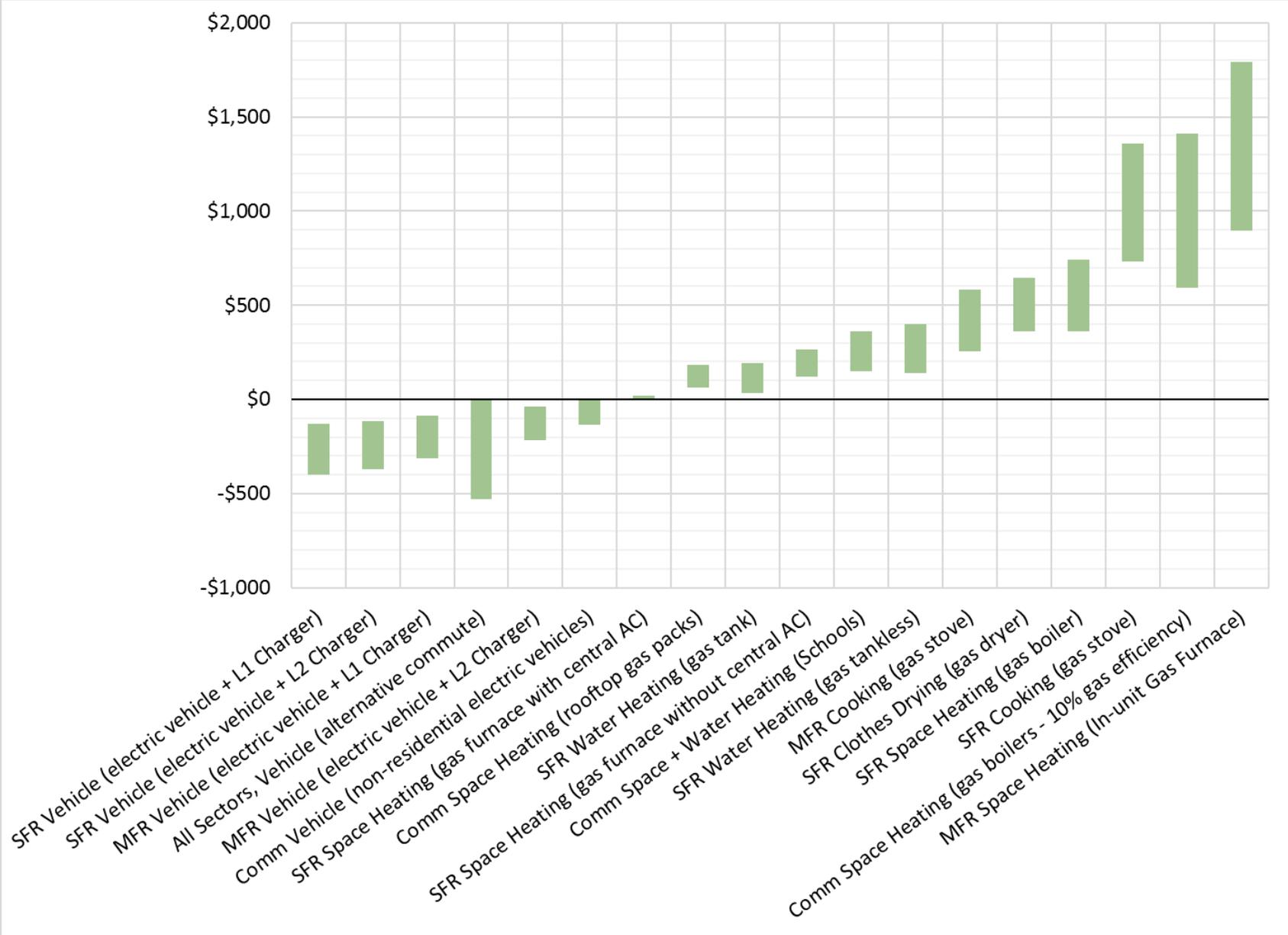


Chart D-2: Contributions of Various Emissions Reduction Measures to Achieving Emissions Goals¹



¹ The land use assumptions in the analysis reflect the 2017 Comprehensive Plan. The analysis assumes that land use won't change beyond what is in the Comprehensive Plan. Mobility policy actions could have more efficacy with land use changes.

Chart D-3: Key Actions by Cost per Metric Ton of Carbon Dioxide Equivalent Reduced²



² Cost per metric ton shown as a range from a low-cost scenario to a high-cost scenario

Table D-1: Emission by Source and Milestone (with Upstream Emissions, GWP100³)

	1990 Levels	2019 Emissions	Target Emissions	% Reduction from 1990 levels
Residential / Fleet Transportation ¹	444,666	112,694	25,728	65%
Commuter Transportation		136,144	14,740	
Visitor Transportation		144,318	113,900	
Single-Family Building Gas Use	265,780	67,815	-	61%
Multi-Family Building Gas Use		30,962	25,208	
Non-Residential Building Gas Use		111,518	78,227	
Electricity	226,920	0	0	100%
Other emissions sources	68,300	35,400	30,600	55%
SUBTOTAL, Key Actions Analyzed To-Date	1,005,666	638,851	288,403	-71%
Additional Emissions Reductions TBD			87,303	-9%
TOTAL	1,005,666	638,851	201,100	80%

Table D-2: Emission by Source and Milestone (with Upstream Emissions, GWP20⁴)

	1990 Levels	2019 Emissions	Target Emissions	% Reduction from 1990 levels
Residential / Fleet Transportation ¹	530944	134,560	30,720	65%
Commuter Transportation		162,560	17,600	
Visitor Transportation		172,320	136,000	
Single-Family Building Gas Use	478404	122,067	-	61%
Multi-Family Building Gas Use		55,732	45,374	
Non-Residential Building Gas Use		200,732	140,809	
Electricity	279,000	0	0	100%
Other emissions sources	68,300	35,400	30,700	80%
SUBTOTAL, Key Actions Analyzed To-Date	1,356,648	883,371	401,103	-70%
Additional Emissions Reductions TBD			129,803	-10%
TOTAL	1,356,648	883,371	271,300	-80%

³ 100-year Global Warming Potential.

⁴ 20-year Global Warming Potential.