CITY OF PALO ALTO

2022 SUSTAINABILITY AND CLIMATE ACTION PLAN

ACKNOWLEDGEMENTS

City staff worked tirelessly and enthusiastically to develop the City of Palo Alto Sustainability and Climate Action Plan (S/CAP). Thanks to all City staff, City Council, the S/CAP Ad Hoc Committee, the S/CAP Working Group, the S/CAP Working Group Teams, the Utilities Advisory Commission, the Planning and Transportation Commission, the Parks and Recreation Commission, the City Manager, partner organizations, and members of the public who contributed their expertise, guidance, ideas, and feedback; conducted thorough document reviews; and participated in various meetings. Staff looks forward to working together on implementation of this Plan.

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EXECUTIVE SUMMARY

Cities bear a unique responsibility when it comes to climate change. While occupying only 2 percent of the land on earth, cities consume 78 percent of the world's energy[1], accounting for up 75 percent of global emissions[2], and are home to 55 percent of the global population[3]. Global emissions need to halve by 2030 and reduce to net zero by 2050 to avoid catastrophic climate change, according to the Intergovernmental Panel on Climate Change, the UN-backed body that collates the science needed to inform policy. By 2050, two-thirds of the global population will live in cities[4], meaning that urban climate action is only going to become more urgent as growing populations need safe and secure places to live and work. By taking actions to cut emissions and reduce vulnerabilities, cities can gain multiple co-benefits from climate action.

The City of Palo Alto's Sustainability and Climate Action Plan (S/CAP) establishes the goals of reducing carbon emissions 80 percent below 1990 levels by 2030 (the "80 x 30" goal) and achieving carbon neutrality by 2030. Importantly, the specific goals and key actions listed in the S/CAP for each domain require, at a minimum, City Council approval and sufficient, timely resources. The S/CAP does not convey that the City has the necessary approval or resources; rather, it sets out what is needed to achieve the City's targets.

Palo Alto has already made significant progress in its sustainability and climate action efforts, decreasing its community emissions by 53.9 percent compared to 1990 levels. In 2021, Palo Alto emitted an estimated 359,312 metric tons (MT) of carbon dioxide equivalent (CO_2e)[5], reduced from 780,119 MT CO_2e in the 1990 base year, despite a population increase of 19.5 percent during that same time period. This equates to 5.4 metric tons of carbon dioxide equivalent (MT CO2e) per Palo Alto resident in 2021 compared to 14 MT CO2e per Palo Alto resident in 1990. The California Air Resources Board's 2017 Scoping Plan Update recommends a goal for local governments of 6 MT C02e per capita by 2030.

However, to achieve the 80 x 30 and carbon neutrality goals, Palo Alto must meet a GHG emissions target of 156,024 MT CO_2e, or 2 MT CO2e per Palo Alto resident by 2030. Palo Alto will need to reduce total emissions by about 203,288 MT CO_2e, requiring a significant increase in the scale and speed of reductions. To meet the 80 x 30 and carbon neutrality goals, this S/CAP provides goals, strategies and key actions in eight areas: Climate Action, Energy, Mobility, Electric Vehicles, Water, Climate Adaptation and Sea Level Rise, Natural Environment, and Zero Waste.

In 2022, the Intergovernmental Panel on Climate Change (IPCC) produced the Sixth Assessment Report[6] (AR6). This report identified the actions needed to have a reasonable chance of holding average global temperature rise to 1.5 degrees Celsius (2.7 degrees Fahrenheit), the point at which systemic impacts to global climate will have significant impacts to human societies and

[1] https://www.un.org/en/climatechange/climate-solutions/cities-pollution
[2] https://www.unep.org/explore-topics/resource-efficiency/what-we-do/cities/cities-and-climate-change
[3] United Nations. World Urbanization Prospects. Demographic Research vol. 12 197–236 https://population.un.org/wup/Publications/Files/WUP2018-Report.pdf (2018).
[4] United Nations Department of Economic and Social Affairs. World Urbanization Prospects. Demographic Research vol. 12 197–236 https://population.un.org/wup/Publications/Files/WUP2018-Report.pdf (2018)
[5] See section 4: Greenhouse Gas Emissions to learn more about how Palo Alto's emissions are calculated.
[6] IPCC 2022 Sixth Assessment Report. https://www.ipcc.ch/report/ar6/wg2/

ecosystems. The Paris Agreement's[7] long-term temperature goal is to keep the increase in global average temperature to well below 2 °C (3.6 °F) above pre-industrial levels and to pursue efforts to limit the increase to 1.5 °C (2.7 °F). It is worth noting that average global temperature rise has already reached 1.1 °C, meaning that great urgency is required to achieve these goals.

Because of this rise in average global temperature, even if all global emissions were eliminated today, we will see climate change impacts in the future, including sea-level rise, hotter temperatures, and increased fire risk. Therefore, Palo Alto also understands the importance of laying out a framework for enhancing its resilience to these impacts, while simultaneously working to reduce the effect of climate change.

Preliminary staff and consultant modeling conservatively estimated the cost to achieve the identified 71% reductions from 1990 levels. The modeling assumed up-front capital costs were paid off over the life of the equipment and took into account ongoing costs and benefits. Staff estimates the annual cost to the community in 2030, assuming all reductions are implemented would be $53 million in costs offset by $43 million in benefits for a net $10 million in community costs per year,[8] which is less than 5% of the total amount the community spends on energy each year. By 2033, benefits are estimated to match costs and from then forward, achieving these emissions reductions would represent a net benefit to the community. This means achieving the S/CAP goals could result in *lower* household and business expenses throughout the community in the long term.

To ensure full implementation of the S/CAP, staff will provide annual progress reports, including greenhouse gas (GHG) inventories, and will prepare a Work Plan for 2025 - 2030.

We will also need to explore revenue sources to fund additional solutions. The uncertainty of global financial markets, including impacts from inflation and the possibility of a recession, coupled with supply chain constraints are important factors to consider. With the cost of commodities and services rising, consumers will have less to spend on discretionary areas. Federal policies like the Inflation Reduction Act could help, although infrastructure projects such as modernizing the electric grid require high upfront investment.

This S/CAP provides a pathway to meet our goals and build upon our past successes. It is also a call to action to residents, community organizations, and businesses to take an active part in our transition to a low-carbon future and clean economy. In this process, we will foster a vibrant economy, increase our resiliency, and support Palo Alto’s vision for a livable and sustainable community for all generations to come.

[7] The Paris Agreement is a legally binding international treaty on climate change, adopted on December 12, 2015.
[8] All costs and benefits are in 2021 dollars.

SECTION 1

INTRODUCTION

Why a Sustainability and Climate Action Plan?

At the heart of the region that drives the fifth largest economy in the world, what is created in Palo Alto has influence far beyond its borders. Palo Alto has made impressive progress toward reducing its carbon impacts, GHG emissions, and resource consumption since establishing its first Climate Protection Plan in 2007. While cities around the world ratchet up their own sustainability initiatives, Palo Alto will need to act boldly to maintain its leadership position—and to ensure the wellbeing of this community in the face of the challenges ahead.

Palo Alto is poised to take the next step in climate and sustainability leadership. The Sustainability and Climate Action Plan (S/CAP) is Palo Alto's ambitious plan to create a prosperous, resilient city for all residents. To support Palo Alto's leadership position on climate protection, this S/CAP is designed to be a roadmap for our community's response to challenges posed by climate change. It is a living document that reflects the ongoing efforts and challenges our community faces as the impacts from climate change grow more frequent, severe, and urgent.

In 1987, the United Nations Brundtland Commission defined sustainability as "meeting the needs of the present without compromising the ability of future generations to meet their own needs." A sustainable Palo Alto will meet the needs of today's residents while protecting ecosystems, natural resources, and public infrastructure for future generations. Sustainability can be thought of as a three-legged stool, comprised of social equity (people), economic health (prosperity), and environmental protection (planet). Collectively, these "legs" are the foundation for a strong and healthy quality of life. For its people to thrive — today and tomorrow — Palo Alto must strengthen all three pillars.

Since 1991, the Palo Alto City Council, City Manager, and City of Palo Alto Departments have adopted policies, plans, ordinances, resolutions, and principles that have helped to increase the sustainability of Palo Alto[9]. In addition, sustainability principles are integrated in the 2030 Comprehensive Plan[10]. The 2030 Comprehensive Plan contains the City's official policies on land use and community design, transportation, housing, natural environment, safety, business and economics, and community services. Several goals and policies overlap with the S/CAP, a subsection of which can be found in Appendix C.4.: City Policy. In April 2021, City Council formed the S/CAP Ad Hoc Committee to guide the development, implementation, communication, and future engagement of the S/CAP.

Our city cannot solve the climate crisis alone. Palo Alto will need to collaborate with our partners in county, state, and federal government, along with community organizations and local businesses, to create new programs, services, and policies that will support our community in taking actions that reduce GHG emissions and build a prosperous, resilient city for all residents.

Benefits of Climate Action

Beyond the direct benefit of a more stable climate, many climate actions generate co-benefits such as improved local air quality, reduced cost of living, and increased productivity. Assessing co-benefits is important, as the process provides a truer and fuller range of beneficial outcomes that in turn, allow us to better prioritize actions. The following co-benefits were selected for the S/CAP because they align with community priorities and apply to multiple S/CAP Issue Areas (e.g., Energy, Electric Vehicles, Zero Waste).

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[9] https://www.cityofpaloalto.org/City-Hall/Sustainability/Documents
[10] https://www.cityofpaloalto.org/Departments/Planning-Development-Services/Long-Range-Planning/2030-Comprehensive-Plan

Air Quality

Actions to mitigate climate change can improve air quality through reduced exposure (indoor and outdoor) to particulate matter (PM2.5 and PM10), nitrous oxide (NO_2), ozone (O_3), sulfur dioxide (SO_2) or airborne toxins. If the U.S. reduced emissions in a way consistent with the Paris Agreement, it could reduce premature deaths from air pollution by about 30 percent in the next decade.[11] For the purposes of the S/CAP, Air Quality is a separate co-benefit from Public Health.

Public Health

Actions to mitigate climate change can improve physical and mental health, and access to healthy food. Research suggests that living within 50 to 200 meters (55 to 219 yards) of major roadways can trigger asthma symptoms among adults and children and contribute to the development of asthma in children.[12] Consequently, actions aimed at reducing traffic congestion, taking vehicles off the road, and transitioning to electric vehicles can reduce risk of cardiovascular disease, chronic and acute respiratory illnesses, cancer, and preterm births for those located near busy roads. Actions that encourage active modes of transportation can reduce obesity and the risk of noncommunicable diseases, improve mental health, and diminish the cost of public health services. Transit-oriented and 15-minute neighborhoods[13] increase local access to essential services and nutritious food sources.[14] Increased intake of more climate-friendly foods, such as whole grains and vegetables, can reduce the risk of chronic diseases. Adaptation actions that mitigate urban heat island[15] effects, such as planting shade trees, lessen potential health risks to sensitive populations. Health benefits from climate action bring tangible healthcare savings as well. The cost of reducing CO_2 emissions is less than the medical costs of treating the health effects of climate change.[16] Furthermore, improved indoor air quality by removing gas stoves from homes could prevent 20 percent of childhood asthma in California.[17]

Public Safety

Actions that address sustainability and climate change can improve public safety through reduced traffic, reduced incidence of traffic collisions, and reduced gas leaks. Such actions can also bolster resilience to other dangers by decreasing exposure to climate hazards, adapting assets to withstand climate threats and decreasing the number of people, assets, and services exposed to climate hazards. Climate actions that support public safety can also enhance community cohesion

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[11] Nature. Climate and health impacts of US emissions reductions consistent with 2 °C. https://www.nature.com/articles/nclimate2935

[12] McConnell, R., et al. (2010). Childhood incident asthma and traffic-related air pollution at home and school. *Environ. Health Perspect.* 118, 1021–1026. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2920902/.

[13] A 15-minute neighborhood is a neighborhood in which you can access all of your most basic, day-to-day needs within a 15-minute walk of your home.

[14] The Lancet. The 15-minute city offers a new framework for sustainability, liveability, and health. https://doi.org/10.1016/S2542-5196(22)00014-6

[15] Areas that experience higher temperatures than outlying areas, generally with concentrated buildings and limited vegetation.

[16] Haines, A*. (2017).* Health co-benefits of climate action. *The Lancet Planetary Health*. Volume 1, Issue 1, Pages 4-e5, ISSN 2542-5196. https://doi.org/10.1016/S2542-5196(17)30003-7.

[17] Gruenwald, T., et al. (2023). Population Attributable Fraction of Gas Stoves and Childhood Asthma in the United States. *International Journal of Environmental Research and Public Health* 20, no. 1: 75. https://doi.org/10.3390/ijerph20010075

– the networks of formal and informal relationships among neighbors that foster a mutually supporting community. For example, one study found that even small amounts of greenery increased the safety of urban areas.[18] A survey of residents in many different types of neighborhoods found that the more that neighborhoods were walkable, and neighbors knew each other, the more likely neighborhood residents were to participate politically, trust others, and be socially engaged.[19]

Regional Benefit
The S/CAP is focused on sustainability and climate change actions we can take in Palo Alto. These actions will provide benefits to adjacent communities by generating jobs, expanding the electric vehicle charging network, reducing congestion, and flood reduction. Regional collaboration is an essential component to the success of many of the City's sustainability and climate actions.

Resource Conservation
Actions that address sustainability and climate change can increase resource conservation in building energy, vehicle fuels, and water; increase natural habitat conservation and regeneration, and decrease waste generation.

Lifecycle Emissions
Actions that address climate change can reduce emissions associated with the extraction, manufacture, and transport of energy resources (e.g., natural gas production, distribution). This includes fugitive emissions, which are emissions of gases or vapors from pressurized equipment due to leaks and other unintended or irregular releases of gases, mostly from industrial activities. Methane, which is the primary component of natural gas, is a very potent greenhouse gas, with a global warming potential that is 25 times higher than CO_2 over a 100-year period.

Cost of Living
Actions that address sustainability and climate change can reduce cost of living through utility cost savings, travel cost savings, and other savings. For example, a study by the University of California Transportation Center estimated that maintenance of electric vehicles (EVs) would cost only 50 percent to 75 percent of the average maintenance cost of a conventional vehicle.[20]

Productivity
Actions that address sustainability and climate change increase productivity through reduced commute times and reduced traffic, prioritized housing near transit, improved thermal comfort in buildings, and reduced economic activity losses from climate-related events (e.g., flooding, power outages).

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[18] Kuo, F.E. and Sullivan, W.C. (2001). Aggression and violence in the inner city: Impacts of environment via mental fatigue. *Environment & Behavior*. 33(4): 543-571.
[19] Leyden K. M. (2003). Social Capital and the Built Environment: The Importance of Walkable Neighborhoods. *Am. J. Public Health*. 93:1546–1551.
[20] Delucchi, M., Wang, Q. and Sperlin, D. (1989) Electric Vehicles: Performance, Life-Cycle Costs, Emissions, and Recharging Requirements. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.294.3080&rep=rep1&type=pdf.

Equity

Climate actions can foster a more equitable and inclusive community by addressing an existing inequity in the community, such as disproportionate poor air quality, access to housing, or flood risk. City-driven climate action approaches have the potential to increase equity and inclusion in both the planning process as well as in long-term outcomes.

SECTION 2

SUSTAINABILITY AND CLIMATE ACTION PLAN (S/CAP) OVERVIEW

The 80 x 30 Goal: An introduction

To put California on the path to a low-carbon future, the California Air Resources Board (CARB) approved the *Climate Change Scoping Plan* in 2008. The plan directed the State to reach 1990 emissions levels by 2020. Local governments were asked to reduce their municipal and community-wide emissions by at least 15 percent by 2020 compared with current levels (2008 levels or earlier). This prompted many cities to adopt emissions reduction targets of at least 15 percent below 2005 levels. Palo Alto had already adopted a Climate Protection Plan in 2007 - one of the first municipal climate action plans in the U.S. – which set a short-term goal of reducing municipal GHG emissions 5 percent from 2005 levels by 2009 and a long-term goal of reducing municipal and community-wide GHG emissions 15 percent from 2005 levels by 2020. Palo Alto achieved both of those goals, and by 2012 had reduced municipal GHG emissions an estimated 53 percent below 2005 levels and had reduced municipal and community-wide combined GHG emissions an estimated 22 percent below 2005 levels.

1990 Emissions

780,119

metric tons of carbon dioxide equivalent

2021 Emissions

359,312

metric tons of carbon dioxide equivalent

Target Reductions

80% BELOW 1990 LEVELS **BY 2030**

Current Reductions

54% BELOW 1990 LEVELS **IN 2021**

In 2015, Governor Brown issued Executive Order B-30-15 to set the 2030 emissions target (40 percent less than 1990 levels by 2030). It was codified by California Senate Bill 32 (SB 32). CARB followed up with an updated *California's 2017 Climate Change Scoping Plan.*[21]

In 2016, Palo Alto City Council adopted a combined municipal and community-wide emissions reduction target of 80 percent below 1990 levels by 2030 (the "80 x 30" goal). Council also adopted a draft S/CAP Framework, including Guiding Principles, Decision Criteria, and Design Principles as the road map for development of subsequent S/CAP Implementation Plans. This

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[21] California Air Resources Board. (2017). The 2017 Climate Change Scoping Plan Update: The Proposed Strategy for Achieving California's 2030 Greenhouse Gas Target. https://ww3.arb.ca.gov/cc/scopingplan/2030sp_pp_final.pdf.

S/CAP retains the 80 x 30 goal but is a comprehensive plan – not a draft or a framework – for achieving our sustainability and climate goals. The S/CAP is an ambitious plan to reduce the City and community's GHG emissions, while also guiding how we use our land and natural resources in ways that ensure quality of life for future generations.

80 x 30 is the science-based target that represents our fair share of the global emissions reduction target required to halve emissions by 2030, to reach global net zero by 2050, and to limit global warming to 1.5 °C above pre-industrial levels.

The Carbon Neutral by 2030 Goal

When the 80 x 30 goal was adopted by Council in 2016, California's emissions reduction goal was to reduce GHG emissions 80% below 1990 levels by 2050. In September 2018, Governor Brown issued California Executive Order B-55-18, setting the goal to achieve carbon neutrality as soon as possible (by 2045 at the latest), and achieve and maintain net negative emissions from that point forward. In October 2022, Council adopted an ambitious carbon neutral by 2030 goal, building on the City's existing 80 x 30 goal.

The basic definition of carbon neutrality is taking steps to achieve net zero emissions by reducing the amount of GHGs put into the atmosphere and then "offsetting" an equivalent amount of any remaining emissions using carbon removal methods. Common methods include new forest growth and removing carbon from the air and storing it underground. This carbon neutrality target is based on the Paris Agreement.[22]. According to the Intergovernmental Panel of Climate Change (IPCC), holding temperature rise below 1.5°C will mean global emissions of CO_2 will need to decline 45 percent from 2010 levels by 2030 and reach net zero by 2050. U.S. cities that have adopted aggressive targets of reducing emissions by 80 to 100 percent by 2050 or sooner include Berkeley, Menlo Park, San Francisco, Santa Monica, Boulder, Minneapolis, New York City, Portland, Washington D.C., and Palo Alto.

U.S. cities that have adopted Carbon Neutrality Goals include: Irvine, Los Angeles, Menlo Park, Palo Alto, and San Jose by 2030; San Luis Obispo, San Mateo County, Santa Barbara by 2035; Davis by 2040; Albany, Berkeley, Dublin, Fremont, Los Angeles County, Oakland, Redwood City, Santa Clara County, and Santa Monica by 2045; and, Long Beach, San Francisco, and Santa Monica by 2050.

Palo Alto currently purchases carbon offsets to balance emissions from natural gas (methane) use, but we do not include these offsets in our GHG inventory. We do, however, include these offsets for the purposes of estimating our progress towards achieving carbon neutrality. If we include natural gas (methane) carbon offsets, then we are at 71.3% emissions reductions.

[22] Paris Agreement. https://unfccc.int/files/essential_background/convention/application/pdf/english_paris_agreement.pdf

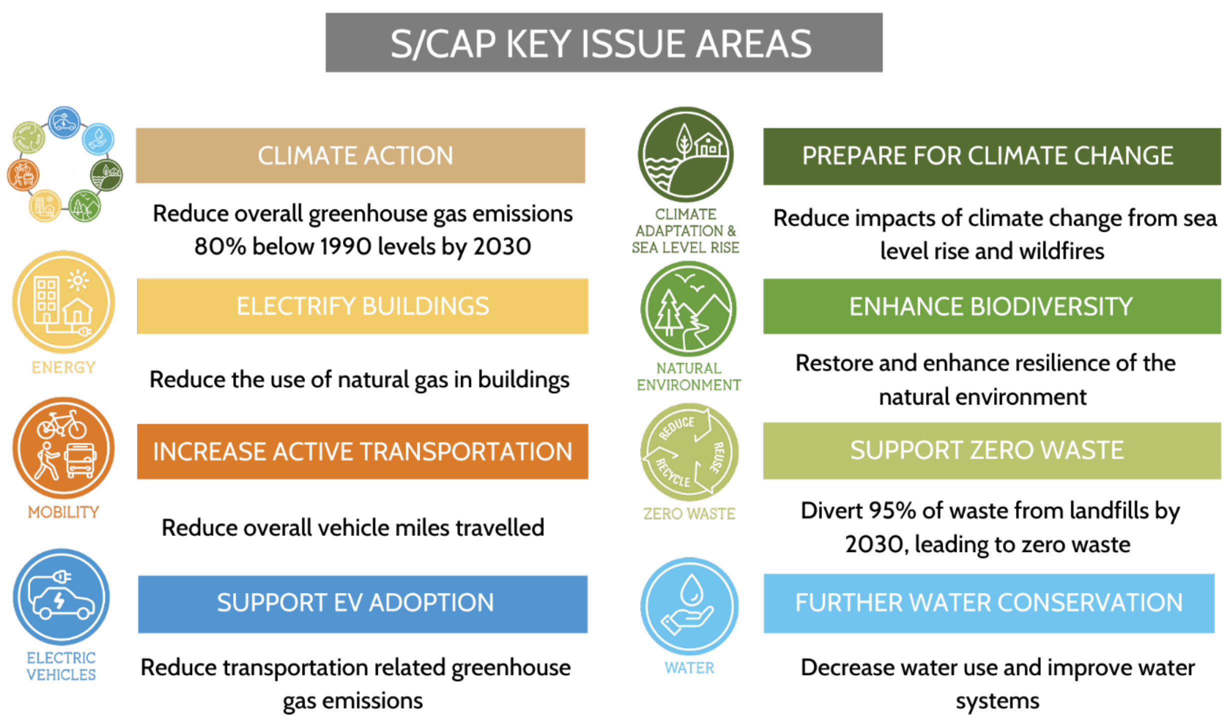
What's New in This S/CAP

Since our first Climate Protection Plan was adopted in 2007, much has changed related to climate protection. Consequently, this S/CAP:

- Incorporates new global, state, and local policies and climate targets, including carbon neutrality.
- Ensures that our GHG inventory complies with the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC), which is an accounting and reporting standard for cities.
- Identifies how Palo Alto's goals align with global carbon reduction needs, as well as the costs of inaction.
- Includes an assessment of the co-benefits of various Key Actions.
- Includes a preliminary assessment of the various financing tools available for making the costs of the S/CAP more manageable.
- Looks at all the goals and key actions through an equity lens to make sure everyone benefits, especially the most vulnerable members of our community.

S/CAP Goals

While the 80 x 30 and carbon neutral by 2030 goals are the overarching sustainability and climate and sustainability goals, we have several equally important goals in the following eight areas: Climate Action, Energy, Mobility, Electric Vehicles, Water, Climate Adaptation and Sea Level Rise, Natural Environment, and Zero Waste. The S/CAP goals are described in further detail in section 5.



The Role of Equity

We cannot address climate change without also addressing equity. Commonly, climate change disproportionately threatens those who are the least responsible for generating pollution, the most vulnerable to its impacts, and the least able to adapt. This is true globally, and it is also true in Palo Alto. Many climate change impacts will disproportionately affect vulnerable populations - populations with greater vulnerability to climate impacts because of their social inequities, physical characteristics, or baseline conditions. According to ICLEI-Local Governments for Sustainability (ICLEI), an international organization of local and regional governments, climate equity ensures that all people have opportunities to benefit equally from climate solutions, while not taking on an unequal burden of climate impacts.[23] Simultaneously, the S/CAP outlines ways to assist low-income community members, renters, and small businesses in accessing carbon-free energy and technologies. When all community members have the same ability to plan for and shape their futures, the result is a healthier and more resilient community.

However, achieving this vision requires hard work and intention. Palo Alto recognizes the importance of proactively including socially vulnerable groups and those who have traditionally been underrepresented in planning processes to participate in the City's sustainability and climate efforts. As Palo Alto implements the programs and policies that result from this S/CAP, we will seek support and feedback from diverse groups of community stakeholders. Moving forward, Palo Alto will evaluate programs and policies using key performance metrics that encourage equitable engagement and impact.

Community Engagement

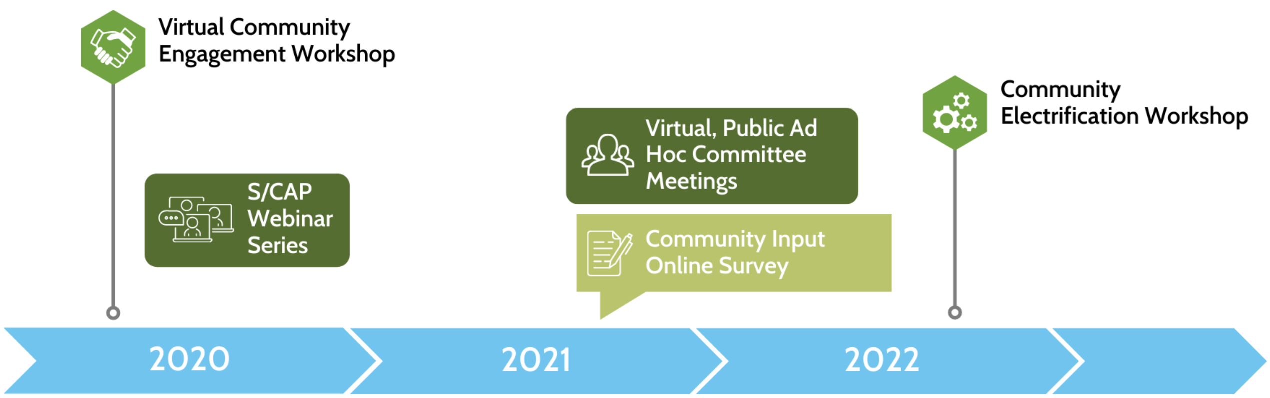
Stakeholder and community engagement is an essential element of S/CAP development. Original March 2020 outreach plans included in-person engagement, listening sessions, and community workshops to solicit feedback on the draft S/CAP Potential Goals and Key Actions. COVID-19 disruption required City staff to switch to a virtual model for a majority of the S/CAP outreach. S/CAP engagement efforts included:

- Eight-part, virtual, on-demand S/CAP Community Engagement Workshop (March 2020-April 2020)
- Webinar series highlighting specific topics addressed in the S/CAP (September 2020-December 2020)
- Virtual public meetings of the S/CAP Ad Hoc Committee, including extensive public participation (August 2021-June 2022)
- On-line survey to help inform sustainability and climate conversations taking place with the S/CAP Ad Hoc Committee and City Council (Launched September 2021)
- In-person community workshop focused on electrification tools and options for residents (October 2022)
- Monthly Sustainability Newsletter
- Monthly Climate Action Blog Series

[23] ICLEI: Local Governments for Sustainability. (n.d.). Climate Equity. https://icleiusa.org/programs/climate-equity/

In addition, the S/CAP Ad Hoc Committee formed an S/CAP Ad Hoc Working Group to draw upon the expertise of community members. Working Group members are individuals who commit to attending multiple S/CAP Ad Hoc Committee meetings and to working on discrete projects outside the meetings. There are currently 5 community members in the S/CAP Ad Hoc Working Group, including a high school student who regularly engages with youth. The S/CAP Ad Hoc Committee and S/CAP Ad Hoc Working Group participated in a Residential Building Electrification Workshop (November 2021) and formed Working Group Teams that engaged additional community members as well as members of the Utility Advisory Commission.

We incorporated all the extensive community feedback into the second and third iterations of the S/CAP Goals and Key Actions. Staff incorporated guidance from the S/CAP Ad Hoc Committee, the S/CAP Working Groups, and the S/CAP Working Group teams into the fourth and final version of the S/CAP Goals and Key Actions. City Council accepted the final version of the S/CAP Goals and Key Actions in October 2022. Staff brought the full S/CAP to City Council for adoption in June 2023 after considering the Addendum and the Final Comprehensive Plan Environmental Impact Report and finding them adequate.



Guiding Principles

The Vision Statement for the 2030 Comprehensive Plan Governance Element declares that:

> *"Palo Alto will maintain a positive civic image and be a leader in the regional, State and national policy discussions affecting the community. The City will work with neighboring communities to address common concerns and pursue common interests. The public will be actively and effectively involved in City affairs, both at the Citywide and neighborhood levels. Where appropriate, the City Council will delegate decision-making responsibilities to local boards and commissions. The Council will also assign advisory roles to these bodies as well as other community groups. Residents, businesses and elected and appointed officials will work collaboratively to address the issues facing the City in a timely manner. This inclusive, participatory process will help build a sense of community."*[24]

[24] https://www.cityofpaloalto.org/Departments/Planning-Development-Services/Long-Range-Planning/2030-Comprehensive-Plan

S/CAP builds on that vision with these guiding principles as a basis for effective and sustainable decision-making:

- Consider “sustainability” in its broadest dimensions, including quality of life, the natural environment and resilience, not just climate change and GHG emissions reductions.
- Address the sustainability issues most important to the community and select most cost-effective programs and policies—recognizing that this will entail moral and political, as well as economic, decision factors.
- Seek to improve quality of life as well as environmental quality, economic health, and social equity.
- Foster a prosperous, robust, and inclusive economy.
- Build resilience—both physical and cultural—throughout the community.
- Include diverse perspectives from all community stakeholders, residents, and businesses.
- Recognize Palo Alto’s role as a leader and linkages with regional, national, and global community.

Design Principles

In both evaluating this S/CAP, and in developing and evaluating future programs guided by it, Palo Alto is guided by these design principles:

- Focus on what’s feasible - recognizing that technology and costs are shifting rapidly.
- Prioritize actions that are in the City’s control – recognizing that we can urge others to join us, but leading by example is most effective
- Be specific about the actions and costs to achieve near-term goals, while accepting that longer-term goals can be more aspirational
- Use ambient resources: Maximize the efficient capture and use of the energy and water that fall on Palo Alto.
- Full cost accounting: Use total (life cycle) cost of ownership and consideration of externalities to guide financial decisions, while focusing on emission reductions that are achievable at a point in time (i.e., not on life cycle emissions).
- Align incentives: Ensure that subsidies, if any, and other investment of public resources encourage what we want and discourage what we don’t want.
- Flexible platforms: Take practical near-term steps that expand rather than restrict capacity for future actions and pivots.

Decision Criteria

In selecting specific programs and policies to pursue, and in allocating public resources to support them, Palo Alto will be guided by these decision criteria:

- Greenhouse gas reduction impact
- Quality of life impact
- Mitigation cost
- Return on investment (ROI)
- Ecosystem health
- Resilience
- Impact on future generations

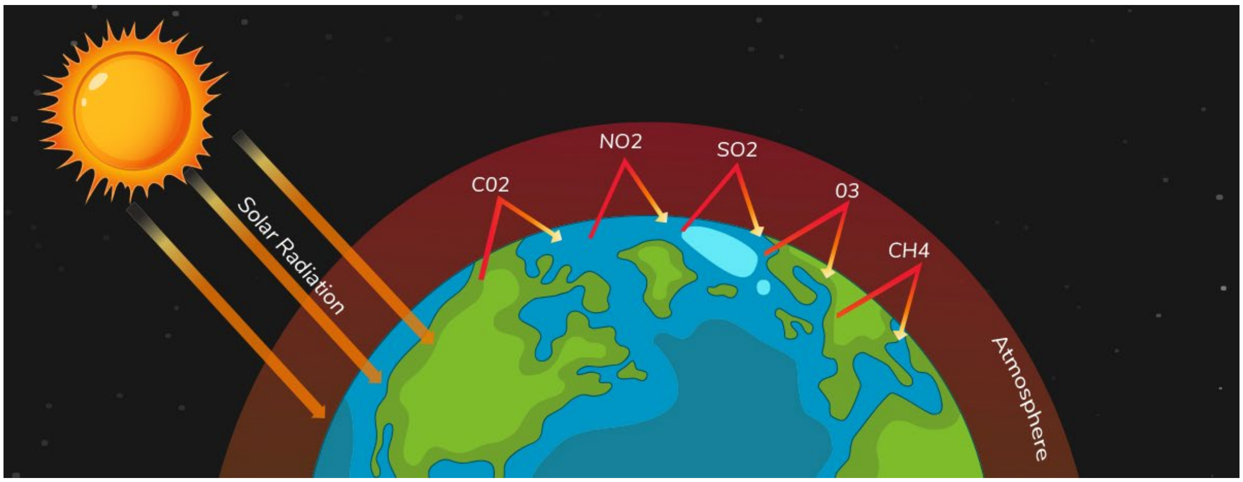
SECTION 3

IMPACTS OF CLIMATE CHANGE

Climate Science 101[25]

Climate change presents one of the most significant challenges of our time. Increasing atmospheric levels of GHG emissions destabilize the Earth's climate system. GHG emissions are invisible, and include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and three man-made gasses: hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF^6).

As more GHGs are trapped inside the Earth's atmosphere, more of the sun's energy is trapped as heat, which means temperatures keep getting hotter. In fact, the world has already become nearly 1°F warmer since 1880, and we're seeing extreme consequences because of it, including more intense storms, greater wildfire risk, and rising sea levels.



Although we're already seeing impacts of climate change, there's a range of how relatively mild or devastating the future impacts might be, depending on how aggressively we act to address climate change. Scientists have laid out four pathways, or scenarios, based on future levels of GHG emissions. The pathways range from the very optimistic to the highly pessimistic. The strategies laid out in this S/CAP are in alignment with the most optimistic pathway. For more information about climate change, its impacts, and the four pathways, see Appendix B: Climate Change, in Section 8.

The Earth Has a Fever

Atmospheric scientist Dr. Katharine Hayhoe, Professor and Director at the Texas Tech University Climate Science Center, has a simple way to explain the impact of rising global temperatures: "When we say the planet is warming by one or two or three degrees Celsius, often we think, 'Well, that's nothing.' But if our body's temperature goes up one and a half to three or even four degrees Fahrenheit, we are running a fever. We go to the doctor. If it was three or four degrees, we go to the hospital. And that's what's happening to our planet. It is running a fever. And that fever is affecting us."

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[25] This section was adapted from the Regionally Integrated Climate Action Planning Suite (RICAPS) Climate Action Plan (CAP) Template Version 9.4. The CAP Template was developed in partnership with the City/County Association of Governments of San Mateo County (C/CAG) and the County of San Mateo Office of Sustainability through the San Mateo County Energy Watch program and its RICAPS initiative. RICAPS is co-funded by C/CAG and PG&E.

What We Are Seeing Already

Climate change will have many different effects on society and on the natural world. Plant and animal species are adapting to changing environments by migrating to new areas. As species move, they bring diseases with them to farms and human populations. Some species become extinct due to either human-caused climate change or to human activities such as habitat destruction or toxic pollution.

The region's annual maximum temperature increased 1.7°F from 1950-2005.

Coastal fog, which is critical to the region's climate and ecosystems, is less frequent than ever before.

Sea level has risen over 8 inches in the last century.

The forceful 2015-2016 El Niño weather pattern, which was one of the three largest in history, resulted in unprecedented outer coast beach erosion due to winter wave energy that was more than 50 percent greater than a typical winter.

The 2012-2016 statewide drought led to the most drastic moisture shortages in the last 1,200 years, resulting in a 1-in-500-year low in Sierra snowpack, $2.1 billion in economic losses, 21,000 jobs lost statewide in agricultural and recreational sectors, and a continuing exhaustion of groundwater sources.

California has seen larger, hotter, and more intense wildfires in recent years, driven by extended drought and climate change. Of the 20 largest fires in California's history, eight occurred between 2017- 2019[26].

Future Projections

Even if considerable efforts to reduce GHG emissions are conducted, Palo Alto will likely see substantial temperature increases by 2050. By 2100, temperature rise will be dependent on the emissions scenario. (For more information about the four emissions scenarios, see Appendix B.4)

Precipitation in Palo Alto will continue to vary each year. The differences between wet and dry years are projected to become more extreme and damaging in the coming decades. If

[26] CARB's fire emission modeling results indicate that wildfires transferred an average of 15 million metric tons of CO2 (MMTCO2) per year from plants into the atmosphere during 2000-2019. When including 2020 and 2021, the annual average is 22 MMTCO2 per year. To put things into perspective, 22 MMTCO2 is equivalent to the amount of carbon contained in the structural lumber of 1.2 million average California single-family homes, or about 15 percent of all single-family homes in California. https://ww2.arb.ca.gov/sites/default/files/classic/cc/inventory/Wildfire%20Emissions%20FAQ%202022.pdf

no action is taken to combat climate change, the Sierra snowpack, a critical source of water for the State, will decrease by an average of 64 percent by the end of the century.[27]

As temperature continues to increase, it is anticipated to cause longer and more intense California droughts, posing major problems for government operations, water supplies, ecosystems, agriculture, and recreation.

Studies suggest that even with significant emissions reductions, it is inevitable that there will be at least 6 feet of sea level rise over the next several centuries due to the delayed effects of climate change.

Climate change could have broad impacts to communities and people – hitting those most vulnerable first and worst. High levels of socioeconomic inequity in the Bay Area create large differences in the ability of individuals to prepare for and recover from heat waves, floods, and wildfires.

Financial Impact of Climate Change

As climate-related natural disasters become more frequent and intense, costs for disaster response and relief are anticipated to increase. With flooding, storms, droughts, wildfires, and other climate-related natural disasters becoming more common, flood insurance and flood prevention costs will grow.[28]

Climate change is anticipated to impact public buildings, storm water infrastructure, transportation infrastructure, community services, and land-use planning and development. Climate damage to homes and businesses could negatively impact the economy and reduce Palo Alto's income from property and sales taxes, not to mention damage the quality of life for all community members.

If Palo Alto allocates resources and invests in climate-protecting strategies now, it will be insurance against some of the costliest effects of a hotter planet in the future.

[27] UCLA Center for Climate Science. (2018). Climate Change in the Sierra Nevada. https://www.ioes.ucla.edu/wp-content/uploads/UCLA-CCS-Climate-Change-Sierra-Nevada.pdf
[28] American Meteorological Society. (2018). Explaining Extreme Events from a Climate Perspective. https://www.ametsoc.org/ams/index.cfm/publications/bulletin-of-the-american-meteorological-society-bams/explaining-extreme-events-from-a-climate-perspective/.

SECTION 4

GREENHOUSE GAS EMISSIONS

Greenhouse Gas (GHG) Inventory Framework

Cities represent the single greatest opportunity for tackling climate change, as they are responsible for 75 percent of global energy-related carbon dioxide emissions, with transportation and buildings among the largest contributors[29]. The first step for cities to realize their potential is to identify and measure the sources of their emissions. Best practices for identifying these sources and quantifying emissions is to utilize a standardized GHG inventory.

There are two types of Greenhouse Gas (GHG) emissions inventories:

1. **Generation-based GHG inventory** – This measurement method helps a community understand its level of emissions based on community energy use. It includes 1) direct consumption of energy, 2) consumption of energy via the electrical grid, and 3) emissions from the treatment/decomposition of waste. This is the industry-accepted methodology for quantifying community GHG emissions, with emissions reported by emission source category[30].
2. **Consumption-based GHG inventory** – This measurement method helps a community understand its level of emissions based on consumption. It offers an alternative, more holistic, approach for quantifying emissions within a community, quantifying consumption of goods and services (including food, clothing, electronic equipment, etc.) by residents of a city, with emissions reported by consumption category.

In 2014, World Resources Institute, C40 Cities Climate Leadership Group (C40) and ICLEI – Local Governments for Sustainability (ICLEI)[31] partnered to create a global standard protocol for the first type: generation-based GHG inventories. The GHG Protocol standard for Cities[32] provides a robust framework for accounting and reporting city-wide GHG emissions for a generation-based inventory. The GPC Protocol 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 Protocol[33], which provides more detailed methodology specific to U.S. Communities. The GPC Protocol 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

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[29] See UN Environment Programme, "Cities and Climate Change," https://www.unep.org/explore-topics/resource-efficiency/what-we-do/cities/cities-and-climate-change

[30] 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.

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

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

[33] U.S. Community Protocol; https://icleiusa.org/us-community-protocol/

- Demonstrate the important role that cities play in tackling climate change, and facilitate insight through benchmarking – and aggregation – of comparable data

Palo Alto's 2021 GHG Emissions Inventory

The 2021 Palo Alto GHG inventory, completed by AECOM, uses the approach and methods provided by the GPC. Inventory calculations were performed using the ClearPath[34] tool, a software platform designed for creating GHG inventories. The City's GHG inventory conforms to the GPC Basic protocol for a generation-based GHG inventory. Staff did not complete a consumption-based GHG inventory as there is no State guidance yet, though staff believes this inventory type is valuable. CARB has been tasked with developing an implementation framework and accounting to track consumption-based emissions over time.[35] 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 awaits State guidance on how to account for these consumption-based emissions reductions, the community can work to reduce these emissions in the meantime.

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 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 generation-based inventory follows the city-inducted framework in the GPC protocol, which totals GHG emissions attributable to activities taking place within the geographic boundary of the city[36]. Under the Basic reporting level as defined by the GPC protocol, 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.

In 2021, Palo Alto emitted an estimated 359,312 metric tons (MT) of carbon dioxide equivalent (CO_2e) from the residential, commercial, industrial, transportation, waste, water, and municipal sectors.[37] In comparison to the 1990 base year emissions (which were about 780,000 metric tons),

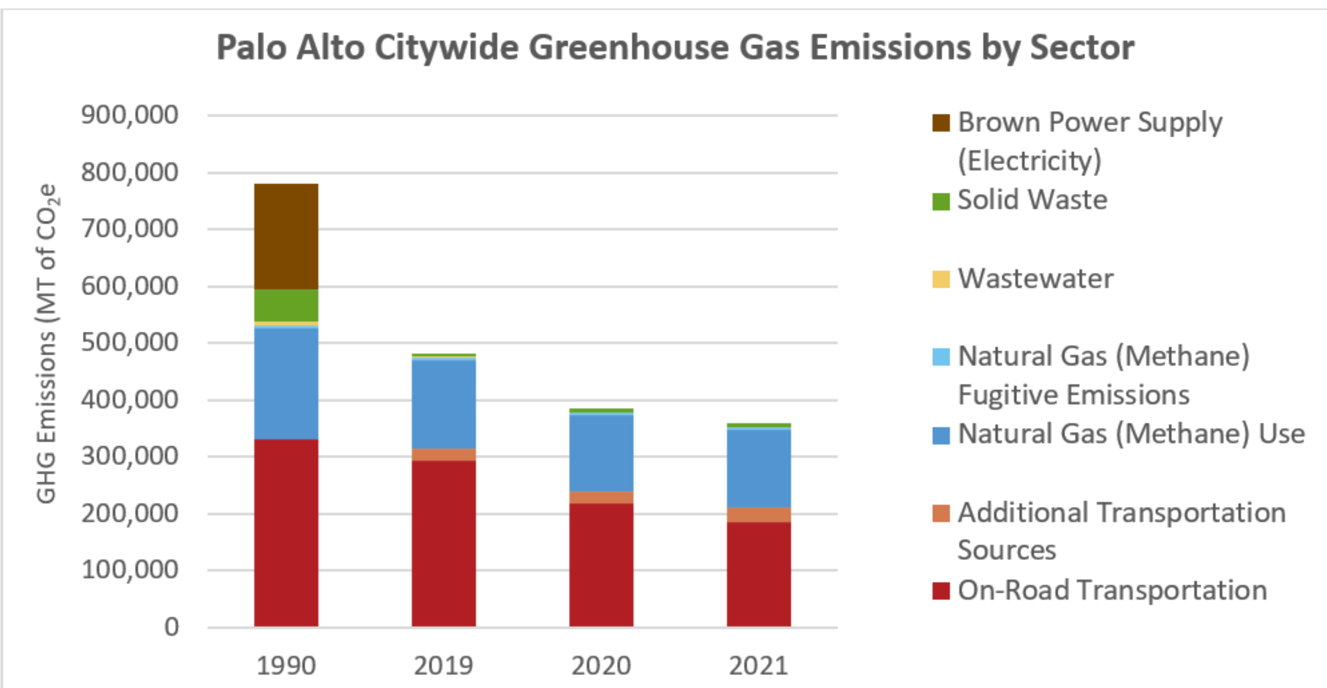
[34] https://icleiusa.org/clearpath/
[35] Executive Department State of California. (2019). Executive Order B-55-18 to Achieve Carbon Neutrality. https://www.ca.gov/archive/gov39/wp-content/uploads/2018/09/9.10.18-Executive-Order.pdf.
[36] https://ghgprotocol.org/sites/default/files/standards/GHGP_GPC_0.pdf
[37] Carbon dioxide equivalent is a unit of measure that normalizes the varying climate warming potencies of all six GHG emissions, which are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs),

that is a 53.9 percent decrease in total community emissions, despite a population increase of 19.5 percent during that same time period. This equates to 5.4 metric tons of carbon dioxide equivalent (MT CO2e) per Palo Alto resident in 2021 compared to 14 MT CO2e per Palo Alto resident in 1990. The California Air Resources Board's 2017 Scoping Plan Update recommends a goal for local governments of 6 MT C02e per capita by 2030.

Of that 53.9 percent reduction to-date, 44.2 percent came from achieving carbon neutrality for the City's electricity portfolio, 28.6 percent from declines in transportation emissions, 13.9 percent from reduction in natural gas (methane[38]) consumption, 11.5 percent from declines in solid waste emissions, and 1.7 percent from declines in wastewater-related emissions. In comparison to 2020, that is a 6.7 percent decrease in total community emissions.

For the emissions sources in 2021, 51.7 percent are from on-road transportation, 37.8 percent are from natural gas (methane) use, and the remainder are from other sources. A comparison of 1990, 2019, 2020, and 2021 GHG emissions is shown in Figure 1 and Table 1. The full comparison between the inventories can be found in Appendix D.1. 1990 vs. 2020 Greenhouse Gas Emissions by Sector and Subsector. Additional existing emissions sources that were missing from the 1990 GHG inventory were included in the 2021 GHG inventory to comply with the GPC Basic protocol (Airport Emissions, Off-road Vehicles, Caltrain Commuter Rail, Composting, and Palo Alto Landfill Gas Flaring).

Figure 1: 1990 vs 2021 GHG Emissions by Sector



perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). For example, one metric ton of nitrous oxide is 210 metric tons of CO_2e.

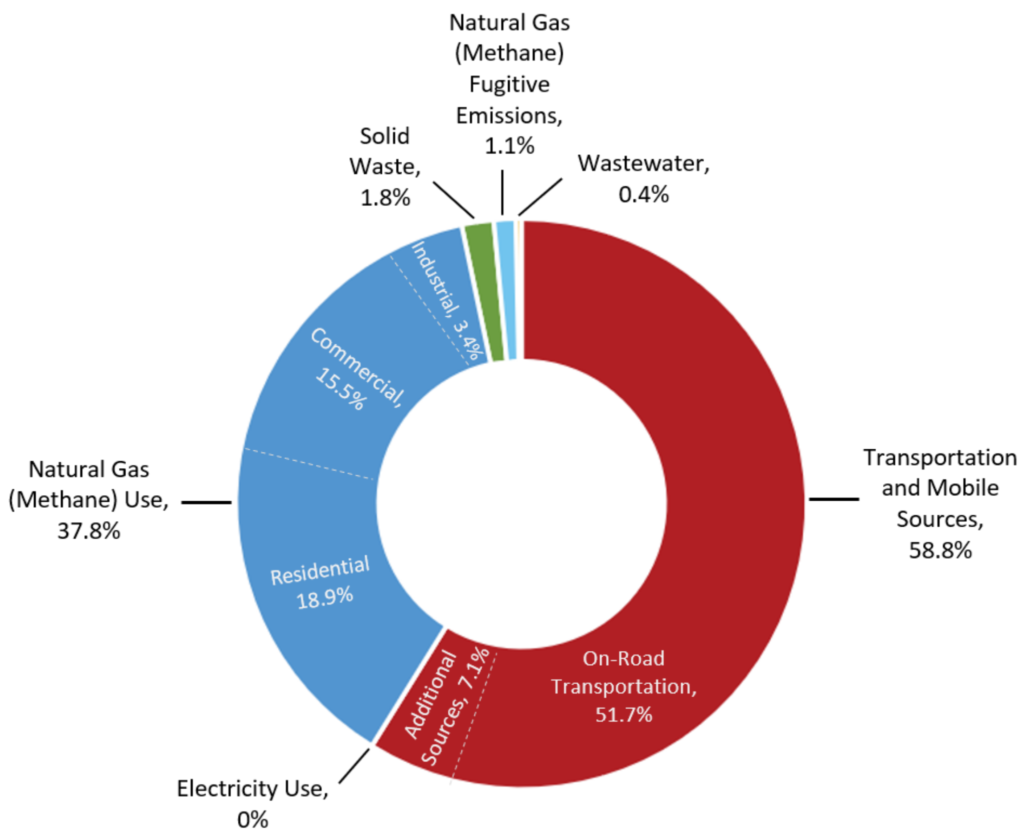
[38] Methane, which is the primary component of natural gas, is a very potent greenhouse gas, with a global warming potential that is 25 times higher than CO2 over a 100-year period.

Table 1: 1990 vs 2021 GHG Emissions by Sector

Sector	1990 GHG emissions (MT CO_2e)	2019 GHG emissions (MT CO_2e)	2020 GHG emissions (MT CO_2e)	2021 GHG emissions (MT CO_2e)	Percent Change in 2021 from 1990
On-Road Transportation	331,840	293,413	217,279	185,925	-44.0%
Additional Transportation Sources		21,668	21,244	25,478	n/a
Natural Gas (Methane) Use	194,000	153,509	134,365	135,697	-30.1%
Natural Gas (Methane) Fugitive Emissions	4,718	5,009	4,384	4,427	-6.2%
Wastewater-Related Emissions	8,504	2,197	1,388	1,262	-85.2%
Solid Waste	55,057	6,531	6,660	6,522	-88.2%
Brown Power Supply (Electricity)	186,000				- 100%
Total GHG Emissions (MT CO_2e)	**780,119**	**482,237**	**385,320**	**359,312**	**-53.9%**

As shown in Figure 2, the two largest categories of emissions are (a) transportation and mobile sources and (b) natural gas (methane) use.

Figure 2: 2021 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 (methane) use includes emissions that result from natural gas (methane) consumption in both private and public sector buildings and facilities, and residential, commercial, and industrial sources. Fugitive emissions (methane gas that escapes during the drilling, extraction, and transportation processes) related to natural gas (methane) consumption are calculated separately and are discussed below. 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.

Transportation and Mobile Sources

In 2021, transportation and mobile sources accounted for 58.8 percent of total GHG emissions in Palo Alto, a 11.4 percent decrease from 2020. 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 Protocol.
- 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: 2021 Transportation and Mobile Sources

Subsector	2019 GHG emissions (MT CO_2e)	2020 GHG emissions (MT CO_2e)	2021 GHG emissions (MT CO_2e)	Percent of Total 2021 Emissions (%)
On-Road Transportation	293,413	217,279	185,925	51.7%
Airport Emissions	2,192	1,664	2,641	0.7%
Off-road Vehicles	14,634	15,029	18,961	5.3%
Caltrain Commuter Rail	4,842	4,552	3,876	1.1%
Total Transportation & Mobile Sources	**315,081**	**238,523**	**211,403**	**58.8%**

Estimating vehicles miles traveled (VMT) is a complicated process and is one of the few emissions sources that the City does not estimate annually. Forecasts of on-road transportation emissions are typically based on outputs from a travel forecasting model, other accounting-type method (sketch models), or Big Data (vehicle navigation data from built-in GPS and location-based services data from cell phones). Previously, Fehr & Peers provided VMT estimates for 2019, 2030, and 2040, with AECOM using the VMT estimates for 2019 to estimate the VMT for 2020. The VTA model used to calculate Palo Alto's 2019 annual VMT is only updated every few years and has not yet been updated to better reflect changes in VMT due to the pandemic. For 2021, AECOM used the VMT estimates from the Google Environmental Insights Explorer.

The Google Environmental Insights Explorer (EIE) uses aggregated data to derive local data, including distance driven by mode, then applies regional assumptions from the Climate Action for Urban Sustainability (CURB) tool — an internationally recognized third-party data source — to estimate the mix of vehicle and fuel types. This reflects actual trips from geospatial data based on continuous observation. Total distance traveled for all trips is aggregated and modeled to the entire city using aggregated location information from Google Location History and other sources. Google EIE is now GPC compliant, which is why staff opted to use the Google EIE data instead of the VTA model, which has not been updated since before the pandemic. In addition, ICLEI recommends cities use Google EIE data to estimate VMT.

On-road transportation accounts for approximately 51.7 percent of Palo Alto's total emissions, a 14.4 percent decrease from 2020. Because the 2021 GHG inventory uses Google EIE to calculate VMT and not the VTA model, it is possible that the emissions reductions in on-road transportation were because of the change in methodology and not from actual reductions in VMT. Using the VTA model, Fehr and Peers estimated VMT to be 729,969,567 total annual miles in 2020 compared to 518,286,844 total annual miles in 2021 using Google EIE. In addition, Google EIE does not use speed bin analysis[39], whereas Fehr and Peers did. However, moving forward, future GHG inventories will continue to use Google EIE to calculate VMT, so the 2022 GHG inventory will be a better comparison.

Off-road transportation accounts for approximately 5.3 percent of Palo Alto's total emissions, a 26.2 percent increase from 2020, mainly from transportation refrigeration units and light commercial (outdoor power equipment such as compressors and generators). Off-road transportation emissions were not calculated in 1990. It is important to note that most of the off-road transportation emissions are based on models at the County level that were not adjusted to reflect any pandemic-induced activity changes and do not reflect Palo Alto-specific variation.

Caltrain commuter rail emissions account for approximately 1.1 percent of Palo Alto's total emissions, a 14.9 percent decrease from 2020. Caltrain electrification is a key component of the

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[39] GHG emissions are commonly calculated using forecasts of VMT that are grouped according to the average speed of the traveling vehicles, which is called speed bin analysis. Slower-moving vehicles generate more pollutants, while travel speeds between 40-50 miles per hour (mph) tend to represent the most fuel-efficient operating conditions for internal combustion engines.

Caltrain Modernization program[40], with Caltrain scheduled to be electrified by the end of 2023 or early 2024. Once the Caltrain Modernization program is complete, most of the Caltrain commuter rail emissions will be eliminated.

Airport emissions account for approximately 0.7% of Palo Alto's total emissions, a 58.7% increase from 2020. Intracity flights fuel use is estimated by the City and not reflective of actual fuel consumption.

Natural Gas (Methane) Use

In 2021, natural gas (methane) emissions accounted for 37.8 percent of total 2021 GHG emissions in Palo Alto, a 1 percent increase from 2020 and a 30.1 percent decrease from 1990. As shown in Table 3, Palo Alto's total natural gas (methane) consumption in 2021 was 25,518,320 therms. Residential energy accounts for 18.9 percent of total emissions, commercial energy accounts for 15.5 percent of total emissions, and industrial energy accounts for 3.4 percent of total emissions. The pandemic drastically affected natural gas (methane) consumption. The temporary shelter-in place order, as well as changes in how and where people worked, resulted in major changes in the commercial and industrial sectors, with fewer people staying in hotels, going to restaurants, and going to retail establishments in 2020. In 2021, as the commercial and industrial sectors began to rebound, natural gas (methane) use increased 4 percent in the commercial sector and 1.8 percent in the industrial sector. Natural gas (methane) use decreased 1.5% in the residential sector.

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 (methane) emissions; 2) pursuing efficiency strategies to reduce natural gas (methane) 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 (methane) use within the City. However, offsets are not included in this GHG inventory.

Table 3: 2021 Natural Gas (Methane) Use

Subsector	2019 Consumption (Therms)	2020 Consumption (Therms)	2021 Consumption (Therms)	Percent of Total 2021 Emissions (%)
Residential Energy	13,565,360	12,952,262	12,756,160	18.9%
Industrial Energy	2,707,034	2,253,641	2,294,119	3.4%
Commercial Energy	12,954,768	10,061,842	10,468,041	15.5%
Total Natural Gas (Methane) Use	**28,867,162**	**25,267,739**	**25,518,320**	**37.8%**

[40] Caltrain Modernization Program; https://calmod.org/

Natural Gas (Methane) Fugitive Emissions

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

In 2021, natural gas (methane) fugitive emissions accounted for 1.2 percent of total GHG emissions in Palo Alto, an increase of 1 percent from 2019 and a decrease of 6.2 percent from 1990. Per the GPC, fugitive emissions from natural gas (methane) are based on overall community consumption and a leakage rate of 0.03 percent.

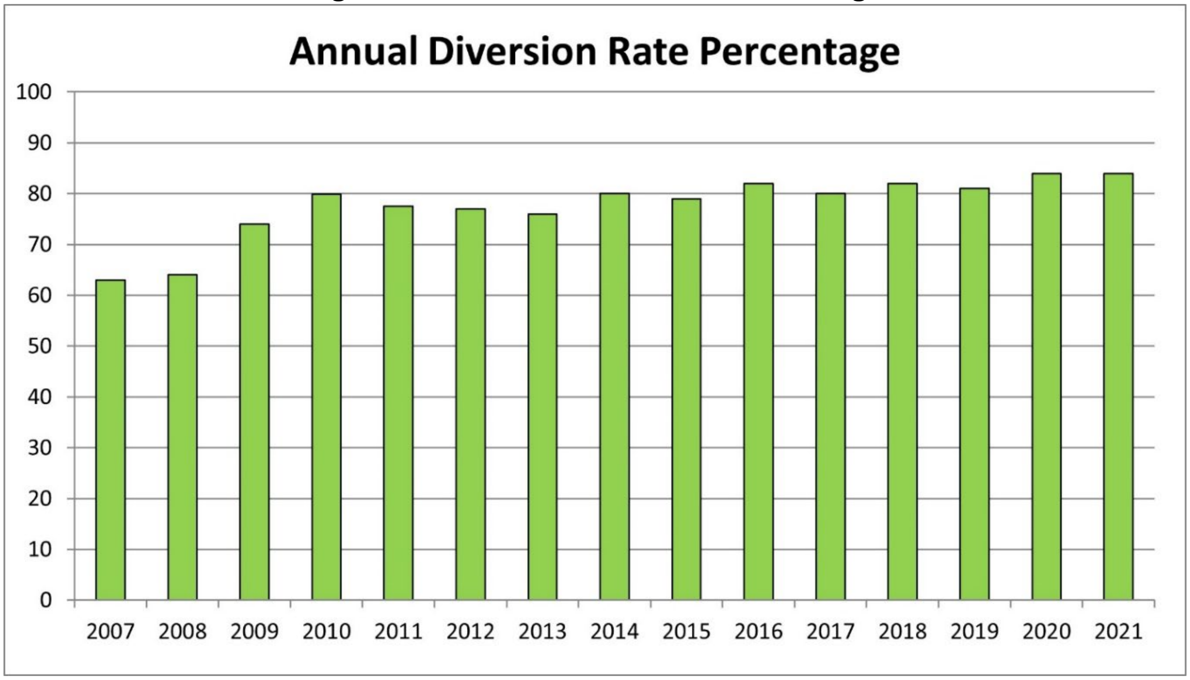
As mentioned previously, the GPC Basic methodology includes GHG emissions attributable to activities taking place within the geographic boundary of the city. As such, the 2021 GHG inventory does not include a category of emissions that are called "upstream emissions," which includes emissions from extraction of natural gas (methane) and its transportation across the western United States through California to Palo Alto. Leaks during gas extraction and transportation can be very significant, so the actual impacts of natural gas (methane) use can be much more significant than is represented in a formal greenhouse gas inventory.

Solid Waste

In 2021, Palo Alto's solid waste diversion rate was 84 percent, far exceeding the 50 percent mandate for local jurisdictions. "Diversion" includes all waste prevention, reuse, recycling, and composting activities that "divert" materials from landfills. The City uses the diversion rate to measure progress on waste reduction and resource conservation goals. As shown in Figure 3, the diversion rate of 84 percent is an improvement from the 62 percent rate 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 percent diversion of materials from landfills by 2030[41].

[41] Sustainability and Climate Action Plan Framework, November 2016; https://www.cityofpaloalto.org/civicax/filebank/documents/64814

Figure 3: Annual Diversion Rate Percentage



Solid waste emissions accounted for 1.8 percent of total 2021 GHG emissions in Palo Alto, a 2 percent increase from 2020 and an 88.2 percent decrease from 1990. As shown in Table 4, the 1990 inventory included Palo Alto Landfill Gas Fugitive emissions, whereas the 2021 inventory did not, and the 2021 inventory included composting emissions at the ZeroWaste Energy Development Company's (ZWED) Dry Fermentation Anaerobic Digestion (AD) Facility in San Jose, CA, composting emissions at the Synagro El Nido Central Valley Composting (CVC) facility in Dos Palos, as well as Palo Alto Landfill Gas Flaring Emissions. The increase in solid waste emissions from 2020 is due largely to the increase in emissions from the closed landfills within the community.

In 2021, emissions from the closed landfills located within the community accounted for 1.4 percent of total waste emissions.

Table 4: 1990 vs 2021 Solid Waste Emissions by Subsector

Subsector	1990 GHG emissions (MT CO_2e)	2019 GHG emissions (MT CO_2e)	2020 GHG emissions (MT CO_2e)	2021 GHG emissions (MT CO_2e)	Percent of Total 2021 Emissions (%)
Composting	Not included	731	1,623	1,256	0.3%
Palo Alto Landfill Gas Flaring	Not included	281	316	237	0.1%
Palo Alto Landfill Gas Fugitive	24,325	n/a[42]	n/a	n/a	n/a
Landfill Waste	30,732	5,519	4,721	5,029	1.4%
Total	**55,057**	**6,531**	**6,660**	**6,522**	**1.8%**

[42] Not included because the landfill was closed

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

In 2016, Governor Brown signed Senate Bill 1383 (SB 1383) to reduce GHG emissions from a variety of short-lived climate pollutants, including methane from organic materials disposed in landfills. SB 1383 is the largest and most prescriptive waste management legislation in California since the California Integrated Waste Management Act of 1989 (AB 939). SB 1383 sets several statewide goals, including:

- Reduce statewide disposal of organic waste by 50% by January 1, 2020 and 75% by 2025.
- Recover at least 20% of the currently disposed edible food for human consumption by 2025.

Wastewater Treatment

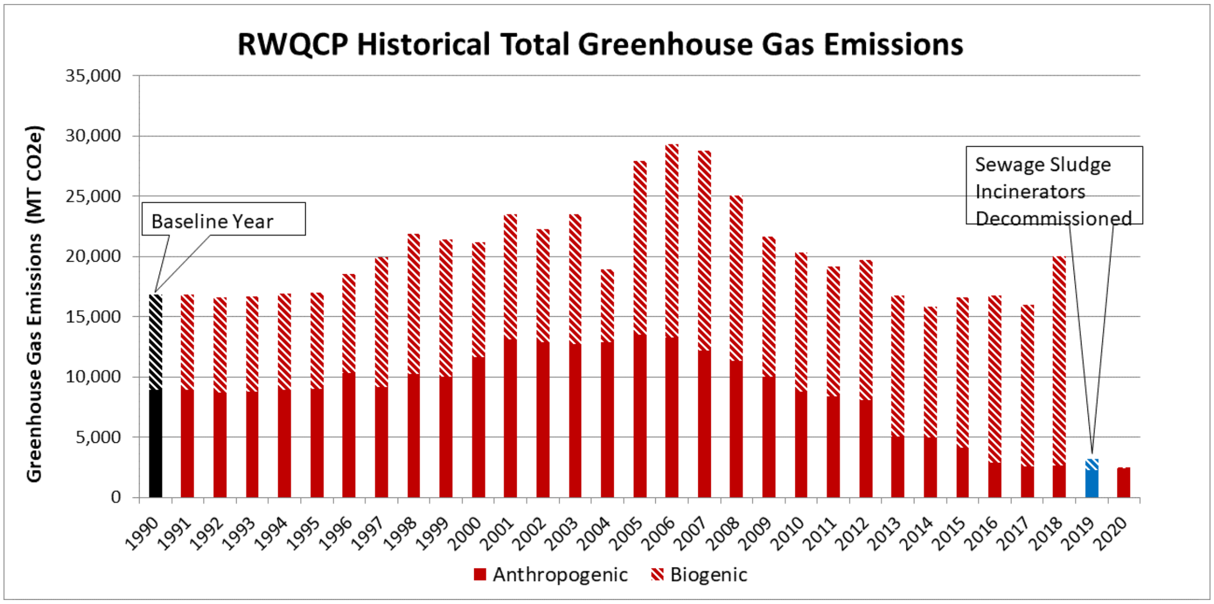
As shown in Table 5, in 2021 the City of Palo Alto Regional Water Quality Control Plant (RWQCP) wastewater-related emissions accounted for 0.4 percent of total 2021 GHG emissions in Palo Alto – a 9.1 percent decrease from 2020 and an 85.2 percent decrease from 1990. RWQCP GHG emissions originate from electricity, natural gas (methane), and landfill gas usage required to treat the wastewater, as well as GHGs that are emitted from the wastewater itself either during treatment or after (effluent). The nitrogen within wastewater is subject to transformation to nitrous oxide at varying stages in the treatment process as well as after being discharged to a receiving water (effluent). These emissions are included in the RWQCP totals. The RWQCP operations achieved significant GHG reductions in 2019 when the facility's sewage sludge incinerators were replaced with the more environmentally-friendly Sludge Dewatering and Truck Loadout Facility. Previously, the RWQCP incinerators were the City's largest facility-related GHG source. The updated biosolids treatment process has and will continue to reduce climate-warming GHG emissions by approximately 15,000 MT of CO_2e per year when compared to the emissions from incineration. This approximates the carbon dioxide emissions of 3,000 passenger cars. The dewatered sludge is used as agricultural soil supplements.

Table 5: 1990 vs 2021 Wastewater-Related Emissions by Subsector

Subsector	1990 GHG emissions (MT CO_2e)	2019 GHG emissions (MT CO_2e)	2020 GHG emissions (MT CO_2e)	2021 GHG emissions (MT CO_2e)	Percent of Total 2021 Emissions (%)
Wastewater Biosolid Treatment[43]	n/a	812	0	0	0%
Wastewater Treatment and Effluent	8,504	1,385	1,388	1,262	0.4%
Total	**8,504**	**2,197**	**1,388**	**1,262**	**0.4%**

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

Figure 4: RWQCP Historical Total Greenhouse Gas Emissions



The Impact of Remote Work

The pandemic created the need, perhaps temporarily, 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 Area[44]. 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:

- In the Bay Area, the share of people who reported primarily working from home grew from 3.4 percent in 1990 to 6.4 percent in 2018.
- 51 percent (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 percent (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.

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

- 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.

In Palo Alto, if we assume 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 percent[45] compared to 2019 levels.

[45] 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.

SECTION 5

GOALS AND KEY ACTIONS

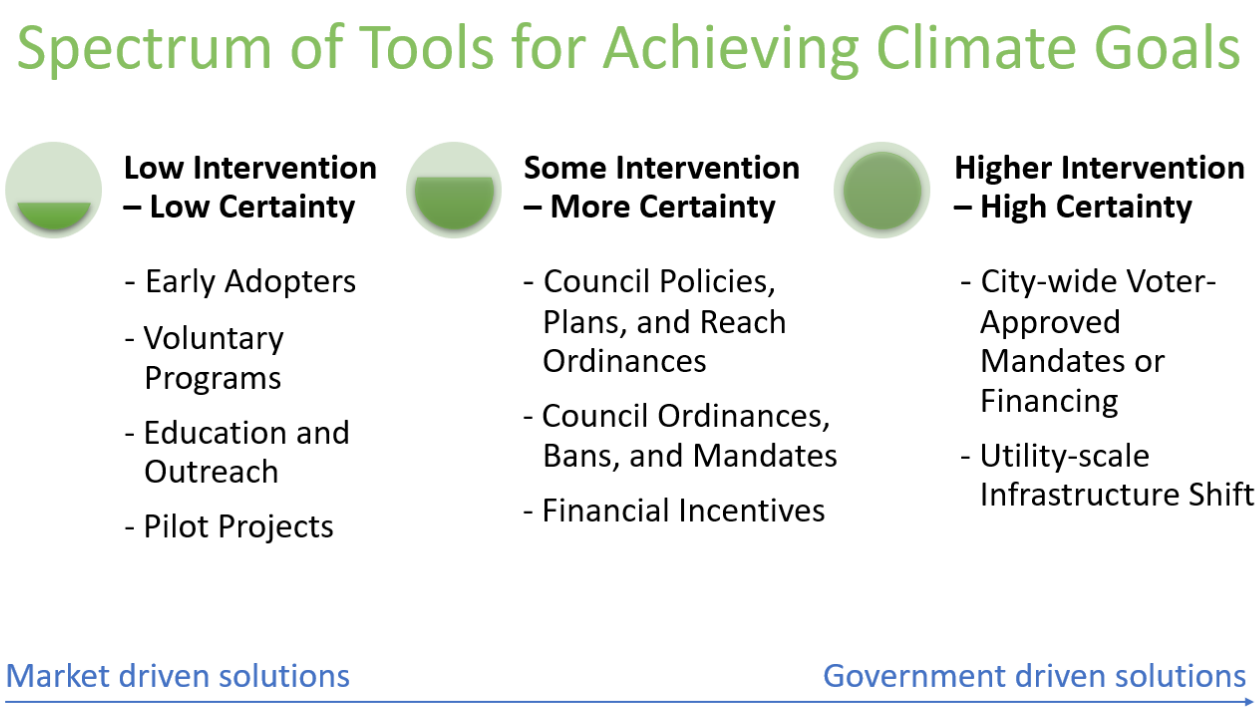
Introduction

This Sustainability and Climate Action Plan (S/CAP) outlines Goals and Key Actions in eight areas: Climate Action, Energy, Electric Vehicles, Mobility, Water, Climate Adaptation and Sea Level Rise, Natural Environment, and Zero Waste. The City's consultant, AECOM, performed an impact analysis that estimated the GHG reduction potential of the proposed actions, estimated costs, and additional sustainability co-benefits, as well as the outcomes needed to meet the "80 x 30" goal to reduce GHGs 80% below 1990 levels by 2030. The Impact Analysis can be found in Appendix D.3 in Section 8.

The Key Actions do not capture the full breadth and depth of the sustainability and climate action programs and projects across the City. Rather, they are the Key Actions that we are prioritizing, based on the outcomes needed and sustainability co-benefits that were identified in the impact analysis to achieve the 80 x 30 goal. The City is developing and implementing additional Supplemental Actions that contribute towards the City's sustainability and climate goals but are not highlighted here. Many of the Supplemental Actions are included in the Climate Change – Protection and Adaptation Work Plan and will be included in future Work Plans.

Each of the S/CAP Key Actions falls along a Spectrum of Tools for Achieving Climate Goals, as shown in Figure 5. The Spectrum ranges from market driven solutions that require low intervention with a corresponding low certainty of achievement, such as voluntary programs, to government driven solutions that require higher intervention but yield high certainty of achievement, such as city-wide voter-approved mandates.

Figure 5: Spectrum of Tools for Achieving Climate Goals



The Goals and Key Actions proposed in this document will work together towards achieving Palo Alto's goals to reduce GHG's 80 percent by 2030, relative to a 1990 baseline and achieve carbon neutrality by 2030. The proposed S/CAP Goals and Key Actions are meant to be a high-level road map to achieving the community's 80 x 30 and carbon neutrality goals. More details and specifics will be provided in the S/CAP Workplan.

Sustainability and Climate Action Plan GOALS

Climate Action **Reduce GHG emissions 80% below 1990 levels by 2030**

ENERGY

- Reduce GHG emissions from the direct use of natural gas in Palo Alto's building sector by at least 60% below 1990 levels (116,400 MT CO_2e reduction)
- Modernize the electric grid to support increased electric demand and to accommodate state-of-the-art technology

ELECTRIC VEHICLES

- Reduce transportation related GHG emissions at least 65% below 1990 levels (215,696 MT CO_2e reduction)
- Develop a public and private charging network to support EV adoption

MOBILITY

- Reduce total vehicle miles traveled 12% by 2030, compared to a 2019 baseline, by reducing commute vehicle miles traveled 20%, visitor vehicles miles traveled 10%, and resident vehicle miles traveled 6%
- Increase the mode share for active transportation (walking, biking) and transit from 19% to 40% of local work trips by 2030

WATER

- Reduce Palo Alto's potable water consumption 30% compared to a 1990 baseline (subject to refinement based on forthcoming California water efficiency standards expected in 2024)
- Develop a water supply portfolio which is resilient to droughts, changes in climate, and water demand and regulations, that supports our urban canopy

CLIMATE ADAPTATION & SEA LEVEL RISE

- Develop and adopt a multi-year Sea Level Rise Adaptation Plan including a Sea Level Rise Vulnerability Assessment and adaptation plan
- Minimize wildland fire hazards by ensuring adequate provisions for vegetation management, emergency access and communications, inter-agency firefighting, and standards for design and development within wildland areas

NATURAL ENVIRONMENT

- Restore and enhance resilience and biodiversity of our natural environment throughout the City
- Increase tree canopy to 40% city-wide coverage by 2030
- By 2030, achieve a 10% increase in land area that uses green stormwater infrastructure to treat urban water runoff, compared to a 2020 baseline

ZERO WASTE

- Divert 95% of waste from landfills by 2030, leading to zero waste
- Implement short- and medium-term initiatives identified in the *2018 Zero Waste Plan*

Sustainability and Climate Action Plan KEY ACTIONS Summary

Climate Action (page 45-46)

- **C1.** Provide Building and Transportation Emissions Consultations for Residents
- **C2.** Develop Major Employer Custom Emissions Reduction Plans
- **C3.** Study Additional Key Actions Needed for 80 x 30
- **C4.** Study Staffing and Budgetary Needs
- **C5.** Study Funding Alternatives
- **C6.** Conduct an Electrification Affordability Study
- **C7.** Study Carbon Neutrality Options
- **C8.** Accelerate GHG reductions through Mandates or Price Signals

Energy (pages 47-48)

- **E1.** Reduce GHG emissions in Single-Family Appliances and Equipment
- **E2.** Reduce GHG emissions in Non-Residential Equipment
- **E3.** Reduce Gas Use in Major Facilities
- **E4.** Reduce Natural Gas Use at City facilities
- **E5.** Support Income-Qualified Residents and Vulnerable Businesses with Electrification
- **E6.** Develop Electric Rate Options
- **E7.** Use Codes and Ordinances to Facilitate Electrification
- **E8.** Electric Grid Modernization Plan
- **E9.** Additional Electrification Opportunities in Commercial and Multi-Family Buildings

Electric Vehicles (pages 49-50, 51-52)

- **EV1.** Raise Awareness of Alternative Transportation Modes, Micromobility, and EVs
- **EV2.** Collaborate to Promote EV Adoption Regionally
- **EV3.** Promote EV Adoption and Alternative Commutes for Commuters
- **EV4.** Facilitate the Adoption of EVs, E-bikes and other Light EVs
- **EV5.** Promote Alternative Transportation Modes and Infrastructure to Support Adoption
- **EV6.** Expand EV Charging Access for Multi-Family Residents
- **EV7.** Improve EV Charging Access for Income-Qualified residents
- **EV8.** Ensure EV Charging Capacity Supports EV Growth
- **EV9.** Electrify Municipal Vehicle Fleet
- **EV10.** Support Policy to Electrify Fleet Vehicles

Mobility (pages 49-50, 53-54)

- **M1.** Increase Active Transportation and Transit for Local Work Trips
- **M2.** Expand Availability of Transit and Shared Mobility Services
- **M3.** Implement the Bicycle and Pedestrian Transportation Plan
- **M4.** Improve Transportation Demand Management for Employees and Residents
- **M5.** Implement Smart Parking Infrastructure in Public Garages and Parking Fees in Business Districts
- **M6.** Study Land Use and Transportation
- **M7.** Continue to Implement the City's Housing Element

M8. Improve Transit and Traffic Flow
M9. Create Housing Density and Land Use Mix that Supports Transit and Non-SOV Transportation
M10. Encourage Reductions in GHGs and VMT

Water (pages 55-56)

W1. Maximize Water Conservation and Efficiency
W2. Build a Salt Removal Facility
W3. Implement One Water Portfolio Projects
W4. Develop a Dynamic Water Planning Tool

Climate Adaptation and Sea Level Rise (pages 57-59)

S1. Complete a Sea Level Rise Vulnerability Assessment
S2. Implement a Sea Level Rise Adaptation Plan
S3. Begin Design Process for a Levee Project
S4. Complete Bridge Improvements and Identify Protection Strategies from Flood Events
S5. Implement the Foothills Fire Management Plan
S6. Minimize Fire Hazards Through Zoning
S7. Collaborate on Reducing Wildfire Hazards
S8. Implement CAL FIRE Public Education Programs

Natural Environment (pages 60-61)

N1. Increase Palo Alto's Tree Canopy
N2. Ensure No Net Tree Canopy Loss for all Projects
N3. Reduce Pesticide Use in Parks and Open Space Preserves
N4. Enhance Pollinator Habitat
N5. Establish a Carbon Storage of Tree Canopy Baseline and KPI
N6. Maximize Biodiversity and Soil Health
N7. Coordinate Implementation of City Natural Environment-Related Plans
N8. Expand Water Efficient Landscape Ordinance (WELO) Requirements
N9. Phase out Gas-Powered Lawn and Garden Equipment
N10. Support the Green Stormwater Infrastructure Plan
N11. Incorporate Green Stormwater Infrastructure in Municipal Projects

Zero Waste (pages 62-63)

ZW1. Encourage Food Waste Prevention and Require Food Recovery from Commercial Food Generators
ZW2. Promote Residential Food Waste Reduction
ZW3. Champion Waste Prevention, Reduction, Reusables, and the Sharing Economy
ZW4. Provide Waste Prevention Technical Assistance to the Commercial Sector
ZW5. Prioritize Domestic Processing of Recyclable Materials
ZW6. Eliminate Single-Use Disposable Containers
ZW7. Expand the Deconstruction and Construction Materials Management Ordinance
ZW8. Implement Reach Code standard for Low Carbon Construction Materials

Climate Action

The eight areas of the S/CAP (Climate Action, Energy, Electric Vehicles, Mobility, Water, Climate Adaptation and Sea Level Rise, Natural Environment, and Zero Waste) are all equally important. However, three areas – Energy, Electric Vehicles, and Mobility – have the highest potential for the largest greenhouse gas (GHG) emissions reductions. Each of these three areas has Goals and Key Actions that are specific to each area, but the overarching 80 x 30 goal and several Key Actions encompass all three.

Palo Alto has already made significant progress in its sustainability and climate action efforts, decreasing its community emissions by 53.9 percent compared to 1990 levels. However, to achieve the 80 x 30 and carbon neutrality goals, Palo Alto must meet a GHG emissions target of 156,024 MT CO2e, or 2 MT CO2e per Palo Alto resident by 2030. Achieving these ambitious emissions reduction goals requires steadily transitioning toward a more electrified infrastructure to meet building and transportation needs. And it requires an inclusive approach: the City will focus on funding mechanisms that will leverage resources and approaches that reduce the costs associated with this transition for all community members: residents, businesses, and City.

There are many supporting investments to make in the City's electric infrastructure and in management and retirement of the City's gas infrastructure as electrification progresses. System-wide City investments in expansion and modernization of the in-city electricity infrastructure will assure the community's electric capacity, reliability, and resiliency. The community will approach its electrification goals with efficiency in mind, encouraging best practices for deployment to reduce costs and impacts to the electric and gas systems. And to ensure new electrified systems have the least emissions possible, the City will continue to pursue a carbon-free electricity portfolio that evolves to reflect customer needs and the broader evolution of the electric system in the Western United States to which it is connected.

GOAL

➲ Reduce GHG emissions 80% below 1990 levels by 2030

KEY ACTIONS

Community assistance

C1. Enable any resident to receive guidance on reducing their building and transportation emissions via phone consultations, interactive web applications, or communications platforms.

C2. Work with major employers, including Stanford entities, to develop custom emissions reduction plans that address commute, building, and other emissions on an employer-by-employer basis.

Staff Analysis

C3. Complete study to identify any additional Energy, EV, or Mobility key actions needed to achieve 80% reduction in greenhouse gas emissions from 1990 levels by 2030, such as electrification of additional multifamily or commercial end uses, greater electrification of vehicles, or other emissions reduction actions not already identified in this Plan.

C4. Complete a technical and legal study of the staffing and other resources needed to operate programs, services, and related City processes at a high enough capacity to accommodate all necessary emissions reduction activities through 2030.

C5. Complete a technical and legal study of funding alternatives, such as a carbon tax, parcel taxes, or other community funding mechanisms.

C6. Complete an affordability study to identify vulnerable populations and businesses who may need help with electrification and the scale of subsidy needed. Develop a Council-approved affordability policy to guide incentive and program funding design.

C7. Complete a study of carbon neutrality options, including the potential contribution of expansion of the Palo Alto urban canopy in achieving carbon neutrality goals.

Staff and Council action

C8. Present options for Council consideration to accelerate EV, Mobility, and Energy emissions reduction activities identified in this Plan through mandates or price signals, such as building emissions performance standards, carbon pricing, on-sale or replace-on-burnout ordinances, parking rules in public and private spaces, and withdrawal of gas by a date certain.

KEY PERFORMANCE INDICATORS

- GHG reductions
- Community awareness
- Participation in Climate Pledge

Energy

Building efficiency and electrification are key to achieving Palo Alto's - and California's – GHG reduction goals. Overcoming building electrification barriers at both the local and regional level will be necessary to increase market adoption in existing buildings. It is critical to modernize the City's electric grid to accommodate the technologies that will enable this transformation.

In California, buildings account for 70 percent of total electricity use[46] and 20 percent of total GHG emissions[47]. In 2021, buildings in the residential and commercial/industrial sectors accounted for 37.8 percent of total emissions in Palo Alto, with 18.9 percent from residential, 15.5 percent from commercial, and 3.4 percent from industrial. To reach Palo Alto's 2030 emissions reduction target, natural gas (methane) consumption will need to decline significantly through a combination of energy efficiency and electrification. Energy efficiency is simply using less energy to perform the same task; for example, replacing a low-efficiency gas furnace with a high-efficiency gas furnace. Electrification is the practice of replacing gas equipment in buildings, including gas furnaces and gas water heaters, with very efficient electric equipment primarily based on heat pump technology, such as air source heat pumps and heat pump water heaters. In Palo Alto, this all-electric lifestyle is cleaner and healthier than using fossil fuels and can also be more affordable. Achieving the City's goals requires promoting the replacement of fossil fuel equipment with efficient electric equipment in all buildings, residential and commercial, aiming wherever possible to avoid the installation of new fossil equipment that would be hard and costly to replace. Preventing the installation of any new fossil fuel device in all buildings - residential and commercial

[46] California Energy Commission. (2018). Energy Consumption Database Management System. Retrieved from http://www.ecdms.energy.ca.gov/elecbyutil.aspx
[47] California Air Resources Board. (2019) California Greenhouse Gas Emissions for 2000 to 2017. Retrieved from https://ww3.arb.ca.gov/cc/inventory/pubs/reports/2000_2017/ghg_inventory_trends_00-17.pdf

– is a common sense strategy, easy to communicate and needed, but is not sufficient to meet the City's 80 x 30 goal alone. It is a gradual process that will not overstress the grid, while avoiding the installation of long-lived devices that would be difficult to replace in the future, avoiding stranded assets.

GOAL

- Reduce GHG emissions from the direct use of natural gas in Palo Alto's building sector by at least 60% below 1990 levels (116,400 MT CO_2e reduction)
- Modernize the electric grid to support increased electric demand and to accommodate state-of-the-art technology

KEY ACTIONS

Reduce greenhouse gas emissions in appliances and equipment

E1. Reduce all or nearly all greenhouse gas emissions in single-family appliances and equipment, including water heating, space heating, cooking, clothes drying, and other appliances that use natural gas.

E2. Reduce greenhouse gas emissions in non-residential equipment, including mixed-fuel rooftop packaged HVAC units, cooking equipment, and small nonresidential gas appliances.

Reduce natural gas use in buildings

E3. Partner with major facility owners to reduce gas use in major facilities by at least 20%.

E4. Reduce natural gas use at City facilities.

Make it affordable

E5. Support income-qualified residents and vulnerable businesses with electrification efforts while ensuring affordability of on-going utility bills.

E6. Develop electric rate options for electrified homes, EV charging, and solar + storage microgrid customers.

Paving the road to electrification

E7. Use codes and ordinances - such as the energy reach code, green building ordinance, zoning code, or other mandates - to facilitate electrification in both existing buildings and new-construction projects where feasible.

E8. Develop and implement an electric grid modernization plan to increase capacity and resilience.

E9. Seek additional electrification opportunities in commercial and multi-family buildings to contribute as much as possible towards achieving an additional 8% city-wide emissions reduction below 1990 levels.

KEY PERFORMANCE INDICATORS

- GHG emissions from natural gas use in buildings (single-family, multifamily, nonresidential)
- Percentage of single-family households with no gas connections
- Percentage of gas use reduction in major facilities and City facilities

Transportation

In California, more than 50 percent of total GHG emissions stem from transportation. The primary driver of emissions is from cars and trucks. In Palo Alto, 58.8 percent of emissions come from transportation, with 51.7 percent from on-road vehicles.

Carbon Intensity of Fuels, Vehicle Efficiency, and Vehicle Miles Traveled

Reducing emissions from the transportation sector requires addressing three areas: 1) reducing the carbon intensity of fuels, 2) increasing vehicle efficiency, and 3) reducing VMT. Palo Alto can impact the first and third spheres because vehicle efficiency improvements are largely accomplished via federal and state regulations placed on car makers to increasingly green the fleets they produce.

<u>Reducing the Carbon Intensity of Fuels and Electrifying Vehicles</u>

The two main fuels used to power vehicles across the state - gasoline and diesel - have a very high carbon intensity. Transitioning to lower carbon intensity fuels, especially electricity, is key to reducing emissions in the transportation sector. Similar to electrification of fossil fuel equipment in buildings, as the electric grid continues to rely more heavily on renewable energy sources for electricity generation, the emissions reduction potential of replacing gasoline and diesel vehicles with electric vehicles continues to increase. The S/CAP section on Electric Vehicles (EVs) below details work to be done to support increased EV use, including increasing access to EV charging equipment and encouraging best practices for EV charging.

<u>Reducing VMT</u>

State and other analyses accounting for the time to transition to cleaner passenger vehicles such as EVs show that adoption of this automobile technology alone will not be fast enough to reach our climate goals. It takes 15 – 20 years to replace a car fleet[48], which is longer than the 2030 target. The California Air Resources Board (CARB) has stated that even under full implementation of state regulations requiring cleaner engines on our roads and with Governor Newsom's Executive Order N-79-20 requiring 100 percent of zero-emission vehicle sales in the light-duty vehicle sector by 2035, "a significant portion of passenger vehicles will still rely on ICE [internal combustion engine] technology….Accordingly, VMT reductions will play an indispensable role in reducing overall transportation energy demand and achieving the state's climate, air quality, and equity goals."[49]

One way to reduce transportation emissions relatively quickly is by reducing VMT, or the demand for driving. This can be accomplished through efficient land use by siting housing, employment, and essential services closer together and through improving other transportation modes such as cycling, e-biking, walking, and transit. The benefits of integrated planning and sustainable development go far beyond simply reducing the GHG emissions that contribute to climate change and its damaging effects. Communities that are well designed provide housing options for all income and age groups and enable community members to use a range of transportation options that reduce congestion, improve air quality, and increase economic development. One way to think about how to make improvements in this area is to consider the percent of Palo Altans who live within a 10- or 15-minute walk of essential retail or other supportive land uses such as parks, educational or health facilities, and transit.

Reducing the demand for driving by improving transportation options so that commuters can access Palo Alto without driving would benefit the 115,000 people who come to Palo Alto for employment. Fortunately, moves to improve walking, biking, and transit are some of the most cost-effective in the City's climate change toolkit. The Mobility section below describes how Palo Alto can reduce VMT.

For the purposes of the S/CAP, transportation-related Goals and Key Actions are grouped into two areas: Electric Vehicles and Mobility. The Electric Vehicle (EV) and Mobility plans work in synch to jointly reduce GHG emissions and VMT.

In additional to the emissions reductions benefits, encouraging wide-scale adoption of EVs and electrification of all types of transportation, as well as encouraging alternative transit modes that include walking, biking, mass transit, and shared transportation, are essential to achieving local, state, and federal reduction targets for criteria pollutants to improve regional air quality.

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[48] David R. Keith *et al* Environmental Research Letters. (2019). Vehicle fleet turnover and the future of fuel economy, February 15, 2019, p.2. Retrieved from https://iopscience.iop.org/article/10.1088/1748-9326/aaf4d2
[49] California Air Resources Board. (2022). 2022 Scoping Plan for Achieving Carbon Neutrality, November 16, 2022, p. 192. Retrieved from https://ww2.arb.ca.gov/sites/default/files/2022-12/2022-sp.pdf

Electric Vehicles

More than half of Palo Alto's emissions come from transportation, making adoption of Electric Vehicles (EVs) a crucial component to reaching our carbon reduction goals. Compared to fossil fuel vehicles, EVs are cheaper to drive, have lower maintenance costs, and produce no emissions. Driving and charging an EV in Palo Alto especially makes sense given the City's carbon neutral electricity supply and low electric retail rates. GHG emissions are a function of two factors: the carbon intensity (GHG/VMT) of fuels, addressed here, and Vehicle Miles Traveled (VMT), addressed in the next section. The EV and Mobility plans work in synch to jointly reduce GHG emissions and VMT.

In order to reach Palo Alto's 2030 emissions reduction target, we must implement strategies to reduce the carbon intensity of fuels.

GOALS

- Reduce transportation related GHG emissions at least 65% below 1990 levels (215,696 MT CO_2e reduction)
- Develop a public and private charging network to support EV adoption

KEY ACTIONS

Education, awareness, and collaboration

EV1. Raise awareness of financial and emission savings of alternative transportation modes, micro-mobility (such as e-bikes and e-scooters), EVs, the economics of these transportation modes compared to gasoline vehicles, and available incentives.

EV2. Collaborate with regional partners, other agencies, and local nonprofit partners to promote EV adoption regionally to reduce commuter and visitor emissions.

EV3. Partner with employers and business districts to promote commuter EV adoption and EV charging access as well as alternative commute promotion.

EV4. Facilitate the adoption of EVs, e-bikes and other light EVs.

EV5. When offering programs to facilitate EV adoption, EV charger installation, or building electrification, promote alternative transportation modes and infrastructure to support adoption (such as bicycle or micro-mobility infrastructure) as well where feasible.

Expand EV infrastructure

EV6. Expand access to on-site EV charging for multi-family residents.

EV7. Improve access to EV charging for income-qualified residents.

EV8. Evaluate mandates or other mechanisms to ensure EV charging capacity is available to support EV growth.

Electrify fleet vehicles

EV9. Convert all Palo Alto municipal vehicles to EVs when feasible and when the replacement is operationally acceptable.

EV10. Support state policy efforts to electrify fleet vehicles, including delivery trucks

KEY PERFORMANCE INDICATORS

- GHG emissions from vehicle travel
- Percentage of registered EV vehicles in Palo Alto
- Percentage of new vehicle sales that are EVs
- Percentage of multifamily residents with access to overnight EV charging
- Gasoline sales in Palo Alto

Mobility

Road transportation represents the largest percentage of Palo Alto's existing carbon footprint – and a congestion headache. One way to reduce transportation-related emissions relatively quickly is by reducing VMT. VMT reduction can be influenced by local programs and policies, including roadway engineering, land use, and zoning, since these elements affect travel mode choice.

In order to reach Palo Alto's 2030 emissions reduction target, we must implement strategies to reduce VMT.

GOALS

- Reduce total vehicle miles traveled 12% by 2030, compared to a 2019 baseline, by reducing commute vehicle miles traveled 20%, visitor vehicles miles traveled 10%, and resident vehicle miles traveled 6%
- Increase the mode share for active transportation (walking, biking) and transit from 19% to 40% of local work trips by 2030

KEY ACTIONS

Promote alternatives to single occupancy car trips

M1. Implement transportation and land use infrastructure investments, programs, policies, and incentives to increase the mode share for active transportation (walking, biking) and transit for local work trips.

M2. Expand the availability of transit and shared mobility services from 61% of residents to 100% of all residents, including a bike/scooter shared micro-mobility service to provide last-mile connections, an on-demand shuttle / transit service pilot, and Neighborhood Mobility Hubs.

M3. Update and implement the Bicycle and Pedestrian Transportation Plan to expand bicycle and pedestrian infrastructure and establish a Vision Zero data collection and analysis program to target safety improvements.

M4. Improve Transportation Demand Management for employees and residents, including adopting a TDM Ordinance, allocating funding to scale up TDM programming, establishing a Safe Routes for Older Adults/Aging in Place program, and continuing the Safe Routes to School program.

Change the way we think about parking cars

M5. Implement smart parking infrastructure in public garages and proposals for Council to price parking in business districts, including implementing an optional Healthy Climate Fee, ideally on gas vehicles, to partially offset GHG emissions from driving to support alternative modes in Palo Alto.

Learn how we can grow without increasing GHG emissions

M6. Conduct a land use and transportation study to identify scenarios, changes, services, and programs that would reduce greenhouse gas emissions and accommodate projected housing growth without increasing transportation sector emissions. Include mobility equity needs analysis.

M7. Continue to implement the City's Housing Element of the Comprehensive Plan to improve jobs - housing balance and reduce vehicle miles traveled (VMT).

M8. Improve transit and traffic flow through programs to install transit signal priority equipment, implement traffic signal equipment improvements, and improve transit times.

Leverage current tools to foster mobility related GHG reductions

M9. Utilize development regulations and standards to continue creating a housing density and land use mix that supports transit and non-SOV (Single Occupancy Vehicle) transportation modes.

M10. Utilize pricing, fees, and other program and policy tools to encourage reductions in GHGs and VMT.

KEY PERFORMANCE INDICATORS

- Total VMT
- Commute mode share for all modes
- Commute Benefits participation by City employees
- Transit ridership, the proportion of residents within a quarter-mile walkshed of frequent transit, and the proportion of residents covered by on-demand transit services (data may not be available every year)
- Number and proportion of residents within a 10-minute walk of retail or other essential services/land uses (data may not be available every year)
- Number of businesses participating in TDM programs (when regional TDM Program data becomes available)

Water

Water is a limited resource in California, and its availability will be further impacted by climate change and new environmental regulations. Both potable water supplies and hydroelectric needs could be challenged by long-term shifts in California's precipitation regime. With shifting climate patterns, and significant long-term water supply uncertainty, it would be prudent to reduce water consumption while exploring ways to capture and store water, as well as to increase the availability and use of recycled water.

Water reuse will increase in importance as California's population expands and climate change and new environmental regulations pose uncertainties in imported water supply availability. Whether a water supply shortage exists or not, "Making Water Conservation a California Way of Life" is a concept embraced by the City.

In 2021, wastewater treatment accounted for 0.4 percent of Palo Alto's GHG emissions. While the Goals and Key Actions for water don't explicitly address GHG reduction, energy and water use are linked. Energy is needed to transport and to treat water, treat wastewater, and heat domestic hot water in homes and businesses across California. Approximately 20 percent of California's electricity and approximately 30 percent of natural gas (methane) used by homes and businesses across the state is dedicated to pumping, treating, and heating water.

GOALS

- Reduce Palo Alto's potable water consumption 30% compared to a 1990 baseline (subject to refinement based on forthcoming California water efficiency standards expected in 2024[50])

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[50] The California Water Action Plan, first released in 2014 and updated in 2016, is a roadmap to water resilience and reliability. Ten principles define California's Water Action Plan, including "Make Conservation a California Way of Life." Executive Order (B-37-16) instructed State agencies to help Californians adopt permanent changes to use water more wisely. In 2018 the legislature enacted SB 606 and AB 1668 that provide new requirements for water conservation and

- ➲ Develop a water supply portfolio which is resilient to droughts, changes in climate, and water demand and regulations, that supports our urban canopy

KEY ACTIONS

W1. Maximize cost-effective water conservation and efficiency through incentives, outreach/education, and other programs.

W2. Design and build a salt removal facility for the Regional Water Quality Control Plant.

W3. Develop and implement projects that result from a "One Water" Portfolio for Palo Alto[51], including but not limited to: stormwater, recycled water, on-site reuse, conservation, groundwater.

W4. Develop a tool for dynamic water planning in the future.

KEY PERFORMANCE INDICATORS

- Estimated indoor per capita residential water consumption
- Estimated outdoor residential water consumption for irrigation
- Water consumption of commercial customers with irrigation meters
- Amount of recycled water used in Palo Alto
- Volume of stormwater that is captured and reused

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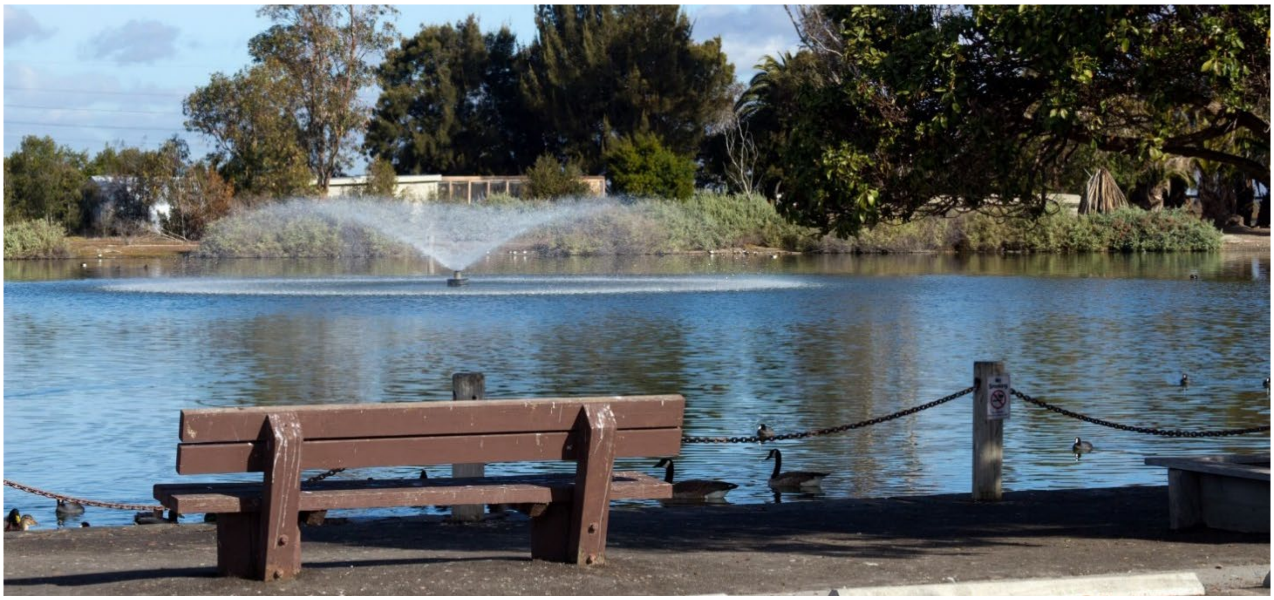
drought. Resulting new regulations will establish water budgets for urban water suppliers based upon state adopted water use efficiency standards for residential indoor and outdoor water use, outdoor irrigation of landscape areas, water loss, and local service area characteristics.

[51] A “One Water” approach envisions managing all water in an integrated, inclusive, and sustainable manner that is more resilient to the impacts of climate change. The One Water approach recognizes that water must be managed in ways that respect and respond to the natural flows of watersheds and the natural ecosystem, geology, and hydrology of an area. projects and programs focus on achieving multiple benefits—economic, environmental, and social.

Climate Adaptation and Sea Level Rise

Climate adaptation refers to the actions taken to improve a community's resilience to climate change. Climate adaptation planning is most effective at the local level but must be done in concert with regional efforts. Effective adaptation entails planning with uncertainties. It is a long-term process that should allow for phased plans and projects that can be adapted to changing conditions and new knowledge.



One focus of climate adaption is sea level rise. The State of California anticipates that relative sea level rise projections stemming from GHG emissions and related climate change pose significant economic, environmental, and social risks to communities along the San Francisco Bay Shoreline, including the City of Palo Alto. Sea level rise in San Francisco Bay is anticipated to range between three feet to more than ten feet by 2100 with rising tides likely thereafter. In Palo Alto, many City services and infrastructure that are essential to the City's public health, safety, and economy are located within areas that are predicted to be inundated by Bay water if adaptation measures are not implemented.

Another focus of climate adaption is preparation for and protection from wildfires. Climate change is expected to increase the frequency, intensity, and duration of wildfire events, especially here in California. On the West Coast, it is projected that an average 1 °C temperature increase could increase the median burned area per year as much as 600 percent in some forests.[52] GHG emissions from wildfires are not currently included in community GHG inventories. From 2000 – 2019, wildfire-related GHG emissions in California averaged approximately 14 million metric tons

[52] US Department of Agriculture. (2012). Effects of Climatic Variability and Change on Forest Ecosystems: A Comprehensive Science Synthesis for the U.S. Forest Sector. https://www.fs.fed.us/pnw/pubs/pnw_gtr870/pnw_gtr870.pdf

(MMT) of CO_2. The California Air Resources Board (CARB) projects that CA wildfire emissions in 2020 were about 112 MMT CO_2.[53]

While the goals and key actions for Climate Adaptation and Sea Level Rise focus primarily on sea level rise and secondarily on wildfire protection, many City programs, initiatives, and systems already in place play a role in protecting Palo Alto from the effects of climate change. For example, the City plans for and responds to extreme weather and natural disasters such as fluvial floods, storms, and earthquakes, and protects Palo Alto residents, businesses and infrastructure in the case of such emergencies.

GOALS

- Develop and adopt a multi-year Sea Level Rise Adaptation Plan including a Sea Level Rise Vulnerability Assessment and adaptation plan
- Minimize wildland fire hazards by ensuring adequate provisions for vegetation management, emergency access and communications, inter-agency firefighting, and standards for design and development within wildland areas

KEY ACTIONS

Minimize the impacts of sea level rise

S1. Complete a Sea Level Rise Vulnerability Assessment to identify risks and hazards to the Palo Alto Baylands, City infrastructure, and residential and business property, considering high tide, 100-year coastal storm event scenarios and rising shallow groundwater impacts.[54]

S2. Develop and implement a Sea Level Rise Adaptation Plan with goals to 1) Preserve and Expand Habitat, and 2) Protect City and Community Assets, and Private Property.

S3. Determine levee alignment and begin design process for a levee project that protects the Palo Alto community from sea level rise, and incorporates other related priorities including habitat restoration, recreation, transportation, City facilities, and community properties.

S4. Complete bridge improvements and identify protection strategies from significant flood events.

Minimize the impacts of wildland fire hazards

S5. Implement the Foothills Fire Management Plan to balance conservation of natural resources with reduction of fire hazards especially in open space areas.

S6. Minimize fire hazards by maintaining low density zoning in wildland fire hazard areas and enforcing building codes for fire resistant construction.

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[53] California Air Resources Board (2020). Greenhouse Gas Emissions of Contemporary Wildfire, Prescribed Fire, and Forest Management Activities. https://ww3.arb.ca.gov/cc/inventory/pubs/ca_ghg_wildfire_forestmanagement.pdf

[54] The completed Sea Level Rise Vulnerability Assessment can be found at https://www.cityofpaloalto.org/files/assets/public/public-works/environmental-compliance/sea-level-rise/palo-alto-sea-level-rise-vulnerability-assessment-june-2022-062822-linked-final.pdf or https://www.cityofpaloalto.org/sealevelrise

S7. Work collaboratively with other jurisdictions and agencies to reduce wildfire hazards in and around Palo Alto, with an emphasis on effective vegetation management and mutual aid agreements.

S8. Implement CAL FIRE recommended programs in educating and involving the local community to diminish potential loss caused by wildfire and identify prevention measures to reduce those risks.

KEY PERFORMANCE INDICATORS

- Percent of vulnerable locations protected from three feet of sea level rise
- Percent of properties protected from San Francisquito Creek flooding
- Progress towards sea level rise levee alignments
- Implementation of Foothills Fire Management Plan mitigation measures

Natural Environment

Sustainability is not only about mitigation, adaptation, and resilience, but also regeneration – identifying opportunities for renewal, restoration, carbon sequestration, and growth of our natural environment. Palo Alto will continue to build and restore the natural environment and its supporting ecosystem services and bio-capacity, including soils, tree canopy, biodiversity, and other components. Enhancing and maintaining green stormwater infrastructure[55] will use natural areas and systems to provide habitat, flood protection, stormwater management, cleaner air, cleaner water, and human health enhancement.

Many actions that address climate vulnerability and risk also reverse GHG emissions. Shade trees absorb, or sequester, carbon dioxide from the atmosphere. Studies show that a young tree sapling can sequester anywhere from 1.0 to 1.3 pounds of carbon each year, while a 50-year-old tree can sequester over 100 pounds annually.[56] Restoration of wetlands can both sequester carbon and protect shoreline communities and habitats from sea-level rise and storm surge. Healthy soils on farmland also play an important role in absorbing carbon.

Actions to sequester carbon in trees, soils, and native and drought-tolerant vegetation can increase biodiversity of plants and animals and minimize stormwater runoff by mitigating impacts from impervious surfaces and providing opportunities to capture and use rain while also treating runoff pollutants. Biodiversity is critical to the health of City parks and other open spaces. Natural area conservation and retrofit of impervious areas protect natural resources and environmental

[55] Green stormwater infrastructure (GSI) is infrastructure built into our urban environment to collect, slow, and clean stormwater runoff through the use of natural processes. GSI examples include stormwater "biotreatment" using soil and plants ranging in size from grasses to trees; pervious paving systems (e.g., interlocking concrete pavers, porous asphalt, and pervious concrete); tree trenches that capture sidewalk and street stormwater runoff; and other methods to capture and use stormwater as a resource.

[56] U.S. Department of Energy Energy Information Administration. (1998). Method for Calculating Carbon Sequestration by Trees in Urban and Suburban Settings. https://www3.epa.gov/climatechange/Downloads/method-calculating-carbon-sequestration-trees-urban-and-suburban-settings.pdf

features that sequester carbon, reduce stormwater runoff, promote infiltration, prevent soil erosion, and increase ecosystem biodiversity.

GOALS

- Restore and enhance resilience and biodiversity of our natural environment throughout the City
- Increase tree canopy to 40% city-wide coverage by 2030
- By 2030, achieve a 10% increase in land area that uses green stormwater infrastructure to treat urban water runoff, compared to a 2020 baseline[57]

KEY ACTIONS

Maintain and protect tree canopy

N1. Develop programs to plant trees to increase tree canopy – that will be integrated with traditional tree planting programs and green stormwater infrastructure programs – and provide carbon sequestration, improve water quality, capture stormwater when feasible, and reduce the urban heat island effect.

N2. Ensure No Net Tree Canopy Loss for all projects.

N3. Continue to review the use of pesticides in all parks and open space preserves to identify opportunities to further reduce and eliminate the use of pesticides.

N4. Enhance pollinator habitat by including native plants and pollinator-friendly plant landscaping with all park improvement projects when feasible.

N5. Establish a baseline and Key Performance Indicator for carbon storage of tree canopy in the public right-of-way and City-owned property.

Restore and enhance biodiversity

N6. Evaluate and modify plant palette selection in project plans to maximize biodiversity and soil health to adapt to the changing climate and incorporate buffers for existing natural ecosystems.

N7. Coordinate implementation of the Urban Forest Master Plan, Parks Master Plan, and other city-wide planning efforts through interdepartmental collaboration.

N8. Expand the requirements of the Water Efficient Landscape Ordinance (WELO) to increase native and drought-tolerant species composition.

N9. Phase out gas-powered lawn and garden equipment, in compliance with California's AB 1346.

Reduce pollutants entering the Bay

N10. Establish policies and ordinance changes as needed to support the Green Stormwater Infrastructure Plan.

N11. Incorporate green stormwater infrastructure in future municipal projects, including public right-of-way.

KEY PERFORMANCE INDICATORS

- City-wide Tree Canopy coverage
- Native species on City property and in new landscape projects (to measure biodiversity)
- Land area that uses green stormwater infrastructure to treat urban water runoff

[57] Green stormwater infrastructure (GSI) goals will be finalized once additional quantification work is conducted over the next two years to provide accurate, realistic and publicly vetted metrics.

Zero Waste

Zero Waste is a holistic approach to managing materials in a closed loop system (circular economy), where all discarded materials are designed to become resources. Reducing waste is an important strategy for both GHG emissions reductions and overall sustainability. Approximately 42 percent of GHG emissions in the U.S. are associated with the flow of materials through the economy, from extraction or harvest of materials and food, production and transport of goods, provision of services, reuse of materials, recycling, composting, and disposal.

Palo Alto's current diversion rate is 84 percent. Diversion includes all waste prevention, reuse, recycling, and composting activities that divert materials from landfills. Getting to the 95 percent diversion goal will require refinement and enforcement of existing programs, the addition of new policies and programs, fostering producer and consumer responsibility and building community collaboration on waste prevention.

In 2021, solid waste accounted for 1.8 percent of Palo Alto's GHG emissions, which can be lowered through key actions that reduce waste, conserve resources, and prevent pollution.

GOALS

- Divert 95% of waste from landfills by 2030, leading to zero waste
- Implement short- and medium-term initiatives identified in the *2018 Zero Waste Plan*

KEY ACTIONS

Education and outreach

ZW1. Encourage food waste[58] prevention and require edible food recovery for human consumption from commercial food generators.

ZW2. Promote residential food waste reduction.

ZW3. Champion waste prevention, reduction, reusables, and the sharing economy (e.g., promote adoption of a "Zero Waste lifestyle", stimulate value of reuse, repair, and access to sharing goods over ownership).

ZW4. Provide waste prevention technical assistance to the commercial sector.

Collaborate on and expand policies

ZW5. Prioritize domestic processing of recyclable materials and collaborate with stakeholders on legislation to spur domestic recycling and require traceability of materials processing.

ZW6. Eliminate single-use disposable containers by expanding the Disposable Foodware Ordinance.

ZW7. Expand the Deconstruction and Construction Materials Management Ordinance.

ZW8. Implement Reach Code standard for low carbon construction materials.

KEY PERFORMANCE INDICATORS

- Diversion rate
- Number of *Zero Waste Plan*[59] initiatives implemented

[58] "Food waste" refers to edible food that is not eaten, goes bad and is thrown away. It does not include food scraps such as banana peels, apple cores, and bones – they should be composted.
[59] www.cityofpaloalto.org/zwplan

Spotlight on Equity

As discussed in Section 2, we cannot address climate change without also addressing equity. While all of the Goals and Key Actions were developed with an equity lens and will be evaluated using key performance metrics that encourage equitable engagement and impact, there are some Key Actions that more explicitly address equity issues. These include:

- **C1.** Provide Building and Transportation Emissions Consultations for Residents
- **C5.** Study Funding Alternatives
- **C6.** Conduct an Electrification Affordability Study
- **E5.** Support Income-Qualified Residents and Vulnerable Businesses with Electrification
- **E6.** Develop Electric Rate Options
- **EV1.** Raise Awareness of Alternative Transportation Modes, Micromobility, and EVs
- **EV4.** Facilitate the Adoption of EVs, E-bikes and other Light EVs
- **EV5.** Promote Alternative Transportation Modes and Infrastructure to Support Adoption
- **EV6.** Expand EV Charging Access for Multi-Family Residents
- **EV7.** Improve EV Charging Access for Income-Qualified residents
- **M1.** Increase Active Transportation and Transit for Local Work Trips
- **M2.** Expand Availability of Transit and Shared Mobility Services
- **M3.** Implement the Bicycle and Pedestrian Transportation Plan
- **M4.** Improve Transportation Demand Management for Employees and Residents
- **M6.** Study Land Use and Transportation
- **M7.** Continue to Implement the City's Housing Element
- **M9.** Create Housing Density and Land Use Mix that Supports Transit and Non-SOV Transportation
- **W4.** Develop a Dynamic Water Planning Tool
- **S1.** Complete a Sea Level Rise Vulnerability Assessment
- **S2.** Implement a Sea Level Rise Adaptation Plan
- **N1.** Increase Palo Alto's Tree Canopy
- **ZW3.** Champion Waste Prevention, Reduction, Reusables, and the Sharing Economy

SECTION 6

GETTING TO 80 X 30: COSTS AND IMPACTS

The preceding sections describe the principal sources of Palo Alto's GHG emissions and related goals and actions for achieving the community's targets of reducing emissions 80 percent below 1990 levels by 2030. This section outlines the outcomes needed to achieve the 80 x 30 goal and the impact analysis of the GHG reduction potential, costs, and sustainability co-benefits of the Key Actions.

Assessing the Impacts of Co-Benefits of achieving 80 x 30

As discussed in Section 1, many climate actions generate additional benefits beyond GHG reductions. The co-benefits shown in Table 6 were selected for the S/CAP because they align with community priorities and apply to multiple S/CAP Issue Areas (e.g., Energy, Electric Vehicles, Zero Waste). As a result of implementing some of the climate actions, there will be the following positive outcomes in addition to emissions reductions.

Table 6: S/CAP Co-Benefits

Evaluation Criteria	Definition
Air Quality	Improve air quality through reduced exposure (indoor and outdoor) to particulate matter (PM2.5 and PM10), nitrous oxide (NO_2), ozone (O_3), sulfur dioxide (SO_2) or airborne toxins.
Public Health	Improve public health through reduced incidents of diseases/death attributed to pollution, increased use of active transportation options (e.g., walking, biking), etc.
Public Safety	Improve public safety through reduced traffic, reduced incidents of traffic accidents, reduced gas leaks, decreased exposure to climate hazards, assets adapted to withstand climate hazards, decreased number of people/assets/services exposed to climate hazards, etc.
Regional Benefit	Provide benefits that extend beyond the city, such as generating jobs, expanding the electric vehicle charging network, implementing flood reduction projects, etc.
Resource Conservation	Increase resource conservation in building energy, vehicle fuels, and water; increase natural habitat conservation and regeneration; and decrease waste generation
Lifecycle Emissions	Reduce emissions associated with the extraction, manufacture, and transport of energy resources (e.g., natural gas production, distribution).
Cost of Living	Reduce cost of living through utility cost savings, travel cost savings, etc.
Productivity	Increase productivity through reduced commute times and reduced traffic, prioritized housing near transit, improved thermal comfort in buildings, reduced economic activity losses from climate-related events (e.g., flooding, power outages), etc.
Equity	Address an existing inequity in the community, such as disproportionate poor air quality, access to transit, flood risk, etc.

The methodology used to evaluate the co-benefits and the full results of the co-benefits analysis can be found in Appendix D.4 in Section 8. The results of the co-benefits analysis were used to prioritize and further refine the Key Actions. The co-benefits analysis was not updated after the Key Actions were further refined and uses version three of the Goals and Key Actions. The order and titles of the Key Actions used in the co-benefits analysis may differ from the final version of the S/CAP Goals and Key Actions.

Outcomes Needed to Achieve 80 Percent Reduction from 1990 Levels

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 need for increased community awareness. 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.

Table 7 and Figure 6 below show more detail on the sources of the City's various types of emissions. Table 7 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 term[60], 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 <u>all</u> gas appliances and systems in single-family homes and to electrify <u>most</u> gas appliances in multi-family and commercial buildings. However, electrification of multi-family and commercial builidings may be more expensive because it is more technically complicated. And for some types of uses, staff and AECOM 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 71 percent reductions below 1990 levels, leaving a 9 percent 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.

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[60] 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.

Table 7: Emissions by Source and Milestone

Source	1990 Levels	2019 Emissions	2030 Target Emissions	% Reduction from 1990 levels
Residential / Fleet Transportation		84,100	19,200	
Commuter Transportation	331,840	101,600	11,000	65%
Visitor Transportation		107,700	85,000	
Single-Family Building Gas Use		49,500	0	
Multi-Family Building Gas Use	194,000	22,600	18,400	61%
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	221,400	71%
Additional Emissions Reductions TBD			65,200	9%
TOTAL	**780,119**	**482,300**	**156,000**	**80%**

Figure 6: Contributions of Various Emissions Reduction Measures to Achieving Emissions Goals

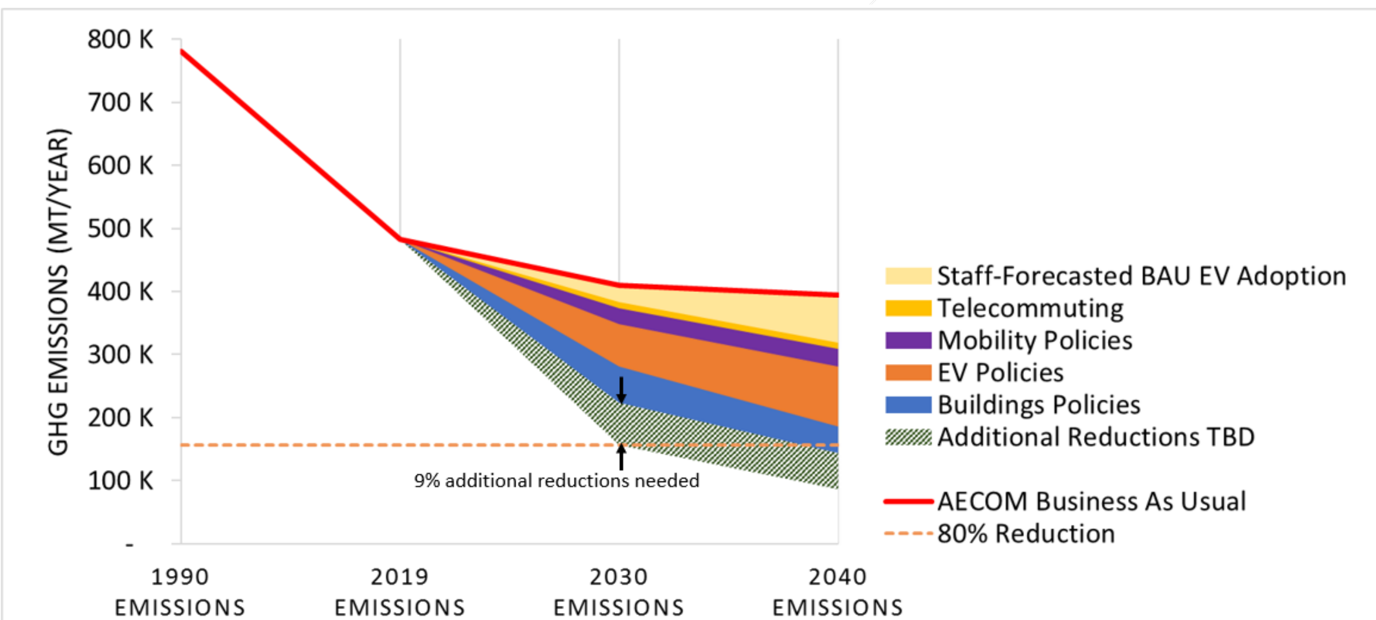
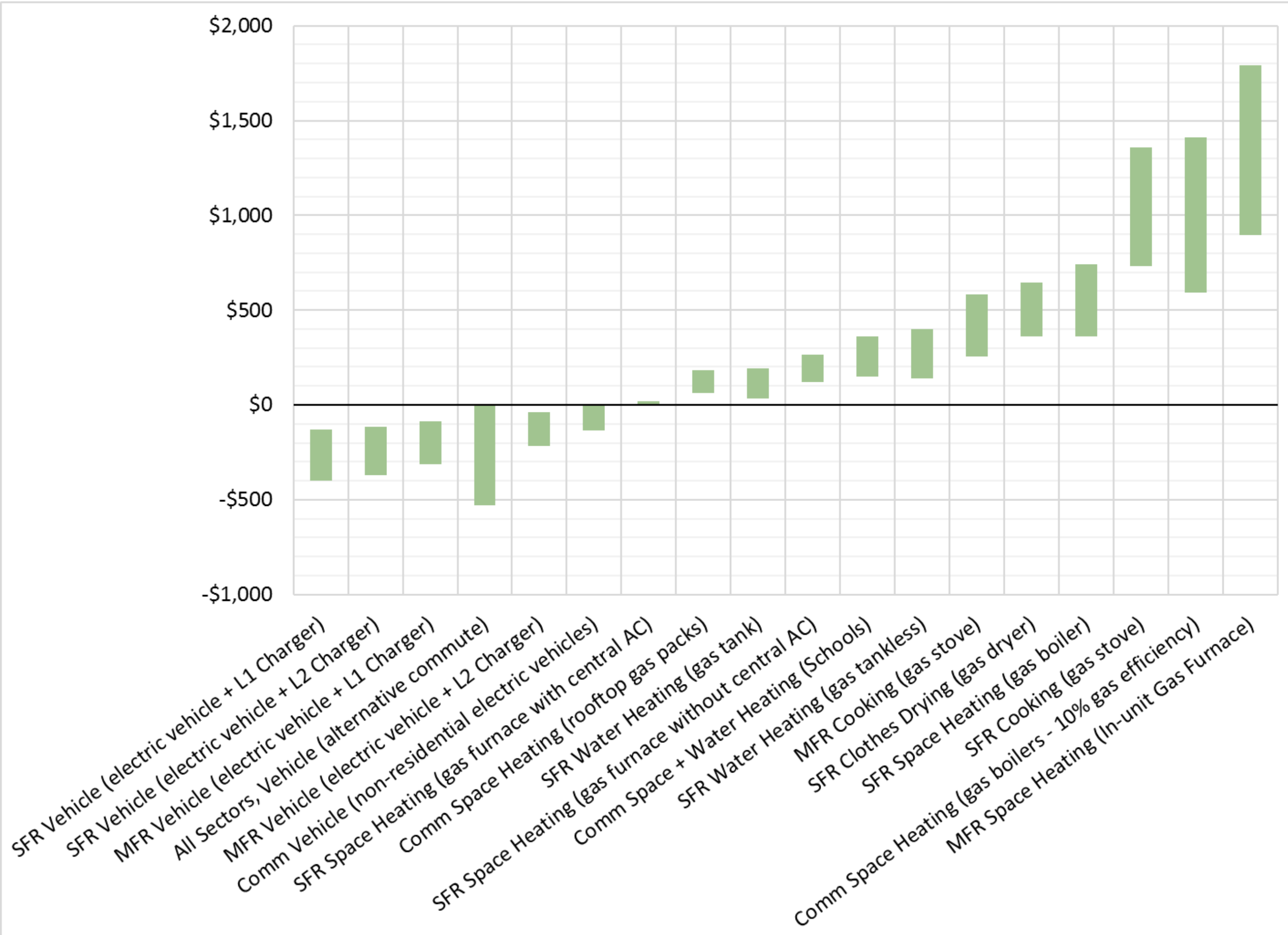


Figure 7 summarizes the cost per metric ton of carbon dioxide equivalent (MT CO_2e) reduced for various emissions reductions technologies, while Figure 8 shows the costs in more detail. To provide some context for the costs in the chart, the current cost of building renewable energy in California as a way to reduce carbon is \$30 per MT CO_2-e to \$60 per MT CO_2-e,[61] though the

[61] Calculated based on current Renewable Energy Credit prices (\$/MWh) converted to \$/ton CO_2-e

California Public Utilities Commission (CPUC) projects that will rise to around $200 per MT CO_2-e by 2030.[62] The cost of renewable natural gas is $270 per MT CO_2-e to $450 per MT CO_2-e.[63]

Figure 7: Key Actions by Cost per Metric Ton of Carbon Dioxide Equivalent Reduced[64]



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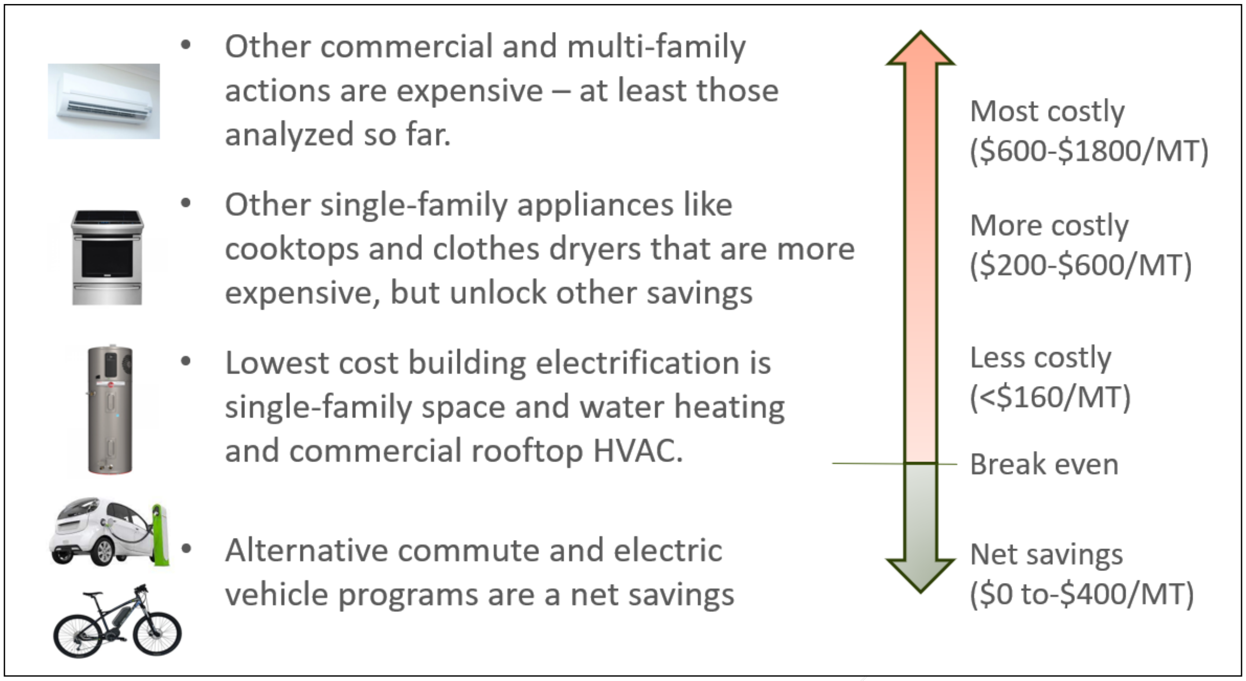
[62] Extracted from CPUC RESOLVE model by a City consultant, E3

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

[64] Cost per metric ton shown as a range from a low-cost scenario to a high-cost scenario

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 20 percent
- VMT are reduced 12 percent
- By 2030, 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.

Table 7 and Figure 6 only represent the direct emissions reductions associated with electrifying vehicles and buildings; that is, the emissions 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 (methane) to the home, gas pump, or commercial building due to leakage occurring 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. Even more significantly, natural gas (methane) has a very high short-term global warming potential.

Consideration of these upstream emissions further emphasizes the importance of reducing natural gas (methane) 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. 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 CO_2e 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 percent reduction in emissions if they could be claimed.

Strategies to Achieve Building and Transportation Emissions Reductions

Achieving the emissions reductions listed above will require bold action by the City and unprecedented participation from the community. It will require education and engagement of the entire community, from residents to real estate managers to employers to commuters. Also required to meet our goals are programs to facilitate participation and streamlined business and permitting processes that ensure a positive customer experience.

Staff considered a range of policy tools that involved different levels of government intervention in electrification activity, as illustrated previously in Figure 5. Low intervention policy tools include outreach efforts or voluntary programs. Medium intervention actions could include ordinances requiring electrification of appliances when they need to be replaced, and low-level carbon pricing. Higher intervention actions include mandating electrification by a date certain or imposing carbon pricing, 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 actions will be needed to achieve the outcomes required to achieve the 80 x 30 goals. However, rapid and effective implementation of low intervention actions (such as simple, effective voluntary electrification programs and simplified permitting processes) is needed to give the community confidence that higher intervention actions can be implemented without excessive cost or other impact to community members.

Total Cost to Achieve 80 Percent Reduction from 1990 Levels

Preliminary staff and consultant modeling conservatively estimated the cost to achieve the identified 71% reductions from 1990 levels. The modeling assumed up-front capital costs were paid off over the life of the equipment and took into account ongoing costs and benefits. Staff estimates the annual cost to the community in 2030, assuming all reductions are implemented would be $53 million in costs offset by $43 million in benefits for a net $10 million in community costs per year,[65] which is less than 5% of the total amount the community spends on energy each year. By 2033, benefits are estimated to match costs and from then forward, achieving these emissions reductions would represent a net benefit to the community. This means achieving the S/CAP goals would likely result in *lower* household and business expenses throughout the community in the long term.

These estimated annual costs are based on an estimated community capital investment of $740 million through 2030. This includes the up-front capital cost for the necessary vehicle and mobility investments, investments in charging infrastructure, and investments in appliances and building infrastructure. It also includes a preliminary estimate of the utility improvements needed to support the transformation.

These cost estimates are preliminary and do not include the cost to achieve the remaining 9 percent gap in GHG emissions reductions discussed on page 64. They do not incorporate potential decreases in the cost of equipment and improvements in installation strategies that will come with increased adoption of these types of equipment. They also do not include Federal and State incentives adopted after April 2020, such as the Inflation Reduction Act. Some cost estimates from the preliminary analysis have already been shown to be low, however, particularly the cost of modernizing the electric system to accommodate electrification. The S/CAP Goals and Key Actions include actions focused on refining the community cost of electrification, identifying additional outside funding sources (such as Inflation Reduction Act provisions) and benefits, and identifying potential funding sources for any residual costs not covered by these outside funding sources and benefits.

[65] All costs and benefits are in 2021 dollars.

Potential funding tools

As noted above, financing these costs over a long period (10-30 years, depending on the measure) can make the cost of electrification more manageable. Various financing mechanisms could be explored, ranging from publicly managed financing through municipal or green bonds or public-private financing partnerships to financing more focused on individual borrowers, such as energy loans or on-bill financing, where customers take a loan to finance home sustainability improvements, and pay off part of the loan each month through their utility bill. The viability of some of these measures requires exploration. For example, municipal debt is typically issued to fund public improvements, rather than improvements to private property, which is a significant element of the key actions. Further analysis is required to assess which financing approaches can support different S/CAP program elements. Sources of funds for repayment would need to be identified. Sources to consider include taxes (such as carbon taxes or parcel taxes), customer payments via their utility bill, or payments from utility revenue. Each of these sources has its own legal limitations and upon further analysis, may not be viable for funding S/CAP activities.

Costs and savings are spread unequally through the community

Unfortunately, the costs and 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 save, over time and on average, $116/month in household expenses when compared to a non-EV owner. This is due to vehicle fuel and maintenance savings. But a homeowner who electrifies their home is projected to see a $107/month increase. Figure 9 shows the costs associated with electrification for single-family residents and multi-family residents with and without electrified buildings, illustrating this issue. Similarly, a business choosing to electrify may not see significant savings from vehicle electrification, meaning they are only exposed to the costs of electrification with far less associated benefit. Careful design of the funding sources for electrification could help by aligning the costs of electrification with those who benefit most.

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

**Non-electrified homes are assumed to own an EV, which illustrates the incentive to own an EV contrasted with the lack of incentive to electrify a home.*

Cost of Delaying Action

Achieving the 80 percent reduction target over a longer period of time could reduce the total cost to electrify homes. This is because if the community waits longer, it will provide time for appliances to age until the point where they need replacement. Replacing appliances after they have reached their end of life, rather than when some are still usable, allows owners to receive the full value of their appliance, even though it delays the benefits of an electric appliance. Also, pushing the 80x30 target out until after 2030 probably means the City will experience more new all-electric construction and major renovations, which are cheaper than retrofitting existing homes for electric appliances. 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.

SECTION 7

NEXT STEPS - FURTHER EXPLORATION

As noted in the Executive Summary, achieving the emissions reductions detailed in this plan requires that the strategies are implemented in a timely, coordinated, and sustained way, with appropriate resources for successful implementation. Although significant GHG reduction policies and initiatives are already in place, the actions proposed in this S/CAP, by necessity, far surpass the scale of existing efforts. Implementing the S/CAP and ensuring that it results in real GHG emissions reductions will require increased funding, additional coordination across sectors, and enhanced institutionalized climate protection efforts across the community. Currently, all sustainability efforts are coordinated by the Office of Sustainability and other Department of Public Works Divisions, with robust inter-departmental collaboration, especially with City of Palo Alto Utilities. However, many of the strategies outlined in this plan will require additional resources for successful implementation.

Principles for Going to Scale

Implementation of the S/CAP requires diligent planning, with a possible two-phase approach. In Phase 1, the City could devote resources to roll out voluntary programs and prepare to go to scale – developing staffing plans, resourcing plans, and performing reliability and resiliency analyses. The goal could be to launch programs and achieve early successes that give Palo Altans confidence in advance of suggesting increased funding. This includes implementing pilot projects and providing demonstrations to show what is possible. Building awareness is also a critical goal, as is strategic planning. In Phase 2, the S/CAP will be at scale, and ramping up implementation. This will require far more resources than we have available to us and will likely require a robust financing plan.

Principles for Going to Scale include:

- **Engage and raise awareness.** Extensive awareness, engagement, and outreach will be needed – Palo Altans must be aware of both the urgency and reasons for action, and the programs available for them to respond. We also need to engage people for whom sustainability may not be the top priority to provide information about the benefits of acting, such as the health benefits of indoor and outdoor air quality improvements, and address any sensitivities, like resiliency.
- **Activate early adopters and ensure positive customer experiences to create success stories.** Palo Alto must provide confidence to the community so that they can count on us to run an electrified system. We need clear plans to preserve and enhance electric reliability and resiliency – outages will be on peoples' minds. We need more detailed plans about how to best manage the gas system as electrification increases, and manage rates for those who do not convert. We need streamlined and simplified permitting processes and appropriate resources to proactively communicate and reactively respond. All of this will require additional staffing throughout the City.
- **Reward neighborhood-level action (e.g. undergrounding for block-level electrification).** Taking actions at the neighborhood-level allows for better planning, economies of scale, and easier coordination with the City. For example, if all the homes in a neighborhood decide to electrify their appliances at the same time, then the City can better plan overall electric capacity and infrastructure needs.

- **Demonstrate care for small businesses, renters, and low-income groups.** In implementing this S/CAP, the City plans to foster relationships and deepen involvement with small businesses, renters, and low-income populations regarding the challenges of and solutions to climate change. Engagement strategies will consider equity, inclusion, existing barriers and how to mitigate challenges.
- **Collaborate with diverse stakeholders.** Climate change is an issue that crosses geographic and sector boundaries. Palo Alto recognizes the value of collaborating with other public agencies, businesses, and community-based organizations to accelerate climate action. Everyone has a part to play, and Palo Alto cannot do it alone.
- **Partner with major employers to maximize impact.** For Palo Alto to succeed in achieving its S/CAP goals, we need support from the private sector. Markets need to shift. The goods and services available to our community should support our efforts to build a sustainable, resilient economy that doesn't threaten the stability of the climate.
- **Seek ways to increase funding for greater impact (e.g. on-bill financing, outside funding).** For implementation of the S/CAP, Palo Alto will evaluate strategies for financing climate protection actions and provide adequate, reliable, and consistent long-term program funding.
- **Clear, documented strategies before going to scale.** The success of any plan depends on a clear roadmap for successful implementation. Some of the strategies in this S/CAP will require detailed, specific, and carefully vetted plans for implementation.
- **When the community is ready, fully scale up.** Support of the community is a critical component of successfully scaling up to achieve the 80 x 30 goal.

Implementation

Staff is evaluating the resource impacts across City departments and identified resources needed to implement this S/CAP.

Some of the actions will be absorbed and integrated into existing departmental operating or projects budgets. Additional resources needed include consultant services, temporary staffing, infrastructure needs, and ongoing costs, which includes additional staff positions and augmenting the City's ongoing budget for S/CAP implementation. Resources allocated to implementing the S/CAP will be refined and finalized as part of the annual process for budget development and approval by the City Council.

The City will monitor the effectiveness of the emissions reductions actions in this S/CAP, as well as progress towards achieving S/CAP goals, through annual GHG emissions inventories and progress reports to City Council. The S/CAP is considered a living document that may need to be revised in order to achieve 80 x 30.

The City's strategy to finance implementation of current and future actions will evolve over time. Strategies the City may consider could include:

- Leveraging partnerships and collaborative projects
- Charging carbon impact fees for development projects

- Implementing user fees for selected activities and services
- Implementing paid parking in selected locations
- Adding transportation impact fees to requirements for new construction projects
- Establishing a Climate Action Fund
- Seeking one-time or short-term grant funding for S/CAP-related projects

Funding Opportunities

At both the state and federal level, several newly adopted climate bills have the potential to accelerate efforts to reduce emissions towards achieving carbon neutrality. The federal Inflation Reduction Act of 2022 (IRA) will invest $369 billion for energy security and climate change programs over the next ten years. This includes $14,000 in rebates for consumers to buy heat pumps or other energy efficient home appliances, $7,500 in tax credits for new electric vehicles (and $4,000 for used electric vehicles), and funding to support 950 million solar panels, 120,000 wind turbines and 2,300 grid-scale battery plants[66]. In California, the California Climate Commitment will invest $54 billion towards climate action, including $6.1 billion for electric vehicles, $8.1 billion to support energy reliability, and $13.8 billion for clean public transportation[67]. Government budgets ebb and flow year over year; staff will continuously monitor the status of federal and state budgets and potential funding for S/CAP-related programs.

Community Engagement

[66] https://www.whitehouse.gov/briefing-room/statements-releases/2022/08/15/by-the-numbers-the-inflation-reduction-act/
[67] https://www.gov.ca.gov/wp-content/uploads/2022/09/Fact-Sheet-California-Climate-Commitment.pdf

The support and buy-in of the community are critical to the successful implementation of the S/CAP. The City is planning an extensive community engagement strategy to inform the community about the issues outlined in the S/CAP, raise awareness about the magnitude of the challenge and why action is needed, provide education about the strategies outlined in the S/CAP, and widely distribute information on programs and funding opportunities for residents and local businesses. Palo Alto will look for opportunities to partner with other organizations, including youth groups and Palo Alto Unified School District, and bring workshops and trainings to the community. Overall, the goal is to increase community awareness about climate change to influence everyday consumer behavior and purchasing decisions. Palo Alto's messaging can encourage community members to take action not just at home, but also at work, and with community organizations of which they're members.

Leaving Room for new Strategies

Palo Alto envisions that the core strategies of the S/CAP will remain constant as we move forward. As we live in an age and place of abundant technological innovation, more advanced technologies and creative innovations may be integrated into the S/CAP in the future. The City will continually monitor the progress of S/CAP efforts and explore additional strategies as opportunities arise. For example, carbon sequestration is a potential strategy to explore as the S/CAP moves forward.

Carbon Sequestration

Our forests and oceans are natural carbon sinks, each absorbing 25 percent[68] of the carbon dioxide that is released into the atmosphere.[69] The process of capturing and storing this atmospheric carbon is known as carbon sequestration, and is a strategy that – when combined with other efforts – can help combat climate change.

There are several processes that can capture and store carbon, ranging from biochar to geologic sequestration, and more.

- **Biological Sequestration**: The process of planting trees and other vegetation in forests, grasslands, and rangelands. Reforestation is one of the cheapest sequestration processes and helps support biodiversity. In our cities, encouraging residents, businesses, and parks to maintain or plant new trees can help to pull carbon dioxide from the atmosphere.
- **Biochar**: This process involves the burning of organic materials to create biochar, a compound that can hold carbon for long periods, rather than releasing it into the atmosphere as it degrades. Research shows that biochar will not break down for at least 100 years and possibly up to 1,000 years. This type of carbon sequestration may be a solution for landfill and wastewater treatment applications.

[68] NOAA. (n.d.). Ocean-Atmosphere Co2 Exchange. Retrieved from https://sos.noaa.gov/datasets/ocean-atmosphere-co2-exchange/.

[69] A healthy ocean has what is known as positive and negative "flux;" the former when CO_2 from the ocean is released into the atmosphere, and the latter when CO_2 is absorbed. Today, in large part due to human activity, the oceans absorb more CO_2 than they release. It is projected that by 2100, the oceans will be a CO_2 sink. The increase of CO_2 from fossil fuels is significantly impacting the acidity of the ocean, ultimately affecting not only the sea life, but also the air we breathe.

- **Biogas**: A methane and carbon dioxide gas produced from anaerobic digestion of agriculture waste products, landfills, and wastewater systems. Biogas can be used for heating, electricity, or transportation fuel; it is currently widely used in wastewater treatment plants in California.
- **Carbon Capture and Storage (CCS)**: CCS is a three-part process that involves capturing carbon dioxide, transporting the carbon dioxide, and storing it underground typically through geologic sequestration.
- **Geologic Sequestration**: Carbon is captured and injected into underground rock formations for long-term or permanent storage.
- **Technological Sequestration**: Scientists are working to develop new and innovative ways to capture carbon. Some technologies are looking at capturing carbon directly from the air. Other potential technologies include repurposing carbon for use in other technologies.
- **Trees End of Life Sequestration**: A portion of the carbon dioxide trapped in trees during growth is released after they are cut down during the decomposition process. In order to avoid releasing this carbon dioxide, carbon can be stored for longer timeframes by locking carbon into wood products, such as lumber or furniture, or creating biochar. When urban trees fall down or are purposefully removed, residents and local municipalities should consider these end-of-life use cases to prevent the carbon dioxide from being re-emitted into the atmosphere.

It’s not yet clear what role carbon sequestration will have in Palo Alto’s sustainability and climate action strategy, but it’s something the City will evaluate moving forward.

Conclusion

The challenge of preparing for and mitigating the effects of climate change is unprecedented in its scale and potential disruption to our way of living. Recent climate disasters have given us a preview of what could become the “new abnormal.”

This S/CAP provides an overarching, strategic framework for Palo Alto to achieve the goal of reducing GHG emissions by 80 percent by 2030, an important step towards our goal of achieving carbon neutrality by 2030. While developing and publishing this S/CAP is an important step, it’s even more critical that this S/CAP remain a living document, to be updated as technology and policies progress.

This S/CAP not only supports the City’s efforts to manage its own GHG emissions, it’s also a call-to-action to residents, community institutions, and businesses to take an active part in our transition to a low-carbon future and clean economy. In this process, Palo Alto will foster a vibrant economy, increase its resiliency, and support a collective vision for a livable and sustainable community for generations to come.

SECTION 8

APPENDIX

A. Glossary

A.1 Glossary of Definitions

California Environmental Quality Act (CEQA)	A state law requiring state and local agencies to assess the environmental impacts of a proposed private or public project they undertake or permit. If a proposed activity has the potential for a significant adverse environmental impact, an environmental impact report must be prepared and certified as to its adequacy before action can be taken on the proposed project.
Carbon Neutrality	Taking action towards the goal of achieving net zero emissions
Climate Action Plan	A climate action plan is a planning document that identifies ways in which the community and county can reduce greenhouse gas emissions.
Climate change	Any significant change in measures of climate (such as temperature, precipitation, or wind) lasting for an extended period (decades or longer). There is international concern that increasing concentrations of greenhouse gases (GHGs) in the atmosphere are changing the climate in ways detrimental to our social and economic well-being.
Climate Equity	Addressing historical inequities suffered by people of color, allowing everyone to fairly share the same benefits and burdens from climate solutions and attain full and equal access to opportunities regardless of one's background and identity
Community-wide Emissions	Emissions based on energy use that are released from activities taking place within a defined geographic area (i.e. the City of Palo Alto)
Decarbonization	Moving away from energy systems that produce carbon dioxide (CO2) and other greenhouse gas emissions
Green Building	Sustainable or "green" building is a holistic approach to design, construction, and demolition that minimizes the building's impact on the environment, the occupants, and the community.

Greenhouse Effect	The trapping and build-up of heat in the atmosphere near the Earth's surface is often called the "greenhouse effect". Some of the heat flowing back toward space from the Earth's surface is absorbed by greenhouse gasses in the atmosphere and then reradiated back toward the Earth's surface. As the atmospheric concentrations of these gases rise, the amount of heat reradiating back to the Earth's surface increases as well, resulting in global temperature increases.
Greenhouse Gases	Gases, including water vapor, carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), that trap heat in the atmosphere are often called greenhouse gases. Some greenhouse gases such as carbon dioxide occur naturally and are emitted to the atmosphere through natural processes and human activities. Other greenhouse gases (e.g., fluorinated gases) are created and emitted solely through human activities. GHGs influence climate change though the greenhouse effect.
Greenhouse Gas Inventory	Looks at greenhouse gas emissions caused by all activities within a city's geographic boundary. Typical sectors include residential, commercial, and industrial energy use, transportation, off-road equipment, waste generation, and energy associated with water delivery and treatment.
Mobility	The potential for movement and the ability to get from one place to another using one or more modes of transport to meet daily needs.
Mode Shift	A change from one form of transportation to another.
Municipal Emissions	Emissions based on energy use related to municipal operations (i.e. natural gas use in City owned facilities, transportation related emissions from City vehicle fleet, etc.)
Net Zero Emissions	Reducing greenhouse gas emissions to as close to zero as possible, with any remaining emissions re-absorbed from the atmosphere.
Sea Level Rise	An increase in the level of the world's oceans due to the effects of global warming.

Vehicle Miles Traveled (VMT)	The number of miles traveled by a motor vehicle for commute trips.

A.2 Glossary of Abbreviations

AB 32	Assembly Bill 32, The California Global Warming Solutions Act of 2006
BAAQMD	Bay Area Air Quality Management District
BAU	Business as Usual
CARB	California Air Resources Board
CEC	California Energy Commission
CEQA	California Environmental Quality Act
The City	City of Palo Alto
CO2	Carbon dioxide
CO2e	Carbon dioxide equivalent
CPAU	City of Palo Alto Utilities
CPUC	California Public Utilities Commission
EV	Electric vehicle
GHG	Greenhouse gas
ICLEI	Local Governments for Sustainability
IPCC	Intergovernmental Panel on Climate Change
KPI	Key performance indicator
kWh	kilowatt hour
MT	Metric ton
MMT	Million metric tons
RPS	Renewable portfolio standard
S/CAP	Sustainability and Climate Action Plan
SOV	Single Occupancy Vehicle
TNC	Transportation Network Company
TOD	Transit-oriented development
U.S. EPA	United States Environmental Protection Agency
VMT	Vehicle miles traveled
WRI	World Resources Institute

B. Climate Change[70]

B.1 Global Goal to Limit Warming to 1.5°C

The Intergovernmental Panel on Climate Change (IPCC), the leading international scientific body on climate change, released a report[71] in mid-2018 shifting the threshold at which significant and potentially irreversible climate change impacts occur from 2°C to 1.5°C of average global temperature increase above pre-industrial levels. The IPCC report promotes immediate actions to meet the 1.5°C threshold to prevent or slow these impacts. Many of the impacts of warming up to and beyond 1.5°C, and some potential impacts of mitigation actions required to limit warming to 1.5°C, fall disproportionately on low income and socially vulnerable people.

Substantial changes in regional climate occur between 1.5°C and 2°C of global average temperature increase. For example, the number of people exposed to severe heat waves triples. Keeping temperatures at 1.5°C as compared to a 2°C warming would result in global reductions in risk, including:

- **Sea level rise:** Decreasing global rate of rise by approximately 3.9 inches
- **Heat waves:** Decreasing the number of people being frequently exposed by 420 million worldwide
- **Heavy precipitation and drought:** Reducing intensity and frequency worldwide
- **Drinking water:** Lowering the number of people without access to drinking water by 50 percent

Limiting warming to 1.5°C will require changes by 2050, including:

- Eliminating GHG emissions in our cities
- Deep reductions in global emissions of non-CO2 climate pollutants, particularly methane
- Reducing oil use by 32-74 percent
- Reducing natural gas use by 13-60 percent
- Leveraging renewables to supply 36-97 percent of energy
- Making buildings and transportation energy efficient
- Implementing adaptation options, including coastal defense and hardening, efficient irrigation, green infrastructure, and disaster risk management

B.2 State and Local Goals and Targets

California has some of the most aggressive climate action goals in the United States. The State has set a goal of emissions reductions to 40 percent below 1990 levels by 2030 (or 49 percent below 2005 levels). To achieve this, California has created the following strategies:

- Increase renewable electricity production to 50 percent

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[70] This section was adapted from the Regionally Integrated Climate Action Planning Suite (RICAPS) Climate Action Plan (CAP) Template Version 9.4. The CAP Template was developed in partnership with the City/County Association of Governments of San Mateo County (C/CAG) and the County of San Mateo Office of Sustainability through the San Mateo County Energy Watch program and its RICAPS initiative. RICAPS is co-funded by C/CAG and PG&E.

[71] Intergovernmental Panel on Climate Change (IPCC).(n.d.). Intergovernmental Panel on Climate Change Special Report: Global Warming of 1.5ºC. https://www.ipcc.ch/sr15/.

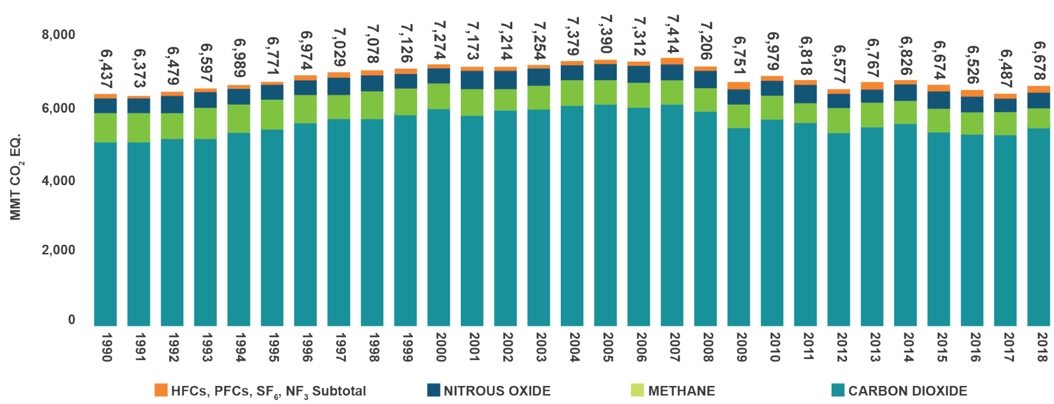
- Reduce petroleum use by 50 percent in vehicles
- Double energy efficiency savings at existing buildings
- Reduce GHG emissions from natural and working lands
- Reduce short-lived climate pollutants such as black carbon, methane, tropospheric ozone, and fluorinated gases
- Make California more resilient to climate change in accordance with California's 2018 *Safeguarding California Plan*

B.3 Trends in National and State Emissions

National Emissions

According to the U.S. EPA, gross total U.S. GHG emissions in 2017 were 6,456.7 million metric tons (MMT) of CO2 equivalent (CO2e), representing a 12 percent decrease below 2005 levels.[72] Emissions have also decreased 4.5 percent since 2014, largely driven by transitioning power plants from using coal to natural gas, as well as warmer winter conditions. CO2, the largest component of man-made GHGs, made up 81.6 percent of total U.S. GHG emissions in 2017, followed by methane at 10.2 percent, nitrous oxide at 5.6 percent, and fluorinated gases at 2.6 percent.

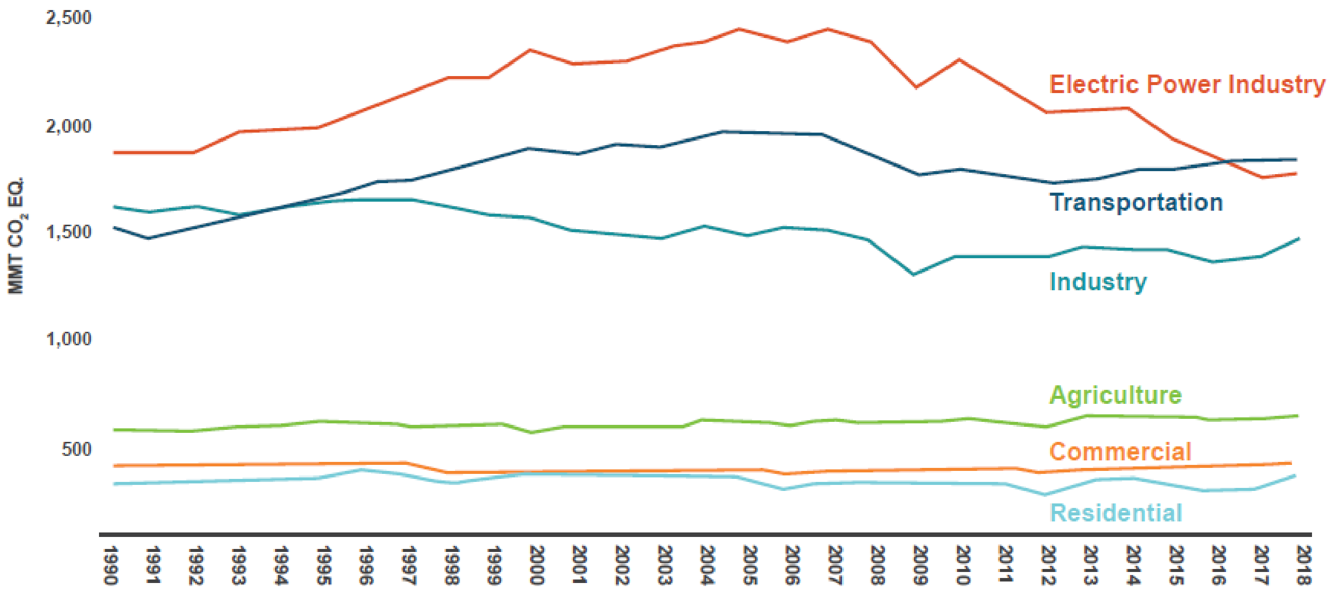
Figure 10: Gross U.S. GHG Emissions by Gas: 1990-2018[73]



In 2018, the industrial sector contributed the largest share of GHG emissions (29.1 percent), followed by transportation (27.9 percent), commercial (16.2 percent), residential (15.6 percent), and agriculture (10.5 percent). Land use and forestry offset 11 percent of total gross emissions. Of the five main sectors, transportation has seen the largest increase in emissions since 1990 (22 percent increase), while industrial emissions have seen the largest decrease (15.5 percent decrease).

[72] U.S. Environmental Protection Agency. (2018). Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2018. https://www.epa.gov/sites/production/files/2020-02/documents/us-ghg-inventory-2020-chapter-2-trends.pdf.
[73] Ibid.

Figure 11: U.S. GHG Emissions by Economic Sector[74]



California Emissions

Similar to the national trend, total GHG emissions in California have decreased in recent years. According to the California Air Resources Board (CARB), total California GHG emissions in 2017 were 424 million metric tons (MMT) of CO2e, representing a 2 percent decrease below 1990 levels and a 13 percent decrease below 2005 levels.[75]

California has seen an overall decrease in carbon intensity of electricity generation, driven by a large increase in zero-GHG and renewable energy resources due in part to California's Renewable Portfolio Standard (RPS)[76] and Cap-and-Trade Program.[77] In 2017, the transportation sector contributed the largest share of GHG emissions (41 percent), followed by industrial (24 percent), in-state electricity (9 percent), agriculture and forestry (8 percent), residential (7 percent), imported electricity (6 percent), and commercial (5 percent).

[74] Ibid.

[75] California Air Resources Board. (2019). California Greenhouse Gas Emissions for 2000 to 2017. https://ww3.arb.ca.gov/cc/inventory/pubs/reports/2000_2016/ghg_inventory_trends_00-16.pdf.

[76] California Energy Commission. Renewables Portfolio Standard – RPS. (n.d.). https://www.energy.ca.gov/programs-and-topics/programs/renewables-portfolio-standard.

[77]California Air Resources Board. (2020). Cap-and-Trade Program. https://ww3.arb.ca.gov/cc/capandtrade/capandtrade.htm.

Figure 12: California GHG Emissions by Sector: 2000-2017

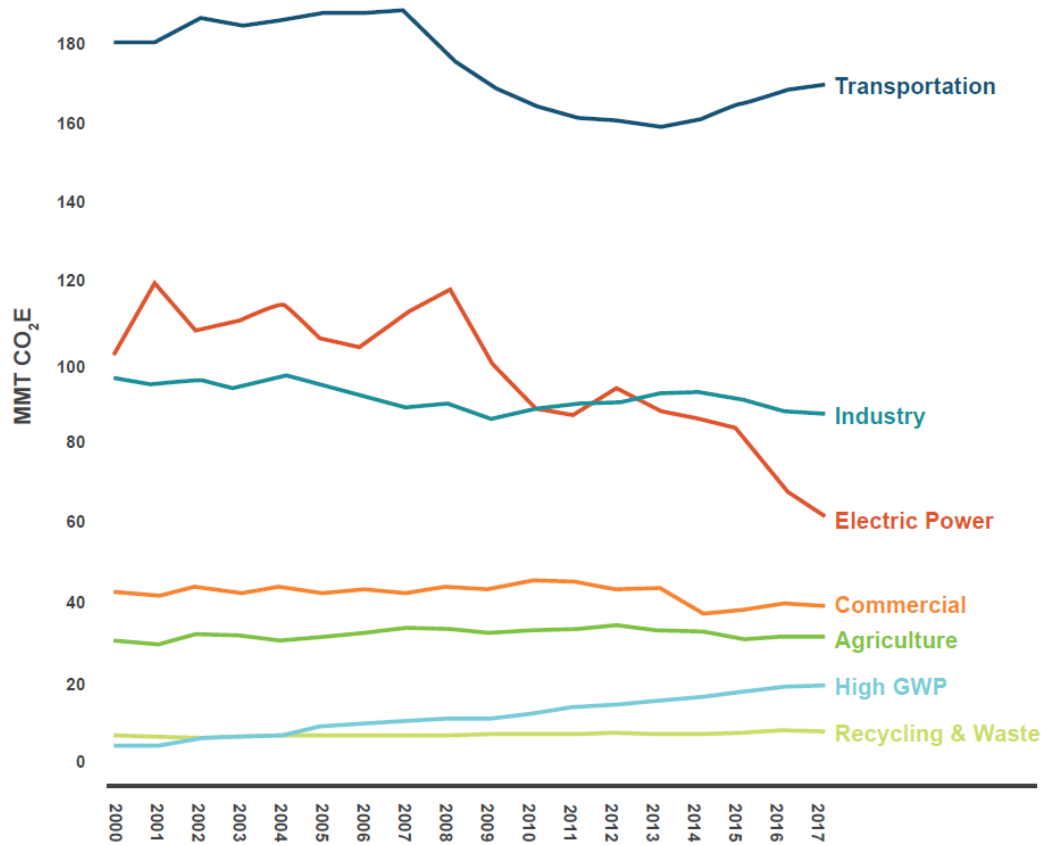
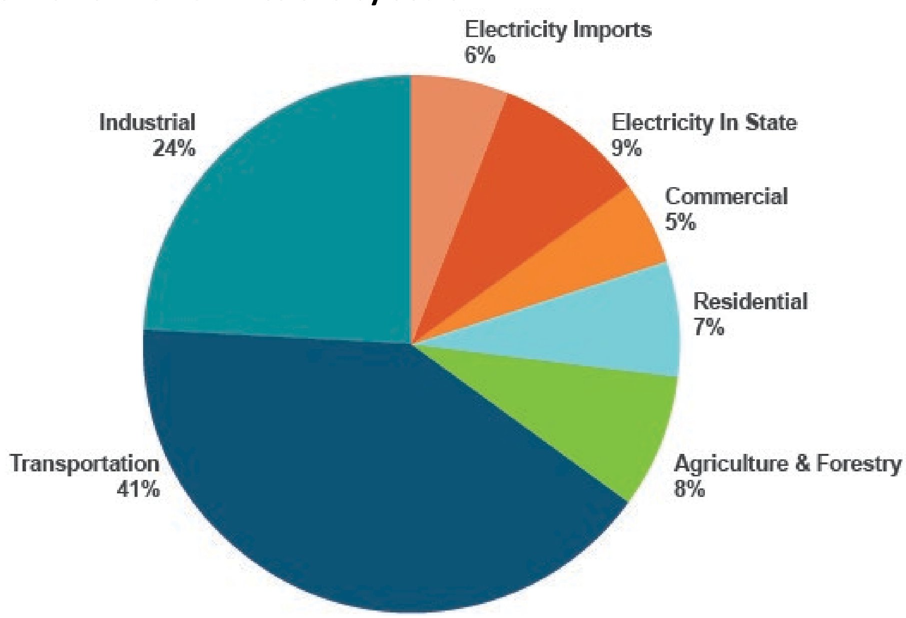


Figure 13: California 2017 GHG Emissions by Sector



B.4 IPCC Scenarios

The following is a reprint of an article that was published in Fast Company on August 26, 2014.[78]

Four Scenarios Show What Climate Change Will Do To The Earth, From Pretty Bad To Disaster

Climate change is going to do a lot of damage. How bad that damage will be is still under debate.

The most recent Intergovernmental Panel on Climate Change (IPCC) report left no doubt about the future of the world if we don't slow the rate at which we release heat-trapping gases into the atmosphere. In a word, it's going to get bad.

But exactly how bad is still an open question, and a lot depends not only on how we react, but how quickly. The rate at which humans cut down on greenhouse gas (GHG) emissions–if we do choose to cut them–will have a large bearing on how the world turns out by 2100, the forecasts reveal.

This graphic from the World Resources Institute gives a sense of the dynamics at play. It presents four "emissions pathways," ranging from the very optimistic to the highly pessimistic.

WE ACTUALLY DO SOMETHING ABOUT CLIMATE CHANGE

The first "Low Emissions" scenario is for a 66 percent drop in greenhouse emissions by 2050 compared to 2010 levels. It's what we might call a soft landing, because under those conditions scientists believe we'll be relatively safe. The world would have warmed only by 2 degrees C over pre-industrial levels (the level set by various international agreements). Still, almost of the quarter of the world would suffer depleted groundwater supplies by 2080, and many more people will face extreme flooding, the WRI says. So, life wouldn't be peachy.

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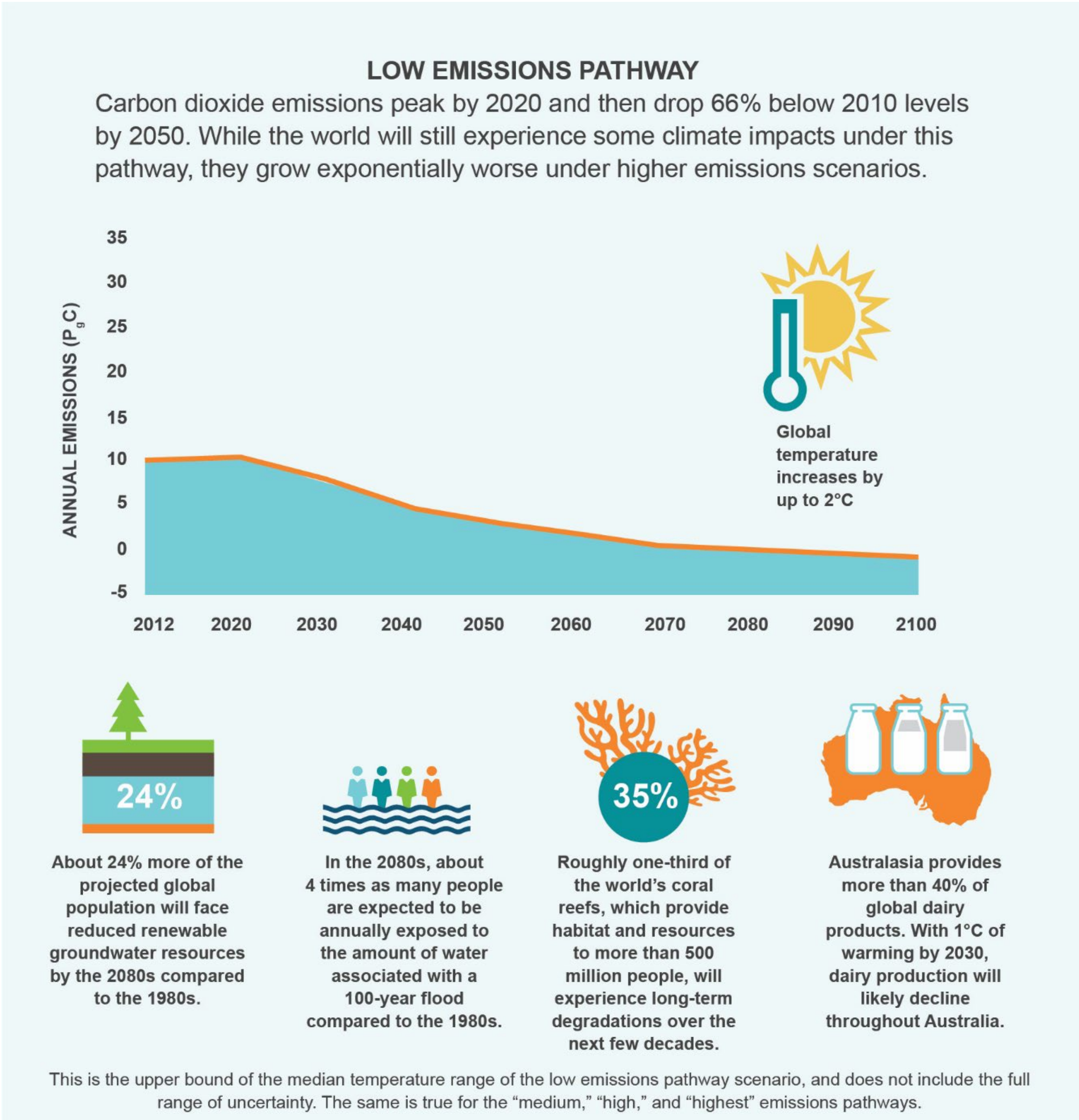
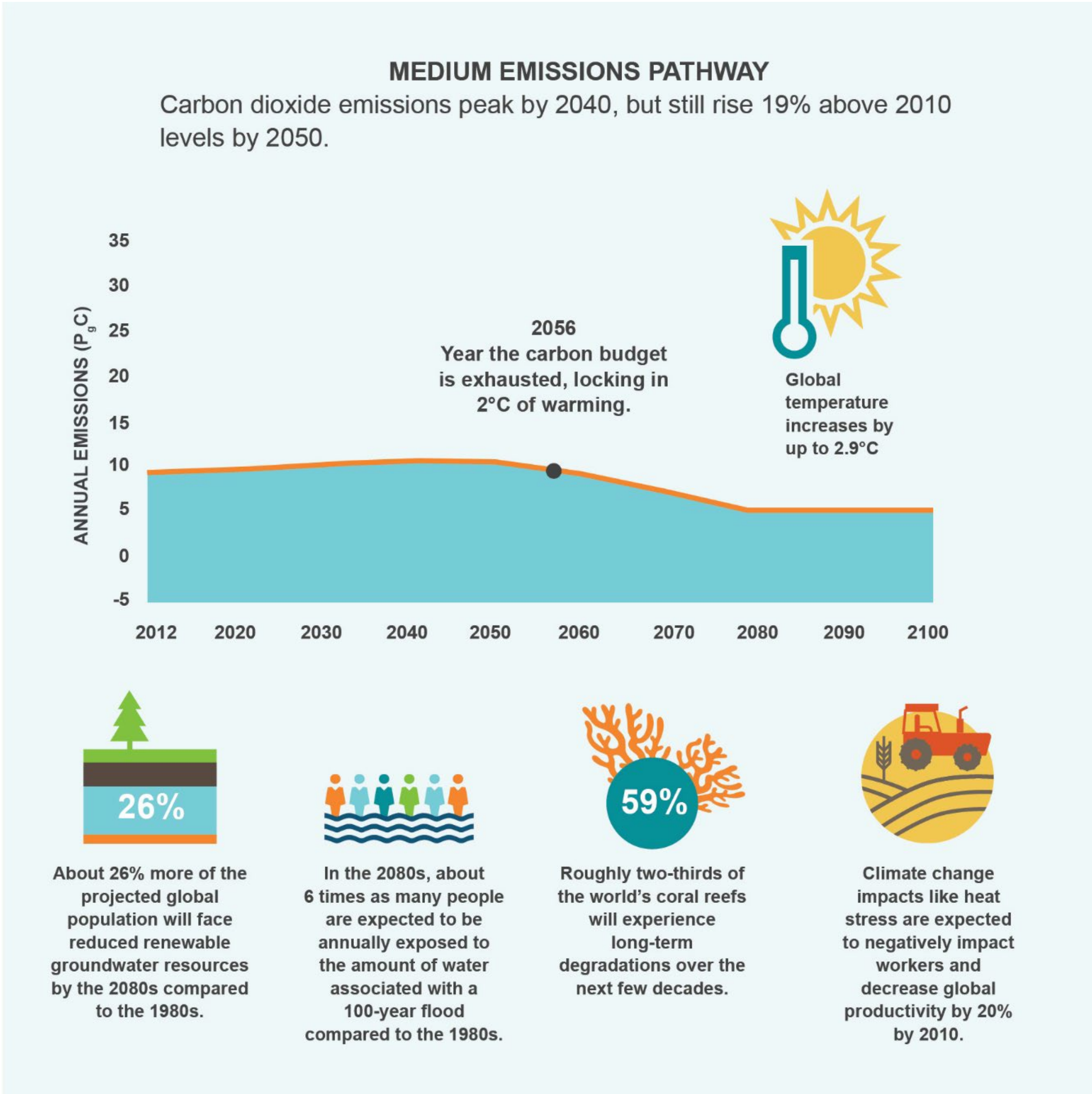
[78] Schiller, B. (2014, August 26). 4 Scenarios Show What Climate Change Will Do To The Earth, From Pretty Bad to Disaster. Fast Company. https://www.fastcompany.com/3034316/4-scenarios-show-what-climate-change-will-do-to-the-earth-from-pretty-bad-to-disaster



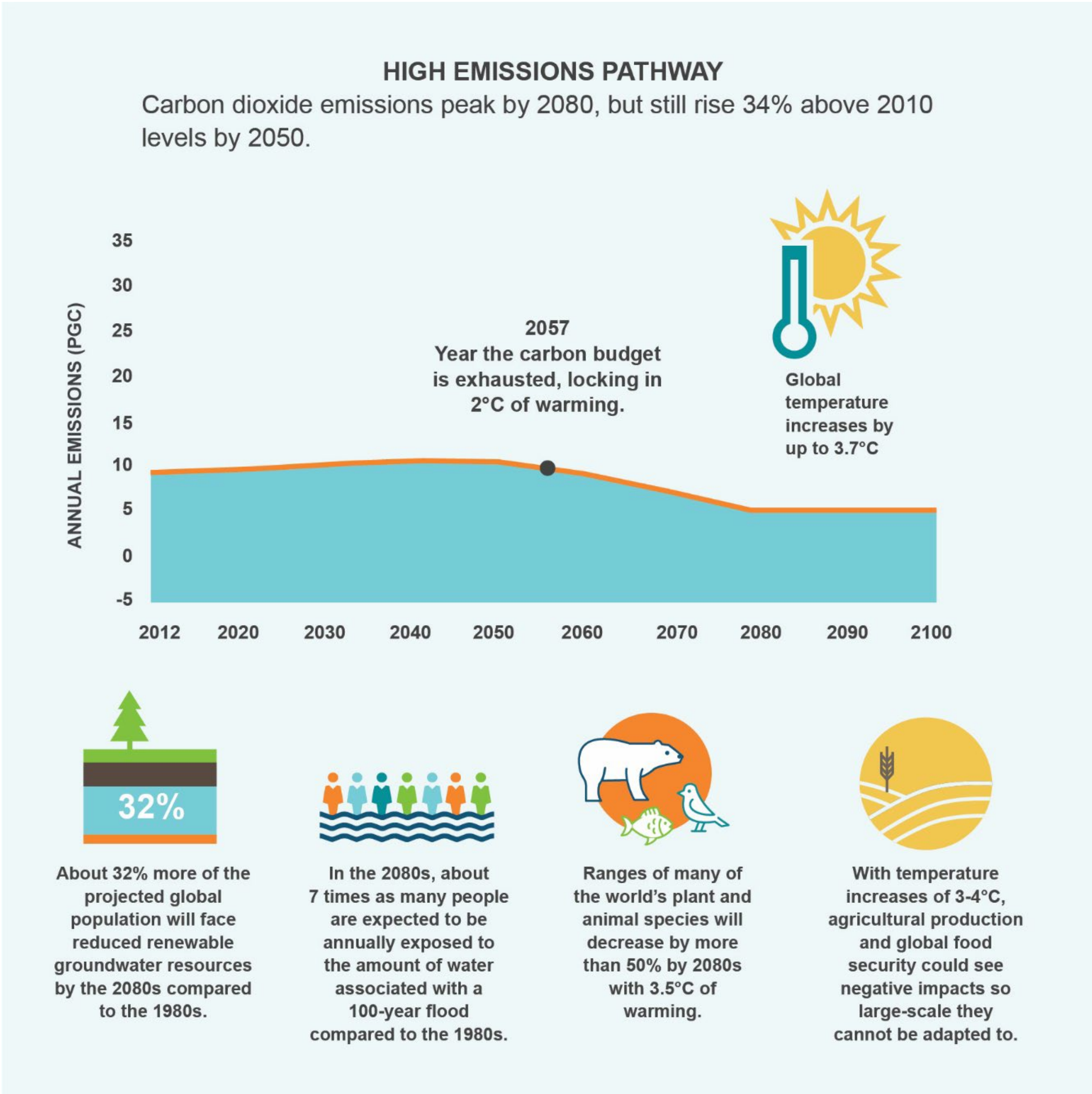
WE KEEP DOING WHAT WE'RE DOING

The "Medium Emissions" scenario sees increases in emissions until 2040 and the world exceeding its "carbon budget"–the level at which it should stay within the 2 degrees limit–by 2056. By 2100, the planet has warmed by 2.9 degrees, and economic productivity has fallen by 20 percent. By the 2080s, six times as many people are experiencing catastrophic flooding as the 1980s.



WE REV THE ENGINES

The "High Emissions" scenario doesn't see emissions peaking until 2080, while global temperatures jump 3.7 degrees C by 2100. The carbon budget is exhausted in 2057. The impact on agricultural production is so heinous that adaption is no longer viable, the WRI predicts.

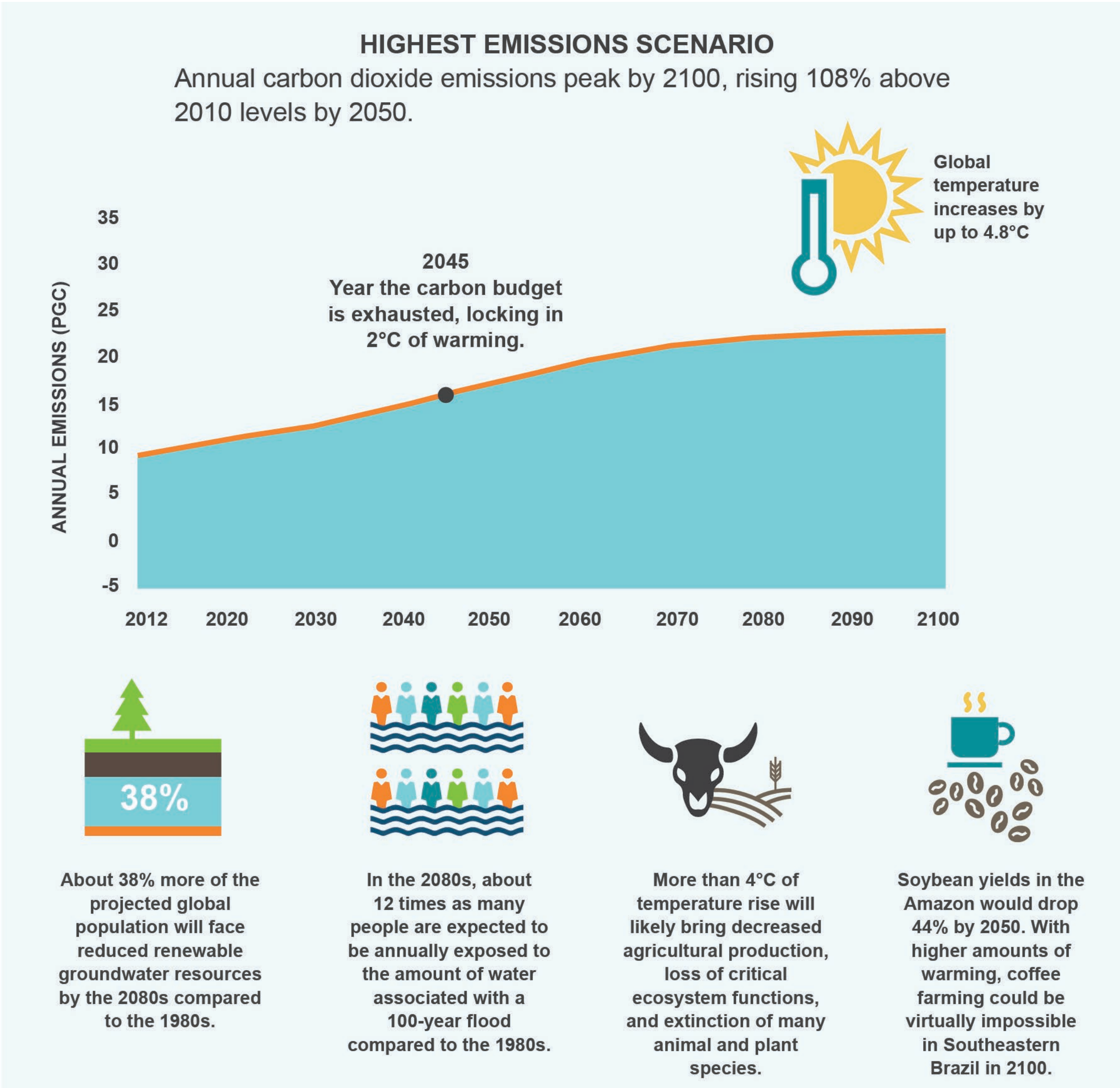


WE DESTROY THE PLANET

As if that's not bad enough, there's one last "Highest Emissions" scenario (they should have called it the Doomsday Scenario, really). It sees the carbon budget obliterated in 2045 and global temperatures increasing a whopping 4.8 degrees by century's end. Many animals have become extinct and farming in some places, like southern Brazil, has become impossible.

But won't we adapt to the new conditions, you might ask? Well, maybe. The scenarios here assume flat technology development, not the leaps forward in innovation that we can hope for. We could have drought-resistant crops and new ways of recycling and desalinating water, for instance, that could make these predictions less forceful.

The easier course, though, is to cut emissions. To have a fighting chance of coping with climate disorder, we have to cut greenhouse gases quickly, not just wait until it's convenient.



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C. Policy[79]

C.1 Global Policy

United Nations Sustainable Development Goal #13: Climate Action
The 2030 Agenda for Sustainable Development, adopted by all United Nations Member States in 2015, provides a shared blueprint for peace and prosperity for people and the planet, now and into the future. At its heart are the 17 Sustainable Development Goals (SDGs), which are an urgent call for action by all countries - developed and developing – in a global partnership. Goal #13 is "Take urgent action to combat climate change and its impacts."[80]

C.2 State Policy and Regulatory Context

The State of California has been a leader in developing and implementing policies and regulations to directly address the risk of severe climate change. Below we summarize the key statewide legislation aimed at reducing greenhouse gas (GHG) emissions and adapt to climate impacts. There are many supporting pieces of legislation and other related initiatives that are sector specific.

Climate Change Scoping Plan
The Climate Change Scoping Plan was approved by ARB in December 2008 and outlines the State's plan to achieve the GHG reductions required in AB 32. The Scoping Plan contains the primary strategies California will implement to achieve a reduction of 169 MMT of carbon dioxide equivalent (CO2e), or approximately 28% from the state's projected 2020 emission level.

Assembly Bill 32 (AB 32), California Global Solutions Act, 2006
In September 2006, the California legislature passed Assembly Bill 32 (AB 32), which set the goal of reducing GHG emissions back to 1990 levels by 2020. AB 32 finds and declares that "global warming poses a serious threat to economic well-being, public health, natural resources and the environment of California." The legislation granted authority to the Air Resources Board to establish multiple mechanisms (regulatory, reporting, voluntary, and market) to achieve quantifiable reductions in GHG emissions to meet the statewide goal.

Senate Bill 32 (SB 32), California Global Solutions Act of 2006, 2016
Senate Bill (SB) 32 expands upon the Global Warming Solutions Act of 2006, requiring the California Air Resources Board (CARB) to ensure that statewide GHG emissions are reduced to 40% below 1990 levels by 2030 and 80% below 1990 levels by 2050.

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[79] This section was adapted from the Regionally Integrated Climate Action Planning Suite (RICAPS) Climate Action Plan (CAP) Template Version 9.4. The CAP Template was developed in partnership with the City/County Association of Governments of San Mateo County (C/CAG) and the County of San Mateo Office of Sustainability through the San Mateo County Energy Watch program and its RICAPS initiative. RICAPS is co-funded by C/CAG and PG&E.
[80] United Nations Sustainable Development Goals. (n.d.). Sustainable Development Goal 13. Retrieved from https://sustainabledevelopment.un.org/sdg13.

Executive Order B-55-18 to Achieve Carbon Neutrality, 2018
Executive Order B-55-18 set a target of statewide carbon neutrality by 2045 and to maintain net negative emissions thereafter. This goal is in addition to the existing statewide targets of reducing greenhouse gas emissions.

Senate Bill 97, CEQA Guidelines for Addressing GHG Emissions, 2007
In August of 2007, Senate Bill (SB) 97 was signed into law, expressly recognizing the need to analyze GHG emissions as a part of the California Environmental Quality Act (CEQA) process. SB 97 required the Office of Planning and Research (OPR) to develop, and the California Natural Resources Agency to adopt, amendments to CEQA Guidelines addressing the analysis and mitigation of GHG emissions. Those amendments became effective in March of 2010. Proposed projects that must comply with CEQA regulations include General Plans, Specific Plans and specific types of development projects.

Senate Bill 350, Clean Energy and Pollution Reduction Act, 2015
In October of 2015, Senate Bill 350 (SB 350) was signed into law, establishing new clean energy, clean air and greenhouse gas reduction goals for 2030 and beyond. SB 350 codified Governor Jerry Brown's aggressive clean energy goals and established California's 2030 greenhouse gas reduction target of 40 percent below 1990 levels. To achieve this goal, SB 350 increases California's renewable electricity procurement goal from 33 percent by 2020 (legislation originally enacted in 2002) to 50 percent by 2030. Renewable resources include wind, solar, geothermal, wave, and small hydroelectric power. In addition, SB 350 requires the state to double statewide energy efficiency savings in electricity and natural gas end uses by 2030.

Senate Bill 379, Climate Adaptation and Resiliency Strategies, 2015
SB 379 requires all cities and counties to include climate adaptation and resilience strategies in the Safety Elements of their General Plans upon the next revision beginning January 1, 2017. The bill requires the climate adaptation update to include a set of goals, policies, and objectives for their communities based on the vulnerability assessment, as well as implementation measures, including the conservation and implementation of natural infrastructure that may be used in adaptation projects.

Senate Bill 100, The 100% Clean Energy Act, 2018
In September of 2018, Governor Brown signed Senate Bill 100 (SB 100), requiring the State's load serving entities (including energy utilities and community choice energy programs) to achieve 50 percent renewable resources target by December 31, 2026, to achieve a 60 percent target by December 31, 2030 and supply 100 percent of retail sales of electricity to California end-use customers and 100 percent of electricity procured to serve all state agencies by December 31, 2045. At the same time, Governor Brown also signed Executive Order B-55-18, requiring California to achieve carbon neutrality as soon as possible, and no later than 2045, and to maintain negative emissions thereafter.

Senate Bill 1477, Low Emissions Buildings and Sources of Heat Energy, 2018
In September 2018, Governor Brown signed Senate Bill 1477 (SB 1477), that requires the California Public Utilities Commission (CPUC) to oversee two new low-carbon heating programs, investigate potential pilot programs to build all-electric, zero-carbon buildings in areas damaged by wildfires,

coordinate with the California Energy Commission on updates to the State's building (Title 24) and appliance (Title 20) energy efficiency standards, and establish a building decarbonization policy framework. The bill authorizes $200 million over four years to be invested in programs to advance low-carbon space and water heating technologies in both new and existing buildings. Funding for the programs is slated to come from natural gas utility carbon allowance proceeds from California's cap-and-trade program.

Assembly Bill 1493, Clean Car Standards, 2002
AB 1493 requires ARB to develop and adopt regulations to reduce GHG emissions from passenger vehicles, light-duty trucks, and other non-commercial vehicles for personal transportation. In 2004, ARB approved amendments to the California Code of Regulations adding GHG emissions standards to California's existing standards for motor vehicle emissions. In 2009, ARB adopted amendments to the "Pavley" regulations that reduce GHG emissions in new passenger vehicles from 2009 through 2016.

Senate Bill 375, Sustainable Communities and Climate Protection Act, 2008
SB 375 aligns regional transportation planning efforts, regional GHG reduction targets, and affordable housing allocations. Metropolitan Planning Organizations (MPOs) are required to adopt a Sustainable Communities Strategy (SCS), which allocates land uses in the MPO's Regional Transportation Plan. Qualified projects consistent with an approved SCS or Alternative Planning Strategy and categorized as "transit priority projects" receive incentives under new provisions of the California Environmental Quality Act (CEQA).

Senate Bill 743, Vehicle Miles Traveled Policy, 2013
SB 743 was passed in 2013 and implemented in 2018 through the adoption of new CEQA regulations, or guidelines for conducting transportation impact analysis. The updated guidelines provide a new performance metric, vehicle miles travelled (VMT) as a basis for determining significant transportation impacts under CEQA. VMT would replace level of service (LOS) of the primary impact threshold under CEQA; however, cities can still retain the ability to use LOS for operational purposes. While LOS often required wider roads as a mitigation measure, projects expected to induce significant increases in VMT will be able to mitigate their impacts through measures such as car-sharing services, unbundled parking, improved transit, and enhanced pedestrian and bicycle infrastructure.

Assembly Bill 2127, Electric Vehicle Charging Infrastructure Assessment, 2018
AB 2127 requires the Energy Commission to prepare and biennially update a statewide assessment of the electric vehicle charging infrastructure needed to support the levels of electric vehicle adoption required for the state to meet its goals of putting at least 5 million zero-emission vehicles on California roads by 2030 and of reducing emissions of greenhouse gases to 40% below 1990 levels by 2030.

Senate Bill 1383, Short-Lived Climate Pollutant Reduction Strategy, 2016
SB 1383 requires the state to reduce emissions of short-lived climate pollutants to achieve a reduction in methane by 40% below 2014 levels by 2030, as specified. The bill also established specified targets for reducing organic waste in landfills by reducing organic waste disposal 50% by 2020 and 75% by 2025 and increasing edible food recovery by 20 percent by 2025.

Bay Area Air Quality Management District CEQA Guidelines
The Bay Area Air Quality Management District (BAAQMD) encourages local governments to adopt a GHG Reduction Strategy that is consistent with AB 32 goals. The GHG Reduction Strategy may streamline environmental review of community development projects. According to the BAAQMD, if a project is consistent with a GHG Reduction Strategy, then it can be presumed that the project will not have significant GHG impacts. This approach is consistent with the following State CEQA Guidelines, Section 15183.5.a:

> *"Lead agencies may analyze and mitigate the significant impacts of greenhouse gas emissions at a programmatic level, such as…a plan to reduce greenhouse gas emissions. Later project-specific environmental documents may tier from and/or incorporate by reference that existing programmatic review. Project-specific environmental documents may rely on an [Environmental Impact Report] containing a programmatic analysis of greenhouse gas emissions."*

This S/CAP provides a foundation for future development efforts in the community. It is expected that environmental documents for future development projects will identify and incorporate all applicable voluntary and mandatory actions from S/CAP for projects undergoing CEQA review.

C.3 State-Level Programs

The City isn't expected to make all the reductions on its own. The following programs help cities meet their climate goals.

California Advanced Clean Cars Program
In 2012, CARB adopted a set of regulations to control emissions from passenger vehicles, collectively called Advanced Clean Cars. The program was developed in coordination with the U.S. EPA and National Highway Traffic Safety Administration (NHTSA) and combines the control of smog-causing pollutants and GHG emissions into a single coordinated package of regulations. ww2.arb.ca.gov/our-work/programs/advanced-clean-cars-program

California Climate Commitment
The 2022 California Climate Commitment invests $54 billion to fight climate change and enacts new world-leading measures that will cut pollution, deploy clean energy and new technologies, and protect Californians from harmful oil drilling. https://www.gov.ca.gov/wp-content/uploads/2022/09/Fact-Sheet-California-Climate-Commitment.pdf

California Long Term Energy Efficiency Strategic Plan
Published in 2008 and updated in 2011, the California Long Term Energy Efficiency Strategic Plan outlines goals and strategies for key market sectors (i.e., commercial, residential, industrial, and agricultural) and crosscutting initiatives (e.g., heating, ventilation and air conditioning, codes and standards, research, and technology). While the Plan has not been updated since 2011, it is still referenced in numerous State documents and reports. The Plan embraces four specific programmatic goals, known as the Big Bold Energy Efficiency Strategies. These goals are:

- All new residential construction in California will be zero net energy by 2020.
- All new commercial construction in California will be zero net energy by 2030.
- The Heating, Venting and Air Conditioning (HVAC) industry will be re-shaped to deliver maximum performance HVAC systems.
- All eligible low-income customers will have an opportunity to participate in the LIEE program and will be provided all cost- effective energy efficiency measures in their residences by 2020.

More information on California's zero net energy goals can be found online at: www.cpuc.ca.gov/ZNE

California Low Carbon Fuel Standard Program
The Low Carbon Fuel Standard (LCFS) is designed to encourage the use of low-carbon fuels, encourage the production of those fuels, and therefore, reduce GHG emissions. Currently, the LCFS calls for a 20 percent decline in the carbon intensity of diesel fuels below 2010 levels by 2030. ww3.arb.ca.gov/fuels/lcfs/lcfs.htm

California Renewable Portfolio Standard
The Renewable Portfolio Standard (RPS), originally established in 2002, required 20 percent of electricity retail sales to be served by renewable sources by 2017. The program was accelerated in 2015 with SB 350, which mandated a 50 percent RPS by 2030. SB 100, enacted in 2018, accelerated the program further, establishing renewable energy targets of 50 percent by 2026, 60 percent by 2030, and 100 percent by 2045. www.cpuc.ca.gov/rps

Caltrain Electrification
Caltrain Electrification is a key component of Caltrain Modernization Program (CalMod). The current project will electrify the corridor from San Francisco to San Jose, including all track in San Mateo County, and will replace 75 percent of Caltrain's diesel service with electric. The project will lower GHG emissions, improve regional air quality, and reduce noise. https://calmod.org

Organic/Food Waste Diversion
In 2016, Senate Bill 1383 (SB 1383) established methane emissions reduction targets in a statewide effort to reduce emissions of short-lived climate pollutants in various sectors of California's economy. SB 1383 establishes target to achieve a 50 percent reduction in the level of statewide disposal of organic waste from 2014 levels by 2020 and a 75 percent reduction by 2025. Beginning in 2022, SB 1383 requires every jurisdiction to provide organic waste collection services to all residents and businesses. The law grants CalRecycle the regulatory authority required to achieve the organic waste disposal reduction targets. More information about SB 1383 can be found online at: https://www.calrecycle.ca.gov/climate/slcp

C.4. City Policy

Since 1991, the Palo Alto City Council, City Manager, and City of Palo Alto Departments have adopted policies, plans, ordinances, resolutions, and principles that have helped to increase the sustainability of Palo Alto[81]. In addition, sustainability principles are integrated in the 2030 Comprehensive Plan[82].

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[81] https://www.cityofpaloalto.org/City-Hall/Sustainability/Documents
[82] https://www.cityofpaloalto.org/Departments/Planning-Development-Services/Long-Range-Planning/2030-Comprehensive-Plan

The 2030 Comprehensive Plan contains the City's official policies on land use and community design, transportation, housing, natural environment, safety, business and economics, and community services. Several goals and policies overlap with the S/CAP, including, but not limited to the following from the Comprehensive Plan 2030 Implementation Plan[83]:

2. LAND USE ELEMENT	
Goal L-2: An enhanced sense of "community" with development designed to foster public life, meet citywide needs and embrace the principles of sustainability.	
L2.4.5	Update the municipal code to include zoning changes that allow a mix of retail and residential uses but no office uses. The intent of these changes would be to encourage a mix of land uses that contributes to the vitality and walkability of commercial centers and transit corridors.
L2.4.7	Explore mechanisms for increasing multi-family housing density near multimodal transit centers.
Goal L-4: Inviting pedestrian scale centers that offer a variety of retail and commercial services and provide focal points and community gathering places for the city's residential neighborhoods and employment districts.	
L4.8.2	Study the feasibility of converting parts of University Avenue to a pedestrian zone.
Goal L-7: Conservation and preservation of Palo Alto's historic buildings, sites, and districts.	
L7.8.2	Create incentives to encourage salvage and reuse of discarded historic building materials.
Goal L-10: Maintain an economically viable local airport with minimal environmental impacts.	
L10.3.2	Work with the airport to pursue opportunities to enhance the open space and habitat value of the airport. These include: Maintaining native grasses; Reconstructing levees to protect the airport from sea level rise while enhancing public access and habitat conservation; and Evaluating the introduction of burrowing owl habitat.
3. TRANSPORTATION ELEMENT	
Goal T-1: Create a sustainable transportation system, complemented by a mix of land uses, that emphasizes walking, bicycling, use of public transportation, and other methods to reduce greenhouse gas emissions and the use of single occupancy motor vehicles.	
T1.2.1	Create a long-term education program to change the travel habits of residents, visitors, shoppers, and workers by informing them about transportation alternatives, incentives, and impacts. Work with the PAUSD and with other public and private interests, such as the Chamber of Commerce and Commuter Wallet partners, to develop and implement this program.

[83] https://www.cityofpaloalto.org/files/assets/public/planning-amp-development-services/file-migration/historic/long-range-planning/resources/compplan_2017_09_implementation_pdf_w_links.pdf

T1.2.3	"Formalize TDM requirements by ordinance and require new developments above a certain size threshold to prepare and implement a TDM plan to meet specific performance standards. Require regular monitoring/reporting and provide for enforcement with meaningful penalties for non-compliance. The ordinance should also: Establish a list of effective TDM measures that include transit promotion, prepaid transit passes, commuter checks, car sharing, carpooling, parking cash-out, bicycle lockers and showers, shuttles to Caltrain, requiring TMA membership and education and outreach to support the use of these modes; Allow property owners to achieve reductions by contributing to citywide or employment district shuttles or other proven transportation programs that are not directly under the property owner's control; Provide a system for incorporating alternative measures as new ideas for TDM are developed; Establish a mechanism to monitor the success of TDM measures and track the cumulative reduction of peak hour motor vehicle trips. TDM measures should at a minimum achieve the following reduction in peak hour motor vehicle trips, with a focus on single-occupant vehicle trips. Reductions should be based on the rates included in the Institute of Transportation Engineers' Trip Generation Manual for the appropriate land use category and size: • 45 percent reduction in the Downtown district • 35 percent reduction in the California Avenue area • 30 percent reduction in the Stanford Research Park • 30 percent reduction in the El Camino Real Corridor • 20 percent reduction in other areas of the city Require new development projects to pay a Transportation Impact Fee for all those peak-hour motor vehicle trips that cannot be reduced via TDM measures. Fees collected would be used for capital improvements aimed at reducing vehicle trips and traffic congestion; Ensure a stable, sustained funding source to support implementation of TDM measures."
T1.2.4	Evaluate the performance of pilot programs implemented by the Palo Alto Transportation Management Association and pursue expansion from Downtown to California Avenue and other areas of the city when appropriate.
T1.2.5	Site City facilities near high-capacity transit and revise existing regulations, policies, and programs to encourage telecommuting, satellite office concepts, and work-at-home options.
T1.2.6	Pursue full participation of Palo Alto employers in the TMA.
T1.3.1	Develop an electric vehicle promotion program that identifies policy and technical issues, barriers and opportunities to the expansion of electric vehicles.
T1.3.2	Use low-emission vehicles for the Palo Alto Free Shuttle and work with transit providers, including SamTrans and the Santa Clara Valley Transportation Authority **to encourage the adoption of electric, fuel cell or other zero emission vehicles. Also work with private bus and shuttle providers, delivery companies, and ride service**s.
T1.4.1	Update the Zoning Code to ensure compatibility with the electric vehicle infrastructure requirements.

T1.4.2	Periodically review requirements for electric and plug-in vehicle infrastructure in new construction. Consider and periodically review requirements for electric and plug-in infrastructure for remodels. Consider costs to the City, including identifying payment options.
T1.6.1	Collaborate with transit providers, including Caltrain, bus operators and rideshare companies, to develop first/last mile connection strategies that boost the use of transit and shuttle service for local errands and commuting.
T1.12.3	"Work with the Santa Clara Valley Transportation Authority to study the feasibility of, and if warranted provide, traffic signal prioritization for buses at Palo Alto intersections, focusing first on regional transit routes. Also, advocate for bus service improvements on El Camino Real such as queue jump lanes and curbside platforms. "
T1.12.3	"Work with the Santa Clara Valley Transportation Authority to study the feasibility of, and if warranted provide, traffic signal prioritization for buses at Palo Alto intersections, focusing first on regional transit routes. Also, advocate for bus service improvements on El Camino Real such as queue jump lanes and curbside platforms. "
T1.16.2	Consider marketing strategies such as a recurring Palo Alto Open Streets program of events, potentially in coordination with local business groups, which would include street closures and programming.
T1.16.4	"Participate in local and regional encouragement events such as Palo Alto Walks and Rolls, Bike to Work Day, and Bike Palo Alto! that encourages a culture of bicycling and walking as alternatives to single occupant vehicle trips."
T1.19.2	Prioritize investments for enhanced pedestrian access and bicycle use within Palo Alto and to/from surrounding communities, including by incorporating improvements from related City plans, for example the 2012 Bicycle + Pedestrian Transportation Plan and the Parks, Trails & Open Space Master Plan, as amended, into the Capital Improvements Program.
T1.19.4	"Encourage the use of bike sharing, and the provision of required infrastructure throughout Palo Alto, especially at transit stations and stops, job centers, community centers, and other destinations. "
Goal T-2: Decrease delay, congestion, and vehicle miles travelled with a priority on our worst intersections and our peak commute times, including school traffic	
T2.1.1	Implement computerized traffic management systems to improve traffic flow when feasible.
Goal T-3: Maintain an efficient roadway network for all users.	
T3.10.4	Pursue extension of Quarry Road for transit, pedestrians and bicyclists to access the Palo Alto Transit Center from El Camino Real. Also study the feasibility of another pedestrian and bicycle underpass of Caltrain at Everett Street.
Goal T-5: Encourage attractive, convenient, efficient and innovative parking solutions for all users.	
T5.1.2	Consider reducing parking requirements for retail and restaurant uses as a way to encourage new businesses and the use of alternative modes.

T5.1.5	Consider reducing parking requirements for multi-family uses as a way to encourage new multi-family housing and the use of alternative modes, where reduction in parking would not impact the neighborhood.
T5.2.2	Study and implement pricing strategies for public parking in commercial districts, taking into consideration both employee parking demand and the needs of retailers and customers. Use pricing to encourage short term parking on street, long term parking in parking garages, and the use of alternative modes of transportation
T5.2.3	Implement Council-adopted recommendations from the parking management study for the Downtown area, which address the feasibility of removing colorcoded parking zones, and dynamic pricing and management policies to prioritize short-term parking spaces closest to the commercial core for customers, garage parking for employees, and neighborhood parking for residents.
T5.4.1	Explore incentives to encourage privately initiated shared parking among individual property owners when developments have excess parking that can be available for other businesses to use.
Goal T-6: Provide a safe environment for motorists, pedestrians, and bicyclists on Palo Alto streets.	
T6.1.1	Follow the principles of the safe routes to schools program to implement traffic safety measures that focus on Safe Routes to work, shopping, downtown, community services, parks, and schools, including all designated school commute corridors.
T6.1.2	Develop, distribute and aggressively promote maps and apps showing safe routes to work, shopping, community services, parks and schools within Palo Alto in collaboration with stakeholders, including PAUSD, major employers, TMAs, local businesses and community organizations.
T6.4.1	Consider the Adopted School Commute Corridors Network and adopted “Walk and Roll” maps when reviewing development applications and making land use and transportation planning decisions. Incorporate these requirements into City code when feasible.
T6.4.3	In collaboration with PAUSD, provide adult crossing guards at school crossings that meet established warrants.
T6.6.2	Continue to provide educational programs for children and adults, in partnership with community-based educational organizations, to promote the safe walking and safe use of bicycles, including the City-sponsored bicycle education programs in the public schools and the bicycle traffic school program for juveniles
Goal T-8: Influence the shape and implementation of regional transportation policies and technologies to reduce traffic congestion and greenhouse gas emissions.	
T8.1.1	Continue to participate in regional efforts to develop technological solutions that make alternatives to the automobile more convenient.

T8.8.1	"Identify and improve bicycle connections to/from neighboring communities in Santa Clara and San Mateo counties to support local trips that cross city boundaries. Also advocate for reducing barriers to bicycling and walking at freeway interchanges, expressway intersections, and railroad grad crossings. "
4. NATURAL ENVIRONMENT	
Goal N-2: A thriving urban forest that provides public health, ecological, economic, and aesthetic benefits for Palo Alto.	
N2.1.1	Explore ways to prevent and ameliorate damage to trees and tree roots by above and below ground infrastructure and buildings.
N2.4.1	Promote landscape design that optimizes soil volume, porosity, structure and health, as well the location, shape and configuration of soil beds.
N2.7.1	Maintain and irrigate healthy trees in parks, open space, parking lots, and City rights-of-way, while identifying and replacing unhealthy trees in those areas.
N2.7.2	Continue to invest in the care, irrigation and monitoring of street trees during drought conditions.
N2.9.2	Develop a program for using the City's Urban Forestry Fund to replace trees lost to public improvement and infrastructure projects, with replanting occurring onsite or as close to the original site as is ecologically appropriate.
N2.10.1	Continue to require replacement of trees, including street trees lost to new development.
N2.12.1	Explore ways to leverage the fact that Palo Alto's urban forest alleviates climate change by capturing and storing carbon dioxide
N2.13.2	Provide on-going education for City staff, residents, and developers regarding landscape, maintenance, and irrigation practices that protect the urban forest and wildlife species.
Goal N-4: Water resources and infrastructure that are managed to sustain plant and animal life, support urban activities, and protect public health and safety.	
N4.2.1	Educate customers on efficient water use (indoor and outdoor), tree care, and landscaping options.
N4.6.1	Encourage residents to use rain barrels or other rainwater reuse systems.
N4.7.1	Support and participate in the work of the SCVWD to prepare a high-quality groundwater management plan that will address groundwater supply and quality
N4.13.1	Promote the use of permeable paving materials or other design solutions that allow for natural percolation and site drainage through a Storm Water Rebate Program and other incentives.
N4.13.2	Develop and implement a green stormwater infrastructure plan with the goal to treat and infiltrate stormwater.
N4.17.3	Investigate ways to reuse non-traditional water sources including recycled, gray, black and stormwater.

Goal N-7: A clean, efficient energy supply that makes use of cost-effective renewable resources.	
N7.1.1	Meet customer electricity needs with least total cost resources after careful assessment of environmental cost and benefits.
N7.2.1	Promote the adoption of cost-effective, renewable energy technologies from diverse renewable fuel sources by all customers.
N7.4.1	Continue timely incorporation of State and federal energy efficiency standards and policies in relevant City codes, regulations and procedures, and higher local efficiency standards that are cost-effective.
N7.4.2	Implement cost effective energy efficiency programs for all customers, including low income customers.
N7.4.5	Continue to provide public education programs addressing energy conservation and efficiency.
N7.6.1	Explore changes to building and zoning codes to incorporate solar energy, energy storage and other energy efficiency measures into major development projects, including City-owned projects.
N7.7.1	Evaluate the potential for a cost-effective plan for transitioning to a completely carbon-neutral natural gas supply.
N7.7.2	Explore the transition of existing buildings from gas to electric or solar water and space heating.
Goal N-8: Actively support regional efforts to reduce our contribution to climate change while adapting to the effects of climate change on land uses and city services.	
N8.1.1	Participate in cooperative planning with regional and local public agencies, including on the Sustainable Communities Strategy, on issues related to climate change, such as greenhouse gas reduction, water supply reliability, sea level rise, fire protection services, emergency medical services, and emergency response planning.
N8.1.2	Meet or exceed State building energy standards by encouraging higher energy efficiency and/or all-electric new construction and retrofit projects.
N8.2.1	Periodically update the S/CAP consistent with the update schedule in the approved S/CAP; this update shall include an updated greenhouse gas inventory and updated short, medium, and long-term emissions reduction goals.
N8.3.1	Protect the Municipal Services Center, Utility Control Center, and RWQCP from the impacts of sea level rise.
N8.4.1	Prepare response strategies that address sea level rise, increased flooding, landslides, soil erosion, storm events and other events related to climate change. Include strategies to respond to the impacts of sea level rise on Palo Alto's levee system.
5. SAFETY ELEMENT	
Goal S-3: An environment free of the damaging effects of human-caused threats and hazardous materials.	

S3.8.1	Encourage residential and commercial food waste reduction through incentives, educational outreach and programs.
S3.9.2	Educate Palo Alto residents and developers about available incentives to use environmentally friendly deconstruction activities to minimize our carbon footprint, and to save natural resources, as well as space in our landfills.
S3.10.1	Support efforts to enforce extended producer responsibility for solid waste to reduce waste produced from manufacturing, shipping, packaging and the entire life-cycle of the product.

D. Methodology

D.1. 1990 vs. 2021 Greenhouse Gas Emissions by Sector and Subsector

Sector and Subsector	1990 GHG emissions (MT CO_2e)[84]	2019 GHG emissions (MT CO_2e)	2020 GHG emissions (MT CO_2e)	2021 GHG emissions (MT CO_2e)	Percent Change in 2021 from 1990 (%)	Percent of Total 2021 Emissions (%)
Total Transportation & Mobile Sources	**331,840**	**315,081**	**238,523**	**211,403**	**-36.3%**	**58.8%**
- On-Road Transportation	331,840	293,413	217,279	185,925	-44.0%	51.7%
- Airport Emissions	Not Included	2,192	1,664	2,641	n/a	0.7%
- Off-road Vehicles	Not Included	14,634	15,029	18,961	n/a	5.3%
- Caltrain Commuter Rail	Not Included	4,842	4,552	3,876	n/a	1.1%
Total Natural Gas (Methane) Use	**194,000**	**153,509**	**134,365**	**135,697**	**-30.1%**	**37.8%**
- Commercial Energy	Not calculated	66,987	53,515	55,676	n/a	15.5%
- Industrial Energy	Not calculated	14,373	11,961	12,176	n/a	3.4%
- Residential Energy	Not calculated	72,149	68,889	67,846	n/a	18.9%
Natural Gas (Methane) Fugitive Emissions	**4,718**	**5,009**	**4,384**	**4,427**	**-6.2%**	**1.2%**
Total Wastewater-Related Emissions	**8,504**	**2,197**	**3,355**	**1,262**	**-85.2%**	**0.4%**
- Wastewater Biosolid Treatment[85]	n/a	812	0	0	n/a	0%
- Wastewater Treatment and Effluent	8,504	1,385	1,388	1,262	-85.2%	0.4%
Total Solid Waste	**55,057**	**6,531**	**6,660**	**6,522**	**-88.2%**	**1.8%**
- Composting	Not Included	731	1,623	1,256	n/a	0.3%
- Palo Alto Landfill Gas Flaring[86]	Not Included	281	316	237	n/a	0.1%
- Palo Alto Landfill Gas Fugitive	24,325	n/a[87]	n/a	n/a	n/a	n/a
- Landfill Waste	30,732	5,519	4,721	5,029	-83.6%	1.4%
Brown Power Supply (Electricity)	186,000	n/a	n/a	n/a	**-100.0%**	n/a
Total GHG Emissions (MT CO_2e)	**780,119**	**482,237**	**385,320**	**359,312**	**-53.9%**	**100%**

[84] Source: 2016 S/CAP Framework and 2016 Earth Day Report
[85] Includes biosolid composting, anaerobic digestion, and incineration
[86] 2016 Earth Day Report labeled these emissions as biogenic
[87] Not included because the landfill was closed

D.2. Transportation Methodology and Data Sources

Memorandum

Date: August 11, 2020 (Updated November 3, 2020)

To: Josh Lathan, AECOM

From: Daniel Rubins, Bob Grandy and Teresa Whinery, Fehr & Peers

Subject: Palo Alto S/CAP – Task 2.1 Transportation Methodology and Data Sources

SF20-1094

The purpose of this memorandum is to provide options for revising the current work scope for Fehr & Peers in Tasks 2 through 4 for the Palo Alto Sustainability and Climate Action Plan (S/CAP). As requested in the RFP, Fehr & Peers is currently scoped to develop Base and Future VMT estimates, and AECOM is scoped to identify the GHG reduction levels for up to 40 proposed actions using the ClearPath GHG calculator. Since the ClearPath GHG calculator does not address several of the proposed actions identified during the S/CAP process to date, City staff have asked Fehr & Peers to both identify modifications to our current scope and budget to assist in identifying GHG reduction levels for proposed actions as well as to identify optional tasks that would require additional budget allocations that could occur as part of the S/CAP or future efforts to enhance VMT estimation for the desired S/CAP actions.

This memorandum summarizes the VMT calculation method options and approach for the Palo Alto Sustainability and Climate Action Plan (S/CAP). The selected approach will result in an estimate of baseline (1990) and reporting years (2019 and 2030) vehicle miles traveled, and vehicle miles reduction based on S/CAP Actions. This document discussion includes:

1. VMT Metrics
2. VMT Calculation Methods
3. GHG Calculation Methods
4. VMT Reduction Analysis

This memorandum will be supported by a matrix summary (prepared by AECOM) of the pros and cons evaluation of the data sources, qualitative assessment of the robustness of the data, ability of the data to evaluate trends over time, and estimated cost to acquire the data for VMT, fleet mix and greenhouse gas emissions.

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Updates to this memorandum are shown in yellow highlight to indicate what was included in the revised scope of work.

VMT Metrics

Daily VMT is calculated based on the number of vehicles multiplied by the average distance traveled by each vehicle and is a key output from travel forecast models. Daily VMT can be reported in different ways. It can be calculated for the entire roadway network, which may extend beyond a specific geographic area such as the physical limits of a jurisdiction or study area (referred to in this discussion as the origin-destination method); alternatively, daily VMT can be summarized for a specific jurisdiction (referred to in this discussion as the geographic boundary method). Two of the techniques for determining the daily VMT estimates from jurisdictions includes the following methods:

- Geographical boundary VMT method – A geographical boundary–based estimate captures all daily VMT on a roadway network within a specified geographic area. This geographical boundary–based estimate includes local trips within the specified area plus interregional travel that does not have an origin or destination within the geographic area.
- Origin-destination (OD) VMT method[88] – An OD estimate tracks all the vehicle trips generated within a geographic area across the entire network to their ultimate destinations and isolates the daily VMT as follows:
    - Internal-internal (II): All daily trips made entirely within the Palo Alto city limits.
    - One-half of internal-external (IX): One-half of daily trips with an origin within the Palo Alto city limits and a destination outside of Palo Alto city limits. This assumes that the study jurisdiction shares half the responsibility for trips traveling from other jurisdictions.
    - One-half of external-internal (XI): One-half of daily trips with an origin outside the Palo Alto city limits and a destination within Palo Alto city limits. Similar to the IX trips, this assumes that Palo Alto shares the responsibility of trips traveling to other jurisdictions.
    - External-external (XX): 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.

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[88] This VMT method is similar but not the same accounting as the total project generated VMT metric described in the *SB 743 Implementation Decisions for Palo Alto* white paper (June 1, 2020). The total project generated VMT metric accounting includes the full length of each trip compared to the OD VMT method, which only includes half the length of each trip

The choice of the geographical boundary VMT method or the OD VMT method is influenced by several factors. The geographical boundary VMT method is used by some air districts because particulate air pollutants are typically measured with stationary monitoring devices that can only register emissions from the vehicle traffic passing a location. Further, most air districts have historically focused on criteria air pollutants. Regulations require this focus, which largely stems from the fact that air pollutants affect the population directly within the air district, while GHG emissions affect the entire planet; tracking the full amount of travel is more relevant than in air pollutant analysis. The geographical boundary VMT method only considers traffic within the physical limits of the selected study area and does not include the impact of vehicles once they travel outside the area limits.

The OD VMT method tracks vehicle trips being generated by a geographic area (i.e., a city, county, etc.) across the entire regional transportation network to their ultimate destinations. Unlike the geographical boundary VMT method, the OD VMT method recognizes that any trip has two trip ends (starting and ending points) and that both have to be considered in any attempt to reduce daily VMT. The OD VMT method excludes trips that pass through the geographic area—with neither an origin nor destination within the area. This approach quantifies the jurisdiction-related daily VMT so that a jurisdiction's staff and decision-makers can develop policies to alter VMT and greenhouse gas emissions within their control. The OD VMT method is consistent with the Regional Targets Advisory Committee (RTAC) recommendation to the California Transportation Commission presented in the report Recommendations of the Regional Targets Advisory Committee (RTAC) Pursuant to Senate Bill 375 (RTAC, 2009).

S/CAP APPROACH FOR VMT METRICS

- Base Scope Option: The S/CAP will use the OD VMT method extracted after the final assignment of the travel forecasting model.
- Additional Scope Option for VMT Estimates to Support S/CAP and SB 743 Implementation (Selected for Revised Scope of Work): As a part of the S/CAP City staff is considering an environmental analysis approach that would allow future projects consistent with the S/CAP and Comprehensive Plan to benefit from CEQA streamlining. To do this, additional VMT metrics would need to be extracted: 1) total project generated VMT and boundary VMT (from final assignment). These VMT metrics are additional effort but would help streamline CEQA analysis of future land use projects in Palo Alto. To extract total VMT and report by speed-bin, these VMT metrics would be extracted after the final assignment of the travel forecasting model.

VMT Calculation Methods

On-road transportation is the largest source of GHG emissions in most inventories and future forecasts, so good estimates of daily VMT are important. 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. The VMT calculation method options and S/CAP Approach are described below.

Travel Forecasting Models

A travel forecasting model uses specialized software and is designed to reflect the interactions between different land use and roadway elements in a large area. The two travel models most commonly used to assess projects in Santa Clara County are the Santa Clara Valley Transportation Authority (VTA)-City/County Association of Governments of San Mateo County (C/CAG) Bi-County Model ("VTA Travel Model") and Travel Model One ("MTC Travel Model"), which is maintained by the Metropolitan Transportation Commission (MTC) and used for large-scale regional planning efforts. The reader can review the travel forecasting model comparison of the VTA Travel Model and the MTC Travel Model presented in Appendix C of the *SB 743 Implementation Decisions for Palo Alto* white paper (June 1, 2020). There is also a statewide travel model developed by Caltrans, though the level of analysis is at such a large scale that it is typically used to evaluate interregional travel and freight movements rather than localized land use changes.

Sketch Models

In some cases where a travel model is not available or not appropriate, VMT can be estimated using sketch models or spreadsheet tools. VMT may also be estimated directly by multiplying the number of trips by an average trip length. Trips can be estimated using the results of local trip generation surveys or trip generation rate data published by the Institute of Transportation Engineers (ITE). Trip lengths can be extracted from models or from standardized averages or travel pattern data from the regional or sub-regional planning organization. Using trip length averages does not consider changes to the roadway network or to traffic congestion, or the project's potential effects on overall travel patterns. These non-model "accounting methods" could also be paired with a travel model and used between major model updates or to estimate project generated VMT for small projects that would "get lost in a model." Eleven sketch model tools were evaluated in the *SB 743 Implementation Decisions for Palo Alto* white paper (June 1, 2020) – see pages 29 to 32 including Table 2 for more details.

Each of the sketch models reviewed, except for the CA Smart Growth Tool and MXD/MXD+, provide direct estimates of project generated VMT or calculates the percent change in VMT. **None of the models are capable of producing city-wide or region-wide VMT estimates for threshold setting, fully evaluating the project's effect on VMT, or evaluating cumulative VMT**

impacts. Only CalEEMod, GreenTRIP Connect, TRIMMS, and TDM+ evaluate the impacts of TDM strategies for VMT mitigation.

In addition to the eleven sketch models reviewed, there is the recently launched Santa Clara Countywide VMT Evaluation Tool that conducts baseline VMT screening of office, industrial and residential land uses in Santa Clara County. **This web-based tool used the partial home-based VMT per resident and partial home-based work VMT per employee. This tool does not provide the total VMT analysis needed for the Palo Alto S/CAP.**

Other Data Sources and Emerging Big Data Sources

For some Climate Action Plans, daily VMT was estimated by calculating the daily VMT by roadway segment (calculated by multiplying roadway daily counts by the local street distance) for major streets (using local counts) and Caltrans (using the Highway Performance Monitoring System) facilities in the local jurisdiction and then summing all of the daily VMT on each street. Limitations of this method are that it can only be done for Existing Conditions; it cannot reliably be used for future conditions because future volumes cannot be observed (they must be estimated with a model or other non-model method).

Big Data is an emerging data source that provides actual travel data by passively and anonymously collecting archival location data from mobile devices. Big Data can also encompass other datasets that are too large to process in spreadsheets alone, such as household travel surveys, transit databases, and parking databases, as well as land use and employment data sets such as infoUSA. These Big Data sources help planners answer important questions about their communities that were previously difficult, expensive, and time consuming to answer. Sources of this data include:

- Location Based Services (LBS): Location based services data is provided from devices, primarily smart phones, which run applications and connect to cellular, WIFI, and/or GPS networks. LBS data is carrier-neutral and uses multiple location technologies, providing few gaps in coverage and high spatial precision.
- Cell Phone: Data collected via devices (phone, cars, tablets, computers, etc.) with an active connection to the cellular phone network, Voice, or data transmission to cellular network are triangulated between cell phone towers to identify the device location.
- Navigation Global Positioning System: GPS data is provided from devices that use satellites to obtain z/y/z coordinate data. Some GPS devices also connect to WIFI or cellular networks. Navigation-GPS data comes from devices that help people navigate, such as connected cars and trucks, turn-by-turn route guidance apps, and commercial fleet management systems.

Big Data can increase confidence in decision-making and improve forecasting accuracy by providing better empirical planning data. Big Data also makes it possible to answer questions that previously were either impossible or nearly impossible to answer with limited resources. Some key project types include:

- Origin-destination studies
- Travel time and speed studies
- Travel path and route studies

One limitation to Big Data is that it can not be used by itself to forecast future travel behavior. Application of Big Data for this effort would require additional budget resources.

Key Take Aways

An ideal tool for a citywide Climate Action Plan VMT analysis is a travel forecasting model that has been appropriately calibrated and validated for local project size and scale and has trip length data that accounts for trips that extend beyond the model boundary. Many travel forecasting models also account for travel patterns due to congestion, public transit, and non-motorized transit (walking and biking).

Some limitations of these methods include the following:

- Statewide and regional models have limited sensitivity and accuracy for local scale applications off the shelf.
- Regional and local models often truncate trips at model boundaries.
- Sketch, spreadsheet tools and Big Data sources do not capture the full “project effect on VMT” and/or the ability to forecast future conditions.

The VTA Travel Model was selected for the baseline VMT screening analysis and is also the most appropriate VMT calculation method for the Palo Alto S/CAP VMT analysis.

S/CAP Approach for VMT Calculation Method

- Base Scope Option: The S/CAP will use the VTA Travel Model as-is to extract the OD VMT method for the model base year (2015) and future year (2040). The VMT metric specifications will include:
  - The VMT will be extracted after the final assignment using the OD accounting method (II, ½*IX, and 1/2 *XI).
  - The OD VMT will be summarized by 5-mile-per-hour speed bins
  - The portion of clean vehicles will be estimated based on DMV data provided by City staff for Existing Conditions and future will be based on projections in the EMFAC air quality modeling.

The S/CAP 1990 year will be extrapolated based on city provided residential and employment data between 2015 and 1990. The 2019 and 2030 reporting years will be interpolated between the base year and future years of the travel model. Finally, the 2015 and 2040 residents, employees, students, and visitors will be summarized and shared with City staff.

Because there is uncertainty in future forecasting of VMT estimates, a brief discussion will be prepared that highlights areas of uncertainty in the data and the uncertainty with the VMT estimate derived from a regional travel model.

This base scope will also discuss potential ways to 1) improve baseline monitoring, 2) enhance VMT calculation methods, and 3) improve estimates of VMT reductions in a tabular form. This summary will highlight the methods used and how they can be enhanced.

The VMT estimates will be summarized in a memorandum.

- Additional Scope Option for VMT Estimates to Support S/CAP and SB 743 Implementation of CEQA Streamlining (Selected for Revised Scope of Work): The VTA Travel Model can be calibrated and validated to local conditions using Big Data sources. This would help City staff model existing and future VMT estimates with improved understanding. Also, because Big Data is continually collected, it can also be a primary monitoring source for future VMT reporting in Palo Alto with occasional VMT forecasting to modify future VMT reduction goals as needed. Using the Big Data would involve a review and update of input parameters in the travel model to reflect improvements in the travel model.
- Additional Scope Option – Land Use Updates: The 2015 and 2040 land use summary will be provided to City staff for review. Land use updates can be made at an additional cost.
- Additional Scope Option – VMT Alternatives Analysis (Selected for Revised Scope of Work): The base scope will extract VMT estimates from the VTA Travel Model as-is. As an additional service, additional VMT scenarios can be tested to refine the S/CAP approach and/or model the VMT with adopted S/CAP actions.
- Additional Scope Option – Testing Uncertainty: Using the VTA Travel Model and our TrendLab+ tool, we can evaluate the effects of emerging technology, social and demographic trends, or evaluating the effects of COVID19.
- Additional Scope Option for 1990 VMT Modeling: The VTA Travel Model has a base year of 2015, it could be updated and calibrated and validated to 1990 conditions to estimate 1990 VMT estimates. This would be a major effort that would be limited by available land use and transportation network information (i.e., roadway counts) for 1990.

GHG Calculation Methods

With each vehicle mile traveled, a vehicle generates greenhouse gas (GHG) emissions. As a result, transportation is a major contributor to greenhouse gas (GHG) emissions. The simplest GHG emissions estimation method is to multiply VMT by a carbon dioxide (CO_2) emissions factor to estimate GHG emissions.[89] However, types of vehicles within the vehicle fleet, the speed that vehicles travel, and the geographic location of the vehicles affect emission rates. Thus, a variety of methods exist to provide ever increasing precision in GHG emissions estimates because GHG emissions vary based on:

- Region (statewide, air basin, County, etc.)
- Calendar year (2000 through 2050)
- Season (Annual, Summer, Winter)
- Vehicle Categories
- Model year
- Speed (Aggregated, All, or Individual)
- Fuel (All, Gas, Diesel, Electric, Natural Gas)

With more advanced travel forecasting models and even microsimulation models VMT can be segmented and specific carbon dioxide (CO_2) emissions factor to estimate GHG emissions. There possible GHG emission options are listed below:

- Basic GHG Emissions Analysis: VMT by itself can be used to estimate GHG emissions by assuming an average fuel mileage rate to estimate fuel consumption. This coarse estimate of fuel consumption can be converted to a CO_2 equivalent using a fixed CO_2 emissions factor. This approach is coarse and best for order of magnitude estimates. Some sketch models use this approach to estimate GHG emissions.
- Enhanced GHG Emissions Analysis: VMT and speed can be used together to estimate GHG emissions. VMT estimates from a travel model can be disaggregated into 5-miles per hour speed bins and multiplied by a unique CO_2 emissions factor per speed bin using an air quality model such as EMission FACtor (EMFAC) prepared by California Air Resources Board for on-road mobile sources in California.

[89] Carbon dioxide (CO_2) emissions by mass represent nearly all of the greenhouse gases emitted from mobile on-road community transportation sources. Methane (CH_4), nitrous oxide (N_2O), sulfur hexafluoride (SF_6), hydrofluorocarbons (HFCs), and perflurocarbons (PFCs) are other criteria pollutants that contribute to global warming, but do not represent a significant portion of the on-road community transportation emissions by mass.

- Advanced GHG Emissions Analysis: Fuel consumption is potentially the most accurate options for GHG emissions. This method requires either a meso-scale or micro-scale modeling of traffic operations to model the effects of congestion on vehicle speed and estimate fuel consumption. This method is best for transportation infrastructure projects and/or small cities.

S/CAP Approach for GHG Calculation Method

- Base Scope Option: AECOM will prepare the GHG emissions estimates based on the VMT estimates provided by Fehr & Peers. The VMT input to the GHG emissions estimates will use the OD VMT method specified earlier. AECOM will select the appropriate GHG emissions estimate factors by speedbin – most likely using the EMission FACtors (EMFAC) air quality model.
- Additional Scope Option – Fuel Consumption: The City of Palo Alto has expressed an interest in modeling the effects of cleaning the vehicle fleet, more advanced methods of estimating the fuel consumption can be developed using a meso-scale travel forecasting model that is more sensitive to travel congestion than the VTA Travel Model.

VMT Reduction Analysis

The effectiveness of different VMT reduction strategies varies widely based on local context, scale of intervention, and availability of non-automotive transportation. For example, Transportation Demand Management (TDM) strategies are most effective when implemented in a policy environment that encourages land use location efficiency and infrastructure investments that support transit, walking, and bicycling. Measures that more typically come to mind when considering TDM, such as building-specific subsidy and marketing programs for transit or other non-drive-alone modes, or installation of bicycle racks, tend to be less effective than community- wide strategies and investments. Furthermore, programs tied to individual projects or buildings may vary in efficacy based solely on the final building tenants. The *SB 743 Implementation Decisions for Palo Alto* white paper (June 1, 2020) provided additional discussion about the relative importance of transportation reduction measures associated with transportation demand management, site design, and location efficiency, regional policies, and regional infrastructure.

The current standard for calculating VMT reduction efficacy from TDM strategies is the California Air Pollution Control Officer Association (CAPCOA) 2010 report, *Quantifying Greenhouse Gas Mitigation Measures* (CAPCOA report). This resource evaluates the literature behind a number of TDM program elements, and provides methods for calculating a VMT reduction associated with each. There are several limitations in the available VMT reduction data for suburban applications that are discussed in the *SB 743 Implementation Decisions for Palo Alto* white paper (June 1, 2020).

S/CAP Approach for VMT Reduction Analysis Calculation Method

- Base Scope Option: Fehr & Peers will assist AECOM in preparing the GHG reductions estimates by categorizing the mobility goals/actions into 9 VMT reduction tiers as grouped below (Fehr & Peers order of magnitude VMT reductions estimated by Fehr & Peers indicated with an asterisk):
  - Mobility 1 & 6: Land Use and Urban Fabric*
  - Mobility 2: Area Parking Management and Conversion Strategy*
  - Mobility 3: Active Transportation Infrastructure*
  - Mobility 4: Traffic Flow (City Quantification)
  - Mobility 5 & 8: Permanent Work from Home Strategy*
  - Mobility 7: Community Shuttles and Public Transit*
  - Mobility 9: Car Lite Lifestyle/Travel Pricing
  - Mobility 10: Clean Fleet (AECOM Quantification)
  - Mobility 11: Regional Policy Advocacy/Mobility Incentives and Programs (including rideshare, carshare, employer programs, etc.)

  As noted, several of these VMT reduction tiers will quantified by City staff and/or AECOM. For the remaining tiers, Fehr & Peers will provide order of magnitude VMT reduction estimates based on available CAPCOA research and select VMT data available from the California Household Travel Survey and VMT extracted from the VTA Travel Model (e.g., citywide mode split, average vehicle trip length by trip purpose, and trip purpose distribution) for the five VMT reduction tiers indicated by an asterisk above. The VMT reductions will be summarized in a brief memorandum.

- Additional Scope Option for Quantifying the Effects of TNCs: The VMT estimates that will be used for the S/CAP assume historical travel patterns will persist through 2040. However, with the emergence of transportation network companies like Uber and Lyft and autonomous vehicles, there might be upward pressure on VMT generation rates.
- Additional Scope Option for Detailed VMT Reduction Modeling and Monitoring (Selected for Revised Scope of Work)– Using local and big data sources to develop refined VMT reduction estimates specific to Palo Alto. This analysis would also include extracting additional information from the VTA Travel Model (e.g., VMT by trip purpose percentages by II, IX and XI, and mode split by trip purpose). The local and big data sources could also be used for citywide travel behavior monitoring, which is useful for tracking the S/CAPs progress and for SB 743 implementation of VMT reduction strategies.

D.3. AECOM Action Impact Memo

Palo Alto Action Impact Memo

Revised June 7, 2021

Introduction

Palo Alto's 2021 Sustainability and Climate Action Plan (S/CAP) sets an ambitious greenhouse gas (GHG) reduction goal to reduce emissions 80% below the City's 1990 levels by 2030 (the "80x30" goal). AECOM helped the City to evaluate a draft list of key actions to understand the potential for GHG reduction target achievement from local actions only, and to evaluate other community benefits from action implementation (e.g., air quality, public health).

The City and AECOM collaborated on modeling key action impact results within three categories of GHG reduction actions: Energy, Mobility, and Electric Vehicles. AECOM and Utility Department staff collaborated on developing a customized Building action calculator to estimate emissions reductions from various policies to support the electrification of residential and nonresidential buildings; input assumptions to the calculator are based on utility consumption data and other locally applicable data. The City team led development of the Mobility action calculator to understand how different actions could reduce vehicle miles traveled within the community, and the AECOM team provided a strategic review of the calculator's methodology and assumptions to guide revisions. Finally, the City hired a separate consultant to develop an electric vehicle (EV) calculator to model uptake of EV technology resulting from a suite of S/CAP actions. AECOM reviewed the EV calculator results with the City's consultant to identify revisions and methods to align the results of all three modeling approaches in support of this comprehensive action analysis.

The three modeling efforts show that a package of S/CAP actions can reduce emissions to 71% below 1990 levels by 2030, nearly achieving the City's ambitious GHG target through local actions alone. The results help to highlight action areas that will need further analysis or implementation support to fully achieve the City' GHG target through local actions, or can be reviewed to understand the amount of external action needed to demonstrate target achievement (e.g., carbon offset purchases and strategic land use changes).

The S/CAP's other key action categories are Water, Climate Adaptation and Sea Level Rise, Natural Environment, and Zero Waste, and are not primary sources of GHG reductions but do provide additional sustainability benefits to the community. These actions were evaluated to understand their potential community co-benefits and are discussed further in the Sustainability Actions section and in the Palo Alto Action Evaluation Memo from February 2021.

This memo presents details on the action impact analysis process, including descriptions of the emissions forecasts, key action analysis results, modeling approach, and detailed action results. It concludes with recommendations for next steps and an appendix listing the titles and descriptions for the key actions modeled in this impact analysis.

Emissions Forecasts

The action impact analysis is based on an estimate of how the City's emissions could change within the S/CAP analysis period. As part of this effort, AECOM developed a "business-as-usual" (BAU) emissions forecast to estimate how emissions could change over time if no further climate action was taken. This scenario estimated local emissions change through 2040 if no further climate action is taken at the federal, state, or local levels; it assumes implementation levels of current policies and programs as of 2019 would remain constant into the future (i.e., climate policies and programs would be maintained but not enhanced in scope beyond 2019 implementation levels). This BAU forecast scenario shows that emissions would decrease 47% below 1990 levels by 2030. This scenario analysis helps to demonstrate the amount of additional GHG reductions needed by 2030 from local S/CAP actions to achieve the City's GHG target.

However, as part of the action analysis, the City hired a separate consultant to evaluate the potential impact and costs associated with key EV actions. During that analysis, EV adoption estimates were further revised to improve upon the initial BAU scenario to better reflect Palo Alto's local EV adoption rates more accurately. The BAU forecasts were based on EV uptake estimates from the California Air Resources Board's EMFAC tool[90], which were based on 2015-17 survey data and provided at the county level. The City's EV consultant developed a revised BAU scenario with data showing there would be even greater EV travel in Palo Alto than estimated in the BAU scenario. The results of the revised BAU scenario show a 51% decrease below 1990 levels by 2030. This improvement upon the initial BAU scenario further refined the estimate of local GHG reductions needed from key S/CAP actions and helped to improve EV modeling result outputs to better align with Palo Alto-specific trends in EV adoption.[91]

Key Action Analysis Results

After developing the forecasts and quantifying the emissions reduction gap between the forecasts and the 2030 target, the City defined multiple policy opportunities to provide local emissions reductions. Most City emissions come from on-road transportation (60%) and building energy use (33%), so the City placed a greater emphasis on defining key actions to enhance building electrification (e.g., reduction in natural gas use), promote EVs, and reduce vehicle miles traveled. The City identified viable key actions in these sectors and developed three policy scenarios to understand effectiveness under different implementation plans. The City with its consultant teams then developed four detailed calculation models to understand action impacts related to residential buildings, non-residential buildings, mobility, and electric vehicles to quantify emissions reductions and cost impacts of the key actions and policy scenarios modeled. The final policy scenario and associated actions selected represent the most technically feasible and cost-effective pathway to reaching the City's 80 x 30 goal and results in a 71% reduction compared to 1990 levels by 2030. The BAU forecast scenarios, key S/CAP action impacts, and

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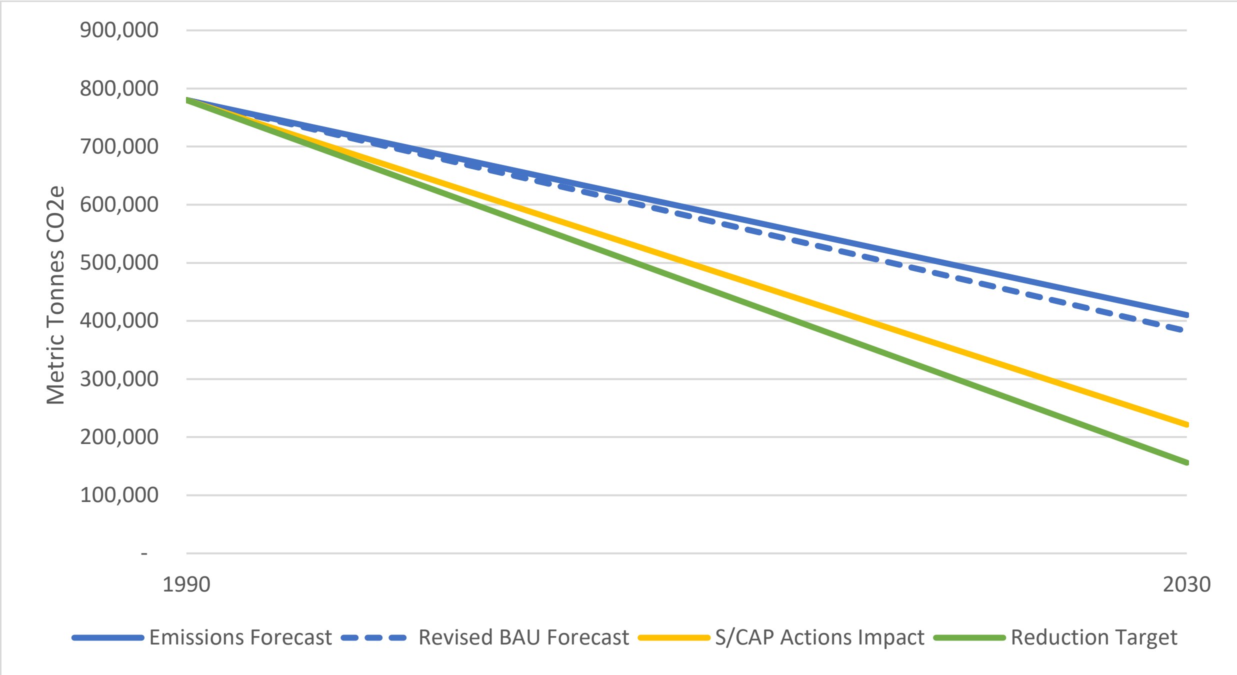
[90] https://arb.ca.gov/emfac/

[91] An original estimate of the 2019 non-residential versus residential VMT split was provided by Fehr & Peers (75%/25%), which informed the emissions analysis presented in the City's April 19th Staff Report. On 5/26/2021, this VMT split was updated with the City's Electric Vehicle consultant's revised value of 70%/30%. Changing this value had a minimal impact on the EV emission calculations. This change decreased total 2019 emissions by 822 MT CO_2e or 0.2%. Therefore, there is a slight discrepancy between previously published 2019 inventory values (482,327 MT CO_2e) and those published after 5/26/2021 (481,505 MT CO_2e).

reduction target are compared in Figure 1 below. The gap between the yellow action impact line and the green target line in Figure 1 illustrates the remaining emissions reductions needed to achieve the City's 2030 GHG target.

Figure 1. Emissions Forecasts and Reduction Target



The suite of key actions represented in Figure 1 and ranked by GHG reduction impact in Table 1 below. Note that due to modeling limitations, GHG reductions were not quantified for specific mobility and EV actions and were instead applied to each traveler category (i.e., residents, commuters, visitors). Therefore, the actions contributing to reductions in those categories are collectively called "Mobility actions" or "EV actions" in Table 1.

Table 1. S/CAP GHG Reduction Actions

RANK	ACTION	GHG REDUCTION (MT CO_2E/YR)
1	EV Actions – Commuter and Visitor	52,715
2a	Electrify single-family homes through gas main disconnect and all-electric mandate for single-family residential substantial remodeling projects	49,500
2b	BAU policies that are not implemented[92]	-6,491
3	EV actions - Residents	39,324
4	Non-residential electrification of mixed-fuel rooftop packaged units	10,234
5	Mobility actions - Commuters	15,157
6	Mobility actions - Visitors	8,642
7	Mobility actions - Residents	4,392
8	Non-residential buildings ≥25k sq. ft. reduce GHG emissions by 20%	6,127
9	K-12 electrification of space and water heating	3,376
10	Multi-family residential mandate end-of-life in-unit space heating and cooking electrification	1,197
	Total	**184,173**

The actions listed above achieve a 71% reduction below 1990 levels by 2030, nearly demonstrating 2030 target achievement. These strategies include technically feasible and cost-effective local actions in the buildings and transportation sectors. Additional key actions in sectors that have a smaller emission impact, such as the solid waste and wastewater sectors, were developed and assessed for co-benefit

[92] BAU reductions that will not occur due to implementation of City actions reflected in action 2a; these BAU reductions are entered back into this table to avoid double counting GHG emission reduction potential from the BAU and S/CAP actions.

impacts but have not been included in the detailed GHG analysis (see the Sustainability Actions section for further discussion). Other emissions sources accounted for in the BAU forecast scenarios cannot be directly impacted by the City or reduced based on current technologies, such as aviation travel. Additionally, there are remaining emissions within the buildings and transportation sectors as they cannot feasibly be fully reduced by 2030.

Therefore, considering the emissions reductions from local actions only would result in a 9% gap between the S/CAP action impact scenario and the City's 2030 GHG target. The remaining emissions can be balanced through some combination of enhanced action implementation, sequestration, carbon offset purchases, and/or industrial-scale carbon removal (see Recommendations section for further discussion).

Model Development

Following key GHG action definition, AECOM and the City collaborated to identify a method for analyzing the GHG and cost impact of each action. AECOM first reviewed publicly available GHG calculators, including CURB and ClearPath, and discussed the relative strengths, weaknesses, and desired project outputs with the City team. The City ultimately decided to develop four customized GHG models (Residential Buildings, Non-Residential Buildings, Mobility, and Electric Vehicles) that more directly reflect the City's specific context and opportunities and enabled the calculation of full life-cycle costs and financing options. The City Utility Department staff and AECOM team collaborated to develop the Residential and Non-Residential Buildings models. The City transportation staff led development of the Mobility model, with strategic review and guidance provided by the AECOM team.[93] And, the City hired a separate consultant to develop the EV model. Each team then used the models to analyze the GHG reduction potential, costs, and savings for the selected key actions, and collaborated through technical review meetings to ensure model outputs were aligned with one another and with the City's GHG inventories and BAU forecasts.

Using the four GHG models, the City developed three policy scenarios that varied the implementation and uptake rates of the selected actions. Due to on-road transportation modeling limitations, the Electric Vehicle and Buildings models assessed each of the three policy scenarios separately, while the Mobility model only evaluated one scenario; the mobility key actions and implementation rates represent what City staff determined is both ambitious and feasible for the City to implement.

To reasonably calculate the local impact of each key action, the teams made informed assumptions on the actions' effectiveness and implementation uptake (or participation) rates based on the best available local data. When local data was not available, broader regional market data was used. As the effectiveness of the actions can also depend on other changing regional, state, or national factors, such as policy decisions, economic growth, and cultural shifts, adjusting the assumptions to account for these factors can increase or decrease the impact estimations.

[93] Note that budget constraints prevented the use of the VTA Travel Demand Model to analyze the proposed mobility key actions. Subsequent analyses of key actions should utilize the VTA model to simulate the interrelationship between Palo Alto's land use patterns and transportation infrastructure and consider scenarios that could amplify GHG reductions.

Each models' methodology and output metrics vary and are presented in a consolidated table in the following section. The City team has also developed technical memorandums for each model to document model development, assumptions, data sources reviewed, and model use to guide future S/CAP updates or modeling revisions based on implementation tracking information and new data sources.

Detailed Action Results

ACTION IMPACT TABLE

Actions were grouped into one of three sectors depending on the model in which they were assessed: Buildings, Mobility, or Electric Vehicles. Extensive research and analysis was completed to estimate the following for each action:

- Annual GHG reductions
- Implementation metrics
- Cumulative Costs from 2020-2030
- Cumulative Savings from 2020-2030
- Co-benefits

Note: Some of the actions included in Table 2 may require further legal analysis or require legislative or regulatory change before they can be fully implemented. The final versions of the Key Actions are included in Section 5.

Table 2 on the following pages lists relevant metrics for all key actions (see Appendix A for detailed action descriptions). The sub-sections following Table 2 describe each metric in the action impact table. All metrics consider implementation from the beginning of 2020 to the end of the 2030 calendar year. Note that Mobility actions were individually analyzed for costs and co-benefits. However, to follow the Action Impact Table format, Mobility actions were aggregated by sector. Therefore, the individual costs and co-benefits were also aggregated at the sector level. Finally, the co-benefits column of Table 2 uses colored text to denote co-benefit impacts as shown in the legend below:

Co-Benefit Legend
Very Positive
Somewhat Positive
Somewhat Negative
Very Negative

Table 2. Action Impact Table

Buildings						
Sector	**Actions**	**Co-Benefits**	**Cumulative Costs (2020-2030)**	**Cumulative Savings (2020-2030)**	**Implementation by end of 2030**	**Annual GHG Reductions by 2030**
Single Family	All-electric mandate for residential substantial remodeling projects	Air Quality, Public Safety, Lifecycle Emissions	None	$0.22 million	846 gas water heaters replaced with electric heat pumps (6% of total gas water heaters converted) 900 gas space heaters replaced with electric heat pumps (7% of total gas space heaters converted) 900 gas cooktops replaced with induction cooktops (6% of total gas cooktops converted) 900 gas dryers replaced with electric (17% of total gas dryers converted) 333 electric panel upgrades needed (6% of panels needing upgrades)	43,009 MT CO_2e/yr**
	Electrify single-family homes	Air Quality, Public Safety, Lifecycle Emissions, Cost of Living, Equity	$322.34 million*	$3.00 million	11,226 gas water heaters replaced with electric heat pumps (81% of total gas water heaters converted) 9,766 gas space heaters replaced with electric heat pumps (77% of total gas space heaters converted) 12,147 gas cooktops replaced with induction cooktops (83% of total gas cooktops converted) 3,199 gas dyers replaced with electric (60% of total gas dryers converted) 3,467 electric panel upgrades needed (63% of panels needing upgrades)	

Multi-Family	Mandate end-of-life in-unit space heating and cooking electrification	Air Quality, Public Safety, Lifecycle Emissions	\$15.76 million*	\$0.34 million	1,755 in-unit gas furnaces replaced with electric heat pumps (20% of total in-unit gas furnaces) 385 gas cooktops replaced with induction cooktops (15% of total gas cooktops) 1,053 electric panel upgrades needed (17% of electric panels that need upgrade)	1,197 MT CO_2e/yr***
K-12	K-12 electrification of space and water heating	Air Quality, Public Safety, Lifecycle Emissions	\$19.00 million	\$1.12 million	100% of schools with gas space and water heating have converted to electric systems	3,376 MT CO_2e/yr
Non-Residential	Electrification of mixed-fuel rooftop packaged units	Air Quality, Public Safety, Lifecycle Emissions	\$174.57 million	\$7.56 million	100% of commercial spaces with gas rooftop packaged heating have converted to electric heating	10,234 MT CO_2e/yr
	Buildings ≥25k sq. ft. reduce GHG emissions by 20%	Air Quality, Public Safety, Lifecycle Emissions	\$ 84.45 million	\$4.56 million	100% of commercial buildings 25k sq. ft. and larger without gas rooftop packaged heating have reduced GHG emissions by 20%	6,127 MT CO_2e/yr

*Includes necessary electric panel upgrade costs

** Single family GHG reductions include electrification of other natural gas sources that were not accounted for in the Buildings model as well as assumptions on all-electric single-family new construction and voluntary electrification at end-of-useful life; this value represents the sum of actions 2a and 2b from Table 1 to avoid double counting of reductions assumed between the BAU scenario and S/CAP actions scenario

*** Includes GHG reduction assumptions on multifamily all-electric new construction

<table>
<tr><th colspan="7">Mobility</th></tr>
<tr><th>Sector</th><th>Actions</th><th>Co-Benefits</th><th>Cumulative Costs (2020-2030)</th><th>Cumulative Savings (2020-2030)</th><th>Implementation by end of 2030</th><th>Annual GHG Reductions by 2030*</th></tr>
<tr><td>Parking and Congestion</td><td>Eliminate free parking, adjust parking requirements, RPP permitting allowances, institute paid parking, and price commuter parking</td><td>Air Quality, Public Health, Public Safety, Regional Benefit, Resource Conservation, Lifecycle Emissions, Cost of Living, Productivity</td><td>$7.09 million</td><td rowspan="4">Residents: $10-16 million

Commuter: $49-58 million

Visitor: $17-30 million</td><td rowspan="4">Resident: 12-18 million VMT reduced in 2030 (4-6% VMT reduction in 2030)

Commuter: 54-63 million VMT reduced in 2030 (16-19% VMT reduction in 2030)

Visitor: 22-36 million VMT reduced in 2030 (6-10% VMT reduction in 2030)</td><td rowspan="4">Resident: 4,392 MT CO_2e/yr

Commuter: 15,157MT CO_2e/yr

Visitor: 8,642MT CO_2e/yr</td></tr>
<tr><td>Biking and Walking</td><td>Implement Bike Master Plan, develop Safe Routes for Adults program, adopt a Vision Zero Plan and install multi-use paths, conduct feasibility study on protected bike infrastructure, increase bike facilities and protected intersections, continue Safe Routes to Schools program, complete Quarry Road Extension, develop bicycle highways</td><td>Air Quality, Public Health, Public Safety, Regional Benefit, Resource Conservation, Equity, Lifecycle Emissions, Cost of Living, Productivity,</td><td>$54.38 million</td></tr>
<tr><td>Community Engagement</td><td>Community engagement and policy adoption</td><td>N/A</td><td>$0.80 million</td></tr>
<tr><td>Transit and Intersections</td><td>Reduce speed limits, install transit signal priority equipment, add bus rapid transit lanes, provide on-demand transit service, enhance traffic signals, allocate funding to TMA</td><td>Air Quality, Public Health, Public Safety, Regional Benefit, Resource Conservation, Cost of Living, Productivity, Equity, Lifecycle Emissions</td><td>$13.03 million</td></tr>
</table>

VMT = vehicle miles traveled

*GHG estimates are for the higher VMT reduction value. These GHG reduction calculations can be found in the EV model.

Electric Vehicles

Sector	Actions	Co-Benefits	Cumulative Costs (2020-2030)	Cumulative Savings (2020-2030)*	Implementation by end of 2030	Annual GHG Reductions by 2030*
Resident	Residential EV credit (free charging)	Air Quality, Lifecycle Emissions, Public Health, Regional Benefit, Resource Conservation, Cost of Living, Equity	EV Charging Costs: Single Family: $11.18 million Multi-family: $23.84 million	Savings from Vehicle Improvement: $182.63 million	85% of new vehicle sales are EVs 55% of Resident VMT are from EVs 20,060 total residential EV charging ports installed	39,324 MT CO_2e/yr
	ICE usage fee	Air Quality, Public Health, Lifecycle Emissions, Regional Benefit, Resource Conservation, Cost of Living				
	Multi-family residential charger installation mandate	Air Quality, Public Health, Lifecycle Emissions, Regional Benefit, Resource Conservation, Equity				
	Low income charger installation incentive	Air Quality, Lifecycle Emissions, Equity, Public Health, Regional Benefit, Resource Conservation, Cost of Living				
Commuter	Alternative Commute Mandate	Air Quality, Lifecycle Emissions, Public Health, Regional Benefit, Resource Conservation	EV Charging Costs: $96.72 million	Savings from Vehicle Improvement: $59.04 million**	40% of Commuter VMT are from EVs 11,057 total workplace EV charging ports installed	52,715 MT CO_2e/yr
	Alternative Commute Incentive	Air Quality, Cost of Living, Public Health, Regional Benefit, Resource Conservation, Lifecycle Emissions, Equity				

	Workplace EV Parking	Air Quality, Public Health, Regional Benefit, Resource Conservation, Lifecycle Emissions				
Visitor	Preferred Parking	Air Quality, Public Health, Regional Benefit, Resource Conservation, Lifecycle Emissions	EV Charging Costs: $16.71 million	Savings from Vehicle Improvement: $49.76 million**	30% of Visitor VMT are from EVs 1,542 total public EV charging ports installed	
Education	Local/Targeted campaigns	Equity	NA	NA	These policies support the implementation metrics above	These policies support the GHG reductions above
	Regional/Statewide campaigns (ABAG/MTC)	Equity				
Mobility	Provide incentives for purchase and usage of LEVs and E-bikes	Air Quality, Public Health, Cost of Living, Regional Benefit, Resource Conservation, Lifecycle Emissions, Equity				
Fleet	Electrification of municipal fleet, buses, and delivery trucks/vans	Air Quality, Public Health, Regional Benefit, Resource Conservation, Lifecycle Emissions				

*Savings and GHG reductions include both EV penetration assumptions and fossil fuel vehicle emissions and MPG improvements
**Only considering savings from miles associated with Palo Alto

ANNUAL GHG REDUCTIONS

"Annual GHG Reductions by 2030" represent the emissions avoided in 2030 by implementing the specific policy action. This metric represents the estimated amount of emissions reduced compared to a business-as-usual scenario where no policy action was implemented by 2030. For reference, Table 1 lists all actions in order of their GHG reduction potential.

Buildings

To estimate the GHG reduction from building electrification actions, assumptions were made for general city building stock characteristics. This includes estimates for the number of single family homes with natural gas systems, annual number of end-of-life system replacements, annual gas use per unit, annual electric use per unit, non-residential natural gas consumption per square foot, and non-residential electric use per square foot. Some of this information was available from Utility Department data, while others were collected by the City and AECOM teams from various databases and building energy surveys to help describe the local building energy use context.

Assumptions were also made for the implementation rates of individual policy actions. For example, the implementation of the "All-electric mandate for residential substantial remodeling projects" action includes assumptions for the percent of homes that would be substantially remodeled from 2020-2030. This assumption was informed by historic City permit data describing building remodels. The annual 2030 GHG reduction from this action represents the emissions avoided assuming those homes still contained natural gas systems in 2030.

Single-family actions were aggregated to estimate total GHG reductions. The Buildings model only accounted for natural gas consumption from space heating, water heating, and stoves and did not consider other natural gas sources such as pool heaters or barbecue grills. Therefore, the single-family GHG reductions were aggregated to include the electrification of other sources of natural gas consumption that weren't accounted for in the Building models. Additionally, in order to account for other impactful emissions reductions, both the single-family and multi-family GHG reductions include reductions from all-electric new construction. Single-family GHG reductions also include reductions from voluntary electrification of appliances at end of useful life. The new construction and voluntary electrification GHG reduction values are disaggregated within the Building model.

As electricity in Palo Alto is 100% carbon neutral,[94] any system that is electrified (e.g., converted from natural gas to electricity) in the City will produce net zero emissions after the retrofit is complete. Therefore, emissions reductions were derived from the amount of natural gas the original system would have consumed in 2030, which would be avoided through the electrification action.

Mobility

Mobility GHG reductions could not be disaggregated by specific actions but were instead grouped by residential, commuter, or visitor categories. All mobility actions were assumed to contribute to a minimum and maximum percent vehicle miles traveled (VMT) reduction for each user category, as

[94] "100% Carbon Neutral" means that the City "will demonstrate annual net zero greenhouse gas (GHG) emissions…by applying the average hourly carbon emissions intensity of the electricity on the CAISO grid to the City's net load for each hour of the year." See Resolution 9913, Resolution of the Council of the City of Palo Alto Amending the Electric Supply Portfolio Carbon Neutral Plan and the Electric Utility Reserves Management Practices

calculated in the Mobility model.[95] The maximum percent VMT reduction values were then applied to the 2030 forecasted VMT in the EV model to develop 2030 S/CAP action maximum VMT reductions. 2030 vehicle emissions factors were internally developed in the EV model using data on vehicle ownership and sales as well as local EV actions. These factors account for vehicle fleet composition and forecasted local EV penetration for each user category. The emission factors were applied to the maximum 2030 S/CAP action VMT reduction amount to develop the maximum 2030 GHG reduction for each user category, as shown in the EV model.

Electric Vehicles
GHG reductions from EV actions could not be disaggregated by specific action but were instead grouped by residential or commuter + visitor (non-residential) categories. After Mobility action VMT reductions were applied to the 2030 forecasted VMT, EV actions were applied to the remaining VMT. The internally developed 2030 emissions factors used for the Mobility actions also account for higher EV penetration due to local EV action. These emission factors were applied to the remaining 2030 S/CAP action VMT to develop total 2030 S/CAP EV action emissions. These emissions were then compared to the original BAU 2030 emissions scenario that applied the BAU emissions factor to the remaining 2030 VMT that was used in the EV action scenario. The BAU emissions factor was higher than the S/CAP EV action emission factor because it does not assume the high level of local EV penetration that additional market data suggest is occurring. The difference between the 2030 BAU emissions and the 2030 S/CAP EV action emissions is the amount of GHG emissions reduced from Palo Alto EV actions in 2030.

IMPLEMENTATION METRICS

The “Implementation Metrics” for each action are directly related to the estimated GHG reductions and illustrate the action uptake or technological transformation that could be achieved. Like the GHG reduction estimations, the implementation metrics depend on the set of policy assumptions that were used in each model. While the implementation metrics of the Building actions were generated by the models after the policy implementation rates were entered, the implementation metrics of the Mobility and EV actions were inputs based on extensive research for each policy. All implementation metrics are compared to a BAU 2030 forecast year. The implementation metrics can be useful in tracking future S/CAP action implementation progress.

CUMULATIVE COSTS AND SAVINGS

“Cumulative Costs and Savings from 2020-2030” represent the average net costs and savings to the community. Costs and savings are presented as cumulative instead of annual as typical annual values vary depending on when the action is enacted, the implementation rate, and how upfront costs are considered in annual averages. Cost and savings should be considered during action prioritization because they help demonstrate the feasibility and acceptability of GHG reduction actions. For example, policies that result in high GHG reduction may be too costly to implement or policies may result in a net positive financial benefit to residents due to long term fuel or energy savings.

Overall, reducing vehicle emissions through use of EVs and alternative travel (e.g., transit, biking, walking) are the most cost-effective measures. Of the building electrification actions analyzed, single-

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[95] The mobility model has not factored in land-use changes. But land use choices towards more transit-supportive, walkable, bikeable neighborhoods will multiply and accelerate the VMT reductions estimated in the model.

family residential water heating and space heating electrification is most cost-effective, along with electrification of commercial rooftop packaged heating, ventilation, and air conditioning (HVAC) units. The costs and savings considered in each model are explained below.

Buildings
Building actions include costs for electrifying natural gas heating systems. The residential action costs include costs for the necessary electric panel upgrades while the non-residential actions do not. Savings include utility bill savings from using electricity instead of natural gas for heating. Cost estimates differ between each action depending on the assumed number of conversions from each policy and the timing of policy implementation.

Mobility
Mobility actions include costs for implementing each specific group of actions. Disaggregated costs by sub-policies are also available within the Mobility model. Savings reflect reduced gasoline expenditures and decreased vehicle maintenance and are only available at the residential, commuter, or visitor user level, not the policy level.

Electric Vehicles
Electric Vehicle costs and savings are available at the resident, commuter, or visitor user level, not policy level. Costs only include the price of EV charger installations that may result from action implementation. Savings reflect reduced gasoline expenditures from purchasing EVs or from traveling in more fuel-efficient vehicles. The commuter and visitor savings only consider the miles traveled associated with Palo Alto.

CO-BENEFITS

Palo Alto selected nine co-benefit evaluation criteria (revised through public feedback) that align with community priorities and apply to multiple S/CAP issue areas (e.g., Energy, Electric Vehicles, Zero Waste). These criteria include air quality, public health, public safety, regional benefit, resource conservation, lifecycle emissions, cost of living, productivity, and equity. For a given action, each of the nine chosen co-benefits was rated on a qualitative ranking scale based on the degree to which implementation of the action will positively or negatively impact the co-benefit. The Action Impact Table shows if the action has a very positive, somewhat positive, somewhat negative, or very negative impact on that specific community co-benefit. Any co-benefits receiving a neutral or no impact rating are not shown. This analysis can ultimately inform the City's final prioritization of its near-term climate actions selected to help achieve the 2030 GHG reduction target.

Please see the *Palo Alto Action Evaluation Memo* for detailed discussion of this process. Between the time the *Action Evaluation Memo* was compiled, and the action impact analysis was completed, some actions were repackaged, and new actions were developed. These actions received new co-benefit ratings and are not reflected in the original memo.

Sustainability Actions

The primary GHG reduction actions selected focus on buildings and transportation as these sectors generate 93% of total City emissions. Actions in sectors that have a small emission impact, such as solid waste and wastewater, have not been included in the detailed GHG reduction analysis. This is because GHG mitigation actions in these sectors have already been implemented, such as updating wastewater treatment processes and collecting landfill gas. The City also developed natural environment actions such as increasing tree coverage and green infrastructure. These actions can reduce GHGs by sequestering carbon, but the actual emissions reductions are difficult to quantify and require further analysis. The City is primarily focused on directly reducing emissions first before turning to sequestration actions to address remaining emissions (see Recommendations section). Finally, the City has developed climate adaptation and sea level rise actions. These do not reduce GHG emissions but do help protect against the impact of climate change. Therefore, these sustainability actions have only been analyzed for their co-benefits.

Generally, the sustainability actions scored positively for their impact on the Resource Conservation and Regional Benefit criteria. This is because these actions were primarily focused on conserving local resources, such as water, trees, food, and materials, while benefiting surrounding communities through larger planning processes. A summary of action ratings for each action sector is presented below:

- Water Actions: Generally scored very positive for Resource Conservation and positive for Regional Benefit.
- Climate Adaptation and Sea Level Rise Actions: Generally scored very positive for Regional Benefit.
- Natural Environment Actions: All scored positively for Resource Conservation and generally scored positively for Regional Benefit. However, the “WELO Requirements of Native and Drought Tolerant Species” action received a somewhat negative Cost of Living score.
- Zero Waste Actions: All scored positively for Resource Conservation and generally scored positively for both Cost of Living and Regional Benefit.

Recommendations

Implementing the building, mobility, and transportation actions will reduce emissions by 71% below 1990 levels by 2030, leaving an 9% gap between the S/CAP action impact scenario and the City’s emissions target of 80%. Based on a review of the modeling results, the AECOM team recommends the City address remaining emissions through a combination of the following strategies:

- Identify which of the current building and transportation actions can be accelerated or enhanced beyond current implementation rates if additional barriers could be removed
- Evaluate local or regional carbon sequestration opportunities, understanding that fully balancing the City’s remaining emissions may not be feasible if sequestration action is strictly confined to the city limits. Actions that contribute to sequestration can be achieved through many of the City’s “Natural Environment” actions.
- Evaluate and monitor industrial carbon removal technologies as this industry continues to rapidly evolve.
- Purchase verified carbon offsets to fully balance the remaining emissions gap that cannot be addressed through the preceding strategies.

AECOM also recommends the City establish a carbon neutrality target and definition that achieves or exceeds the State’s timing for carbon neutrality (Note that the current California Executive Order B-55-18 aims to reach statewide carbon neutrality no later than 2045 but has not yet been codified into law). As inventory methodologies continually change over time, establishing a carbon neutrality target will also help overcome challenges associated with setting targets based on historic GHG inventories;

previous methodological changes will no longer over- or underestimate the amount of local action needed to achieve the City's target, because the City will be aiming to completely reduce all emissions. Additionally, a carbon neutrality target can be easier to convey publicly than a percent-based emissions reduction target.

To align with best practices in GHG reporting, the City has made additional methodological changes to its GHG inventory process, beginning with the 2019 inventory, which included estimating several new emissions sources that were not evaluated in the original 1990 inventory. AECOM recommends the City continue to prepare GHG inventories following the GPC protocol to more fully evaluate GHGs resulting from city activities and to support top-down S/CAP tracking based on total and sector emissions results. The City should also monitor and evaluate individual key action successes using the customized GHG models developed for this project or other appropriate models. Tracking progress for Mobility actions may require creation of more sophisticated models than are currently available, which would require additional staff and/or consultant effort. This will ensure progress monitoring is aligned with the GHG Action Impact analysis and can help identify opportunities for new actions or modeling improvements.

Appendix A

Note: Some of the actions included in Appendix A may require further legal analysis or require legislative or regulatory change before they can be fully implemented. The final versions of the Key Actions are included in Section 5.

MODEL	SECTOR	ACTION TITLE	ACTION DESCRIPTION
Residential Buildings	Single Family	All-electric mandate for residential substantial remodeling projects	Require major alterations (remodels) of single-family homes to meet all-electric requirements.
		Electrify single-family homes	Phase out fossil fuel use in existing buildings starting with areas that have older gas lines that need to be repaired or replaced. Explore ways to accelerate adoption through mandates, carbon pricing, or disconnecting natural gas distribution service to residential areas.
	Multi-Family	Mandate end-of-life in-unit space heating and cooking electrification	Mandate end-of-life in-unit space heating and cooking electrification.
Non-Residential Buildings	K-12	K-12 electrification of space and water heating	Electrify water heating and space heating in all K-12 facilities.
	Non-Residential	Electrification of mixed-fuel rooftop packaged units	Convert all rooftop gas packs on non-residential buildings to electric heat pump systems
		Buildings ≥25k sq. ft. reduce GHG emissions by 20%	Require all commercial buildings above 25,000 sq. ft. to meet a carbon emissions intensity target by occupancy class with a goal of reducing carbon emissions by 20%
Mobility	Parking and Congestion	Eliminate free parking	Reduce SOV use by eliminating free parking and adjusting parking requirements
		Adjust parking requirements	Study parking effects on GHG/VMT in S/CAP and modify parking requirements accordingly.
		RPP permitting allowances	All occupants and businesses of new office buildings that are required to provide their own parking should not be allowed to purchase RPP permits.
		Institute paid parking	Institute paid public and private parking and allow for sharing of existing parking resources.
		Price commuter parking	Price commuter parking in public garages so that transit is a competitive mode.

MODEL	SECTOR	ACTION TITLE	ACTION DESCRIPTION
	Biking and Walking	Implement Bike Master Plan	Reduce the current Palo Alto Resident transportation mode split of 64% Single Occupancy Vehicle (SOV) use for work trips to increase active transportation modes (walking, biking, and transit) by implementing the Bicycle + Pedestrian Transportation Plan, the Complete Streets policy, Vision Zero, and other programs to create safe streets for all road users, particularly vulnerable road users
		Develop Safe Routes for Adults program	Develop a Safe Routes for Older Adults program to address transportation needs of those 65+ years through fixed route and on-demand EV transit options, investing in walking and bicycling infrastructure, and promoting e-bikes/adaptive bikes/adult trikes for older adults. Aim for a 10% alternative mode share by Older Adults.
		Adopt a Vision Zero Plan and install multi-use paths	Adopt a Vision Zero plan to reduce injuries to all road users, particularly vulnerable road users. Reduce traffic injuries to zero.
		Conduct feasibility study on protected bike infrastructure	Conduct a feasibility study to determine candidate streets for protected bicycle infrastructure as this facility type addresses the “interested but concerned” population that would bike if separated from vehicular traffic.
		Increase bike facilities and protected bikeways	Increase the number of bike facilities, including bike parking and signalized intersections with bicycle accommodations (e.g. bicycle signal heads, bicycle detection, integrated bike/ped counters into signals, colored/buffered/protected bicycle lanes).
		Increase bike facilities and protected bikeways	Add protected bikeways to El Camino Real.
		Continue Safe Routes to Schools program	Continue the Safe Routes to School program that has an existing 68% active and shared mode split (bike, walk, carpool, transit), aim for 75% in 2030.
		Complete Quarry Road Extension	Complete the Quarry Road Extension to the PA Transit Center.
		Develop bicycle highways	Develop regional and local bicycle highways to provide uninterrupted bike commutes.
	Community Engagement	Community engagement and policy adoption.	Encourage the use of bike and/or scooter sharing, and the provision of required infrastructure throughout Palo Alto, especially at transit stations and stops, job centers, community centers, and other destinations.

MODEL	SECTOR	ACTION TITLE	ACTION DESCRIPTION
			Designate vehicle-free streets to encourage economic activity and recreational uses.
			Promote the use of bicycles or electric scooters for deliveries within the city.
			Promote walking and biking to local-serving retail.
			Work with PAUSD to reduce SOV trips by staff, students, and parents.
			Promote Telecommuting
	Transit and Intersections	Reduce speed limits	Reduce speed limits to 15mph on 25% of City streets for less bicyclist stress and more bicyclist and pedestrian friendliness and safety.
		Install transit signal priority equipment	Support Transit Signal Priority on transit routes.
		Add bus rapid transit lanes	Add Rapid Bus and queue jump lanes to El Camino Real.
		Provide on-demand transit service	Provide on-demand shuttle service within Palo Alto for neighborhoods not served by high-frequency transit.
		Enhance traffic signals	Enhance traffic signals to improve traffic flow and reduce idling and associated GHG emissions.
		Allocate funding to TMA	Fund the Palo Alto Transportation Management Association (TMA) with the goal of reducing SOV commute-trips citywide by 30%.
Electric Vehicles	Resident	Residential EV credit (free charging)	Annual electric bill discount for residential account holder who can show that an EV is registered at their home and used by the resident; rebate available for up to 2 vehicles per service address per year. Funding will vary depending on legally available options.
		ICE usage fee	Flat fee per ICE vehicle registered. Residents can opt in to submit make/model/odometer and the fee will be adjusted based on MPG and miles driven. Also useful as an education and communication tool. This action may be legally infeasible without legislative or regulatory change at the State level.
		Multi-family residential charger installation mandate	Require all MFR homes to install EV chargers that can serve all residents (minimum one level 1 charger per unit or one level 2 charger for every two units). Exemptions allowed. Current LCFS charger rebate made available. Funding beyond LCFS would be required.

MODEL	SECTOR	ACTION TITLE	ACTION DESCRIPTION
		Low income charger installation incentive	Provide additional funding for charging installation for low income households
	Commuter	Alternative Commute Mandate	Commercial building occupant annually reports the # employees, total # vehicles parked, and # EVs parked. Place limit on single occupancy ICE commuter vehicles
		Alternative Commute Incentive	Require commercial building owner/occupant to provide an annual cash incentive to commuters who use alternative transportation or drive EVs. They may also choose to charge a parking fee for ICE vehicles.
		Workplace EV Parking	Expand designated EV parking while capping/reducing ICE parking spaces
	Visitor	Preferred Parking	Designate zones (e.g. entire street, entire parking garage, or floor of garage) in high traffic areas for clean air vehicle (EV, PHEV, 40MPG+) parking
	Education	Local/Targeted campaigns	Increase awareness of benefits of EVs and rebates/incentives through local/targeted campaigns
		Regional/Statewide campaigns (ABAG/MTC)	Increase awareness of benefits of EVs and rebates/incentives through regional/statewide campaigns (ABAG/MTC)
	Mobility	Provide incentives for purchase and usage of LEVs and E-bikes	Provide incentives for purchase and usage of LEVs and E-bikes
	Fleet	Electrification of municipal fleet, buses, and delivery trucks/vans	Electrification of municipal fleet, buses, and delivery trucks/vans

D.4. AECOM S/CAP Action Evaluation Memo

AECOM
300 California Street, Suite 600
San Francisco, CA 94104
aecom.com

Project name:
City of Palo Alto S/CAP

Date:
February 11, 2021

AECOM Imagine it. Delivered.

To: Christine Luong, Karin North

CC: Vanessa Goh

Memo

Subject: S/CAP Action Evaluation Memo[96]

Introduction

The primary goal of Palo Alto's 2020 Sustainability and Climate Action Plan (S/CAP) is to develop actions that can reduce greenhouse gas (GHG) emissions 80% below the city's 1990 levels by 2030. Implementation of many S/CAP strategies will also likely provide additional co-benefits that may not be accounted for in a typical GHG analysis. For example, actions designed to address climate change can also improve local air quality, reduce the cost of living, or increase productivity. Assessing the impact of actions, whether positive or negative, against a selected set of co-benefits helps provide a holistic picture of the actions' broader impact. During the action development process, co-benefit evaluation can help identify opportunities to refine draft actions to increase their co-benefit impact. It can also be useful for an action prioritization process by providing various points of comparison between actions and can also be viewed alongside action feasibility evaluations if such an analysis is performed.

The City of Palo Alto selected nine co-benefit evaluation criteria (revised through public feedback) that align with community priorities and apply to multiple S/CAP issue areas (e.g., Energy, Electric Vehicles, Zero Waste). The criteria were used to qualitatively evaluate the draft S/CAP actions to demonstrate each action's impact on these community values. The results of this analysis can ultimately inform the City's final prioritization of its near-term climate actions selected to help achieve the 2030 GHG reduction target.

Evaluation Criteria

As a first step, AECOM and the City team developed a draft list of co-benefit criteria that reflected both municipal and community priorities. As the primary function of evaluation criteria is for action comparison, co-benefits were selected that applied broadly to different action types instead of only relating to a specific kind of action (e.g., a co-benefit of "Increased Mobility" would only apply to transportation actions, and would not be particularly useful in evaluating the relative impact of non-transportation actions).

The draft criteria were posted on the City's S/CAP website for review and public comment. Based on community

[96] Note: The results of the co-benefits analysis were used to prioritize and further refine the Key Actions. The co-benefits analysis was not updated after the Key Actions were further refined and uses version three of the Goals and Key Actions. The order and titles of the Key Actions used in the co-benefits analysis may differ from the final version of the S/CAP Goals and Key Actions.

feedback, the City modified the draft co-benefit definitions and added a new evaluation criterion to asses action impact on lifecycle emissions. The following table lists the final co-benefits and definitions used to evaluate the S/CAP actions:

Co-Benefit Criteria	Definition
Air Quality	Improve air quality through reduced exposure (indoor and outdoor) to particulate matter (PM2.5 and PM10), nitrous oxide (NO_2), ozone (O_3), sulfur dioxide (SO_2) or airborne toxins.
Public Health	Improve public health through reduced incidents of diseases and/or death attributed to increased active transport, water quality, etc. (Note: air pollution-related health impacts are included under Air Quality).
Public Safety	Improve public safety through reduced traffic, incidents of traffic accidents, gas leaks, and number of people/assets/services exposed to climate hazards such as flooding, extreme heat/cold, and extreme weather events.
Regional Benefit	Provide benefits that extend beyond the city, such as generating jobs, expanding the electric vehicle charging network, implementing flood reduction projects, etc.
Resource Conservation	Increase resource conservation through water conservation, material consumption and waste reduction, and natural environment conservation, creation, or regeneration.
Lifecycle Emissions*	Reduce emissions associated with the extraction, manufacture, and transport of fossil fuel energy resources (e.g., natural gas distribution, coal production, etc.).
Cost of Living	Reduce upfront costs and provide savings (e.g., utility costs, travel costs, etc.) to residents.
Productivity	Increase productivity through reduced commute times and reduced traffic, prioritized housing near transit, improved thermal comfort in buildings, reduced economic activity losses from climate-related events (e.g., flooding, power outages), etc.
Equity	Address an existing inequity in the community, such as disproportionate poor air quality, access to transit, flood risk, etc.

*Added after draft criteria were posted publicly

Evaluation Process

To evaluate climate actions, AECOM used the *C40 Cities Action Selection and Prioritization (ASAP) tool* and methodology available at: https://resourcecentre.c40.org/resources/action-selection-and-prioritisation. This excel-based software tool supports the climate action decision-making process by documenting actions and providing outputs to streamline action comparison. It is worth noting that the ASAP tool is designed to *support* decision-making, not to *make* decisions itself, and that different stakeholders can reach different conclusions when assessing the co-benefits of specific actions. The subjective and qualitative assessments facilitated through the ASAP tool are not intended to be perfect, but are helpful in highlighting important action impacts to consider during the S/CAP development process. The results from the tool can be used to further assess and prioritize actions as well as communicate the benefits and feasibility of the actions.

The ASAP evaluation process can be used to assess the impact of actions in three separate categories, including primary benefits (i.e., GHG emissions and/or climate risk reduction), co-benefits (e.g., public health, economic prosperity), and feasibility (e.g., authority level, financial need). For this project, the City only used the ASAP tool to evaluate action impacts in the co-benefit category. This provided additional action information to supplement a separate primary benefit analysis of the actions' GHG reduction potential.

The ASAP tool uses a Likert rating scale to quantitatively evaluate an action's co-benefit impact. For a given action, each of the nine chosen co-benefits was rated on a qualitative ranking scale based on the degree to which implementation of the action will positively or negatively impact the co-benefit. Each action and co-benefit pair received one of the five impact ratings shown in the table below:

Rating	Score	Rating Definition
Very Positive	2	The action has a positive impact across the community
Somewhat Positive	1	The action has a positive impact across a small portion of the community or a slightly positive impact across the entire community
Neutral	0	The action has no impact, the impact is unknown, or the positive and negative impacts may negate each other
Somewhat Negative	-1	The action has a negative impact across a small portion of the community or a slightly negative impact across the entire community
Very Negative	-2	The action has a negative impact across the community

AECOM and the City team clarified the definitions and ratings of each co-benefit criteria and integrated public feedback through a series of project meetings. Once the criteria were finalized, AECOM used the ASAP tool to rate each action for its impact on all co-benefit criteria, except for the Equity criterion which was evaluated by the City's internal S/CAP teams. The City's teams also reviewed AECOM's initial ratings and made adjustments based on their interpretation of the draft S/CAP actions. Below is an example of the Air Quality criterion rating scale and example actions that match each rating option; note that the first three example actions were draft S/CAP actions and the final two rating example actions are provided for comparison but were not included as draft S/CAP actions:

Criterion	Rating	Score	Rating Definition	Example Action
Air Quality: Improve air quality through reduced exposure (indoor and outdoor) to particulate matter (PM2.5 and PM10), nitrous oxide (NO_2), ozone (O_3), sulfur dioxide (SO_2) or airborne toxins.	Very Positive	2	The action has a positive impact across the community	Ban Registration of Gas Vehicles *Rationale*: *Applies to community-wide vehicle fleets*
	Somewhat Positive	1	The action has a positive impact across a small portion of the community or a slightly positive impact across the entire community	Electrify Municipal Fleet *Rationale*: *Applies to a small portion of total community vehicle fleet*
	Neutral	0	The action has no impact, or the impact is unknown	Community Outreach - EV Education *Rationale*: *Outreach/education/information is an indirect action – project team assumed no co-benefits associated with this action type*
	Somewhat Negative	-1	The action has a negative impact across a small portion of the community or a slightly negative impact across the entire community	Reduce Parking Pricing in Downtown/Commercial Districts (not a draft S/CAP action) *Rationale: Induces additional vehicle travel in a specific area*
	Very Negative	-2	The action has a negative impact across the community	Roadway Expansion to Decrease Congestion (not a draft S/CAP action) *Rationale: Induces additional vehicle travel across community*

Using a five-point rating allows a long list of potential actions to be evaluated relatively easily and consistently but can limit the amount of nuance that can be reflected in the evaluation process. Prior to action evaluation, AECOM and the City team established certain rating rules to ensure consistency when applying the action ratings to similar action types. In addition to the more generic rating rules, AECOM and the City team defined the following evaluation approaches for three special circumstances that apply to specific action types:

- EV charging installation and incentive actions will promote EV use and therefore indirectly impact Air Quality and Lifecycle Emissions, so similar actions received positive ratings for these co-benefit criteria.
- Any advocacy, outreach, education, plan creation, or assessment actions produce a neutral impact on

co-benefits unless they result from cooperating with neighboring agencies, in which case they received a positive rating for the Regional Benefit criterion.

- Electrification actions have the potential to both increase and decrease cost of living, so most of these actions received a neutral Cost of Living rating.

Results

The ASAP tool produces a series of scores and graphic outputs that aid in evaluating the strengths, weaknesses, and tradeoffs of the actions evaluated. These outputs enable comparison between actions to support decision-making and prioritization while intuitively communicating the benefits of individual actions to stakeholders and the public. *Note: The final versions of the Key Actions are included in Section 5.*

The following co-benefit criteria scoring chart displays the top 30 actions by co-benefit criteria scores*:

*The Health and Wellbeing category includes Air Quality, Public Health, and Public Safety; Environment includes Regional Benefit, Resource Conservation, and Lifecycle Emission; Economic Prosperity includes Cost of Living and Productivity; Inclusivity and Civil Society includes Equity; no Essential Public Services criteria were selected within the ASAP tool for use in Palo Alto

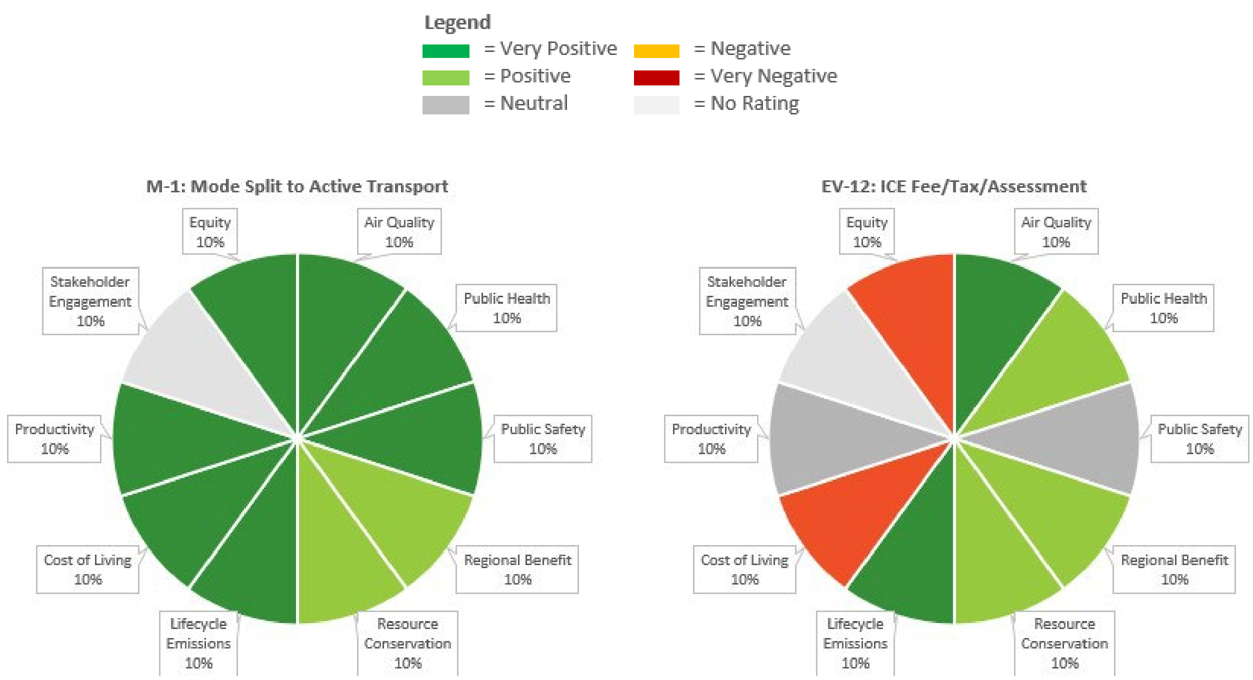
The highest-scoring actions identified in this chart include:

1. Mode Split to Active Transport
2. Transportation Demand Management (TDM) Program
3. Sea Level Rise (SLR) Adaptation Plan
4. Reduce Vehicle Miles Traveled (VMT) through Land Use

These actions produce the largest positive impact based on the selected co-benefits. Overall, no actions produced a net negative score for co-benefits. In particular, no actions scored negatively for the Air Quality, Public Health, Public Safety, Regional Benefit, Resource Conservation, Lifecycle Emissions, and Productivity criteria. However, some actions received negative scores in the Equity and Cost of Living criteria. The actions that received the lowest negative scores for these criteria include:

1. Internal Combustion Engine (ICE) Fee/Tax/Assessment
2. Natural Gas Disconnect in Residential Buildings by 2030
3. Ban Registration of Gas Vehicles
4. Single Occupancy Vehicle (SOV) Pricing

The ASAP tool also allows action co-benefits to be assessed individually in co-benefit pie charts. These charts provide a clear visual representation of the positive or negative impact of each action, and can be used to quickly compare the overall co-benefit evaluation results from one action to another Note that the ASAP tool allows users to weight certain criteria more heavily than others, which would result in variation in the pie chart wedge sizes; Palo Alto did not apply any co-benefit weighting in its analysis, so all co-benefits provide an equal share of the total evaluation score.



Appendix A on the following pages provides a color-coded summary table showing all rating results by action and evaluation criteria. *Note: Some of the actions included in Appendix A may require further legal analysis or require legislative or regulatory change before they can be fully implemented. The final versions of the Key Actions are included in Section 5.*

Legend

Very Positive
Somewhat Positive
Neutral/Unrated
Somewhat Negative
Very Negative

Action	Air Quality	Public Health	Public Safety	Regional Benefit	Resource Conservation	Lifecycle Emissions	Cost of Living	Productivity	Equity
E-1: Community Engagement - Electrification									
E-2: Electrification - Streamlined Permitting									
E-3: All-Electric Utility Rate									
E-4: Existing SFR Remodel Electrification									
E-5: Existing MF Retrofit - Gas Wall Furnace to Electric Heat Pump									
E-6: SF Home Sale - Electrification Evaluation and Education									
E-7: SFR Home Sale Electrification									
E-8: SFR Home Electrification									
E-9: Natural Gas Disconnect in Residential Buildings by 2030									
E-10: Residential Electrification On-bill Financing									
E-11: K-12 Electrifcation - Space and Water Heating									
E-12: Non-Residential Retrofit - Gas Packaged Rooftop Units to Electric Heat Pumps									
E-13: Non-Residential NC - All-Electric Mandate									
E-14: Public Buildings - 80% Electrification									
E-15: Existing Commercial >25,000 sq. ft. - Carbon Emissions Intensity Target									
E-16: Assess Opportunities - Distributed Energy/Micrograds									

Legend

Very Positive
Somewhat Positive
Neutral/Unrated
Somewhat Negative
Very Negative

Action	Air Quality	Public Health	Public Safety	Regional Benefit	Resource Conservation	Lifecycle Emissions	Cost of Living	Productivity	Equity
E-17: Identify Funding - Electrification Infrastructure Preparation									
E-18: Identify Funding - Building Electrification									
M-1: Mode Split to Active Transport									
M-2: Reduce SOV use through Parking Requirements									
M-3: Implement CIP Transit Projects									
M-4: Smart Traffic Signaling									
M-5: TDM Programs									
M-6: Reduce VMT through Land Use									
M-6a: Trees Along Pathways/Bikeways									
M-7: Private Transit GHG Reduction									
M-8: Support Telecommuting Infrastructure									
M-9: SOV Pricing									
M-10: Eliminate Gasoline Vehicle Use									
M-11: Advocacy of Transit Options									
EV-1: Incentivize Private EV Charging Stations									
EV-2: Charging Network Plan									

Legend

Very Positive
Somewhat Positive
Neutral/Unrated
Somewhat Negative
Very Negative

Action	Air Quality	Public Health	Public Safety	Regional Benefit	Resource Conservation	Lifecycle Emissions	Cost of Living	Productivity	Equity
EV-3: Electrify Municipal Fleet	Somewhat Positive	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Somewhat Positive	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated
EV-4: Community Outreach - EV Education	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated
EV-5: Advocate for State EV Rebate Program to Include Motorcycles/Bicycles	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Somewhat Positive	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Somewhat Positive
EV-6: Increase Light EV VMTs + Reduce ICE VMTs	Very Positive	Very Positive	Very Positive	Neutral/Unrated	Somewhat Positive	Very Positive	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated
EV-7: Plan to Encourage EV Adoption of Inbound Vehicles	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated
EV-8: Lower Electric Retail Rates for EV Charging	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Very Positive	Neutral/Unrated	Somewhat Positive
EV-9: Lobby State for Stricter Emission Standards	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Somewhat Positive	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Somewhat Positive
EV-10: MF Parking Spaces - 25% with EV Charging	Somewhat Positive	Somewhat Positive	Neutral/Unrated	Somewhat Positive	Neutral/Unrated	Very Positive	Somewhat Positive	Neutral/Unrated	Very Positive
EV-11: Existing Commercial Parking - EV Charing Requirements	Somewhat Positive	Somewhat Positive	Neutral/Unrated	Somewhat Positive	Neutral/Unrated	Very Positive	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated
EV-12: ICE Fee/Tax/Assessment	Very Positive	Somewhat Positive	Neutral/Unrated	Somewhat Positive	Somewhat Positive	Very Positive	Very Negative	Neutral/Unrated	Very Negative
EV-13: Electrify Private Bus Fleets	Somewhat Positive	Somewhat Positive	Somewhat Positive	Somewhat Positive	Somewhat Positive	Somewhat Positive	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated
EV-14: Ban Registration of Gas Vehicles	Very Positive	Very Positive	Neutral/Unrated	Somewhat Positive	Somewhat Positive	Very Positive	Somewhat Negative	Neutral/Unrated	Very Negative
EV-15: Evaluate Funding for EVs	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated
W-1: Education and Incentives - Water Efficiency	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Very Positive	Neutral/Unrated	Very Positive	Neutral/Unrated	Somewhat Positive
W-2: Water Reuse Project	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Very Positive	Very Positive	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated
W-3: Green Stormwater Infrastructure	Somewhat Positive	Somewhat Positive	Somewhat Positive	Neutral/Unrated	Very Positive	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated

Legend

Very Positive
Somewhat Positive
Neutral/Unrated
Somewhat Negative
Very Negative

Action	Air Quality	Public Health	Public Safety	Regional Benefit	Resource Conservation	Lifecycle Emissions	Cost of Living	Productivity	Equity
W-4: Salt Removal Facility	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Very Positive	Very Positive	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated
W-5: One Water Portfolio	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Somewhat Positive	Somewhat Positive	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated
W-6: Baseline and KPIs for Reduction of Impervious Surfaces	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated
A-1: SLR Vulnerability Assessment	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Somewhat Positive
A-2: SLR Adaptation Plan	Somewhat Positive	Very Positive	Very Positive	Very Positive	Very Positive	Neutral/Unrated	Neutral/Unrated	Very Positive	Somewhat Positive
A-3: Review SAFER Recommendations	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Somewhat Positive	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated
A-4: Discuss SLR Levee Alignment Alternatives with Surrounding Community	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Very Positive	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated
A-5: Coordinate Regionally, Act Locally	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Very Positive	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Somewhat Positive
NE-1: Tree Planting	Very Positive	Neutral/Unrated	Somewhat Positive	Somewhat Positive	Very Positive	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Very Positive
NE-2: New Construction Plant Selection - Biodiversity and Soil Health	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Somewhat Positive	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated
NE-3: Urban Forest Master Plan + Parks Master Plan	Very Positive	Neutral/Unrated	Very Positive	Somewhat Positive	Very Positive	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Somewhat Positive
NE-4: WELO Requirements for Native and Drought Tolerant Species	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Somewhat Positive	Neutral/Unrated	Somewhat Negative	Neutral/Unrated	Neutral/Unrated
NE-5: Green Stormwater Infrastructure Plan	Somewhat Positive	Somewhat Positive	Somewhat Positive	Neutral/Unrated	Very Positive	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated
NE-6: No Net Tree Canopy Loss	Very Positive	Somewhat Positive	Somewhat Positive	Somewhat Positive	Very Positive	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated
NE-7: Reduce Pesticides	Neutral/Unrated	Somewhat Positive	Neutral/Unrated	Neutral/Unrated	Somewhat Positive	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated
NE-8: Enhance Pollinator Habitat in Parks	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Somewhat Positive	Somewhat Positive	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated	Neutral/Unrated

Legend

Legend
Very Positive
Somewhat Positive
Neutral/Unrated
Somewhat Negative
Very Negative

Action	Air Quality	Public Health	Public Safety	Regional Benefit	Resource Conservation	Lifecycle Emissions	Cost of Living	Productivity	Equity
NE-9: Baseline and KPIs for Tree Carbon Storage									
ZW-1: Deconstruction and Construction Materials Management Ordinance									
ZW-2: Disposable Foodware Ordinance -- Eliminate Single-Use Cups and Containers									
ZW-3: Commercial Food Generators -- Require Food Waste Prevention and Recovery									
ZW-4: Residential Food Waste Reduction									
ZW-5: Incentivize Reusable Diapers									
ZW-6: Champion a Circular Economy									