17

City of Palo Alto

(ID # 6566)

City Council Staff Report

Report Type: Study Session **Meeting Date: 1/25/2016**

Summary Title: Sustainability/Climate Action Plan Study Session

Title: Study Session Regarding Ongoing Preparation of a Sustainability/Climate Action Plan (S/CAP) to Update and Replace the City's 2007 Climate Protection Plan

From: City Manager

Lead Department: City Manager

Recommendation

Staff recommends that the Council review and discuss the City's developing Sustainability and Climate Action Plan (S/CAP), including the proposed Greenhouse Gas (GHG) reduction goals and key measures regarding transportation, energy, and water.

Note: This is the first in a series of Council meetings on this subject scheduled for the spring of 2016. No Council action is proposed ay this time, but has been scheduled in the aftermath of the S/CAP summit to allow for Council discussion.

Summary

The Office of Sustainability, working with consulting partner DNV GL, has collected input from the community of Palo Alto, researched global best practices for greenhouse gas (GHG) emission reductions and resource conservation, and evaluated the cost/benefit ratios for a range of carbon reduction strategies. Based on that work, staff is pursuing development of a multi- faceted plan to deliver pace-setting GHG reductions and energy use strategies in ways that enhance quality of life, prosperity and resilience in Palo Alto. These measures should also reduce operating costs when implemented holistically, and deliver tangible economic, quality of service, and quality of life benefits to all residents.

This overview of the draft S/CAP includes potential key elements for Council's consideration and comment, with the understanding that the S/CAP is a long-term plan with varying time horizons for potential changes. It is clear that transportation and natural gas present our biggest challenges -- road transportation accounts for more than 61% of Palo Alto's remaining carbon footprint, while natural gas accounts for more than 25%—and that Palo Alto will be unable to achieve the State of California GHG reduction goals of 80% by 2050 without significantly reducing emissions from both these categories. (Key elements are summarized here, and described in more detail in the Discussion session that follows.)

- **Transportation: Make it more convenient not to drive** by developing responsive, multimodal, service-focused transportation services—and ending subsidies such as

free parking or shifting them to support non-SOV travel—to reduce congestion and climate impacts.

- **Electricity:** Support a systematic **shift from natural gas** to all-electric systems powered by carbon neutral electricity, wherever technically and legally feasible and cost- effective. Given the consumer costs and stranded costs to the Utility, this may require various transition strategies over time.
- **Buildings:** Explore **building stock upgrades** to Zero Net Energy or Net Positive through design, efficiency, renewables and bundled services packages, and (if technically and legally feasible and directed by City Council) encourage all-electric new construction.
- **Resource Efficiency:** Aggressively cut energy and water demand in buildings and operations, reduce emissions and impacts and save money for the residents, business, and the City with an emphasis on integrative design[1] and policy approaches to **drive large gains in resource efficiency[2].**
  - **Sustainable Water Management**: Balance water importation, rainwater harvesting, groundwater management, recycled water use and onsite treatment options in an integrated, long-term strategy.
  - **Municipal Operations: Embed sustainability** in city procurement, operations and management, including "default to green," adoption of internal carbon pricing and reporting of sustainability impacts in staff reports, capital improvement project proposals and management reports.
  - **Financing Strategies: Finance** cost-effective initiatives by pricing carbon, applying a portion of parking revenues to mobility alternatives, and channeling local and external investment in support of these goals.

Note that the legal and financial implications and cost-effectiveness, and degree of public support of these elements, and other elements throughout this report, will require detailed careful consideration and review, and are subject to Council direction.

Future staff analysis and reports will focus on:

- **Sea Level Rise Response: Build resilience** through risk mapping, mitigation, adaptation and, where necessary as a secondary response, retreat strategies.
- **Ecosystem and Human Systems Protection**: Provide a healthy, resilient environment where all species can thrive and enjoy life.
- **Buildings: Rapidly upgrade** the resource efficiency of residential and commercial building stock
- **Utility of the Future: Adapt CPAU** to the business model challenges facing the utility industry
- **Information systems: Advance "smart city"** platforms for transportation, utilities, buildings, operations, finance, etc.

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[1] "The conventional definition of integrated design is that project team members from all disciplines work together early and often throughout the project design process. The enhanced definition presented here includes what goes on when the design team gets together - the synthesis of climate, use, building design and systems." http://designsynthesis.betterbricks.com/what-integrated-design

[2] http://www.rmi.org/rmi/Whole%20System%20Thinking%20and%20Integrative%20Design

- **Community engagement**, Support household practices and behavior change and including expanded potential to reduce "scope three" emissions."[3]

Relationship to Comprehensive Plan

Staff received instruction from Council to synchronize with the City's ongoing Comprehensive Plan Update and provide a holistic approach to sustainability and climate action across all City activities. The City Council has also -- on several occasions -- indicated its desire to reflect sustainability and climate adaptation in the vision and goals of all elements of the Comprehensive Plan Update. Integration of these two plans will provide a policy framework and a roadmap for achieving emission and consumption reduction targets, and support the City's efforts to maintain ecosystems and biodiversity in our parks, gardens, forests and food systems, and provide a clear process for addressing community needs with high quality services.

As part of its review of the Comprehensive Plan, Council will want to discuss the format in the plan for linkage to the S/CAP and adopted sustainability goals.

Staff is asking Council to consider a portfolio of GHG emission reduction strategies that could collectively achieve GHG reductions at a faster pace than proposed by the State of California, which has set a reduction target of 80% by 2050, and an intermediate target of 40% by 2030. Could—and should—Palo Alto, which has already reduced emissions by an estimated 35%, seek to achieve the State's 80% reduction goal to be achieved earlier than 2050? What should that target be and what would be the requirements and implications of doing so?

As Council and community discuss the S/CAP and the options before us, we will need to consider several key questions:

Leadership: What level of GHG emission reduction goals will Palo Alto target?

Pace: How fast will Palo Alto attempt to achieve these reductions? **Implementation:** Which measures will Palo Alto enact to achieve these reductions? **Invest:** How much will Palo Alto invest?

Funding: How will Palo Alto fund those investments?

Criteria: What factors will Palo Alto use to make these decisions?

Organization of this report

Background: The Climate Challenge. Technology and the Pace of Change. Palo Alto History and Opportunities. Why Act Now. Objectives.

Discussion: Footprint. Ten Realms of Action. Key Levers: Rethinking Mobility; Electrifying Our City; Water. Other Levers: Buildings; Municipal Operations; Palo Alto Utilities; Information Technology; Engaging the Community; Ecosystems. Potential Sources of Funds. Key Questions. Timeline: Next Steps/Plan.

Environmental Review

NOTE: *This staff report provides a summary of the S/CAP, which is still a work in progress and*

[3] Indirect emissions, such as those resulting from purchased goods and services and air travel

provides substantially more detail than presented here. Given the complexity of the issues discussed, staff decided not to complete and circulate a draft plan until benefiting from Council and community input on general directions and issues. The full draft will be presented for future study sessions, at which Council will have the opportunity to go deeper into specific issues, the extensive quantitative analysis that supports them, and the requirements of both a 15-year strategic plan (including goals, key strategies and decision criteria) and a series of five-year action plans to implement them. The focus of this initial study session is to lay out the key components of the SCAP and strategies under consideration-- focusing more on identifying aspirations, priorities and concerns rather than detailed assessment of specific actions--and then come back to Council for deep dives on transportation, energy, water and adaptation (and other issues that Council may direct).

Background

Palo Alto is at the heart of the region that drives the eighth largest economy in the world, and what is created in Palo Alto has influence far beyond its borders. Palo Alto has made remarkable progress toward reducing its carbon impacts, GHG emissions and resource consumption since establishing one of the first Climate Protection Plans in the US in 2007.

In the eight years since then, the world has gotten hotter, the west has gotten dryer, and more cities have stepped into the ranks of climate leadership.

As the climate heats up, cities will need to act wisely in order to ensure the wellbeing of their communities in the face of the challenges ahead. Palo Alto can help show the way ahead, improve our community's quality of life and inspire changes elsewhere. Cities around the world are ratcheting up their own sustainability initiatives, and we can also learn and be challenged by their efforts.

In the course of developing this new Sustainability and Climate Action Plan, we face two fundamental choices with regard to climate:

- Will we move from carbon neutral electricity to a carbon neutral utility to eventually become a carbon neutral city (which will require major changes in transportation as well as energy use)?
- And how quickly will we do that?

The Climate Challenge

Science: The International Panel on Climate Change (IPCC) has determined that "we risk severe, pervasive and irreversible impacts" from climate change, and need "substantial" greenhouse gas emissions reductions (of 40-70% or more) by mid-century. The International Energy Agency has asserted that 80% of proven fossil fuel reserves must "stay in the ground" if the planet is to avoid the worst climate change projections. Meanwhile, climate disruption records continued to be broken in 2014, which was the warmest year recorded since 1880. Munich Re America reported that "Insured winter storm losses in the United States in 2014 were the highest in eight years, at $2.3 billion, while insured losses due to severe thunderstorm events exceeded

$10 billion for the sixth year in a row."[4] The UN World Meteorological Organization (WMO)[5] reported that high ocean temperatures contributed to exceptionally heavy rainfall and floods in many countries and extreme drought in others. Twelve major Atlantic storms battered the United Kingdom in early months of 2014, while floods devastated much of the Balkans throughout May. Crippling droughts have struck large swathes of the continental United States while Northeast China and parts of the Yellow River basin did not reach half of average summer rainfall, causing severe drought.

State of California: Assembly Bill 32 (the California Global Warming Solutions Act of 2006), committed the State to reduce its GHG emissions by 20% from 1990 levels by 2020, and Executive Order S-3-05, signed in June 2005, set an aspirational goal to reduce emissions 80% by 2050. The first scoping plan by the California Air Resources Board (CARB) detailed ways to achieve the AB32 goal; CARB's recent update addressed the need to accelerate reductions to meet the 2050 goal, and the need for local jurisdictions to meet or exceed the State's goals.[6]

Then in April 2015, Governor Jerry Brown issued Executive Order B-30-15 establishing a California GHG reduction target of 40% below 1990 levels by 2030.[7] Recent revisions to California's Title 24 will require that all new residential buildings be Zero Net Energy (ZNE) by 2020, and all new commercial buildings by 2030; this will apply to retrofit projects above certain thresholds.[8] Meanwhile, Governor Brown has challenged the state to increase the renewable portfolio standard (RPS) to 50% of needs, reduce petroleum up to 50% and double the efficiency of existing buildings by 2030.[9] A milestone climate change bill, SB 350, which passed in 2015, enshrined most of these proposals into law (though it was stripped of the goal to reduce petroleum use by 50% before it was passed). A companion bill, SB 32, which would have made the state's long-term targets for carbon emissions reductions, currently set by executive order, a matter of law, did not garner sufficient support and staff expects it will be re-introduced in 2016.

United States: President Obama's March 19, 2015 Executive Order[10] requires the federal government to cut GHG emissions by 40% by 2025 from 2008 levels and increase Federal renewable energy sources to 30%; budget savings from these initiatives are estimated at $18 billion. Several major federal suppliers, including Lockheed Martin, General Electric, and IBM, announced new voluntary GHG reduction commitments; IBM says it will cut energy-related GHG emissions 35% (against 2005 levels) by 2020. (Among local companies, HP has set a goal to reduce the GHG emissions from operations 20% by 2020 compared to 2010 levels and SAP plans a 51% reduction in its total GHG emissions from its year 2007 published baseline levels.)

Europe: The European Union has adopted an emissions reduction target of 40% below 1990 levels by 2030. The United Kingdom has committed to reduce its emissions by 50% below 1990

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4 http://www.claimsjournal.com/news/national/2015/03/04/262111.htm

5 http://www.un.org/apps/news/story.asp?News=49970#.VRm-yvnF-So

6 First Update to the Climate Change Scoping Plan: Building on the Framework Pursuant to AB32 – The California Global Warming Solutions Action of 2006

7 http://gov.ca.gov/news.php?id=18938

8 http://cleantechnica.com/2014/04/15/californias-net-zero-energy-building-will-reshape-us-construction-industry/

9 http://gov.ca.gov/news.php?id=18828

10 https://www.whitehouse.gov/the-press-office/2015/03/19/executive-order-planning-federal-sustainability-next-decade

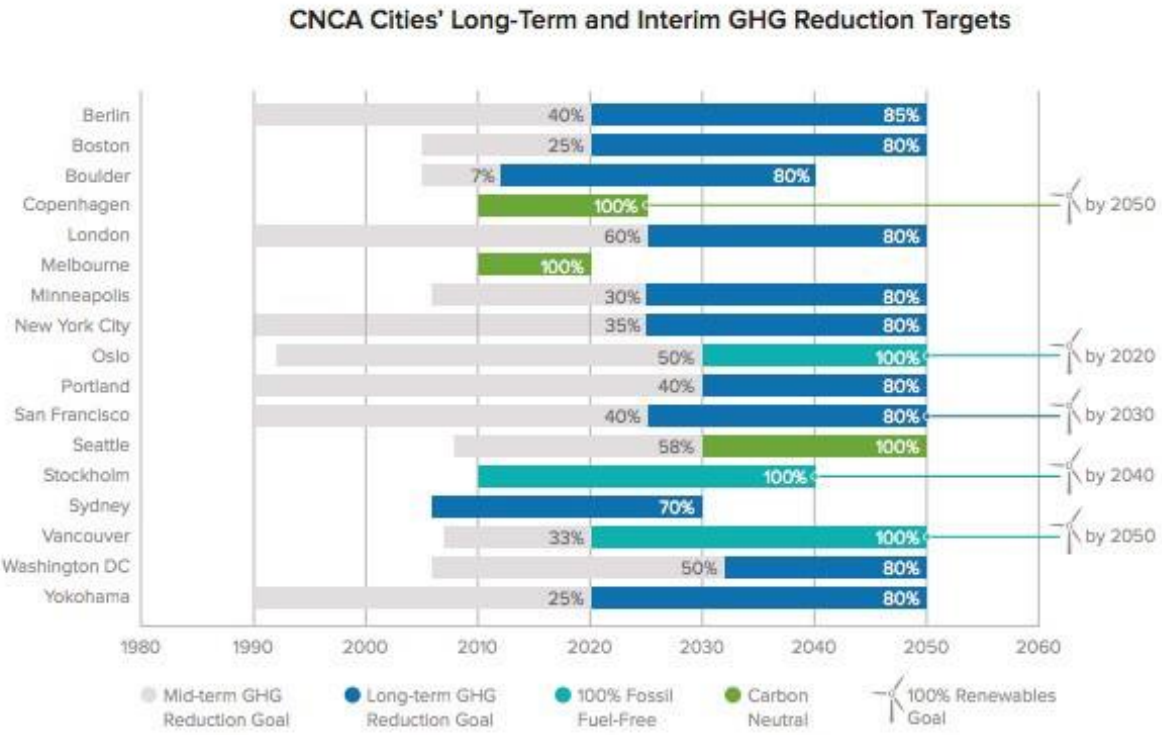
levels within the 2022–2027 timeframe, and Germany has set 2030 emissions target of 55% below 1990 levels.

Other cities: Other cities around the region and around the world have been actively engaging this issue, with innovative programs around flexible transportation systems, congestion management, electric vehicles, energy efficiency, and renewable power development—and in many ways have been leading ahead of their national governments. Examples include:

Table 1: Examples of Climate Action Goals of Other Cities

Goal	Who	Comments
80% GHG reduction by 2050	• State of California • Carbon Neutral Cities Alliance (CNCA: 17 cities, from Oslo to New York and San Francisco) • Mountain View	San Francisco has established very simple "0/50/100" goals: • Achieve zero waste goal • Make 50% of all trips outside of personal vehicles • Source 100% of residential (and 80% of commercial electricity) from renewable sources
"Net Zero" by 2040	• Cambridge MA	Includes 50% reduction in city building energy use
80% GHG reduction by 2030	• Fort Collins CO	Starting from a much higher baseline than Palo Alto, with coal-generated electricity
Carbon neutral by 2025	• Copenhagen • Melbourne • Adelaide • University of California	Copenhagen has also targeted a 75% bicycle commute mode share—by 2025.
100% renewable electricity[1]	• Burlington VT • Greensburg KS • Aspen CO • And a growing list of others	(This is often reported in the press as "100% renewable energy" but refers specifically to electricity
Transportation mode shift	• Los Angeles	50% of trips on foot, bicycle or transit by 2035 EVs to constitute half of the light duty fleet by 2017, and 80% of fleet purchases by 2025.)

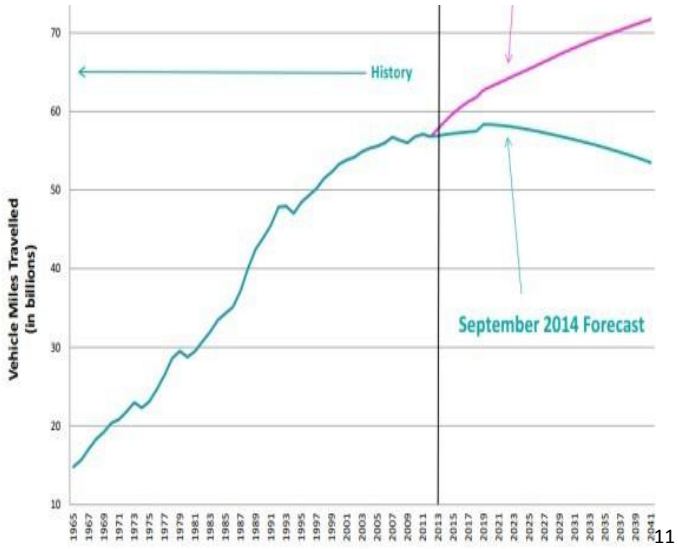
Figure 1: Climate Neutral Cities Alliance (CNCA) Goals



Technology and the Pace of Change

Rapid technology change and behavior shifts make the usual practice of planning based on extrapolation of past trends a bit uncertain. For example, Vehicle Miles Travelled (VMT), the widely used transportation metric, has risen steadily for decades, but recently shows signs of turning down, as Millennials buy fewer cars (and reportedly even forego getting drivers' licenses); car buying by the 18-30 demographic in the US peaked in 1983. The chart below shows recent projections from the US Department of Transportation, which indicate a flattening of historically rising VMT projections, with a downturn expected.

Figure 2: Changing Vehicle Miles Travelled Forecasts



[11]

Prices for solar photovoltaic (PV) systems, electric vehicles (EVs), batteries, autonomous vehicle controls, sensors and many other technology categories have been plummeting for years. Tony Seba, Stanford lecturer and author of *Clean Disruption*, asserts that this combination of trends portends a profound shift in US automobile culture, with potentially rapid displacement of internal combustion engine (ICE) vehicle by EVs, perhaps by 2030, and potentially a dramatic reduction in private vehicle ownership in the same time frame. Such trends could make conservative planning risky; for example, ExxonMobil's 2014 projection of battery prices in 2040 will likely be reached in the market by 2020.

This makes the job of transportation planners, for example, and parking garage developers, uncertain and challenging. How will we determine what, where and how much to build in the face of these trends, and neither overbuild nor underbuild?

Palo Alto History and Opportunity[11]

For more than 20 years, Palo Alto has been an internationally recognized leader in **sustainability innovation**, with a wide range of initiatives—citizen-led, staff-initiated, and council-directed—that have in many cases raised the bar on urban sustainability. This status is well deserved, given our community's deep-rooted environmental values and City's early climate initiatives.

Early actions like our 2007 Climate Protection Plan (one of the first five city climate plans in the US), bold recent actions like carbon neutral electricity, and systematic improvements ranging from water conservation and EV readiness to green building ordinances and safe routes to schools, and hundreds of other measures[12] have put Palo Alto in the forefront of sustainability leadership internationally. Based on annual data for the calendar year 2014, the community of

[11] Transportation Research Institute, University of Michigan. National trends.

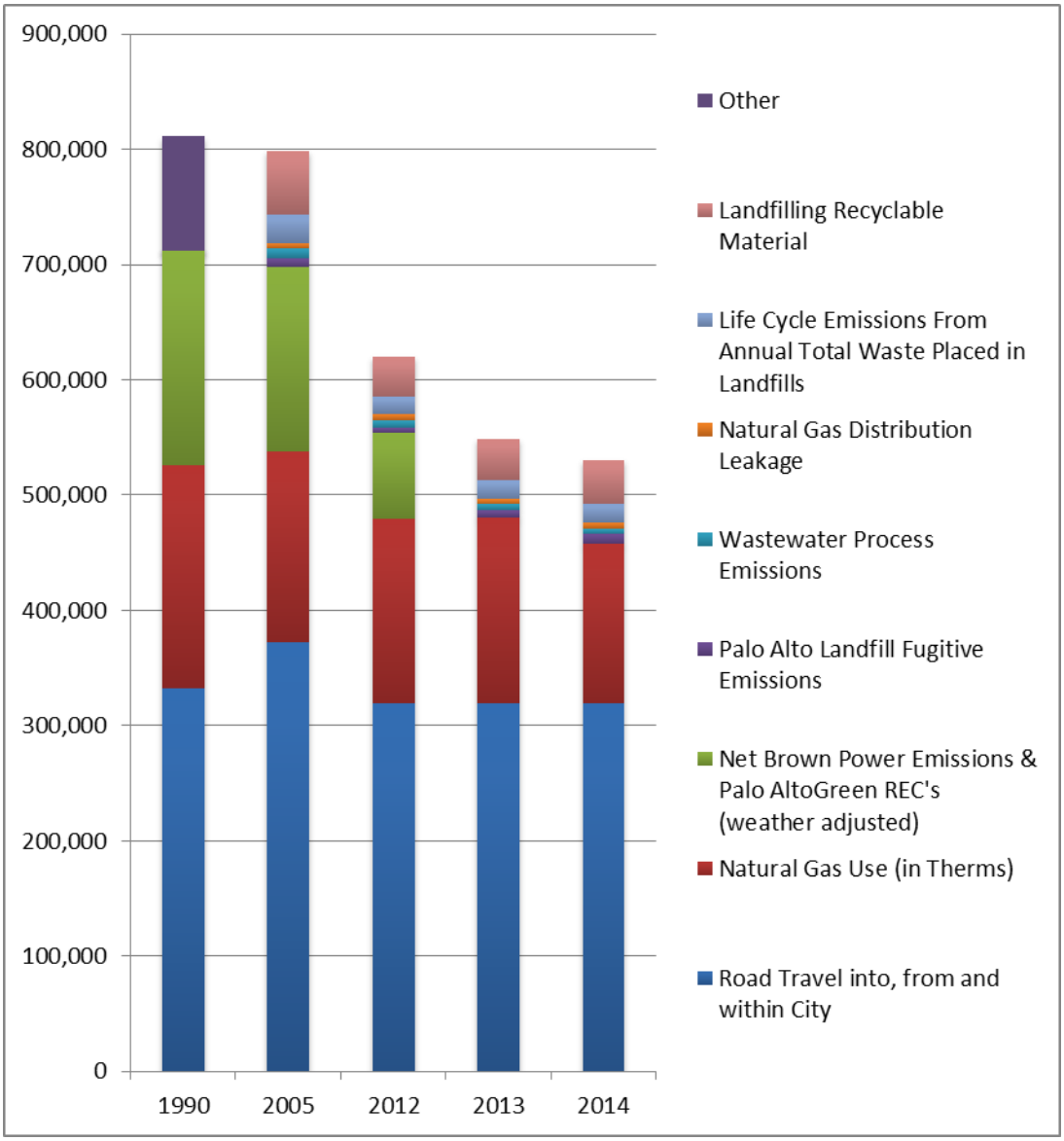
[12] https://www.cityofpaloalto.org/civicax/filebank/documents/45024

Palo Alto has cut its overall greenhouse gas (GHG) emissions by an estimated 34% from 2005 levels and 35% from 1990 levels[13]—one of the largest reductions of any city in the world.

Because of its community commitments and past accomplishments, Palo Alto is uniquely positioned to advance a world-leading climate plan.
Some of the needed initiatives are within the capacity of City government. Some will require the active collaboration of neighboring jurisdictions. All will require the support, commitment and actions our entire community.
While many people still assume that "sustainability" is expensive, and that the initiatives identified here would require sacrifice of money, comfort or both, the evidence that staff has reviewed from cities and businesses around the world suggest that well designed and managed sustainability programs can be fiscally prudent, cost effective and in many cases can yield attractive returns on investment of public resources.

[13] These are revisions of previous estimate, due to an August 2015 modification of their 2013 estimate of 1990 and 2012-2014 transportation emissions by consultants Fehr and Peers.

Figure 3: Palo Alto Community-wide GHG Emissions (net of Renewable Energy Credits)



Extrapolating from its historic GHG reduction trend suggests that Palo Alto is well on its way to an estimated 47% reduction by 2030 and 80% reduction by 2050; note however that this trend includes the one-time drop in reportable GHG emissions that resulted from the carbon neutral electricity policy in 2012 and 2013.[14] Staff estimates that existing initiatives (including EV-ready and PV-ready mandates and the electrification initiatives that Council has directed staff to explore) could bring those reductions still lower.[15])

[14] The estimate of a 47% reduction by 2030 is calculated by staff based on extending Palo Alto's 2005-2012 rate of GHG reductions forward to 2030; it excludes the dramatic one-time reduction gained by the City's carbon neutral electricity policy. There is of course no guarantee that Palo Alto will sustain that rate of reduction; it may achieve less, or, as proposed in this report, may achieve greater reductions. Note that the Draft EIR being prepared for the Comprehensive Plan Update will contain a more conservative (i.e. lower) estimate for purposes of compliance with the California Environmental Quality Act (CEQA).

[15] Placeholder estimate. Will be refined by consultant work authorized by Amendment 1 to S/CAP consultant DNV GL's contract, December 14 2015. Staff anticipates having those results in advance of this January 25 study session.

Why Act Now

The International Energy Agency has determined that 80% of fossil fuels need to "stay in the ground for the 2°C target to be within reach. ExxonMobil recently predicted "catastrophic" climate change, with global temperatures rising 5-7°C. The global climate agreement reached at the COP21 conference in Paris in December 2015 saw nearly 200 countries agree to common action on climate.

The New York Times noted (quoting from the agreement) that

- *The Agreement 'calls for **"holding the increase in the global average temperature to well below 2°C above pre-industrial levels** and to pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels...." This language recognizes the scientific conclusions that an increase in atmospheric temperatures of more than 2 degrees Celsius, or 3.6 degrees Fahrenheit, would lock the planet into a future of catastrophic impacts...But it also recognizes the scientific conclusions that warming of just 1.5 degrees Celsius, or 2.7 degrees Fahrenheit, could present an existential threat to low- lying island nations that would be inundated by sea level rise at that rate of increase.'*
- *The existing national plans submitted for the conference 'would probably result in an increase above 3 degrees Celsius.'*
- *'When countries update their commitments, they will commit to the **"highest possible ambition," but the agreement does not set a numeric target.**'*

Objectives

In the wake of the Paris conference—where Canada and other countries called the 2°C target inadequate and proposed a 1.5°C target—we may expect to see changes in global expectations, and perhaps in California climate policy.[16]

There are multiple reasons for Palo Alto to pursue the sustainability and climate initiatives outlined in this plan:

- to improve the living standards, quality of life and value delivered to residents;
- to save the City and community money through improved efficiency;
- to reduce future risk from climate related events and their impacts on the community;
- to balance fiscal responsibility with other community values;
- to attract and retain innovative clean businesses;
- to make our contribution in support of State and international commitments to reducing global emissions;
- to provide a leadership example to other cities and the community for which Palo Alto is known.

[16] Note also that the "80% reductions by 2050" that stands as the global reference target, and California's stated goal, was a political consensus based on the "the scientific conclusions that an increase in atmospheric temperatures of more than 2 degrees Celsius, or 3.6 degrees Fahrenheit, would lock the planet into a future of catastrophic impacts"—in other words, a minimal rather than maximal goal, though many today consider it a "best practice." In view of the 1.5 degrees Celsius target that was proposed at the Paris COP by Canada and other countries, that reference target may change. In any case, it may be advisable to consider "80x50" a minimal rather than a maximal goal.

Meeting or exceeding California's GHG reduction goal of 80% by 2050 will require both staying the course on our current efforts, and building on, intensifying and evolving them in the face of changing technologies and conditions.

Solutions appropriate for Palo Alto will need to address specific local economic considerations and community needs. This in turn requires understanding the specific needs of the City and community related to energy and resource consumption, transportation, development and the considerations of daily life. And it requires the data systems that provide this view into the systems that produce the experience of living and working in Palo Alto.

Discussion

For the past year, hundreds of Palo Altans have provided input to the S/CAP planning process, contributing their ideas regarding objectives of the plan as well as emission reduction measures that could be used to achieve meaningful GHG reductions and other measures that could achieve sustainability objectives related to water conservation, adapting to climate change, and other issues.

Based on this input, the Office of Sustainability considered three possible emission reduction targets[17]: 80% emissions reduction by 2050, or "80X50," consistent with the State's goal; 80% emissions reduction by 2030 or "80X30"; or 100% reduction (to carbon neutral or better) by 2025 or "100X25." In each case, staff identified and started to evaluate (technically and economically) the mix of strategies that could achieve each goal. Interestingly, staff found that each target could be achieved with similar strategies implemented at a very different pace. Based on this analysis, this staff report presents potential strategies for Council consideration and discussion, and asks whether the Council is interested in further planning to develop an S/CAP that exceeds the State's goal, and if so, by how much? Specifically, staff invites Council to consider whether to:

- **Set a goal of** reducing GHG emissions by at least 80% by 2030—20 years ahead of California's 80% goal, and achieve that goal by:
- Building, step by step, on Palo Alto's historic Carbon Neutral Electricity Plan to next **become a Carbon Neutral Utility**[18], by **encouraging electrification** (and other measures) to eliminate the impact and eventually the use of natural gas,
- **Becoming a Carbon Neutral City** soon after by working with its own resources and in collaboration with neighboring jurisdictions to dramatically **reduce dependence on the internal combustion engine and private vehicles**
- Advocating for policies that **advance climate positive initiatives across the Bay Area** and the state.

[17] Note that in all these scenarios, reductions are partially driven by factors outside our control, including Federal and state policy, legal and regulatory constraints, cost-effectiveness of measures and technology, the pace of technology innovation, and behavioral changes by our population. In this way, the S/CAP may be similar to California Air Resources Board's (CARB's) update to the State's scoping plan, which suggests that near-term actions and targets need to be specific, quantifiable, and within an agency's control, while longer term actions and targets may require changes in technology and/or actions by others, and could be less precise.

[18] A Carbon Neutral Utility could be achieved in an estimated 15-20 years through the efficiency and electrification strategies discussed below, or immediately by using carbon offsets as a bridging strategy modeled on Palo Alto's use of RECs to accelerate the transition to Carbon Neutral Electricity. Note that this would mean significant economic changes for the gas utility, and could require a full or partial exit strategy for the gas utility. (This is a "back of the envelope" estimate. S/CAP consultants are producing a more refined estimated under a Contract amendment authorized by Council December 14 2015.)

Footprint

Palo Alto has systematically reduced its GHG emissions through a series of measures, many of them predating the 2007 Climate Protection Plan (CPP). The figures below show Palo Alto's emissions reduction trajectory in relation to the State of California's declared 2050 trajectory, and the 80x30 trajectory proposed for consideration here.

Figure 4: Projected Emissions Based on Current Palo Alto Trends vs Emissions Reductions Required to Meet State of California Targets: 1990-2050

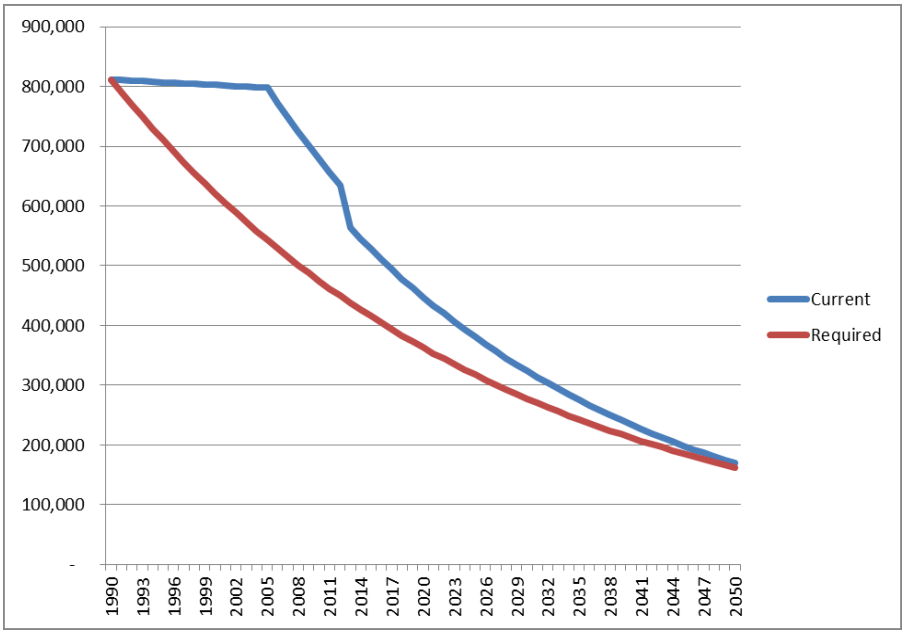
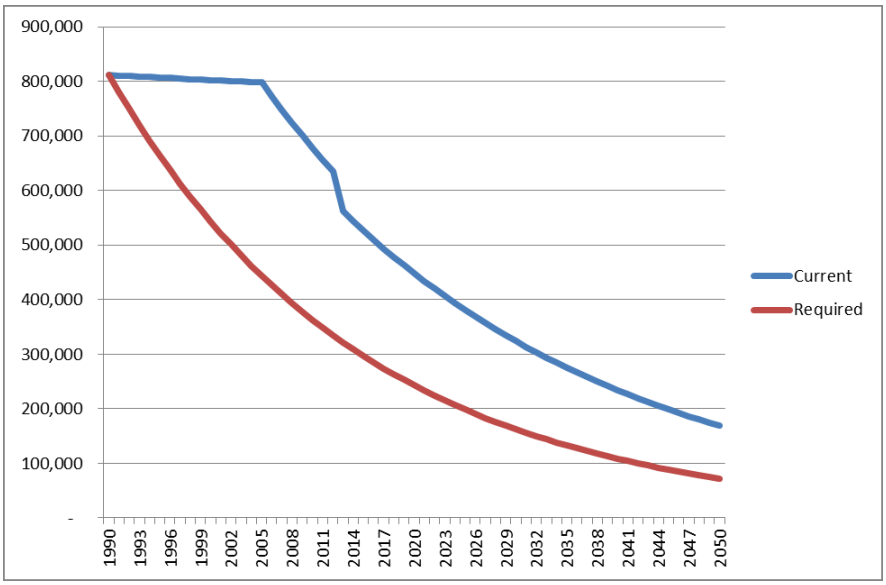


Figure 5: Projected Emissions Based on Current Palo Alto Trends vs Emissions Reductions Required to Meet State of California Targets: 1990-2030



These historic reductions have been achieved most significantly though the CNE initiative, ongoing CPAU efficiency and incentive programs; the Green Building Ordinance (GBO) and Energy Reach Code (which are perhaps the most aggressive in the state and nation) including its EV-ready and PV-ready requirement; operational improvements at the RWQCP; the ZeroWaste and Environmentally Preferable Purchasing initiatives; the Urban Forest Master Plan; and more. Initiatives already in motion or under consideration will drive additional reductions: electrification analysis; the next green building ordinance (GBO), including potential "zero net energy" requirements; "default to green" purchasing policy, including rapid electrification of the City fleet; launching the Downtown Transportation Management Association (TMA) to achieve a City Council initiated goal of reducing single occupant vehicle (SOV) trips in and around the City's commercial centers by 30% or more[19]; build-out the City's adopted bicycle and pedestrian plan; implementing parking technologies to better manage existing downtown parking supplies; initiating a paid parking study for downtown; and establishing Transportation Demand Management (TDM) requirements on new development projects.[20]

It is clear from the chart that transportation and natural gas present our biggest challenges: road transportation accounts for more than 61% of Palo Alto's remaining carbon footprint, while natural gas accounts for more than 25%—and that Palo Alto will be unable to achieve the State of California goals without significantly reducing emissions from both these categories.

Ten Realms of Action

Staff and consultants have examined ten realms of action: Transportation, Energy, Water, Buildings, City operations, Palo Alto Utilities, Infrastructure, Adaptation/Resilience, Ecosystems and Engaging the Community. Key strategies and actions are summarized in Figure 6 and Table

[19] https://www.cityofpaloalto.org/civicax/filebank/documents/39106, 2/24/14

[20] https://www.cityofpaloalto.org/civicax/filebank/documents/46324

2; Others are summarized later in this report. This staff report focuses on three: transportation and energy, because they represent the vast majority of Palo Alto's emissions (excluding "scope three" emissions, which are not considered in this analysis), and water, because of the challenges of the current drought and potential risks of long-term drought. The others are summarized here but will be addressed in detail in future reports.

Figure 6: S/CAP Levers, Goals and Strategies

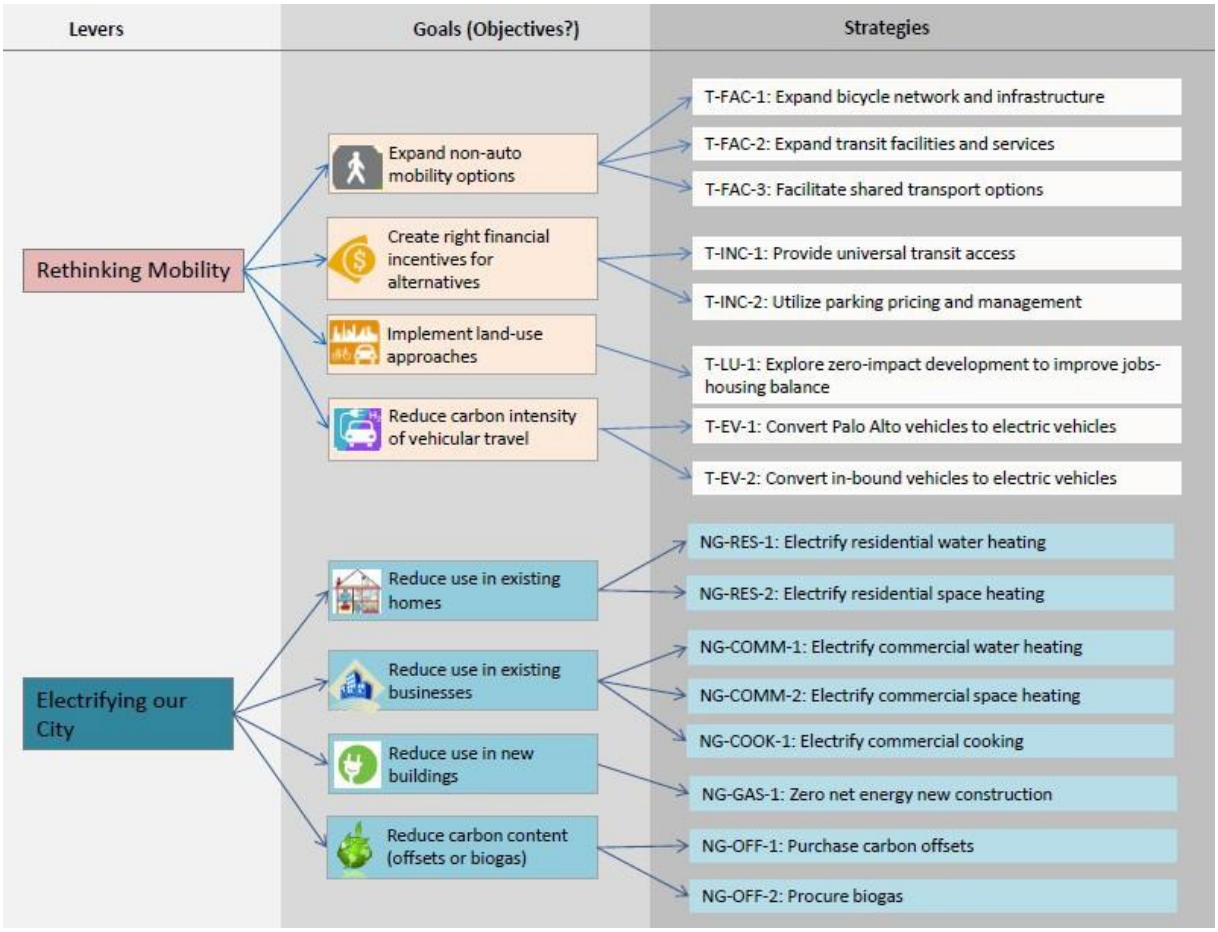


Table 2: Key Actions—Summary

Transportation	• Accelerate EV adoption by expanding EV charging infrastructure • Introduce market-rate pricing for parking in Palo Alto, starting with Downtown (and based on recommendations of the paid parking study that is currently getting underway) • Support and expand on the TMA's efforts to provide incentives for non-single-occupancy vehicle (SOV) travel to and from downtown, including provision of transit passes to employees (by major employers) and residents (by the City) • Significantly enhance alternatives to SOV, making investments in public transit and other programs such as Mobility as a Service (MaaS) to reduce automobile dependence • Ensure that new development reduces rather than increases peak period trips by SOV
Energy	• Encourage "fuel switching" from GHG-emitting natural gas to carbon neutral electricity ("electrification") where legally and technically feasible and cost-effective to do so • Support aggressive bundled energy efficiency measures and accelerated retrofit cycles through building codes and City of Palo Alto Utilities (CPAU) incentives; avoid "premature lock-in" • Examine a shift to an "opt-out" model for the PaloAltoGreen Gas program (which would bring Palo Alto's GHG emissions to over 40% now), and explore legally compliant, cost-effective strategies for investing a portion of those funds in qualified local offsets
Water	• Accelerate legally compliant, cost-effective incentives & requirements for radical resource efficiency. • Shift landscapes, including the urban forest to lawns and shrubs, to "drought" adapted vegetation • Capture, treat and store storm water with permeable green infrastructure • Adapt CPAU strategies for the possibility of reduced or less dependable long-term hydroelectric supply
Buildings	• Accelerate the upgrading of PA building stock through building code mandates and CPAU service and financing offerings
City Operations	• Embed Sustainability criteria and accountability throughout City operations
Finance	• Develop and actively market "bundles" of services offerings (e.g., audits + efficiency retrofits + fuel switching + rooftop solar + charging station + …) with integrated financing • Introduce internal carbon pricing into City operations (as has been done by Microsoft and others) to drive internal efficiency gains • Consider development of a local carbon fund (tax, fee or voluntary) to provide an investment pool for S/CAP implementation

As noted earlier in this staff report, any specific proposals that are developed to implement the above listed "realms of action" and "key actions" would need to be assessed for their cost-effectiveness, potential policy trade-offs and legal constraints that might influence the

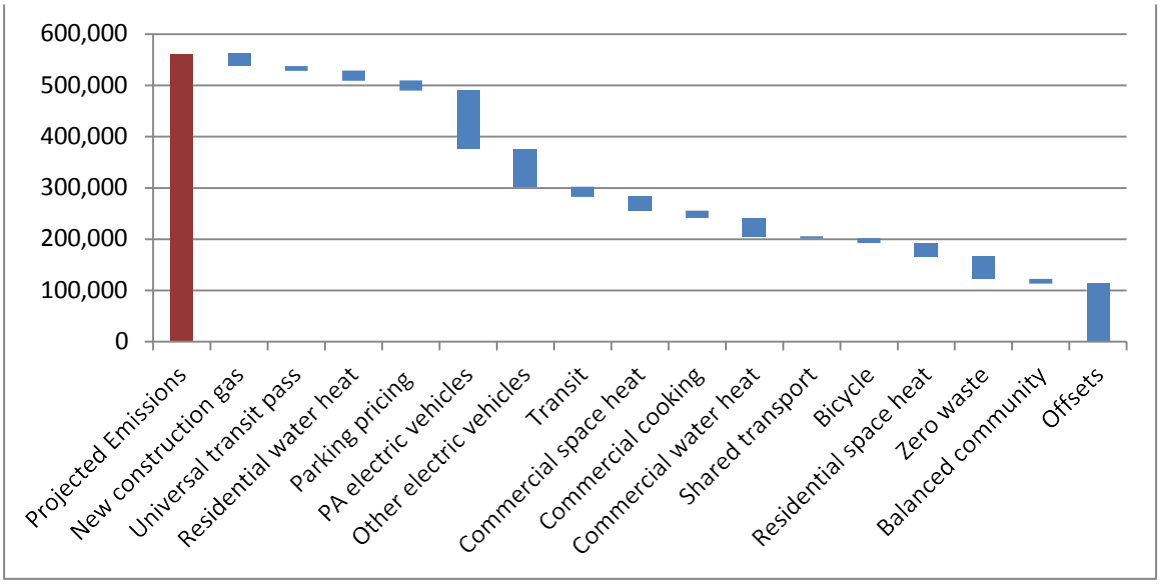
design of any such proposal or identify areas where the City could intervene at the federal, state or local level to advocate for constitutional, statutory or regulatory change.

Investment and Impacts

The charts that follow summarize the investments and impacts associated with the strategies presented below.[21]

This "waterfall chart" shows the current estimates of the GHG reductions that could result from each initiative (in metrics tons of CO2 equivalent, or MTCO2e).

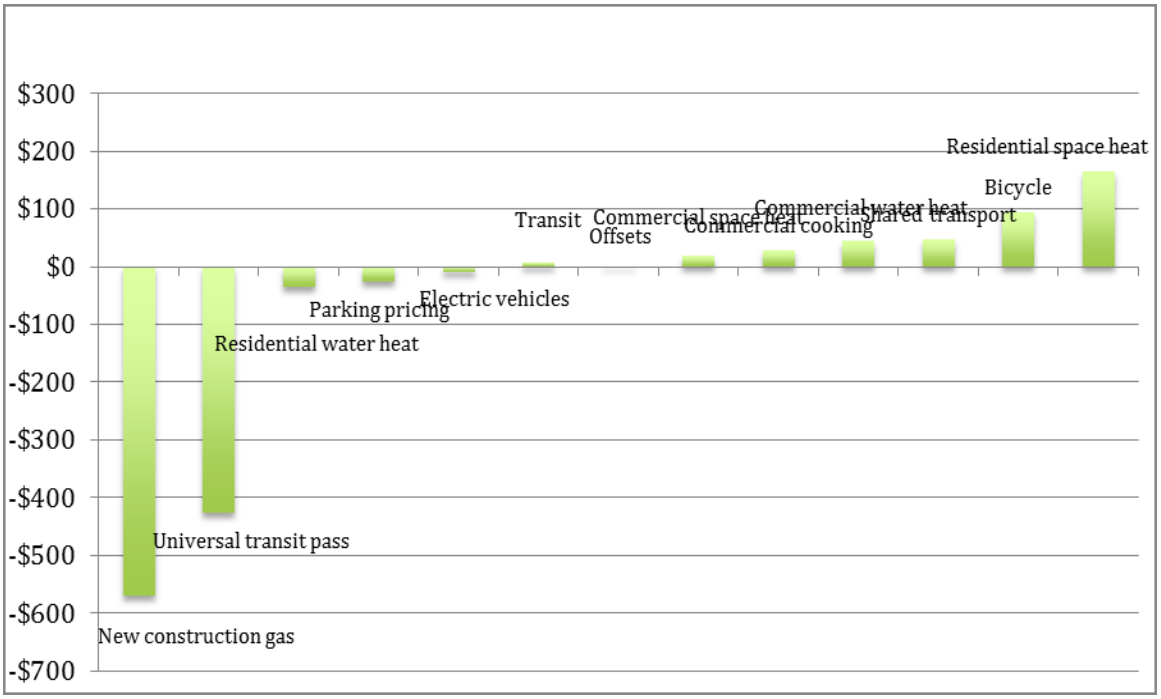
Figure 7: "Waterfall" Chart Showing Potential GHG Reductions from Each Measure



This "McKinsey chart" shows the estimated "mitigation cost" (in $/MTCO2e reduced) for each strategy.

[21] The methodology behind these analyses is explained in Attachment A.

Figure 8: McKinsey Chart": Estimated "Mitigation Cost" (in $/mTCO2e reduced)



It is evident from these charts that the greatest GHG reductions are likely to come from electrification of vehicle fleets (largely through provision of EV charging infrastructure), encouraging all-electric new construction, electrification of water and space heating, and pricing parking; the most economic reductions are to be gained from encouraging all- electric new construction, issuing universal transit passes, electrification of water heating, pricing parking, and electrification of vehicle fleets. The intersection of these lists provides an initial set of priority actions for Council consideration.[22]

Key Levers: Detail

1. Key Levers: Rethinking Mobility

Road transportation represents about 61% of Palo Alto's carbon footprint—and a headache for everyone. Palo Alto's Comprehensive Plan calls for reducing reliance on the automobile, and

[22] Note: The quantities displayed here are estimated, using analytical models based on projections of the potential impacts of different actions, and assumptions of the potential rates of adoption that could be achieved. As with all such models, it would be prudent to assume that near term projections (such as the next five years) are more accurate than linger term projections (such as the next 15 or even 35 years), and staff recommends revisiting and recalibrating the S/CAP every five years—or more often, as new information warrants. The potential impacts of some actions—like replacing natural gas water heaters with electric heat pump water heaters (HPWH)—are relatively straightforward to analyze with a high degree of confidence; the potential impacts of other actions—like advanced mobility strategies—are much more difficult to analyze, because causal relationships for new technologies are not yet well understood, and because the academic literature often used as a basis for these technologies generally lags the technologies. As such, these should not be taken as predictions of what will happen, but as a portfolio of strategies that could potentially achieve the targets set. The S/CAP consultants have constructed these models to be transparent and flexible; it's relatively straightforward to modify assumptions and observe the effect those modifications have on outcomes.

we've made progress in some areas: for example, 44% of high school students commute by bicycles. Beyond our borders, federal CAFE standards have reduced the carbon intensity of the US vehicle fleet. But congestion continues unabated, and the majority of Palo Altans, and commuters to Palo Alto, still make Single Occupancy Vehicle (SOV) trips.

Traditional approaches to transportation—adding capacity by building roads and parking—send the wrong signals, encourage SOV travel and add pain. But what if we asked a different question: ***How could we make it more convenient for anyone, anywhere, anytime to not have to get into a car and drive?***

Issue(s): Emissions. Congestion, Quality of life.

Goals: Reduce congestion. Reduce emissions. Increase convenience. Triple bike share, double walk mode share and reduce SOV trips 30% in the Downtown area by 2020. Eventually, eliminate 80- 100% of road transportation emissions, while increasing mobility and convenience

Levers: Expand non-automobile mobility options. Expand transit facilities and services. Create the right incentives**.**

Strategies: Reduce GHG/VMT by shifting vehicle fleets (City owned, privately owned and commercially owned) from fossil-powered to electric. Phase out automobile subsidies by requiring drivers to pay for parking. Reduce trips and vehicle miles travelled (VMT) by developing mobility services that make not driving more convenient than driving. Collaborate with regional partners.

Barriers/concerns/unknowns: Significant dependence on external factors including technology, policy, other actors. Possible reluctance to change behavior. Possible resistance to paying for parking directly (as opposed to indirectly). Significant investments in transit, rideshare, and non-SOV incentives may be required (though much of this could come from other actors than the City).

GHGs from road travel are a function of two factors: Vehicle Miles Travelled (VMT), and the carbon intensity of that travel (GHG/VMT). Reducing GHG/VMT is largely a function of vehicle technology, driven for example by Federal CAFE standards, state policy, improved fuel efficiency, electrification and customer adoption. Most of these factors are outside the purview of cities, but Palo Alto has some ways to influence VMT, by developing attractive alternatives to SOV trips, and GHG/VMT, largely by encouraging electrification of City, resident and commuter fleets.

The City supports a number of emerging transportation demand management (TDM) initiatives including its first Transportation Management Association (TMA)[23] to develop, manage, and market transportation programs to reduce single occupancy vehicle trips in the Downtown Core area. The Comprehensive Plan Update also provides an opportunity to establish policies that outline when TDM should be applied and programs that specify how compliance will be periodically measured and enforced. TDM plans for individual development projects can establish TDM requirements and set enforceable SOV mode-share targets. TDM plans would establish a list of acceptable TDM measures that include transit use, prepaid transit passes, commuter checks, car sharing, carpooling, parking cash-out, bicycling, walking, and education

[23] http://www.paloaltotma.org/

and outreach to support the use of these modes. They should provide a system for incorporating alternative measures as new ideas for TDM are developed.
Staff has identified seven strategies for addressing these goals, each with one or more specific strategies: Expand non-auto mobility options; Expand transit facilities and services; Facilitate shared transportation; Provide universal transit access; Phase out SOV subsidies by charging for parking; Ensure that any new development addresses and mitigates its impacts (e.g. through trip caps or other TDM initiatives); Reduce the carbon intensity of vehicular travel. The most significant strategies (in terms of potential impact and cost) are summarized here.

Actions

1.a. Reduce the carbon intensity of vehicular travel by encouraging shift to EVs

Expanding the percentage of trips taken in EVs would have the largest impact on emissions from road transportation, which is in turn the largest category of Palo Alto emissions. Palo Alto has one of the highest rates of EV ownership in the country (estimated by staff at 2-3% of registered vehicles), but several factors limit EV adoption, including price (which is dropping rapidly), total cost of ownership (often poorly understood), and vehicle performance—especially "range anxiety."
The City has undertaken a number of measures to address those limitations, including hosting periodic "ride and drive" events to provide staff and residents direct experience of EV performance and economics; analyzing total cost of ownership; establishing an "EV first" preference for the City fleet; and working to expand EV charging infrastructure in Palo Alto by parking garage operators, employers and potentially third party providers.
City ordinances require all new construction and significant renovations for commercial and multi-family buildings to pre-wire and allocate parking spaces for Electric Vehicle Supply Equipment (EVSE), or EV chargers, at specified rates. The City has been adding additional public charging stations, with grant support from regional agencies; third party providers of charging systems could enable flexible expansion of charging infrastructure without requiring commitment of City funds. (The City may want to consider flexible rather than maximal approach to charging infrastructure, since as the range of available EVs expands, the importance of "away from home" charging may become less significant, and if private vehicle ownership continues to decline, as some have suggested, saturation may be achieved at a lower volume of chargers.)

1.b. End incentives to private car use.

Ending parking subsidies and significantly increasing the cost of parking all over Palo Alto is a strategy that could reduce reliance on the private automobile and encourage residents and employees to use transit, ride-hailing services, biking, walking, or other modes. Use parking revenues to finance non-SOV alternatives, modeled on the "Stanford Engine".[24]
Palo Alto provides approximately 4,000 off-street and 7,000 on-street parking spaces in the downtown and California Avenue areas. A quick web survey of other workplaces and shopping

[24] Stanford's commute alternatives program finances the Marguerite shuttle and other services from a $3/day parking fee. The program is responsible for reduction of SOV rates from 78% to 48%; it also saved $107m in capital not spent on parking garages that were no longer needed (and freed land for more academically pertinent uses).

districts suggests approximately 30,000 additional spaces. The on-street spaces are provided at no cost to drivers (in contrast to many other cities in the region), and the publicly- owned off-street spaces are provided at either no cost (short-term parking) or at a cost that is below comparable rates in neighboring communities (long-term parking).

Given the actual cost of creating and maintaining on- and off-street parking spaces (an estimated $3,600/year for parking garages, based on the amortized cost of providing parking spaces at a capital cost of $60,000 per space), free parking provides a significant incentive for SOV trips, despite the City's long-standing policy commitment (as noted in the 1998 Comprehensive Plan) to reduce those trips. Instituting and/or requiring parking fees commensurate with this cost would remove that incentive, reduce SOV trips, and provide a funding source for programs that make the use of alternative modes easier for all. Potentially, in combination with other strategies listed here and the shift in driving trends already noted, it could also reduce the need to build additional parking structures (as has been the case at Stanford).

Preliminary analysis, based on parking rates in surrounding jurisdictions, suggests that Palo Alto could potentially realize parking revenues of $5-15 million per year[25], which would in turn provide substantial resources for the programs discussed here. The City has contracted for a paid parking study, now getting underway, that will provide additional insight into Palo Alto's options and more closely examine costs and revenues.

1.c. Provide low cost transit benefits to all Palo Alto residents and employees

A universal EcoPass provides one of the most economical ways to reduce emissions. (See mitigation costs chart.) EcoPasses are transit passes sold by VTA that enable the carrier to use their bus system. Presently EcoPasses are available to employers similar to GoPasses (for the train), and could potentially be made available to residents in transit served areas. The EcoPass (and comparable passes from other transit providers) could be provided at relatively modest cost, potentially funded by parking revenues and employer "feebates," and provide residents and workers with free access to select transit services. A variant of this approach, already being explored by the Downtown Transit Management Association, would provide discounts for use of ride-hailing services like Lyft and Uber as a "first and last mile" solution for commuters.

1.d. Develop "Mobility as a Service" (MaaS) in Palo Alto* and the region*:

Financial incentives are not the most effective level to change behavior, unless convenience is addressed as well.

"Mobility as a Service" (MaaS) is a concept that proposes to shift the focus from fixed transportation to flexible, responsive transportation services designed to meet people's diverse and changing needs by providing seamless regional multi-modal mobility services, including improved transit, and bike share; dynamic, on-demand shuttles; flexible first & last mile solutions; and walkable/bikeable communities. The full MaaS concept, articulated most fully by Tekes, the Finland technology funding agency and the Finland Ministry of Transportation and Communications (with which Palo Alto has developed a collaboration) and the SV MaaS initiative which Palo Alto initiated with Joint Venture Silicon Valley (JVSV), envisions one or more "Mobility Aggregator" services that provide subscription-based, customer-centered

[25] This is a wide range, estimated by staff by applying a range of regional parking rates to the quantity of Palo Alto's on street and off street parking spaces.

experience that provides "plan/book/buy/ride" access to multiple transportation modes in a single unified smartphone app with easy fare payment, one-stop billing and integrated employer subsidies.[26]

The elements of MaaS are increasingly familiar, as Transportation Network Companies (TNCs) like Lyft and Uber and responsive shuttle services like Chariot and Bridj grow in familiarity and market share, and transit agencies struggle to adapt to shifting rider expectations.[27]

In response to Council's challenge to reduce SOV trips 30% for key commercial centers by 2020, staff are exploring pilots of such programs, initially through "first and last mile" programs being developed by the Downtown TMA, enhancement the City's own commute alternative program for employees, and developing an RFP for technology providers that could develop a mobile app or "wallet" allowing the user to conveniently plan, book, access and pay for a bundle of transit/rideshare services. (Companies at the Stanford Research Park are exploring comparable programs.)

1.e. Evaluate what would be required to achieve bicycle mode share levels being targeted by other cities, ranging from Portland and Copenhagen and LA.

Palo Alto is a bicycle-friendly city, and the City is making a significant investment in new bicycle boulevards and other improvements included in the adopted Bicycle and Pedestrian Plan. However, bicycle ridership is low compared to cities like Portland and Copenhagen and the next iteration of the Bicycle and Pedestrian Plan could set higher goals and seek to achieve higher bicycle and pedestrian mode share levels. Provisioning protected bike lanes can be expensive in terms of GHG mitigation, but provides health and quality of life benefits as well. On the other hand, expanding surface area for bike at the expense of surface area for cars may prove controversial, at least until the potential decline in VMT and automobile demand becomes apparent and palpable to more people.

1.f.* Explore "zero impact" standards *in residential and commercial development

Adopt plans that target future residential and commercial development in specific transit-friendly districts. Impose "no net impact" caps for energy, GHGs, water--and trips.

Scenario Four of the Comprehensive Plan EIR contemplates this approach. The cities of Menlo Park, Mountain View, Sunnyvale, and Cupertino and Helsinki and others have begun to impose trip caps; for example, developments in North Bayshore in Mountain View are required—as a condition of permitting—to provide transportation amenities that will keep SOV rates under 45%.

A *combination* of these four caps is unprecedented (as far as we know), and could provide a powerful incentive to property owners and developers to build innovative, efficient and affordable buildings and developments.

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[26] SV MaaS is testing and refining, with major Silicon Valley employers, a three-pronged strategy to reduce incentives for SOV commutes and make non-SOV travel increasingly convenient—that could readily scale to other employers throughout the region. The key elements:

a. Gradually increasing the price for parking at major employers.

b. Application of parking revenues to non-SOV transportation alternatives. (Parking pricing + incentives = revenue-neutral workplace feebate--a self-financing system of charges and rebates to encourage environmentally-preferable practices.)

c. Smart applications (apps) to increase non-SOV convenience for commuters and benefits tracking/management for employers.

[27] The Shared Use Mobility Center has developed databases and interactive maps of "shared use mobility" services, programs and policies across the country. http://www.sharedusemobilitycenter.org/

Embrace "tactical urbanism"

Many of the innovations in transportation planning and land use encourage small, fast local experiments are new, some unprecedented, and would benefit by a more flexible and agile and experimental planning and learning process. (Tactical urbanism is an umbrella term used to describe a collection of low-cost, temporary changes to the built environment, usually in cities, intended to improve local neighborhoods and city gathering places. Tactical Urbanism is also commonly referred to as guerilla urbanism, pop-up urbanism, city repair, or D.I.Y. urbanism.[28])

Leverage existing Open Data & Smart City initiatives to support mobility services

Real time access to relevant data is essential to efficient platforms for public & private mobility service providers. Palo Alto should provide open access to its own transportation data. Since transportation issues are regional, Palo Alto should work with other communities in the region to share data and develop common or compatible protocols. Palo Alto should encourage mobility providers to share their data in turn (or perhaps require that as a condition of operation.)

Benefits:

These transportation-focused strategies will provide both direct and indirect benefits. Direct benefits include reduced congestion, reduced GHG emissions, and health and economic benefits to commuters and developers. Indirect benefits include, for example, reduced CapX and OpX for roads and parking structures; less capacity pressure on roadways enabling release of some surface area to bicycle and pedestrian modes; more permeable surfaces as road demand declines, enabling enhanced storm water capture (see "green infrastructure," below) and reduced heat island effect.

2. Electrifying our City

Key Levers: Energy (general)

Issue(s): Natural gas emissions currently represent ~25% of Palo Alto's carbon footprint. Natural Gas (i.e., methane, is a potent greenhouse gas, with a global warming potential (GWP) at least 23 times that of CO2.[29] Carbon Neutral Electricity opens the option of fuel switching from natural gas.

Goals: Reduce or eliminate emissions from natural gas. Reduce costs. Increase comfort, reliability and resilience.

Means: Efficiency. Renewables. Electrification. Expand PPAs and distributed generation & storage. Build the "smart grid." Set a price on carbon. Adapt CPAU's business model to the challenges facing the utility industry.

Levers: Staff has identified several "levers" for addressing these goals, each with one or more specific strategies: Reduce demand through resource efficiency and conservation electrification of heating and cooking functions currently provided with natural gas; encourage zero net energy, zero net carbon and all-electric design in new construction; periodically evaluate the suitability of biogas as pipeline gas; and, potentially, use of carbon offsets as a bridging

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[28] https://en.wikipedia.org/wiki/Tactical_urbanism#cite_note-1

[29] Recent research indicates that the impact natural gas may be 180% of current analysis, due to leakage throughout the supply chain and the lifecycle of methane in the atmosphere.

strategy.

Actions:

Set high energy & carbon performance standards for new construction and renovations.

Accelerate retrofits, including electrification.

Raise efficiency & RPS goals; aggressively market toward them; challenge staff and community to improve efficiency 10% per year for the next ten years.

Develop contingency plans to maintain carbon neutral electricity in face of potential reduced reliability of hydroelectric power

Explore microgrid and district energy strategies in key districts

Proactively explore "utility of the future" strategies to take advantage of potential disruptive change facing the industry[30]

Benefits: Emissions. Savings. Health[31]*. Agility. Resilience.*

Palo Alto has made remarkable progress in decarbonizing its electricity sector. In addition to the City's purchase of hydro-electric power resources, CPAU has worked actively to develop its renewable electricity portfolio. In 2013, Palo Alto approved a Carbon Neutral Electric Resource Plan committing Palo Alto to using carbon neutral electric resources from that year on—through purchase of Renewable Energy Credits (RECs) for the "brown power" portion of CPAU's portfolio that will largely be replaced by 2017 with expanded purchases of renewable power. However, low hydro production may necessitate the purchase of brown power and RECs after 2017 as well.

Many CPAU programs are already under way to reduce energy usage in homes and local businesses, through education and outreach, incentive programs and energy use disclosure requirements. But the results have been modest and inconsistent. Palo Alto should accelerate those efficiency gains (to reduce pressure on CPAU's renewable capacity), drive down natural gas usage and shift to carbon neutral electricity.

Further reductions in GHG emissions associated with utility energy consumption could be achieved through:

- Breakthrough efficiency in electricity consumption to reduce city's overall energy demand and the need for continued energy purchases through power purchase agreements (PPAs) for renewable power.
- Innovation technically and financially to move the city away from natural gas by both reducing natural gas consumption as much as possible, partly through energy efficiency, and electrification of traditionally gas uses (i.e. heating) combined with increase local energy generation and, potentially, transitional use of offsets.

There are potential concerns regarding "complete" electrification, including:

- Induced demand. In the absence of adequate energy storage, morning and evening demand peaks in Palo Alto, which would not be met by local renewables, would call upon the resources of the existing grid, which would be met by fossil resources; in

[30] Discussed at UAC April 1, 2015: http://cityofpaloalto.org/civicax/filebank/documents/47849

[31] E.g., indoor air quality and health benefits from electrifying appliances such as stove tops and clothes dryers that are located IN the home due to reduced hydrocarbon fumes.

this scenario, according to some, electrification intended to reduce GHG emissions could potentially increase them.)

- Redundancy/resilience. If CPAU customers shifted most or all natural gas demand to electricity, the city system could be more vulnerable to electrical outages. Micro-grids, for example, could reduce that risk, but the risks should to be evaluated as part of any electrification strategy.
- CPAU economics. A successful electrification strategy could greatly reduce natural gas revenues; yet CPAU would still need to maintain the integrity of the natural gas infrastructure. (See "Utility of the Future," below.)
- Regulatory constraints. Publicly-owned utilities operate in a complex, highly regulated legal environment with respect to almost every aspect of the utility business from rate design to safety and reliability to required program and service offerings. Investor- owned utilities (like PG&E) operate under a different legal and regulatory construct, particularly with respect to rate setting. Proposals to address GHG emissions must always harmonize discrete policy proposals with legal and regulatory constraints, cost-effectiveness and cost of service principles, and the overall safety and reliability principles that are at the core of the utility's mission.

In August 2015, the City Council authorized an electrification (a/k/a "fuel switching") work plan[32] to research and analyze ten specific electrification strategies; that work is underway and will yield analytic findings and recommendations over the course of 2016 and early 2017.

Key Actions: Natural Gas [broken out from energy for clarity]

2.a. Encourage all-electric in new construction

Because new construction of advanced alternatives is generally more economic than retrofits, this strategy is one of the most cost-effective evaluated.

2.b. Make PA GreenGas "opt out."

Shift PAGG from an opt-in program to an opt-out, which would bring Palo Alto to 40% GHG reductions—California's 2030 target—now!).[33]

2.c. Reduce energy use through efficiency measures and equipment replacement

Continue to support and, where feasible, consistent with legal and regulatory requirements, and cost-effective, accelerate aggressive energy efficiency and accelerated retrofit cycles through building codes and CPAU incentives. Develop programs that take advantage of natural equipment life cycles by encouraging CPAU customers, through focused marketing and/or predictive analytics, to upgrade at time of replacement to most efficient technology, determined on a total cost of ownership basis.

2.d. Pursue and apply electrification feasibility analysis.

Encourage "fuel switching" where cost effective from GHG-emitting natural gas to carbon neutral electricity. Initial analysis of the cost-effectiveness of fuel switching strategies identified residential water heating (replacing hot water heaters with heat pump water heaters (HPWH)

[32] http://www.cityofpaloalto.org/civicax/filebank/documents/48443

[33] Emission offsets are controversial, but may play a successful transitional role in reducing natural gas-related emissions. Other options include: (1) Make the PAGG portfolio the default gas portfolio (2) Explore investing a portion of those funds in qualified *local* offsets to fund other S/CAP initiatives, using offsets as "bridging" strategy as the City has done with carbon neutral electricity

and some EVs as "cost-effective" within current parameters. CPAU plans to begin a pilot program testing HPWH replacement strategies and customer response in early 2016.[34] Other electrification opportunities, including residential space heating electrification, commercial water heating and space heating electrification, and commercial cooking electrification, are less cost effective at this time when assessed as individual measures, but may be more cost-effective when offered as bundled services. (For example, Boulder CO is developing an integrated service offering that combines energy audit, weatherization, efficient appliances, rooftop solar and an EV in a single bundle that lowers monthly cost to the customer and is paid for through on-bill financing. The offering may be target marketed using predictive analytics, based on customer use patterns and permit data, to identify the customer who would benefit the most.)

Related actions: Build capacity to serve expanded electrical demand through efficiency, local generation, and continued renewable power purchase. Adjust rate tiers in order to not penalize fuel-switchers. Note that all rates must be based on the cost to provide service. Any rate design proposal must be specifically analyzed for legal, regulatory, and cost-effectiveness issues, or other barriers (e.g. operational implementation) that may impose constraints on using rates as a tool to implement or otherwise incentivize or subsidize fuel switching.

2.e. Monitor biogas options.

Biogas (or methane generated from crop or waste resources) is part of the strategy mix in California's PATHWAYS analysis. CPAU has determined biogas is not an economically viable option for Palo Alto at this time, and PG&E has expressed concerns about the safety and quality of biogas if this commodity is introduced into its pipeline transmission system.

2.f. Monitor the long-range viability of CPAU's natural gas business.

As customers shift away from natural gas, CPAU's natural gas revenues will decline, while the Utility will still need to maintain the safety and integrity of its natural gas pipelines and systems and retain qualified workers. This could generate financial stress at some point in the future and leave stranded assets.

2.g. Infrastructure considerations for the natural gas utility

Longer-term implications of moving away from natural gas in Palo Alto need to be studied in further detail. For instance, natural gas utility estimates for long-term infrastructure planning costs and anticipated infrastructure upgrades need to be assessed relative to costs and benefits of electrification for specific natural gas distribution areas and neighborhoods. Aging natural gas infrastructure needs to be considered as part of assessing electrification opportunities. Steps may include:

- Identifying natural gas distribution areas requiring costly network upgrades
- Developing plans to target these areas for electrification and associated electrical upgrades needed with aggressive, targeted incentives
- Assessing whether and how avoided cost of infrastructure upgrades could pay for

[34] In addition to cost-effectiveness hurdles, electrification programs may be legally constrained as well. For example, efforts to shift customers from natural gas to electricity, which will have investment and revenue impacts on each enterprise fund, may raise issues with regard to Prop 26, which prevents municipal utilities from "cross- subsidizing" electricity and gas customers. This will need to be evaluated as part of developing electrification strategies.

electrification

Benefits: *Emissions. Savings. Agility. Resilience.*

3. Key Levers: Water

Background/Issue(s): Palo Alto has done an outstanding job of meeting annual water use reduction requirements of the current "drought." But both potable water supplies and hydroelectric needs could be challenged by long-term shifts in California's precipitation regime. With shifting climate patterns[35], significant uncertainty exists related to whether the drought conditions are the "new normal" for California However, all climate projections show increases in average temperatures and reduced snowpack where Palo Alto sources much of its water—which could impact Palo Alto's hydroelectric power and thus its carbon neutral electricity strategy.

Under state law[36], City of Palo Alto Utilities (CPAU) must prepare an Urban Water Management Plan every five years. The Plan must assess the reliability of Palo Alto's water sources over a 20-year planning horizon and report its progress on a 20% reduction in per-capita urban water consumption by the year 2020.[37]

CPAU's 2010 Urban Water Management Plan presumes continuation of modern California precipitation regimes, which might not accurately represent the future we face. CPAU is beginning development of the 2015 plan (due June 2016 to the State). Given current climatic projections, long-term increases in water supplies from San Francisco Public Utilities Commission (SFPUC) appear highly unlikely, and any tapping of groundwater supplies, even with the new storage facilities, would only provide emergency short term relief. The key is therefore to reduce consumption of water while rapidly increasing the availability and use of recycled water.

Goals: Safe and reliable water supply for the possible "new normal" of less (and less reliable) precipitation

Means: Efficiency. Recycled water. Green infrastructure for local storm water capture and storage. Onsite wastewater treatment.

Strategies: Reduce potable water consumption. Supplement existing water supplies.

Actions:

Develop long-term efficiency goals, and aggressively market toward them Incorporate net zero water standards in future Green Building Ordinances

Evolve Palo Alto landscapes to adapt to changing precipitation trends, and allocate water resources to protect our urban canopy

Develop and incent local water capture and storage, from household to social scale Pilot and evaluate onsite wastewater treatment technologies

Pursue recycled water production and use Benefits: Resilience. Savings.

Strategy: Reduce potable water consumption.

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[35] The California Department of Water Resources (http://www.sei-international.org/news-and-media/3252), the Association of California Water Agencies (http://www.acwa.com/events/2016-executive-briefing-defining-new-normal) and others are examining the potential impacts of Climate Change on Hydrologic Trends and Water Management.

[36] Water Conservation Bill of 2009

[37] http://www.water.ca.gov/urbanwatermanagement/

In Palo Alto, overall water use per account decreased by 27% between 2000 and 2010, and all customer classes showed a reduction in annual water use per account. The relative share of the total water usage made up by the residential customers has continued to grow with residential single-family users increasing their share from 41% to 47%. Overall water consumption in the residential sector in total increased its share from 50% to 62% of total citywide consumption. Palo Alto's drought response has to date achieved reductions of well over 25% in 2015 compared with 2013 levels.

Long-term water reduction strategies should focus not only on implementing these procedures during times of drought, but also using the incentives and policy drivers the water management plan to drive sustained water consumption reduction, which will require structural changes in water demand (such as building design and landscaping choices) as equipment and fixture upgrades and behavioral choices.

Strategy: Supplement Existing Water Supplies

New sources of both potable and non-potable water to support redundant supplies for water security requires 1) increasing ground water capture through capturing rain water, storm water retention and encouraging ground water recharging through green infrastructure investment, design criteria and policies, 2) maximizing the potential for water recycling from the Regional Water Quality Control Plan (RWQCP), and potentially 3) careful exploration of on-site waste water treatment technologies (such as those in use at Moffett Field).

Ground water capture and management is critical to provide sufficient on-call reserves during severe droughts, and to maintain sustainable ecosystems. Policies to maximize capture also reduce the risk of storm water outflow and flooding. Policies the city should promote for ground water capture include:

- **Green stormwater infrastructure.** Promote the design of green streets and alleys to promote the integration of green infrastructure elements into the street and/or alley design to store, infiltrate, and evapotranspire stormwater.
- **Set policy and codes to require permeable pavement installation on new and retrofit of commercial building and residential projects.** These pavements are particularly cost effective where land values are high such as in Palo Alto and where flooding is a problem.
- **Promote rainwater and greywater harvesting.** Address through building policy or legally compliant, cost-effective utility incentives the capturing rainwater and greywater and using it for landscape watering needs reducing the use of potable water for landscape irrigation.
- **Incent downspout disconnection.** Address through building policy or legally compliant, cost-effective water utility incentive the disconnection of rooftop drainage pipes to drain rainwater to rain barrels, cisterns, or permeable areas instead of the storm sewer.
- **Develop recycled water (and potentially direct delivery of purified water) capacity and uses**, from both the RWQCP and onsite waste water treatment.

City of Palo Alto should also maximize water recycling from the RWQCP. Under current upgrade plans, the RWQCP could produce as much as 27 million gallons per day, of which approximately 33% meets quality standards for "unrestricted use" and 19.4 MGD of restricted water use.

The City continues to examine methods to expand the use of recycled water. Completion of the Recycled Water Market Survey and Facility Plan is a step in that direction. The City expects that the costs of implementing expanded recycled water use can be reduced through a combination of regional coordination and state and federal matching funds.

Other Actions [Summary]
These "other actions" are listed in brief summary form, and will be addressed in detail in future study sessions.

4. Key Levers: Buildings

Goals: "Net Positive," healthy, productive, efficient built environment
Means: Building ordinances and reach codes. Performance benchmarking and disclosure. Education & outreach to realtors, developers, building trades, financiers
Actions:
Set & enforce building standards >15% above California's.
Establish a "loading order" for efficiency & ZNE measures: New buildings > Major retrofits > Ownership transfer
Apply retro-commissioning and performance benchmarking to ensure and incentivize high performance. (Retro-commissioning is a systematic process to ensure that a building performs as designed. Performance benchmarking is comparing one building's performance to performance of comparable buildings.)
Ensure that City buildings meet green building requirements. Conduct regular building audits, set performance improvement goals, assign accountability
Assess and accelerate electrification transition (with CPAU). Use "predictive analytics" to identify and engage likely candidates for retrofit and equipment upgrades, based on expected end-of-life of existing equipment
Benefits: Reduced emissions. Operating cost savings. Enhanced asset value. Grid resilience and more manageable energy demand curve.

5. Key Levers: Municipal Operations

Efficiency, low carbon and other sustainability initiatives can save money, improve operating performance, reduce emissions, and provide leadership by for the community.
Goals: "We go first"
Means: Procurement. Procedures. Accountability. Training.
Actions:
"Default to Green" in procurement (For example, City policy requires that City management procure EVs as first choice, and select fossil fueled vehicles only if appropriate EVs are not available.)
Embed sustainability commitments and criteria into CIP process, building construction, renovation and operation
Establish internal carbon targets and trading, pricing to increase GHG-reduction

accountability.[38]
Apply retrofits to cut resource use 5-10%/year—performance contracting. Reinvest operating savings into further sustainability initiatives
Collaborate with other cities to share best practices & advance regional initiatives
Benefits: Footprint. Cost savings. Happy customers. Lead by example.

6. Key Levers: Palo Alto Utilities

Goals: Reliable, safe, economical, sustainable and resilient services
Means: Lead the charge. Adapt business model to changing industry dynamics.
Actions:
Promote—and monetize—radical resource efficiency.
Increase PPA contracting to hedge hydro uncertainty, subject to the City's Risk Management Policies and Procedures; maximize local solar+storage as resilient complement to grid solar.
Deploy Smart Grid as key part of "smart and connected city"
Restructure rates to not penalize increased electrical demand
Explore and develop microgrids; prepare to upgrade grid to meet rising demand from electrification.
Adapt CPAU business model to service-focused, Distributed Generation/Storage
Benefits: Leadership. Resilience. Savings.

7. Key Levers: Adaptation & Resilience

This is a large topic, addressed here only briefly. Santa Clara County has conducted extensive analysis of these topics in their SV 2.0 project. SCAP consultants have provided detailed assessment of risks and potential responses. City staff have several related workstreams underway, some of which will be presented in a parallel study session currently scheduled for January.
Goals: Reduce vulnerability to Sea Level Rise (SLR), flooding, rising temperatures, extreme weather events
Means: Inform, protect, retreat. Build resilience into City planning.
Actions:
Continue to pursue "green infrastructure" as required by the Regional Water Quality Control Board and as warranted by staff analysis; include supporting policies in the Comp Plan Update aimed at increasing storm water infiltration.
Pursue policies and projects to reduce storm and flood vulnerability
Evaluate and if needed strengthen SLR and flooding concerns into planning, zoning, permitting and insurance requirements
Address the vulnerability of City assets to sea level rise (SLR)
Benefits: Survival of critical assets and services. Reduced costs, public safety.

[38] More than 400 companies, 40 nations and 23 cities, states and regions have established internal carbon pricing, as a way of incorporation climate plan goals into management and operating decisions.

8. Key Levers: Information Technology

Goals: Enable staff, residents and business to understand trends innovate programs
Means: City as platform: Provisioning data and information services that support operational efficiency and program innovation
Actions:
Extend open data initiatives to include mobility, utility, operations & environmental quality
Provide visual performance dashboards that simplify tracking and benchmarking sustainability performance—and support effective action
Accelerate smart grid deployment. Enable customer and 3rd party access to accurate, timely data. Protect privacy.
Benefits: Agility. Participation. Learning. Data-driven decisions.

9. Key Levers: Engaging the Community

Goals: Broad community engagement, participation, guidance, initiative
Means: Inform & convene. Support individual & collaborative action. Disclose & report impacts.
Actions:
Pilot "CoolBlock" collaborations to support neighborhood cooperation toward sustainability and resilience goals
Deploy/encourage dashboards and "fitbit for sustainability" apps Estimate/report "scope 3" emissions, to seed conversations about consumption **Benefits:** QOL, savings, accelerated GHG reductions, conviviality, political support

10. Key Levers: Ecosystems

Goals: Protect and enhance the regenerative capacity of ecosystems
Means: Value and enhance the common wealth.
Actions:
Use "ecosystem functionality" layers in planning processes.
Expand and protect canopy, biodiversity, soil health and water capture; adapt canopy and parklands to changing climatic regimes
Value and enhance the common wealth for future generations.
Benefits: Quality of life. Adaptation/resilience.

Potential Sources of Funds[39]

Staff has identified a variety of potential sources of funds to finance the initiatives that Council may choose to purse, though all of these sources (including private financial vehicles) need a more complete assessment of applicable legal and regulatory requirements and the risks and obligations associated with the various approaches. These include operating savings, parking feebates, utility rates, revolving loan funds, local offsets, carbon tax or fee, voluntary contributions, as well as green bonds and private financial vehicles.[40] There is evidence that

[39] The City of Palo Alto has just been award an $85k grant from USDN for a multi-city exploration of potential sustainability financing strategies

[40] This despite a common misperception: Most people who have not been deeply engaged in sustainability work assume that low-carbon and other sustainability initiatives will necessarily require financial, performance or quality of life sacrifices, because "better usually costs more." As we've seen in the world's product innovation, green building, and corporate eco-efficiency, this is not necessarily the case; in

market demand exceeds supply for well-
constructed sustainability and climate related investment opportunities; as a result some initiatives discussed here may be financeable through private investors. (Subject to Council selection of goals and measures, the strategies outlined here could yield Net Present Value in the hundreds of millions of dollars.)

Key questions

As Council and community discuss the S/CAP and the options before us, we will need to consider several key questions:

Leadership: What level of GHG reduction goals will Palo Alto target?

Pace: How fast will Palo Alto attempt to achieve these reductions?

Implementation: Which measures will Palo Alto enact to achieve these reductions?

Invest: How much will Palo Alto invest?

Funding: How will Palo Alto fund those investments?

Criteria: What factors will Palo Alto use to make these decisions?

Legal Issues

Subsequent Study Sessions and Council Reports will address the cost implications and policy trade-offs of various mandates and proposals, and identify and assess any constraints that may exist (including any imposed by legal, statutory or regulatory requirements) in more detail. All measures and actions identified in this broad overview of the current state of the S/CAP process must be specifically analyzed and considered in the context of all applicable legal, statutory and regulatory requirements, including, for instance, constitutional limitations on utility rates and use of ratepayer funds imposed by Californians when they adopted Proposition 26, obligations set forth in the Cap-and-Trade regulations adopted by the California Air Resources Board, and other miscellaneous requirements embedded in the California Public Utilities Code.

Timeline: Next steps/Plan

Staff proposes a series of events over the course of the spring, to support Council and community in developing and reviewing the draft S/CAP and deciding together how to proceed.

- A community summit on January 24, 2015 to engage several hundred Palo Altans (and most of the Council) in an open discussion of the potential goal and the critical elements of Transportation, Energy and Water.
- This study session, which can explore the overall strategic sweep and key elements of the entire SCAP, and begin a high level conversation to surface aspirations and identify concerns, and frame the study sessions which will follow.

fact a growing body of evidence documents that attractive returns on investment are possible from well-designed and well-executed sustainability initiatives. In the words of the late Ray C. Anderson, founder and CEO of Interface Flor, "If you think sustainability is too expensive, you're doing it wrong.")

- A series of study sessions over the course of the year, to enable deeper consideration of these three elements, and develop understanding of the requirements of both a 15 year strategic plan and a five year action plan.
- The annual Earth Day Review of City sustainability initiatives in late April.
- An action item—potentially in the early fall— to adopt goals and strategies, appropriate initial funding, establish criteria by which Council will allocate funding in response to specific staff proposals, and identify next steps.

Resource Impact

This study session has no resource impact beyond the staff and consultant time required to prepare and review this staff report, and participate in the meeting. Climate plan updates are significant undertakings for any jurisdiction, and since 2014 the City of Palo Alto has invested time and resources in this project. The need to allocate multiple members of City staff, significant time on the City Council's agenda, and financial resources for consultant assistance and event/meeting programming will continue until the adoption of the updated Climate Plan (and its companion environmental document). Implementation of the Climate Plan will require investment of public funds, in amounts to be determined based on selection of goals and strategies, across the various funds of the organization.

Policy Implications

The Sustainability and Climate Action Plan will set forth proposed City policies and actions with regard to the topics addressed, and a framework for future discussions regarding these topics. The S/CAP Plan addresses many issues that are also addressed by the Comprehensive Plan. While staff has attempted to coordinate the two work streams as much as possible, there are inevitable differences, given the nature of each initiative, which will need to be reconciled as the planning processes advance in 2016. The Comprehensive Plan is an update of Palo Alto's 1998 Comprehensive Plan, and has been underway since 2008; it will build on the existing plan, and incorporate goals, policies, and programs addressing climate change and climate adaption for the first time. The EIR for the Comp Plan Update will take a conservative look at potential GHG emissions through the year 2030.

The S/CAP is a de novo undertaking, commenced in 2014; it is disruptive in nature, presenting possible strategies for making Palo Alto more sustainable in 2030 and beyond. As is typical for such planning efforts, near term actions can be specific and quantifiable, while longer term actions are necessarily more aspirational and specific, focusing on externally driven goals and attempting to determine if and how to meet them. These two different processes will converge on some matters, and not others; however staff recognizes that the two plans must ultimately work together to express the community's vision for the future, and establish specific policies and strategies to guide future investments and decisions. Staff has not attempted to resolve all these differences as the staff level, since many of them are a matter of political, not professional, judgment, and thus within the purview of Council and community, not staff.

Environmental Review

Adoption of a Climate Plan will require review pursuant to the California Environmental Quality Act (CEQA). While some sustainability measures have been included in the Draft EIR that is being developed for the Comprehensive Plan Update, the final S/CAP may include strategies that have not been adequately addressed by the Update. Thus the final S/CAP will have to be reviewed to determine the appropriate level of CEQA review required. This review may utilize the Comprehensive Plan EIR, or require preparation of an Initial Study/Negative Declaration, or even preparation of an additional EIR, depending on the strategies and commitments it contains.

Attachment:

- ATTACHMENT A: Stabilization Wedges and Analytical Assumptions (DOC)

Attachment: Stabilization Wedges and Analytical Assumptions

The projected GHG reductions presented in this CMR are based on extensive analysis, summarized in these "stabilization wedges" and tables of assumptions.

The wedges, based on the methodology developed by Robert Socolow of Princeton University, illustrate the GHG reductions delivered over time by each element of a portfolio of strategies.

The wedges are driven (through an Excel model not presented here, but available for review) by these tables of assumptions, which show the target implementation levels and adoption rates for each measure. As these assumptions are changed, projected GHG reductions change, as shown by the accompanying charts.

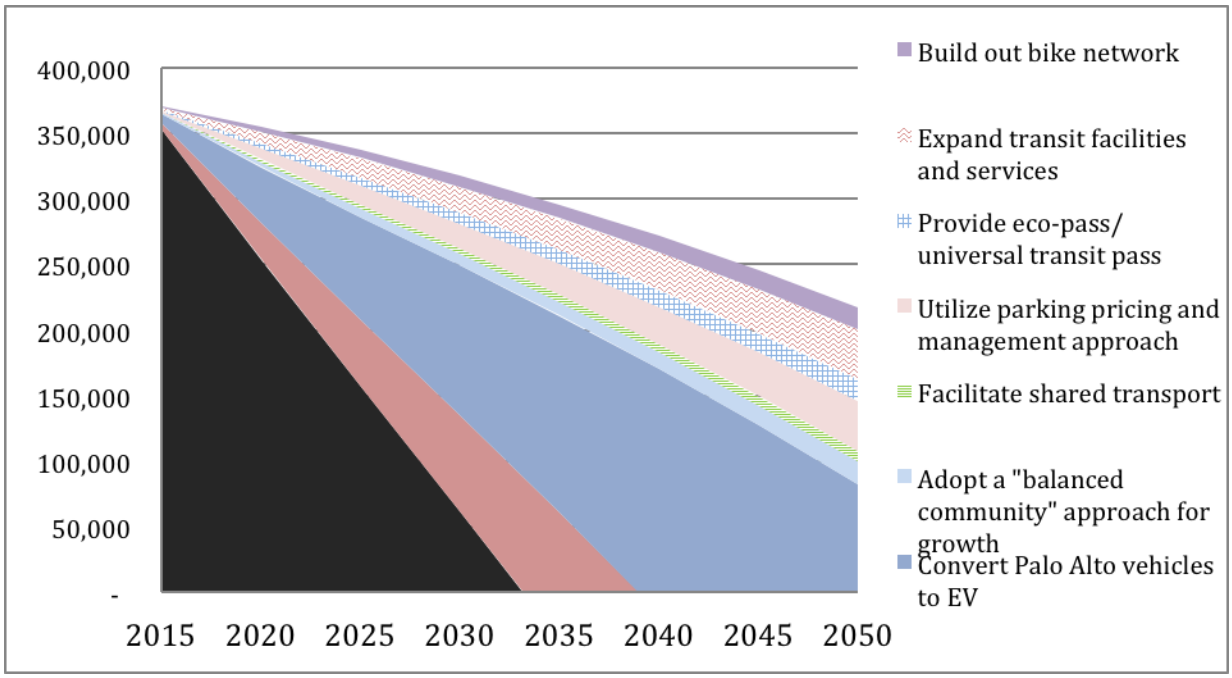
These projections were developed using analytical models based on projections of the potential impacts of different actions (in turn based on engineering analysis or published research), and assumptions of the potential rates of adoption that could be achieved. As with all such models, it would be prudent to assume that near term projections (such as the next five years) are more accurate than longer-term projections (such as the next 15 or even 35 years), and staff recommends revisiting and recalibrating the S/CAP every five years—or more often, as new information warrants.

Note that the potential impacts of some actions—like replacing natural gas water heaters with electric heat pump water heaters (HMWH)—are relatively straightforward to analyze with a high degree of confidence. The potential impacts of other actions—like advanced mobility strategies—are much more difficult to analyze, because causal relationships for new technologies are not yet well understood, and because the academic literature often used as a basis for these technologies generally lags the technologies themselves.

As a result, these should not be taken as predictions of what *will* happen, but as a portfolio of strategies that *could* potentially achieve the targets we set. (These projections should be considered estimates within perhaps a +/-20% range.) The S/CAP consultants have constructed these models to be transparent and flexible; it's relatively straightforward to modify assumptions and observe the effect those modifications have on outcomes.

The target implementation levels and adoption rates shown here are aggressive, and would require focused and consistent effort to achieve (for example, replacing most gas water heaters at end-of-life with HPWHs, rather than a few). But these rates provide one possible roadmap for achieving the 2030 target, and a basis for discussion of what we choose to accomplish.

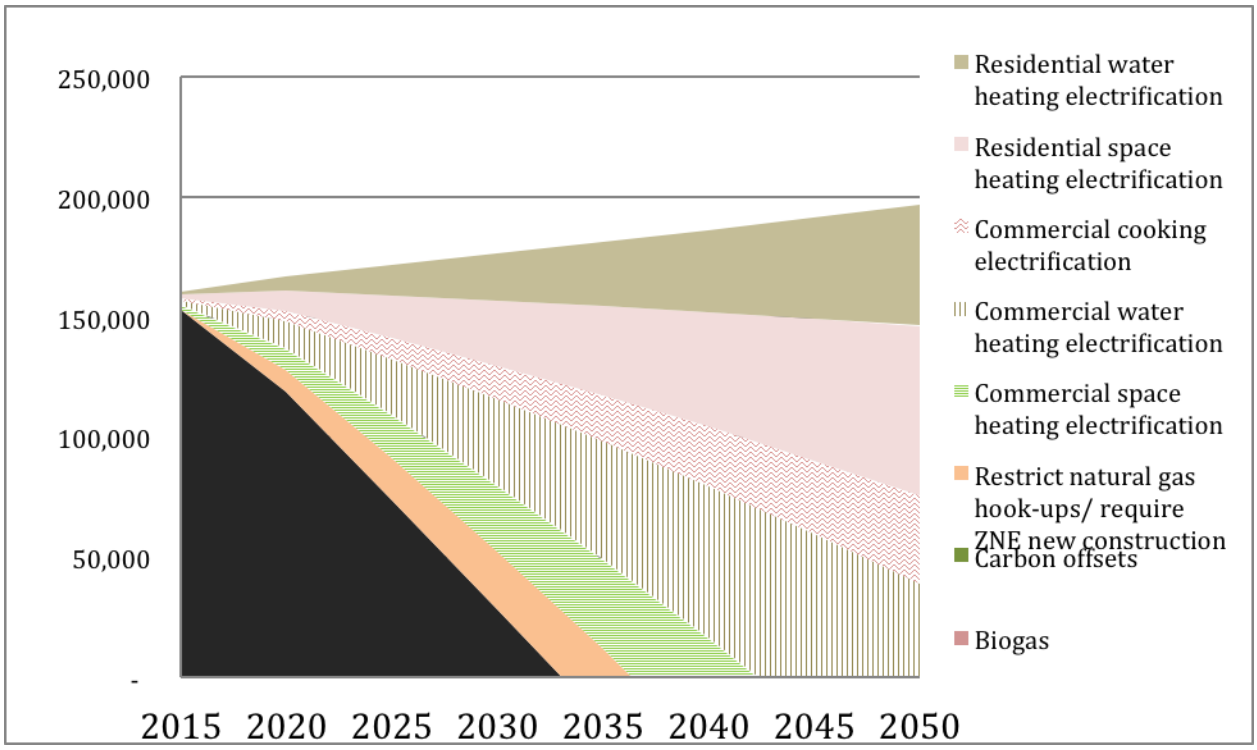
Transportation (City & Community GHG Emissions, mTCO2e)



Strategy Name	Selected? *(Yes/No)*	Assumptions	Implementation Level	Target Year	Annual Adoption Rate
BAU - Transportation					
Build out bike network	Yes	Convert all class II bike lanes to protected bike lanes (PBL) Increase bike boulevard mileage from 22-32 miles Expand bike share to 28 stations per square mile	40%	2030	2.7%
Expand transit facilities and services	Yes	Caltrain modernization ridership targeted in 2040 achieved Expand SamTrans, VTA and Palo Alto shuttles by 100% El Camino Real and Dumbarton Bus Rapid Transit	60%	2030	4.0%
Facilitate shared transport	Yes	Dynamic ridesharing based on San Francisco casual carpool rates, with Palo Alto share proportionate to Palo Alto Caltrain ridership	60%	2030	4.0%

Provide eco-pass/universal transit pass	Yes	Expanded Universal Transit Pass (UTP) - Caltrain GoPass, SamTrans Way2GoPass, and VTA Ecopass, for all residents and employees	100%	2030	6.7%
Utilize parking pricing and management approach	Yes	All employment sites institute parking pricing, parking cash-out, parking feebate equivalent to market price of parking Full cost pricing of residential parking (unbundling or eliminating minimum parking requirements)	50%	2030	3.3%
Adopt a "balanced community" approach for growth	Yes	Target a jobs-housing balance of 1.44 with growth in specific areas (e.g., Stanford Research Park, downtown core, Stanford Shopping Center, etc).	15%	2030	1.0%
Convert Palo Alto vehicles to EV	Yes	Incentives, rebates and programs to encourage electric vehicle adoption by Palo Alto residents	90%	2030	6.0%
Convert all other vehicles to EV	Yes	Offer charging stations, and other incentives for people coming into Palo Alto to drive EVs	80%	2030	4.0%
Carbon offsets	No	Purchase carbon offsets	0%	2030	

Natural Gas (City & Community GHG Emissions, mTCO2e)



Strategies	Selected? *(Yes/No)*	Implementation Level	Target Year	Annual Adoption Rate
BAU - Natural Gas				
Residential water heating electrification	Yes	100%	2030	7%
Residential space heating electrification	Yes	70%	2030	5%
Commercial water heating electrification	Yes	85%	2030	6%
Commercial space heating electrification	Yes	85%	2030	6%
Commercial cooking electrification	Yes	50%	2030	3%
Restrict natural gas hook-ups/ require ZNE new construction	Yes	100%	2030	100%
Carbon offsets	No	0%	2030	0%
Biogas	No	0%	2030	0%