CITY OF MOUNTAIN VIEW

COUNCIL ENVIRONMENTAL SUSTAINABILITY COMMITTEE

AGENDA

REGULAR MEETING—THURSDAY, FEBRUARY 5, 2015
ATRIUM CONFERENCE ROOM AT CITY HALL—500 CASTRO STREET
6:30 P.M.

1. **CALL TO ORDER**

2. **ROLL CALL**

   Committee Members: Pat Showalter, Lenny Siegel, and Chair Chris Clark.

3. **MINUTES APPROVAL**

   Minutes for the April 9, 2014 meeting have been delivered to Committee members and copies posted on the City Hall bulletin board. If there are no corrections or additions, a motion is in order to approve these minutes.

4. **ORAL COMMUNICATIONS FROM THE PUBLIC**

   This portion of the meeting is reserved for persons wishing to address the Committee on any matter not on the agenda. Speakers are limited to three minutes. State law prohibits the Committee from acting on nonagenda items.

5. **UNFINISHED BUSINESS**—None.

6. **NEW BUSINESS**

   6.1 **CLIMATE PROTECTION ROADMAP**

   Overview:

   Staff will present an overview of a proposed pre-Draft Climate Protection Roadmap (CPR). Staff seeks guidance on whether the Committee endorses the overall approach and on any specific strategies or implementation mechanisms.

Recommendation:

Provide input on the proposed pre-Draft CPR. This input will be incorporated into a Public Review Draft CPR and presented to the City Council during a Study Session.

6.2 **ELECTRIC VEHICLE CHARGER DEPLOYMENT UPDATE**

Overview:

Staff will provide an overview of alternatives for the deployment of additional electric vehicle (EV) chargers in Mountain View and provide a recommendation regarding collecting fees for use of public Level 2 chargers.

Recommendation:

Accept five dual-port, Level 2 EV chargers under a Bay Area Climate Collaborative grant, and institute a fee for use of public Level 2 EV chargers in Mountain View.

7. **COMMITTEE/STAFF COMMENTS, QUESTIONS, COMMITTEE REPORTS**

No action will be taken on any questions raised by the Committee at this time.

8. **ADJOURNMENT**

SA/8/CDD
816-02-05-15A-E

AGENDAS FOR BOARDS, COMMISSIONS, AND COMMITTEES

- The specific location of each meeting is noted on the notice and agenda for each meeting which is posted at least 72 hours in advance of the meeting. Special meetings may be called as necessary by the Committee Chair and noticed at least 24 hours in advance of the meeting.

- Questions and comments regarding the agenda may be directed to the Transportation and Business Services Division of the Public Works Department at (650) 903-6311.

- Interested persons may review the agenda and staff reports at the Public Works Department counter beginning at 4:00 p.m. the Friday evening before each regular meeting. A copy can be mailed to you upon request. Staff reports are also available during each meeting.

- **SPECIAL NOTICE—Reference: Americans with Disabilities Act, 1990**
  Anyone who is planning to attend a meeting who is visually or hearing-impaired or has any disability that needs special assistance should call the Public Works Department at (650) 903-6311 48 hours in advance of the meeting to arrange for assistance. Upon request by a person with a disability, agendas and writings distributed during the meeting that are public records will be made available in the appropriate alternative format.

- The Board, Commission, or Committee may take action on any matter noticed herein in any manner deemed appropriate by the Board, Commission, or Committee. Their consideration of the matters noticed herein is not limited by the recommendations indicated herein.

- **SPECIAL NOTICE—**Any writings or documents provided to a majority of the Council Environmental Sustainability Committee regarding any item on this agenda will be made available for public inspection in the Public Works Department, located at 500 Castro Street, during normal business hours and at the meeting location noted on the agenda during the meeting.

ADDRESSING THE BOARD, COMMISSION, OR COMMITTEE

- Interested persons are entitled to speak on any item on the agenda and should make their interest known to the Chair.

- Anyone wishing to address the Board, Commission, or Committee on a nonagenda item may do so during the "Oral Communications" part of the agenda. Speakers are allowed to speak one time on any number of topics for up to three minutes.

CITY OF MOUNTAIN VIEW

COUNCIL ENVIRONMENTAL SUSTAINABILITY COMMITTEE

MINUTES

REGULAR MEETING—WEDNESDAY, APRIL 9, 2014
PLAZA CONFERENCE ROOM AT CITY HALL – 500 CASTRO STREET
6:30 P.M.

1. **CALL TO ORDER**

The meeting was called to order at 6:30 p.m. by Chair Siegel.

2. **ROLL CALL**

Present: Committee members Ronit Bryant, Chris Clark, and Chair Jac Siegel.

Absent: None.

3. **MINUTES APPROVAL**

No members of the public wished to speak.

Motion—M/S Bryant/Clark—Carried 3-0—Approve the minutes of the November 18, 2013 meeting.

4. **ORAL COMMUNICATIONS FROM THE PUBLIC**

John Scarboro, with Carbon Free Mountain View, gave a presentation on why Mountain View needs Consumer Choice Aggregation (CCA) and explained what a CCA is, where Mountain View's electricity comes from, how carbon-free electricity can help meet Mountain View's greenhouse gas reduction goals, Marin County's experience with their CCA, and other CCA benefits.

Speaking from the floor in support of Mountain View pursuing a CCA:

- Bruce Karney
- Mike Balma
- Cherie Walkowiak
- Wendee Crofoot

5. **UNFINISHED BUSINESS**—None.

6. **NEW BUSINESS**

6.1 **ENVIRONMENTAL SUSTAINABILITY ACTION PLAN 2 UPDATE**

Environmental Sustainability Coordinator Attinger presented an oral staff report and he and Transportation and Business Manager Forsberg responded to the Committee's questions.

No members of the public wished to speak.

The Committee deliberated this item.

Motion—M/S Clark/Bryant—Carried 3-0—To endorse staff's proposal.

6.2 **ENERGY UPGRADE MOUNTAIN VIEW PROGRAM UPDATE**

Environmental Sustainability Coordinator Attinger presented an oral staff report and responded to the Committee's questions.

Speaking from the floor in support of Energy Upgrade Mountain View:

- John Scarboro
- Debbie Mytels
- Mike Balma

Speaking from the floor in opposition to continuing Energy Upgrade Mountain View beyond June 2014:

- Bruce Karney

6.3 ELECTRIC VEHICLE CHARGER DEPLOYMENT UPDATE

Environmental Sustainability Coordinator Attinger presented an oral staff report and responded to the Committee's questions.

Speaking from the floor in support of additional electric vehicle chargers in Mountain View:

- John Scarboro
- Mike Balma

7. COMMITTEE/STAFF COMMENTS, QUESTIONS, COMMITTEE REPORTS

None.

8. ADJOURNMENT

The meeting was adjourned at 7:50 p.m.

SA/3/CDD
816-04-09-14mn-E

CITY OF MOUNTAIN VIEW

MEMORANDUM

Community Development Department

DATE: February 5, 2015

TO: Council Environmental Sustainability Committee

FROM: Steve Attinger, Environmental Sustainability Coordinator
Terry Blount, Assistant Community Development Director/ Planning Manager
Randal Tsuda, Community Development Director

SUBJECT: Climate Protection Roadmap

PURPOSE

This memorandum presents a proposed pre-Draft version of a Climate Protection Roadmap (CPR) for the Committee's review and input.

RECOMMENDATION

Provide input on the proposed pre-Draft CPR. This input will be incorporated into a Public Review Draft CPR and presented to the City Council during a Study Session.

BACKGROUND

In November 2009, the City Council adopted voluntary, absolute greenhouse gas (GHG) emission reduction targets for the community as a whole. Absolute targets require a reduction in total emissions below a baseline year (2005) and do not account for residential and commercial growth. The adoption of the targets was in response to the Global Warming Solutions Act (AB 32) being signed into law, requiring California to reduce State-wide GHG emissions over time.

Since that time, the City has developed several plans and policies to guide its sustainability efforts and GHG reduction strategies, such as two Environmental Sustainability Action Plans (ESAPs) and a regulatory-based Greenhouse Gas Reduction Program (GGRP) associated with the General Plan update. However, a comprehensive plan to meet the City's community-wide, absolute 2050 GHG reduction targets has not been developed.

While the GGRP seeks to limit the *increase* in GHG production associated with growth anticipated in 2020 and 2030 under the 2012 General Plan update, it does not aim to reduce emissions below 2005 levels in alignment with the City's absolute 2050 reduction targets. The actions identified in the GGRP are required under the California Environmental Quality Act (CEQA) to implement the General Plan, whereas the Mountain View CPR is more comprehensive and includes strategies and implementation mechanisms the City could adopt in order to meet its broader 2050 GHG reduction targets.

The City's community-wide, absolute GHG reduction targets are:

- 5 percent below 2005 levels by 2012;
- 10 percent below 2005 levels by 2015;
- 15-20 percent below 2005 levels by 2020; and
- 80 percent below 2005 levels by 2050.

While these reduction targets are voluntary and there are no legal consequences of not achieving them, working to reduce the City's GHG emissions supports the State's GHG reduction goals under AB 32.

In February 2013, the City Council authorized staff to develop community-wide and municipal operations Climate Action Plans (CAPs) in conjunction with the County of Santa Clara (County), which had secured PG&E and Strategic Growth Council grant funding to develop CAPs for several local cities. Staff has worked with the County's consultant, AECOM, to develop a pre-Draft, community-wide Climate Protection Roadmap (Attachment 1). In parallel, staff has also worked on the development of a draft Municipal Operations Climate Action Plan (MOCAP) to guide the City's municipal operations GHG reduction efforts. A Draft MOCAP will be presented to the City Council via Study Session on March 31, 2015, and a Draft CPR is tentatively scheduled to be presented to the City Council via Study Session in April 2015.

ANALYSIS

The purpose of the CPR is to provide the City Council with a series of strategies and actions the City could undertake to reduce its community-wide GHG emissions and potentially reach the absolute GHG reduction targets adopted by the City Council in November 2009. The strategies include level-of-magnitude cost and GHG reductions, and can be used by the City Council and staff as the basis for further conversation and

development of more detailed work plans for those strategies deemed a priority. However, in receiving the CPR, the City Council would not be committing to implement any of the strategies/actions specifically.

In creating the CPR, the City undertook the following process:

1. Projected 2050 community-wide emissions under two scenarios—one projecting future emissions if the City continues Business As Usual (BAU), and the other scenario taking into consideration the potential impacts key State emission reduction programs may have on Mountain View's community GHG reduction efforts, or Adjusted Business As Usual (ABAU).

2. Conducted an activity-based emissions impact analysis to identify the types of macro-level changes in emissions-generating activity that could create sizable reductions in community emissions.

3. Performed a core strategy analysis to review the effectiveness and feasibility of specific emission reduction strategies that could reduce community emissions.

4. Completed a review of Best Practice City-level implementation mechanisms for each core strategy. Implementation mechanisms are policies, programs, or other actions that the City could take to implement a core strategy.

5. Identified potential strategies and implementation mechanisms that could enable the City to achieve its 2050 community-wide GHG reduction target under an ABAU scenario.

Reaching the City's Community-Wide GHG Reduction Targets

Under a BAU scenario, the City's community-wide emissions are expected to reach 1,235,873 metric tons of carbon dioxide equivalent (MT CO_2e) annually by 2050, which is 840 percent above the 2050 absolute emission reduction target of 147,190 MT CO_2e. Under an ABAU scenario which takes into consideration the future emissions reduction potential of existing State and Federal GHG-related policies and regulations, the City's emissions are expected to reach 899,645 MT CO_2e annually by 2050, 611 percent above the 2050 emission reduction target of 147,190 MT CO_2e.

Implementing all of the actions identified in the CPR could generate 100 percent of the emission reductions needed (approximately 750,000 MT CO_2e) to reach the 2050 reduction target under an ABAU scenario.

Proposed Community-Wide GHG Reduction Strategies

The proposed CPR strategies focus on Building Energy, Transportation, and Solid Waste, since those three areas generated almost 98 percent of community-wide GHG emissions in 2005. Strategies are not included for the Water/Wastewater and Off-Road Mobile areas because of their very small contributions to community emissions.

To assist decision-makers in evaluating the proposed GHG reduction strategies, Chapters 2 through 4 provide estimated, level-of-magnitude one-time implementation costs and GHG reduction ranges. For actions the City Council wishes to pursue, staff will provide more detailed financial costs, the impact to staff resources, the timeline, and the benefits on a project-by-project basis. Based on this information and Council priorities, staff can develop a more detailed work plan for achieving the City's absolute reduction targets.

Building Energy Strategies

While Building Energy-related GHG emissions comprised about 40 percent of 2005 community emissions, the six Building Energy strategies are estimated to provide up to 50 percent of the emission reductions needed to reach the City's 2050 reduction target under an ABAU scenario. The strategies focus on increasing the amount of renewable energy used by the community, but also cover fuel switching (defined below) and energy efficiency in new construction and existing buildings.

Transportation Strategies

GHG emissions from Transportation produced about 56 percent of total 2005 community emissions, and the three Transportation strategies are estimated to provide up to 47 percent of the emission reductions needed to reach the City's 2050 reduction target under an ABAU scenario. The three strategies focus exclusively on fuel switching from conventional gasoline and diesel transportation to vehicles that run on compressed natural gas, electricity, or biofuels.

Solid Waste Strategies

Solid Waste-related emissions represented 1.5 percent of the City's 2005 community emissions, and the Solid Waste strategies are estimated to provide up to 3 percent of the emission reductions needed to reach the City's 2050 reduction target under an ABAU scenario. While the CPR contains only one overarching Solid Waste strategy, which is to develop and implement a Zero Waste Plan (ZWP), the ZWP itself will contain more details on the relevant required policies, programs, and actions.

A Focus on Fuel Switching

The purpose of the CPR is to chart the most direct path toward achieving the City's community-wide, absolute 2050 GHG reduction target. As such, many of the CPR strategies and mechanisms are focused on energy fuel switching from traditional fossil fuel-based sources to renewable ones, since fuel switching provides the most effective way of reducing emissions quickly. *It should be noted that the absence of other strategies and mechanisms in the CPR for addressing climate change does not infer that they are less important, only that they may not help the City reduce its emissions as quickly*.

California Environmental Quality Act Compliance

To comply with CEQA, staff evaluated the CPR for its potential environmental impacts and determined that none of the proposed strategies and implementation mechanisms has the potential for causing a significant negative effect on the environment. Since the CPR can be seen with certainty to have no significant negative effect on the environment, it is not subject to CEQA (CEQA Guidelines Section 15061.b.3).

2012 GHG Reduction Target and Inventory

Toward evaluating the City's progress against its 2012 GHG reduction target (5 percent below 2005 levels), staff is conducting a 2012 emissions inventory, which will be completed by mid-February 2015. At that time, staff will update the relevant sections of the CPR and provide an assessment of the City's progress.

NEXT STEPS

Staff seeks input from the Committee on the CPR, including whether the Committee endorses the plan's overall approach, if any of the proposed strategies or mechanisms should be prioritized or removed, or if any new strategies should be added.

Based on Committee comments, staff will produce a final Draft CPR, which will be presented to the City Council via Study Session in April.

There would be no fiscal impact to receiving the final CPR, as it does not commit the Council to funding any of the underlying actions. The CPR will be used as a framework to further analyze and prioritize strategies and actions, and to forward specific actions to the Council for funding.

SA/3/CDD/
816-02-05-15M-E-1

Attachment: 1. Pre-Draft Climate Protection Roadmap

cc: PWD, CDD, TBM, ACDD, PP, CBO, SWPM

DRAFT City of Mountain View Climate Protection Roadmap

Chapter 1 — INTRODUCTION

The City of Mountain View has developed a Climate Protection Roadmap (CPR) as part of its multifaceted approach to addressing climate change. This Introduction provides summary information about the CPR's impetus and structure, the current and future state of greenhouse gas (GHG) emissions in the City, past and current city GHG reduction efforts, the State and regional policy context, CPR methodology, and potential reduction scenarios pending the implementation of the recommended mechanisms. Following this Introduction are three technical chapters. The first two chapters focus on the two largest contributors to the City's GHG emissions, Building Energy and Transportation. The third chapter covers Solid Waste, the third largest GHG contributor, and summarizes the City's current waste reduction initiatives (i.e. zero waste).

CPR Background and Purpose

This section outlines the background and purpose of the CPR, including its origin, and how it relates to various other city GHG reduction plans, documents, and efforts.

CPR Background

In November 2009, the City Council adopted the following voluntary, absolute community-wide GHG emission reduction targets:

- 5% below 2005 baseline levels by 2012
- 10% below 2005 baseline levels by 2015
- 15–20% below 2005 baseline levels by 2020
- 80% below 2005 baseline levels by 2050

Absolute targets call for a reduction in total community-wide greenhouse gas emission levels, *and do not allow for increased emissions due to population growth*. Together, the targets put the community on a trajectory toward achievement of meaningful contributions to State, national, and international climate protection efforts.

In 2012, the City adopted a Greenhouse Gas Reduction Plan (GGRP) to mitigate the emissions associated with future development allowed in the 2030 Mountain View General Plan.[1] At the time, Bay Area Air Quality Management District (BAAQMD) guidelines required qualified greenhouse gas reduction plans to contain a target for 2020 and provide substantial evidence that the plan's reduction actions would achieve the selected target. The BAAQMD guidelines allowed cities to use either an absolute or an efficiency-based target.[2] During development of the GGRP, it became clear that it would be very difficult to achieve the adopted community-wide 2020 emission reduction target due to high levels of future development and emissions growth, and the general political and economic infeasibility

[1] Per Section 15183.5 of the California Environmental Quality Act, page 199 of the 2014 CEQA Statute and Guidelines http://resources.ca.gov/ceqa/docs/2014_CEQA_Statutes_and_Guidelines.pdf

[2] Absolute targets require a reduction in total emissions below a reference level (the baseline year), whereas efficiency-based targets require the level of emissions per capita (or per service population) to be reduced below a reference level. It should be noted that efficiency targets allow a community's total emissions to increase while efficiency improves.

of implementing aggressive emission reduction policies and programs. For this reason, the City selected to use a BAAQMD-approved emissions efficiency target within the GGRP, i.e., a per-capita target that would result in a community emissions efficiency of below 6.0 metric tons of carbon dioxide equivalent per service population. (Service population is defined as residents and employees.) This means that Mountain View may continue to grow and increase its overall absolute GHG emissions while striving to reduce its "per-capita" emissions.

While the GGRP defines actions that will improve community greenhouse gas efficiency in 2020 and 2030, it does not contain actions strong enough to achieve the City's adopted absolute targets. The City recognized the incongruence of the efficiency targets used within the GGRP with its previously adopted absolute targets and sought to resolve the issue by conducting a study to evaluate the feasibility of achieving the adopted targets. The City initiated the CPR project for this purpose.

In addition to the GGRP, the City has also developed a Municipal Operations Climate Action Plan (MOCAP) to define the actions that the City can implement to reduce greenhouse gas emissions resulting from its own operations (e.g., government buildings, facilities, and vehicle fleets). While municipal emissions account for only about 2% of the community's total emissions, the MOCAP details strategies and actions that demonstrate the City's commitment to climate protection. These actions will assist in the achievement of the 2050 community-wide GHG reduction target.

CPR Purpose

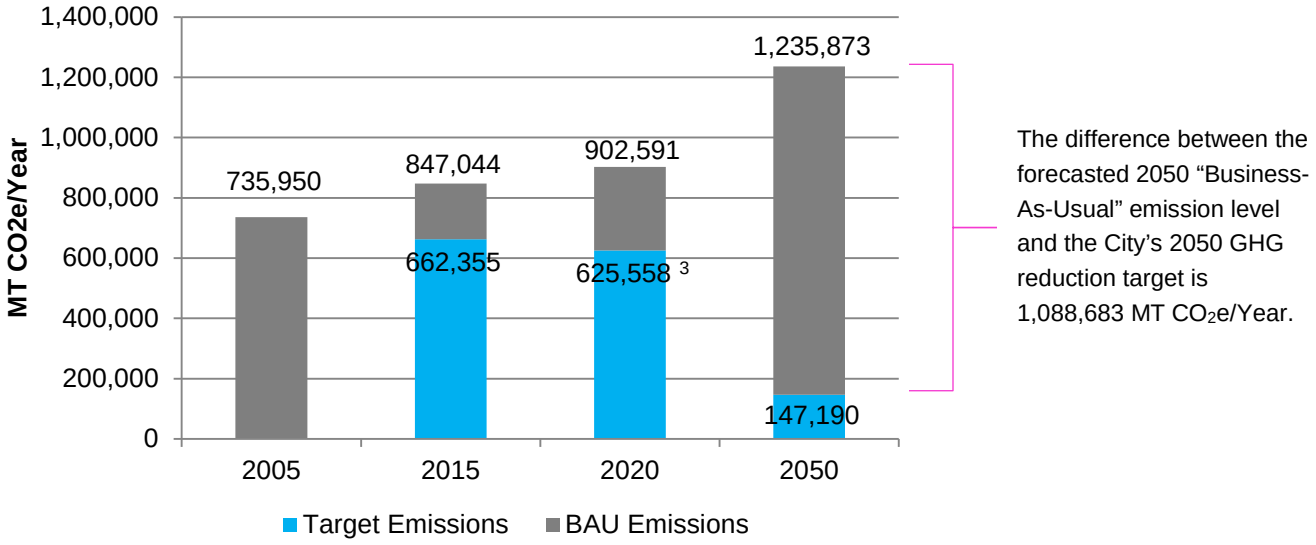
As demonstrated in Figure 1 below, the community's greenhouse gas emissions are anticipated to increase to 22% above 2005 levels by 2050. The City's adopted absolute target is to reduce community emissions 80% below 2005 levels by 2050. Considerable activities will therefore need to occur within Mountain View and elsewhere to achieve this target.

The CPR seeks to evaluate mechanisms through which the community could achieve the 2050 emission reduction target and identify various roles the City might play in facilitating such reductions. The first step of the analysis was to identify the array of technological, behavioral, and/or other system transitions that could reduce emissions within the community. The second step was to identify the most important transitions (referred to as cores strategies within the document). The third step was to identify actions (referred to as implementation mechanisms) within the City's authority that could contribute to these transitions.

The CPR is not a plan in and of itself, but an analysis that may be used by City officials to evaluate the potential for long-term community-wide emission reduction initiatives moving forward. Due to the high-level nature of the analysis, the CPR does not explicitly direct implementation of any specific city actions. However, it outlines viable options for future city programs, policies, and actions that could be pursued following additional feasibility analysis.

Moving toward achieving the community emission reduction targets, the City should conduct detailed analysis of the included mechanisms, and develop and implement appropriate and effective programs, policies, and/or actions. Over time, the City should monitor and evaluate the effectiveness of the programs, policies, and/or actions and make adjustments as necessary.

Figure 1.1: Community Emissions Reduction Targets 2015, 2020, and 2050[3]



The City's Commitment to Climate Protection and Sustainability

The City has a long history of programs that demonstrate a commitment to sustainability overall and climate protection specifically. As an example, the City has had a robust curbside recycling program since 1987, which has helped to divert thousands of tons of materials away from landfills. In October 2007, the Council voted to endorse the U.S. Mayors Climate Protection Agreement, joining nearly 700 cities across the United States to commit to working to reduce GHG emissions.

The City of Mountain View has implemented numerous efforts to reduce CO_2 emissions locally and contribute to the regional and national efforts to address the challenges of climate change. Under the City Council's leadership, the City has implemented numerous programs, policies, ordinances, and actions to help improve energy efficiency, conserve energy and promote living and transportation alternatives that benefit the environment. The City of Mountain View has garnered awards and recognitions for many of these projects, demonstrating how local governments can make a difference toward addressing global environmental challenges.

Following is a brief description of the City's more recent major sustainability activities and programs. *Additional details on the City's historic climate protection activities can be found in Appendix A*.

<u>2008 Environmental Sustainability Task Force Report</u>

In October 2008, the City Council accepted the final report of the Environmental Sustainability Task Force (ESTF), containing 89 recommendations outlining policies, strategies, and actions to conserve resources and reduce the community's carbon footprint. The recommendations were prioritized within 11 topic areas, from short-term to long-term, and included approximate implementation costs and greenhouse gas (GHG) reduction potentials.

[3] Note that the 2020 community target calls for a 15% to 20% reduction below 2005 levels. A 15% reduction is show in Figure 1.1.

2009 and 2012 Environmental Sustainability Action Plans

The City's two Environmental Sustainability Action Plans (ESAPs) represent short-term "road maps" for strategic investment in environmental sustainability initiatives. They contain numerous actions across different topic areas, but lack detailed GHG reduction estimates. The ESAPs are reviewed periodically and updated by the Council Environmental Sustainability Committee (CESC) and City Council to include additional Task Force recommendations, to address new regulatory requirements, and to track the City's progress in achieving its GHG reduction targets. They contain both quick payback actions that reduce the City's operational expenses and bigger, longer-term projects that will reduce community GHG emissions. The ESAPs also set forth actions that establish a policy framework to embed sustainability practices in the community and City organization.

2009 and 2010 GHG Reduction Targets

As described earlier, in November 2009 and March 2010 the City Council adopted voluntary, absolute GHG reduction targets for the community as a whole and for City operations, respectively. The targets were consistent with the policies of most other local cities and efforts worldwide to address climate change. These absolute targets do not consider growth in employment and population, as mitigating climate change requires a stabilization of, and ultimately a reduction in, global emissions.

2030 General Plan

A General Plan describes a community's vision and identifies strategies for managing the City's development and preservation in order to guide future growth. The 2030 General Plan establishes goals, policies, and actions related to climate change, and the 2030 General Plan Action Plan (GPAP) tracks specific actions that implement the General Plan's goals and policies.

Greenhouse Gas Reduction Program

Highlighted earlier, the City's GGRP implements General Plan policies related to climate change, sustainability, and GHG emissions. A key purpose of the GGRP is to describe how to mitigate the 2030 General Plan GHG impacts to meet CEQA requirements.

A limitation of the GGRP is that it is primarily a mitigation strategy in order to be considered a "qualified plan" by the Bay Area Air Quality Management District (BAAQMD) and comply with CEQA requirements. As a mitigation strategy, the policies and actions need to be realistic, quantifiable, and achievable. Therefore, some actions identified in the General Plan have not been included in the GGRP because there is not enough information to forecast their GHG emissions reduction potential at this time. Examples include the City-wide shuttle system, an updated Transit-Oriented Zoning Designation, or a district-level approach to achieving higher sustainability in the North Bayshore Area. The GGRP is updated every three to five years to include GPAP actions, to assess if it is achieving its goal of reducing GHG emissions, and to review the City's overall strategy for GHG emission reductions.

State Policy and Regulatory Context

Many strategies for addressing climate change have emerged at the international, national, state, and local levels. California remains a leader in the effort to reduce greenhouse gas emissions through a diversity of mitigation strategies. This section highlights the primary State legislation and guidance that directs emission mitigation efforts at the local government level.

With the passage of Assembly Bill 32 (AB 32)—also known as the California Global Warming Solutions Act—California is the first state in the U.S. to mandate emissions reductions across its entire economy. To support AB 32, California has developed policy and legislation that seeks to control emissions of gases that contribute to climate change. These efforts include regulatory approaches such as mandatory reporting for significant sources of emissions and caps on emission levels, as well as market-based mechanisms, such as cap-and-trade. While the majority of the State's policies have been directed at industry, some legislation directs action at the local government level. Descriptions of legislation most relevant to local governments are provided below.

Executive Order S-3-05

Recognizing California's vulnerability to reduced snowpack, exacerbation of air quality problems, and sea level rise resulting from a changing climate, Governor Arnold Schwarzenegger signed Executive Order S-3-05 (EO S-3-05) in 2005. This EO established targets to reduce emissions to 2000 levels by 2010, to 1990 levels by 2020, and to 80% below 1990 levels by 2050.

Assembly Bill 32 – California Global Warming Solutions Act

In 2006, California became the first state to adopt a GHG reduction target through Assembly Bill 32 (AB 32), thereby making EO S-3-05 legally binding. AB 32 requires California to reduce statewide emissions to 1990 levels by 2020. AB 32 directs the California Air Resources Board (CARB) to serve as the lead agency to implement this legislation. Mandatory actions under the legislation to be completed by CARB include:

- Identification of early action items that can be quickly implemented to achieve emission reductions. These early action items were adopted by CARB in 2007 and include regulations affecting landfill operations, motor vehicle fuels, car refrigerants, and port operations, among other regulations.
- Development of a Scoping Plan to identify the most technologically feasible and cost-effective measures to achieve the necessary emissions reductions to reach 1990 levels by 2020. The Scoping Plan contains a variety of reduction measures that include direct regulations, alternative compliance mechanisms, different types of incentives, and voluntary actions, as well as a market-based Cap-and-Trade Program. The Scoping Plan identifies local governments as strategic partners to achieving the State goal and translates the statewide GHG reduction goal to a local goal of 15% of current emissions by 2020. The initial Scoping Plan was developed in 2008, and the first update to the Scoping plan was completed in 2014. The update highlights California's progress toward meeting the near-term 2020 emission reduction goals defined in the initial Scoping Plan. It also evaluates how to align the State's longer-term GHG reduction strategies with other State policy priorities for Water, Waste, Natural Resources, Clean Energy, Transportation, and Land Use.
- Creation and adoption of regulations to require the State's largest industrial emitters of GHGs to report and verify their emissions on an annual basis.

Senate Bill 97 – California Environmental Quality Act Guideline Amendments

Senate Bill 97 (SB 97) was adopted in 2007 and directed the Governor's Office of Planning and Research (OPR) to amend the California Environmental Quality Act (CEQA) Guidelines to include the analysis and mitigation of emissions as part of the CEQA process (which is to identify the significant environmental impacts of proposed projects and to avoid or mitigate those impacts, if feasible). The CEQA Guidelines prepared by OPR were adopted by the Natural Resources Agency in December 2009 and went into effect March 18, 2010. Under these guidelines, project proponents are required to analyze

emissions of proposed projects, and if the emissions are determined to be significant, proponents are required to consider a range of mitigation measures to reduce these emissions.

General Plans or other development plans (e.g., Specific Plans) are considered projects under CEQA and therefore the lead agency (i.e., the City) is required to examine potential emissions that could result from the adoption of the plan. Additionally, future development projects accommodated within the plan must conduct an evaluation of potential emissions and will likely need to mitigate its impact. Local governments have the opportunity to streamline the analysis of emissions at the project level by using an adopted Climate Action Plan (or similar plan) as long as it is consistent with CEQA Guidelines. Consistency with CEQA Guidelines means that the Climate Action Plan (CAP) accomplishes the following:

- Quantifies and analyzes emissions, both existing and projected over a specified time period, resulting from activities within a defined geographic area.
- Establishes an emissions level, based on substantial evidence, below which the contribution to emissions from activities covered by the plan would not be cumulatively considerable.
- Specifies measures or a group of measures, including performance standards that substantial evidence demonstrates, if implemented on a project-by-project basis, would collectively achieve the specified emissions level.
- Establishes a mechanism to monitor the plan's progress toward achieving the specified emissions level, and requires an amendment to the plan if it is not achieving the specified levels.
- Is adopted in a public process following environmental review.

BAAQMD expanded and incorporated these statewide requirements into its own guidelines. All projects and plans prepared in the district are reviewed by the agency for compliance with these requirements. Additional guidance from the State Attorney General's Office and OPR has indicated that mitigation efforts within CAPs must put a community on a trajectory toward contributing to the State's long-term 2050 emission reduction target (i.e., 80% below 1990 levels). Although the State has not defined what a local government's specific emission reduction target should be, it is assumed that considerable reductions in community emissions would need to be demonstrated.

SB 375 – Sustainable Communities and Climate Protection Act

Senate Bill 375 (SB 375), also known as the Sustainable Communities and Climate Protection Act of 2008, builds upon AB 32 and aims to reduce Transportation-related greenhouse gas emissions via coordinated Transportation and Land Use planning. It required CARB to set reduction targets for emissions from passenger vehicle use for each region governed by the State's Metropolitan Planning Organizations (MPOs), and directs the MPOs to include a Sustainable Communities Strategy (SCS) in its Regional Transportation Plan (RTP) to achieve these targets. The emission reduction target for the San Francisco Bay Area is a 7% per capita reduction by 2020 and a 15% per capita reduction by 2035 from passenger vehicle use. In 2013, the Metropolitan Transportation (MTC), in collaboration with the Association of Bay Area Governments (ABAG) adopted Plan Bay Area, a long-range integrated Transportation and Land Use/Housing strategy through 2040, which includes the region's SCS and the 2040 RTP. Plan Bay Area demonstrates how the region will achieve the emissions reduction targets set by CARB. While there are no explicit requirements for cities to comply with the RTP, it is possible that regional Transportation funds could be withheld from cities that do not comply with the Plan's objectives.

While current State guidelines are currently voluntary, more emphasis is being placed on monitoring and reporting emissions to demonstrate the effectiveness of policies and local consistency with State reduction goals. Future CEQA, General Plan, and CAP guidelines are anticipated to define additional requirements for local governments. While the CPR is not a climate action plan, it will help the City

analyze opportunities to considerably reduce community emissions in a way that contributes to the State's long-term emission reduction goal.

CPR Planning Framework and Methodology

The intent of the framework is to provide a high-level, but comprehensive overview of the likely transitions that will need to occur within the community to achieve the 2050 target and then to identify the initiatives the City could implement to facilitate such transitions. It should be noted that many of the transitions are dependent on anticipated advances in technology or changes market conditions. The City may only be able to influence some of these transitions at the periphery. That said the proposed implementation mechanisms will likely contribute to such transitions occurring locally, regionally, and nationally.

The planning framework used to develop to Climate Protection Roadmap consisted of four phases including: (a) development of a 2050 emission forecast, (b) an activity-based emissions impact analysis, (c) a core strategy analysis, and (d) a review of best practice City-level implementation mechanisms.

2050 Emission Forecast

Understanding the magnitude and type of emissions is a critical component of any climate protection planning effort. In the first phase of the project, the City developed a 2050 emission forecast. To obtain an estimate of 2050 emissions, activity growth was linearly extrapolated from the GGRP 2020 and 2030 emission forecasts to this later 2050 horizon. In the Business-As-Usual (BAU) forecast activity intensities and emission factors were held constant. The Adjusted Business-As-Usual (ABAU) forecast reflects the reduction in building sector emissions resulting from the implementation of the State of California's Renewable Energy Portfolio Standard[4].

Activity-Based Emissions Impact Analysis

After the 2050 emission forecast was completed, an activity-based emissions impact analysis was performed to identify the types of macro-level changes in emissions generating activity that could create sizable reductions in community emissions. This high-level analysis provided insights into the ways emissions in the Energy, Transportation, and Solid Waste sectors could be reduced and the importance of different technology and other system transitions (e.g., energy efficiency improvements, fuel switching, increased waste diversion, etc.). In this analysis, it became clear that fuel switching and enhanced low-carbon and renewable energy generation would be critical to achieving the 2050 GHG emission reduction target. Please see the section *"Predominant Focus on Fuel Switching"* toward the end of the chapter for additional discussion of fuel switching and its predominance in this CPR.

Core Strategy Analysis

The emission impact analysis served as an important input into the third phase of the CPR study, the core strategy analysis. This analysis included a review of the effectiveness and feasibility of specific emission reduction strategies (technological and other systems transitions) that could reduce community emissions. A strategy was identified as a "core strategy" if it had considerable greenhouse gas emission reduction potential and fewer technical feasibility (e.g., cost of technology) and other barriers (e.g., remote environmental externalities). Staff from relevant City departments reviewed and provided comments regarding the draft list of core strategies.

[4] The Adjusted Business-As-Usual emission forecast does not reflect the impacts to State vehicle efficiency standards (e.g., Pavley I and II). While this is common practice in nearer-term (e.g., 2020 and 2030) climate action plans the CPR excluded these reductions to avoid inaccurate Transportation emission reduction estimates once high levels of fuel switching to EV and CNG vehicles are included.

Best Practice Review

In the final phase of the CPR study, implementation mechanisms were identified for each core strategy. Implementation mechanisms are defined as policies, programs, or other actions that the City could take to facilitate the implementation of a core strategy within the community. An extensive literature review was conducted to identify best practices from cities around the world. Implementation mechanisms appropriate to Mountain View's scale and context were included. For each mechanism a description, case studies, and potential implementation challenges and opportunities are provided in the chapters to follow.

Greenhouse Gas Inventories and Forecasts

This section describes the emission forecast for the City of Mountain View's community greenhouse gas emissions from 2005 to 2050. It presents the 2005 baseline emission inventory and the magnitude of each emission sector, and then discusses the 2020 and 2030 Business-As-Usual emission forecasts that were used within the City's GGRP. These forecasts were then used within the CPR to extrapolate the Business-As-Usual 2050 emission forecast. Finally, a description of the Adjusted Business-As-Usual forecast is provided that reflects the future emission reduction potential of existing State and Federal policies and regulations.

2005 Baseline GHG Inventory

As part of the GGRP development process, the City developed a baseline emissions inventory that addressed the following emission sectors: Energy, Transportation, Solid Waste, Water, Wastewater Treatment, and Off-Road Transportation. The inventory identified that the community generated total of 735,950 metric tons of carbon dioxide equivalent emissions (MT CO_2e) in 2005. As shown in Table 1.1, Transportation emissions constitute more than half of Mountain View's community-wide emissions, followed by building and facilities Energy (residential, commercial, and industrial), Solid Waste, Water use and Wastewater treatment, and Off-Road Mobile sources. The inventory makes it clear that addressing Transportation- and Energy-related emissions will be critical to the achievement of the 2050 GHG reduction target.

Table 1.1: 2005 Community Baseline Emissions Inventory

Emission Sector	Subsector	Emissions ($MT CO_2e$/Year)	Communitywide Total (%)
Energy - Residential	Electricity	36,307	4.9%
	Natural Gas	64,065	8.7%
Energy – Non Residential	Electricity	108,220	14.7%
	Natural Gas	52,005	7.1%
Energy - Industrial	Electricity	4,308	0.6%
	Natural Gas	5,066	0.7%
Direct Access Energy	Electricity	25,591	3.5%
	Subtotal	**295,562**	**40.2%**
Transportation	*Subtotal*	**413,143**	**56.1%**
Solid Waste	Solid Waste	11,113	1.5%
	Alternate Daily Cover	70	0.0%
	Subtotal	**11,183**	**1.5%**
Water	Water Demand	4,384	0.6%
	Wastewater Treatment	5,117	0.7%
	Subtotal	**9,502**	**1.3%**
Off-Road Mobile	Construction	4,793	0.7%
	Lawn and Garden Equipment	1,767	0.2%
	Subtotal	**6,561**	**0.9%**
Total		**735,950**	**100.0%**

Note: Columns may not sum to total shown due to rounding.

2020 and 2030 Business-As-Usual Emission Forecasts

For the purposes of the GGRP, community emissions forecasts were developed for the years 2020 and 2030. The Business-As-Usual forecasts for non–Transportation sector emissions were developed using urban development (i.e., the construction of new residential units and non-residential square footage) as the driving factor of emissions-generating activity growth. Estimates of future development contained within the endorsed 2030 General Plan were multiplied by baseline year activity intensities (e.g., energy use, waste generation, and water consumption per residential unit or commercial square foot) to calculate future year emissions estimates. Transportation emissions were developed through a separate process that evaluated the vehicle travel impacts of the endorsed Land Use plan and changes to the community's roadway network. 2020 emission estimates were developed by linear interpolation between the 2005 baseline year and the 2030 values.

As demonstrated in Table 1.2, community emissions were estimated to increase by 166,641 MT CO2e per year (a 23% increase) between 2005 and 2020, and by 277,735 MT CO_2e per year (a 38% increase) between 2005 and 2030. The magnitude of community emissions growth from 2005 to 2020 and 2030 is directly related to the anticipated increase in population and employment growth (and their consumption activities). In 2020 and 2030, Transportation and Energy-related emissions remain the two largest sectors.

Table 1.2: Community Emissions Forecasts 2020 to 2030

Emission Sector	2005 Emissions (MT CO_2e/Year)	2020 Emissions (MT CO_2e/Year)	Increase from 2005 (MT CO_2e/Year)	2030 Emissions (MT CO_2e/Year)	Increase from 2005 (MT CO_2e/Year)
Energy	295,562	359,336	63,774	401,852	106,290
Transportation	413,143	512,943	99,800	579,477	166,333
Waste	11,183	11,424	241	11,585	402
Water	9,502	10,722	1,220	11,535	2,033
Off-Road Mobile	6,561	8,166	1,605	9,236	2,676
Total	**735,950**	**902,591**	**166,641**	**1,013,685**	**277,735**
% Increase	**-**	**-**	**23%**	**-**	**38%**

2050 Business-As-Usual Emission Forecast

To complete the 2050 forecast, the City extrapolated emission growth to 2050 based on the annual average rate of emission growth that is anticipated to occur between the baseline year and 2030. This forecasting method was selected because the General Plan does not provide development projections beyond 2030. Additionally, the City does not have established population and employment forecasts for 2050. Use of the extrapolation forecasting method is justifiable given these data limitations. It should be noted that the method assumes that a similar amount of development will occur between 2030 and 2050 as the General Plan expects to occur between 2010 and 2030.

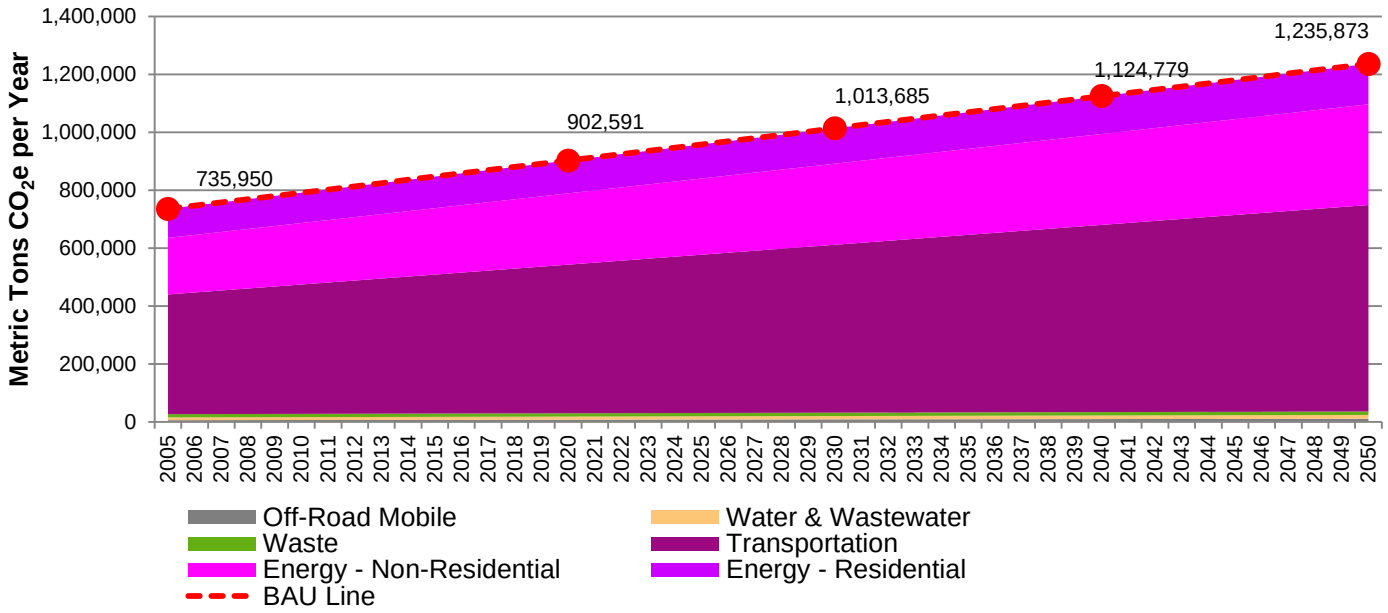
Table 1.3 and Figure 1.2 indicate that community emissions are expected to increase by approximately 499,992 MT CO_2e per year between 2005 and 2050 to a level of 1,235,873 MT CO_2e per year. This considerable increase in emissions (68% above 2005 levels) would be a significant challenge to achieving the City's adopted emissions target of reducing emission to 80% below 2005 levels by 2050. Luckily State and Federal policies and regulations will reduce the scale of the reductions needed. These State and Federal actions are described below under the Adjusted Business-As-Usual forecast.

Table 1.3: 2050 Business-As-Usual Community Emissions Forecast

Emission Sector	Subsector	Emissions (MT CO_2e/Year)	Communitywide Total (%)
Energy - Residential	Electricity	49,739	4.0%
	Natural Gas	89,561	7.2%
Energy – Non Residential	Electricity	218,920	17.7%
	Natural Gas	98,807	8.0%
Energy - Industrial	Electricity	1,961	0.2%
	Natural Gas	2,306	0.2%
Direct Access Energy	Electricity	25,591	2.1%
	Subtotal	**486,884**	**39.4%**
Transportation			
	Subtotal	**712,543**	**57.7%**
Solid Waste	Solid Waste	11,833	1.0%
	Alternate Daily Cover	74	0.0%
	Subtotal	**11,907**	**1.0%**
Water	Water Demand	6,142	0.5%
	Wastewater Treatment	7,020	0.6%
	Subtotal	**13,162**	**1.1%**
Off-Road Mobile	Construction	8,567	0.7%
	Lawn and Garden Equipment	2,811	0.2%
	Subtotal	**11,377**	**0.9%**
Total		**1,235,873**	**100.0%**

Note: Columns may not sum to total shown due to rounding.

Figure 1.2: Business-As-Usual Community Emissions by Sector, 2005–2050



2050 Adjusted Business-As-Usual Emission Forecast

In general, the largest anticipated reductions are from State and Federal vehicle fuel efficiency improvements to passenger vehicles and light-duty trucks.[5] As residents and businesses replace older vehicles with newer ones, people will consume less fuel and generate fewer emissions per vehicle mile traveled. California's low-carbon fuel standard will also reduce Transportation-related emissions in Mountain View by requiring a transition away from fossil fuels (i.e., gasoline and diesel) toward lower-carbon bio-fuels (e.g., ethanol). California law also requires utilities to obtain 33% of their electricity from renewable energy sources by 2020. In 2005, about 12% of Pacific Gas & Electric's (PG&E's) portfolio was from renewable sources. This increase in renewable generation will reduce Mountain View's electricity-related emissions.[6] The medium- and heavy-duty vehicle efficiency improvements program and 2008 California Energy Code (Title-24) requirements for new construction will create smaller, but still important, communitywide emission reductions.

As shown in Table 1.4 and Figure 1.3, with implementation of State and Federal policies and regulations, community emissions would be 899,645 MT CO_2e per year in 2050. These State and Federal actions are expected to reduce 336,228 MT CO_2e per year and will make it considerably easier for the community to achieve the 2050 emission reduction target. That said, 2050 emissions are still expected to be 22% above 2005 levels. Achieving the 2050 target will require extensive transformations in how the community uses energy in its building and Transportation. The following section of this report outlines the core transformations that will be necessary and what the City of Mountain View can do to facilitate them.

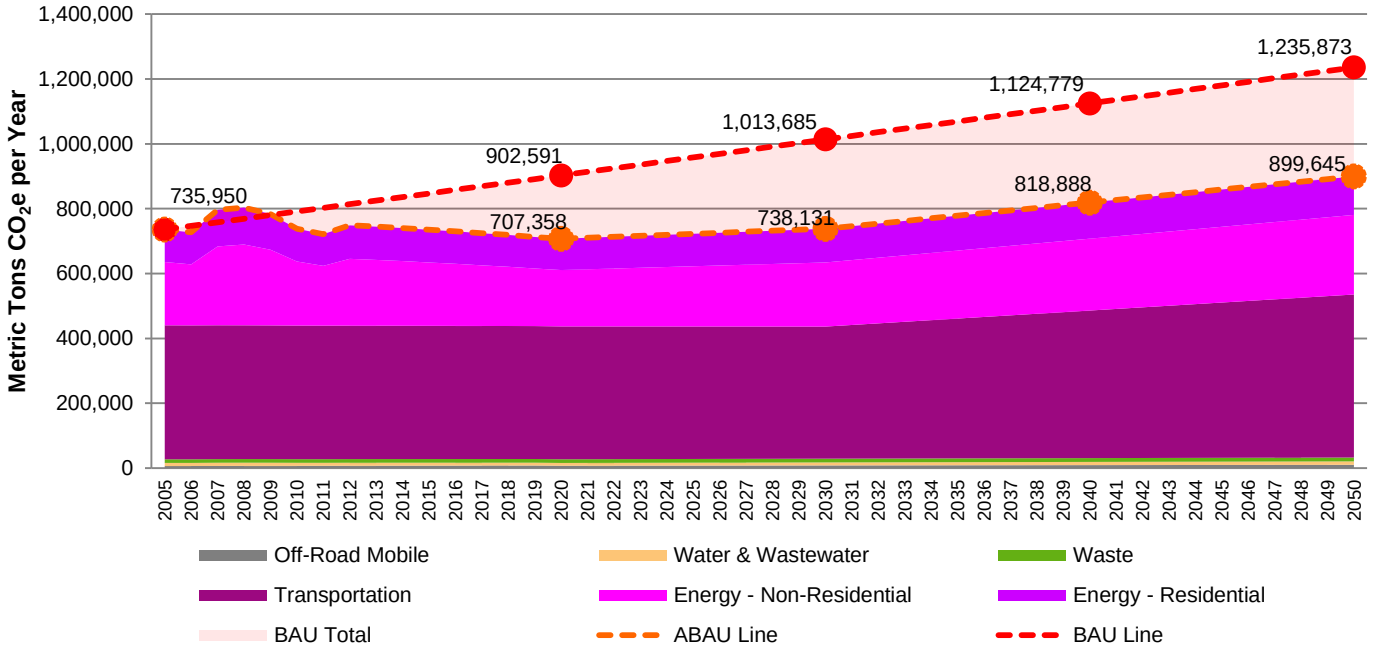
[5] See Appendix B for more detailed descriptions of the State and Federal actions.
[6] The curve in the Adjusted Business-As-Usual line seen in Figure X (between 2005 and 2012) is the result of a dynamic electricity emission factor. Fluctuation in electricity emissions factors have occurred frequently in the past based on variables such as available sources of energy, energy cost, and climate variability.

Table 1.4: 2050 Adjusted Business-As-Usual Community Emissions Forecast

Emission Sector	Subsector	Emissions (MT CO2e/Year)	Communitywide Total (%)
Energy - Residential	Electricity	29,146	3.2%
	Natural Gas	89,561	10.0%
Energy – Non Residential	Electricity	128,282	14.3%
	Natural Gas	98,807	11.0%
Energy - Industrial	Electricity	1,149	0.1%
	Natural Gas	2,306	0.3%
Direct Access Energy	Electricity	14,996	1.7%
	Subtotal	**364,247**	**40.5%**
Transportation			
	Subtotal	**502,711**	**55.9%**
Solid Waste	Solid Waste	11,833	1.3%
	Alternate Daily Cover	74	<0.1%
	Subtotal	**11,907**	**1.3%**
Water	Water Demand	4,207	0.5%
	Wastewater Treatment	6,333	0.7%
	Subtotal	**10,541**	**1.2%**
Off-Road Mobile	Construction	7,710	0.9%
	Lawn and Garden Equipment	2,529	0.3%
	Subtotal	**10,239**	**1.1%**
Total		**899,645**	**100.0%**

Note: Columns may not sum to total shown due to rounding.

Figure 1.3: Adjusted Business-As-Usual Community Emissions by Sector, 2005–2050



Implications of State and Federal Actions

Implementation of State and Federal policies and regulations will effectively reduce emissions within the Mountain View community. Table 1.5 provides emission reduction estimates for the policies and regulations used within the CPR analysis.[7] These reductions are applied to the Business-As-Usual forecast to derive an "Adjusted Business-As-Usual" forecast.

Table 1.5: Estimated Emission Reductions from State and Federal Actions in 2050

State/Federal Action	Reductions in 2050 (MT CO2e/Year)	% of Total State/Fed Actions
Renewable Portfolio Standard	125,258	37%
Vehicle Fleet Fuel Efficiency Standard, Low Carbon Fuel Standard	210,970	63%
TOTAL:	336,228	100%

Emission Reduction Strategies and Mechanisms

While State and Federal actions will make considerable contributions, other significant transformations will need to occur in order for the City to achieve its 2050 community emission reduction target. Tables 1.6, 1.7, and 1.8 below outline the potential scale of reductions that may be achieved if the identified core strategies and associated implementation mechanisms for Building Energy, Transportation, and Solid Waste are implemented by the City and realized within the community. These cores strategies and implementation mechanisms are discussed in more detail in Chapters 2-4.

[7] It should be noted that not all State and Federal reductions were applied within the CPR analysis due to potential double counting between CPR-identified City actions and State and Federal actions.

Table 1.6: Building Energy Strategies and Mechanisms

Strategy Type	Implementation Mechanism	Estimated GHG Reduction in 2050 (MT CO_2e/Year)
A) Lower-Carbon Electricity	A.1. Community choice energy policy	High 50,000–100,000
	A.2. Large-scale renewable electricity generation	
B) Renewable Energy Generation – Solar Photovoltaic	B.1. Mandatory solar photovoltaic requirements for new construction	High 50,000–100,000
	B.2. Solar power districts policy and program	
C) Renewable Energy Generation – Solar Hot Water	C.1. Solar hot water campaign	Low 2,000–25,000
	C.2. Mandatory solar hot water policy	
D) Fuel Switching – Heating and Hot Water: From Natural Gas to Electric Heat Pumps	D.1. Heat pump promotional campaign	High 50,000–100,000
	D.2. Heat pump permit streamlining	
	D.3. Mandatory electric heat pump policy	
E) Energy Efficiency – Existing Buildings	E.1. Advanced energy-use analytics promotion	Low 2,000–25,000
	E.2. Energy-management systems promotion	
	E.3. Commercial district partnerships	
	E.4. Building benchmarking and disclosure policy	
	E.5. Point-of-sale energy rating policy	
	E.6. Building commissioning promotion	
	E.7. Mandatory retro-commissioning policy	
F) Energy Efficiency – New Construction	F.1. Zero-energy building code	Low 2,000–25,000
	F.2. Passive home energy design policy	
	F.3. Energy-efficient appliance policy	
	TOTAL:	**156,000–375,000**

Table 1.7: Transportation Strategies and Mechanisms

Strategy Type	Implementation Mechanism	Estimated GHG Reduction in 2050 (MT CO_2e/Year)
A) Fuel Switching – Compressed Natural Gas (CNG)	A.1. Publicly accessible CNG fueling stations	Very High over 100,000
	A.2. Shared commercial CNG fueling station outreach program	
B) Fuel Switching – Battery Electric Vehicles (BEV)	B.1. Community electric vehicle adoption campaign	Very High over 100,000
	B.2. Public electric vehicle charging facilities	
	B.3. Parking facility electric vehicle charging standards	
	B.4. Residential multi-family electric vehicle charging standards	
	B.5. Residential single-family electric vehicle charging standards	
C) Fuel Switching – Second Generation Biofuels	C.1. Encourage development of biofuel stations	High 50,000–100,000
	C.2. Waste-to-biogas facility for fleet vehicles	
	TOTAL:	**300,000–350,000**

Table 1.8: Solid Waste Strategies and Mechanisms

Strategy Type	Implementation Mechanism	Estimated GHG Reduction in 2050 (MT CO_2e/Year)
A) Reduce Landfilled Waste	A.1. Target Materials for Diversion	Low 2,000–25,000
	A.2. Promote Waste Reduction and Material Re-Use	
	A.3. Explore Future Processing Technologies	
	TOTAL:	**2,000–25,000**

As outlined in Table 1.9 below, the proposed CPR strategies and mechanisms will likely produce GHG emission reductions in the range of 458,000-750,000 MT CO_2e per year, depending on the level of implementation and other factors.

If full implementation of the core strategies in the Building Energy, Transportation, and Solid Waste sectors is achieved, it is likely that the City will achieve 100% of its target of reducing emissions 80% below 2005 levels by 2050. Additional reductions from the Land Use and Transportation strategies identified in the General Plan and from decreasing emissions from waste in the Shoreline Landfill will also contribute toward the community's goal.

Table 1.9: Emission Reductions Achieved by CPR in 2050 under ABAU

	GHG Emissions Level (MT CO_2e/Year)	% of Required Reductions Achieved
2005 Baseline	735,950	
80% Below Baseline	147,190	
2050 ABAU Level	899,645	
Reductions Required to Reach 80% Below Baseline under ABAU	752,455	
Reductions from CPR (low end of range)	458,000	61%
Reductions from CPR (middle part of range)	604,000	80%
Reductions from CPR (high end of range)	750,000	100%

Predominant Focus on Fuel Switching

Energy-related emissions can be reduced through three primary methods: *conservation* (using less energy through a change in behavior or the designed environment), *efficiency* (using energy more effectively through technological improvements), and *fuel switching* (using a different form of energy to achieve the same result). Tables 1.6 and 1.7 demonstrate the important role that fuel switching will likely play in the achievement of the 2050 community emission reduction target. Each of the core building energy and Transportation strategies with a "High" or "Very High" emission reduction potential is a form of fuel switching. The CPR's emphasis on fuel switching strategies over other types of strategies is related to the scale of emission reductions needed to achieve the 2050 community target, and the reality that conservation and efficiency have more cultural/technical limits as compared to fuel switching. While concerted local, State, and Federal actions will be required to reduce existing barriers to fuel switching, it offers reduction potential of the scale needed.

Note: Hydrogen was not included as a future Transportation fuel because: (a) it is still speculative that hydrogen will achieve mass adoption [only Japan has anything close to market-scale hydrogen], and (b)

its level of emissions depends greatly on the fuel source of the hydrogen (e.g., clean electricity generation, natural gas, etc.) and it is therefore difficult to model hydrogen's emission reduction potential.

Within the CPR core strategy analysis and development process, the likely technical potential of each strategy was evaluated. While conservation and efficiency will play important roles in transforming the community's emissions, technical/cultural limitations were identified that limited their emission reduction potential compared to fuel switching strategies. For example, energy conservation is limited by the cultural limits of the proportion of the population willing to make do with less energy consumption and/or the proportion of the community's homes and jobs that can be located in walkable or transit-oriented areas. Similarly, efficiency depends on the technological limits of internal combustion engines and building equipment performance. The primary limitations to fuel switching strategies are price barriers, and most of these are anticipated to decrease during the 35-year horizon of the CPR. Remaining barriers to fuel switching could be overcome with local, regional, and State regulation and/or financial incentives.

Within the Transportation sector, it should be noted that the core strategies do not include bike and pedestrian infrastructure improvements, Transportation Demand Management (TDM) requirements, or Transit Oriented Development (TOD). While these types of strategies will contribute to emission reductions and are important for other sustainability reasons, they are not likely to create the same magnitude of reductions as fuel switching.

A considerable issue facing Mountain View is that most of the City consists of a relatively low-density suburban residential Land Use pattern, and while there is an effort to increase density and diversity in certain corridors, most of the City will remain as it is today. Low-density suburban residential areas are likely to remain auto-dependent unless there are outside influences, such as considerable fuel or travel cost (e.g., cordon pricing, tolls) increases. This assumption is supported by Fehr and Peer's (F&P) analysis of trip and vehicle miles traveled (VMT) reductions related to the recently-adopted General Plan. Even with the numerous mixed-use and TDM techniques that the City aims to utilize, the F&P analysis identified only a ~1% reduction in VMT from a BAU scenario, which will not provide the large reductions needed to achieve the 2050 target.

Thus, while fuel switching is a deviation from current emission reduction efforts, the CPR analysis supports that such strategies will be essential to achieving the community's 2050 target. The City will benefit by using the CPR to direct subsequent evaluation of the actions it can take to promote fuel switching.

Solid Waste Emissions and Implementation Mechanisms

Chapter 4 of the CPR contains potential Solid Waste strategies and implementation mechanisms that could form part of a roadmap that enables Mountain View to reach its 2050 GHG reduction target. In 2050, Solid Waste emissions will be the third largest source in the City (1.3%).

The potential implementation mechanisms are organized around the primary goal of adopting a Zero Waste Plan (ZWP). The ZWP will target a significant reduction in landfilled waste by focusing on a whole system approach to the use of resources. It will include specific strategies to target materials for diversion, promote waste reduction and material re-use, and explore future processing technologies, with an overall goal of reaching a 90% diversion level.

Chapter 4 introduces the high-level mechanisms that will form the foundation of the ZWP, and provides an estimated GHG reduction range based on reaching a 90% diversion level. Additional strategies, mechanisms, policies, and actions will be detailed in the ZWP.

Chapter 2 — BUILDING ENERGY

This chapter contains potential Building Energy implementation mechanisms that could form part of a roadmap enabling Mountain View to reach its 2050 greenhouse gas (GHG) reduction target. Buildings make up the second largest source of GHG emissions in the City (~40% as of 2005). Considerable emission reductions must therefore occur within this sector to achieve an 80% reduction in community emissions by 2050.

Table 2.1 below divides Building Energy sector carbon reduction opportunities into six core strategies and identifies potential mechanisms (policies and programs) that the City could adopt to implement each strategy. A brief description is provided for each mechanism, followed by a list of potential barriers and precedent examples of cities where similar policies, projects, or programs exist.

Of the three sectors in the CPR (Building Energy, Transportation, and Solid Waste), the Building Energy sector has the largest number of strategies and mechanisms aimed at reducing GHG emissions, since most of the strategies, taken alone, have marginal effects on GHG reductions. It is only when multiple strategies are implemented together that greater GHG mitigation is achieved. As an example, conducting building optimization prior to installing a rooftop solar photovoltaic (PV) system ensures that the appropriate system is deployed. In addition, implementation of one strategy can beneficially influence and enable the deployment and development of others. For instance, extensive community-based solar could free rooftops for installation of solar thermal water heating.

Further, each of the strategies listed here have a demonstrable track record of actual implementation and GHG emission reduction potential. Although the up-front cost can create a barrier to implementation, over a number of years the majority of these strategies pay for themselves through energy cost reductions. Cost and payback periods vary for each strategy, and therefore should be evaluated on a case-by-case basis. Payback periods for solar PV systems may be 10 years or longer, while outlay for energy-efficiency measures may be recouped within months.

Table 2.1: Building Energy Implementation Mechanisms

Strategy Type	Implementation Mechanism	Estimated Cost	Estimated GHG Reduction in 2050 (MT CO2e/Year)
A) Lower-Carbon Electricity	A.1. Community choice energy policy	Cost Neutral	High 50,000 - 100,000
	A.2. Large-scale renewable electricity generation	Depends on Model	
B) Renewable Energy Generation – Solar Photovoltaic	B.1. Mandatory solar photovoltaic requirements for new construction	Low $10,000 - $30,000	High 50,000 - 100,000
	B.2. Solar power districts policy and program	Medium $30,000 - $100,000	
C) Renewable Energy Generation – Solar Hot Water	C.1. Solar hot water campaign	Medium $30,000 - $100,00 (with Rebates High $100,000 - $300,000)	Low 2,000 - 25,000
	C.2. Mandatory solar hot water policy	Low $10,000 - $30,000	
D) Fuel Switching – Heating and Hot Water: From Natural Gas to Electric Heat Pumps	D.1. Heat pump promotional campaign	Medium $30,000 - $100,00 (with Rebates High $100,000 - $300,000)	High 50,000 - 100,000
	D.2. Heat pump permit streamlining	Low $10,000 - $30,000	
	D.3. Mandatory electric heat pump policy	Low $10,000 - $30,000	
E) Energy Efficiency – Existing Buildings	E.1. Advanced energy-use analytics promotion	Medium $30,000 - $100,00	Low 2,000 - 25,000
	E.2. Energy-management systems promotion	Medium $30,000 - $100,00	
	E.3. Commercial district partnerships	Medium $30,000 - $100,00	
	E.4. Building benchmarking and disclosure policy	Low $10,000 - $30,000	
	E.5. Point-of-sale energy rating policy	Low $10,000 - $30,000	
	E.6. Building commissioning promotion	Medium $30,000 - $100,00	
	E.7. Mandatory retro-commissioning policy	Low $10,000 - $30,000	
F) Energy Efficiency – New Construction	F.1. Zero-energy building code	Medium $30,000 - $100,00	Low 2,000 - 25,000
	F.2. Passive home energy design policy	Medium $30,000 - $100,00	
	F.3. Energy -Efficient Appliance Policy	Medium $30,000 - $100,00	
		TOTAL:	**156,000–375,000**

A) Lower-Carbon Electricity

In order to achieve an 80% reduction in energy-related GHG emissions by 2050, Mountain View, as a community, would need to transition to very low carbon electricity.[1] The State of California's Renewable Portfolio Standard (RPS) will achieve important reductions in emissions, creating electricity that is approximately 70% carbon free. However, the community will need to implement strategies in addition to the RPS and utilize electricity that is approximately 85% carbon-free or higher.

A.1: Community Choice Energy Policy

Description:

Community Choice Energy (CCE) districts, also known as Community Choice Aggregation (CCA), provide communities with local energy choices. A CCE allows a specific community or city to leverage its aggregate energy demand to negotiate preferred rates from renewable energy generators. Utility companies continue to deliver the purchased electricity via existing transmission and distribution infrastructure. Creation of a CCE would allow the community to purchase renewable energy in amounts that exceed PG&E's mandated portfolio of carbon-free electricity. Partnerships between jurisdictions may be necessary to increase feasibility.

Barriers:

- **Community Involvement:** CCE districts require a proactive community, willing to adopt certain risks and uncertainties associated with non-traditional energy contracts. Price disparity between the CCE and PG&E could lead to consumer opt-out. Additionally, there are risks associated with commodity price volatility and cost responsibility surcharge (CRS) volatility. Finally, energy contracts are complex, requiring consideration of supply volumes, procedural concerns (e.g. opt-out protocols), and coordination/prioritization of stakeholders. Because of these factors, education, outreach, and awareness programs are essential for the success of a CCE.

- **Complexity of Energy Pricing:** Negotiating energy prices requires an understanding of wholesale energy prices as well as a market understanding of potential future energy costs. Evaluating the full costs and benefits of a CCE can be a nuanced and time-intensive endeavor. It may be difficult to fully define provisions for disclosure and due process in rate setting and to allocate costs for participants, including exit fees. The California Public Utilities Commission (CPUC) sets the exit fees that are paid by consumers when they leave the service of a utility to enter a CCE. The exit fee serves to offset energy the utility has already purchased on behalf of those consumers.

Precedents:

- **Marin County, CA:** The community of Marin County established Marin Clean Energy (MCE), California's first CCE program, providing customers the choice of having 50% to 100% of their purchased power provided by renewables. The service is a partnership with PG&E to provide billing and electric delivery services. The program was launched in May 2010 and serves approximately 125,000 customers (including some consumers in the City of Richmond).

[1] At least 80% to 85% of the electricity would need to be from carbon- free sources.

- **Sonoma County, CA:** The Sonoma County Water Agency has established Sonoma Clean Power (SCP), a CCE. SCP operates under an 'opt-out' regime, automatically enrolling residents within its service area. Service began in May 2014, with an initial customer base of 20,000. Customers currently opt out at a rate of 5.4%. SCP provides two levels of service: its CleanStart package offers a renewable energy mix of approximately 33%, and the EverGreen package offers 100% renewable energy. Based on residential energy prices effective May 1, 2014, SCP estimates monthly costs for 500 kWh to total $75.80 (CleanStart) or $93.30 (EverGreen). By 2016, the SCP is expecting to secure nearly 500,000 MWh of electricity from both renewable and non-renewable sources.

A.2: Large-Scale Renewable Electricity Generation

Description:

Develop a utility-scale renewable electricity generation facility (or facilities) to supply electricity for municipal and/or community use. Utility-scale renewable energy (USRE), as defined by California Energy Commission's renewable energy program, is considered to be equal to 10 MW or larger. Since available land in Mountain View is decreasing, and a utility-scale facility would need a large amount of land, Mountain View could develop such a facility in conjunction with another city (or cities) that has more available land through a "community-based solar" model. Under such a model, Mountain View residents or businesses could pay and get credit for renewable energy generated outside of the City's borders.

Barriers:

- **Available Space:** Utility-scale renewable generation requires large amounts of land and should be located near the primary sources of energy demand. For instance, PV installations require approximately 8 acres (installed) per MW. Identifying concentrations of buildings with sufficient energy demand near appropriate undeveloped and unconstrained acreage may prove difficult.

- **Price Parity:** The United States Energy Information Administration (EIA) estimates that for the next 10–15 years, natural gas will be near $5 per mBTU.[2] This creates a very competitive energy market with depressed prices. There have also been some concerns regarding the underpricing of solar panels by Chinese manufacturers, indicating that the actual cost of PV installations may experience a cost increase.

- **Transmission Capacity:** Accessing additional sources of renewable electricity may require new and updated transmission and distribution infrastructure. Enhancing linear transmission capacity is an expensive endeavor with complex permitting concerns. Transmission lines often cross multiple jurisdictions, and due to the linear length of the projects, often encroach on sensitive populations, ecosystems, or infrastructure assets. In addition, previously designated transmission corridors are typically at capacity with existing transmission lines.

Precedents:

- **Butte County, CA:** The Butte County Solar Energy System was completed in August 2004. It is located at the Butte County Government Center in Oroville, California. The total project output is 1.18 MW direct current (DC). This system provides all the electrical energy needs for three

[2] http://www.eia.gov/analysis/

County buildings. There are four separate arrays containing a total of 6,360 185-watt photovoltaic panels. When this system became operational, it was the fifth largest solar energy system in the United States.

- **Los Angeles, CA:** Early in 2014 the City of Los Angeles signed an agreement with the energy company Constellation to design, build, and operate a 27 MW renewable energy power plant. The plant will be built at the Los Angeles Bureau of Sanitation's Hyperion Treatment Plant, which is among the ten largest wastewater treatment plants in the world. Its sewage treatment process produces a Class 1 renewable fuel, anaerobic digester gas. This gas will be used in the biogas co-generation power plant and will supply electricity to the wastewater treatment facility.

B) Renewable Energy Generation – Solar Photovoltaic

Solar photovoltaic (PV) panels are able to convert sunlight into usable clean electricity. While PV panels can have high up-front costs for the consumer if purchased outright, solar lease programs enable consumers to install solar systems with little or no up-front costs. With a solar system, consumers can receive nearly free electricity for decades rather than paying the fluctuating costs of a utility provider. Grid-tied electricity systems also offer the potential for owners to make a profit by selling electricity that is not used on site back to the utility.

B.1: Mandatory Solar Photovoltaic Requirements for New Construction

Description:

Require new residential and commercial construction to either pre-wire for, or install, solar photovoltaic systems. If the latter, establish minimum generation requirements by use category and establish off-site community solar requirements for sites without proper solar access.

Installing solar energy conduit/wiring or PV systems as part of a new development is often cheaper than retrofitting the site at a later date. Establishing requirements for new construction to install low- or zero-carbon technologies to generate a certain percentage of the energy demand can be an effective way to catalyze market transformation for renewables. A solar energy mandate provides a clear signal to manufacturers and installers that there will be a demand for their product and services going forward. It also encourages developers to incorporate PV in the most cost-effective way possible into their development. A mandate for installation could be preceded by requiring a feasibility study for the integration of possible alternative fuel technologies into each project. This could include examining the potential for a district energy solution and/or the potential for the project to tap into an existing energy network. (See Copenhagen in the Precedents section below.)

Barriers:

- **Price Parity:** The United States EIA estimates that for the next 10–15 years, natural gas will be near $5 per mBTU. There have also been some concerns regarding the underpricing of solar panels by Chinese manufacturers, indicating that the actual cost of PV installations may experience a cost increase.

- **Installation Costs:** For some new construction projects, the added cost of installing solar power (and thus the pre-wiring) may not make economic sense. Costs include the hardware and panels, as well as the soft-costs of consulting, design, permitting, and installation.

- **Developer Resistance:** Although new buildings with solar electricity may be more attractive to buyers due to reduced energy expenses, and would increase the value of the property, developers may resist a policy that requires them to go beyond pre-wiring, and install a PV system, due to the increased cost that they would have to pass along to the buyer through a higher sales price.

Precedents:

- **London, England:** Since the London Plan was published in 2014, major development (all new non-residential developments above a threshold of 1,000 square meters) is required to include on-site renewable energy generation sized to provide a 10% reduction in carbon emissions over an established baseline. The latest version of the London Plan (published in 2011) contains an updated policy on reducing carbon emissions. This requires that certain standards above code be realized. The updated policy also requires an energy assessment detailing how targets have been met through energy efficiency measures, through the use of decentralized energy systems such as combined heat and power (CHP), and through on-site renewables. The current target is for a 40% improvement over the 2010 UK building regulations energy code and for zero-carbon emissions between 2016 and 2031 (depending on building type).

- **San Francisco, CA**: Effective January 2012, San Francisco's Green Building Ordinance requires new commercial buildings comprising 25,000 gross square feet or more to: (a) generate 1% of the building's energy demand renewably on site, or (b) purchase 100% green power, or (c) improve energy efficiency 10% beyond California's 2005 Title 24 energy code.

- **Copenhagen, Denmark:** The City focused its policy in creating funding streams (for example, through a carbon tax) to develop new infrastructure and facilitate low-cost loans from the national Treasury and banks. Copenhagen is further focusing on implementing special zoning for district heating, and putting in place an obligation to connect to the system (with the required timeframe dependent on building usage). Similar approaches could be used to connect new development to community-based renewable energy.

B.2: Solar Power Districts Policy and Program

Description:

Commercial and industrial areas of a city offer large roof spaces for installation of mid-size PV systems (50 kW to 1 MW). Installing PV panels on buildings situates renewable energy generation in high demand areas, thereby reducing the need for additional transmission and distribution infrastructure.

Solar generation is often associated with a number of environmental consequences due to the large amount of land required to produce solar energy at economic prices. Locating PV installations in highly developed areas reduces the risks to other environmentally sensitive areas. Also, local corporations may be able to capture several tax benefits by purchasing a PV system.

By working directly with the commercial sector, cities are able to identify areas (e.g., parking lots, building rooftops) within the community that have a high potential for PV installation. Cities can also work to reduce barriers to installation, including streamlining building codes and permitting processes.

Barriers:

- **Price Parity:** The United States EIA estimates that for the next 10–15 years, natural gas will be near $5 per mBTU. This creates a very competitive energy market with depressed prices. There have also been some concerns regarding the underpricing of solar panels by Chinese manufacturers, indicating that the actual cost of PV installations may experience a cost increase.

- **Transmission Capacity:** If a PV facility over-generates for the needs of the commercial facility, such as on weekends and holidays, offloading electricity may require new and updated transmission and distribution infrastructure. Enhancing linear transmission capacity is an expensive endeavor with complex permitting concerns.

- **Uncertainty Regarding Net Metering:** Net metering is a rate structure that encourages solar development. Consumers with approved solar facilities can feed excess energy onto the grid, offsetting electricity later provided by the electric utility to the consumer. Net metering programs are currently facing political instability and their future is uncertain. Additionally, PG&E has a cap in place for accepting excess solar-generated power. This cap is currently 5% of PG&E's aggregate customer peak demand.

- **Incentive Costs**: A city that offers financial incentives for such a program will have to identify and reserve adequate funding over several years, unless the city can partner with another agency that can fully or partially provide the funding.

Precedents:

- **Los Angeles, CA:** The Los Angeles Department of Water and Power (LADWP) encourages the development of both residential and commercial solar systems through the Solar Incentive Program (SIP), providing an incentive payment to LADWP customers who purchase and install their own solar power PV systems. Aimed at meeting the goals of SB 1 (the State's 10-year solar project initiative), the program incentive levels are structured as a 10-step declining incentive, based on the amount of solar PV installed and connected to the LADWP's electricity grid. As of February 2014, the LADWP Solar Incentive Program was still available for non-residential customers. Presently $5.9 million remains for new non-residential solar incentive applications. Additionally, LADWP is currently developing a Feed-in Tariff (FiT) Program to allow customers to sell renewable energy produced from their own systems.[3]

- **New York, US**: The New York State Energy Research and Development Authority (NYSERDA) offer customer information and incentive programs for commercial PV installations. Through a cash incentive program, NYSERDA encourages installation of new commercial grid-connected PV systems that are 200 kW or less. Incentives are granted on a first-come, first-served basis, and must be installed by program-qualified installers. NYSERDA's PV incentive is accepting applications through December 31, 2023, or until funds are fully committed. In addition, NYSERDA is now offering low-interest rate financing options for PV systems.

[3] As a municipally controlled utility, LADWP has different capabilities and incentives than PG&E, which is investor owned. This offers some flexibility in their incentive programs that may not be available to PG&E.

C) Renewable Energy Generation – Solar Hot Water

According to the United States EIA, water heating for California residences typically accounts for 25% of the energy consumed in a home.[4] Water heaters currently use either electricity or natural gas. Solar water heaters are uncommon, but have high potential for GHG reductions, depending on the current type of water heater and the chosen replacement. Conventional or storage tank water heaters keep water at a consistent temperature 24 hours per day, and additional energy is lost in situations where the storage tank is uninsulated. In relation to water heating options, installing a solar water heater will provide the highest GHG reductions.

C.1: Solar Hot Water Campaign

Description:

Through an orchestrated City campaign, Mountain View can encourage increased adoption of solar hot water (SHW) systems. Homeowners could be encouraged to install them through group purchasing models and simplified permitting requirements.

A successful program would require partnerships with regional non-profits, system installers, and financial entities, as well as collaboration at a local and regional level between regulatory agencies and government departments.

Barriers:

- **Competing Technologies:** Solar PV installation has higher public visibility and "green roofs" are also becoming increasingly popular. Given limited residential roof space, there is competition between these technologies for market penetration.

- **Cost:** Depressed natural gas prices have limited the cost effectiveness of solar thermal hot water systems. Generally, as a system gains popularity and adoption, installation prices are reduced. Without successful campaigns and policies, it is possible that solar hot water (also known as "solar thermal") will not experience these market efficiencies and will take longer to reach price parity with electric and gas hot water systems.

Precedents:

- **California, US:** The California Solar Initiative (CSI) - Thermal Program offers cash rebates for solar water heating systems on qualifying single-family, multi-family, and commercial properties. The rebate program is overseen by the California Public Utilities Commission and funding comes from ratepayers of multiple California utilities including PG&E.

C.2: Mandatory Solar Hot Water Policy

Description:

This policy would require new, single-family, town house, and City-owned buildings to install solar thermal water heaters. Policy and program development related to solar thermal often lags behind policy development promoting solar PV systems, and therefore expanding market penetration through

[4] http://www.eia.gov/consumption/residential/reports/2009/state_briefs/pdf/ca.pdf

building codes and financial incentives would likely increase installation rates in Mountain View. Additionally, as is true for PV systems, streamlining the permit process for solar thermal water heaters would also increase adoption.

It should be noted that a mandate for installation could be preceded by requiring a feasibility study for the integration of alternative fuel technologies into projects.

Barriers:

- **Overshadowing by Solar PV:** Solar hot water systems have a large potential to reduce GHG emissions and energy use. However, solar PV system market penetration has overshadowed SHW systems. Focusing on GHG emission reduction benefits and developing implementation strategies, rebates, and streamlined permitting processes could increase the profile of this technology.

- **System Sizing:** It is easy to calculate the number of gallons of hot water produced by a typical 4 foot by 8 foot solar hot water collector in a variety of climates, but these systems typically overproduce for the number of gallons actually used by homeowners. Hot water is produced even on days when there is no use and there is currently no system for transmitting or distributing this water to other sources of demand.

Precedents:

- **California, US:** The CSI-Thermal Program will allocate $351 million to promote solar hot water through a program of direct financial incentives to retail customers, training for installers and building inspectors, and a statewide marketing campaign. Incentives are available to customers who currently heat their water with electricity or natural gas in the service territories of investor-owned utilities. Single-family SHW systems that displace natural gas will initially qualify for incentives of up to $2,719, while electricity-displacing systems will qualify for incentives of up to $1,834. Actual incentive amounts will be based on the expected performance of the system and positioning. Incentive levels will decline in four steps as the program meets certain installation benchmarks.

- **Barcelona, Spain:** Barcelona adopted its Solar Thermal Ordinance in 2000, requiring new buildings and renovations (including complete change of use renovations) to install solar water heating systems that provide 30%-70% of domestic hot water requirements. Over 50 Spanish cities and towns have followed Barcelona's example. These local ordinances are now being supported further by the Spanish Technical Building Code. Enforced in 2006, the Code applies to all of Spain and stipulates that 30%-70% of domestic hot water must be obtained using solar energy.

- **Hawaii, US:** In June 2008, Hawaii enacted legislation (SB 644) with the intent to require installation of solar hot water systems on all new single-family home construction. As of January 1, 2010, building permits are not issued for new single-family homes that do not include a solar hot water system.

- **North Vancouver, British Columbia:** The City of North Vancouver established a Hydronic Heat Energy Service Bylaw to create a district heating service area for Lower Lonsdale, with a requirement that specified municipal buildings and all new or retrofitted buildings over a 1,000 square meters be connected to, and use, the system. A wholly owned subsidiary, Lonsdale

Energy Corporation (LEC), was incorporated in 2003 to operate the system. This bylaw requires developers in the district to provide infrastructure to connect to the system, avoiding the construction of baseboard heating in the district. This government commitment ensured that the district would be flexible enough to use a variety of energy sources and would thereby reduce GHG emissions.

- **San Francisco, CA (tentative):** San Francisco is currently investigating the feasibility of mandating solar hot water heater installation on a percentage of new residential development.

D) Fuel Switching – Heating and Hot Water: From Natural Gas to Electric Heat Pumps

Heat pumps and water heaters currently use either electricity or natural gas. The GHG reduction potential in switching the energy source depends on the current type of heating and the chosen replacement. Air- and ground-source heat pumps each offer this benefit. A very high percentage (greater than 80%) of buildings would need to switch from using natural gas for heating and hot water to the use of electric ground- or air-source heat pump systems to achieve an 80% reduction in the energy-related emissions by 2050.

Electric air-source heat pump water heaters work like a refrigerator in reverse. By using fans and an evaporator to pull warmth from the surrounding air, the heat pump transfers it to water in a storage tank. Because it uses warm ambient air temperature to heat, this is an efficient way to heat water.

Ground-source heat pumps are a related technology. As almost half of the solar energy our planet receives is absorbed by the ground, the area just below the earth's surface remains at a constant, moderate temperature year round. Ground-source heating and cooling systems utilize the stable underground temperature through a piping system. Water circulates in this system to exchange heat between a building, the ground-source heat pump, and the earth, providing heating, cooling, and hot water at remarkably high efficiencies.

D.1: Heat Pump Promotional Campaign

Description:

Multiple rebate and finance programs have been successfully used to encourage the development and adoption of new technologies, including electric cars and household PV systems. In the same fashion, a City campaign involving rebates and financing programs could encourage adoption of ground- and air-source heat pump systems for space and water heating. Ground-source heat pumps can provide long-term cost savings for users, while reducing GHG emissions in the process. Mountain View can work with energy service providers to explore creative solutions for financing and installation.

Barriers:

- **Interest of Community and Funding:** The primary barriers to any promotional campaign are the interest of those campaigning and their audience, as well as the funding to plan, develop, and distribute the appropriate resources. The up-front cost of a ground-source heat pump system remains a high deterrent for adoption, even though the long-term savings often creates a logical incentive for adoption.

Precedents:

- **Corvallis, OR:** Energize Corvallis oversees numerous outreach programs to reduce residential energy consumption, including the Green Shares program. In addition to holding volunteer training sessions and distributing educational materials, the Green Shares program connects contractors with leads to increase sales of heat pump water heaters for residential energy savings. Other programs develop mailers and work in cooperation with Oregon State University in preparation for the Campuses Take Charge program.

- **Seattle, WA:** Through the Seattle City Light, consumers can receive a $500 rebate when they buy a qualified heat pump water heater. The program also offers consumers information on the technologies and guides them through the process of finding the right system and installer.

D.2: Heat Pump Permit Streamlining

Description:

Whether they are applied to an open- or closed-loop heat exchange system, multiple permits are required to ensure proper installation and minimize environmental and property impacts. To encourage adoption of this technology, Mountain View can reduce the regulatory barriers to heat pump installation (similar to past PV streamlining programs). In addition to regulatory streamlining, the City can provide education about its building permits and inspections for heat pump systems.

Barriers:

- **Regulatory Hurdles:** Rule making and permitting requires time and oversight. Additionally, while streamlining the permitting process can reduce the barriers of individual adoption, regulators must still ensure that the permits achieve their initial goals of environmental and other protection.

Precedents:

- **Corvallis, OR:** The Corvallis City Council has adopted the Community Sustainability Action Plan, developed in 2008 by the Corvallis Sustainability Coalition to meet its goal “to develop a community-wide sustainability initiative.” One objective of this plan is to support the installation of locally owned renewable energy generation in and around Corvallis. Action items include: the development of building standards that specify renewable energy production readiness; the establishment of criteria for net-zero energy and sustainable building practices; and collaboration among the City, County, and State to create incentives through property tax reductions to achieve net-zero building energy use.

- **Seattle, WA:** By 2030, Seattle is working to amend its code to allow public space, including the public right-of-way, to be used for alternative energy infrastructure, such as solar panels and ground-source heat wells. Seattle’s Climate Action Plan encourages policy makers to expand their thinking about how land use policies and building energy strategies can be developed to integrate highly efficient new construction. One example provided is that land use codes could foster building designs that better capture passive heating and cooling opportunities. The Climate Action Plan also encourages the construction of district energy systems, where heating and cooling could be shared by multiple buildings, using waste heat and renewable energy sources collaboratively, and distributing excess generation to areas of demand.

D.3: Mandatory Electric Heat Pump Policy

Description:

The benefits of electric heat pump systems are numerous, and multiple approaches should be undertaken to ensure widespread and efficient adoption. Beyond implementing incentive programs, Mountain View can require the use of heat-pump systems (for heating and water heating) for all new residential and commercial construction. There are a number of potential approaches to ensure that a mandate meets the needs of the community, including the exemption of high thermal-load commercial uses from the heat pump requirement.

Barriers:

- **Not All Solutions Are Universal:** While heat pump systems can produce financial benefits in addition to emission reductions, such benefits are subject to a number of variables that may differ from property to property (i.e., the energy demand of a particular building and local climate and soil conditions). Each building is located in a slightly different region and must be assessed as an individual entity to ensure that these solutions are correct for the given instance. Any mandate must consider multiple possibilities or be flexible enough to ensure that appropriate technologies are being used for the right situation.

Precedents:

- None found to date.

E) Energy Efficiency – Existing Buildings

Energy efficiency is often seen and marketed as the "low hanging fruit" of GHG reductions. Residents and businesses can select technologies that provide short- to medium-term paybacks and yield long-term financial savings. Traditionally, building owners have selected technologies such as efficient lighting, efficient appliances, and increased insulation. As advancements are made in energy-efficient technologies and energy-management systems, additional savings are possible.

E.1: Advanced Energy-Use Analytics Promotion

Description:

This program would encourage businesses and residents to utilize smart grid-enabled, high-resolution, real-time, remote energy-use analysis (advanced analytics), with the potential to identify inefficient energy systems and generate up to 30% reductions in operations-related energy use. Programs can be created with utility and other private sector stakeholders to encourage adoption of systems.

An important application of advanced analytics is better management of a building's plug load (i.e., energy used by appliances and electronics). Despite increased efficiency of building envelopes and HVAC systems, plug-load demand (driven by increasing intensity of electronics use) is anticipated to increase relative to total building energy demand. A 2010 American Council for an Energy-Efficient Economy (ACEEE) report states that plug loads can be reduced by 40%–60% at relatively low cost through the adoption of new technologies and operational/behavioral changes. The ACEEE report and other studies demonstrate that the primary barriers to reducing plug-load energy use are related to lack

of information. Enhanced consumer understanding of plug-load reduction opportunities can be accomplished through outreach and education, and through the use of advanced analytics that engage consumers in real-time energy efficiency and demand management. Additional new technologies such as plug-load control devices (e.g. power-sensing plug strips, advanced occupancy sensors) and DC micro-grids or office applications, could also contribute considerable reductions. Mountain View could develop a specific campaign to promote the uptake of plug-load reduction practices and systems (e.g., structured for matching specific outreach with targeted end-users), and facilitate the deployment of new advanced-analytics systems.

Barriers:

- **System Availability for Residential Buildings:** To date, advanced analytics has been utilized more in commercial buildings than residential buildings. Creating outreach and partnerships that facilitate the penetration of advanced analytics into the residential sector will be necessary.

Precedents:

- No explicit community-scale precedents found to date.

E.2: Energy-Management Systems Promotion

Description:

For a building to operate efficiently, it is crucial that it be monitored and managed to optimize performance, according to design and function. Outreach programs can be created to encourage adoption of building-management systems in commercial and residential buildings. Once building-management systems are installed, it is also critical that they be managed effectively, with an understanding of the facility's operation cycles and energy use. In order to achieve efficient building management, these outreach programs can be combined with advanced analytics (see E.1 above).

Barriers:

- **Building-Management Autonomy:** New building-management technology often works through remote centers and shared data. Facilities managers would require training on the technology in order to use it collaboratively and effectively. There may be resistance to the loss of on-site autonomy and some reluctance toward sharing a building's operational data.

- **Time and Cost:** Upgrading a building's management system can be an expensive and time-intensive endeavor. Education and outreach would be required in order to secure market penetration. Additionally, tools should be provided that outline the business case for installation of energy-management systems, which could include incentive programs like cost sharing.

Precedents:

- **Department of Energy, US:** Partnering with the University of Southern California, General Electric (GE) Global Research, and GE Consumer & Industrial Division, the U.S. Department of Energy (DOE) is currently conducting research into building-level energy management systems (BLEMS). The objective is to create an integrated plug-and-play capability for historic energy management systems (EMS), such as those based on X-10, Zigbee, 802.15, and newly developed EMS for buildings of any size. This project would bring together ad hoc legacy

energy-management systems under a single, unified framework, thus allowing them to interrelate and making building management more streamlined.

E.3: Commercial District Partnerships

Description:

Commercial district associations can be formed to allow for information sharing and collaboration between members. This collaborative and "open-source" effort can serve to achieve dramatic reductions in energy use, GHG emissions, and water use from member buildings by changing how buildings and projects are planned, designed, and constructed. Eco-District pilots within the City could be identified where there is good potential for district energy solutions, and where all new development must achieve a certain percentage improvement over current code (implement a stretch code) in order to obtain planning permission. Ideally these zones would also be mixed-use areas, with very good access to transit, public amenities, open space, etc. This type of pilot would work best for new, master-planned areas of the City, but could also work for appropriate infill development.

Barriers:

- **Membership Motivation:** Forming a coalition of several entities that agree to share previously labeled proprietary data is a difficult undertaking. The districts must develop methods to encourage trust and agreement.

Precedents:

- **London, UK:** The Mayor of London's low carbon zones program (RE: CONNECT) supports a community approach to cutting the capital's carbon footprint. The program was designed to show the potential of a complete approach to reducing a community's CO_2 emissions by involving local residents, communities, and businesses. Its aim is to cut carbon emissions locally, helping London meet its target of reducing CO_2 by 60% by 2025, and contributing to the Mayor's vision to make London the greenest big city in the world. Ten boroughs were chosen to receive funding and support from the Mayor and the Greater London Authority (GLA) to create local, low-carbon zones (LCZ). Each of the zones set a target to reduce carbon emissions by 20.12% by 2012 and each zone developed innovative delivery models to do so. According to the Energy Planning report from 2013, the energy initiatives will reduce fossil fuel use and resulting CO2 emissions by 36% more than required by Part L 2010 of the Building Regulations (reductions will be equivalent to approximately 49,474 tons CO_2 per annum).

- **Seattle, WA:** The 2030 District initiative incentivizes property owners and managers to share utility data that is usually considered proprietary. This collaborative group has created the 2030 District Committee, intended to develop a baseline of district-wide energy use and collectively meet the challenges set by the 2030 District initiative. The committee aggregates and analyzes data to define current baselines. It also explores best practices for energy efficiency improvements, as well as incentive and financing plans for implementation.

- **Washington, DC:** The SW Ecodistrict area, among many other sustainability initiatives, is targeting zero-carbon production in the long term, and will be required to design to a high standard of energy efficiency using LEED Platinum as a baseline requirement (assuming an approximate 50% energy-use reduction, increasing over time). Leveraging the existing central plant to provide a district energy system will be an essential part of the low-carbon energy

strategy and route to zero carbon, once this system can be converted to a long-term, zero-carbon fuel source.

- **Silicon Valley, CA:** The Smart Energy Enterprise Development Zone (SEEDZ) Initiative Joint Venture has an objective to build a “two-way” power network that facilitates energy management and clean-energy deployment. Stakeholders include major corporations, research institutions, government entities, and investor-owned utilities. The SEEDZ decision-making process includes active consideration of stakeholder “gives” and “gets” related to collaborative energy solutions.

E.4: Building Benchmarking and Disclosure Policy

Description:

Laws that mandate annual benchmarking and disclosure of their energy usage encourage more efficient building-management practices. This policy would require commercial building owners/managers to collect and disclose energy-use information to the City each year. The data allows the City and its partners to identify high-energy users and to target efforts. To facilitate adoption of such policies, some commercial uses (e.g., data centers) could be exempted, if deemed appropriate.

A mandatory disclosure ordinance would require owners of large buildings to measure and report their energy consumption annually. This requirement could take advantage of the US Environmental Protection Agency's (EPA) free online benchmarking tool. Additionally, outreach programs and cooperation with the real estate industry may advance the effort to institutionalize a recognized additional value proposition for energy-efficient buildings that have successful management systems in place.

Barriers:

- **Time and Cost:** Realtors, appraisers, loan officers, mortgage holders, and others may not want to spend the time or money needed to learn how to use benchmarking data. Building managers may not see the value in learning how to use benchmarking data.

Precedents:

- **New York, NY:** Under Local Law 84, owners of properties in New York City are required to track and report annual benchmark data. New York is the first city in the nation to publicly disclose data for large, multi-family buildings, proving transparency and comparative analysis through access to energy and water use data.

- **San Francisco, CA:** San Francisco’s Existing Commercial Buildings Energy Performance Ordinance (EPO) and the San Francisco Environment Code, Chapter 20, Sections 2000 et seq. require an “Annual Energy Benchmark Summary” report by April 1 of each year for all non-residential building owners. Through an account with ENERGY STAR Portfolio Manager, the City helps building operators understand the process needed in order to achieve the benchmarking benefits. In turn, this ordinance requires the City to make building performance information available to the public.

- **Seattle, WA:** The Energy Benchmarking and Reporting Program in Seattle requires owners of non-residential and multi-family buildings (20,000 square feet or larger) to track energy performance and report annually**.**

- **Austin, TX:** The City of Austin's Energy Conservation Audit and Disclosure Ordinance (ECAD, Austin City Code, Chapter 6–7), updated in 2013, requires all commercial buildings served by Austin Energy to determine and submit an energy benchmark rating for their facilities (manufacturing buildings are exempt). Businesses are asked to self-rate their buildings using the US Environmental Protection Agency ENERGY STAR Portfolio Manager benchmarking tool and to submit those ratings to the City of Austin. Starting in mid-February of each reporting year, the online Portfolio Manager tool will allow businesses to release benchmark/rating data to the City of Austin. All improvements are voluntary. The rating system is designed as a starting point to help businesses evaluate their buildings in terms of energy efficiency. Austin Energy maintains a unit of energy-efficiency experts available to educate business owners in energy-efficiency measures and available rebates.

E.5: Point-of-Sale Energy Rating Policy

Description:

Point-of-sale or point-of-lease energy performance disclosure requirements ensure that energy consumption information is available during real estate transactions. With this information, operational energy costs are integrated into property values. The requirements may also motivate owners to improve the energy efficiency of their properties in order to make them more attractive to buyers or renters.

The mandatory disclosure requirement would cover all buildings, including smaller commercial and residential buildings, and would require owners to report the energy performance score to the City, buyers, and prospective buyers or renters at the point-of-sale or lease. A building's energy performance score would be determined using the EPA Portfolio Manager (for commercial or multi-family buildings), the Home Energy Rating System (HERS) index (for residential), or an equivalent tool.

Barriers:

- **Building Owner Resistance:** Building owner associations may resist such a program due to added costs and administrative burdens. Integration of these associations into the program development process has helped programs in other cities.

- **Cost Burden:** In 2011, the Australian government analyzed the impact of its proposed Residential Building Mandatory Disclosure requirement for energy and water performance. Among other impacts, it evaluated the potential cost burden on home owners and real estate professionals that the requirement could create. Costs varied greatly depending on the assessment method selected, ranging from high costs associated with a full professional thermal performance simulation to low costs using an owner checklist of building components. The analysis demonstrated that requiring a full professional thermal performance simulation would place a high cost burden on real estate transactions and the community costs would exceed the community benefits. The analysis did however find that a simplified thermal performance assessment plus an evaluation of building components (the second most rigorous method evaluated) would create a considerably lower cost burden while generating the highest level of community benefits. This finding applied regardless of whether disclosure is mandated

at point-of-sale and lease, or point-of-sale only. Therefore, the program would need to be designed to reduce cost burden, while achieving the desired result of quality energy performance data.

- **Quality Control:** The success of such a program will depend on the integrity of the performance ratings. The City would need to ensure that there are adequate numbers of certified auditors, and work with organizations such as the Building Performance Institute or the Residential Energy Services Network to ensure the availability of auditors and training courses. Auditors would submit findings to the City's Building division staff and other appropriate parties, and the City would review the audits and verify portions of them through field checks.

Precedents:

- **Austin, TX:** In 2007, the City of Austin established varying energy disclosure requirements for various types of buildings: residential single-family, residential multi-family, and commercial buildings. Notably, mandatory upgrades are required in cases where a multi-family building's energy use per square foot exceeds the average energy use in all of Austin's multi-family buildings by 150%. The requirements provide exemptions for mobile homes, condominiums, residences that can document recent efficiency investment, and commercial buildings for which existing rating systems do not work well (e.g., data centers).

- **European Union:** The European Union's (EU's) Directive on the Energy Performance of Buildings mandates that EU nations develop building energy performance measurement protocols and establish building energy certification programs for residential and commercial buildings. Building owners are required to provide energy performance certificates to prospective buyers and tenants during a sale or lease transaction, and during building construction. Buildings providing public services must also display an energy certificate.

E.6: Building Commissioning Promotion

Description:

During commissioning, a building's systems and subsystems (HVAC, plumbing, electrical, fire, lights, cogeneration, controls, security, building envelopes, etc.) are optimized for functional and energy-efficiency performance. This ensures that a building is operating according to its design, and offers opportunities to enhance building system and subsystem performance. A City-led outreach campaign would promote commissioning and retro-commissioning in newly constructed and existing buildings. The program could explain the financial savings potential of commissioning and retro-commissioning, and identify service providers that work within the community.

Barriers:

- **Cost:** Costs related to documented benefits remains a significant barrier for building commissioning of new and modified construction projects. It can be a difficult negotiation to determine which party bears the financial burden for commissioning (e.g., buyer, seller, contractor, or tenant).

Precedents:

- **California, US:** The California Commissioning Collaborative (CCC) is a California non-profit public benefit corporation working to develop and promote building commissioning practices throughout the State. This includes working towards more affordable service delivery and providing outreach and education programs regarding the commissioning process.

- **Pennsylvania, US:** The Pennsylvania Department of Environmental Protection's Cambria office was the first certified LEED-NC v 2.0 Gold project in the United States. As with all LEED-certified buildings, commissioning was a requirement for this certification and the office stands as a high visibility project to raise public awareness.

E.7: Mandatory Retro-Commissioning Policy

Description:

Retro-commissioning involves the identification and improvement of less-than-optimal energy performance of equipment and control systems in existing building equipment, so that they operate as efficiently as designed. It improves how building equipment and systems function together. Depending on the age of the building, retro-commissioning can often resolve problems that occurred during design or construction, or address problems that have developed throughout the building's life. Retro-commissioning improves a building's operations and maintenance procedures to enhance overall building performance. Retro-commissioning measures are typically low- or no-cost measures, often yielding a payback within a few months. Mountain View could require retro-commissioning of existing buildings for the purpose of ensuring optimal performance of building systems.

Barriers:

- **Timeframe:** Although retro-commissioning would provide opportunities to overhaul a building's systems and subsystems, there is no assurance that these opportunities are captured and maintained. System improvements can be lost within weeks of the commissioning process if corrections are not maintained by building staff.

Precedents:

- **Seattle, WA:** Seattle is currently developing a voluntary retro-commissioning pilot program. Pending successful results from the pilot, the City will explore the expansion of retro-commissioning programs.

F) Energy Efficiency – New Construction

The energy-efficiency mechanisms for new construction are similar to those for existing buildings. However, the permitting process for new construction creates an additional opportunity to implement construction codes (such as the code identified in F.1). Additionally, incorporating best practices in new construction can often be more cost effective than retrofitting existing buildings. This may allow better integration of building-management systems and control technologies.

F.1: Zero-Energy Building Code

Description:

The State of California has stated its intention to have all new residential homes (constructed after 2020) and all new commercial buildings (constructed after 2030) attain a zero-net energy usage factor. The building code would require high efficiency and renewable generation to offset remaining energy draw. The City could monitor the progression of this State initiative and seek to develop its own, should statewide efforts fail. Additionally, the City could choose to accelerate a roll-out of the commercial requirement earlier than 2030.

Barriers:

- **Code Compliance**: A high percentage of new construction does not comply with energy code requirements, which is a major barrier to achieving the City's efficiency goals. To address this issue, the City adopted energy code compliance rules in 2010 that require a variety of progress inspections during construction. The City will need to evaluate the effectiveness of these compliance initiatives.

- **Implementation Timing and 2050 Reductions:** The timing of code implementation is critical to achieving the anticipated energy GHG reduction. The earlier more stringent codes can be adopted, the more efficient the City's building stock will be in 2050. New buildings constructed at a lower level of efficiency represent a lost reduction opportunity.

- **Implementation Timing and Cost Burden:** Code improvements need to consider the cost burden of the new requirements. Increases in efficiency are best implemented at a rate that accommodates aggressive, yet realistic, market transformation and that allows additional construction costs to be minimized.

- **Limits to Prescriptive Code:** According to DOE, it is not clear that a 50% improvement beyond 2006 International Energy Conservation Code (IECC) can be achieved through a refinement of the prescriptive IECC. This is in part due to the fact that IECC standards only regulate heating, cooling, water heating, and lighting end uses. Plug-load end uses are not included as they cannot be regulated prescriptively. Due to the National Appliance Energy Conservation Act of 1987, IECC's standards cannot apply to high-efficiency appliances or HVAC equipment. Therefore IECC needs to meet its goal using changes to the envelope, lighting systems, and distribution systems only. For these reasons, it is likely that a performance-based code is required. DOE has discussed several new approaches including: prescriptive baseline with a performance requirement, annual performance budget (Btu per square foot annual carbon budget, or post-occupancy metering (outcome-based)). IECC may evolve toward a performance-based code. It is likely that Mountain View will need to adopt a performance-based code in order to achieve its targeted level of efficiency[5].

[5] The difference between a performance-based code and an outcome-based code: Performance-based code allows designers to use any efficiency to achieve a targeted level of performance. Compliance is evaluated using pre-occupancy building energy modeling to demonstrate the anticipated level of performance. Outcome-based codes differ by evaluating compliance through post-occupancy energy use analysis. Outcome-based codes are exciting because they are able to influence building plug loads. There are, however, inherent difficulties in designing and enforcing an outcome-based code.

Precedents:

- **California, US:** Title 24, Part 6, of the California Code of Regulations, specifies energy efficiency requirements for buildings. The standards are updated periodically to allow consideration and possible incorporation of new energy efficiency technologies and methods. Each revision in California's energy code in 2002, 2005, and 2008 cut energy use by 10%–15% compared to the previous standard. The 2013 code cut energy use by an additional 25% above the 2008 code. The 2013 code is seen as the most energy-efficient state-level energy code in the nation. The California Energy Commission is pursuing a trajectory toward requiring net-zero-energy performance in residential buildings by 2020 and in commercial buildings by 2030.

- **Seattle, WA:** The Seattle Energy Code (SEC) is based on Washington State's Energy Code and includes amendments that add stringency to energy code baseline requirements. The SEC is considered one of the most stringent energy codes in the nation, comparable to California Title 24. The State is planning to reduce energy use by 70% below 2006 SEC levels by 2031 through regular updates. Local governments can exceed the State code for commercial construction, but State legislative action is needed to increase or expand energy code requirements in the residential sector. The City of Seattle is considering the adoption of an outcome-based code program for commercial and multi-family construction. A desired benefit of the proposed outcome-based code program would be the ability to address plug loads, which contribute to a growing percentage of overall energy consumption.

F.2: Passive Home Energy Design Policy

Description:

Passive House is a building standard that emphasizes highly energy-efficient technologies and construction techniques for new construction and remodels. The standards are capable of dramatic reductions in building energy. In Europe, buildings meeting Passive House standards use 90% less energy than current building stock, and 75% less energy than average new buildings. While direct comparison is difficult, it appears that Passive House standards outperform current and near-term model codes (e.g., IECC). This advantage will, however, diminish as the model codes strengthen.

Passive solar energy design can reduce considerable amounts of space heating and cooling related to energy use. Mountain View could adopt a requirement that new development incorporate passive energy design systems (e.g., orientation, natural ventilation, etc.).

Barriers:

- **Cost and Complexity:** Designing a passive building requires significant analysis and a complex understanding of the location, geography, and micro-climates. This is an expensive process and could be cost prohibitive.

- **Existing Infrastructure:** It can be difficult to incorporate passive design features within areas that have already been developed. Existing infrastructure that has been designed according to other factors and orientations often proves limiting. Additionally, many passive design features may not meet local codes and ordinances.

Precedents:

- **Denmark:** Saint-Gobain Isover, a Scandinavian insulation company, established a Comfort Houses pilot project consisting of the development and monitoring of 10 single-family houses constructed as passive houses. The project was conducted to provide data and knowledge regarding passive house performance for the building industry and other interested parties.

- **European Union:** The EU's Directive on Energy Performance of Buildings states that the commission intends to propose minimum performance requirements for new and renovated buildings that approach the level of passive houses by 2015. This statement is reiterated in the EC Energy Efficiency Action Plan.

F.3: Energy-Efficient Appliance Policy

Description:

ENERGY STAR is a voluntary program with the US EPA that helps businesses and individuals reduce GHG emissions while saving money through energy efficiencies. A new building must undergo a process of inspections, tests, and verification to earn the ENERGY STAR label, but once this is achieved, the building maintains greater value in the future. Mountain View can create policies that encourage the procurement of energy-efficient appliances (e.g., ENERGY STAR rated) for new buildings. While questionable from a legal feasibility perspective, the City could also explore a mandatory standard for major appliances in new construction.

Barriers:

- **Resistance to Up-Front Cost:** Newer more efficient technologies, including those with certified ENERGY STAR labels, often increase the cost of new building construction, which potentially hinders their implementation. While these technologies will likely pay off in the long term, requiring their utilization will pose a hurdle for some developers.

- **Legality of Mandatory Measures:** While there is precedent for mandatory efficiency standards for appliances at the municipal level, it is questionable if such requirements are legal. Federal commerce law may prevent cities from establishing such requirements. For this reason, a voluntary/promotion approach is likely more feasible.

Precedents:

- **Los Angeles, CA:** Los Angeles has an aggressive green building code that is based on the 2013 California Green Building Standards Code, commonly known as CALGreen. Within the City's municipal code there is a requirement for ENERGY STAR (or equivalent) major appliances in new construction. Through these codes and standards Los Angeles ranks number one on EPA's list of cities with the most buildings with the ENERGY STAR label.

- **Massachusetts, US:** The Massachusetts Board of Building Regulations and Standards (BBRS) has developed the Stretch Energy Code as an appendix to the State's energy code. The Stretch Energy Code provides an option for cities and towns wanting to require energy efficiency greater than the base codes currently mandatory for municipalities across the Commonwealth. The Stretch Code Appendix offers a streamlined and cost-effective pathway to achieving approximately 20% greater energy efficiency in new residential and commercial buildings than

is required by the base energy code. This is largely achieved by moving to a performance-based code, where developers are required to design buildings that reduce energy use by a given percentage below base code, rather than being required to install specific efficiency measures.

Chapter 3 — TRANSPORTATION

This document contains potential Transportation implementation mechanisms that could form part of a roadmap enabling Mountain View to reach its 2050 Greenhouse Gas (GHG) reduction target. Transportation comprises the largest source of GHG emissions in the City (~56% as of 2005), and emissions must be reduced dramatically in this sector to achieve an 80% reduction in community emissions by 2050.

Table 3.1 below divides Transportation sector carbon reduction opportunities into three core strategies, then identifies potential mechanisms (policies and programs) that the City could adopt to implement each strategy. A brief description is provided for each mechanism, followed by a list of potential barriers and precedent examples from cities where similar policies or programs exist.

The core strategies focus on transitioning to alternative vehicle fuels (fuel switching). There will be necessary interplay between each strategy for transportation emission reductions, and adopting any one fuel type will influence the deployment and development of others. Achieving the ideal mix of fuels will depend on the type, size, and number of vehicles. While residents and businesses should be encouraged to adopt alternative fuels, some level of organic growth and market influence should occur to achieve an optimized distribution of alternative fuels.

Table 3.1: Transportation Implementation Mechanisms

Strategy Type	Implementation Mechanism	Estimated Cost	Estimated GHG Reduction in 2050 (MT CO2e/Year)
A) Fuel Switching – Compressed Natural Gas (CNG)	A.1. Publicly accessible CNG fueling stations	Cost Neutral	Very High over 100,000
	A.2. Shared commercial CNG fueling station outreach program	Low $10,000–$30,000	
B) Fuel Switching – Battery Electric Vehicles (BEV)	B.1. Community electric vehicle adoption campaign	Medium $30,000–$100,000	Very High over 100,000
	B.2. Public electric vehicle charging facilities	Cost Neutral or Revenue Generating	
	B.3. Parking facility electric vehicle charging standards	Low $10,000–$30,000	
	B.4. Residential multi-family electric vehicle charging standards	Low $10,000–$30,000	
	B.5. Residential single-family electric vehicle charging standards	Low $10,000–$30,000	
C) Fuel Switching – Second Generation Biofuels	C.1. Encourage development of biofuel stations	Medium $30,000–$100,000	High 50,000–100,000
	C.2. Waste-to-biogas facility for fleet vehicles	High $100,000–$300,000	
		TOTAL:	**300,000–350,000**

A) Fuel Switching – Compressed Natural Gas

Compressed natural gas (CNG) presents an alternative fuel source for modified internal combustion engines. In the United States, natural gas vehicles have historically been used as fleet vehicles (e.g. buses and municipal trucks). CNG is likely to play an important role in reducing carbon and particulate emissions in medium and heavy duty vehicles. Due to its moderate emissions factor, the technology would be ideally utilized in medium and heavy trucks.

CNG produces considerably lower particulate emissions and could contribute to air quality goals. CNG offers opportunities for lower fuel prices, less engine wear, and lower operation and maintenance costs compared to gasoline and diesel vehicles. Natural gas fueling infrastructure could serve as a stepping-stone to hydrogen fueling infrastructure. Additionally, there is an opportunity for use of renewable natural gas (biogas) in vehicles and distribution.

However, CNG fuel conversion faces several challenges. Up-front cost of CNG vehicles is typically higher than a gasoline- or diesel-powered equivalent. There is currently a lack of natural gas fueling infrastructure, and the CNG emission factor is not low enough to result in an 80% reduction in all vehicles. Finally, while CNG provides important air quality benefits and reduces GHG emissions when compared to traditional diesel engines, cleaner technologies exist. Also, investment in CNG buses may lock in this pollution for the duration of the buses' lifecycle.

CNG is considered a moderate strategy for achieving the City's 2050 GHG emissions reduction target. Following is an overview of four recommended implementation mechanisms to encourage the adoption and deployment of CNG technology.

A.1: Publicly Accessible CNG Fueling Stations

Description:

The carbon intensity of the region's transportation could be reduced if a considerable portion of the private sector adopts CNG as a primary transportation fuel source. CNG and CNG vehicles are becoming increasingly available and cost-effective. However, achieving a large-scale transition will require an increase in publicly accessible CNG fueling stations on private or public property, which the City could help facilitate in conjunction with commercial or industrial property owners. CNG fueling stations open to public use can serve as a catalyst for community CNG vehicle adoption. If multiple cities in a region coordinate this effort, it would expand the public's fueling options, particularly if existing commercial fueling stations add CNG fueling capability. Expanding fueling infrastructure would also address a key market barrier, which is the perceived unreliability of a regional fueling system.

Barriers:

- **Increased Liability Due to Boiling Liquid Vapor Explosion (BLEVE):** Explosive properties of CNG represent a public health and safety risk.
- **Permitting:** CNG stations are likely to require an involved permitting process and there may be unforeseen issues with construction delays and availability of equipment.
- **Upfront Capital Costs:** Initial costs for municipal CNG fueling stations are large, though long-term operations and maintenance savings can offset these initial costs. If a suitable location(s) isn't available on existing public or private property, the cost to acquire land could be significant.

- **Siting**: Locating the fueling station(s) on City property could present challenges, since some locations are not easily accessible to the public, and existing commercial fueling stations may not choose to offer CNG in the future.

- **Manufacturer Support**: There is uncertainty and risk associated with whether auto manufacturers will continue to offer and develop new CNG vehicles for light duty and commercial use that are cost effective and supported for parts replacement.

Precedents:

- **Ontario, CA:** Within the last year, the City of Ontario expanded its CNG fueling facility and invested in CNG vehicles for the municipal fleet. The CNG station is also open for public use seven days a week, twenty-four hours a day. The project includes installation of new and replacement fuel dispensers and provision of additional CNG fuel storage capacity. The City was awarded a grant fund from the Mobile Source Air Pollution Reduction Review Committee (MSRC) Local Government Match Program.

A.2: Shared Commercial CNG Fueling Station Outreach Program

Description:

Develop an outreach program to encourage local commercial fleet operators to develop shared CNG fueling stations. A successful outreach campaign would identify market segments and develop outreach and financing solutions. This, combined with targeted outreach to commercial fleet owners and operators, could greatly improve awareness about the potential for improvements in the region's commercial fleets.

Barriers:

- **Cultural:** It may be difficult to shift commercial operations and private interest enough that it increases adoption of CNG vehicles and cooperation between businesses and other stakeholders.

Precedents:

- **Chicago, IL:** Partnering with the Gas Technology Institute (GTI), Chicago Area Clean Cities Coalition, the State of Illinois, municipalities, and private companies, the City of Chicago has developed multiple alternative fueling stations, including 17 CNG fueling stations that are shared for public and private use.

B) Fuel Switching – Battery Electric Vehicles

Battery electric vehicles (EV) utilize 100% electric powertrains for propulsion and can be recharged from any external source of electricity. Extended range EVs may have an internal gasoline generator that is able to recharge the battery and extend the car's range. However, the typical operation of EVs does not produce GHG emissions on the road. Rather, emissions are accounted for at the electric generation source. Because California has a Renewable Portfolio Standard (RPS) of 33% renewable energy on its grid by 2030, charging and operating EVs generally produces a low level of GHG emissions. In addition, EVs produce little to no local air pollution, and increased adoption of EVs would contribute to regional air quality goals.

While a lack of charging infrastructure (range anxiety) and concerns regarding up-front purchase costs may dissuade potential buyers from adopting EV technology, aggressive outreach, technological

advances, and a changing market are helping overcome these obstacles. Programs such as Tesla Motor's "Supercharger" are rapidly expanding the infrastructure necessary for mainstream EV adoption.

Considerable improvements in battery technology are progressively reducing battery costs. In 2012, McKinsey and Company analyzed electric vehicle competiveness with internal combustion engine (ICE) vehicles. The study looked at two core variables: battery cost and gasoline fuel price. According to the study, based on 2011 conditions, hybrid electric vehicles were becoming competitive on a full ownership cost basis. By 2030, EVs will likely be directly competitive with ICEs.[1] It is likely that up-front costs for EVs will remain slightly higher than ICEs, but operations and maintenance costs over time will more than make up this premium.

Ultimately, EV characteristics make them well-suited for reducing transportation carbon emissions and addressing regional air quality issues. Technology developments and infrastructure expansion will likely reduce existing barriers.

B.1: Community Electric Vehicle Adoption Campaign

Description:

As with many new technologies and programs, successfully implementing EV adoption programs will require concerted promotion and education. Outreach programs could include a "Clean Vehicles = Clean Air" marketing campaign, EV demonstration days, websites, and applications for mobile devices.

Barriers:

- **Preconceptions:** Many residents have preconceptions that EVs cannot meet their daily travel needs. Range anxiety and lack of knowledge about charging options currently prevents a portion of the population from purchasing EVs. It would be essential to educate residents about the appropriateness and benefits of EVs in most Bay Area driving situations. Identifying potential EV adopters and developing the appropriate messaging would be required.

- **First Cost:** Currently, EVs are more expensive than base model gasoline vehicles. This will limit the portion of the market that will purchase EVs in the near-term. Given the large percentage of affluent residents/employees in the community, this should be less of a constraint than in other markets.

Precedents:

- **Santa Barbara, CA:** Santa Barbara has a community-based outreach campaign that includes advertisement of EV infrastructure through its City and Air Pollution Control District website. During its Earth Day Festival, Santa Barbara hosts a Green Car Show, which includes a Ride & Drive Event, inviting potential customers to get behind the wheel of an EV. There are also demonstrations of a solar carport, and information on publicly available charging stations.

B.2: Public Electric Vehicle Charging Facilities

Description:

A comprehensive network of publicly accessible charging stations will be required to extend the travel range of EVs and assure users that they will not be left stranded without the ability to charge. In municipally-controlled areas, additional electric vehicle charging stations will be necessary for mass

[1] U.S. Department of Energy, Energy Information Administration reference case gasoline price forecasts and DOE and other industry battery price forecasts.

adoption of electric vehicles. Several parking studies have indicated that many residential developments provide less off-street parking than residents require. Additionally, EV charging stations will be necessary in commercial areas, and municipally-controlled areas represent an opportunity to be 'first-movers' in building this capacity.

Barriers:

- **Cost:** Depending on electrician and permitting costs, EV charging stations can cost between $4,000 and $15,000 to install. This represents a significant cost to commercial parking facility owners. Rebates and other financial incentives may be necessary to reduce this hurdle.

- **Demand and Supply:** Installing EV chargers will help facilitate EV adoption. Because the infrastructure is costly, there is reluctance to install infrastructure until demand is proven, but without the chargers, demand may be depressed. Policies will be needed to break this impasse.

- **Operational Issues**: Potential for charger vandalism and ongoing operations and maintenance costs represent uncertain future risks.

- **Parking Constraints**: Spaces restricted to EVs could take away from already-limited parking spaces, especially given the current low EV market share.

Precedents:

- **Chicago, IL:** As of May 2013, there were 214 public charging stations in the Chicago metro area. Most of these stations are equipped with Level 2 chargers, and some are equipped with direct-current (DC) fast chargers. A free, user-friendly, online and mobile map identifies the locations of charging stations and displays in real-time whether they are in use. The map also differentiates between regular and high-power stations that can charge your car more quickly.

- **Copenhagen, Denmark:** The City Council has reserved 500 parking spaces for EV providers to set up and operate charging stations for a period of ten years. To date, 106 charging stations, 218 parking spaces, one fast-charging station, and one hydrogen fueling station have been set up. As relevant standards and legislation are made ready, the City of Copenhagen will offer long-term concessions to ensure the full-scale roll-out of infrastructure on public roads. This includes on-going cooperation with car manufactures and service providers who can contribute to creating a public infrastructure.

- **Portland, OR:** The City has developed a strategy to address the many issues around adoption of EV technology. "Electric Vehicles: The Portland Way" was adopted by the City Council on July 20, 2010. One of the key areas in the document addresses streamlining the permitting process for charging stations. Also, Portland is currently benefiting from The EV Project, a federally funded initiative that will install over 2,000 charging stations in the Willamette Valley. Of these stations, approximately 1,000 will be accessible to the public, enabling EV users to charge at destinations throughout the region.

- **Westminster, London, England**: In 2006, the Westminster City Council installed two on-street EV charging stations as part of a pilot/demonstration project. The City established criteria for siting on-street chargers, including compliance with the Westminster Way Street design guidelines, suitability for disabled users, and compatibility with the majority of electric vehicles used in London. Following this successful pilot project, the City has installed 33 on-street charging stations to date.

B.3: Parking Facility Electric Vehicle Charging Standards

Description:

To facilitate the broad adoption of EVs, the City will need to increase the number of "EV ready" spaces in public and private parking lots and garages. To accomplish this, the City could establish EV ready requirements for existing City parking spaces and for new private lots and garages. Additional policies could encourage retrofit of existing garages and lots.

Another potential policy mechanism to facilitate these retrofits would be a commercial parking tax applied to customers who park in facilities that do not have adequate EV charging infrastructure. The tax could be structured proportionate to the level of EV charging infrastructure in the facility. Revenues could be spent on funding or rebates for further EV charging infrastructure development.

Barriers:

- **Cost:** Depending on electrician and permitting costs, EV charging stations can cost between $4,000 and $15,000 to install. This represents a significant cost to commercial parking facility owners.

- **Demand and Supply:** Installing EV chargers will help facilitate EV adoption. Because the infrastructure is costly, there is reluctance to install infrastructure until demand is proven, but without the chargers, demand may be depressed. Policies will be needed to break this impasse.

- **Loss of Parking Spaces**: There is a requirement to provide one EV charging space that is accessible, which means the loss of an additional parking space (and revenue) due to the loading/unloading aisle.

Precedents:

- **Bay Area "Plug-in Electric Vehicle (PEV) Readiness Plan" and Bay Area "Ready, Set, Charge, California!":** These plans highlight strategies and guidance from research, analysis, and public input to help the Bay Area achieve the goal of increasing EV adoption over the next 10 years. This includes recommendations for design guidelines and codes for charging stations on commercial properties.

- **Puyallup, WA:** The City of Puyallup has adopted a municipal code addressing EV infrastructure, including charging stations in commercial development. The code intends to encourage the use of EVs and to set standards for, and expedite the establishment of, convenient, cost-effective EV infrastructure that is needed for such a transition.

B.4: Residential Multi-Family Electric Vehicle Charging Standards

Description:

A large portion of current and future residences in Mountain View are and will be multi-family dwellings. Limited accessibility to at-home charging stations for residents in multi-family housing may be a barrier to EV adoption in the Bay Area. To help remove this barrier, the City could implement parking standard requirements for EV charging stations in new and renovated multi-family developments.

Barriers:

- **Increased Cost of Development:** Because EVs currently have low market penetration, adoption of EV pre-wiring requirements may slightly increase development costs in a region with an already expensive residential market and limited development opportunities.

- **Property Owner/Developer Resistance:** Building owners and developers may resist these requirements because current market adoption of EVs is low. Market research may be required to indicate that occupants of multi-level family housing would exhibit sufficient demand for charging stations.

Precedents:

- **Palo Alto** and **Cupertino, CA:** The Bay Area "Plug-In Electric Vehicle (PEV) Readiness Plan" and Bay Area "Ready, Set, Charge, California!" plan provide recommendations for local governments to offer guidance to the public and adopt regulations for expanding the number of charging stations available to residents. Municipalities such as Palo Alto and Cupertino have adopted codes requiring pre-wiring for charging stations at multi-family buildings. Cupertino is amending Chapter 16.58, Title 16 of its Municipal Code to require at least 5% of all multi-family parking be devoted to EV charging. On August 4, 2014, the Palo Alto City Council held its second reading of an ordinance to include Section 16.14.380 of the Palo Alto Municipal Code, adopting the local amendments to the California Green Building Standards Code requiring that all new multi-family residential and non-residential construction provide for the current and future installation of EV chargers. This complements the adoption of a 2013 Municipal Code, requiring new single-family residences to accommodate 240-volt Level 2 charging stations.

- **Santa Clara County, CA:** On December 17, 2013, the County Board of Supervisors adopted an ordinance (NS-1100.118) requiring either pre-wiring or installation of charging stations for PEVs in new buildings (i.e. residential, multi-family, and commercial) in the unincorporated areas. The ordinance requires that new buildings install conduit and ensure electrical panel capacity to enable the future installation of Level 2 electric vehicle charging equipment. For new non-residential and multi-family residential buildings that provide more than 100 new parking spaces, the ordinance requires the installation of Level 2 PEV charging stations for 1% of the parking spaces. The purpose of this ordinance is to increase the availability of PEV charging system infrastructure throughout the County, to encourage ownership of plug-in electric vehicles, and to serve as a model for consideration and adoption by the County's fifteen municipalities.

- **Vancouver, Canada:** In 2009, the City of Vancouver, British Columbia revised its building code to require a portion of parking stalls in new development to be EV ready. Section 13.2.1.1 of the Vancouver Code requires 20% of multi-family building parking stalls designated for use by building owners or occupants to accommodate EV charging equipment. Section 13.2.1.2 of the Code requires the electrical room in a multi-family building to include sufficient space for the future installation of electrical equipment necessary to accommodate EV charging for 100% of the parking stalls designated for use by building owners or occupants.

B.5: Residential Single-Family Electric Vehicle Charging Standards

Description:

It is expected that most EV charging will initially take place at people's homes. Pre-wiring requirements for EV charging stations in new single-family residential development is an important policy to help encourage EV adoption. A report by the California Investor Owned Utilities Statewide Codes and Standards team recognizes that changes to the building code to make charging infrastructure more available, accessible, and affordable will be needed to facilitate adoption of plug-in EVs.

Barriers:

- **Increased Cost of Development:** Because EVs currently have low market penetration, adoption of EV pre-wiring requirements may slightly increase development costs in a region already facing an expensive residential market and limited development opportunities.

- **Property Owner/Developer Resistance:** Building owners and developers may resist these requirements because current market adoption of EVs is low. Market research may be required to indicate that occupants of multi-level family housing would exhibit sufficient demand for charging stations.

Precedents:

- **London, England:** Since 2009, the City of London's building code has required residential, workplace, and retail development to install EV chargers, including 20% of new residential and workplace parking stalls and 10% of new retail parking stalls. The code requires an additional 20% of residential stalls and 10% of workplace and retail stalls to be EV ready.

- **Santa Clara County, CA:** Refer to Section B.4 for a full description of Santa Clara's EV charger programs and policies.

- **Palo Alto** and **Cupertino, CA:** Refer to B.4 for a full description of Palo Alto and Cupertino's EV charger programs and policies.

- **San Jose, CA:** In 2012, the City of San Jose's Planning, Building, and Code Enforcement Department implemented a streamlined residential permitting process to facilitate the installation of home charging systems and accelerate the adoption of EVs.

- **Sunnyvale, CA:** The Bay Area "Plug-in Electric Vehicle (PEV) Readiness Plan" and Bay Area "Ready, Set, Charge, California!" plans provide cities and consumers with information regarding installation of EV equipment. The City of Sunnyvale has taken action on these plans and established a code requiring pre-wiring for new single-family housing units.

C) Fuel Switching – Second Generation Biofuels

Rapid increases in the use of crop-based (first-generation) biofuels have resulted in concerns over their impact on food supplies and ecosystems. Many first generation biofuels, including biodiesel, may result in remote environmental impacts, such as tropical forest clearing or increased food scarcity and prices. It is critical that overall lifecycle impacts are considered in biofuel selection. These concern have led to an increased focus on the development of biofuels generated from non-food biomass feed stocks (second-generation).

The World Bank's 2010 report, *Second-Generation Biofuels - Economics and Policies,* acknowledges that these second-generation biofuels could significantly contribute to future energy supplies, but cost is a major barrier to commercial production in the near-to-medium term. The cost of second generation biofuels can range from two to three times that of gasoline on an energy equivalent basis. The cost of biodiesel produced from second generation feed stocks, such as microalgae, is many times higher than the current price of diesel. Given the uncertainty about future technological breakthroughs that could make some second-generation biofuels cost competitive, policymakers need to carefully consider providing support to specific types of biofuels.

Biofuels' characteristics make them well-suited for reducing transportation carbon emissions. This is especially true in medium- and heavy-duty trucks and in passenger vehicles needing longer range performance. Technology developments will likely make biofuels more cost competitive with

conventional fuels in coming decades. Biofuels are a core strategy for achieving the City's 2050 GHG emissions reduction target.

C.1: Encourage Development of Biofuel Stations

Description:

A comprehensive network of publicly accessible biofuel stations will need to be developed to serve medium- and heavy-duty vehicles in the community. Given that there is currently limited adoption of this technology, there is also limited market opportunity for private companies to develop the appropriate infrastructure to support the technologic shift. Therefore, it will be necessary to encourage private sector development of biofuel stations through preferable zoning or other incentives.

Barriers:

- **Adoption and Scalability**: Biofuels are a great option for medium- and heavy-duty vehicles due to the capabilities of the technology. However, in smaller vehicle classes, the advantage of these technologies decreases. Therefore, there is a lack of incentive for large build-outs of biofuel stations.

- **Usability Issues**: Although biofuel has been around for a number of years, there are several potential usability issues, such as (1) cold weather fuel system problems due to gelling of the biodiesel, (2) unregulated quality of the fuel, (3) an adequate number of facilities, (4) staffing to collect the raw product and refine it, (5) proper transport and storage of the raw and refined product, (6) diesel vehicles needing their lines flushed and rubber hoses/filters/gaskets changed prior to using biodiesel, and (7) high maintenance costs associated with switching back and forth between diesel and biodiesel.

Precedents:

- **Chicago, IL:** Partnering with the Gas Technology Institute (GTI), Chicago Area Clean Cities Coalition, the State of Illinois, municipalities, and private companies, the City of Chicago has developed multiple alternative fueling stations, including eleven E-85 stations that are available for public and private use.

C.2: Waste-to-Biogas Facility for Fleet Vehicles

Description:

Energy generation from waste is an ideal option for any sustainable infrastructure. It converts a previously unused substance that normally requires storage and management into something with utility and value. Therefore, as technologies, infrastructure, and management of resources improve, waste-to-energy projects become increasingly viable and popular. In partnership with other jurisdictions and commercial stakeholders, the City could develop or facilitate the development of a waste-to-biogas facility on city-owned or private land for use by municipal and commercial fleet vehicles. Organizing various waste streams and collecting various waste materials in the City to generate biogas to fuel municipal and commercial fleets would enable Mountain View to utilize a previously wasted resource.

Barriers:

- **Coordination:** Many biogas facilities produce a small quantity of fuel. It may not be economically feasible to process these small quantities or transport them to a useful location. Large-scale facilities are required in order to produce enough biogas to make such an arrangement scalable or economically feasible.

- **Technology, Infrastructure, and Location:** Waste-to-energy technology is becoming increasingly popular. One major factor determining the feasibility of a waste-to-energy project for a fleet is the distance from the fleet to the biogas fueling station(s). If the distance is too great, reductions in GHG emissions may not be possible.

- **New Technology Uncertainties**: Biogas is a newer technology, and not widely available today as a replacement for gasoline vehicles. Fleet managers have similar concerns with biogas as with biofuel; see item C.1: Usability Issues.

Precedents:

- **San Francisco, CA**: Partnering with Recology, San Francisco continues to lead the nation in diverting material from landfills to achieve the highest use of all materials. Recently the City has investigated transitioning from a strategy of composting community food waste outside the City to generating biogas from the waste in anaerobic digesters within the City. Analysis indicates that from a lifecycle perspective, the use of biogas in City vehicles would reduce more GHG emissions than using the biogas for electricity and heat generation.

Chapter 4 — SOLID WASTE

This document contains potential Solid Waste implementation mechanisms that could form part of a roadmap enabling Mountain View to reach its 2050 GHG reduction target. Waste currently makes up the third largest source of GHG emissions in the City (~1.5% as of 2005), and includes emissions from waste generated in Mountain View that has been, and will be, placed in landfills (approximately 52,000 tons in 2013.). As landfilled waste decomposes, methane is generated from organic materials such as food, wood and paper. Methane is a very potent greenhouse gas, with 1 pound of methane considered to be as powerful as 25 pounds of carbon dioxide.

Although emissions from solid waste are relatively small in comparison to those from Transportation and Building Energy use, reducing the amount of waste deposited into the landfill through material reuse, reduction, recycling, and composting is an important strategy to reduce greenhouse gas emissions, particularly since the community has relatively direct control over its waste production. In addition, buying and using products generates additional emissions "upstream," which are not easily captured in an inventory. Upstream from the consumer, fossil fuel energy is used to extract the raw materials, such as wood, metals, etc. from which products are made. Additional energy is needed to transport raw materials, manufacture goods in factories, transport finished products, and transport the waste that many products become. Therefore, reducing community-generated waste, especially through "reducing" and "reusing" activities, contributes to overall greenhouse gas emission reductions.

The details below focus on a strategy of reducing landfilled waste through adoption and implementation of a Zero Waste Plan (ZWP) that identifies measures to decrease waste through increased recycling, composting and materials management equivalent to a 90% diversion rate. The strategy identifies a few potential implementation mechanisms that the City will focus on. A brief description is provided for each mechanism, followed by a list of potential barriers and precedent examples from cities where similar policies or programs exist. The ZWP is currently under development and further details, including results of a waste characterization study and community input, can be found on the City's website in the Public Works Department section under Recycling and Zero Waste.

Table 4.1: Solid Waste Implementation Mechanisms

Strategy Type	Implementation Mechanism	Estimated Cost	Estimated GHG Reduction in 2050 (MT CO2e/Year)
A) Reduce Landfilled Waste	A.1. Target Materials for Diversion	Very High over $300,000	Low 2,000–25,000
	A.2. Promote Waste Reduction and Material Re-Use		
	A.3. Explore Future Processing Technologies		
		TOTAL:	**2,000–25,000**

A) Reduce Landfilled Waste

The primary strategy to reduce GHG emissions associated with waste is to reduce the amount of waste being landfilled. The various mechanisms to implement this strategy are defined in a Zero Waste Plan (ZWP). Mountain View has already committed to preparing such a plan, as one of the goals included in the Environmental Sustainability Action Plan (ESAP) adopted by the City Council in February 2009. It is anticipated that the ZWP will be presented to the City Council for adoption in 2015.

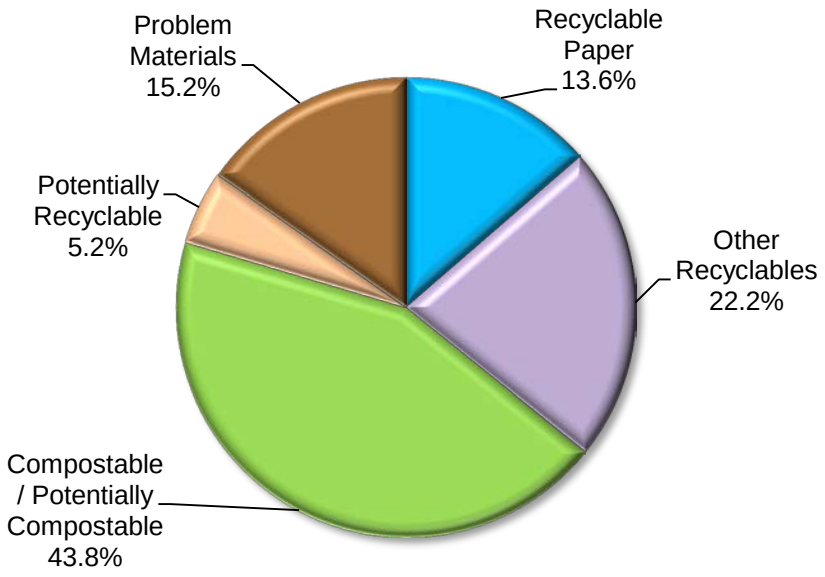
Examples of broad categories to be addressed in the ZWP are provided below, followed by a list of potential barriers and precedent examples of jurisdictions where similar policies, projects, or programs exist.

A.1: Target Materials for Diversion

Description:

In 2010, the City completed a waste characterization study to provide a detailed analysis of the types of waste being thrown away by residents and businesses. Through this analysis, the Zero Waste Plan can target opportunities for recycling or diverting waste. The study found that nearly 80% of waste (excluding construction and demolition waste) fell into the recoverability categories of recyclable paper, other recyclables, and compostable/potentially compostable; see Figure 4.1.

Figure 4.1: 2010 Waste Characterization Analysis



Since the Waste Characterization study was completed in 2010, several programs have been implemented to begin capturing more of the recyclable and compostable materials being thrown away. For example, all commercial customers in Mountain View now have access to a composting collection program that diverts food waste and compostable paper, with nearly 6,500 tons currently being diverted annually. In addition, all commercial and multi-family customers are being contacted to ensure they are recycling in compliance with State law. The City's waste hauler provides a staff person dedicated to City accounts to assist these customers in maximizing their waste diversion opportunities.

The City adopted an ordinance in 2008 mandating a minimum diversion rate of 50% for construction and demolition materials. The ordinance applies to projects 5,000 square feet or larger and requires verification of diversion efforts. Construction and demolition waste includes easily recycled materials such as concrete, stones, dirt, asphalt, wood, metal, and dry wall, as well as other not-so-easily recycled materials like insulation, carpeting, and fixtures. All construction and demolition waste collected by the City's hauler is taken to the SMaRT Station®, where it is sorted to obtain an average overall 78% recovery rate. With robust construction and demolition recycling facilities located in Santa Clara County,

it is not difficult for contractors to achieve a minimum 50% diversion rate for materials self-hauled to facilities other than the SMaRT Station.

Additional programs to further increase diversion in the future could target residential food waste, additional construction and demolition materials (especially wood since it is an organic material), special events, and mandatory residential recycling.

Barriers:

- **Cost**: Organic source separation programs increase operational and processing costs. Continuous outreach and education programs are required to maintain participation levels and can be costly, especially among transient apartment dwellers.

- **Space Constraints**: Some businesses and multi-family developments have space constraints that make it difficult to implement new source-separation programs, such as those to collect food waste.

- **Participation**: Hygiene concerns and confusion regarding the separation and collection process can lead to low participation in residential food waste programs.

- **Infrastructure**: Capacity for anaerobic digestion and organic composting must be developed to meet increased supply of organic materials. There will also need to be an expanded system for collection, transportation, and regulation.

- **Political Resistance**: It can be difficult to implement mandatory programs due to potential opposition by residents and businesses.

Precedents:

- **Portland, OR**: Since 2011, the weekly curbside collection of compost for residents has been provided with every-other-week garbage collection to discourage disposable waste. The Bureau of Planning and Sustainability helps to implement this program and provides detailed information online to inform residents about pick-up schedules as well as appropriate contents for compost. Between 2011 and 2012, three times more yard debris and food scraps were turned into compost than had previously been recorded.

  Portland also requires every garbage and recycling company that offers commercial service to offer composting collection either directly or through subcontracting, with business participation being voluntary. These requirements are part of the Portland Composts! Program.

- **San Francisco, CA**: The 2009 San Francisco Mandatory Recycling and Composting Ordinance is a local municipal ordinance requiring all residents and businesses in San Francisco to separate their recyclables, compostable organics, and landfill trash, and to participate in recycling and composting programs. It was the first municipal ordinance in the United States to universally require source separation of all organic material, including food waste.

  San Francisco monitors and enforces compliance among businesses and uses outreach and education to encourage compliance among residents. Included in this ordinance, multi-family residences of six units or more are offered a reduced-rate service. However, building owners are fined if they fail to provide tenants with adequate service and information.

A.2: Promote Waste Reduction and Material Re-Use

Description:

The most effective method of reducing the amount of waste sent to landfills is to not generate as much waste in the first place. Some examples include: reusing pallets and lumber in multiple shipping and construction applications; refilling toner cartridges; sending electronic rather than paper newsletters; using ground-up tires in the base of roadways; and making packaging design changes that use less material or use highly recyclable materials. While most waste reduction and reuse efforts are not within direct control of the City, there are policies and activities that can influence businesses and residents to make these efforts. For example:

- The City plans to implement a residential waste reduction program that will use competitions and rewards to encourage residents to reduce the amount of total waste materials coming into and leaving their homes.

- In 2008, the City Council adopted a policy supporting Extended Producer Responsibility (EPR) efforts. EPR requires producers and manufacturers to take some responsibility for the ultimate disposal of the products they make and distribute. This responsibility can encourage innovative product redesign and result in consumer pricing that reflects the true lifecycle cost of a product. Currently, most of these efforts are taking place at the State level, with recent legislation addressing materials that are historically difficult to manage at the end of life, such as paint, mattresses, and carpeting. However, regional efforts may arise that the City could participate in to address other problem materials such as batteries, pharmaceuticals, fluorescent bulbs, and excessive packaging.

- Reducing the availability or use of common materials that are not recyclable or that are cost ineffective to recycle. The recent adoption of City ordinances banning the use of single-use plastic bags at retail stores and foam food take-out containers at restaurants are examples of this strategy.

Barriers:

- **Political Resistance**: Most EPR efforts must be implemented at the State level, leaving little the City can do except expressing support for such legislation. It can be difficult to implement material or product bans at the local level.

Precedents:

- **Seattle, WA**: CleanScapes, Seattle's waste hauler, has developed an education and outreach campaign focused on overall waste reduction. The Neighborhood Waste Reduction Rewards Program rewards the neighborhood that reduces the most overall waste (garbage, recycling, organics) during the competition time period. The rewards are usually in the form of a capital improvement project voted on by the winning neighborhood.

A.3: Explore Future Processing Technologies

Description:

Since the mid 1990's, all waste collected in Mountain View has been processed at the SMaRT Station in Sunnyvale to remove recyclable materials prior to landfilling. Approximately 19% of the total waste stream is recovered in this way, and the equipment at the facility is currently undergoing improvements to increase recovery to 25% or more. Future improvements to this facility, or the use of other facilities incorporating new technologies, could further help to capture and process materials, and potentially create energy as well.

For example, waste biogas-to-energy technologies come in multiple forms that generally include processing organic material anaerobically and converting it to usable biogas. Once converted, the biogas can be used on-site for electricity generation or sent off-site for use in equipment and vehicles. These processes can also produce by-products that may have a secondary use (e.g. road construction fill) and revenue potential.

There are other conversion technologies (including thermal processes such as pyrolysis and gasification) being developed, and some will eventually become proven in the United States. One or more of these technologies may be appropriate for the post-separation waste stream in Mountain View.

Barriers:

- **Scalability, Cost, and Lifecycle Considerations**: While waste-to-energy production is appealing, it often falls short of expectations from a "lifecycle" perspective due to scalability and cost.

- **Public Opposition**: Many environmental and community groups oppose thermal technologies. Their opposition is focused on potential toxic pollution, lack of data and proven success of commercial-scale gasification projects, alleged flaws in the proposed technologies, and public health and air quality impacts.

Precedents:

- **San Jose, CA**: In partnership with the Zero Waste Energy Development Company, San Jose is processing commercial organic waste using a commercial-scale, dry-fermentation, anaerobic digester. This is the first of its kind in the U.S.

- **Monterey Peninsula, CA**: The Monterey Regional Waste Management District (MRWMD) teamed with a private corporation, Zero Waste Energy (ZWE), to develop a dry anaerobic digester for food scraps and organic materials. The digester processes organic waste into electricity and high-quality compost. The system is anticipated to process up to 5,000 tons of organic waste per year, generating 100 kW of electricity or up to 3,200 BTU per ton of biogas with 58-60% methane content. This energy will be sold to the neighboring Monterey Regional Water Pollution Control Agency.

Historic Mountain View Climate Protection Activities

Following are some of the key climate protection activities the City has implemented at a community level in the recent past.

Transportation

- Mountain View's award-winning Downtown Transit Center serves as an intermodal transit hub for pedestrian, bicyclists, Caltrain commuter rail service, VTA light rail and public transit services, and public and private shuttles. The Mountain View Caltrain stop is the third most utilized stop along the peninsula corridor.
- The City completed the 2013 Shoreline Regional Park Community Transportation Study which identified a series of transportation improvement strategies to respond to anticipated increases in employment and development in the North Bayshore Area as envisioned by the 2030 General Plan.
- In 2013, the City adopted commute mode-share targets for the North Bayshore Area:

Travel Mode	Commute Mode-Share Target
Single-Occupancy Vehicle (SOV)	45%
Transit (Public and Private)	35%
Active Transportation	10%
Ride-Sharing (Carpools and Vanpools)	10%

- Adopted the City's first Pedestrian Master Plan in 2013, a City-wide document with pedestrian-oriented policies and guidelines that builds on the City's past and current pedestrian planning efforts and provides tools for future improvements.
- Mountain View is one of five Bay Area cities along the Caltrain corridor (San Jose, Mountain View, Palo Alto, Redwood City and San Francisco) participating the regional Bay Area Bike Share Program that was launched in 2013 with 700 bicycles and 70 stations, including 70 bikes and 7 stations in Mountain View. An additional 3 stations and 300 bicycles in Mountain View have been approved and will be installed in the near future.
- Completed the 2014 Shoreline Boulevard Transportation Corridor Study to determine the feasibility, and develop a conceptual design for, integrated transit, bicycle, and pedestrian facilities in the Shoreline Boulevard Corridor from the Downtown Transit Center to the North Bayshore Area. The facilities/improvements will support the commute mode shift targets endorsed the City Council in March 2013 in response to the anticipated increases in employment and development in the North Bayshore Area as envisioned in the 2030 General Plan and required as part of the North Bayshore Precise Plan adopted in November 2014.
- The City has been awarded a second $500,000 grant to continue its Vehicle Emissions Reductions Based at Schools (VERBS) Program activities through 2016-17. The goal of the VERBS program is to reduce greenhouse gas emissions by promoting walking, bicycling, transit and carpooling to school. During the first three-year VERBS program period, age-appropriate educational programs were provided to Grade K to 12 students at all public and private schools in the City, as well as Los Alto High School. The City's VERBS consultant completed 800 programs and events for students, cyclists and parents, totaling more than 45,300 participants (includes students and/or parents participating in multiple events.

- Currently updating the City's 2008 Bicycle Transportation Plan to provide a vision, strategies and actions for improving and encouraging bicycle travel in and through the City of Mountain View.
- Development, construction and operation of approximately 15 miles of Class I bikeways/multi-use paths (Stevens Creek, Permanente Creek and Hetch-Hetchy Trails), 26 miles of Class II bikeways/on-street bike lanes, and 10.5 miles of Class III bike routes.
- Designation as a "Bicycle-Friendly Community" by the League of American Bicyclists.
- In support of its two-year (Fiscal Years 2013-14 and 2014-15) goal to improve bicycle, pedestrian and other forms of mobility and safety, the City Council committed more than $3.5 million to fund mobility-related capital projects during the two-year period.
- Launched a two-year pilot community shuttle program in January 2015 to provide new transportation options free of charge for Mountain View residents whose mobility needs have not been met in the past by existing transportation services available in the community.
- A collaboration among private employers and landowners, a new free commuter shuttle (MVgo) began operating in January 2015, and runs between the downtown train station and corporate campuses in North Bayshore and the Whisman area.

Land Use

- **2030 General Plan**: In 2012, the new General Plan focused future growth along major transit corridors in key "change areas." It includes key policy directions to implement "complete streets," highly sustainable development, among other sustainability policies.
- **Precise Plan Updates**: In late 2014, the City completed major updates to Precise Plans in the following 3 key areas, which establish development regulations that implement the 2030 General Plan.
    - **North Bayshore**: Includes a Bonus Floor Area Ratio (FAR) system that creates incentives for highly sustainable development. Identifies multi-modal improvements to the area to make biking and walking more attractive. Through Transportation Demand Management (TDM) requirements, sets an aggressive Single Occupancy Vehicle target of 45% for vehicles during the morning commute period.
    - **El Camino Real**: Establishes new development standards, land uses, and public improvements for the El Camino Real corridor to revitalize the corridor with a vibrant mix of uses and pedestrian improvements. Focuses growth near transit stops, and includes strategies for pedestrian and bicycle improvements.
    - **San Antonio**: Establishes new zoning regulations and requirements to implement the 2030 General Plan vision for the area to become a diverse regional and community destination with a wide variety of land uses and bicycle and pedestrian improvements. Identifies improvements to connect to nearby rail, transit, and bus facilities.
- **Transit Oriented Development (TOD)**: The City has created award-winning TOD projects that concentrate housing and jobs near transit and link pedestrian and bicycle pathways to transit stations and on-site services to reduce the need for cars. The City's TOD ordinance allows increased FAR for developments that meet transit-oriented development regulations.

Energy Efficiency and Renewable Energy

- Effective August 2011, the Mountain View Green Building Code (MVGBC) amended the State-mandated California Green Building Code (CalGreen) to include local green building standards and requirements for private development.

- The City developed and implemented a residential energy efficiency program (Energy Upgrade Mountain View) over 3.5 years that served over 2,000 residents and is generating approximately 700 metric tons of GHG savings annually on an on-going basis. (On average, the top quartile of users reduced their energy bills by 21%, their electric use by 22%, and their natural gas use by 19%.)
- Through the City's participation in CaliforniaFIRST, eligible Mountain View residents and businesses have been able to take advantage of low-cost financing to make "green" improvements to their properties.
- The City provides 4 electric vehicle (EV) charging stations in the parking garage under City Hall and the Center for Performing Arts.
- The Mountain View Public Library provides Kill-a-Watt power meters for check-out, enabling residents to see how much electricity various home appliances use when “on” and “off.”

Waste Reduction, Recycling, and Composting

Following are key milestone dates in the City’s almost 30-year history of solid waste activities.

- 1987: A curbside recycling program is implemented, collecting materials first in burlap bags and then switching to small, stackable bins.
- 1992: The City adopts a Source Reduction and Recycling Plan, outlining a plan to divert 25% of the waste stream from disposal by 1995 and 50% by 2000.
- 1993: The SMaRT Station opens; an innovative facility to sort through all disposed trash to recover recyclable materials prior to landfilling. The facility also processes all curbside recycling and serves as a drop-off recycling center.
- 1995: The City begins a multi-family recycling program.
- 1995: The City achieves a 37% diversion rate, exceeding its 25% target.
- 2000: The commercial recycling program is expanded and made free of charge.
- 2000: The City achieves a 52% diversion rate, exceeding its 50% target.
- 2004: The curbside recycling program is updated, replacing stackable bins with rolling split-carts.
- 2005: The City receives an award from the State for achieving an overall 74% diversion rate.
- 2009: A commercial food waste collection pilot is introduced.
- 2009: Installation of new state-of-the-art equipment at the SMaRT Station increases recovery of materials.
- 2009: The City adopts an ordinance requiring construction projects to recycle and salvage debris.
- 2013: A commercial food waste pilot program is implemented city-wide, and multi-family and commercial recycling programs are refreshed.
- 2013: The City implements a ban on single-use plastic carry-out bags.
- 2014: A conversion of the waste collection fleet from diesel to clean-burning compressed natural gas begins.
- 2014: A ban on foam food take-out containers is implemented.
- 2015: The City plans to complete its Zero Waste Plan (with a goal of achieving a 90% diversion rate) and implement a residential food waste collection pilot and waste reduction rewards program.

Water Conservation

- Since 2000, the City has given away 7,600 free water-saving devices (showerheads, faucet aerators, and pre-rinse spray valves for restaurants), provided rebates for or directly installed 4,500 low-flow toilets and urinals, provided rebates for 4,500 clothes washers and 400 sub-meters, conducted 2,300 home audits/irrigation surveys, and rebated 150 pieces of irrigation equipment and lawn conversions.
- Potable water use has decreased 15% from historical levels (FY 2013-2014 compared to the average "baseline" years of 1995-2004) due to the City's water conservation programs and various other factors.
- In 2009 the City completed installation of recycled water pipelines throughout the North Bayshore area, allowing customers to use recycled water for landscape irrigation and offsetting up to 270 million gallons of potable water annually, once conversion of eligible sites is completed.
- In 2010 the City adopted new "Water Conservation in Landscaping Regulations" for development projects, requiring the implementation of water-efficient practices.

Landscaping

Several sustainable landscape practices are utilized by the Parks & Open Space (Parks) and Forestry & Roadway Landscape (Forestry) divisions. The practices help to maintain healthy plants and turf, reduce waste shipped to landfill, and conserve water.

- **Grasscycling**: The Parks Division maintains 135 acres of turf. The turf crew utilizes a 16-foot span gang mower as well as mowers with 72, 48, 36 and 21-inch decks. All of these mowers are mulching mowers that return the cut grass to the turf. This practice has two benefits. The grass clippings returned to the turf break down over time releasing nutrients that are utilized by the turf. The practice helps to reduce the amount of fertilizer needed to keep the turf healthy. Returning grass clippings also reduces the amount of green waste generated and reduces transportation costs for that waste.
- **Compost Materials**: Using compost or mulch in planting beds, shrub beds and bare areas help add nutrients to soils as they decompose. Mulch adds to the aesthetic look of areas and helps suppress weed growth. All the mulch in Mountain View is provided by trimming operations of the tree crew. This practice is beneficial for the landscape and reduces green waste and the associated transportation costs for its disposal.
- **Central Irrigation Control System**: The Parks Division has an Internet-based irrigation control system utilized since 1993 for all park and roadway median operations. The system user downloads local evapotranspiration (ET) information on a weekly basis. Evapotranspiration is the total amount of water loss through evaporation and plant transpiration. The information is uploaded to 175 linked irrigation controllers. The controller program times are then automatically increased or decreased to replace only the water lost through ET. Use of the central irrigation control system has saved millions of gallons of water over the years. Staff also routinely troubleshoots the parks and roadway median irrigation systems to look for irrigation breaks and adjust sprinkler heads to minimize water waste.
- **Pesticide Use Reduction Strategy**: Since 2003 the City has made a concerted effort to use fewer toxic pesticides and reduce the amount of pesticides used. Pesticides are classified as Category I through III, with Category I being the most toxic. The City has made a commitment to use only safe Category III pesticides. Herbicide use has been reduced by using mulch in planter beds, around tree wells and in large bare areas in medians. Utilizing biological controls for many insect pests has also reduced pesticide use.

- **Landscape Plant Palette**: The Parks Division is aware of the need for water-wise landscaping and has incorporated this into the choice of landscape plants for the last fifteen years. Plants are selected that will thrive in our environment and have reduced water needs once established.
- **Urban Canopy Cover**: In 2015, the City will adopt the Community Tree Master Plan. The plan discusses the environment value provided by trees for the community. Mountain View currently has canopy coverage of 17.7 %. This is similar to other peninsula communities. The plan will set a twenty year goal to increase Mountain View's canopy cover by 5% from 17.7% to 22.7%. Approximately 11,000 additional public and private trees will need to be planted over the next two decades to reach this goal.
- **Green Waste Recycling**: Mountain View separates all green waste from trash. Green waste is transported to the Sunnyvale SMaRT Station and turned into compost. The compost is sold and reused in the landscape. This also reduces the amount of material going to local landfills.

Habitat Restoration

The City has conducted the following activities in the Shoreline regional park.

- **Planting and Landscaping**: For all plantings outside of the golf course and Rengstorff House Gardens, our policy is to use California native plants that are drought tolerant and can tolerate a high salt content, as we only use non-potable water within Shoreline. We place a high emphasis on habitat plants that will provide ecological services and food and shelter resources for wildlife species. Planting islands (small groupings of native plants) are placed in strategic locations to provide prime habitat for wildlife species especially in grassland areas to create different ecological habitats.
- **Removal of Non-Native Invasive Plants**: Our first line of approach is mowing to prevent non-native invasive plants from going to seed to reduce weed infestations for the following year, especially for annual weeds. We also use some limited herbicides and hand removal depending on the plant species and its location within Shoreline with respect to protected animals.
- **Wildlife Habitat**: We actively leave some areas of grassland un-mowed to provide habitat for those species that prefer taller, stratified levels of vegetation. We also place rock and brush piles in strategic areas to provide micro-habitats for wildlife species especially prey species of burrowing owls and other raptors.

Description of State and Federal Policies and Actions with Emission Reduction Potential Used within CPR Analysis

Renewable Portfolio Standard (RPS)

Renewable Portfolio Standards (RPS) requirements mandate that utilities incorporate renewable energy sources in their electricity generation so that by certain milestone years, a specified minimum percentage of energy generation comes from renewable, non-GHG-emitting sources. RPS-eligible energy sources include wind, solar, geothermal, biomass, and small-scale hydro-power. The following actions have established increasingly stringent RPS requirements for California utilities:

- **State Bill 1078 (SB 1078):** requires investor-owned utilities to provide at least 20 percent of their electricity from renewable resources by 2020.
- **Senate Bill 107 (SB 107):** accelerates the timeframe to take effect in 2010.
- **Executive Order S-14-08 (EO S-14-08):** increases the RPS further to 33% by 2020.
- **Senate Bill X1-2 (SB X1-2):** codifies the 33% requirement in State law in 2011.

Pacific Gas and Electric (PG&E), Mountain View's electricity provider, delivered 23.8% of its electricity from renewable sources in 2013.

Title 24 – Building Energy Efficiency Standards Updates

The 2013 updates to California's Building Energy Efficiency Standards improve upon the 2008 Standards for new construction of, and additions/alterations to, residential and non-residential buildings. The purpose of these standards is to ensure that building construction, and system design and installation achieve energy efficiency and preserve outdoor and indoor environmental quality. The 2013 Building Energy Efficiency Standards focus on several key areas to improve the energy efficiency of newly constructed buildings and additions and alterations to existing buildings, and include requirements that will enable both demand reductions during critical peak periods and future solar electric and thermal system installations. The most significant efficiency improvements to the residential standards are proposed for windows, envelope insulation, and HVAC system testing. The most significant efficiency improvements to the non-residential standards are proposed for lighting controls, windows, unitary HVAC equipment, and building commissioning.

Assembly Bill 1493

Assembly Bill 1493 (AB 1493, also known as the Pavley Standard), enacted in 2002, requires automakers to meet GHG emission reduction standards for new passenger cars, pickup trucks, and sport utility vehicles of model years 2009 to 2016. Manufacturers have flexibility in meeting these standards through a combination of reducing tailpipe emissions of carbon dioxide (CO_2), nitrous oxide (N_2O), and methane (CH_4), and receiving credit for systems demonstrated to mitigate fugitive emissions of hydro-fluorocarbons from vehicle air conditioning systems. The second phase of AB 1493 (Pavley II) will require light-duty vehicles with model years 2017 to 2025 to control GHG emissions. Pavley II is now part of the Advanced Clean Cars Program, which aims to address reduction in other criteria pollutants as well.

CITY OF MOUNTAIN VIEW

MEMORANDUM

Community Development Department

DATE: February 5, 2015

TO: Council Environmental Sustainability Committee

FROM: Steve Attinger, Environmental Sustainability Coordinator
Terry Blount, Assistant Community Development Director/ Planning Manager
Randal Tsuda, Community Development Director

SUBJECT: Electric Vehicle Charger Deployment Update

PURPOSE

This memorandum describes staff's progress toward researching alternatives for the deployment of additional electric vehicle (EV) chargers in Mountain View, and provides a recommendation regarding collecting fees for use of public Level 2 (L2) chargers.

RECOMMENDATION

Accept five dual-port, L2 EV chargers under a Bay Area Climate Collaborative (BACC) grant, and institute a fee for use of public L2 EV chargers in Mountain View.

BACKGROUND

At its November 18, 2013 meeting, the Committee requested staff research alternatives for the deployment of additional EV chargers in Mountain View and return to the Committee with additional information regarding:

- Growth projections for EV use.
- Costs (operating, installation, electricity).
- Funding opportunities.
- Possible locations (with a focus on City facilities) and recommended number of chargers.

- What other nearby cities are doing regarding the deployment of EV chargers.

- A recommendation regarding whether or not to charge for the electricity used.

In December 2013, staff learned of the BACC's effort to coordinate and submit a $500,000 grant application to the California Energy Commission (CEC) on behalf of local agencies in the nine-county Bay Area region to fund the deployment of additional EV charging infrastructure throughout the region. The City submitted a request to the BACC for the inclusion of five dual-port, L2 charging stations at the 850 California Street parking structure, which would enable 10 vehicles to charge simultaneously. Staff is pleased to report that BACC was awarded the grant, and staff expects to complete installation of the five new chargers by this summer.

Under the terms of the grant, the City:

- Receives five dual-port, L2 ChargePoint CT 4000 series model EV chargers, including a one-year warranty.

- Receives installation of the chargers, up to $5,000 per charger, including a warranty on labor and construction materials for one year after installation. Installation fees in excess of $5,000 per charger are to be paid by the City.

- Receives two years of quarterly charger maintenance.

- Agrees to pay a ChargePoint network services fee of $230 per year per port (a total of $2,300 per year) for two years, which covers payment processing, cloud-based charger information services, software upgrades, station programming, cellular connections, and 24/7 driver support.

- Agrees to implement a plan to optimize the use of the charging site to allow multiple EVs to use the charging equipment during a typical day, and to prohibit utilization of a charging station "beyond a reasonable period of time."

ANALYSIS

Following is the information requested by the Committee.

Growth Projections for EV Use

The increasing adoption rate of plug-in electric vehicles (PEVs) in the U.S. and worldwide has been dramatic in the last several years. The introduction of the Nissan LEAF Battery-Electric Vehicle (BEV) and the Chevy Volt Plug-in Hybrid Vehicle (PHEV) in late 2010 marked the start of truly affordable plug-in electrics, and as of the end of 2014, there are well over 285,000 BEVs and PHEVs on the roads in the U.S. from 15 different manufacturers. Growth of PEVs has been faster in their first four years than gas-electric hybrid vehicles, such as the Toyota Prius, Honda Insight, and Honda Civic Hybrid, were in their first four years in the early 2000s. Nearly 120,000 PEVs were put on the roads in the U.S. during 2014 alone.[1] Sales of PEVs in California exceeded 100,000 cars as of August 2014, and accounted for approximately 40 percent of all PEVs sold in the U.S.[2] Hybrid electric vehicles (HEV) and PEVs account for nearly 10 percent of all new car sales in California, with HEVs at 6.4 percent, PHEVs at 1.7 percent, and BEVs at 1.5 percent.[3] The San Francisco Bay Area accounts for over 42 percent of BEV sales in California, with Santa Clara County alone at over 17 percent.[4]

It is difficult to predict with precision what the growth rates of EVs will be over the next decade. Demand has been increasing steadily for four years, and investments and public statements being made by auto manufacturers, particularly Nissan, Tesla, BMW, GM, Ford, and others, lead to an expectation of continued growth. Even if one assumes modest sales growth over the next few years of 10 percent to 20 percent, the growth in the total number of EVs on the road will be high since the market is so new. There are very few aging EVs being taken out of service each year—most of the EVs on the road today are less than two years old.

Demand growth for public charging is expected to grow along with the population of EVs. While longer-range EVs may, at first glance, seem to require less public charging at destinations, longer-range EVs may in turn encourage longer trips to be made, thus, maintaining significant demand even among those vehicles. Longer-range EVs will also

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[1] Inside EVs, "Monthly Plug-in Sales Scorecard": http://insideevs.com/monthly-plug-in-sales-scorecard/

[2] Center for Sustainable Energy, "California Races Ahead in Electric Car Adoption": https://energycenter.org/article/california-races-ahead-electric-car-adoption

[3] Electric Vehicle News, "Electric vehicles account for almost 10% of Californian new-car sales": http://www.electric-vehiclenews.com/2014/11/electric-vehicles-account-for-almost-10.html

[4] Center for Sustainable Energy, "CVRP Rebate Statistics": https://energycenter.org/clean-vehicle-rebate-project/rebate-statistics

cost more to purchase, so there is likely to be a predominance of shorter-range EVs on the road, at least for the next several years. For more information on EV growth projections, see Attachment 1.

Public EV charging infrastructure supports visitors and employees, as well as nearby apartment dwellers who otherwise lack access to EV chargers.

Costs

The City estimates the following costs associated with installing Level 1 (L1) and Level 2 (L2) EV chargers in Mountain View, under the terms of the BACC grant and under circumstances where no grant money is available.

	5 Dual-Port L2 Chargers Under BACC Grant	**1 Dual-Port L2 Charger (assuming no grant funds)**	**1 Single-Port L1 Charger (assuming no grant funds)**
Chargers	Free.	$2,000 to $8,000	$500 to $750
Permitting, Striping, Signage	$3,000	$600	$600
Installation	Free up to $5,000 per charger. Costs beyond this amount, which could be up to $15,000, to be paid by City.	$2,000 to $8,000	$500 to $1,000
Operation (Network Service Fee)	$4,600 for two years.	$600 per year	N/A
Electricity	$15,000 to $20,000 per year.	$3,000 to $4,000 per year	$1,000 per year
Maintenance/ Repairs	Free for two years. Costs after two years (est. $2,500 to $5,000 per year) to be paid by City.	$500 to $2,000 per year	$500 per year

The estimated average annual cost of electricity for a charging station is $1,000 to $4,000, depending on the type of vehicles that use the charger, the utility rate tariff, and the amount of electricity used. The electricity cost, network service fee, and any maintenance costs could be fully covered by collecting hourly usage fees from users of L2 chargers. Depending on the features included, the cost of purchasing and installing

a charging station can range from $1,000 to $20,000, with installation the largest variable.

EV Charger Funding Opportunities

Including the five new, dual-port L2 EV chargers to be installed in the 850 California Street parking structure, the City's nine publicly accessible chargers were all acquired through grant funds or donation. For funding additional chargers, staff is unaware of any current grant opportunities for this purpose, but continues to monitor available sources in order to take advantage of grant funding where available.

Other EV Funding Opportunities

The CEC recently offered a grant for EV-related activities, including charging equipment, City permit process streamlining, and other EV-related activities. As it did with this grant, the City could apply for future similar grants, either alone or in partnership with other agencies.

Charger Type and Locations

Staff recommends the following approach when installing EV chargers and selecting locations.

- Prioritize installing chargers in the following locations:
  - Downtown parking locations 1, 8, 6, and 7 (see parking map in Attachment 2).
  - Community Center and Senior/Child-Care Center.
- Install about four L1 chargers for every one L2 charger.
- All other things equal, favor lowest-cost-to-install locations.
- Avoid prime parking locations.
- Avoid the roof of parking structures (due to exposure to the elements), unless the chargers are powered by solar power.

What Other Cities are Doing

Currently, the City does not require EV charging station users to pay a fee for the electricity they consume, but some nearby cities do require payment. Attachment 3 provides a summary of public EV charging stations in Mountain View and five other South Bay cities. Three of the five other cities currently collect a fee for the electricity, and the remaining two cities have stated that they intend to collect a fee for the electricity in the future. Cupertino and Redwood City collect per-hour fees, while San Jose collects a per-session fee and per-kilowatt-hour (kWh) fee. Palo Alto and Cupertino have made code changes requiring new parking facilities to be prewired for EV charging systems.[5]

Instituting a Fee for the Electricity

The City has evaluated BACC recommendations for EV charger fees, analyzed the policies of neighboring cities, and convened a community task force of EV experts. Based on this information, and as shown in the table below, staff recommends: (1) collecting an hourly fee for use of City L2 chargers; (2) increasing this fee beyond two hours to encourage turnover of vehicles; and (3) providing use of L1 chargers for free, given that they cannot easily be equipped to collect fees and to encourage EV ownership and reduction in greenhouse gas emissions. The proposed hourly fees would cover electricity, network, and maintenance costs, and the City would also install appropriate signage.

L2 Chargers	**7:00 a.m. to 9:00 p.m.**	**9:00 p.m. to 7:00 a.m.**
Up to 1 Hour	$1.50 (flat fee)	$1.50 (flat fee)
Second Hour	$1.50/hour (prorated by minute)	$0.25/hour (prorated by minute)
Beyond 2 Hours	$5.00/hour (prorated by minute)	$0.25/hour (prorated by minute)

The three existing ClipperCreek L2 chargers in the Civic Center Garage are not currently equipped to collect fees. To ensure a consistent policy, staff proposes identifying funds to retrofit these chargers to be able to collect the hourly fees proposed above. Staff estimates a one-time retrofit cost of approximately $2,000, and annual fees of $250, for all three ClipperCreek chargers. Note that these three chargers would utilize a different network system than the chargers obtained through the BACC grant.

[5] Palo Alto Online, "Palo Alto speeds ahead with new electric-vehicle requirements": http://www.paloaltoonline.com/news/2014/07/03/palo-alto-speeds-ahead-with-new-electric-vehicle-requirements

NEXT STEPS

Based on Committee comments, staff will propose to the full City Council to: (1) accept the five, dual-port L2 chargers under the terms of the BACC grant; and (2) institute a policy to begin collecting a fee for use of the City's public L2 EV chargers.

ACKNOWLEDGMENTS

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SA-TB-RT/7/CDD
816-02-05-15M-E

Attachments:
1. Electric Vehicle Growth Projections
2. Map of Downtown Parking Facilities
3. Electric Vehicle Chargers at Public Facilities—Selected South Bay Cities

cc: PWD, CDD, TBM, ACDD/PM, EDM, BDS, FFM

Attachment 1

Electric Vehicle Growth Projections

There are many factors that are expected to contribute to continued growth of the EV market, including:

- *Battery Cost Reductions* – The dominant cost associated with building EVs is the battery. The Nissan LEAF's battery was estimated to cost around $18,000 initially (2010), but Nissan now (2014) offers replacement batteries at a cost of $5500. Estimates for continued cost reductions over the next several years vary widely, but it's clear that a large investments are being made to reduce costs and dramatically increase capacity – an example is Tesla Motor's recent decision to build a $5 billion battery "gigafactory" in Nevada.
- *Public Charging Availability* – As public charging stations become more widely available, potential BEV adopters see limited driving range as a less serious drawback to owning a BEV. This becomes a virtuous circle – more public charging capacity results in more EV adopters, which in turn creates demand and funding for more chargers, and more awareness of EVs in general. Charging at workplaces has also become far more common, particularly in Silicon Valley.
- *Increasing Range* – Likely the greatest limitation to BEV adoption is the limited driving range of the affordable BEVs offered today. Most offer a driving range of around 60-80 miles. While that range is sufficient for the majority of Bay Area commutes, particularly of workplace charging is available, it can be limiting for weekend trips or errands run before or after a commute. PHEVs, like the Chevy Volt, can be a good compromise for buyers today, as they provide extended range with a gasoline engine. But as battery energy density increases and costs drop, the industry fully expects affordable BEVs with ranges of 150-200 miles within the next few years [1]. It is reasonable to expect a spike in demand in BEVs when those vehicles become available.
- *Incentives* – Government incentives such as federal tax credits, state tax rebates, and carpool lane privileges are expected to continue for at least the next few years. As these incentives ultimately phase out, the cost structure of EV manufacturing will likely drop sufficiently to compensate.
- *Gas Prices* – Gas prices are currently in decline, which could slow EV adoption to the degree that fuel cost savings is a driving factor in purchasing an EV. In the long run, gas prices will inevitably go up again, but even at current gas prices around $2.50-$3.00 per gallon, EVs have a fuel cost advantage for the vast majority of owners, depending on local electricity rates.
- *Word-of-Mouth* – Many EV owners purchased or leased their vehicle because they know someone else who has one. Once drivers see that they can live with their

[1] http://green.autoblog.com/2010/05/15/nissan-leaf-profitable-by-year-three-battery-cost-closer-to-18/

limited range, and experience the other advantages of EVs including low noise and vibration, lower maintenance cost, and peppy acceleration, they become EV converts.

- *Low Maintenance Costs* – BEVs have far fewer moving parts than ICE vehicles. They do not require oil changes, smog checks, belt replacements, maintenance of emissions control systems, etc. This advantage is particularly appealing as vehicles age.
- *Used Car Market* – as the earliest EVs come off their original 3-year leases, a market for pre-owned EVs will grow, making EVs available to a larger demographic of car buyers. The expected low maintenance cost of EVs relative to traditional gasoline vehicles will be particularly appealing in the pre-owned car market. These factors will tend to keep EVs on the road as they age, and in areas where there is good EV support, such as the Bay Area.

San Francisco Bay Area Estimates

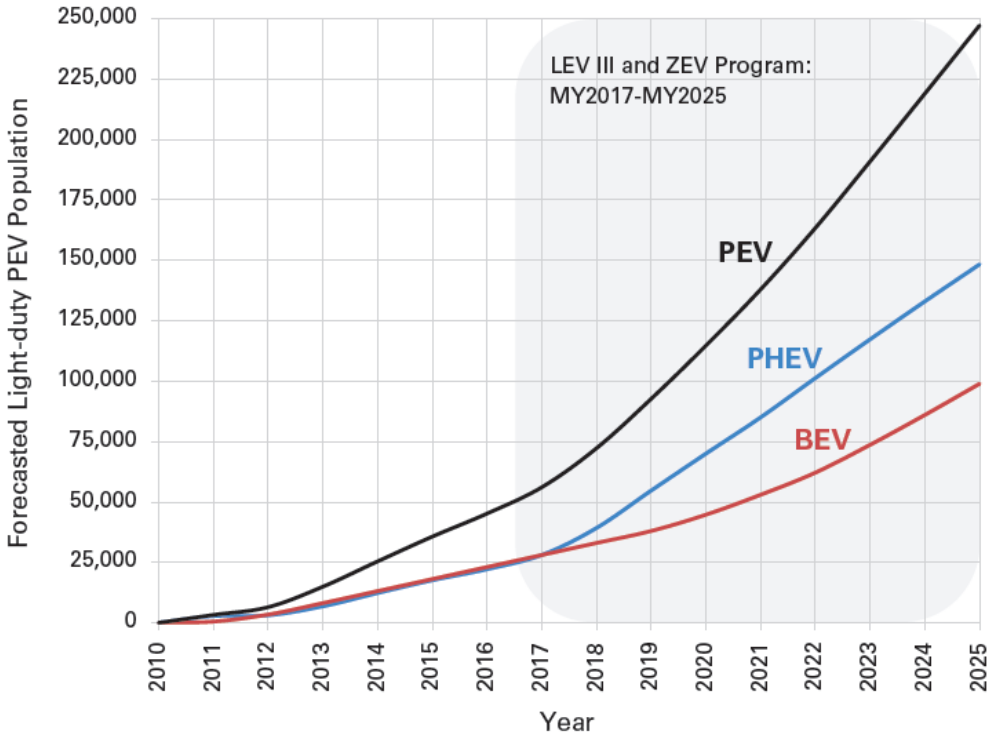


Figure 1 — Forecasted Baseline PHEV and BEV Populations (in the light-duty sector) for the Bay Area

Estimates prepared for the Bay Area Air Quality Management District show the number of EVs and required charging stations over the next 10 years. Figure 1 shows the forecasted number of EVs in the Bay Area over the next 10 years, while Table 1 shows

the projected demand for Level 1 and Level 2 charging stations needed to support the forecasted EV population.

Year	Vehicle Forecasts		Estimated Demand for L1 and L2 EVSE			Estimated Demand for DCFC
			ICF Estimates		Estimates Using EPRI Method	
	PHEV	BEV	Low	Mid		
2015	17,600	18,100	7,900	14,200	4,370	75–150 DCFC stations at 35–50 locations
2020	70,000	44,700	13,960	30,960	16,730	
2025	148,000	98,900	20,790	45,190	35,550	

Table 1 — Estimated Publicly Available Level 1 and 2 Chargers Needed to Support Forecasted PEV Population

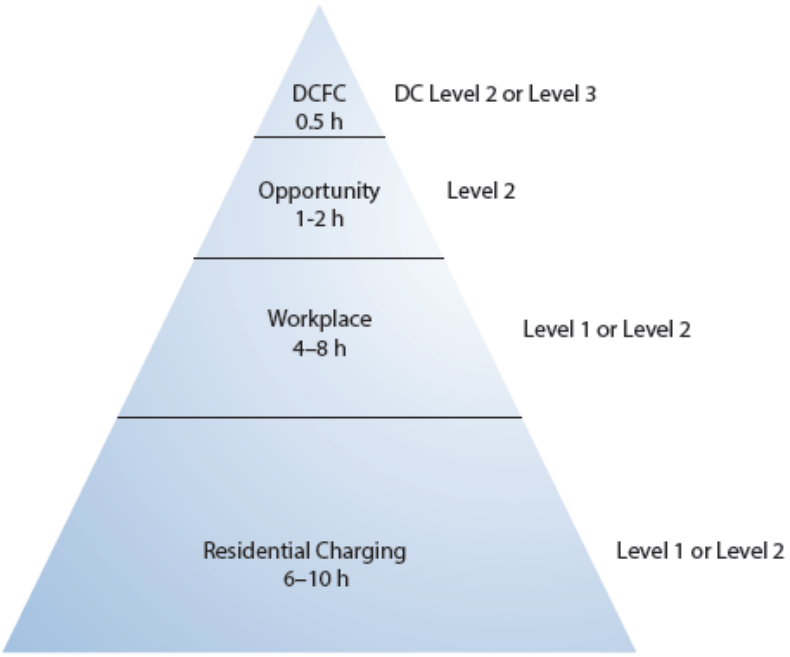


Figure 2 — Charging Triangle, By Charging Type and with Charging Level

Electric vehicle charging can be broken out into several categories, as depicted in Figure 2. As represented by the base of the triangle, most electric vehicle charging occurs at residences while vehicles are parked overnight. This may extend to regular overnight charging at public stations, if they are made available close to residences that do not have charging capability, particularly apartments and condominiums. The second most popular category of charging occurs at workplaces, where employees are generally

parked long enough to receive a significant change, utilization rates are more consistent and predictable, and funding for providing such an employee benefit is likely to be available. Workplace charging allows for much longer all-electric commutes. The third category, Opportunity or DC Fast charging at public locations, makes up the least amount of overall vehicle charging, but is critically important to enable longer trips or multiple trips between overnight charges, to encourage BEVs over PHEVs, to cover drivers when trip distances are less predictable, and to generally reduce the need for families to own and maintain a fossil-fuel-powered vehicle in addition to their PEV.

Table 2 shows typical full-charging times for several popular EVs. Charge times can vary across different trims or model years, even within the same model. Late-model Nissan LEAFs (2013 and later), for example, can fully charge at Level 2 in about three hours, as can most current BEVs.

EVSE Type	Power Source	Estimated Time to Achieve a Full Charge			
		Toyota Prius Plug-in	Chevrolet Volt	Nissan LEAF	Tesla Model S
Level 1	Typical wall outlet (120V)	3:00	7:30	15:30	37:30
Level 2	Similar to household electric dryer outlet (240V)	1:20	3:10	6:30	16:00
DC Fast	Specialized power source	n/a	n/a	00:40	00:30

Table 2 — Power Sources and Estimated Charging Times for Different Types of Chargers

ChargePoint is the manufacturer and maintainer of perhaps the most popular network-linked public charging stations in the US. Their data shows that EV owners are increasingly willing to pay to charge their EVs. Figure 3 shows this trend over the first 2.5 years of EV adoption.

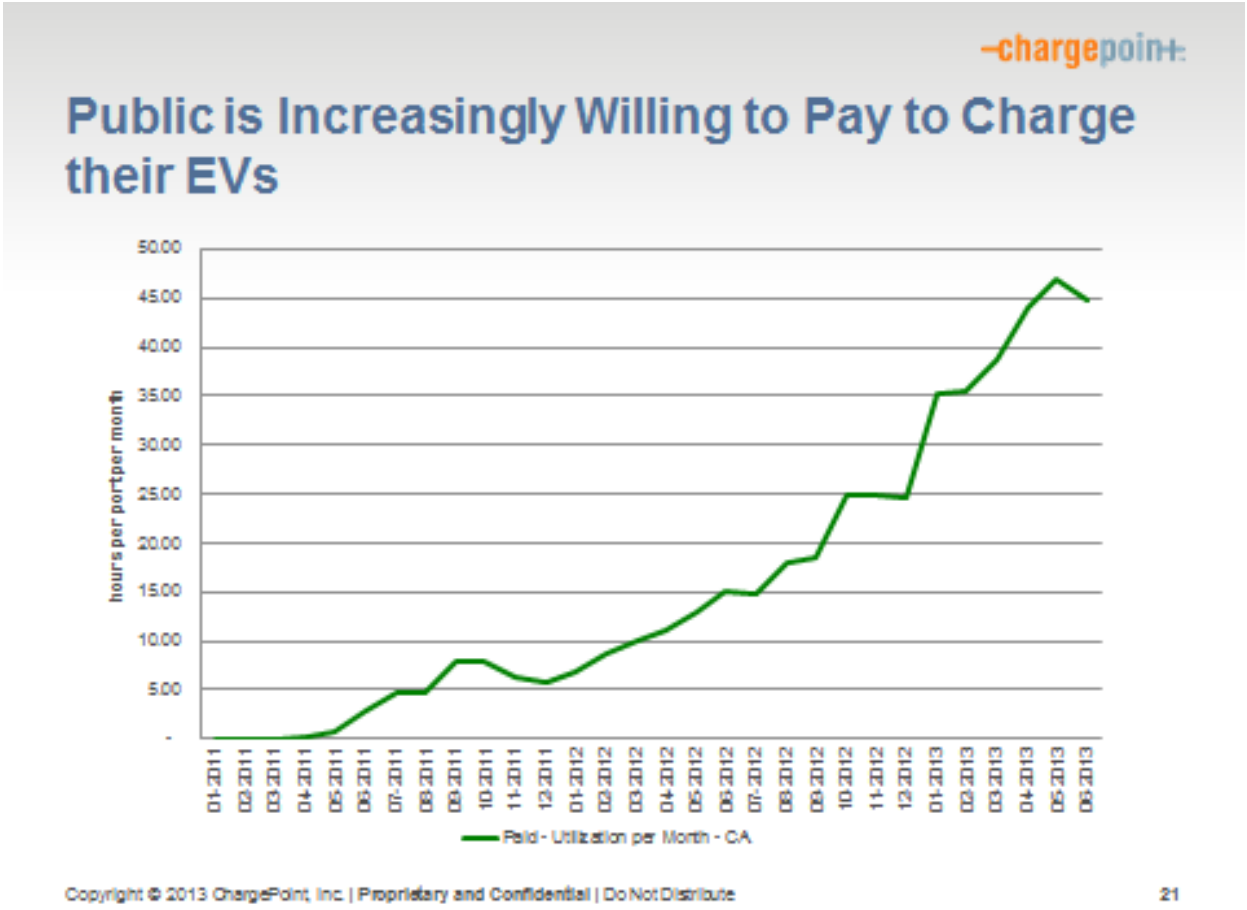
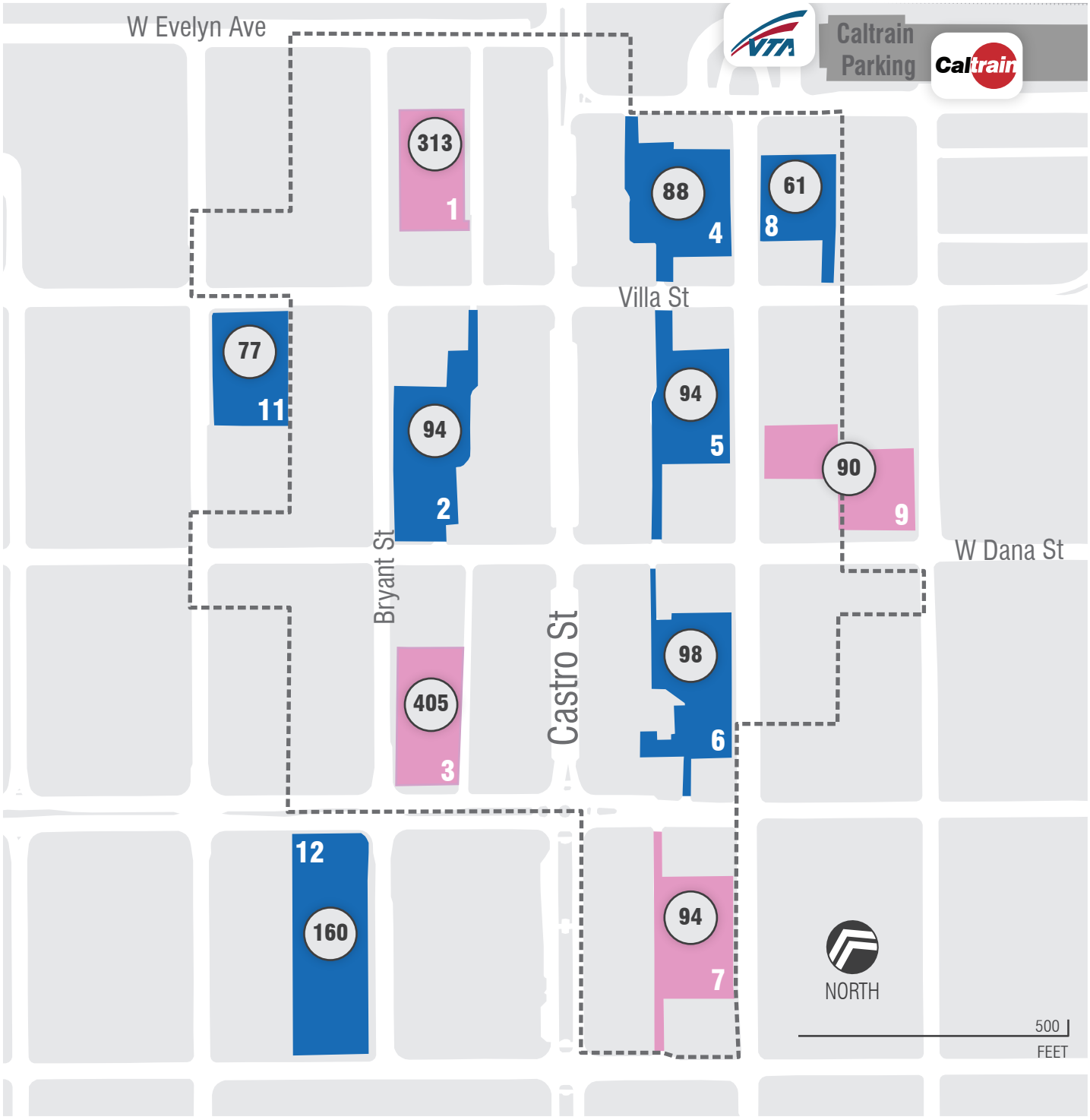


Figure 3 — Number of Paid EV Charging Hours, 2011-2013

Map of Parking Facilities in Study Area



Permit Parking

- Permit parking allowed
- Permit parking not allowed
- 160 Number of spaces in lot
- Parking district boundary
- Caltrain station
- VTA station

Electric Vehicle Chargers at Public Facilities

— Selected South Bay Cities —

City	Number of Charging Stations/Ports	Charger Type	Financing Mechanism	Fee Charged to Users	Comments
Mountain View	4/4 [1]	Level 2	Grant, donation	No	
Redwood City	12/22	Level 1 and Level 2	Grant	Yes $1.50/hour for Level 1/2 and $5.00/hour for Level 3 fast charger	In addition to the hourly rate, a 4-hour time restriction will also be implemented for all EV parking spaces.
Palo Alto [2]	10/15	Level 1 and Level 2	Grant and City funds	No	Palo Alto will charge a fee for the electricity in the future. Stanford Shopping center has one Level 3 fast-charger and the fee is $7 for 30 minutes.
Sunnyvale	1/1	Level 2	Grant	No	The charger is solar-powered. Sunnyvale is participating in the BACC BayCAP grant project and hopes to install 4 additional dual-port public chargers, and will likely charge use fees.
Cupertino [3]	1/2	Level 2	Grant and City funds	$1.50/hour	The charger averages 5 charges per day, and 130 unique users per month.
San Jose	53/80	Level 1 and Level 2	Mostly grant, but some City funds	Yes $1.25/session plus $0.25/kWh 8:30am-9:30pm; $1.25/session plus $0.20/kWh 9:30pm-8:30am	Evening pricing was instituted to facilitate EV ownership by residents of downtown complexes who don't have access to charging stations. The goal is to make the program revenue neutral to San Jose.

[1] *Electrical outlets are located next to the existing four charging stations, enabling additional electric vehicles to charge using their own charging units. Also, the City plans to install an additional five dual-port, Level 2 chargers at the 850 California Street parking structure, which will bring the total available charging ports to 14.*

[2] *Palo Alto's City Council has unanimously supported a proposal to change the city's building code to require new homes to be pre-wired to support 240v level 2 chargers. The council also backed related proposals to streamline the process for obtaining a permit for a charger and to "develop strategies to further encourage electric vehicle use in Palo Alto."*

[3] *Cupertino's City Council unanimously adopted an ordinance to require pre-wiring for electric vehicle charging systems in new buildings to lower the cost for future installation, adopting the California Building Code related to electrical vehicle charging stations, which requires:*

- *For new one- and two-family dwellings, one- and two-family dwelling rebuilds, new multi-family dwellings, and new non-residential buildings, a listed conduit such as a metal or plastic pipe, (otherwise referred to as a raceway) is required to be installed from the main building electrical panel out to the parking area. The minimal cost of installing the raceway will alleviate increased expenses of installing such wiring in the future and encourage use of electric vehicles.*

- *For new multi-family dwellings, and new non-residential buildings, at least 3% of parking spaces, but no less than one, must be capable of supporting future electrical vehicle supply equipment (EVSE). This is consistent with the lower Tier 1 voluntary requirement in the California Green Building Code. Tier 2 requires at least 5% of the parking spaces, but not less than two, to be capable of supporting future EVSE systems.*