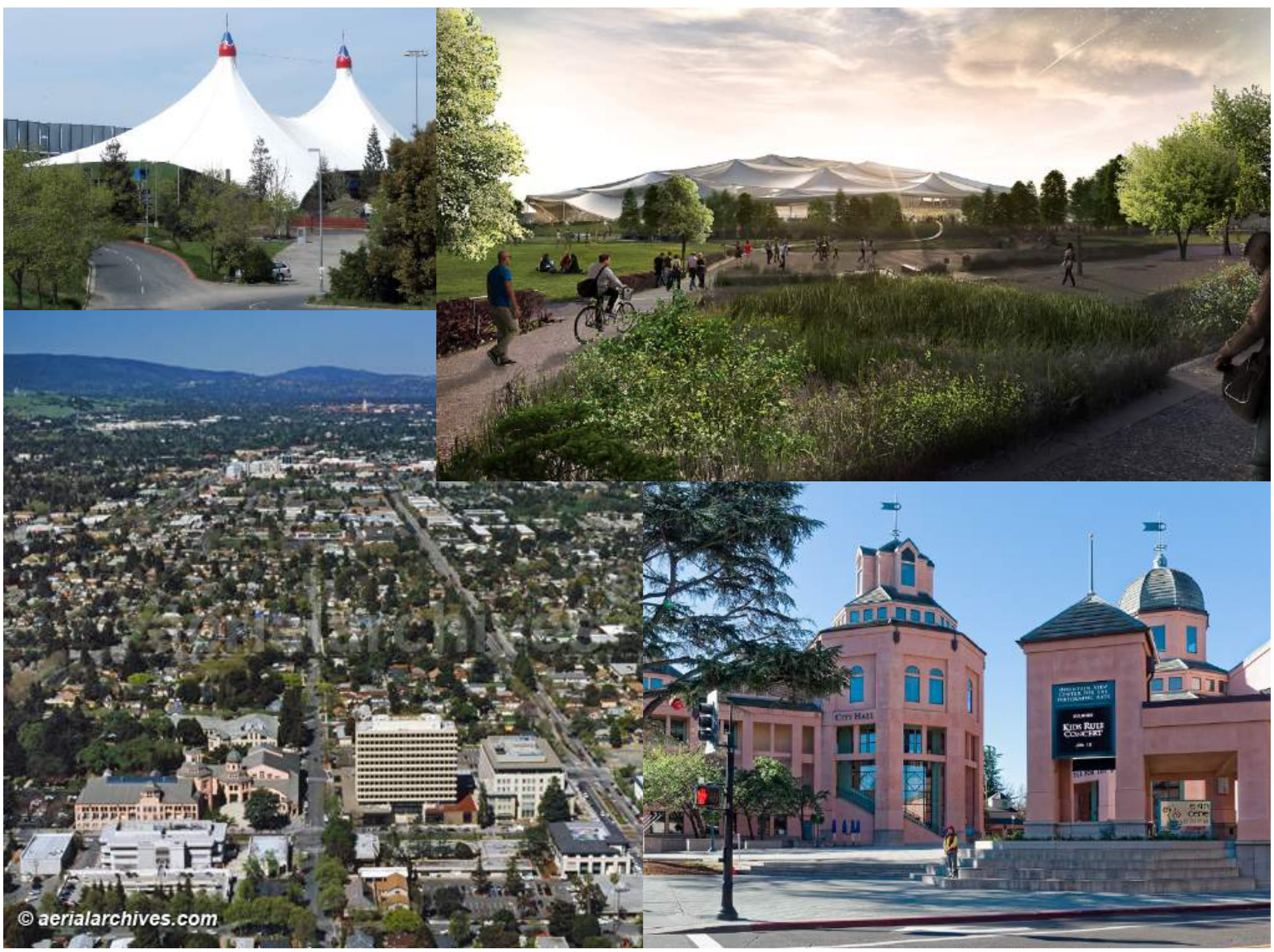
CITY OF MOUNTAIN VIEW

Final Report of the 2017-2018 Environmental Sustainability Task Force



June 19, 2018

This page intentionally left blank

Table of Contents

Acknowledgements

This report was prepared by a task force of dedicated volunteers who live or work in Mountain View. Some of us hold advanced degrees in sustainability-related disciplines. Some work in environmental jobs. For the most part, though, our task force was made of people for whom protecting the environment is a passion. Service on this task force was a labor of love. Think of this report as a gift from us to the rest of our community. We hope it is a gift that will be appreciated for many years to come.

We would like to first acknowledge the Mountain View City Council for establishing our task force in September 2017: Mayor Ken Rosenberg, Vice-Mayor Lenny Siegel, and Council members Lisa Matichak, John McAllister, Margaret Abe-Koga, Chris Clark, and Pat Showalter.

We would also like to thank, from the bottom of our collective heart, the Mountain View City staff members who have supported us throughout our work: Environmental Sustainability Coordinator Steve Attinger, Environmental Sustainability Fellow Hannah Perkins, and Environmental Sustainability Analyst Margie Suozzo.

Thanks also to these City of Mountain View employees: City Manager Dan Rich, Principal Planner Martin Alkire, Senior Planner Eric Anderson, Solid Waste Program Manager Lori Topley, Parks and Open Space Manager Bruce Hurlburt, Fleet and Facilities Manager Scott Estes, Assistant City Attorney Nicole Wright, Senior Deputy City Attorney Leslie Jensen, Economic Development Manager Alex Andrade, Assistant Public Works Director Dawn Cameron, Transportation Planner Nate Baird, Transportation Planner Helen Kim, Forestry and Roadway Manager Jakob Trconic, Deputy City Clerk Wanda Wong, Planning Secretary Linda Brooks, Transportation Manager Ria Lo, Community Outreach Coordinators Nancy Ducos, Eileen Li, Natasha Drozdova, and Nora Beltran, and the staff of the City's Document Processing Department and Historic Adobe Building.

We are also grateful for the assistance we received from Tiffany Wise-West of EcoShift Consulting, Catherine Campbell-Orrock from Berkeley's Office of Energy & Sustainable Development, Sunnyvale's Solid Waste Contract Administrator Debi Sargent, Dan Rubins of Fehr & Peers, Tim Goncharoff of Santa Cruz County, Maya Perkins and Mila Zelkha of Bay Area Forward, Bruce England and Deb Henigson of Mountain View Coalition for Sustainable Planning, Marc Peckler of Chariot, Ellie Casson of Waymo, Jeral Poskey of Google, Chelsea Marcell of the City of Fremont's Green Challenge, Sandra Slater and Sue Lebeck of The Cool Block, and Lisa Altieri of Community Climate Solutions.

We also received valuable assistance from Santa Clara County Supervisor Joe Simitian and his staff, California Codes and Standards consultant Misti Bruceri, Brian Shaw of Stanford University, Alix Bockelman of MTC/ABAG, Therese Trivedi and Krute Singa of MTC, Melanie Jacobson of ID 360, Betty Seto and Blake Herrschaft of DNV-GL, Kevin Bates of Sharp Development, Alice Zanmiller of the County of Marin, Eden Brukmiller of the San Francisco Department of the Environment, Katie Cantrell of the Factory Farming Awareness Coalition, Christine Tam of the City of Palo Alto, Rachel DiFranco of the City of Fremont, Tomonie Hood, Zero Waste and Building Coordinator for EPA Region 9, John Supp and Alan Suleiman of Silicon Valley Clean Energy, and James Tuleya of Carbon Free Silicon Valley.

Three King County (Washington) staff members were also helpful: GreenTools Program Manager Patti Southard, Solid Waste Division Representative Nori Catabay, and Built Green Program Manager Leah Missik.

We also received valuable assistance from the Mountain View Farmers Market, Heidi Chun, and the entire staff of the Chamber of Commerce, Adina Levin of Friends of Caltrain, and the staff of Assemblyman Marc Berman.

We also wish to thank all the members of the public – more than 130 of them – who attended one of our formal outreach meetings, the hundreds more who visited our booth at the Farmer's Market, Arbor Day, the Family Parade, and NASA, Google and Fenwick & West Earth Day events, and the more than 900 individuals who completed our online sustainability survey. Your knowledge, time, and passion for Mountain View's future has been invaluable to our work and has been particularly inspirational to us.

Our work has been guided by a seven-member steering committee: Bruce Karney (task force Chair), Thida Cornes (task force Vice Chair), Mary Dateo (Transportation Working Group Chair), Emily Chueh (Buildings and Land Use Working Group Chair), Jane Horton (Circular Economy Working Group Chair), IdaRose Sylvester (Outreach, Regional Collaboration, and Advocacy Working Group Chair) and Bruce Naegel (Measurement and Metrics Working Group Chair).

In addition to the five Working Groups, we were also fortunate to have had an outstanding Vision Subcommittee consisting of Jane Horton, Thida Cornes, Mary Dateo and IdaRose Sylvester.

Our report was carefully edited for clarity and consistency across our many recommendations by Jane Horton and Amber Kerr, with assistance from Ron Schafer. We thank you for volunteering to take on this daunting task and doing it so well.

We acknowledge the dedication and contribution of all the members of the task force who have not already been mentioned. Each of you made vital contributions to the work of the task force: Hala Alshahwany, Chirjiv Anand, Mike Balma, Paul Blumenstein, Cliff Chambers, Vannina Champenois, Marianna Grossman, Monica Hartono, Jada Ho, John Jensen, Ines Koch, Heather Lamont, Nirit Lotan, Kingdon Palmer, David Paradise, Varun Rathi, Amanda Rajapaksa, Ronald Schafer, Marna Schwartz, Jeff Sloan, Lauren Sparandara, Gavi Subramanian, Sarah Truebe, Peyton White, and Gema Wood.

Finally, we thank our families and friends, who have been so supportive of our long nights and our nonstop discussions on sustainability. Their support, in all forms, enabled so much of the work we have done.

Vision: Towards a Sustainable Mountain View

Welcome to the future… it's 2031!

Mountain View has changed quite a bit in the last decade by adopting a vision of an inclusive sustainable future that has improved the quality of life for all who live and work here. The City has increasingly focused its resources on implementing that vision, and now we are reaping the benefits. Housing, transportation, work, education, and leisure time drove our sustainability vision.

If we had continued business-as-usual, our streets would now be impassable. Instead, traffic flows better than it did a decade ago. Many people now live near their workplace instead of making long commutes. We addressed congestion by supporting alternate modes of transportation and improving existing transportation to better utilize the space we have. These changes helped reduce greenhouse gas (GHG) emissions and create a thriving and healthy environment where walking, bicycling, scooters, and skateboards all play a part in the transit mix. Our enhanced mass transit includes autonomous shuttles that have improved travel times.

Mountain View has advantages other communities do not have, including a carbon-free power source, a strong business base, and a highly-educated, skilled, and motivated work force. In our path to forge a better future, we took advantage of these powerful opportunities. We worked to mitigate climate change in part for the world beyond Mountain View. By demonstrating success in how to address climate change, we have become a leader in the field, and our efforts not only benefit Mountain View but had far-reaching effects.

In addressing the work/life balance that was impacted by housing shortages, we added thousands of housing units to our city. New housing is all-electric, which provides energy without increasing GHGs. We have also upgraded our existing commercial and residential buildings from natural gas to electricity. With our vision, we integrated new housing with transit centers and ensured we accommodated and encouraged electric vehicles. Our new housing is transit-friendly and affordable. Our new housing has created communities with parks, amenities, and schools, providing healthy and vibrant places to live and work in our sustainable Mountain View.

We embraced "Think globally, act locally." In 2018 there was a crisis in the recycling industry; China was no longer accepting our sorted waste to recycle, and we were at the mercy of other countries that might or might not accept materials depending on cost and space. Fortunately, Mountain View led the effort to collaborate with other Bay Area municipalities, and we now send our materials to a local recycling center where they are responsibly processed. We have reduced GHG emissions, created jobs, and can be proud of where we send our recyclables for repurposing.

By 2031, thanks to the foresight of Mountain View's residents and city government, our city has become a model of sustainability and an even more desirable place to live and work. We have shown that we can protect the environment for future generations while making life better for everyone in Mountain View.

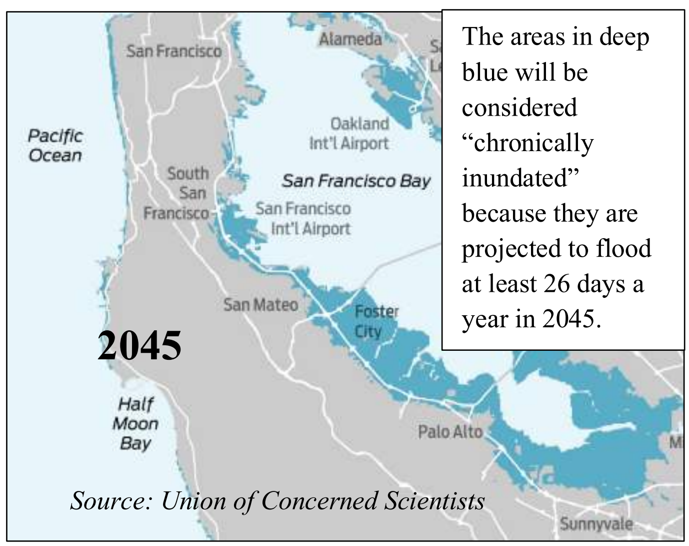
Executive Summary

Shoreline Lake at Sunrise

Shoreline Lake is one of many spectacular places to visit in Mountain View. It is open to anyone who chooses to spend time there, as are our many parks.

Cities in Silicon Valley are responding to the challenge of climate change by reimagining futures that are healthy and vibrant. Mountain View City Council has, in recent years, set a bold new direction for the City. It has implemented land use policies meant to increase housing, aid mobility, and provide infrastructure for a healthy, climate-friendly environment. It has taken a lead role regionally in the creation of Silicon Valley Clean Energy (SVCE) to bring 100% carbon-free electricity to the community. However, despite these efforts, total 2015 community-wide emissions were 9.1% higher than in 2005 (the City's "baseline" emissions year), with transportation emissions increasing from 53% in 2005 to 60% in 2015. This puts 2015 emissions levels 21% above the City's adopted reduction target of 10%, a very large gap. And, with a 2020 reduction target of 15-20%, and emissions continuing to climb, the gap will increase, causing Mountain View to fall further behind.

Additional bold action is needed to achieve Mountain View's goals of greenhouse gas reduction (**80% reduction by 2050**), sustainability, equitability, and maintaining and improving the quality of life throughout the City. Strong actions are required now, before our city population increases dramatically, so that critical changes can be implemented before we develop new large-scale housing and business projects. By ensuring that future development follows strong carbon-reduction measures, Mountain View will reduce its contribution to climate change.



The areas in deep blue will be considered "chronically inundated" because they are projected to flood at least 26 days a year in 2045.

Source: Union of Concerned Scientists

Mountain View must do its part to tackle the consequences of climate change, such as sea-level rise and flooding, which (if not addressed) will cause displacement of many of Mountain View's residents and businesses.

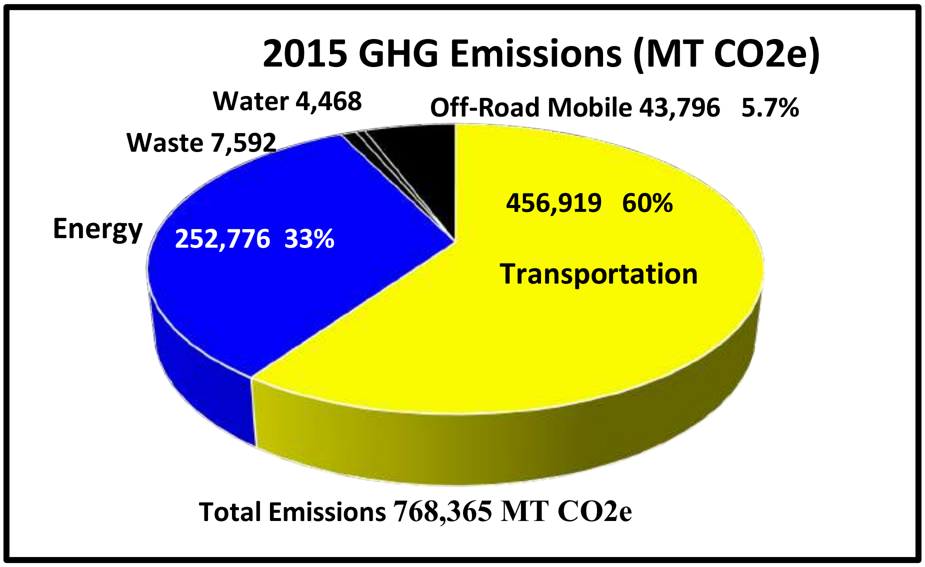
Where chronic flooding will occur: With rapid sea-level rise, if no action is taken, much of the Bay Area will be subject to flooding, and many residents will have to move, according to a new report from the Union of Concerned Scientists[1]. It will take

[1] https://blog.ucsusa.org/kristy-dahl/sea-level-rise-chronic-inundation-san-francisco-bay-area

substantial resources to prevent this, via massive projects like the Shoreline Project, which is intended to protect the shoreline of Santa Clara County.

Overview of recommendations

The chart below shows that Mountain View generated a total of **768,365 metric tons of carbon dioxide equivalent (MT CO2e)** emissions community-wide in 2015, with transportation accounting for 60% of total emissions and energy making up an additional 33%.



Our recommendations therefore focus primarily on these two key sectors (transportation and energy), but we also recommend changes in the areas of waste, water, and consumption. Many of these include behavior modifications that will have significant impact as our population increases.

Inclusion must be a consideration in all planning; we recommend achievable short-term and long-term community-wide actions to reduce greenhouse gas emissions and create a sustainable environment.

Our recommendations are in alignment with Mountain View's vision of *a thriving community where residents and businesses actively consider the environmental impact of their daily activities and strive to leave the world better than they found it*. Together, the City and community can transform Mountain View into a model of sustainable development to meet the needs of the present without compromising the ability of future generations to meet their needs. [2]

Transportation:

Mountain View's service population grew by 37% between 2005 and 2015, which drove up traffic and the resulting greenhouse gas (GHG) emissions significantly. This is particularly critical because transportation accounts for roughly 60% of Mountain View's GHG emissions.

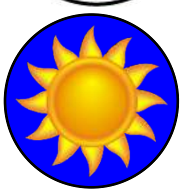
[2] https://www.mountainview.gov/depts/comdev/sustain/default.asp

Similar population growth is planned for the foreseeable future. In addition, autonomous vehicles will offer even more people the opportunity to drive alone. The resulting traffic and emissions will reduce the quality of life in Mountain View if aggressive action is not taken to provide transportation alternatives. Mountain View has many transportation initiatives underway, but we believe the city must take a more aggressive approach, both in speed of delivery, and in the range of solutions offered.

Good land use planning can help reduce driving, **but to be most effective, it needs to be coupled with good transportation options.** People cannot reduce their driving if driving is the only viable option, as it is today for most people in Mountain View.

A holistic suite of actions has been demonstrated to be effective in encouraging people to switch to alternative modes of transportation: **restrict parking**, **make transit free and convenient**, **design streets for bikes and pedestrians**, and **extensively encourage alternative commuting practices through outreach**. These actions all work together. Taken separately, they are unlikely to have the necessary impact. Together they can be transformative.

These, together with **accelerating the electrification of vehicles**, can help Mountain View to significantly reduce GHG emissions from transportation about 30% below 2005 levels, and significantly reduce vehicle miles traveled.



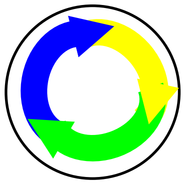
Buildings, Land Use, and Energy:

The buildings segment represents the second-largest portion of the overall GHG emissions at 33% in 2015. This segment is one of the few areas in which Mountain View has direct control over GHG emissions through its local building codes and ordinances. The number of building units is expected to increase by over 50% by 2030 so now is the time to set the standards for sustainable growth.

With the establishment of Silicon Valley Clean Energy (SVCE), Mountain View has access to a clean electric grid; now we can reduce GHG emissions from natural gas usage by creating and implementing a decarbonization policy and roadmap.

To achieve this vision, Mountain View must adopt an aggressive green-building code and expand its green-building incentives. In all new and remodeled buildings, highly efficient, GHG-free systems should be incorporated from the start. Setting specific measurable goals for Transit Oriented Development (TOD) is important to reduce emissions at the crossroads of buildings and transportation. For existing buildings, a key focus will be leveraging and promoting incentives from public and private entities. This includes expanding the EV-charging infrastructure where many private programs can accelerate success and where a special focus on multi-family environments is needed. As the City asks the community to make these changes, it's important for Mountain View City operations to lead by example with the highest standards for retrofits and new construction.

While direct emissions reductions are the focus of the task force, it's important to look holistically and work to reduce embodied emissions generated through building construction, which account for 15% of the lifetime emissions of a new building. In addition, increasing the tree canopy, promoting native vegetation and reconnecting people to nature is important for creating a healthier and more sustainable community as well as mitigating some of the worst effects of climate change.



The Circular Economy:

***Consumption*:** We recommend that a Consumption-based Inventory (CBI) be added to the methods used to calculate carbon emissions. We believe that recommendations referencing CBI measurements should be considered with equal weight as recommendations using standard city-scale GHG inventory methods.

Mountain View should collaborate with other Bay Area municipalities to find a solution to start processing our recycling domestically, instead of shipping material to recycle overseas.

***Single-use items**:* Our goal is to create a Mountain View free of single-use plastic, where sustainable options are available, and people can make conscious choices about their plastic consumption.

***Waste and Water**:* We recommend expanding the City's composting program to all residential and commercial buildings, and we recommend building anaerobic digesters that can produce energy from diverted food waste and organics.

Lifestyle: We recommend that Mountain View participate in "Green Monday," which is a global movement to encourage people to eat more plant-based foods.

***Sustainable Landscaping**:* Mountain View should encourage replacement of lawns with low-input alternatives and should incentivize a transition to zero-emissions landscaping equipment (leading by example, with city operations transitioning to zero-emission landscaping equipment by 2030).

Inclusion and Outreach:

Implementation of the ESTF-2 recommendations will require **sustained investment**, including in community outreach efforts.

90% of Mountain View residents are concerned about climate change; 67% are extremely concerned (based on the results of the Outreach, Regional Collaboration, and Advocacy Working Group online survey). Though two community forums, the online survey, and interactions with stakeholders at several other events, we discovered that the Mountain View community wants much more interaction, collaboration and information on the City's existing and future sustainability efforts.

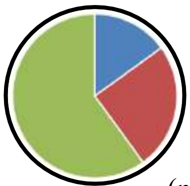
Several key recommendations serve to enable the implementation of all other recommendations:

- The City of Mountain View needs to **elevate the Sustainability Office** and increase staffing, including hiring of a high-visibility, cross-functional Chief Sustainability Officer. To succeed, the City will need internal outreach (across City departments), to help implement and enforce the recommendations, and public outreach (to all residents). Strong regional collaboration will also be essential. However, this is not obtainable under the City's present sustainability staffing levels.

- Mountain View needs to have a robust **Residential and Business Outreach Program** that empowers its residents and businesses to take action that improves their environment and the environmental sustainability of the City of Mountain View.

- Having **community engagement tools** would facilitate significant GHG reductions. Our goal is for community outreach efforts to result in 50% of households in Mountain View taking at least one action to reduce GHG emissions by 2030.

The residents have spoken. Regional collaborators have spoken. The scientists have spoken. The time is now: Mountain View needs to invest in the future.



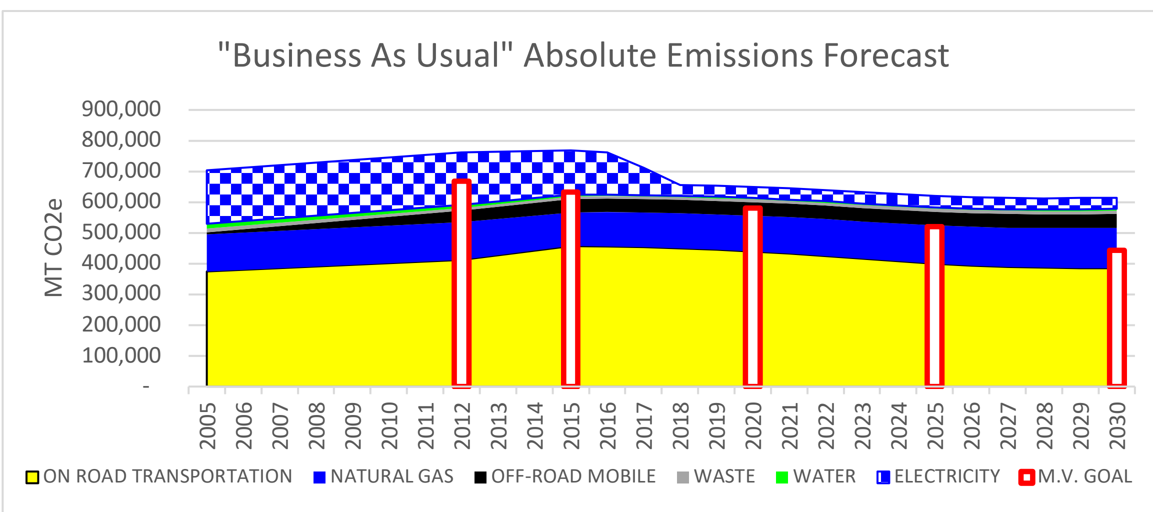
Metrics and Measurement:

The task force strongly believes that "you can't manage what you don't measure." Consequently, we recommend that Mountain View should have an emissions budget (not just a goal) for every year, not just every fifth year. We recommend that Mountain View measure its emissions every year and report the results quickly. Emissions that exceed the annual budget should be mitigated by purchasing carbon offsets.

The recommendations from the task force calculate their impact based on improvements to the Business as Usual (BAU) emission estimates. These forecasts account for residential population, workforce size, housing unit growth, office space growth, and current emissions.

Business as Usual:

The following chart shows Mountain View's expected GHGs given projected population growth, accounting for implementation of policies and projects already in place. If no additional action is taken, Mountain View's reduction targets will be missed.



Key Success Factor: Staffing

Because decisive action is necessary to meet Mountain View's GHG goals, and because the necessary action is not simple, staffing this effort appropriately is a key success factor.

When benchmarking other Bay Area cities with aggressive climate plans, we realize that Mountain View is seriously understaffed in the sustainability area. For our recommendations to succeed, adequate staff will be required. Therefore, we recommend that in the fiscal year 2018-19, three full-time employees be hired, including a Chief Sustainability Officer (CSO) and two supporting staff.

Cities and states have become the first line of defense against climate change in the US. We want our city to join with other cities in this vital effort; ongoing adequate staff is necessary to make this a reality.

Conclusion

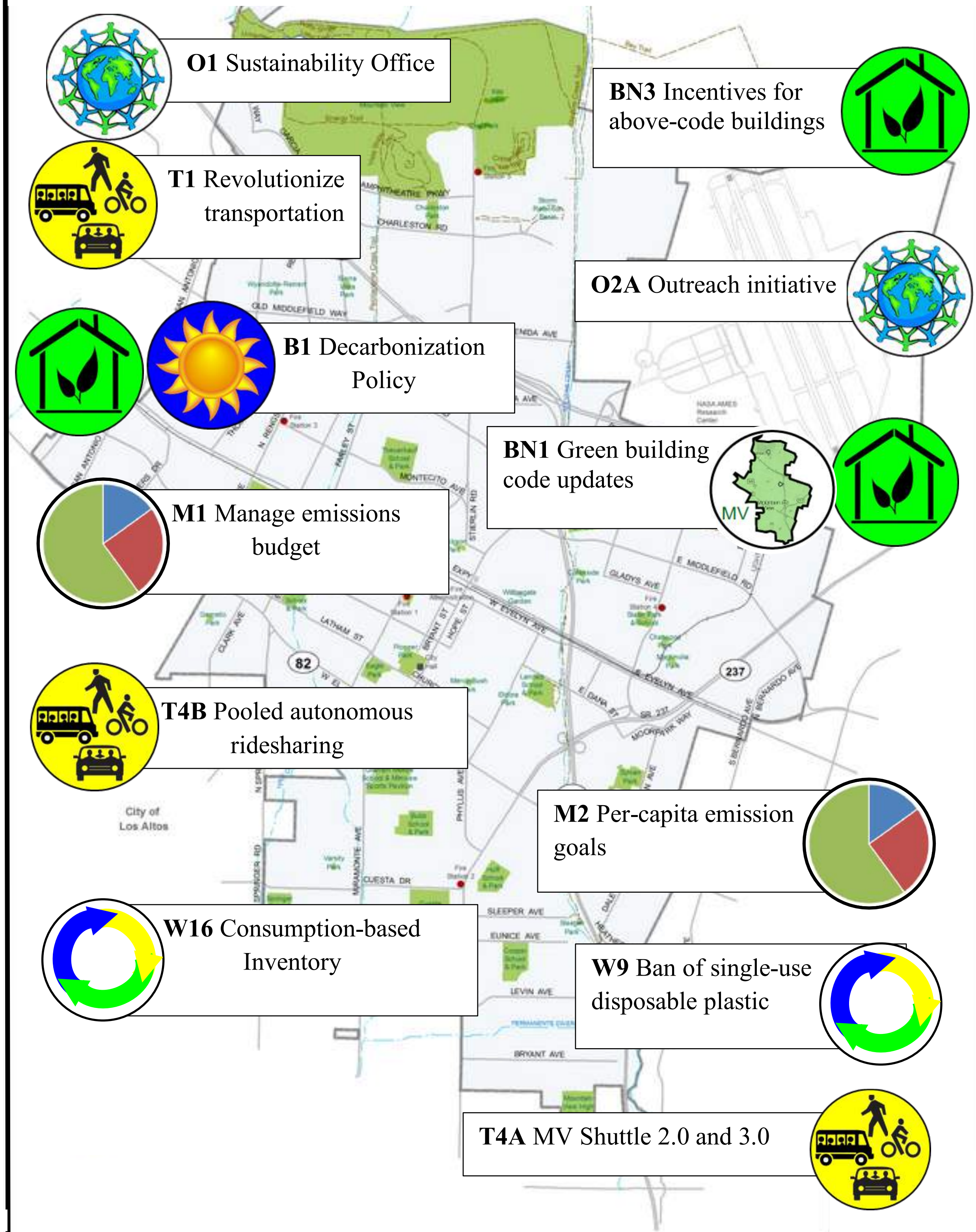
As part of our process to create recommendations, we held two community forums through which we received powerful and creative feedback, with 130 interested community members in attendance. We participated in local Earth Day events and hosted community tables at the farmers' market and other public events. Our sustainability survey had over 900 responses; our recommendations reflect the voices of people who want a sustainable future for Mountain View.

Given our position in Silicon Valley, and our history of regional collaboration, Mountain View has an opportunity to create impactful programs for emissions reduction that provide a catalyst for other communities. Given the global nature of climate change, expanding the impact of Mountain View's actions provides visibility to the community and multiplies local efforts. Now is the time for bold and innovative action while collaborating for a sustainable future.

In conclusion, after much study, community engagement, and consultation with staff and other experts, the Environmental Sustainability Task Force 2 (ESTF-2) urges City Council to demonstrate its commitment to leading on climate action by adopting these proposals in full. It will be necessary to allocate significant resources to catalyze the real changes that will make it possible to meet our GHG targets while making the community more resilient. Mountain View can be a shining example of innovation and action that other communities can emulate, as we work together to build a more equitable and sustainable region for all.

Task Force members participating in various outreach activities

Mountain View's 2030 Sustainability Vision



This page intentionally left blank

Chapter 1: Recommendation Summaries and Prioritization

Each of the five working groups began by prioritizing its own recommendations. Representatives of the working groups then met to identify the task force's twelve highest priority recommendations and to put them into rank order. Table 1 shows the outcome of this process. There are a total of 36 recommendations, so one-third of them were given highest-priority status.

Somewhat surprisingly, the recommendations with the highest priority were not necessarily those that had the biggest impact on reducing GHGs or those that had the lowest cost per MT, although some of our top recommendations score highly on one or both of those criteria. The highest-ranked recommendations often are those that are the hardest to accomplish, because we believe that if we do not get started on them right away, their benefits will not happen soon enough for the City to meet its goals.

Table 1 – Highest-Priority Recommendations

Priority	Recommendation number and name	Start
1	Create a new Sustainability Office for Mountain View **(O1)**	2018
2	Revolutionize transportation in Mountain View (**T1)**	2018
3	Adopt a decarbonization policy for buildings (**B1)**	2019
4	Manage Mountain View's emissions budget as carefully as its financial budget (**M1)**	2020
5	Solve the local solo-trip problem: Pilot discounted pooled ridesharing **(T4B)**	2020
6	Adopt a consumption-based emissions inventory for Mountain View's GHG accounting (**W16)**	2020
7	Create financial and non-financial incentives for new above-code buildings (**BN3)**	2018
8	Implement a residential and business outreach initiative **(O2A)**	2018
9	Update green building code to move towards low-carbon buildings (**BN1)**	2019
10	Set GHG reduction targets according to per capita goals based on service population (**M2)**	2020
11	Adopt a citywide ban on single-use disposable plastic foodware **(W9)**	2020
12	Solve the local solo-trip problem: MV Shuttle 2.0 and 3.0 (**T4A)**	2022

The task force members would like the Council to know that we also identified priorities for five themes that are inherent in the twelve high priorities. Recommendations within a given theme often have interdependencies, and it can be important for Council to commit to implementing all the recommendations within a theme before starting any of them. We prioritized the themes as follows:

1. Chief Sustainability Office and funding for community outreach (O1 and O2A)
2. Transportation recommendations (T1, T4B and T4A)
3. Building-related recommendations (B1, BN3 and BN1)
4. Measurement, tracking and goal setting (M1, W16 and M2)
5. Eliminating single-use plastic to achieve multiple environmental benefits (W9)

Explanation of Columns in the Recommendation Summary Tables

Table 2 provides a summary of our highest priority recommendations using these column headings:

Recommendation Number and Name: The initial letter identifies the Working Group of origin (**B** = Buildings and Land Use, **M** = Measurement and Metrics, **O** = Outreach, Regional Collaboration, and Advocacy, **T** = Transportation, and **W** = Circular Economy). The number that follows (e.g., 2, 7, 4A) is an artefact of the working group process and does not imply priority or status. The Buildings and Land Use group used an additional letter: **BN** applies to new buildings, **BE** applies to existing buildings, and **BT** applies to trees.

Recommendation type: The following terms were suggested; others may also be used: educational, incentive, fee, voluntary, mandatory, ordinance.

Duration: The number of years the recommendation will be active, or "Permanent" or "Indefinite".

MT CO2e reduced thru 2030: This is the sum of the expected annual reductions in GHG emissions through 2030 if the recommendation is implemented (as compared to the business-as-usual forecast). The measurement is in Metric Tons (MT). The "time value of carbon" is not used in this calculation. A ton of CO2e reduction counts the same no matter what year it occurs in.

City's net cost: This is the net cost to the City of Mountain View, expressed in thousands or millions of dollars. If the City realizes net savings or an increase in net revenue, then this is a negative number. To keep the math simple, we did not use net present value or inflation adjustments.

Incremental net cost: This is the net cost to residents and businesses from **new** taxes, fees, and any new building code requirements. Only net costs occurring between 2018 and 2030 are included.

Net cost per MT CO2e: The City's net cost plus incremental net cost, divided by the MT of CO2e reduction.

Easy to implement: This is a subjective assessment scored using 0 to 3 filled circles. 0 = very hard to implement this recommendation, 1 = hard, 2 = somewhat easy, 3 = easy.

Easy to measure: This is a subjective assessment scored using 0 to 3 filled circles. 0 = very hard to measure results from this recommendation, 1 = hard, 2 = somewhat easy, 3 = easy.

Private investment leverage: This is a quantitative assessment scored using 0 to 3 filled circles. 0 = no leverage of private investment, 1 = low leverage (less than $1 of private investment per dollar of public investment, 2 = medium leverage (above 1:1, but below 4:1), 3 = high leverage (better than 4:1).

Local economic benefits: This is a quantitative assessment scored using 0 to 3 filled circles. 0 = no local economic benefit, 1 = low (less than 25% of benefits will be local) 2 = medium (26-50% local), 3 = high leverage (>50% local).

Other environmental benefits: This is a subjective assessment scored using 0 to 3 filled circles. 0 = no significant benefits, 1 = modest or unquantifiable benefits, 2 = significant benefits though possibly hard to measure, 3 = substantial and measurable benefits.

Health benefits: This is a subjective assessment scored using 0 to 3 filled circles. 0 = no significant benefits, 1 = modest or unquantifiable benefits, 2 = significant benefits though possibly hard to measure, 3 = substantial and measurable benefits.

Table 2 – Summaries of the 12 Highest Priority Recommendations (in Priority Order)

Recommend-ation number and name	**MT CO_2e reduction thru 2030**	**City's Net Cost**	**Incremental Net Cost**	**Net Cost per MT CO_2e**	**Easy to implement**	**Easy to measure**	**Private investment leverage**	**Local economic benefits**	**Other environmental benefits**	**Health benefits**
Create a new Sustainability Office for Mountain View **(O1)**	Unkn.	$6.5M	$0	Unkn.	●●○	●●○	●○○	●●○	●●●	●○○
Revolutionize transportation in Mountain View **(T1)**	529K	$0	$0	N/A	○○○	●●●	○○○	○○○	○○○	○○○
Adopt a decarbonization policy for buildings **(B1)**	0	$380K	$0	N/A	●○○	●●●	●●○	●●○	●○○	●●●
Manage Mountain View's emissions budget as carefully as its financial budget **(M1)**	256K	$1.4M	$0	$5.66	●●○	●○○	○○○	○○○	○○○	○○○
Solve the local solo-trip problem**:** Pilot discounted pooled ridesharing **(T4B)**	304	$100K	$0	$328	●●○	●●○	●●●	●●○	●●●	●○○
Adopt a consumption-based emissions inventory for Mountain View's GHG accounting **(W16)**	0	$167K	N/A	N/A	●○○	●○○	○○○	○○○	●○○	●○○
Create financial and non-financial incentives for new above-code buildings **(BN3)**	18,442	$216K	$0	$11.71	●●○	●●○	●●○	●●○	●●○	●●○

Recommend-ation number and name	**MT CO_2e reduction thru 2030**	**City's Net Cost**	**Incremental Net Cost**	**Net Cost per MT CO_2e**	**Easy to implement**	**Easy to measure**	**Private investment leverage**	**Local economic benefits**	**Other environmental benefits**	**Health benefits**
Implement a residential and business outreach initiative **(O2A)**	Unkn.	$3.6M	$0	Unkn.	●●○	●○○	●○○	●○○	●●●	●○○
Update green building code to move towards low-carbon buildings **(BN1)**	54,283	$367K	$5.86M	$6.78	●●○	●●○	●●○	●●○	●●○	●●○
Set GHG reduction targets according to per capita goals based on service population **(M2)**	Unkn.	$15K	$0	Unkn.	●●●	●○○	○○○	○○○	○○○	○○○
Adopt a citywide ban on single-use disposable plastic foodware **(W9)**	22,500	$213K	Unkn	Unkn	●●○	○○○	○○○	●○○	●●●	●○○
Solve the local solo-trip problem: MV Shuttle 2.0 and 3.0 **(T4A)**	143K	$405K	$112M	$787	●●●	●●●	●●○	●●○	●○○	●○○

Medium Priority Recommendations

The remaining 24 recommendations are all classified as "Medium Priority" items. These appear in **Table 3**. *Within each column*, the recommendations are in priority order, with the highest-priority items at the top.

None of the recommendations of this Task Force should be considered "**Low Priority**." Any such recommendations were eliminated during our deliberations.

Tables 4-8 provide more detailed information for the medium-priority recommendations from each of the five working groups.

For an **overall** summary of all high- and medium-priority recommendations together, see **BCF Table 5** on the last four pages of the report.

Table 3 – Medium Priority Recommendations ("Start to implement by year" in parentheses)

Transportation	Buildings and Land Use	Circular Economy	Outreach, Collab., and Advocacy	Measurement and Metrics
Restrict parking to encourage and fund alternative modes (**T6**) (2019)	Incentivize switching residential HVAC and water heaters from natural gas to electricity (**BE1**) (2019)	Implement a sustainable landscaping program in Mountain View (**W12**) (2020)	Provide community engagement tools to facilitate household-level GHG reductions (**O2B**) (2019)	Set annual GHG reduction targets for Mountain View that decline by a constant percentage (**M13**) (2020)
Support bicycling as a primary mode of transportation (**T5**) (2018)	Measure effectiveness of housing near transit (**BN8**) (2019)	Lead collaboration among Bay Area cities to develop a solution to overseas recycling crisis (**W1**) (2020)	Conduct annual summit to review and track county, state, and federal sustainability actions (**O3**) (2021)	Eliminate emissions associated with Direct Access electricity by 2025 (**M4**) (2021)
Expand EV charging infrastructure on public property and right-of-ways (**T3**) (2019)	Adopt a revenue-neutral differential utility tax encouraging low-carbon energy use (**BE9**) (2019)	Pass a resolution to support "Green Monday" (**W2**) (2020)		Implement a knowledge resource for electrification & other sustainability actions (**M10**) (2022)
Expand transportation demand management (TDM) to all of Mountain View (**T7**) (2021)	Encourage installation of EV chargers in existing multi-unit dwellings (**BE7**) (2020)	Expand Mountain View's composting program to all residential and commercial properties (**W5**) (2020)		
Implement group-buy programs to expand personal EV adoption (**T2**) (2020)	Increase efficiency of existing buildings through voluntary programs and city ordinances (**BE4**) (2020)	Partner with Palo Alto to install anaerobic digesters to produce clean energy (**W15**) (2025)		
	Use city buildings to demonstrate leadership in electrification and energy efficiency (**BE12**) (2019)			
	Require LEED Platinum for city-owned new construction or major renovation (**BN6**) (2019)			
	Reduce embodied carbon in building construction and maintenance (**BN4**)(2020)			
	Enliven Mountain View with native plants and oak trees (**BT1**)(2019)			

Table 4 – Transportation Medium Priority Recommendations

Recommend-ation number and name	**MT CO_2e reduction thru 2030**	**City's Net Cost**	**Incremental Net Cost**	**Net Cost per MT CO_2e**	**Easy to implement**	**Easy to measure**	**Private investment leverage**	**Local economic benefits**	**Other environmental benefits**	**Health benefits**
Restrict parking to encourage and fund alternative modes (**T6**)	61,549	$135M saved	$135M	$0	●○○	●●○	●●○	●●○	●●○	●●●
Support bicycling as a primary mode of transportation **(T5)**	88,105	$28M	$0	$322	●○○	●●○	●●○	●●●	●●●	●●●
Expand EV charging infrastructure on public property and right-of-ways **(T3)**	143,000	$660K	$0	$4.62	●●○	●●○	●●●	●●○	●●●	●●●
Expand transportation demand management (TDM) to all of Mountain View (**T7**)	3,100	$1.5M	Ongoing	$440	○○○	●●●	●●●	●●○	●●○	●○○
Implement group-buy programs to expand personal EV adoption (**T2**)	16,803	$160K	$0	$5.22	●●●	●●●	●●○	●●○	●○○	●○○

Table 5 – Measurement and Metrics Medium Priority Recommendations

Recommend-ation number and name	**MT CO_2e reduction thru 2030**	**City's Net Cost**	**Incremental Net Cost**	**Net Cost per MT CO_2e**	**Easy to implement**	**Easy to measure**	**Private investment leverage**	**Local economic benefits**	**Other environmental benefits**	**Health benefits**
Set annual GHG reduction targets for Mountain View that decline by a constant percentage (**M13)**	0	$30K	$0	N/A	●●●	●○○	○○○	○○○	○○○	○○○
Eliminate emissions associated with Direct Access electricity by 2025 (**M4)**	251K	$135K	$0	$0.54	●●○	●●○	●○○	○○○	○○○	○○○
Implement a knowledge resource for electrification & other sustainability actions (**M10)**	722	$30K	$0	$38.86	●●○	●○○	●●●	●●●	○○○	○○○

Table 6 – Buildings and Land Use Medium Priority Recommendations

Recommend-ation number and name	**MT CO_2e reduction thru 2030**	**City's Net Cost**	**Incremental Net Cost**	**Net Cost per MT CO_2e**	**Easy to implement**	**Easy to measure**	**Private investment leverage**	**Local economic benefits**	**Other environmental benefits**	**Health benefits**
Incentivize switching residential HVAC and water heaters from natural gas to electricity **(BE1)**	73,100	$100K	$0	$1.37	○○○	●●●	○○○	●○○	●●●	●●●
Measure effectiveness of housing near transit **(BN8)**	18,560	$90K	$0	$4.85	●●●	●●●	●●●	●○○	●●○	●●○
Adopt a revenue-neutral differential utility tax encouraging low-carbon energy use **(BE9)**	18,279	$175K	$0	$9.60	●○○	○○○	●○○	○○○	●○○	●○○
Encourage installation of EV chargers in existing multi-unit dwellings **(BE7)**	15,614	$255K	$0	$16.30	●○○	●●○	●●○	●○○	●○○	●○○
Increase efficiency of existing buildings through voluntary programs and city ordinances **(BE4)**	70,000	$1.8M	$0	$25.71	●○○	●●○	●●●	●●●	●○○	●○○
Use city buildings to demonstrate leadership in electrification and energy efficiency **(BE12)**	820	$522K saved	$0	$637 saved	●●●	●●●	●○○	●○○	●○○	●○○

Recommend-ation number and name	**MT CO_2e reduction thru 2030**	**City's Net Cost**	**Incremental Net Cost**	**Net Cost per MT CO_2e**	**Easy to implement**	**Easy to measure**	**Private investment leverage**	**Local economic benefits**	**Other environmental benefits**	**Health benefits**
Require LEED Platinum for city-owned new construction or major renovation **(BN6)**	5,340	$634K	$0	$119	●●○	●○○	●●○	●●○	●●●	●●○
Reduce embodied carbon in building construction and maintenance **(BN4)**	29,000 (CBI)	$1.9M	$300K	$76	●○○	●●○	●●●	●●●	●●○	●○○
Enliven Mountain View with native plants and oak trees **(BT1)**	49	$180K	$0	$3,673	●○○	●●○	●○○	●●○	●●●	●●○

Table 7 –Circular Economy Medium Priority Recommendations

Recommend-ation number and name	**MT CO_2e reduction thru 2030**	**City's Net Cost**	**Incremental Net Cost**	**Net Cost per MT CO_2e**	**Easy to implement**	**Easy to measure**	**Private investment leverage**	**Local economic benefits**	**Other environmental benefits**	**Health benefits**
Implement a sustainable landscaping program in Mountain View **(W12)**	5,770	$307K	$173K	$83	●○○	●●○	●●○	●○○	●●●	●●●
Partner with Palo Alto to install anaerobic digesters to produce clean energy **(W15)**	8,304	$11.4M	$0	$275	○○○	○○○	○○○	○○○	○○○	○○○
Lead collaboration among Bay Area cities to develop a solution to overseas recycling crisis **(W1)**	Unkn.	$309K	Unkn.	Unkn.	○○○	○○○	○○○	○○○	○○○	○○○
Pass a resolution to support "Green Monday" **(W2)**	115,803 (CBI)	$78,580	$0	$0.68	●●●	●●○	○○○	●●○	●●●	●●●
Expand Mountain View's composting program to all residential and commercial properties **(W5)**	91,837	$225K	Unkn.	$2.45	●○○	●●●	○○○	●○○	●●○	○○○

Table 8 – Outreach, Regional Collaboration, and Advocacy Medium Priority Recommendations

Recommend-ation number and name	**MT CO_2e reduction thru 2030**	**City's Net Cost**	**Incremental Net Cost**	**Net Cost per MT CO_2e**	**Easy to implement**	**Easy to measure**	**Private investment leverage**	**Local economic benefits**	**Other environmental benefits**	**Health benefits**
Provide community engagement tools to facilitate household-level GHG reductions **(O2B)**	30K	$1.6M	$0	$55	●●●	●●○	●●○	●●○	○○○	○○○
Conduct annual summit to review and track county, state, and federal sustainability actions **(O3)**	N/A	$504K	$0	N/A	●●●	●○○	○○○	○○○	○○○	○○○

Chapter 2: Transportation Recommendations

Transportation in Mountain View: The Transportation Revolution

Transportation Revolution: Favor active transportation, shared rides, and electrification before solo driving.

Problem Overview

Today, for most people in Mountain View, there are no viable alternatives to driving a solo car.

Without alternatives, we cannot address the 60% of our community's greenhouse gas (GHG) emissions that arise from transportation, nor can we manage the growing congestion and threat of gridlock.

Mountain View is taking an aggressive approach to reduce its jobs / housing imbalance, which will reduce average per capita vehicle miles traveled, and per capita GHG emissions, in a substantial manner (1). However, as the North Bayshore Environmental Impact Report (EIR) clearly shows, more improvement is needed (2). Good land use planning needs to be coupled with aggressive improvements in transportation to more fully address GHG emissions and congestion. Without significant action, vehicle trips are expected to grow along with population, negatively affecting the quality of life in Mountain View (see Table 1).

Table 1. **Daily Vehicle Trips,** Mountain View Business-As-Usual

2005 (actual)	**413,000**
2015 (actual)	**566,000**
2030 (projected)	**754,000**
2030 (if 10% city-wide reduction achieved due to North Bayshore, East Whisman) (1)	**679,000**

Mountain View has a narrowing window of opportunity to make the transformation that is necessary to reverse this trend. As the inevitable congestion builds, transforming transportation will become increasingly costly and difficult. To compound the problem, autonomous Single Occupancy Vehicles (SOV) could increase traffic by as much as 50% above Business-as-Usual (3), as that technology becomes more prevalent in the very near future.

Addressing commute trips, while important, is not sufficient. In Mountain View, commute trips are expected to make up less than 1/3 of all trips, and commute miles less than half of all miles (4).

Recommendations

A holistic suite of actions has been demonstrated to be effective in encouraging people to switch to alternative modes of transportation: restrict parking, make transit free and convenient, design streets for bikes and pedestrians, and extensively encourage alternative commuting practices through outreach. These actions all work together. Taken separately, they are unlikely to have the necessary impact. Together they can be transformative.

These, together with accelerating the electrification of vehicles, can help Mountain View to reduce GHG emissions from transportation about 30% below 2005 levels, and significantly reduce Vehicle Miles Traveled (VMT).

The default mode of transportation today is single-occupancy vehicles. Enabling and convincing people to adopt other transportation modes will require significant change to infrastructure, as well as significant cultural change. In the short term, incentives and extensive outreach will be needed to encourage people to try new modes of transportation. Those incentives provide value to everyone, both to the new-mode adopters, and to people who continue to drive, by reducing congestion for everybody.

In addition to the significant reduction of GHG emissions, the measures we are recommending will improve quality of life and health, by reducing congestion and making streets safer and more pleasant for walking and biking. They will also improve community vibrancy and resilience by creating more shared social spaces, such as dedicated pedestrian space downtown, and conversion of surplus parking to wider sidewalks, more trees, and parklets.

Recommendation Overview and Prioritization

Priority	We recommend to the MV City Council that Mountain View:	Start Year
1	Revolutionize transportation in Mountain View **(T1)**	2018
2	Solve the local solo-trip problem: Pilot discounted pooled ridesharing (**T4B)**	2020
3	Solve the local solo-trip problem: MV Shuttle 2.0 and 3.0 (**T4A)**	2020
4	Restrict parking to encourage and fund alternative modes (**T6**)	2021
5	Support bicycling as a primary mode of transportation **(T5)**	2018
6	Expand EV charging infrastructure on public property and right-of-ways **(T3)**	2019
7	Expand transportation demand management (TDM) to all of **Mountain View (T7)**	2021
8	Implement group-buy programs to expand personal EV adoption (**T2**)	2020

Explanation of Recommendations for Shared Transportation: T4A and T4B

Recommendations T4A and T4B both describe options to providing shared transportation. In the long term, we believe they each will lead to a future that includes the use of large autonomous high-occupancy vehicles (HOV).

Large autonomous HOV offer a promise of providing transportation at a much lower cost than traditional buses, with potentially more schedule and route flexibility, which could revolutionize public transit. However, safety must be demonstrated and the necessary regulations for large autonomous HOV developed, so these will not be available for some years. In the short term, Mountain View must offer improved shared transportation alternatives. This could be via piloting small shared-ride autonomous vehicles (T4B), or via more conventional shuttles, first piloted via crowd-sourced shuttle routes (T4A).

Due to the urgent need to address shared transportation, we recommend that the city pursue the pilot phases as described in both T4A and T4B. Both approaches capitalize on newly available technology. Each approach has features that may appeal to different segments of the population. Via the pilots, the city will be able to demonstrate demand, better assess the best path to offering HOV transportation, and lay the groundwork for expanding to larger autonomous vehicles, potentially used over greater distances, as they become available.

Footnotes / References

1. Increasing Density and Mixed-Use Development

Business-as-Usual (BAU) numbers in Table 1 are based on the BAU calculations in the BAU Appendix of this document.

With the land-use changes in North Bayshore, a 20% reduction in trip generation there is expected, and East Whisman is expected to be similar, per Dan Rubins of Fehr & Peers, in a presentation to ESTF-2 on 12/7/2017. Numbers are not yet publicly available for East Whisman, but even if the two areas combined ultimately make up 50% of Mountain View's service population, *which seems unlikely given the growth in other parts of Mountain View*, that reduction would reduce total VMT from BAU growth by 10%. It is important to note that a VMT reduction in N. Bayshore / E. Whisman of 20% **is dependent on providing transportation options other than driving, in addition to incorporating mixed-use land development**, per Dan Rubins. This is echoed in a recent set of studies confirming that public transportation is a key ingredient, together with increasing density and mixed-use development, in reducing VMT:

Sarah DeWeerdt, "Urban density alone won't get Americans out of their cars ", (Daily Science, Dec. 26, 2017) URL: http://www.anthropocenemagazine.org/2017/12/its-going-to-take-a-lot-more-effort-to-get-americans-out-of-their-cars/

2. North Bayshore EIR

"**Impact GHG-1:** Under the 2030 full buildout under the amended North Bayshore Precise Plan, annual service population emissions of CO2e/yr./service population would exceed the City's established GGRP threshold of 4.5 MT of CO2e/year/service population for the Precise Plan area changes and would also exceed the mid-term 2030 target under SB 32. This impact is, therefore, significant."

City of Mountain View, *North Bayshore Precise Plan Final SEIR* (November 2017), p.133.

3. Threat or Opportunity: Imminent Technology Changes

Autonomous vehicles are expected to be available for public use within the next decade. Autonomous single-occupancy vehicles (SOVs) are a significant threat. People who previously could not drive will be able to do so. In addition, autonomous vehicles offer the possibility of zero-occupancy vehicles, if people send them on errands, or return them to their home parking place in between trips. Autonomous vehicles could increase VMT by as much as 50%, per Dan Rubins of Fehr and Peers, in a presentation to the ESTF-2 task force on 12/7/2017.

Shared-use autonomous vehicles offer an enormous opportunity to reduce VMT, by reducing the cost to provide (HOV) transportation, and by potentially making trips more flexible for users than regular transit.

However, the default mode of transportation today is the SOV. It will take a significant culture change to encourage people to switch modes of transportation.

4. For estimates of Mountain View's commute trip and mile percentages, see the References section of Recommendation T1.

Revolutionize transportation in Mountain View (T1)	Policy	Ongoing
Recommendation name	Type	Duration

529,087*	$0	$0	n/a	○○○	●●●	○○○	○○○	○○○	○○○
MT CO2e reduction 2018-2030	City's Net Cost	Incremental Net Cost	Net cost per MT CO2e reduction	Easy to implement	Easy to measure	Private investment leverage	Local economic benefits	Other environmental benefits	Health benefits

** Total CO2e saved by the Transportation recommendations that are enabled by this recommendation.*

Problem description

Transportation causes nearly 60% of Mountain View's greenhouse gas emissions. As the service population has grown, GHG emissions have risen along with the number of daily vehicle trips.

T1 Table 1. **Business as Usual** **Mountain View Daily Vehicle Trips** *(based on BAU, see BAU Appendix of document)*	
2005	413,000
2015	566,000
2030 projected	754,000

Reducing vehicle trips is critical to address not only GHG emissions but also congestion; there is not enough space on Mountain View's roads for the growing number of vehicles.

The GHG and congestion problems may worsen further if autonomous single occupancy vehicles (SOV) become common; people who previously could not drive will be able to do so. (1)

Electrifying 100% of vehicles would address the GHG problem but does not address congestion.

Mountain View is studying high-occupancy vehicles for North Bayshore. While that area is expected to grow significantly, per the 2030 General Plan it will hold only 25% of Mountain View's service population (T1 Figure 2.) Other areas of the city have already grown significantly and continue to grow.

Therefore, addressing traffic in North Bayshore alone is not sufficient to address the problem.

Addressing commute trips, while important, is not sufficient. Mountain View commute trips are expected to be less than one-third of all trips, and commute miles less than half of all miles (2).

Mixed-use development is expected to reduce the number of vehicle trips per person, but that only has significant impact if implemented in conjunction with good transportation alternatives.

To reduce the number of vehicles on the road, there need to be good transportation alternatives. **In Mountain View today, most people have no practical alternatives to driving.**

The Transportation recommendations together target switching approximately 30% of SOV trips and increasing the rate of vehicle electrification by about 50% – a very aggressive, but realistic, goal.

Recommendation

To **switch 30% of all trips away from SOVs** requires giving people good transportation alternatives. A **holistic suite of measures** is needed to reinforce the necessary behavior change. Evidence from other localities shows that restricting parking, making transit free and convenient, designing streets for bikes and pedestrians, and extensively encouraging alternative commuting practices through outreach all work together. Taken separately, they are unlikely to have the necessary impact. Together, they can be transformative.

Several actions are needed to make significant progress on this ambitious suite of measures by 2030.

1. **Set a clear direction for the city government to fully develop biking, walking, multi-passenger electric transit, and EV infrastructure throughout the city within the next decade**, so that these modes become attractive and preferred alternatives to driving alone, with the goal to

- switch 30% of all trips to alternative modes of transportation by 2030, by improving transit and biking, restricting parking, and encouraging alternative modes (Recommendations T4A, T4B, T5, T6, and T7, respectively)
- drastically accelerate adoption of electric cars and bikes (Recommendations T2 and T3) by 2030.

How: Make it clear within the upcoming Comprehensive Modal Plan (3) that the city must enable travel alternatives that reduce GHG emissions and SOV vehicle-miles traveled.

2. Accelerate our efforts to significantly upgrade both infrastructure and outreach.

Mountain View has many plans for bicycle and pedestrian improvement (4); a small number have been implemented. The Comprehensive Modal Plan is about to start. Some shuttles are in place, some outreach is performed, and a limited number of EV chargers have been installed. However, the pace of implementation needs to speed up to meet our GHG goals and to forestall the worst of the imminent congestion.

How: Assign sufficient resources (staff and/or contractors) to accelerate the process.

3. Redirect city resources from a vehicle focus to a new focus on alternative modes of transportation and electrification. City resources include:

- Use of public property / public space, i.e. roadways and parking
- City staffing assignments, including public works, planning, and traffic enforcement
- City development codes
- Transportation funding and project prioritization.

How: Incorporate metrics into organizational goals that support travel mode switching.

4. Provide sufficient funds.

How: Parking restrictions (Recommendation T6)

City-wide TDM requirements (Recommendation T7)

Public/private partnerships (Recommendations T2, T3)

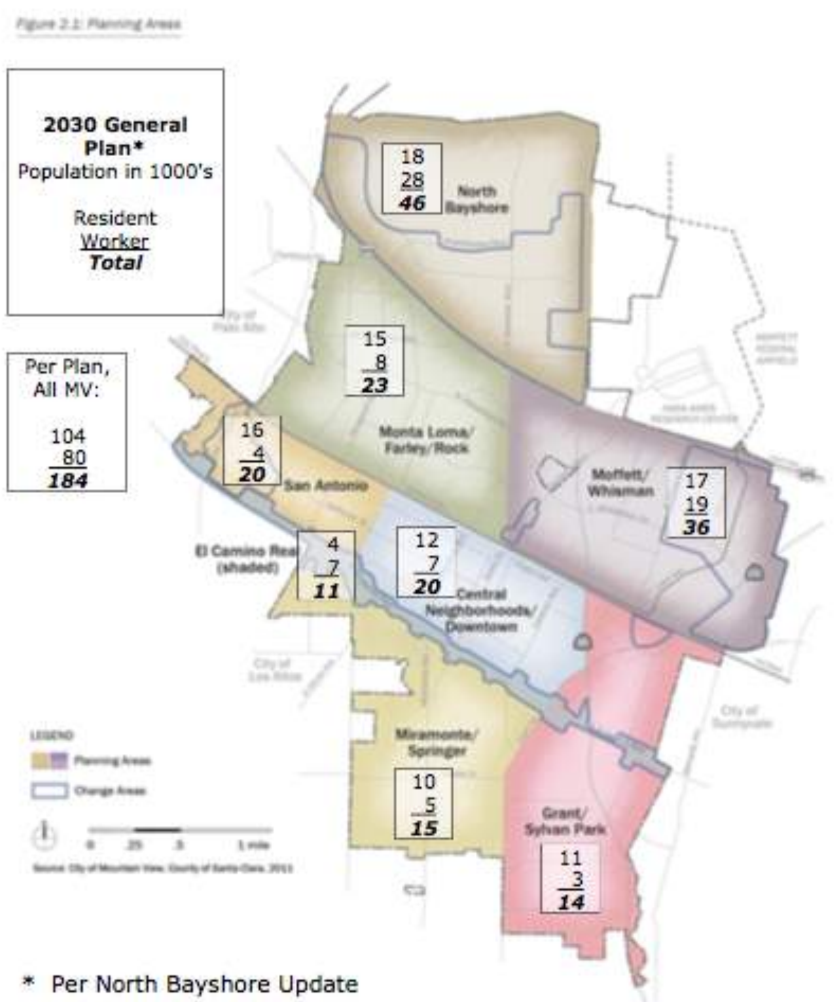
Additional staff we recommend hiring will have time to apply for grants and leverage financial resources from sources including BAAQMD, MTC, CalTrans, and Strategic Growth Council

Municipalities where already implemented Stanford, Emeryville, Vancouver, B.C.

Funding sources Grants will offset the cost of additional staff / consultants.

Assumptions with Low Uncertainty: Congestion will increase with population unless action is taken.

Author Mary Dateo



T1 Figure 2. 2030 Population by Planning Area, per 2030 General Plan with North Bayshore Update

NOTE:

North Bayshore is projected to hold only 25% of entire population.

Central MV + San Antonio + El Camino combined, like North Bayshore in size, are projected to grow to 51,000 people, more than North Bayshore.

2016 actual service population is 170,000, approaching the General Plan number of 184,000, *even before significant building in North Bayshore has begun*.

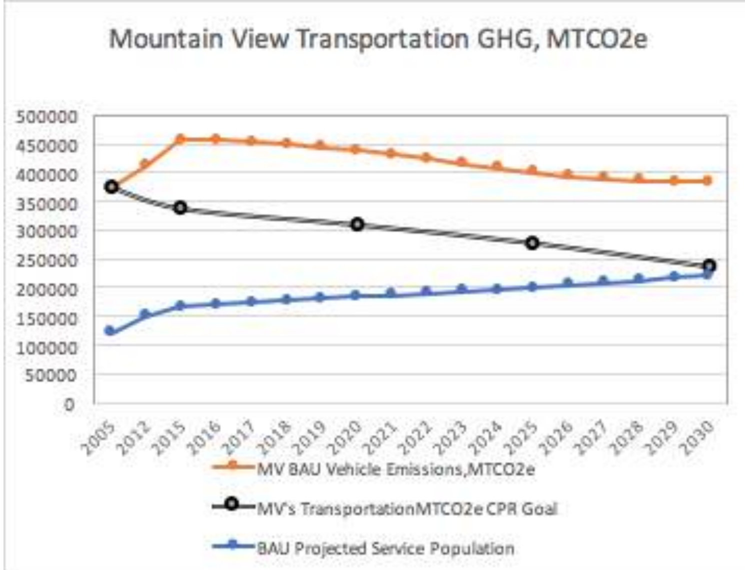
Detailed analysis

Environmental analysis

Business-as-Usual Projection:

ESTF-2 has adopted a service population growth projection through 2030 that is shown in T1 Figure 4. Based on that population growth, T1 Figure 3 also shows the resulting GHG emissions from the increased Light Duty Vehicle traffic, i.e. cars and small trucks.

GHG emissions are expected to begin decreasing, due to federal and state fuel efficiency standards, but not enough to reach the city's 15% (shown) or 20% reduction goal for 2020, or the 37% reduction goal for 2030.



T1 Figure 4. Business as Usual Population Growth and Greenhouse Gas (MTCO2e)

Assumptions:

- Vehicle miles traveled will grow proportionally with population increase.
- Vehicle miles will be the same per capita for both service and resident population.
- EMFAC data was used to estimate the resulting GHGs.

Taken as a whole, the Transportation recommendations will move Mountain View significantly (approximately 30%) toward achieving the 2030 goal of a 37% reduction from 2005 levels. Savings will be addressed in specific recommendations.

Total GHG MT CO2e savings for T1 are based on the sum of all the transportation recommendations, as follows:

T2: 16,803

T-3: 143,000

T4A and T4B: 216,530 MT

The goal is to ramp up local HOV transportation to replace a significant number of single occupancy vehicle miles by 2030. T4A and T4B both propose pilots for future local high-occupancy vehicle (HOV) transportation, and then ramping up once success is demonstrated. The city is encouraged to pursue both pilots, to determine the best way forward. The combination of the two options is expected to save a maximum of 216,530.

T4A: 143,000

T4B pilot: 308. If it ramps up fully as described in its Detailed Analysis section, instead of ramping up T4A, the full program would save 216,530.

T5: 88,105

T6: 61,549

T7 3,100

Total GHG savings for all the transportation recommendations: 529,087

In addition, the recommendations will help address congestion, and support Mountain View's 2017 Goal 3: "Develop and implement comprehensive and coordinated transportation strategies to achieve mobility, connectivity, and safety for people of all ages."

Additional opportunities exist for further transportation GHG reduction; it was beyond the bandwidth of the task force to pursue every possibility.

Additional Opportunities

- Leverage success of Large Autonomous Vehicles
  - Large Autonomous Vehicles, once proven, could greatly expand VTA's ability to provide service
  - Further explore potential services such as to BART, Highway 85 corridor, nearby cities, East Bay
- Electric bikes expected to take off
- Medium and Heavy-Duty Vehicles were not studied as part of this effort
- Employers restrict parking
- Build on behavior change initiated by these recommendations to reach 2050

In addition, transit-oriented development and mixed-use development are expected to significantly reduce per capita vehicle-miles traveled, especially when combined with measures such as the Transportation recommendations.

Cost analysis

The Comprehensive Modal Plan is in the process of having the RFP written, so changes to that plan can still be incorporated. Setting measurable organizational goals is assumed to be part of routine management processes.

Time spent increasing staffing is assumed to be part of routine management processes. The staff time needed to implement the specific recommendations is addressed in each of those recommendations.

SWOT analysis

Strengths:

- Mountain View's many strong plans for bicycles and pedestrians, including the Bicycle Transportation Plan, the Mountain View Transit Center Master Plan, the Pedestrian Master Plan, the Pedestrian and Bicycle Components of the North Bayshore Precise Plan, and the California / Escuela / Shoreline Complete Streets Feasibility Study
- The to-be-developed Comprehensive Modal Plan
- Mountain View's Automated Guideway Transit studies
- Willing partner in Google, which has drafted an aggressive Google Bicycle Plan
- VTA Google North Bayshore Transportation Access Study – Draft

Weaknesses:

- Constrained staff time
- Constrained funds

Opportunities and co-benefits:

- Congestion Reduction: alternative modes of transportation take less space than driving and parking a car.
- More customers will be able to reach shopping districts, since cycling and transit will not be limited by available parking space
- Builds on the city's 2017-2019 Goal 3: "Develop and implement comprehensive and coordinated transportation strategies to achieve mobility, connectivity, and safety for people of all ages."
- Millions of dollars of cost avoided to add new parking spaces
- Reduced particulate pollution, which causes morbidity and mortality
- Health benefits of active modes of transportation
- Traffic safety benefits that tend to result from strategies to increase transit (5)
- Higher correlation of happiness to biking and walking than to driving (6)
- Cost avoidance of owning a car, for residents / visitors
- Improved equitability of transportation

Threats:

- As roads become increasingly congested from population growth and autonomous SOV, resistance to re-purposing capacity will grow. Reallocating resources to add more capacity for bicycles, pedestrians, and transit is likely to face resistance. The resistance to VTA's proposed Bus Rapid Transit on El Camino Real is a recent example. It will be critical to make significant progress quickly.
- Ingrained driving habits.
- The EPA is considering easing the Corporate Average Fuel Economy (CAFE) standards for improved gas mileage. The GHG that would have been saved by the higher CAFE standards would need to be achieved via other means.

Municipalities where already implemented

"Stanford's investment in its programs and bicycle-friendly infrastructure has caused its share of commuters bicycling to work or school to nearly double over the last 15 years…20% of Stanford commuters bicycle to campus." (7)

Stanford reduced its drive-alone percentage from 67% in 2003 to 43% in 2017. (8)

Stanford and **San Francisco** both have over 45% of commutes via transit / bicycling / walking.
Palo Alto is currently over 20%; Mountain View is at only 14%. (9)

Netherlands, Germany, Denmark: each of these has demonstrated a significant increase in bicycling and other alternatives to solo cars within a 10-15-year period. (10)

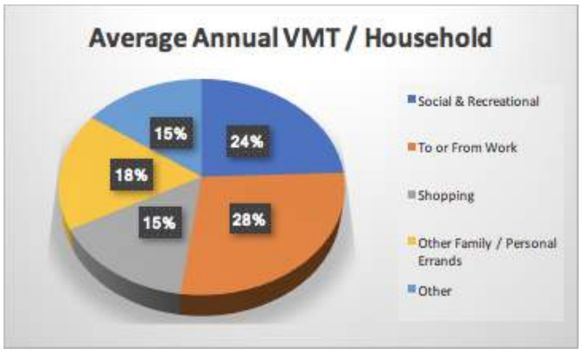
T1 References

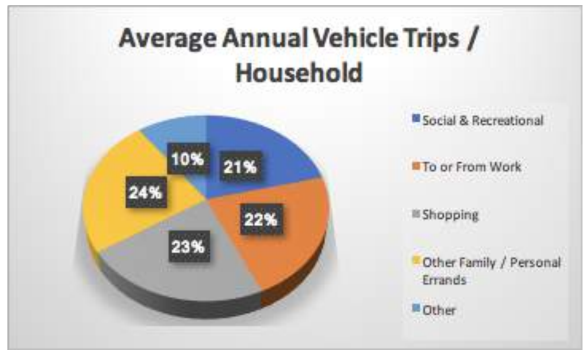
1. "...if self-driving cars are privately owned by individuals, many of those expensive cars will spend considerable time circling the block endlessly and returning to remote parking lots instead of paying for parking. Think of what *this* will do for congestion. Similarly, some have suggested that private ownership of AVs will cause cities to sprawl into new rings of 'exurbs' as drivers forgo their distaste for car travel, in some cases abetted by being able to travel at higher speeds in AV-only lanes…",

"The effects on traffic congestion could go either way. In the most positive scenario, if all AVs are shared rather than privately owned, the congestion problem evaporates. Vehicle use would drop significantly (thanks to poolings), and road space utilization would improve dramatically. On-street and much off-street parking, including parking lots and garages, could be repurposed as public space- including wider sidewalks, more trees, bike lanes, and street furniture- and used for affordable housing and parks."

Daniel Sperling, *Three Revolutions* (Washington, D.C.: Island Press, 2018), Chapter 1.

2. Mountain View Commute Trips Estimate





T1 Figure 3. Nationally, more than two-thirds of all trips and vehicle-miles traveled are *non*-work-related.

Data source: U.S. Department of Transportation Federal Highway Administration *Summary of Travel Trends 2009 National Household Travel Survey*, Table 6, page 15.

Mountain View seems likely to have a higher percentage of commute trips than the national average due to the jobs / housing imbalance, but it is not likely to vary too greatly. Based on the assumptions in T1 Table 2, and on 2014 census data (the most recent year for which data is available from https://onthemap.ces.census.gov/), **the percentage of trips in MV in 2014 that were commute trips is roughly estimated as 24%.**

% Commute Trips	
Assume:	
Average number of trips/day by service population, per Fehr & Peers report (based on California data)	3.4
Worker Trips / Year: Assume workers travel 5 days a week, 2 times per day, 48 weeks a year	480
% of workers who commute via car, taxi or motorcycle, plus half the people who carpooled, per MV Bicycle Plan	79%
Per Census employment info, % of MV residents who are employed	48%
% of jobs in MV worked by residents in 2014, per US Census Data for MV	9%
Categories of Workers, based on % from Census data for MV	
Residents who work inside of MV	7,335
Residents who work outside of MV	29,600
Workers who live outside of MV	77,671
Trips/Year Commute, Workers in MV	31,774,225
Trips/Year Commute, Residents who work Outside of MV	11,181,696
Trips/Year Commute, Total	42,955,921
Trips/Year, All Trips	180,969,994
Commute Trips %	24%

Mountain View Commute Miles Estimate

Based on the assumptions listed below and on 2014 census data (the most recent year for which data is available from https://onthemap.ces.census.gov/), **Mountain View commute miles in 2014 are roughly estimated at 44%** of all vehicle miles traveled in Mountain View.

VMT for Commutes: Data / Assumptions			
Trip counts and distances per US Census, for MV https://onthemap.ces.census.gov/			
2014- most recent year for which data is available			
Live Outside, Work in MV	77,671		
Live in MV, Work in MV	7,335		
Total Jobs per Census NOTE: Slightly higher than BAU population count of MV Workers on which VMT is based	85,006		
Living in MV but working outside	29,600		
% of workers who commute via car, taxi or motorcycle, plus half the people who carpooled, per MV Bicycle Plan	79%		
Commute trips per year: 5 days a week, 2 trips a day, 48 weeks /year	480		
Workers who Work in MV (Primary Jobs), including residents	**Workers**	**Avg Distance** (Trips > 10 miles: only half the distance credited to MV, per convention)	**Total Miles**
All Jobs (note- slighly higher than estimated Worker Population)	85,006		
< 10 miles	33,054	5	62,432,395
10-24 miles	27,146	8.5	87,164,720
25-50 miles	16,081	18.75	113,901,723
> 50 miles	8,725	30	98,878,680
Total Annual Miles by External Workers, 2014			**362,377,518**
Workers who Live in MV (Primary Jobs), (includes same 7,335 residents, subtract them from the <10 mile category)			
All jobs	36,935		
< 10 miles	24,074	5	31,616,623
10-24 miles	6812	8.5	21,873,060
25-50 miles	2857	18.75	20,236,131
> 50 miles	3192	30	36,174,298
Total Annual Miles by Internal Workers, 2014			**109,900,111**
Total Annual Miles, All workers, 2014			472,277,630
Total Annual Miles, 2014, all miles			1,077,331,445
Estimate, Percentage of commute miles			**44%**

3. The proposed Mountain View *Comprehensive Modal Plan* scope was presented to City Council at a study session at the Sept. 19, 2017 City Council meeting. The development of the RFP is underway in the spring of 2018; consultant selection is tentatively expected to occur in Fall 2018, and the plan is expected to take about 12-18 months to complete. It is expected to become how the city identifies and prioritizes transportation capital improvement projects for the foreseeable future.

   The *Comprehensive Modal Plan* is agenda item 6.2 in the agenda packet, which can be found at this URL:

   http://www.mountainview.gov/civicax/filebank/blobdload.aspx?BlobID=23870

4. Existing recent bicycle and pedestrian plans include (this is not an exhaustive list):
   - "Bicycle Transportation Plan Update," Nov. 17, 2015
   - "Mountain View Pedestrian Master Plan," Jan. 2014
   - "Mountain View Transit Center Master Plan," May 2017
   - "California / Escuela / Shoreline Complete Streets Feasibility Study," Oct. 7, 2015
   - Sections within precise plans, including
     1. "North Bayshore Precise Plan," Dec. 2014
     2. "San Antonio Precise Plan," Dec. 2, 2014
     3. "El Camino Real Precise Plan," nov. 17, 2014
5. https://www.apta.com/resources/reportsandpublications/Documents/APTA-Hidden-Traffic-Safety-Solution-Public-Transportation.pdf, page V.
6. http://www.bikeleague.org/content/why-bike-it-makes-us-happy-researchers-say
7. "Stanford Bicycle Commuter Access Study", October 2017, p.11.
8. "Stanford Bicycle Commuter Access Study", October 2017, p.12
9. The bulk of the following table is 2011-2013 data taken from the "Mountain View Bicycle Transportation Plan Update," 2015, p. 41.

   The Stanford data is for 2017, from the "Stanford Bicycle Commuter Access Study", October 2017, p. 12. https://transportation.stanford.edu/sites/default/files/2017-10/Stanford_Bicycle_Commuter_Access_Study_2017.pdf

Stretch goals are highlighted in green.

Mode	Mountain View	Palo Alto	Stanford*	San Francisco	Santa Clara County
Drove Alone	72.7%	64.8%	43.0%	36.7%	76.3%
Carpooled	8.8%	6.3%	8.0%	7.3%	10.3%
Public Transportation	5.1%	6.1%	22.0%	32.5%	3.8%
Walked	2.3%	5.1%	2.0%	10.2%	2.0%
Bicycled	6.5%	9.1%	21.0%	3.7%	1.9%
Taxi, Motorcycle, Other	1.6%	0.5%		2.5%	1.3%
Worked from Home	3.1%	8.1%		7.1%	4.5%

10. Netherlands, Germany, Denmark: "In the mid-1970s, transport and land use policies in all three countries shifted dramatically to favor walking, cycling, and public transport over the private car. The policy reform was a reaction to the increasingly harmful environmental, energy, and safety impacts of rising car use... Most cities improved their bicycling infrastructure while imposing restrictions on car use and making it more expensive. That policy reversal led to turnarounds in the previous decline of bike use. From 1975 to 1995, the bicycling share of trips in the same, previously cited sample of Dutch, Danish, and German cities rose by roughly a fourth, resulting in 1995 bike shares of 20-43%." This is despite similar levels of car ownership in Europe as in the US. Source: John Pucher and Ralph Buehler, "Making Cycling Irresistible", Transport Reviews Vol. 28, 2008, p. 9.

Solve the local solo-trip problem: Pilot discounted pooled ridesharing **(T4B)**	**Incentive**	**1 yr.**	
Recommendation name	Type	Duration	

304	**$100k**	**$0**	**$328**	●●○	●●○	●●●	●●○	●●●	●○○
MT CO2e reduction Pilot Yr. 1	City's Net Cost	Incremental Net Cost	Net cost per MT CO2e reduction	Easy to implement	Easy to measure	Private investment leverage	Local economic benefits	Other environmental benefits	Health benefits

Problem description

For Mountain View to reach its greenhouse gas (GHG) emissions goals, the City must focus on a complete disruption to the transportation status quo and offer unique and transformative solutions to transporting its people. Primarily, the City needs to drastically reduce the ratio of single-occupancy trips via passenger vehicles and switch several hundred thousand trips per day from gas-powered single-occupancy vehicles (SOVs) to electric and high-occupancy vehicles (HOVs).

Mountain View must invest in a transformative solution that leverages a transportation mode that is timely, familiar, and easy-to-use. The introduction of autonomous SOVs and small autonomous HOVs into the transportation mix is imminent. As this technology becomes commonplace, it is imperative that we encourage people to share these vehicles to reduce GHG emissions and alleviate critical pressures on traffic flows in the City. This strategy would require embarking on a new frontier of public transportation.

Recommendation

Mountain View should fund a $100,000 pilot for a discounted pooled ridesharing program and issue a Request for Proposal in which rideshare companies bid on a guaranteed per-person/mile rate for carpool transportation in the City. Mountain View would grant a contract to one or many rideshare companies to provide X "pooled" (high-occupancy) miles to the City over a specified period (ideally beginning in 2020 for the pilot/demonstration program). If the City deems the pilot a success, we recommend a three-phase implementation that is described in later sections. One condition of the contract with the City is that the ride-sharing company provide data on trips origin, destination, time, and day so that the City can determine if there are clusters of demand that would indicate optimal routes and timing for shuttles.

When a user starts or ends their "pooled" trip in Mountain View via a rideshare company's app, the cost of up to three miles of that trip would be credited to the user from Mountain View's "bank." This bank would be drawn down by the rideshare company, against the funds issued by the City at the agreed-upon rate. In this way, Mountain View would incentivize pooled ride-sharing by providing free short-trips and subsidized longer-distance trips (three+ miles) and would have justification for requesting trips data from the private sector to improve its emissions forecasting and transportation planning in the future.

This model would heavily incentivize the adoption of electric autonomous and autonomous high-occupancy vehicles and could drive down the per-person mile vendor cost to $0.10 per person-mile *(T4B Figure 1)*. The key to the design of the model is its assurance that providers are incentivized to make the most efficient use of trips data and use appropriately-sized vehicles as demand dictates (through maximizing the economics of transporting multiple people in one vehicle). In this way, over time, trips with heavy traffic will be sourced with larger vehicles where appropriate, and it will begin to look like a more dynamic version of a traditional transit system that improves itself over time.

SWOT analysis

Strengths:

- Builds on a program that Mountain View has already funded to provide a similar service for subsidized ride-sharing trips to downtown (no "pool" requirement)
- Familiar modality through common rideshare apps
- Design optimizes for high-occupancy vehicles via economic incentives
- Implementation much faster/cheaper than embarking on capital project
- Highly-adaptable and can be renegotiated as transportation landscape changes
- Encourages the use of HOV autonomous vehicles, rather than SOV autonomous vehicles

Weaknesses:

- Transfers some control to a third party
- Highly dependent on willingness of private sector to implement the model into rideshare apps
- Minimal precedent for the City to lean upon

Opportunities and co-benefits:

- Potential to transform Mountain View into an innovation leader in sustainable transportation
- Access to trips data that would improve transportation planning and emissions budgeting
- Viable option for populations that may not be attracted to conventional transit options
- Potential for multi-car families to reduce total vehicle ownership
- Reduced local parking could make way for different forms of land-use/increased green space
- Could assist in solving the problem of constrained parking space (e.g. downtown)
- City could offer parking space overnight to autonomous vehicles for more favorable rate
- Request for Proposal (RFP) favors electric vehicles, further reducing GHG; opportunity exists for public/private partnership in the installation of the necessary electric chargers/payment for electricity (T3).
- Offers a way to provide the necessary functionality for transit to North Bayshore

Threats:

- Could be perceived as a large cash outlay
- Mountain View transportation is now tied to the success of certain private companies
- Perceived safety with night-time pooled rides or women traveling alone

Municipalities where already implemented

Mountain View (subsidized rideshare pilot), Palo Alto (Scoop partnership)

Funding sources

Transportation Demand Management (T7), Parking funds (T6), Avoided cost of parking structure (~$20M), Bay Area Air Quality Management District Grant (T7)

Assumptions and uncertainty

Assumptions with High Uncertainty:

- Per-mile rate that would be offered by various ridesharing companies
- Timing of autonomous vehicle adoption and their respective per-mile rate reductions

Assumptions with Low Uncertainty:

- Willingness of individuals to carpool with strangers
- Ability for rideshare companies to support the City mileage "pool" and share trips data
- Paratransit is provided through a separate contract through VTA

Author Jeff Sloan

Detailed analysis

Current services, Caltrain and VTA, run infrequently, have limited geographic coverage, and run for only a limited number of hours. In addition, even when existing public transit is available, the first and last mile problem serves as a considerable hurdle to adoption of this form of transportation.

Ideally, this solution would improve other aspects affecting Mountain View's sustainability goals such as allowing access to ridesharing companies' trips data that would vastly improve transportation planning and emissions budgeting/forecasting. Also, Downtown Mountain View has a reputation for being a hard place to park a car. This recommendation will make it easy for people to get to downtown restaurants and stores without needing to worry about parking. We expect businesses to also benefit from this recommendation by having more customers than they do today.

The model for this recommendation builds upon the current "pooled" options available through various ridesharing companies such as Uber and Lyft. Lyft's implementation of pooling strategy is called "Lyft Line[3]" and provides a 60% savings to users in some cases, when compared to traditional Lyft. The way this works is that when a user wants to begin a trip, they select the Lyft Line option and the software automatically connects the user with individuals that are embarking on trips on similar routes or in the same direction. This process is nearly identical for Uber's version of carpooled ridesharing, "Uber Pool."

In return for sharing the vehicle, users pay a discounted price on the fare. The focus of this option is upfront pricing and smart routing that maintains minimal delays related to picking up other individuals on the route. Every user has a photo, name, and rating and riders can see the other individuals that will be sharing their vehicle. These pooled services are a bargain to customers and turn every vehicle into a potential shared vehicle.

In the case that a rider chooses the pooled option but other users on the route are not found, the rider will still pay the reduced rate. Since the RFP model highly favors electric vehicles, Mountain View would still see the benefit of reduced greenhouse gas emissions in these instances. However, it would behoove the ridesharing companies to compensate for these events by integrating high-occupancy vehicles for high-volume events such as events at Shoreline Amphitheatre or travel to the weekly Mountain View Farmers' Market. This is how we intend to bring into existence a disaggregated dynamic transit system in Mountain View.

It is important to note that the program would not be limited to a single company, nor would it be limited to Uber and Lyft. Companies like Waymo and Chariot and many others would be possible partners, especially to the degree that they are able to deliver with high-occupancy electric vehicles. Furthermore, considerations for paratransit are essential to ensuring that the entire community is served. Ridesharing companies have solutions for paratransit as part of their product offering, but it is important enough to explicitly state this requirement in the recommendation.

We believe that the implementation of a pooled ridesharing program will follow a phased approach. The first phase (1.0) is the pilot program. This is a proof-of-concept demonstration that illustrates that this is a viable option and will be used by the public. This will prove that ride-sharing companies are willing to negotiate a bulk-rate with the City, set up the data-sharing relationship between Mountain View and ridesharing vendors, and will demonstrate the viability of using larger high-occupancy vehicles for high-volume routes. This first phase would integrate all the aspects of its current piloted rideshare program but integrate the "pooling" requirement that is emphasized in this recommendation. The City should then utilize the lessons learned from stage 1.0 to embark upon stages 2.0 and 3.0.

[3] https://rideshareapps.com/lyft-line/

Stage 2.0 would be a fully operational program that utilizes electric vehicles that are not *necessarily* autonomous, and Stage 3.0 is a fully autonomous-electric program. We believe that autonomous transportation technology is imminent and that the economics of this proposal (pricing at per-person mile) may reduce the length and/or need entirely for Stage 2.0, as vendors operating on this model would quickly be priced out by their competition operating at Stage 3.0. Given the imminence of autonomous vehicles and the nature of a competitive RFP process, the rate of $0.20 per person-mile has been used for the pilot and is assumed throughout the life of the program. However, the specific cost per mile is unknown and will ultimately be negotiated by the City and determined by competition amongst vendors.

Environmental analysis

Carpooling reduces greenhouse gas emissions and eases congestion. "In the most positive scenario, if all AVs are shared rather than privately owned, the congestion problem evaporates. Vehicle use would drop significantly (thanks to poolings), and road-space utilization would improve dramatically. On-street and much off-street parking, including parking lots and garages, could be repurposed as public space– including wider sidewalks, more trees, bike lanes, and street furniture– and used for affordable housing and parks" (Sperling, 2018).

Every carpooled ride removes at least one vehicle from the road and its related GHG emissions. Furthermore, the design of this recommendation highly incentivizes the use of electric and autonomous vehicles through the RFP process, as the cost involved with maintaining conventional vehicles and the labor for drivers would result in a much higher per-mile bid for conventional transportation strategies (e.g. human driven internal combustion engine). To get the public excited about carpooled ridesharing, we have suggested a maximum three- mile subsidy for trips beginning or ending in Mountain View, which is slightly more than half of the average 5.5-mile trip distance.

Given that the discounted price is capped at three business-as-usual (BAU) miles per trip, the City will affect *more* miles than it pays for - as these additional miles will be paid for by the individual user. BAU numbers indicate a 5.5-mile trip distance for this mode of transportation which means that by subsidizing three of these miles, Mountain View will affect >80% more miles than it subsidizes. However, the task force does recognize that the City may decide on a more typical cost sharing arrangement for a 50% subsidy up to a X subsidy maximum (e.g. $5). In this back-up model, which is typical in the industry, the passenger and the subsidizing agent split the cost, up to a subsidy maximum. In this way, the City is not giving away free rides. To illustrate this scenario, for an $11 shared ride, the passenger would pay $6 and the City of Mountain View would pay a subsidy of $5. The specific pricing scenario and subsidy model would ultimately be decided by the City and through contract negotiations.

To meet Mountain View's 2030 goals for greenhouse gas emissions, Mountain View would need to switch at least 20% of SOV trips to higher-occupancy trips by 2030 (along with other measures). With that target, and by utilizing a discounted pooled ridesharing program, Mountain View would save a total of 216,530 MTCO2e. Assuming the pilot is successful, the city could ramp up to achieve that target; one possible scenario is modeled in the cost analysis.

Cost analysis

As this recommendation is a new and unproven innovation in public transportation, we suggest that the City pilot this program and then determine its going-forward plan after analyzing its success. As a result, we recommend that the City set aside $100,000 for this pilot and run it through the same team being utilized for the free rideshares into Mountain View program (Alex Andrade and economic development team).

From discussions with the City, we believe that autonomous paid ridesharing will be ready by spring of 2019. This would allow for a pilot sometime between 2019-2020 (we've assumed 2020) and then a fully-operational program beginning in the 2021/2022 time period. Given the T4B Figure 1 estimate of $0.10/mile pooled autonomous electric vehicle (EV) per-mile cost, we are assuming that a ridesharing company will bid $0.20/mile for a 100% profit margin. In the future, as EV infrastructure is improved through the City, Mountain View may negotiate a lower rate through perks such as allowing vehicles to park cheaply overnight in city lots.

At a $0.20 per person-mile rate, this would account for 500,000 person-miles traveled paid/contracted and 916,667 person-miles affected (~200k trips). We predict that the pilot program will launch in 2020 and have utilized the VMT/GHG savings figure for that year to determine GHG savings associated with the pilot (T4B Figure 2). The numbers in T4B Figure 2, for the pilot as described, are the numbers reported in the header of this recommendation.

To complete the exercise, the group also conducted a mock cost-analysis table that is included in T4B Figure 3. The transportation target for pooled ridesharing mileage through 2030 is roughly 879 million, of which, the City will need to contract for 480 million miles if it is to utilize this program for that entire mileage population (given the 55% mileage-contract to mileage-affected ratio detailed in the environmental analysis). This is only one example of a multitude of possible implementations, but it does provide a basis for cost-modeling that the City can use for its analysis.

Multiplying this assumed City cost per-mile by the number of contracted miles results in a total cost of $95M over a ten-year period. This cost begins with the $100,000 pilot in 2020 and ramps up to $31M in 2030. When multiplying the avoided mileage target by the relevant yearly MTCO2e / Mile ratio, we arrive at a total GHG savings of 216,530 MTCO2e or $443/MTCO2e.

When implemented, the revenue from other transportation recommendations would fully offset the cost of this program (Recommendations T6 and T7). Furthermore, this cost-analysis includes a financial representation of one of many potential implementation strategies that the City could execute when considering the number of miles contracted and the time-horizon for the program. As mentioned above, a piloted approach may be utilized to test the feasibility and success of the program prior to investing long-term.

Scale analysis *See cost analysis*

T4B References

https://medium.com/@johnzimmer/all-lyft-rides-are-now-carbon-neutral-55693af04f36

http://www.paloaltotma.org/carpool/

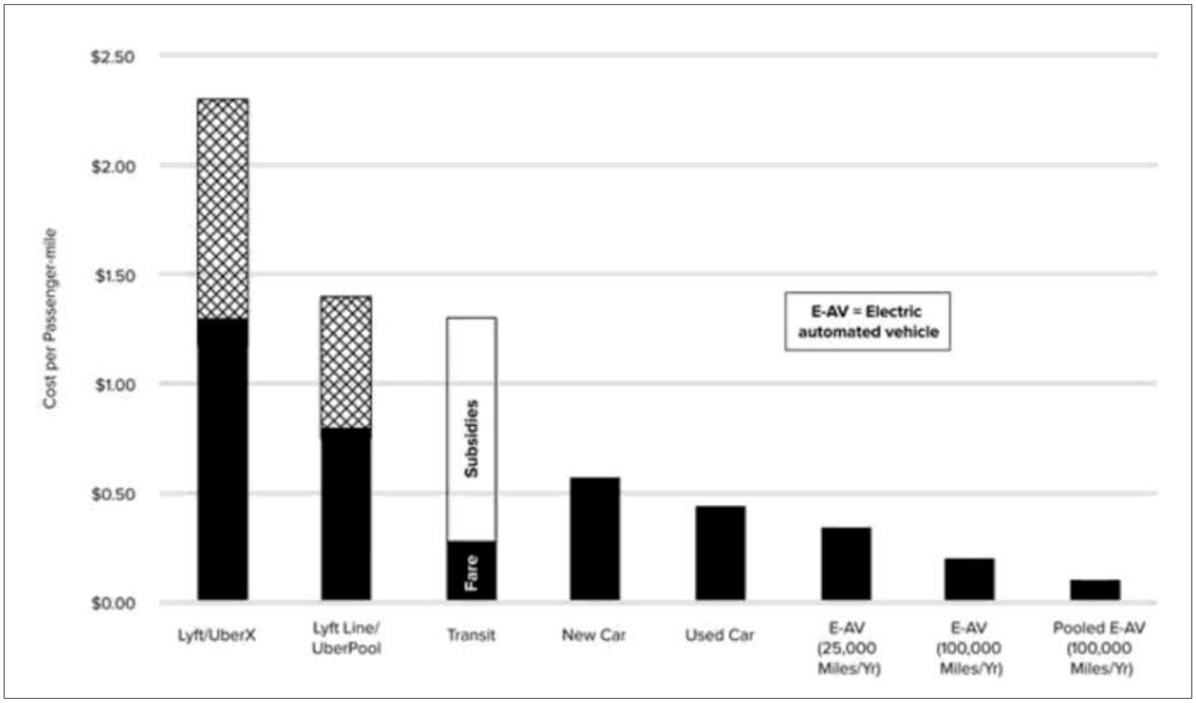
https://www.mv-voice.com/news/2018/01/19/citys-partnership-with-uber-lyft-stalls

https://rideshareapps.com/lyft-line/

Sperling, Daniel. Three Revolutions: Steering Automated, Shared, and Electric Vehicles to a Better Future. Island Press, 2018.

T4B Appendix

T4B Figure 1. Ridesharing Costs by Type .



Source: Sperling, Daniel. Three Revolutions: Steering Automated, Shared, and Electric Vehicles to a Better Future. Island Press, 2018.

T4B Figure 2. Pilot Program.

Pilot Program	
Cost	$100,000
Rate	$0.20
Miles paid	500000
Miles affected /(3/5.5)	916667
GHG saved, MTC02e	309.86
$ / MT CO2e	$323

T4B Figure 3. Discount Pooled Ridesharing Cost Analysis.

	Pilot 1	Pilot 2	Larger Pilot 3	Slow Ramp Up							
Year	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Carpool / Rideshare: goal % of Gas/Diesel to switch						2.00%	4.00%	8.00%	12.00%	16.00%	20.00%
Switch target % of all miles to HOV (includes inadvertent EV miles)	916,667	916,667	1,000,000	4,000,000	8,000,000	25,932,629	52,860,137	107,864,725	165,257,488	225,158,601	287,728,208
Miles that Mountain View Pays for: *3/5.5	500,000	500,000	545,455	2,181,818	4,363,636	14,145,071	28,832,802	58,835,305	90,140,448	122,813,782	156,942,659
Cost to MV at $.20	$100,000	$100,000	$109,091	$436,364	$872,727	$2,829,014	$5,766,560	$11,767,061	$18,028,090	$24,562,756	$31,388,532
Total Miles that are Gas/Diesel	900,389	894,864	969,590	3,849,648	7,639,185	24,564,160	49,711,518	100,789,007	153,535,729	208,126,740	264,767,078
GHG saved, MTC02e	304	294	309	1,189	2,287	7,121	13,996	27,624	41,063	54,445	67,897
$ / GHG	$328.56	$340.45	$353.24	$366.99	$381.66	$397.26	$412.00	$425.98	$439.03	$451.15	$462.29

Solve the local solo-trip problem: MV Shuttle 2.0 and 3.0 (**T4A**)							**Program**	**Permanent**	
Recommendation name							Type	Duration	
143,000	**$405K**	**$112M**	**$787**	○○○	●●●	●●●	●●●	●●○	●●○
MT CO2e reduction 2018-2030	City's Net Cost	Incremental Net Cost	Net cost per MT CO2e reduction	Easy to implement	Easy to measure	Private investment leverage	Local economic benefits	Other environmental benefits	Health benefits

Problem description

People who want to live without a car, need to live without a car, or want to reduce the number of cars they own, are not able to do so, as Mountain View does not have practical alternatives to driving. Current transit, Caltrain and VTA, and the MVgo and Mountain View shuttles, run infrequently, have limited geographic coverage, and run limited hours.

To reduce vehicle miles traveled (VMT), other modes of transportation must be made more attractive.

Recommendation

Public transit is an important part of a comprehensive transportation strategy. Switch 20% of car trips to transit by 2030. Target *all* trips, which can start throughout the day (T4A Fig. 2), not just commute trips:

- for short in-town trips of all types
- to encourage longer trips on Caltrain and VTA, by making the first and last miles as convenient as driving.

Shuttle 2.0:

- Redesign routes, greatly expand geographic coverage, frequency, and hours of operation. To demonstrate demand, consider using crowd-sourced shuttle routes (e.g. Via, Chariot, others) such as to Caltrain, Farmer's Market, etc., and build on demonstrated demand patterns.
- Implement city-wide transportation demand management (TDM) for funding and outreach, (Recommendation T7)

Shuttle 3.0: Leverage autonomous shuttles when available to greatly expand service at lower cost. (1)

T4A Figure 1.

Autonomous Shuttle Pilot, San Ramon (6)

SWOT analysis *see T4A Appendix for full SWOT analysis*

Strengths: Will move people using less space, alleviating congestion.

For businesses, customer traffic will no longer be limited by lack of parking space. Also, cost avoidance from reduced parking requirements; opportunity to develop parking spaces.

Public support exists: at the first ESTF-2 public outreach session, transit was the 2nd-highest request.

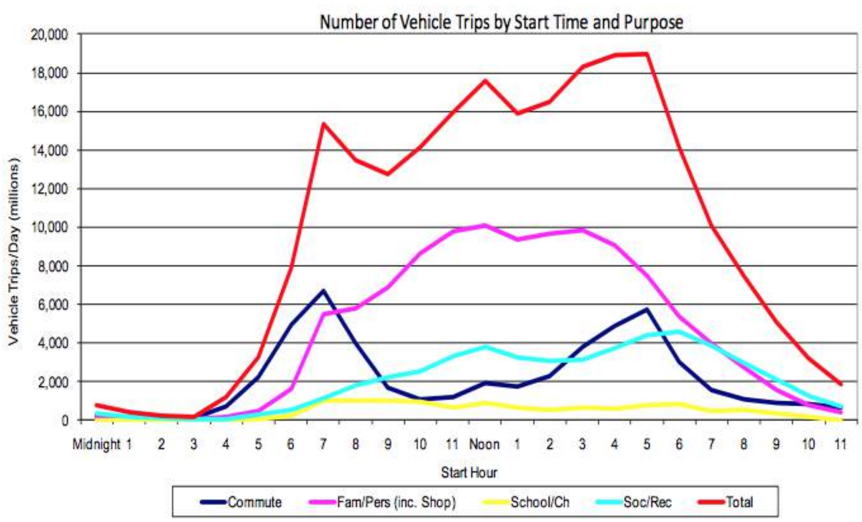
Weaknesses: Costs are significant.

Opportunities and co-benefits: Shuttle 3.0: Autonomous vehicles will slash operating costs, allowing the system to scale up greatly at much lower cost (T4A Table 1), and further improve safety.

Threats: If great transit service is not available in a timely manner, the opportunity may be lost to avoid the expected increases in congestion due to population growth, and due to adoption of autonomous single occupancy vehicles (SOVs) by people previously unable to drive.

As an example of the congestion threat, VTA reports that "**the average weekday travel speed of Route 22 has declined 34 percent, from 15.7 miles per hour in 1995 to 10.3 miles per hour today", largely due to increased vehicle congestion and increased delays at signals.** (2)

Figure 12. Distribution of Vehicle Trips by Trip Purpose and Start Time of Trip 2009 NHTS.



T4A Figure 2.

National Trip Start Times & Purpose

NOTE:

Work trips (black line)

All trips (red line)

Trips occur throughout the day, not just at rush hour

per National Household Travel Survey (3)

Municipalities where already implemented

Crowd-sourced Shuttle routes becoming regular bus routes: San Francisco

Municipal Shuttles: Emeryville Emery Go-Round: **1.6 million riders/year** (4), Stanford Marguerite Shuttle, Vancouver (5)

Autonomous Vehicles: undergoing tests in many cities, including Bishop Ranch, San Ramon (6)

Funding sources

- City-wide TDM requirements (T7), and/or Property-Based Improvement District (PBID) fees
- Possible city tax
- Partner with VTA to fund routes as demand is demonstrated
- California and federal grants / programs (e.g. Federal Transit Administration), BAAQMD, other
- Advertising on shuttles: free electric shuttles are privately operated in Cincinnati, funded by ads (7)
- Paid parking in downtown Mountain View (Recommendation T6

Assumptions and uncertainty *See **Detailed analysis***

Author Mary Dateo

Detailed analysis

Environmental analysis

Federal and State efficiency requirements will reduce the GHGs produced per VMT, but not enough to meet Mountain View's 2030 GHG reduction goals.

Per estimates in Recommendation T1, less than one-third of all Mountain View trips are commute trips, and less than one-half of all miles are commute miles; the remainder are for shopping, errands, social/recreation – see T4A Figure 2. Therefore, much of the VMT reduction must come from providing alternatives to residents, not just commuters.

Implementation Approach

Begin expanding service by implementing pilots. This could be done by partnering with crowd-sourced ride-sharing services, such as Chariot or Via. Initial routes would be chosen to address currently unmet needs, such as trips between Mountain View neighborhoods and popular destinations:

- The Farmer's Market
- Downtown and/or other entertainment centers on Friday/Saturday evenings
- Caltrain
- High schools
- Shopping centers, medical centers, regional parks

Other possible routes include:

- Lunchtime trips to/from major employment centers to downtown and to shopping centers
- Trips between Caltrain and shopping centers, medical centers, regional parks

As demand is proven, expand the service to more hours, higher frequency, and/or larger vehicles. Use flexible and/or fixed routes as appropriate.

Assumptions about the Necessary Level of Service:

The goal is to make non-SOV travel the first choice for all vehicle travel. Over time:

- Extend hours to cover at least 16 hours per day, including early and late commute times and first / last Caltrain times, so that early and later commuters have a ride at both ends of their day, and so that older children can take the shuttle to/from school and extra-curricular activities. Trips start throughout the day, as shown in T4A Figure 2.
- Design shuttle routes and increase frequency such that
  - The Transit Center is reachable from most of the city within 10 minutes of shuttle arrival
  - Most of Mountain View is reachable within 30 minutes, **to include all key destinations** such as shopping, major parks, healthcare, theatres and entertainment, senior and teen centers, high school and middle schools, hotels
  - Wait times are 15 minutes or less for most of the day
    Note: high frequency is important throughout the day, not just during commute hours, for residents and visitors, and because it also affects commuter choice: "In most market research studies, one of the major reasons given on why people drive to work is the worksite is located in an area that is isolated from any other activities, requiring a personal vehicle to tend to midday needs for lunch, errands, or going to meetings." (8)
  - High frequency should also be provided on weekends, since residents and visitors are also intended to be served, to reduce VMT.

  - On fixed-route service, consider allowing on-demand stopping
- Restrict parking, Recommendation T6.
- Implement TDM requirements for all new development and for re-development throughout the city, to create the necessary outreach, and to help offset costs, Recommendation T7.
- Use electric vehicles to eliminate GHG and control operating and maintenance costs.
- Switch from conventional to autonomous shuttles to reduce operating costs as they become available.
- Evaluate feasibility of on-demand routes or stops, especially after-hours.
- Make check-on quick and easy (free or paid) via Clipper and/or phone app.
- Purchase vehicles that are easy-on/easy-off to accommodate strollers, wheelchairs, personal shopping carts and bicycles, to minimize stop times, and to help keep average speeds high

The following improvements, not included in this cost analysis, may help increase the speed of transit:
- Allocate reversible dedicated lanes for transit in congested areas.
- Create HOV+Transit lanes on lower-utilized roads, possibly such as California, Shoreline, Middlefield, before they become too congested to do so.
- Incorporate signal light priority for shuttles, buses and light-rail.

Major Assumptions

- Large autonomous shuttles, which need to meet different government regulations, appropriate for mixed-use traffic, will be available by 2029
- The number of daily car trips per person will remain the same through 2030: 3.4 trips/person.
- Assume three miles per individual trip on the shuttle. Most trips within Mountain View will be short. However, this recommendation does enable longer transit trips by addressing the first and last mile, adding a bit to the average trip length, so that each shuttle trip will eliminate an average of four miles of VMT. For example, having a convenient and free means of reaching the Caltrain station will encourage more people to take Caltrain on longer trips.
- Average shuttle occupancy will be 50% (higher than 100% at certain times, lower at other times).
- Average shuttle size for the pilots would be 12-15 persons. As demand is proven, larger shuttles for 28-30 people would be added, and/or run at higher frequencies as demand is proven.
- Business-as-usual (BAU) transit mode share would remain at 5% without implementing this recommendation
- Paratransit service will continue to be available to those who need it via existing providers.
- Outreach, which is critical to the success of switching trips to the shuttle, must be extensive and on-going. Outreach is addressed in *Recommendation T7.*
- To simplify the cost and GHG calculations, they are calculated beginning on the first day of 2029 for autonomous shuttles. However, industry best-practices will be used in piloting and demonstrating the design of the routes.

Timing Assumptions

- 2018-2019: complete Mountain View's Comprehensive Modal Plan, just beginning
- 2019-2021: develop city-wide TDM requirements, Recommendation T7, determine/negotiate shuttle organizational design, incorporate surveys and public input, design the pilots, address funding, purchase the shuttles or subcontract, and design outreach.

- 2022-2028: expanded service to begin in Mountain View, starting with pilots, making use of shuttles with drivers
- 2029: Incorporate autonomous shuttles as they become available
- 2030: Provide expanded service to key destinations in neighboring cities

Cost analysis

This recommendation categorizes the costs as "Incremental Costs", largely since the current shuttles are operated by the transportation management association (TMA) (MVgo shuttle) and Google (community shuttle) and are not operated by the City. However, this is not meant to recommend that Mountain View necessarily follow this pattern; the necessary analysis and decision to determine how to organize and manage the service is expected to be addressed as part of the City's Comprehensive Modal Plan, and/or during the planning phases of the project. For example, the City might decide to contract out shuttle services itself. Or the City might help expand the Mountain View TMA to provide the shuttle services.

T4A Table 1. Expected GHG Savings Summary

Years	Miles Avoided	Operating Cost	MTCO2e Avoided	$/MTeCO2
2022-2030	549,665,418	$112,801,723	143,295	$787
Sub-Periods				
2022-2028	42,753,418	$34,218,923	12,096	$2,829
2029-2030 (autonomous)	506,912,000	$78,582,800	131,199	$599

Details of the cost and GHG savings are on the following pages.

Assumptions	
NOTE: Numbers regarding shuttle and charger costs, and shuttle operating costs, are based on conversations with a transportation expert.	
NOTE: Operating cost per mile for high-occupancy autonomous vehicles is expected to be as low as $0.10 per hour, per the book *Three Revolutions* , Figure 1.2. By that measure, costs calculated here are in the ballpark, , in 2029 and 2030, at $0.19/mi, depending on whether the operator is a for-profit or nonprofit. Daniel Spurling, Three Revolutions (Washington, D.C.: Island Press, 2018), Chapter 1.	
NOTE: The number of daily trips estimated as part of the "City of Mountain View Automated Guideway Transit Feasibility Study", Feb. 2018, by Lea Elliott are a small fraction of the number of trips estimated here. From that perspective, the operating costs of the AGT, can be considered to be included in this model. However, the capital costs to built a grade-separated lane for AGT are not included.	
Cycle Time: - average Shuttle runs 13 miles/hour for local service, due to number of stops - route (1-way) 6.5 miles, round trip cycle time 1 Shuttle: 1 hour	
- for 10 minute service on that route: 6 Shuttles	6
Speed (mph)	13
Number of hours per day for large shuttles, once implemented	16
Operating Cost: $/hr, $80-100	100
Vehicle Passenger Capacity: 12-15	14
Passenger trips: Assume average occupancy of	50%
Passenger trip distance, average, riding on the shuttle, miles	2
Passenger trip distance, miles avoided on average, all trips	4
Car miles avoided per passenger trip for those trips going to Caltrain: a small but significant fraction of all rides will be to/from Caltrain, light-rail, or VTA bus. By enabling distance transit, the shuttle will eliminate some long car rides. *Avg. distance on Caltrain ~ 22 mi. If in car, would only count half: 11 mi. Then add the avg. 2 miles to the station.*	**13**

Explanation of Operating Cost Assumptions				Costs Per Year				
2019-2021: City Costs		**Operating Cost /year**		**Year**	**Miles Avoided**	**Annual Operating Cost**	**Annual MTCO2e GHG Avoided**	**$/MTeCO2**
Study to confirm routes, staff to oversee the project, develop partnerships / write grants .25 City FTE for 2 years at $180,000 0.5 TMA FTE for 1 years at $120,000 Total: $150,000 Assumption: will write a grant to cover this cost								
Expand TDM: Will be covered in the TDM recommendation								
2022 **Pilot** Pilot (3) expected high-occupancy routes with companies such as Chariot or Via: - Friday Night, Saturday Night - Sunday (Farmer's market) to downtown - Commutes to Caltrain		**Operating Cost /year**		**Year**	**Miles Avoided**	**Annual Operating Cost**	**Annual MTCO2e GHG Avoided**	**$/MTeCO2**
0.25 city FTE to oversee- at $180,000		$45,000						
0.5 TMA FTE to oversee- at $120,000		$60,000		**2022**	1,917,006	$2,211,600	611	$3,622
Sunday Farmer's Market: 6 vehicles, 5 hours (8:30 - 1:30), 51 weeks, $100/hr		$153,000						
Friday, Saturday night: 3 vehicles, 4 neighborhoods, 6:30 - 12:30, 102 operating days, $100/hr		$734,400						
Caltrain Commutes: 8 hours (4 hours morning, 4 hours evening), 6 vehicles (3 neighborhoods), 254 days/year, $100/hr		$1,219,200						
2023: Pilot Additional Routes Lunch-time- neighborhoods to downtown, major shopping centers Mid-week evening downtown High schools- neighborhoods to high schools Caltrain on weekends								
Lunchtime: 2 hours, 3 vehicles, 4 neighborhoods, 254 operating days, $100/hr		$609,600						
Mid-week: Like Friday, Saturday, but begin / end earlier		$367,200						
High Schools: 4 vehicles, 4 hours/day, 180 days/yr, $100/hr		$288,000		**2023**	3,067,974	$3,476,400	948	$3,669
2024: Assume 28-passenger shuttles added for 50% of the routes, resulting in 50% increase In miles for the same cost.				**2024**	4,601,961	$3,476,400	1378	$2,524
2025-2028: 25% growth annually, (miles and costs). Continue piloting new routes and ramping up frequencies / shuttle sizes as appropriate.	25%			**2025**	5,752,451	$4,345,500	1668	$2,606
				2026	7,190,564	$5,431,875	2025	$2,683
				2027	8,988,205	$6,789,844	2463	$2,756
				2028	11,235,256	$8,487,305	3005	$2,824
2029-2030: Large Autonomous shuttles become available/regulations in place. Use such as for N.Bayshore / E.Whisman esp. for commute, special events **2029: Increase frequency and hours of day, still in MV**								
Autonomous shuttles- assume operating expense drops by this %	45%							
Operating Cost: $/hr	$55							
Total Route Count (equivalent), determined via the pilots	11							
average 6-minute service, shuttles / route (more frequent at peak times, less frequent other times of the day)	10							
Route Distance, Miles (out & back)	13							
Total shuttles running	110	$35,332,000		**2029**	233,833,600	$35,437,000	61170	$579
2030: **Continue services from 2029, plus** **Share with Neighboring Cities / Expand to Key Destinations** **such as I-85 corridor, Milpitas BART, ACE**								
Cost fraction assumed by MV (assume neighbors and/or VTA cover half)	1/2							
Route count (equivalent)	4							
Assume average of 10-minute service, shuttles / route (2x distance, 2x b	12							
Route Distance, Miles (1 way)	13							
Average Rider Trip Distance	13							
Car miles avoided / passenger trip (incl. some miles for Caltrain, light rail, VTA shuttle, BART) but- other cities get credit for half the miles	10							
Total shuttles Running	48	$7,708,800		**2030**	273,078,400	$43,145,800	70029	$616

Summary of Operating Cost Assumptions

Years	Miles Avoided	Operating Cost	MTCO2e Avoided	$/MTeCO2
2022-2030	549,665,418	$112,801,723	143,295	$787
Sub-Periods				
2022-2028	42,753,418	$34,218,923	12,096	$2,829
2029-2030	506,912,000	$78,582,800	131,199	$599

T4A Appendix

Full SWOT analysis

Strengths:

- A local shuttle-based transit system will
  - reduce congestion, which is otherwise expected to increase substantially due to the significant population increase, increased used of Lyft and Uber, and/or use of SOV autonomous vehicles
  - reduce the need for parking, so
    - can bring more customers to businesses where parking is limited
    - enables more people to take Caltrain and light rail
    - avoids the cost and disruption that would be needed to add parking in future
  - address the first and last mile problem for long-distance transit riders
  - allow residents to live car-free, or with fewer vehicles, saving them the $8500 per year (5) that a new vehicle costs; this will especially benefit low-income residents, and members of the community currently unable to drive.
  - be safer. "Transit passengers have about one- tenth the fatality rate as car occupants, and even considering risks to other road users transit causes less than half the total deaths per passenger-mile as automobile travel." (7)
  - provide health benefits. …" transit commuters average 5 to 10 more daily minutes of moderate-intensity physical activity and walked more to local services than people who do not use transit, regardless of neighborhood walkability…In addition, efforts to encourage transit and create transit-oriented development often improve pedestrian and cycling conditions, which can further increase fitness and health. (8)
  - be ADA-compliant, so will be easily used by people with strollers, wheelchairs, walkers, luggage, bicycles, etc.
- Existing shuttles have demonstrated the interest of residents and commuters, despite limited hours and limited frequency.
  - In 2017, the average daily Mountain View Shuttle ridership, running only between 10am and 6pm, once every 30 minutes, was 620, up from 513 in 2016.
  - At the first ESTF-2 public outreach session, transit was the second-most requested item. Interest in shuttles was also high at the second ESTF-2 outreach session.

Weaknesses:

- Shuttle purchase costs and operating and maintenance costs are significant.

Opportunities and co-benefits:

- Autonomous vehicles are nearing introduction; this will reduce operational costs and improve safety.
- Mountain View businesses could be engaged to support transit for employees and customers. With high-quality transit, fewer parking spaces would be needed near businesses and shopping districts. The City could allow landlords to develop part of parking lots for housing, in exchange for joining the TMA and adopting TDM.
- Work closely with VTA to help provide funding, and to take ownership of routes as appropriate as demand is demonstrated.

Threats:

- If great transit service is not available in a timely manner, the opportunity may be lost to avoid the expected increases in congestion due to population growth and increased use of autonomous SOVs. As an example of the congestion threat, VTA reports that "the average weekday travel speed of Route 22 has declined 34 percent, from 15.7 miles per hour in 1995 to 10.3 miles per hour today", largely due to increased vehicle congestion and increased delays at signals. (9)
- Insufficient outreach will slow the adoption rate.
- Care must be taken to avoid undercutting existing VTA routes.

T4A References

1. "Autonomous Transit technologies are anticipated to mature over the next 5 to 10 years through continued testing and demonstration projects."
   Lea-Elliot, "City of Mountain View Automated Guideway Transit Feasibility Study" (Feb. 2018) p.12.
2. General Manager, Nuria I. Fernandez, Board Memorandum re "Fast Transit Program" to Santa Clara Valley Transportation Authority Bicycle & Pedestrian Advisory Committee (April 11, 2018) Agenda Item 7. http://vtaorgcontent.s3-us-west-1.amazonaws.com/Site_Content/bpac_041118_wkshp_packet.pdf
3. U.S. Department of Transportation Federal Highway Administration "Summary of Travel Trends 2009 National Household Travel Survey" (June 2011), 52, Figure 12. Underlying data is from: U.S. Department of Transportation Federal Highway Administration, 2009 National Household Travel Survey. URL: https://nhts.ornl.gov/download.shtml
   For an estimate of Mountain View commute trips and commute miles, expected to be less than 33% of all trips and less than 50% of all miles, see the *Transportation in Mountain View: Transportation Revolution* section of this document.
4. Emery Go-Round passenger data is from a 2015 report, URL:
   http://news.theregistrysf.com/businesses-city-launch-two-free-mountain-view-shuttles/
   Organization of the Emery Go-Round, per their website: https://www.emerygoround.com/about-us.html

   > "The Emery Go-Round is a fare-free shuttle service, open to all Emeryville residents, shoppers, visitors and employees of Emeryville businesses. The service is primarily funded by commercial property owners in the citywide transportation business improvement district (PBID).

> Emery Go-Round is a service of the Emeryville Transportation Management Association, a non-profit organization whose primary objective is to increase access and mobility to, from and within Emeryville while alleviating congestion through operation of the shuttle program."

4. "It's increasingly possible to live in Vancouver without a motor vehicle.' Transit ridership rose 9.5% compared to last year and was 24.6% higher than 2002. Bus trips increased 11.1%, and rail trips increased 5.4%. 'The numbers show that demand for public transit continues to grow in response to significant service expansion.'"
   Todd Litman, "Evaluating Public Transit Benefits and Costs" (Victoria Transit Policy Institute: 18 July 2017), 45-46. http://www.vtpi.org/tranben.pdf.
5. Lisa-Brown, "No Driver, No Problem for Parking Lot Shuttles" (GlobeSt.com, March 8, 2017), https://www.bishopranch.com/media-coverage/no-driver-no-problem-parking-lot-shuttles/
6. https://www.bizjournals.com/cincinnati/news/2018/01/22/new-company-offering-free-golf-cart-rides-in.html
7. Dowling Associates, Inc., "Report for City of Alameda TSM/TDM Plan" (2/15/2012), p.21.
8. Andy Brownfield, "New company offering free golf cart rides in downtown and OTR" (Bizjournals.com, Jan. 22, 2018). https://www.bizjournals.com/cincinnati/news/2018/01/22/new-company-offering-free-golf-cart-rides-in.html
9. Daniel Spurling, *Three Revolutions* (Washington, D.C.: Island Press, 2018), Chapter 1.
10. Todd Litman, "Evaluating Public Transit Benefits and Costs" (Victoria Transit Policy Institute: 18 July 2017), 43. http://www.vtpi.org/tranben.pdf.
11. Todd Litman, "Evaluating Public Transit Benefits and Costs" (Victoria Transit Policy Institute: 18 July 2017), 45. http://www.vtpi.org/tranben.pdf.

Restrict parking to encourage and fund alternative modes (T6)							Infra-structure	10 yr.	
Recommendation name							Type	Duration	
61,549	**$135 M savings**	**$135 M**	**$0**	●○○	●●○	●●○	●●○	●●○	●●●
MT CO2e reduction 2018-2030	City's Net Cost	Incremental Net Cost	Net cost per MT CO2e reduction	Easy to implement	Easy to measure	Private investment leverage	Local economic benefits	Other environmental benefits	Health benefits

Problem description

Mountain View currently provides free and abundant parking, which offers a major incentive for the use of solo, internal-combustion engine vehicles, thus contributing to nearly 60% of community greenhouse gas emissions (GHGe). 60% of urban trips are home-based (not commuting)[4]. A suite of policies to restrict and price parking has been shown to reduce GHG emissions from vehicle miles travelled (VMT) significantly when implemented together and paired with other convenient travel alternatives. The fiscal cost of building a parking space is at least $76,000[5], and a new parking garage could cost $20 million.[6] The GHGe associated with land allocated to parking include the embodied emissions in materials for building and maintaining parking lots and structures. Limiting and charging for parking are necessary for getting people to switch from solo driving to other modes (transit, biking, walking and shared rides).

Recommendations

Incentivize non-solo driving through parking restrictions paired with attractive travel alternatives. People will only give up the convenience of driving solo vehicles if biking, walking, transit and shared rides are available and equally attractive. Parking fees would encourage travelers to switch to other modes and would also will raise funds to underwrite shared rides, bike infrastructure, electric vehicle (EV) charging and other measures that together will transform the GHG intensity of transportation. These measures will be implemented when other options are more available, beginning in 2020. Outreach will be key to success.

1. **Implement modest fees for parking** in downtown public lots and parking structures. Use funds collected to **underwrite investments in bicycle and EV-charging infrastructure** (Recommendations T5, T3)**, Transit** (Recommendations T4A and T4B)**, and in Transportation Demand Management (TDM) outreach** (Recommendation T7).
   a. Continue to sell parking passes for employers but raise fees modestly to cover enforcement costs.
   b. Encourage employers to purchase discounted transit passes for employees as an alternative to driving and parking.
2. **Charge for on-street parking downtown.** This will encourage turnover of parking spaces. Annual gross revenue from on-street and garage parking fees would be approximately $17,199,000 per year. Net revenues would be less implementation and enforcement costs.

[4] Capcoa August 2010 page 217

[5] Palo Alto RFP for new Garage in 2018 will cost $88,261 per space or $40.4 million for 460 spaces https://www.paloaltoonline.com/news/2018/01/23/rising-costs-wont-shrink-california-avenue-garage

[6] Downtown Parking Study 2011 by Wilbur Smith Associates http://www.mountainview.gov/civicax/filebank/blobdload.aspx?blobid=8490 page 124

3. **Implement neighborhood parking permits for a modest fee** to ensure that CalTrain and downtown employee parking does not spill into neighborhoods. Fines from parking enforcement can help offset administration costs not recovered from the annual fees. Some free guest passes would be included.
4. **Unbundle parking from rents for residential and commercial tenants city-wide** to have people become aware of the true costs of parking. ($100/month for parking is average cost in country). The City would encourage this change for both existing and new buildings. Construction permits for new buildings or major remodels would require Transportation Demand Management Plans (T7) which could include landlords charging separately for parking and apartment/office rent (unbundling costs).
5. **Rent parking spaces to autonomous EV fleets to recharge and park at night** when demand for shared rides is low and parking lots are otherwise empty, to encourage EV adoption. Revenue from this to be determined through negotiation with autonomous vehicle (AV) companies. See T4A and B.

Create a pedestrian mall on Castro Street from West Evelyn Avenue (or possibly Villa Street) to California Street. This will attract more people to dine, shop and socialize in the downtown area. Convert pavement to pervious surfaces and plantings. Provide a bicycle lane and more bicycle parking, and potentially simplify the transit center re-design. This added attraction, along with free shared rides (T4A and B) will make downtown more attractive and offset any loss of customers due to parking fees. This can be done quickly and at low cost, as demonstrated in NYC.

Pearl St. Pedestrian Mall, Boulder, CO

Carrots and Stick: Communities and companies that have put a price on parking do so in concert with convenient alternatives. This is true for the City of San Francisco and Stanford University where parking is expensive and public transit is available. Redwood City, San Jose and Berkeley charge for parking downtown on streets and in lots. Managers of large corporate or academic campuses ensure that commuters have options and active outreach programs for transit, carpooling, biking and walking. Without such leverage and options, it is hard to get people to give up solo vehicles.

Municipalities where already implemented Bay Area cities that have implemented paid downtown parking include San Francisco, Berkeley, Oakland, Redwood City, and San Jose. Restricted parking is key to success in Emeryville and Stanford.

Funding sources

- California Department of Transportation offers grant funding for Complete Streets and Sustainable Communities http://www.dot.ca.gov/hq/tpp/grants.html
- CA Strategic Growth Council offers grants for sustainable communities and regional collaboration.

* Companies that sell equipment to charge for parking recover their costs from the parking fees for the implementation of parking systems. Potential vendors include:

  - ParkMobile https://parkmobile.io/ (used by Stanford University)
  - PaybyPhone.com (pay by phone, app or kiosk. Used by Berkeley.)
  - IPS Group https://www.ipsgroupinc.com/parksmarter/
  - Sentry http://www.sentrycontrol.com/products/global-parking
  - Parkeon http://www.parkeon.us/

Author Marianna Grossman

Detailed analysis

SWOT analysis

Strengths:

- Using parking fees to fund attractive travel options **improves convenience for everyone**
  - A modest parking fee can generate significant funds to support alternative modes.
  - By encouraging the use of other modes of traffic to reach downtown, parking becomes more convenient for those who do choose to drive.
- Modern technology offers options to make it easy to add paid parking, and easy for patrons to pay for parking using mobile phones or kiosks.
- CalTrain, VTA LightRail and the Mountain View Shuttle serve downtown.
- A pedestrian mall on Castro would enhance the attractiveness of the area, offsetting the possible deterrence of parking fees to keep retail sales constant or growing.
- Multi-family properties with fewer cars can save the cost of providing extra parking.
- Residents will become less dependent on privately owned cars and have lower transportation costs.

Weaknesses:

- Retail merchants may object to parking fees for fear of discouraging shoppers and diners
- Residents may object to having to pay for parking which has previously been unpriced
- Solo driving is a tough habit to break
- Charging for parking could place a burden on low-wage earners who are not able to take transit due to schedules or distances traveled

Opportunities and co-benefits:

- Providing funds for convenient transit or AV, for biking infrastructure, and for Transportation Demand Management (TDM) outreach will bring more customers to businesses than current constrained parking will allow, while avoiding the high cost of providing new parking.
- EV charging can be included with systems that recoup cost of electricity used.
- Bicycle parking could be included in parking space upgrades.
- Discouraging parking will encourage use of more environmentally-friendly options.
- Active transportation communities may be perceived as more “livable”.
- Biking, transit and shared rides must be in place for parking restrictions to be successful and vice versa.
- Work with neighboring cities to implement paid parking throughout Santa Clara and San Mateo Counties.
- In the long term, as fewer parking spaces are needed, parking lots can be repurposed to create green space / permeable space or more offices and housing.

Threats:

- A strong economy combined with reduced immigration could create labor shortages for public works projects, higher construction costs and delays in project completion.
- If other communities continue to offer free parking, that could end up stimulating people to drive longer distances.
- Some drivers may be concerned about privacy from some automated parking systems.

Assumptions and Uncertainty

Assumptions with High Uncertainty:

- Availability of funding for staff to create policies and implement parking technology.
- Availability of labor to complete infrastructure projects.
- Possible loss of business to cities and shopping areas that still offer free parking.

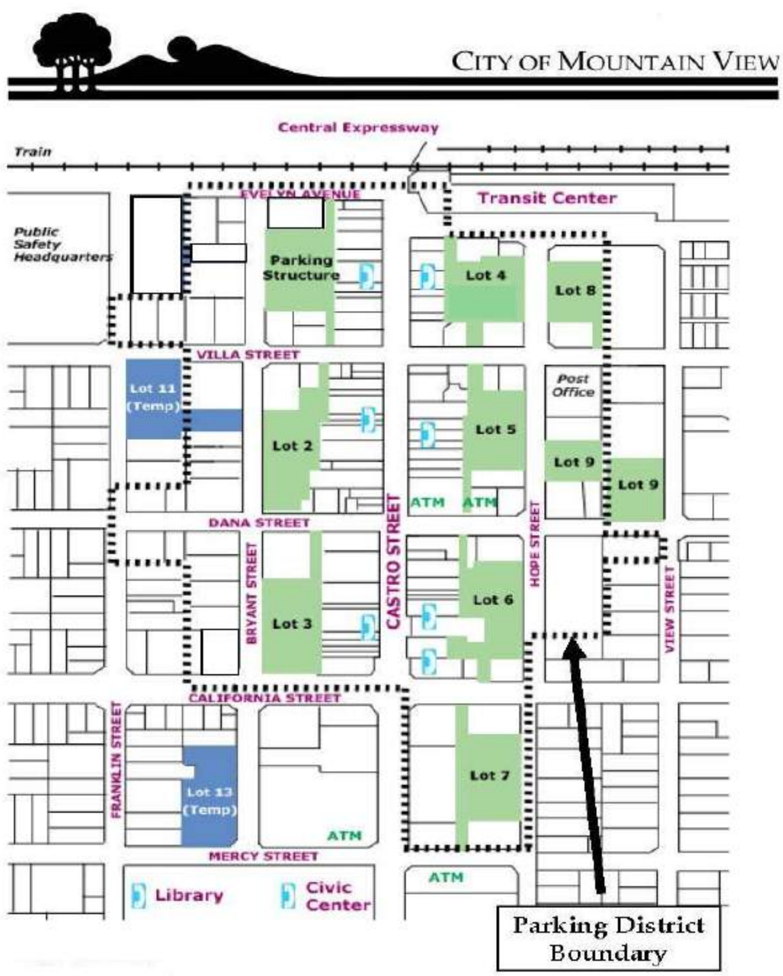
Assumptions with Low Uncertainty:

- Environmental impact of reducing solo vehicle driving to downtown.
- Improved quality of life with more attractive pedestrian and bike facilities.
- Need to protect neighborhood parking for residents from overflow from paid parking.
- Complementary policies are necessary. The "stick" of paid parking must be accompanied by the "carrot" of support for attractive alternatives to motive new behavior.

Reference:

Street Fight: Handbook for an Urban Revolution by J. Sadik-Khan and S. Solomonow, Viking, 2016
"A city whose streets invite people to walk, bike, and sit along them also inspires people to innovate, invest and stay for good.…They must be designed to encourage street life, economy and culture" (p. 3).

Map of Downtown Parking District from the City of Mountain View website



https://www.mountainview.gov/civicax/filebank/blobdload.aspx?BlobID=2331
This is where paid parking would be implemented. The neighborhoods within 6 blocks would be part of the neighborhood parking permit program.

Environmental analysis

The California Air Pollution Control Officers Association (CAPCOA) August 2010 study estimates reductions from implementing parking restrictions and fees.

We estimate that:

Parking restrictions, fees and unbundled parking will cause 3% of all trips city-wide to be switched out of fossil-fuel powered single-occupancy vehicle (SOV)s by 2030

Effects will begin to become evident in 2021 and will ramp up linearly to the 3% by 2030. The new parking policy is intended to remain effective permanently. Costs and GHG savings are calculated through 2030.

The average trip replaced is 5.5 miles, because that is the average distance of every car trip.

The miles saved between now and 2030 is 223,245,381.

The MTCO2e/mile through 2030 is 61,549.

Annual Gross Revenues from Parking Fees would be about $17,199,000 per year.

Rule of Thumb of Impact of Limiting Parking Supply from CAPCOA study says:

- Limit Parking Supply 5-12.5% VMT reduction
- Unbundle Parking Costs from Property Cost 2.6-13%
- Implement Market Price Public Parking (On-Street & Garages Downtown) 2.8-5.5%

We are assuming 3% of all city trips will be affected because not all trips are going to or from downtown.

Impact of Pedestrian Mall

The VMT reduction of a pedestrian mall is small but has other co-benefits, such as carbon sequestration from additional trees and landscaping. 1) The city is already planning to close Castro at Central. 2) We have experience with routing traffic around Castro during street fairs. 3) Closing Castro would provide an ideal permanent location for the farmers' market.

Creating a pedestrian mall with bike lanes and rain gardens will reduce runoff from impermeable surfaces, reduce the urban heat island effect, and increase walking and biking downtown. Charging for parking will encourage mode shift to active transportation (T5*)*, transit (T4A), and shared rides (T4B*)*. The resulting GHG reductions are covered in those plans.

Cost analysis

Cost to implement parking meter or other toll collection system can be paid back through parking revenues. Potential revenue for 75% occupancy of 1584 off-street parking spaces and 1125 on-street parking spaces. Assuming parking fees begin at 8 am and run through 8 pm, seven days per-week at $2.00 per-hour, total annual revenue to the City would be $17,199,000, less the estimated cost $2 million for facility upgrades, enforcement and fees to the parking meter provider. Revenue would be further diminished by providing subsidized parking permits for downtown merchants and employees, especially low-income employees. Given a 40% increase in service population and nearly full occupancy of garages with current population, parking revenue would likely be steady, with increased turnover of parking spaces, while still encouraging people to take alternative forms of transportation.

Per the Alameda study, pp. 62 & 63: *"free parking on a typical surface lot costs about $1,500 – $3,000 per year plus an additional $300 per year operating and maintenance costs. This amount works out to* *about $7 – $12 per space per day in hidden costs."* This is based on land cost of $3 million – $5 million per acre, a 6% interest rate, and current estimates of operating and maintenance costs. See Victoria Transportation Policy Institute, TDM Encyclopedia: http://www.vtpi.org/tdm/[7]

Converting Castro Street to a pedestrian mall and bike path would eliminate a small number of on-street parking spaces but would increase retail and restaurant traffic as the area becomes a magnet for pleasant year-round strolling, dining, shopping and socializing. More bike parking would encourage more people to get downtown by bike.

NYC has done this inexpensively with paint, moveable barriers and furniture, showing an immediate adoption of the space by pedestrians and increased economic vitality for merchants and restaurants.

T6 References

Policy: Restrict and charge for parking to incentivize people to switch from driving solo occupancy and internal combustion engine (SOV and ICE) vehicles. Use funds to underwrite the costs of alternatives (EV charging, Bike Infrastructure, Transit and Shared Rides)

1. Implement modest fees for parking in downtown public lots and parking structures
2. Charge for on-street parking downtown
3. Implement neighborhood parking permits for a modest fee
4. Unbundle parking from rents for residential and commercial tenants city-wide
5. Rent parking spaces to autonomous EV fleets to recharge and park at night
6. Create a pedestrian mall on Castro Street

Background information on Parking in Downtown Mountain View:[8]

From City Website: The Downtown is supported by 11 public parking facilities - 2 parking structures and 9 surface parking lots with approximately 1,500 off-street parking spaces. These off-street parking spaces have timed parking structures from Monday through Friday, 8:00 am to 5:00 pm (excluding holidays). To help manage daytime parking demands between long-term parkers and short-term parkers, the City administers a Downtown Parking Permit Program[9] for property owners, businesses and residents within the Parking District.

2018 Downtown Parking Permit Fees and Application

Annual permits are $336.00 - 2018 Annual Permit Application[10]

Quarterly permits are $112.00 - 2018 Quarterly Permit Application[11]

Monthly permits are $56.00 - 2018 Monthly Permit Application[12]

Daily permits are $112.00 (25 daily permits per pack) -2018 Daily Permit Application[13]

---

7 http://www.vtpi.org/tdm/
8 https://www.mountainview.gov/depts/comdev/economicdev/downtowndev/dtparking.asp
9 https://www.mountainview.gov/depts/comdev/economicdev/dtparking/default.asp
10 https://www.mountainview.gov/civicax/filebank/blobdload.aspx?BlobID=24793
11 https://www.mountainview.gov/civicax/filebank/blobdload.aspx?BlobID=24794
12 https://www.mountainview.gov/civicax/filebank/blobdload.aspx?BlobID=24795
13 https://www.mountainview.gov/civicax/filebank/blobdload.aspx?BlobID=24796

Supporting Materials for Policy Elements:

1. Implement modest fees for parking in downtown public lots and parking structures.
2. Charge for on-street parking downtown.

From the Downtown Parking Study 2011[14]

"Restricting parking through time, price, or other methods causes drivers to reevaluate their transportation choices. Faced with parking restrictions, many will continue to drive to Downtown Mountain View, but some may begin to consider making their trip using an alternative mode of transportation. Restricting and pricing parking makes sustainable modes of transportation like transit, walking, and bicycling relatively more attractive to downtown visitors and employees. Managing parking thus also helps the City maximize the investment it has made in creating a transit, bicycle, and pedestrian friendly downtown. In addition to changing individual mode choices, parking management can also reduce congestion and vehicle miles traveled by ensuring that parking spaces are immediately available to drivers who need them. In congested areas where parking is completely full, a great deal of excess traffic is generated by drivers "cruising" for empty spaces. In large downtowns, Professor Donald Shoup has estimated that as much as 30% of vehicular traffic observed during peak hours is generated by drivers circling to find a vacant space. In addition to generating unnecessary traffic, the hunt for parking also distracts drivers and can create additional safety hazards for pedestrians and cyclists." Page 7

Inventory as of 2011: 5,669 public parking spaces; 3,558 on-street spaces and 2,111 off-street spaces $158,000 is collected from businesses in downtown Parking Maintenance Assessment District and has not been increased since 1997. This covered half the cost of maintenance in 2011. Page 124

Restricting parking can save the City the avoided cost of building a new parking structure, estimated to cost $20 million or from $30,000 to $76,000 per space in a mixed retail/parking building.

Source for Cost of Parking Structures: Wantman Group, Inc. (WGI) Parking Structure Cost Outlook 2017, Oct. 2017[15]

Note: We calculated the maximum GHGe reductions that we could attribute to parking policies and then reduced the percentage based on gradual implementation and that parking downtown is linked to only a portion of VMT in Mountain View.

Source for determining likely VMT reductions for policies to restrict and price parking:

Quantifying Greenhouse Gas Mitigation Measures A Resource for Local Government to Assess Emission Reductions from Greenhouse Gas Mitigation Measures August 2010 California Air Pollution Control Officers Association with Northeast States for Coordinated Air Use Management National Association of Clean Air Agencies Environ Fehr & Peers [16]

Calculations for GHG reductions from restricting parking:

These assumptions were drawn from the CAPCOA GHG Quantification Report from 2010

From Chart 6-2: Transportation Strategies Organization

---

[14] https://www.mountainview.gov/civicax/filebank/blobdload.aspx?blobid=8490
[15] https://wginc.com/parking-structure-cost-outlook-october-2017/
[16] http://www.capcoa.org/wp-content/uploads/2010/11/CAPCOA-Quantification-Report-9-14-Final.pdf

"Parking Policy / Pricing: Max VMT reduction of 20%, through a combination of these items:
Policy: PDT-1 Limit Parking Supply 5-12.5% VMT reduction

3.3 Parking Policy/Pricing 3.3.1 Limit Parking Supply Range of Effectiveness: 5 – 12.5% vehicle miles travelled (VMT) reduction and therefore 5 – 12.5% reduction in GHG emissions. Measure Description: The project will change parking requirements and types of supply within the project site to encourage "smart growth" development and alternative transportation choices by project residents and employees. This will be accomplished in a multi-faceted strategy: · Elimination (or reduction) of minimum parking requirements · Creation of maximum parking requirements · Provision of shared parking (page 207)

"…the degree of effectiveness of this measure will vary based on the level of urbanization of the project and surrounding areas, level of existing transit service, level of existing pedestrian and bicycle networks and other factors which would complement the shift away from single-occupant vehicle travel." (page 208)

Policy: PDT2 Unbundle Parking Costs from Property Cost 2.6-13% VMT Reduction

3.3.2 Unbundle Parking Costs from Property Cost Range of Effectiveness: 2.6 – 13% vehicles miles traveled (VMT) reduction and therefore 2.6 – 13% reduction in GHG emissions. Measure Description: This project will unbundle parking costs from property costs. Unbundling separates parking from property costs, requiring those who wish to purchase parking spaces to do so at an additional cost from the property cost. This removes the burden from those who do not wish to utilize a parking space. Parking will be priced separately from home rents/purchase prices or office leases. An assumption is made that the parking costs are passed through to the vehicle owners/drivers utilizing the parking spaces. Measure Applicability: · Urban and suburban context · Negligible impact in a rural context · Appropriate for residential, retail, office, industrial and mixed-use projects · Complementary strategy includes Workplace Parking Pricing. Though not required, implementing workplace parking pricing ensures the market signal from unbundling parking is transferred to the employee. (page 210)

Transform estimates that an unbundled parking space is worth 16% of the average rent for an apartment.

Policy: PDT-3 Implement Market Price Public Parking (On-Street) 2.8-5.5% VMT Reduction

3.3.3 Implement Market Price Public Parking (On-Street) Range of Effectiveness: 2.8 – 5.5% vehicle miles traveled (VMT) reduction and therefore 2.8 – 5.5% reduction in GHG emissions. Measure Description: This project and city in which it is located will implement a pricing strategy for parking by pricing all central business district/employment center/retail center on-street parking. It will be priced to encourage "park once" behavior. The benefit of this measure above that of paid parking at the project only is that it deters parking spillover from project supplied parking to other public parking nearby, which undermine the vehicle miles traveled (VMT) benefits of project pricing. It may also generate sufficient area-wide mode shifts to justify increased transit service to the area. Measure Applicability: · Urban and suburban context · Negligible impact in a rural context · Appropriate for retail, office, and mixed-use projects · Applicable in a specific or general plan context only · Reduction can be counted only if spillover parking is controlled (via residential permits) · Study conducted in a downtown area, and thus should be applied carefully if project is not in a central business/activity center (page 213)

3.3.4 Require Residential Area Parking Permits Range of Effectiveness: Grouped strategy. (See PPT-1, PPT2, and PPT-3) Measure Description: This project will require the purchase of residential parking permits (RPPs) for long-term use of on-street parking in residential areas. Permits reduce the impact of spillover parking in residential areas adjacent to commercial areas, transit stations, or other locations where parking may be limited and/or priced. Refer to Parking Supply Limitations (PPT-1), Unbundle

Parking Costs from Property Cost (PPT2), or Market Rate Parking Pricing (PPT-3) strategies for the ranges of effectiveness in these categories. The benefits of Residential Area Parking Permits strategy should be combined with any or all the above-mentioned strategies, as providing RPPs are a key complementary strategy to other parking strategies. Measure Applicability: · Urban context · Appropriate for residential, retail, office, mixed use, and industrial projects Alternative Literature: · -0.45 = elasticity of vehicle miles traveled (VMT) with respect to price · 0.08% greenhouse gas (GHG) reduction · 0.09-0.36% VMT reduction Moving Cooler [1] suggested residential parking permits of $100-$200 annually. This mitigation would impact home-based trips, which are reported to represent approximately 60% of all urban trips. The range of VMT reductions can be attributed to the type of urban area." (page 217)

Additional Resource on Evaluating Impact of Parking Infrastructure on GHG Emissions

Research, such as reported by Chester, Horvath and Madanat, show the interrelated environmental impacts of free parking and provide a solid rationale for limiting parking and charging users its true full costs to stimulate switching to greener transportation modes. *Parking infrastructure: energy, emissions, and automobile life-cycle environmental accounting.* Mikhail Chester[1], Arpad Horvath and Samer Madanat. Published 29 July 2010 • IOP Publishing Ltd.[17] [18] [19]

Example of Parking Payment System Using Mobile Phone and/or Kiosk for Payments

Pay-by-space parking system using PayByPhone technology. Can pay with credit card, cash, using app or by calling phone number. These photos are from a UC Berkeley owned garage in downtown Berkeley. Photo taken by Marianna Grossman 5/6/2018

6. Create a pedestrian mall on Castro Street

Example for Inexpensive Conversion of Street to Pedestrian Plaza: This blog explains why it is important to plan for people and places, rather than planning to optimize for cars and traffic. It also shows that conversions for pedestrian malls can be fast and inexpensive.

Lighter, Quicker, Cheaper: Convert Street to Pedestrian Plaza from DeepRoot: Green Infrastructure for Your Community http://www.deeproot.com/blog/blog-entries/the-rise-of-the-pedestrian-plaza-street-to-plaza-conversions-in-the-u-s

"Street closures are often controversial, and all communities worry about the effects of closures on emergency response vehicles, street network connectivity, and the capacity of adjacent streets. Yet most communities find that the closures do not impede access. When designing a street-to-plaza project, it is important to preserve access to homes and businesses while eliminating through traffic. Drivers will have less access to the street, but people walking, or bicycling will have full access. In this type of closure, bollards or planters are installed in a line across the street with five-foot gaps for bicyclists. In the center, a

[17] iopscience.iop.org/journal/1748-9326
[18] http://iopscience.iop.org/volume/1748-9326/5
[19] http://iopscience.iop.org/issue/1748-9326/5/3

10-foot-wide gap is provided for EMS vehicles designed to allow access by EMS vehicles but not the public." From Chapter 1, Three Revolutions: Steering Automated, Shared, and Electric Vehicles to a Better Future by Daniel Sperling, Washington, DC, Island Press, March 2018

Impact of Shared AVs on Parking:

"The effects on traffic congestion could go either way. In the most positive scenario, if all AVs are shared rather than privately owned, the congestion problem evaporates. Vehicle use would drop significantly (thanks to poolings), and road space utilization would improve dramatically. On-street and much off-street parking, including parking garages, could be repurposed as public space–including wider sidewalks, more trees, bike lanes, and street furniture–and used for affordable housing and parks. On the other hand, if self-driving cars are privately owned by individuals, many of those expensive cars will spend considerable time circling the block endlessly and returning to remote parking lots instead of paying for parking. Think of what this will do for congestion."[20]

[20] *Three Revolutions: Steering Automated, Shared, and Electric Vehicles to a Better Future* by Dan Sperling, Island Press, 2018

Support bicycling as a primary mode of transportation **(T5)**							**Infra-structure**	**12 years**	
Recommendation name							Type	Duration	
88,105	**$28M**	**$0**	**$322**	●○○	●●○	●●○	●●●	●●●	●●●
MT CO2e reduction 2018-2030	City's Net Cost	Incremental Net Cost	Net cost per MT CO2e reduction	Easy to implement	Easy to measure	Private investment leverage	Local economic benefits	Other environmental benefits	Health benefits

Problem description

Mountain View is ideally situated for transportation by bike, with flat terrain, a dry, mild climate, and major employers and transit hubs within easy biking distance. However, people wanting to commute or shop by bike often face significant barriers. Although the city has a dense network of bikeways, this network is broken up by gaps, high-stress segments, and inadequate signage that pose significant deterrents for would-be cyclists.

Increasing bicycle transportation is not only an effective way to reduce GHG emissions, ***it is the most cost-effective way to limit road congestion and gridlock as the service population continues to increase***.

Recommendations

The city's Bicycle Transportation Plan (BTP) lays out ambitious goals for creating a network of connected, low-stress bikeways to facilitate bicycle transportation in the city and surrounding region. The city should

- Fund and implement the projects described in the BTP and adopt a planning process for completing the highest-priority projects within five years.
- Explore ways to reduce the friction created by traffic lights and stop signs, which place a greater burden on cyclists than on drivers. As part of these recommended upgrades, the city may need to increase its staffing levels to enable the evaluation and oversight associated with the increased level of construction activity. Our cost estimates assume that the city will hire one additional full-time-equivalent in connection with these goals.
- Ensure that there is adequate bike parking to meet the needs of local bicyclists, and it should work with Caltrain to ensure adequate supply of convenient, secure bike parking at the Mountain View and San Antonio stations.
- Continually assess the demand for short-term and long-term bike parking and install new parking infrastructure as needed.
- Adopt policies that require or incentivize existing employers and multi-family property managers to offer secure bike parking for employees and residents. Existing requirements should be reevaluated considering projected increases in bicycling mode share.
- Implement a bike share program that meets the needs of local cyclists by, for example, providing access to bikes outside the downtown area.
- Maintain programs to support and encourage bike transportation, including incentives provided by employers and TMAs.

To enable the city to make infrastructure improvements based on need rather than opportunistically, the city ought to collect developer fees in a general fund to finance infrastructure improvements that are prioritized according to their intrinsic merits and the needs of the community (as is currently done in San

Francisco and Oakland). This would replace the current practice of applying developer fees to road projects that are adjacent to construction developments.

SWOT analysis

Strengths:

- Favorable geography and climate
- Physically active population
- Existing city policy and plans favoring bike transportation, as embodied in the BTP and the North Bayshore Precise Plan

Weaknesses:

- High expense of capital improvements
- Overlapping regulatory jurisdictions over certain roadways or rights of way
- Possible objections to car lanes being narrowed or eliminated in favor of bike lanes
- Ingrained driving habits

Opportunities and co-benefits:

- Reduced road congestion
- Reduced need for public parking
- Well-documented health benefits
- Perception of bike-friendly communities as being as more "livable"

Threats:

- Increasing labor costs for road improvements, particularly as economy strengthens
- Reduced environmental benefit relative to driving as EVs become increasingly prevalent

Municipalities where already implemented U.S. municipalities of comparable size and demographics that are highly supportive of bike transportation include Palo Alto, CA; Davis, CA; Boulder, CO; and Fort Collins, CO.

Funding sources Additional funding sources are identified in T5 Appendix E to the BTP.

Grants from VTA (through the Bicycle Expenditure Program[21]), ABAG (through the One Bay Area Grant program[22]), and the Bay Area Air Quality Management District[23]

City-generated revenues from parking fees (if the city adopts paid parking; Rec. T6), new taxes under consideration by the City Council, developer fees and TDM/TMA dues and fees (T7).

Assumptions and uncertainty

Assumptions with High Uncertainty:

- Availability of funding for infrastructure projects
- Number of new bicycle trips generated by improved bicycle infrastructure

Assumptions with Low Uncertainty:

- Environmental impact of reducing vehicle miles traveled
- Health benefits of bicycling
- Worsening road congestion between now and 2030

Author: Paul Blumenstein

---

[21] http://www.vta.org/projects-and-programs/planning/bikes-bicycle-expenditure-program-bep
[22] https://mtc.ca.gov/our-work/fund-invest/federal-funding/obag-2
[23] http://www.baaqmd.gov/grant-funding/public-agencies

Detailed analysis

Recommendations

Upgrade the network of bikeways so that residential and commercial districts, employment centers and neighboring communities are all connected by low-stress bike routes

The BTP lays out ambitious goals for creating a network of connected, low-stress bikeways to facilitate bicycle transportation in the city and surrounding region. The city should fund and implement the projects described in the BTP, and should adopt a planning process for completing the highest-priority projects within five years, with a focus on the following goals:

- Eliminate major gaps in the bikeway network
- Reduce the stress levels of principal bikeways through protected or buffered bike lanes
- Create low-stress bike routes along three major north-south routes (e.g., Rengstorff and Shoreline, in addition to the Stevens Creek Trail) and three major east-west routes (e.g., El Camino Real, Caltrain right-of-way and Middlefield)
- Ensure that the Downtown Transit Center, the major employment centers, and the bikeway networks of neighboring communities are easily accessible by bike from any location in the city

In addition to providing low-stress bikeways, the city should explore ways to reduce the friction created by traffic lights and stop signs, which place a greater burden on bicyclists than on drivers. Accordingly, the city should:

- Create bicycle boulevards that eliminate stop signs and incorporate traffic-calming features
- Ensure that signal-controlled intersections accommodate bicyclists either through bike-detecting sensors or on-demand manual controls, and ensure that signals provide adequate time for cyclists to cross
- On multi-lane roads such as Shoreline Boulevard, design intersections to facilitate safe left turns that eliminate the need for cyclists to cut across multiple lanes of traffic

As part of these recommended upgrades, the city may need to increase its staffing levels to enable the evaluation and oversight associated with the increased level of construction activity. Our cost estimates assume that the city will hire one additional full-time-equivalent in connection with these goals.

Pool developer fees to enable the city to take a more methodical approach to infrastructure planning

Road improvements are often financed by developer fees paid by developers of adjacent projects. This opportunistic approach limits the city's ability to plan in upgrading its bikeway network to serve the actual needs of bicyclists. The city should increase the degree to which it collects developer fees in a general fund, as is the case with transportation impact fees and community benefit funds, to finance infrastructure improvements that are prioritized according to their intrinsic merits and the needs of the community. This is currently done in San Francisco and Oakland.

Ensure an adequate supply of bike parking, including secure parking where needed

Bike transportation cannot grow in popularity without an adequate supply of secure parking where bicyclists can leave their bikes for extended periods. In addition, if the city is successful in its goal of promoting bike transportation, particularly if it adopts a dockless bike share program (discussed below), places such as the downtown area will experience "bike litter" as parked bikes clutter public areas.

Accordingly:

- The city should work with Caltrain to ensure an adequate supply of convenient, secure bike parking at the Mountain View and San Antonio stations.
- To encourage bicyclists to park in appropriate places, the city should continually assess the demand for short-term and long-term bike parking and install new parking infrastructure as needed.
- The city should adopt policies that require or incentivize existing employers and multi-family property managers to offer secure bike parking for employees and residents. The city should also provide incentives for shopping centers to create or expand bike parking areas. Existing requirements should be reevaluated considering projected increases in bicycling mode share.

Adopt a bike share program that is tailored to the needs of the city's residents

A well-designed bike share program has significant potential for driving modal shift from driving to bicycling by making bike transportation available to persons who have not made the full commitment to bike ownership. A traditional dock-based program, however, is of limited utility if bike stations only serve limited parts of the city. The city has begun piloting a "dockless" bike share program, which will enable participants to find bikes and drop them off anywhere in the coverage area.

The ideal bike share program would incorporate the following features:

- It would make bikes available wherever there is demand, including locations near residential neighborhoods.
- It would offer some electric-assist bikes (e-bikes) to facilitate longer trips (as is the case with one of the pilot participants, LimeBikes).
- It would offer some cargo bikes (bikes that are specially configured for carrying packages or groceries) to enable shopping by bike.
- In areas where large numbers of bikes are likely to be parked, such as downtown, it would restrict parking to designated bike racks or geo-fenced areas to reduce the risk of "bike litter."

Adopt programs to support and encourage bike transportation

Widespread modal shift from driving to bicycling requires support and education so that more members of the service population will come to recognize bicycling as a viable and attractive transportation alternative. The city should adopt or continue the following programs to support and encourage bike transportation:

- Programs through employers and TMAs to encourage and incentivize bike transportation
- Improved signage
- Online and print resources to highlight low-stress bike routes and assist with trip planning
- Direct support, such as public self-service repair stations and guided tours of low-stress bike routes to popular destinations
- Continued encouragement of biking to school through the Safe Routes to School Education and Encouragement program

Environmental analysis

Based on the bike mode share statistics reported in U.S. cities with comparable geography and demographics, we believe Mountain View can attain the following bike mode shares by 2030:

- 20% of trips to and from work (up from the current 6.1%);[24]
- 25% of trips to and from the Mountain View and San Antonio Caltrain stations (up from the current 17%);[25]
- 30% of trips to and from K-12 schools (up from the current 14.2%);[26]
- 20% of trips to and from local colleges (up from the current 10%); and
- 10% of other local trips (up from an assumed 2%).

Our calculation of projected GHG reduction is presented in **T5 Table 1**[27]. For purposes of these projections, we have assumed that (1) our recommendations do not begin to show an impact on bike mode share until 2021, and, thereafter, they increase bike mode share on a straight-line basis until 2030, (2) the proportions of the service population represented by commuters, K-12 students and college students remain constant between now and 2030, and (3) the number of Caltrain riders boarding at Mountain View and San Antonio rise in proportion to the increase in ridership projected by Caltrain between 2015 and 2040 (assuming the increases occur on a straight-line basis over that period).[28]

Cost analysis

Estimated costs are broken down in **T5 Table 2**.[29] Our primary cost estimates are based on the estimates set forth in the Bicycle Transportation Plan (BTP), assuming that (1) all projects identified on Table 5-7 of the BTP as high or medium priority are completed by 2030, (2) this project completion schedule requires the employment of one additional full-time-equivalent employee over a 10-year period between 2020 and 2030, and (3) completion of these projects results in the city incurring maintenance costs associated with an additional 3.95 miles of Class I bikeway (mixed-use path similar to the Stevens Creek Trail), 4.98 miles of Class II bikeway (standard bike lane), and 3.95 miles of Class IV bikeway (grade-separated bikeway) over an average of seven years between 2020 and 2030 (i.e., assuming it takes an average of 5 years to complete each project starting in 2018). These costs exclude the following projects:

- All projects included in the North Bayshore Precise Plan, which we assume will be completed as part of the redevelopment of the North Bayshore area.
- Projects that city staff has identified for us as being already completed or in process or as having been determined to be infeasible.

---

[24] This mode share is comparable to those reported by Davis, CA and Boulder, CO. See http://bikeleague.org/sites/default/files/bfareportcards/BFC_Spring_2016_ReportCard_Davis_CA.pdf and https://www-static.bouldercolorado.gov/docs/Modal_Shift_1990-2015_Report_2016-05-27-1-201708041213.pdf.

[25] This mode share is comparable to that reported by Caltrain at the Menlo Park station. See http://www.caltrain.com/Assets/_Planning/Bicycle+Access+and+Parking+Plan/Bicycle+Parking+Management+Plan+-+Final.pdf.

[26] This mode share is comparable to that reported by the City of Palo Alto. See https://www.cityofpaloalto.org/civicax/filebank/documents/58233.

[27] https://docs.google.com/spreadsheets/d/1GJecFJhyzDSkXdF9YiE1_ri6EdBD9hSGwJZ5VTdlXPU/edit#gid=1175791848

[28] Caltrain per-station ridership estimates are set forth in http://www.caltrain.com/Assets/_Marketing/pdf/2015+Annual+Passenger+Counts.pdf. Projected increase in ridership is based on http://www.caltrain.com/Assets/Caltrain+Modernization+Program/Documents/PCEP+FAQ.pdf.

[29] https://docs.google.com/spreadsheets/d/1GJecFJhyzDSkXdF9YiE1_ri6EdBD9hSGwJZ5VTdlXPU/edit#gid=378382003

- Increased secure bike parking at Caltrain stations, the cost of which we assume will be covered by Caltrain, as discussed in the Caltrain Bike Parking Management Plan.[30] We estimate that the cost of such parking facilities will be offset by fees paid by bike commuters who use the facilities. For example, at the Palo Alto Caltrain station, secure bike parking is provided by a private vendor, BikeHub, which charges $8.00 for a 7-day pass, $20.00 for a 30-day pass and $95.00 for a one-year pass.[31] We have not included these costs as Incremental Net Cost because they are replacing the higher costs associated with automobile parking.
- Soft costs such as engineering and administrative costs incurred by the city.

T5 References

Mountain View 2015 Bicycle Transportation Plan: http://www.mountainview.gov/civicax/filebank/blobdload.aspx?BlobID=18294

North Bayshore Precise Plan: http://www.mountainview.gov/civicax/filebank/blobdload.aspx?BlobID=15050

El Camino Real Precise Plan: http://mountainview.gov/civicax/filebank/blobdload.aspx?BlobID=15251

Pucher and Buehler, "Making Cycling Irresistible: Lessons from The Netherlands, Denmark and Germany" (Transport Reviews, Vol. 28, No. 4, 495–528, July 2008): http://betterbike.org/wp-content/uploads/2013/12/Making-Cycling-Irresistible-Lessons-from-Europe-Pucher-2008.pdf

Annual school days number is based on http://www.ecs.org/clearinghouse/95/05/9505.pdf

Estimates of bike parking costs are based on Lane Transit District (Eugene, OR) Regional Bike Parking Study (October 2013): https://www.ltd.org/p2p-regional-bike-parking-study/

T5 Appendix

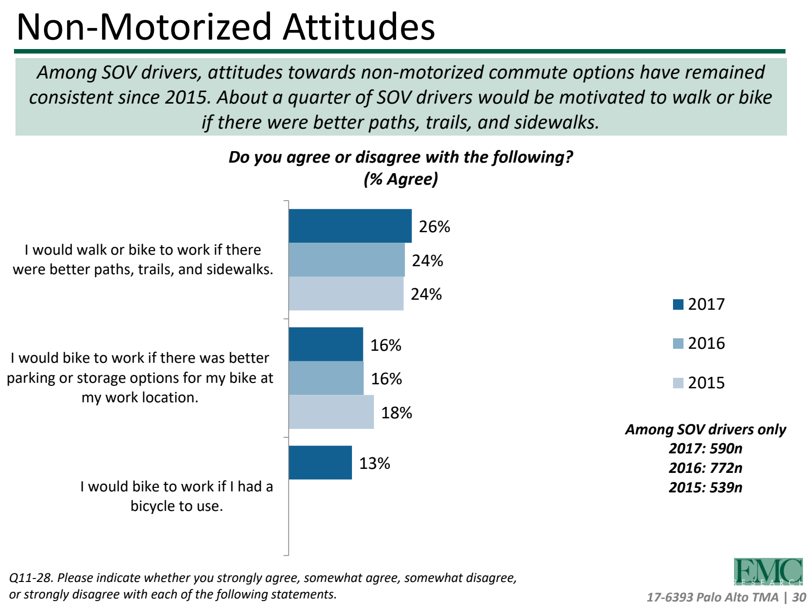
How government support can drive modal shift

The places most often cited as models for bike-friendliness and popularity of bicycle transportation are the Netherlands and Denmark. The bike mode share in these places is largely a reflection of cycling-friendly infrastructure and robust government support, as detailed in a paper by Rutgers professors John Pucher and Ralph Buehler titled "Making Cycling Irresistible: Lessons from the Netherlands, Denmark and Germany."[32]

There is evidence that meaningful steps to support bike transportation can significantly increase the mode share even in a more car-friendly location such as Northern California. California's most bike-friendly community, Davis, currently has a 21.8% bicycling mode share,[33] according to the League of American Bicyclists. According to Stanford's 2017 Bicycle Commuter Access Study, more than 20% of Stanford commuters commute by bicycle.[34] Google's Bike Vision Plan sets a goal of having 20% of its employees bike to work (from the current 10%).[35] According to a survey presented in the 2017 Downtown Palo Alto

[30] http://www.caltrain.com/Assets/_Planning/Bicycle+Access+and+Parking+Plan/Bicycle+Parking+Management+Plan+-+Final.pdf
[31] http://bikehub.com/caltrain/
[32] http://betterbike.org/wp-content/uploads/2013/12/Making-Cycling-Irresistible-Lessons-from-Europe-Pucher-2008.pdf
[33] http://bikeleague.org/sites/default/files/bfareportcards/BFC_Spring_2016_ReportCard_Davis_CA.pdf
[34] https://transportation.stanford.edu/sites/default/files/2017-10/Stanford_Bicycle_Commuter_Access_Study_2017.pdf
[35] https://bikesiliconvalley.org/wp-content/uploads/Google-Bike-Vision-Plan_high_res.pdf

Mode Share Survey[36] prepared by the Palo Alto Transportation Management Association, large numbers of respondents who currently drive to work stated that they would walk or bike to work given more favorable conditions; 24% to 26% cited more bike-friendly or pedestrian-friendly routes, 16% to 18% cited better bike parking or storage options, and 13% cited access to a bicycle:



Designing safer intersections

Designing safer intersections for bicyclists is an even more vexing problem than designing low-stress bikeways. A busy intersection requires both drivers and bicyclists to navigate through the intersection while remaining aware of other vehicles, some of which may be turning in the path of the driver or bicyclist, as well as pedestrians who may be crossing in the path of a turning vehicle. Left turns across multi-lane roads such as El Camino Real or Shoreline Boulevard are particularly challenging due to the need to cut across multiple lanes of traffic to get to the left turn lane.

A type of intersection that is becoming increasingly popular is the "Dutch intersection," which is designed to minimize the space at which bicycles, and cars are forced to cross paths and enhance the visibility of bicyclists to drivers in the places where they do cross paths.

The design and operation of a Dutch intersection can be seen in this YouTube video:

https://www.youtube.com/watch?v=FlApbxLz6pA

Such an intersection is planned for the intersection of El Camino Real and Embarcadero Road in Palo Alto, as depicted in the Caltrans District 4 Bike Plan:[37]

The City of Palo Alto and Stanford University have worked together to develop a protected intersection on El Camino Real (State Route 82) and Embarcadero Road/Galvez Street. The design removes several slip lanes, provides a clear path for bicyclists through the intersection and connects to trails on either side of El Camino Real. Rendering courtesy of the City of Palo Alto and Calander Associates.

---

[36] http://www.paloaltotma.org/wp-content/uploads/2017/08/17-6393-Report-7.pdf
[37] http://www.dot.ca.gov/d4/bikeplan/docs/CaltransD4BikePlan_Report.pdf

Expand EV charging infrastructure on public property and right-of-ways **(T3)**							**Policy**	**12 years**	
Recommendation name							Type	Duration	
143K	**$660K**	**$0**	**$4.62**	●●○	●●○	●●●	●●○	●●●	●●●
MT CO2e reduction 2018-2030	City's Net Cost	Incremental Net Cost	Net cost per MT CO2e reduction	Easy to implement	Easy to measure	Private investment leverage	Local economic benefits	Other environmental benefits	Health benefits

Problem description

Gasoline-powered passenger vehicles generate nearly 60% of Mountain View's GHG emissions. Using electric vehicles (EVs) instead, and charging them in Mountain View, would greatly reduce these emissions. Electric engines are more efficient than internal combustion engines, and our primary electricity provider, Silicon Valley Clean Energy, supplies carbon-free electricity.

Many people who own gas powered vehicles do not have convenient access or maintain the perception that they do not have convenient access, to EV charging stations (EVCs) and therefore cannot switch to using EVs. Convenience is the key to EV adoption [1], and by improving the ubiquity of EV chargers on publicly owned property, Mountain View can remove barriers and demonstrate EV viability to the public.

Recommendation

Develop and implement a program to improve EV infrastructure through convenient charging and priority parking on publicly-owned property. The program should do the following, using staff and consultants where appropriate:

- Allow charging permits for privately owned, public charging in the Public Utilities Easement ("PUE") (e.g., similarly to Project Green Home [2] in Palo Alto)
- Perform a siting survey to identify high opportunity sites – existing areas of public property with zero or insufficient EVCs. This would include identifying above programs and companies most appropriate to provide charging infrastructure.
- Incentivize/encourage public DCFC infrastructure [3] (Direct Current Fast Charging) with ownership, installation, and operation by third parties
- For residential and workplace (L1 and L2), focus on low-cost installations via grants and utility-funded installs [3]
- Improve public signage for EV charging infrastructure
- Convert prime downtown parking spots into EV restricted spaces
- Mandate and maintain a ratio of X% EV parking spots and chargers in public parking lots
- Encourage vendors to install charging in City parks and other public places

SWOT analysis

Strengths:

- Improves public infrastructure and reach of SVCE 100% carbon-free electricity
- Availability of EVCs builds loyalty among residents and employees

- Other municipalities have been successful in this space
- Some components involve low-lift policy changes only (e.g. permitting for PUE chargers)
- Rebates, incentives, financing and assistance are available

Weaknesses:
- May need to upgrade transformers and electricity service capacity and panels
- May compete with high demand for limited parking spaces
- EVC installation hurdles: expense, complexity of process, choosing billing technique
- Effort needed for maintenance of chargers and rule enforcement for parking and EVC use
- Switching to single-occupancy EVs does not address congestion from growing population

Opportunities and co-benefits:
- People using EVs can save money over gas vehicles due to lower maintenance/fuel costs
- Reduced exhaust fumes in garages and parking lots
- Availability of EVCs may increase the market for used EVs whose batteries have reduced capacity but are still useful for "around town" driving
- Mountain View public relations goodwill

Threats:
- Liability insurance may be needed for operators of EVCs in shared spaces; commercial companies that manage EVCs (such as Chargepoint) carry this insurance
- Public may not be receptive to increased parking restrictions
- Public charging could be underutilized

Municipalities where already implemented

Los Altos, CA [4], Ontario, Canada [1], Palo Alto, CA [2], Eden Prairie, MN [5], Saint Paul, MN [5]

Funding sources

- PG&E's Charge Network (covers 80-90%) [3]
- BAAQMD's Charge! Program ($3k/port Q3/4 2018) [3]
- Local Utilities & CCAs (Palo Alto, Sonoma Clean Power) [3]
- California Electric Vehicle Initiative (AB 1184) [6]
- Grants for public charging stations through American Recovery and Reinvestment Act [7]

Assumptions and uncertainty

Assumptions with High Uncertainty:

- Utilization rate for public charge points
- Number of households interested in curbside EV charging
- Ability to quantify the specific effect of public EV infrastructure on EV conversion rate

Assumptions with Low Uncertainty:

- Feasibility of publicly owned sites in Mountain View
- EV range anxiety decreases as EV infrastructure improves

Author Jeff Sloan

Detailed analysis

Environmental analysis

T3 Figure 1 depicts a relationship between EV adoption and the infrastructure that supports the charging of those vehicles. A June 2017 report from the Edison Foundation [8] estimates that approximately five million charging ports will be required to support seven million EVs on the road in 2025. Transitively, this means that each EV charger can support 1.4 vehicles, on average. However, given that we are mainly focused on public charge-points, it would make most sense to obtain a similar ratio to the EU ratio of 10 EVs per public charge point [7] (T3 Figure 3).

Utilizing BAU numbers, which factor in trips of all distances related to Mountain View, each vehicle is expected to travel 18.7 miles per day for 347 days each year – a total of 6,489 miles. Per a UCLA paper [9], the actual lifespan of EV chargers is uncertain at this point, but it can be assumed to be 10 years. Multiplying these figures means that each EV charger installed would serve an average of 10 cars at 6,489 miles per year for 10 years, or 648,900 miles.

Assuming a rate of 0.00035 metric tons of emissions of CO2e per conventional vehicle-mile traveled in 2019 (T3 Figure 2), and assuming no CO2e is emitted from EVs, this suggests that ~225 MTCO2e are avoided per charging station installed ($648{,}900 \times 0.00035$). Please note that, in the Cost Analysis, these numbers are extrapolated over the 2030-time horizon with figures for yearly BAU emissions per VMT.

It is important to note that the EV chargers themselves are not “saving” any emissions per se – these emissions (or lack thereof) come directly from the vehicles. However, EV adoption is a hurdle of human psychology, and the infrastructure must exist to drive widespread adoption of the technology. Even if primary charging of vehicles is performed at home and work, people still must have adequate infrastructure to feel as though they are able to find a charger whenever it is necessary. This alleviation of range anxiety is the primary goal of this recommendation, and thus for the sake of analysis, calculations have been performed relative to the number of vehicles the plan can support.

Cost analysis

There are three main tactics for improving public EV infrastructure as part of this recommendation:

- Encouraging and incentivizing DCFC infrastructure [3] (Direct Current Fast Charging) with ownership, installation, and operation by third parties
- Removing barriers for private investment in EV infrastructure (e.g. public utilities easement installs and promoting low-cost installations via grants and utility-funded installs) [3]
- Direct City investment in EV infrastructure (prime parking, signage, etc.)

The first of these two tactics require policy effort only. The cost of improving permitting programs and taking advantage of opportunities to leverage third-party assets by allowing them to install DCFC infrastructure requires staff time but no direct cash outlay for the City. The final tactic would indeed require a financial outlay from the City, though this varies given the specifics of the program.

A 2015 report [10] by the U.S. Department of Energy indicates that “The cost of a single port EVSE unit ranges from $300-$1,500 for Level 1, $400-$6,500 for Level 2, and $10,000-$40,000 for DC fast charging. Installation costs vary greatly from site to site with a ballpark cost range of $0-$3,000 for Level 1, $600-$12,700 for Level 2, and $4,000-$51,000 for DC fast charging.”

Given those figures, the following pricing structures for these chargers is included below:

	Purchase	Installation	Combined Range
Level 1	$300-$1500	$0-$3,000	$300-$4,500
Level 2	$400-$6,500	$600-$12,700	$1,000-$19,200
Level 3	$10,000-$40,000	$4,000-$51,000	$14,000-$91,000

With this recommendation, the City would not be directly acting upon the expensive Level 3 charging category in terms of installation, but it would allow others to make that investment when opportunities arise. In this way, we may ignore the third costing category from the table above and assume investment in labor and policy would bring about this category of chargers.

For Level 1 and 2 charging, the City can affect the installation rates through policies to encourage installation of EV charging stations and improved EV parking options and signage. The mix ratio of these efforts will be highly determined by both public interest in PUE permitting and site surveying activities – two items that have yet to be determined. Furthermore, it is assumed that the cost of EV infrastructure will decline over the 2018-2030 time-horizon.

Therefore, there is a high-degree of uncertainty regarding the pro-rata allocation of the variables in this equation. For the sake of this exercise, it is assumed that the City can "affect" the installation of EVs with 0.25 staff headcount at a cost of $45,000/yr. The analysis also adds an additional $10,000 per year to attempt to account for changes in signage, parking space modifications, etc.

The Transportation Working Group has set a goal for 18.5% EV drive-alone for Mountain View's service population in 2030. Given that much of the service population lives outside of the City, we have not budgeted for the City carrying the full weight of the service population of 220,000. Instead, a range has been utilized with the low end using the estimated 2030 resident population of 98,000 and the high end using the 2030 service population of 220,000. We supplemented this with the average of those two numbers ([220k - 98k] / 2 = 159k) to match the logic of emissions accounting for trips outside of Mountain View boundaries. Multiplying 98,000 and 159,000 by the ~70% drive alone rate, and the 18.5% target, brings us to a range of approximately **12,000 to 18,000 EVs that will need to be supported with appropriate 2030 infrastructure**.

If each public charger can support 10 vehicles, the City would need to act to enable the installation of **1,200 to 1,800 public charging stations**. We will use the lower end of this, to provide a conservative estimate of GHG savings and cost per MTCO2e saved. The total amount of chargers added to the public infrastructure has been straight-lined across the 2019-2030-time horizon. This 12-year time horizon accounts for $660,000 (12 years of 0.25 staff headcount + $10k) and 142,761 MT CO2e saved (T3 Figure 2). The resulting cost of avoided carbon is $4.62/MT CO2e.

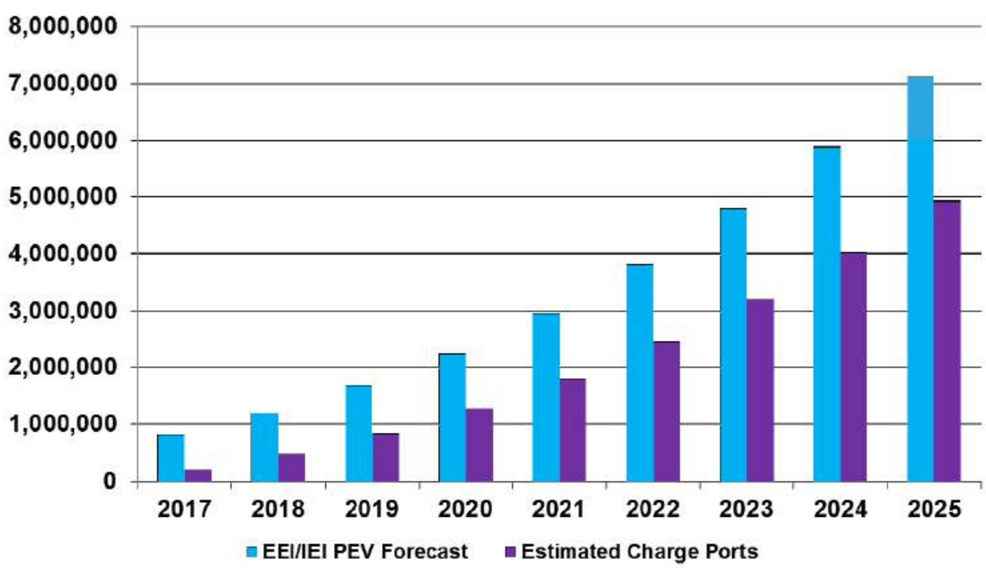
Scale analysis *see cost analysis*

T3 References

[1] https://www.fleetcarma.com/key-increasing-ev-adoption-hidden-ev-driving-charging-data/
[2] http://www.projectgreenhome.org/ev.html
[3] http://www.clean-coalition.org/resources/paec-evci-webinar/
[4] https://www.losaltosca.gov/communitydevelopment/page/los-altos-brings-electric-vehicle-charging-stations-downtown
[5] http://www.driveelectricmn.org/making-your-city-ev-ready/
[6] http://menlospark.org/wp-content/uploads/2018/05/EV-Charrette-2017-Final.pdf
[7] https://www.theicct.org/sites/default/files/publications/EV-charging-best-practices_ICCT-white-paper_04102017_vF.pdf
[8] http://www.edisonfoundation.net/iei/publications/Documents/IEI_EEI%20PEV%20Sales%20and%20Infrastructure%20thru%202025_FINAL%20(2).pdf
[9] https://luskin.ucla.edu/sites/default/files/Non-Residential%20Charging%20Stations.pdf
[10] https://www.afdc.energy.gov/uploads/publication/evse_cost_report_2015.pdf

T3 Appendix

T3 Figure 1. Forecasts for growth in EVs and EV charge ports in the US, 2017-2025.



Source: Edison Electric Institute (EEI) and the Institute for Electric Innovation (IEI), Plug-in Electric Vehicle Sales Forecast Through 2025 and the Charging Infrastructure Required (June 2017), www.edisonfoundation.net.

T3 Figure 2: Cost Analysis Calculations[38]

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
MT/VMT	0.0003569131864	0.0003473871298	0.0003380292038	0.0003282361894	0.0003185183414	0.0003088696715	0.00029933500	0.00028990911	0.00028155189	0.00027407550	0.00026745189	0.00026159687	0.00025644127
Chargers Installed	0	100	100	100	100	100	100	100	100	100	100	100	100
Cumulative Chargers installed		100	200	300	400	500	600	700	800	900	1,000	1,100	1,200
Miles affected	0	6,489,000	12,978,000	19,467,000	25,956,000	32,445,000	38,934,000	45,423,000	51,912,000	58,401,000	64,890,000	71,379,000	77,868,000
MT CO2e		2,254	4,387	6,390	8,267	10,021	11,654	13,169	14,616	16,006	17,355	18,673	19,969
												MT CO2e	142,761

T3 Figure 3: Electric Vehicle to Public Charge Point Ratio.
Source: Table 6, Page 21, in *Emerging Best Practices for Electric Vehicle Charging Infrastructure*, International Council on Clean Transportation, October 2017 [7].

Organization	Region	Electric vehicle/public charge point ratio	Source
European Council	European Union	10	European Parliament (2014)
NDRC	China	8 (pilot cities), 15 (other cities)	NDRC (2015)
IEA Electric Vehicle Initiative	Worldwide	8 (2015), 15 (2016)	EVI (2016, 2017)
EPRI	United States	7-14	Cooper & Schefter (2017); EPRI, 2014
NREL	United States	24	Wood et al. (2017)
CEC/NREL	California	27	CEC & NREL (2017)

[38] https://docs.google.com/spreadsheets/d/14cCZaqtzKYqbREn-4RPma3nZ59rII7VZh7REcSx5pmA/edit#gid=0

Expand transportation demand management (TDM) to all of Mountain View **(T7)**							**Policy, outreach**	**Permanent**	
Recommendation name							Type	Duration	
3,100	**$1.5M**	**Ongoing**	**$440**	○○○	●●●	●●●	●●○	●●○	●○○
MT CO2e reduction 2018-2030	City's Net Cost	Incremental Net Cost	Net cost per MT CO2e reduction	Easy to implement	Easy to measure	Private investment leverage	Local economic benefits	Other environmental benefits	Health benefits

** Costs and CO2e savings above refer to an outreach pilot program.*

Problem description

- Switching from driving to other modes of transportation is a significant lifestyle change. To make it happen, Mountain View needs to pursue a concerted citywide outreach program known as Transportation Demand Management (aimed at residents, customers, and businesses).
- A permanent high-occupancy vehicle (HOV) alternative, such as shuttles or autonomous vehicles, is needed city-wide. The MVgo Shuttle provides limited services near the employers who fund it.

Recommendation

Transportation Demand Management (TDM) is used to describe methods to encourage the use of alternative modes of transportation, including siting and design practices, trip reduction goals, and ongoing services such as providing shuttles and outreach. It can achieve reductions in travel of 10-30% or more (1). To be truly effective, it must be coupled with parking restrictions (2), Recommendation T6.

(For a more detailed explanation of TDM, and examples from recent Precise Plans, see the T7 Appendix.)

1. To begin saving transportation GHG in the near term, **implement a pilot TDM outreach program targeted to residents**. Such programs have been demonstrated to produce significant savings (3).

2. **Develop strong citywide TDM requirements for all new development, including commercial and multi-family residential,** by completing ESAP-3 item 20: "Create Transportation Demand Management (TDM) application requirements, thresholds for which development projects require TDMs, and standardized compliance requirements." Requirements should match or exceed those for North Bayshore, and they should require commitment to permanent TDM outreach efforts. As part of this effort, consider strengthening TDM requirements in existing older Precise Plan areas. Consider setting parking space maximums.

3. **Provide incentives for existing commercial property owners to adopt TDM**. Possible ideas include:
   - Allow them to repurpose a fraction of existing parking lots to build new housing, in exchange for adopting TDM practices and/or joining the TMA.
   - Confirm that Mountain View TDM requirements will satisfy the Bay Area Commuter Benefits Program requirements, making it a convenient option for employers of 50+ full-time employees.

4. **Use TDM commitments to help provide both pooled transportation** (shared rides or shuttles, *Recommendations T4a, T4b*) **and ongoing TDM outreach services citywide, including for residents, small employers, and visitors.**

SWOT analysis

Strengths:
- Mountain View has experience with TDM requirements for new development, including setting trip caps and providing ongoing monitoring and enforcement
- Mountain View Transportation Management Association (TMA) exists and currently runs the MVgo Shuttle

Weaknesses:
- Pricing the TDM fees will require adjustment as the oversight organization grows

Opportunities and co-benefits:
- Residents and developers will benefit from reduced parking space needs, which will allow that space to be repurposed
- Small employers will benefit from a convenient resource to meet their Commuter Benefits Program requirements; providing commuter benefits may aid in employee retention
- Residents, customers, and employees of small employers could receive incentives
- Drivers will have less congested roadways

Threats: Possible lack of familiarity with the benefits of a robust TDM outreach program

Municipalities where already implemented

TDM requirements are already in use in areas of significant development in Mountain View

Robust TDM outreach has been used to significantly reduce SOV trips. Examples include Stanford Commute Club; City of South San Francisco; King County, WA (3); and Victoria, BC, Canada.

Funding sources

City staff time will be required to develop the new city-wide TDM requirements.

TDM requirements on new development will generate requirements such as to join the TMA, which can be used to expand ongoing TDM outreach throughout the city to employees, including for small employers, and residents, and for shuttle/pooled transportation.

Assumptions and uncertainty

Assumptions with High Uncertainty:
- Whether existing TMA sponsors will agree to expand the TMA as described
- Whether existing businesses not in the TMA will join.

Assumptions with Low Uncertainty:
- To be effective, TDM must be coupled with parking restrictions, *Recommendation T6*
- The new TDM requirements will be tailored to the size / type of development

Author Mary Dateo

Detailed analysis

NOTE: There are several ways in which this recommendation could be implemented.

- Assuming the existing TMA is amenable, the city could frame its TDM development requirements to require joining the existing TMA and encourage the TMA to expand its services to provide TDM outreach. This would include residents and employees of small employers. It would also include expanding shuttle service citywide.
- The city could form one or more new TMAs per geographic area.
- The city could retain overall responsibility but could contract the day-to-day operations of shuttle and TDM outreach to one of the many firms that specializes in this business. Determining the best approach will need to be addressed in the early phases of implementing this recommendation, or via the city's development of its Multi-Modal Plan, a project that is expected to be staffed in fall of 2018. (3)

It is beyond the scope of this project to recommend an approach. The city is currently requiring new developments to join the TMA, so the remainder of this recommendation will assume that approach. Cost and environmental impact is expected to be the same regardless of how the solution is organized.

Environmental analysis

A. Recommendation 1: TDM Outreach Pilot

The intention of the outreach pilot is to start influencing people to switch transportation modes in the first few years following completion of ESTF-2, during the time that the larger Transportation recommendations are ramping up to be implemented.

Implementation of an outreach program/campaign in King County, Washington, demonstrated that reaching out to residents can eliminate a significant number of vehicle trips. **That campaign specifically targeted non-commute trips and avoided over half a million non-work car trips a year, by asking residents to commit to reducing 2 trips per week.** (3)

The importance of outreach efforts must not be underestimated. In a 2012 survey in Alameda,

> "over four-fifths of those responding were not aware of the Guaranteed Ride Home Program, the City Car Share Program, or the 511 RideMatch Program." (5)

Offering good transportation alternatives will not have the intended result if people are not aware of them.

The savings calculated in this recommendation assume:

- 33% of MV households are contacted annually from 2022 – 2024
- 10% of those households commit to reducing 2 trips / person / week
- The length of the trips avoided averages 1.5 miles each way: 3 miles round trip
- The number of households in Mountain View, and the number of people per household, are taken from the ESTF-2 BAU forecast
- GHG saved / mile is based on EMFAC data
- People will develop new habits regarding transportation and so will continue to avoid trips after the campaigns are over, though at reduced rates

B. Recommendations 2 and 3: Develop citywide TDM requirements and encourage existing property owners to adopt TDM

To avoid double-counting the GHG savings, the savings for the shuttle, pooled transportation, and bicycling are addressed in *Recommendations T4a, T4b, and T5*.

C. Recommendation 4: Operate citywide TDM requirements

Outreach efforts, considered to be crucial to motivate significant mode-switching, are assumed to become the responsibility of the TMA in subsequent years. Possibly even the pilot would be contracted to the TMA to execute. Operation of the shuttle is obviously also critical to reduce miles and GHGs. However, to avoid double-counting the GHG savings, the savings for the shuttle, pooled transportation, and bicycling are addressed in Recommendations T4a, T4b, and T5.

(Savings from the outreach pilot, Recommendation 1, are counted here in T7 because it is executed before most of Recommendations T4 through T7 have fully ramped up.)

Cost analysis

Below, 3 sets of costs are discussed:

A. For the TDM outreach pilot, Recommendation 1 (costs in the recommendation header)
B. To develop citywide TDM requirements, Recommendations 2 and 4
C. To operate citywide TDM requirements, Recommendation 3

A. Recommendation 1: TDM Outreach Pilot:

One-third time for one city staff person or consultant, for three years total, to develop and oversee outreach pilot: $180,000

In the example from King County, WA, expenditure was $25 / household in the target area. We assume a higher rate of $30 / household.

Assumptions: Residents	
% of households contacted 2022 - 2030	33.0%
Cost per household	$30
Rate of engagement	10%
Number of trips commit to reduce / person / week	2
Length of trip (1.5 miles each direction per trip)	3
Amount of trips avoided in year following the campaign	0.6
Amount of trips avoided in subsequent years	0.4

	Housing Units, from BAU forecast										
	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Total
Resident Population	84,809	86,251	87,717	89,208	90,725	92,267	93,836	95,431	97,149	98,995	
Household Units	38,121	38,851	39,657	40,486	41,334	42,199	43,084	44,053	45,117	46,280	
Number of People / Unit	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.1	
Cost	$384,625	$392,604	$400,811								$1,178,041
Miles Saved, current year participants	873,193	888,040	903,134								
Miles Saved, past year participants		523,916	882,102	1,246,374	1,065,747	1,065,747	1,065,747	1,065,747	1,065,747	1,065,747	
Total Miles Saved	873,193	1,411,956	1,785,236	1,246,374	1,065,747	1,065,747	1,065,747	1,065,747	1,065,747	1,065,747	
GHG Saved/ Mile	0.00032824	0.000318518	0.00030887	0.000299335	0.000289909	0.00028155	0.00027408	0.00026745	0.0002616	0.00025644	
GHG Saved	**287**	**450**	**551**	**373**	**309**	**300**	**292**	**285**	**279**	**273**	**3,112**
$ / MTCO2e											**$436**

City Costs	
TDM Requirements Development	$180,000
TDM Pilot- staff to oversee: 1/3 person for 3 years	180,000
TDM Pilot- program costs	$1,178,041
Total, TDM Pilot	$1,358,041

B. Recommendations 2 and 3: Develop citywide TDM requirements and encourage existing property owners to adopt TDM

City cost:

- 1 year of staff time to develop at $180,000, or 0.25 staff to supervise plus $120,000 for consultant

C. Recommendation 4: Operate citywide TDM requirements

As explained above, it is assumed that a TMA (or multiple smaller TMAs) is the mechanism by which TDM requirements will be delivered.

City Cost:

Mountain View currently pays TMA membership dues, but does not receive services, so does not pay for services. As TMA services expand beyond North Bayshore, and expand to include outreach, the city will receive services, so its dues will increase. There are too many unknowns to predict how much the city's dues might increase.

Incremental net cost:

Fully estimating incremental net costs is beyond the capability of this effort. The list of unknowns includes:

- current TMA dues paid by employers / developers
- ultimate decision by the city of the specific TDM requirements
- number / rate of businesses joining the TMA
- type of businesses joining the TMA
- dues structure negotiated by the TMA partners
- specific services offered, and the timing in which they are offered
- which grants the TMA currently has, or what they might get in the future
- how many existing businesses might be interested in joining the TMA

However, the TDM requirements are expected to supply a significant amount of funds to help support both ongoing TDM outreach, and an expanded Mountain View shuttle.

Ongoing TDM outreach

- A significant portion of ongoing TDM outreach costs, after completion of the outreach pilot, will be staff time. Assuming 4 TMA staff-persons at $120,000 per year, annual cost would be about $500,000.

Shuttle

- Currently the primary service offered by the TMA is the MVgo Shuttle. For each shuttle the TMA currently runs during commute hours, the cost is very roughly estimated to be $125,000 (6). As more businesses are required to join and are offered shuttle and outreach services, total TMA operating costs will increase, increasing the total Incremental Net Cost.
- Some individual employers who currently run private shuttles may save money by joining the TMA and making use of the TMA shuttle.
- Total costs for the expanded Shuttle are covered in Recommendations T4A and T4B.

T7 References

1. "Comprehensive TDM Programs can achieve cost-effective reductions of 20-40% in motor vehicle travel compared with no TDM efforts… Travel reductions of 10-30% are more realistic for TDM Programs implemented by local or regional governments."

   Victoria Transport Policy Institute, "Transportation Management Programs An Institutional Framework for Implementing TDM," 3/23/2016.

   URL: http://www.vtpi.org/tdm/tdm42.htm

   Another source says that trip reduction strategies can reduce VMT as much as 15%. California Air Pollution Control Officers Association, "Quantifying Greenhouse Gas Mitigation Measures", August, 2019, p.62.

   URL: http://www.capcoa.org/wp-content/uploads/2010/11/CAPCOA-Quantification-Report-9-14-Final.pdf
2. "The four employers in the 82- program sample who had restricted/priced parking but did not offer subsidies have an average VTR of only 11.5%. The 37 employers who had both restricted/priced parking and offered subsidies had an average 23.3% VTR."

   Dowling Associates, Inc., "Report for City of Alameda TSM/TDM Plan" (2/15/2012), p.23.

3. Implementation of outreach programs and campaigns to residents can make a significant impact. One example is the King County In Motion Campaign that specifically targeted non-commute trips and **avoided over half a million non-work car trips a year, by asking residents to commit to reducing 2 trips per week.**

   URL: https://kingcounty.gov/~/media/depts/transportation/metro/programs-projects/in-motion/toolkit/tools-of-change-case-study.pdf

   Video (5 minutes): https://www.youtube.com/watch?v=4L_Ihi9OzWI&t=13s

   Current (2018) In Motion website: https://www.kingcounty.gov/depts/transportation/metro/programs-projects/transit-education-outreach/in-motion.aspx

4. Information on the city's Comprehensive Modal Plan was presented by staff to City Council in a study session on 9/19/2017.

   Agenda, Study Session Memo, and Media: https://mountainview.legistar.com/MeetingDetail.aspx?ID=559096&GUID=96756765-59D9-4BC8-9506-222B29942BE8&Options=info&Search=

5. Dowling Associates, Inc., "Report for City of Alameda TSM/TDM Plan" (2/15/2012), p. 3.

6. Dowling Associates, p. 58.

T7 Appendix

1. Transportation Demand Management (TDM) Overview

TDM requirements can be placed on new development as a condition of development, typically a large commercial or multi-family residential project, to require the development project to include measures to mitigate its impact on traffic.

TDM design practices can include capitalizing on nearby transit, building attractive pedestrian and bicycle routes, providing adequate bicycle parking and/or bicycle repair stations, and providing information kiosks about local transit options.

Ongoing TDM services can include these, and more:

a. providing shuttle services
b. providing subsidized transit passes
c. performing commuter surveys
d. monitoring trip modality
e. assisting businesses with Commute Trip Reduction programs
f. outreach activities and educational materials to promote alternative modes of transportation to employees or residents
g. development of individual trip plans
h. incentives: bicycle helmets, lights, or gear
i. "Emergency ride home" programs for non-car commuters
j. showers / changing facilities for cyclists

To meet TDM requirements, developers or large employers sometimes create Transportation Management Associations. TMAs can provide any of the mentioned TDM services. Employers in North Bayshore created such a TMA several years ago, the MTMA; it is a nonprofit agency with a board made up of representatives of its members. Currently, it focuses almost solely on running the MVgo shuttle. It contracts actual management of the TMA to a business that specializes in that work, Gray-Bowen-Scott.

2. For the reader who would like to see some of the main TDM requirements from recent Mountain View Precise Plans, links and page numbers are provided:

Mountain View El Camino Real Precise Plan [39] (see p. 65)

Mountain View San Antonio Center Precise Plan [40](see p.36)

Mountain View North Bayshore Precise Plan [41](see pp. 148-152)

These are included for the convenience of any reader who would like to quickly compare some of the main TDM requirements of these three Precise Plans.

[39] https://www.mountainview.gov/civicax/filebank/blobdload.aspx?BlobID=15251
[40] https://www.mountainview.gov/civicax/filebank/blobdload.aspx?BlobID=15178
[41] https://www.mountainview.gov/civicax/filebank/blobdload.aspx?BlobID=15050

Implement group-buy programs to expand personal EV adoption (T2)							Incentive	8 yr.	
Recommendation name							Type	Duration	
16,803	$160K	$0	$5.22	●●●	●●●	●●○	●●○	●○○	●○○
MT CO2e reduction 2018-2030	City's Net Cost	Incremental Net Cost	Net cost per MT CO2e reduction	Easy to implement	Easy to measure	Private investment leverage	Local economic benefits	Other environmental benefits	Health benefits

Problem description

Approximately 60% of Mountain View community-wide emissions come from the transportation sector. The lion's share of these emissions come from single-occupancy vehicles (SOV)s powered by internal combustion engines (ICE). Mountain View expects to see service population growth from 2005, our greenhouse gas (GHG) base year, to 2030, of 82%. If no action is taken, the resulting increase in vehicle miles traveled (VMT) will outweigh the expected savings from federal and state fuel efficiency standards and will cause Mountain View to exceed its 2030 GHG reduction goal.

However, the typical operation of electric vehicles (EV)s does not produce GHG emissions on the road. Rather, emissions are expelled at the electric-generation source and Mountain View ensures that electricity generation is offset with renewable sources via Silicon Valley Clean Energy (SVCE). In this way, EVs are well-suited for reducing transportation carbon-emissions and their adoption should be promoted and incentivized by the City.

Recommendation

Pilot a group-purchase program of EV chargers/vehicles/bicycles for Mountain View residents and businesses. Discounts of 10-20% [42]would be offered by the supplier for purchases made in a specific time window. The program should be designed so that if it is successful, it can be offered each year at a time when the company's business for the supported product is slowest.

The City would leverage the collective buying-power of its constituents to negotiate a discount from firms in the private sector and then advertise this negotiated discount in the community. Data has shown that 72% of vehicle purchasers[43] in these programs were not intending to purchase an EV prior to the program. In Boulder County (Colorado), $7,000 in staff resources and advertising costs resulted in over $5 million[44] in EV sales. Mountain View should also push certain organizations such as SVCE to implement similar programs that impact EV adoption across the entire county.

A handbook[45] has already been created by Southwest Energy Efficiency Project (SWEEP), aimed at local governments, utilities, nonprofits, and agencies interested in offering a group-purchase program. This can be referenced by City staff to ease implementation of such an effort.

[42] https://www.chargepoint.com/offers/20/
[43] http://www.swenergy.org/how-to-double-or-triple-electric-vehicle-sales-in-your-community
[44] http://www.swenergy.org/how-to-double-or-triple-electric-vehicle-sales-in-your-community
[45] http://www.swenergy.org/data/sites/1/media/documents/publications/documents/Power_Purchase_Handbook.pdf

SWOT analysis

Strengths:

- Proof-of-concept has already occurred with much success from other cities - sometimes doubling and tripling EV sales
- A handbook has already been created by SWEEP
- SWEEP has authored a case study[46] of the group-purchase program in Adams, Boulder and Denver Counties which provides in-depth information on the development and results of the program
- Minimal financial outlay for the City / subsidy through private sector

Weaknesses:

- 1-for-1 internal-combustion-to-EV trade-off does not address congestion
- Highly-dependent on willingness of car manufacturers, dealers, and vendors to offer purchase/lease discounts
- Variability in potential adoption rates make benefits tough to measure
- EVs in Mountain View could effectuate increased ICE sales in other regions, given the nature of Corporate Average Fuel Economy (CAFE) standards (i.e. miles per-gallon requirements averaged over entire fleet)

Opportunities and co-benefits:

- Build upon great success that already exists
- Health benefits of EVs vs. ICE
- Case studies have proven to bring non-EV-centric buyers into the fold
- Financial benefits (e.g. reduced maintenance, reduced fuel cost)
- Encourage other nearby cities to join the campaign

Threats:

- Outreach vital, if advertising is not done correctly, program could fizzle
- Only affects population that will be shopping for an EV/EV-charger during the program period

Municipalities where already implemented

Fort Collins, CO; Boulder, CO; Sonoma, CA

Assumptions and uncertainty

Assumptions with High Uncertainty:

- How effectively this recommendation will accelerate EV-adoption rates
- Number of Mountain View residents searching for vehicles during the program period

Assumptions with Low Uncertainty:

- Willingness of private sector to participate in California-based program

Author Jeff Sloan

[46] http://www.swenergy.org/data/sites/1/media/documents/publications/documents/Colorado_EV_Group_Purchase_Programs_Mar-2016.pdf

Detailed analysis

Environmental analysis

For this analysis, calculations will be based on EV purchases, as opposed to electric bicycles and/or chargers. While these items are an important part of the program, we've focused our data-modeling efforts primarily on higher-cost vehicles. Furthermore, electric bicycle totals are contained in Recommendation T5.

Given the relative similarity in population for the two cities, if we assume that the Mountain View program has a similar level of success as the Boulder, CO program, then such a program would result in $5 million in EV sales in the City. Per T2 Figure 1, given a median price (including high-priced Tesla's which would skew the numbers if using an average) of $37,510 x .20 savings factor for the program, an average of $30,000 EV purchase means this program results in 167 EV vehicles purchased in the first year of the program ($5M/$30k).

Utilizing business-as-usual (BAU) numbers, which factor in trips of all distances related to Mountain View, each vehicle is expected to travel 18.7 miles per day for 347 days each year - a total of 6,489 miles. Furthermore, drivers are expected to keep a car for six years[47] after purchase. Multiplying these two figures means that each car purchased through the program would account for an average 6,489 miles for six years (after that a car could be sold outside of Mountain View, so we will not assume the full life of the vehicle). This means that 167 EV vehicles related to one yearly cycle of the program account for a total of 6.68 million vehicle miles spread over a six- year period.

Assuming BAU rates for metric tons of emissions of CO2e per vehicle mile traveled (VMT) (T2 Figure 2), this brings us to affecting 13,346 MTCO2e for the actions taken for six years of the program. Please note that we have utilized eight years, and it's possible that the City could continue to see results of an investment after that period, albeit with some diminishing returns year-over-year after reaching a certain level of saturation.

Cost analysis

The cost of the first iteration of the program is assumed to be similar in nature to that of the Boulder program, which produced $5M in sales for a $7,000 investment of staff resources. In the interest of accounting for labor differences, this cost has been increased to $20,000 per year. We are recommended this program for eight years, for a cost of $160,000.

All the assumptions from the environmental analysis are integrated here. This means that for the cost of $160,000, the City would save 16,803 MTCO2e at a cost of $9.52/MTCO2e.

Scale analysis

The population of Mountain View, CA and Boulder, CO, are similar. Given the information available, including a specific guide on how to drive these programs and case studies to build off, the size and scale of this program can reasonably be assumed to match the success of the Boulder program.

[47] http://business.time.com/2012/07/27/driver-consensus-its-silly-to-upgrade-cars-every-couple-of-years/

T2 References

http://www.swenergy.org/how-to-double-or-triple-electric-vehicle-sales-in-your-community

http://www.swenergy.org/data/sites/1/media/documents/publications/documents/Colorado_EV_Group_Purchase_Programs_Mar-2016.pdf

http://www.swenergy.org/data/sites/1/media/documents/publications/documents/Power_Purchase_Handbook.pdf

https://www.chargepoint.com/drivers/home/promo/

https://www.chargepoint.com/offers/20/

https://www.sciencedirect.com/science/article/pii/S1361920916307933

https://www.fhwa.dot.gov/ohim/onh00/bar8.htm

http://business.time.com/2012/07/27/driver-consensus-its-silly-to-upgrade-cars-every-couple-of-years/

T2 Appendix

T2 Figure 1: Price of Battery Electric Vehicles

Currently Available Battery Electric Vehicles (BEVs) in the US (January 20, 2018)							
Make/Model	**EV Type**	**Range (miles)**	**MSRP**	**Cost / Mile of Range**	**kWh Battery Pack**	**Cost per kWh**	**Availability**
BMW i3	BEV	114	$44,450	$390	33	$1,347	Unknown, likely at least all key ZEV states
Fiat 500e	BEV	87	$32,995	$379	24	$1,375	CA, OR
Ford Focus Electric	BEV	115	$29,120	$253	33	$882	EV-certified Ford dealerships throughout US
Chevrolet Bolt EV	BEV	238	$36,620	$154	60	$610	All 50 US states
Honda Clarity Electric (3)	BEV	89	$37,510	$421	25.5	$1,471	California, Oregon - by lease only
Hyundai Ioniq Electric	BEV	124	$29,500	$238	28	$1,054	California
Kia Soul EV	BEV	111	$33,950	$306	30	$1,132	CA, CT, GA, HI, MA, MD, NJ, NY, OR, RI, TX, WA
Nissan LEAF (1)	BEV	107	$30,680	$287	30	$1,023	All 50 US states
smart fortwo electric drive (1)	BEV	58	$23,900	$412	17.6	$1,358	All 50 US states
Tesla Model 3 (2)	BEV	310	$50,000	$161	78	$641	Deliveries to early reservation holders
Tesla Model S 75D	BEV	275	$74,500	$271	75	$993	Tesla stores/galleries in 26 states and D.C.
Tesla Model S 100D	BEV	351	$94,000	$268	100	$940	Tesla stores/galleries in 26 states and D.C.
Tesla Model S P100D	BEV	337	$135,000	$401	100	$1,350	Tesla stores/galleries in 26 states and D.C.
Tesla Model X 75	BEV	237	$79,500	$335	75	$1,060	Tesla stores/galleries in 26 states and D.C.
Tesla Model X 100D	BEV	295	$96,000	$325	100	$960	Tesla stores/galleries in 26 states and D.C.
Tesla Model X P100D	BEV	289	$140,000	$484	100	$1,400	Tesla stores/galleries in 26 states and D.C.
VW e-Golf	BEV	125	$30,495	$244	35.8	$852	CA, CT, ME, MD, MA, NJ, NY, OR, RI, VT, D.C.
Total / Average (Mean)	13*/17	192	$58,719	$314	55.6	$1,085	
Median	17	114.5	$37,510	$306	35.8	$1,054	
Average (Mean) - excluding Tesla	10	142	$46,092	$324	40.4	$1,144	
Median - excluding Tesla	10	112.5	$31,838	$296	30.0	$1,093	

*14 distinct BEV models, 17 when including all battery variations for Tesla Models S/X

(1) These vehciles are expected to have larger battery packs at some point 2018 in the US

(2) Tesla has not officially revealed battery pack size; various documents point to around 78 kWh https://electrek.co/2017/08/07/tesla-model-3-new-details-revealed/

(3) Honda Clarity BEV is only available by lease at $199/month (base) - MSRP shown is an estimate based on Edmunds.com data

Information as of January 20, 2018 | Research and chart: EVAdoption.com

Source: http://evadoption.com/ev-statistics-of-the-week-range-price-and-battery-size-of-currently-available-in-the-us-bevs/

T2 Figure 2: GHG Savings Calculations[48]

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
MT/VMT	0.0003569131864	0.0003473871298	0.0003380292038	0.0003282361894	0.0003185183414	0.0003088696715	0.00029933500	0.00028990911	0.00028155189	0.00027407550	0.00026745189	0.00026159687	0.00025644127
2018 Program	1,113,333	1,113,333	1,113,333	1,113,333	1,113,333	1,113,333							
2019 Program		1,113,333	1,113,333	1,113,333	1,113,333	1,113,333	1,113,333						
2020 Program			1,113,333	1,113,333	1,113,333	1,113,333	1,113,333	1,113,333					
2021 Program				1,113,333	1,113,333	1,113,333	1,113,333	1,113,333	1,113,333				
2022 Program					1,113,333	1,113,333	1,113,333	1,113,333	1,113,333	1,113,333			
2023 Program						1,113,333	1,113,333	1,113,333	1,113,333	1,113,333	1,113,333		
2024 Program							1,113,333	1,113,333	1,113,333	1,113,333	1,113,333	1,113,333	
2025 Program								1,113,333	1,113,333	1,113,333	1,113,333	1,113,333	1,113,333
Sum (Miles)	1,113,333	2,226,666	3,339,999	4,453,332	5,566,665	6,679,998	6,679,998	6,679,998	5,566,665	4,453,332	3,339,999	2,226,666	1,113,333
# of vehicles	167	334	501	668	835	1,002	1,002	1,002	835	668	501	334	167
MT CO2e	397	774	1,129	1,462	1,773	2,063	2,000	1,937	1,567	1,221	893	582	286
												MT CO2e	16,083

[48] https://docs.google.com/spreadsheets/d/14cCZaqtzKYqbREn-4RPma3nZ59rII7VZh7REcSx5pmA/edit#gid=0

Chapter 3: Buildings and Land Use Recommendations

Mountain View has the goal of reducing the GHG emissions 80% by 2030 throughout the City including residential and commercial sources. Buildings represent the second largest segment of the overall GHG emissions at 23% in 2018. Which dropped from 33% in 2015 due to the introduction of carbon-free electricity. Building GHG emissions are today related to the consumption of natural gas for space heating, hot water heating and commercial kitchen gas.

Outside of municipal operations, buildings are one of the few areas that Mountain View has direct control over through local building codes and ordinances.

The Goal: Low-Carbon Buildings and Communities by 2030

In the 2030 vision, our buildings will be low-carbon. Natural gas will not be needed to operate them. The air quality is improved, and the buildings feel comfortable. Renewable energy will provide all power needed. Our municipal buildings will lead us on the way.

Our housing will be sustainably developed and interconnected, with space for nature and trees, with below-market rate (BMR) housing near transit hubs and within walking distance to local amenities. Personal cars will be less important but those that are around will be electric and EV-chargers will be ubiquitous.

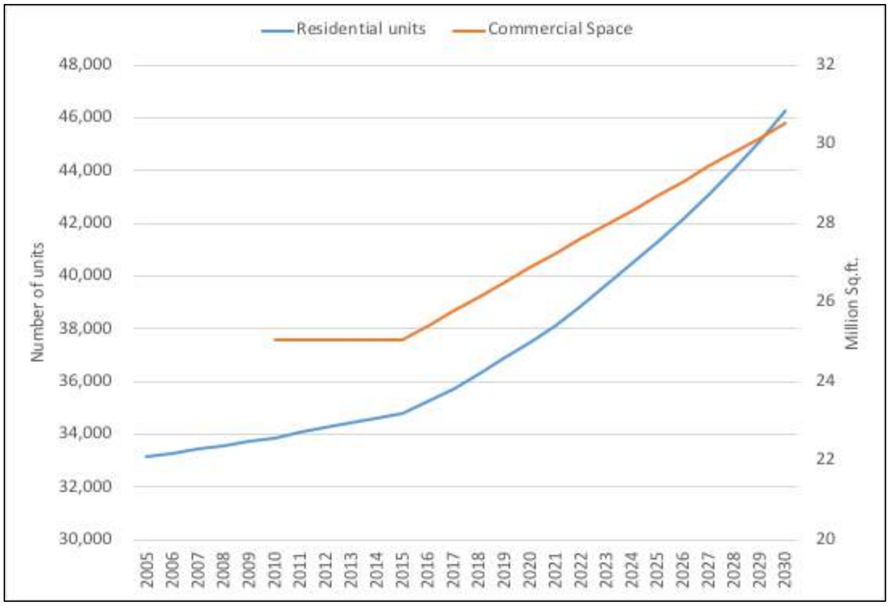
This future will be the outcome of our groups' twelve **Buildings and Land Use** recommendations.

B&LU Figure 1. Buildings and Land Use 2018 to 2030

How to get there

Fuel-switching from natural gas to electricity in all buildings: Our priorities are in line with Mountain View's Climate Protection Roadmap (2015), in that electrification is the number one goal to achieve low-carbon buildings.

Significant growth in residential units (mainly multifamily apartments) and commercial sq. ft. is planned for Mountain View, 55% and 22% respectively above 2015 levels by 2030 (Graph 1). Now is the time to implement new building codes and incentivize the construction of above-code low-carbon buildings.



B&LU Graph 1: Growth in Residential Units and Commercial sq. ft

Update all existing buildings (> 60% of all buildings in 2030) to support a low carbon future: electrification, electric vehicles, energy efficiency.

The electrification of the building stock will shift the demand from the natural gas infrastructure to the electricity grid. Distributed energy resources (DER's) - such as solar, storage, energy efficiency and demand management[49]- will have a major role to play. Ideally our buildings will become smart automated buildings that react to the capacity of the grid with smart appliances, solar panels and battery storage. Energy efficiency of the overall building will reduce the burden on the grid.

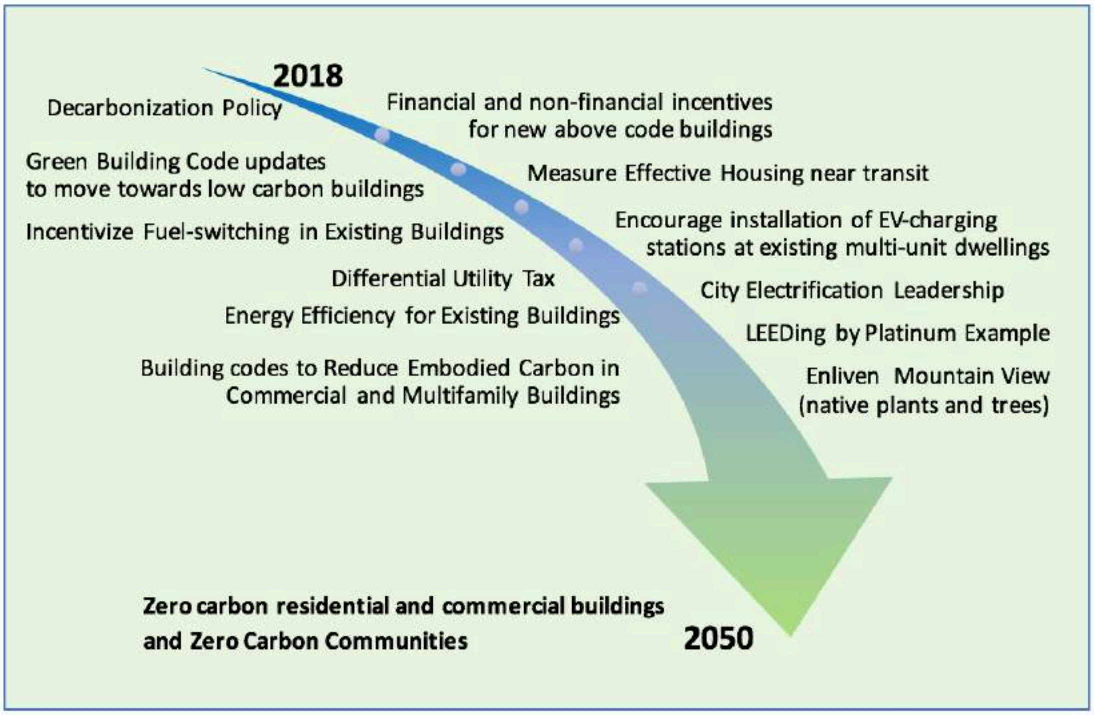
Mountain View can increase the economic benefit of electrification across the board by making a change in its Utility User Tax: increase the tax rate on natural gas and reduce it on electricity (currently the rate is identical for both).

Mountain View is fortunate to have innovative and forward-looking corporations located in the city and it should work in partnership to move these sustainability initiatives forward.

Inclusion and equitability will need to be woven into all the programs to support the most negatively impacted residents and businesses in Mountain View.

[49] https://blog.aee.net/distributed-energy-resources-101-required-reading-for-a-modern-grid

B&LU Figure 2: The Twelve Buildings and Land Use Recommendations



The growth in buildings and population since 2015 and planned for 2030 is much more than previously anticipated in the Greenhouse Gas Reduction Program (2012) and the Climate Protection Roadmap (2015). With this growth the City has more funding available to implement these two major goals of low carbon buildings and low carbon communities.

Recommendation abbreviations used on the next pages:

B = Buildings (General); **BN** = New Buildings; **BE** = Existing Buildings; **BT** = Buildings and Trees.

Suggested implementation sequence:

The Building and Land Use group suggests that the City of Mountain first implement the recommendation on incentives for above code buildings (BN3) citywide, and to create and implement a roadmap to decarbonize all buildings by 2050.

All decarbonization and building code / ordinance related recommendations will need to be addressed during the roadmap development.

Outreach-based recommendations can be best started with the support of a Chief Sustainability Officer with additional staffing and funding for online engagement tools, commercial outreach and advocacy. They are critical to the success of many of our recommendations.

The recommendation "Measure Effectiveness of Housing Near Transit" needs to be implemented with the highest-ranking transportation recommendation on "Multi-Modal Plan." All other recommendations can be started by the respective departments as soon as possible. For example, the recommendation on "LEEDing by example" (BN6) is based on the retrofit of the Rengstorff aquatic center, which is in the budget for 2018/2019.

Timeline:
BUILDINGS AND LAND USE

		2018/2019 (before budget)	2019 after budget approval/ 2020
1.	Decarbonization Policy (B1)	Sustainability Team (1.) Building Department	ROADMAP Process: Development of code and ordinance to move towards low carbon buildings
2.	Financial and Non-financial Incentives for new Above Code Buildings (BN3)	Planning Department (1.)	
3.	Green Building Code Updates to move towards Low Carbon Buildings (BN1) (ESAP-3 2018/2019: Consider Green Building Code Review)	Sustainability Team Building Department (1.)	Roadmap
4.	Measure Effective Housing Near Transit (BN8)	Planning Department (2.) (together with Multi Modal Plan)	
5.	Incentivize Switching Residential Space Heating/Cooling and Water Heating Systems from Natural Gas to Electricity (BE1)		Roadmap Sustainability Outreach (1.)
6.	Encourage installation of Electric Vehicle Charging Stations at existing multi-unit dwellings (BE7)		Roadmap Sustainability Outreach (2.)
7.	Differential Utility Tax (BE9)	Financial Department (1.)	Sustainability Outreach (3.)
8.	Energy Efficiency for Existing Buildings (BE4)		Roadmap Sustainability Outreach (4.)
9.	City Electrification Leadership (BE12)	Public Works (1.)	
10.	LEEDing by Platinum Example (BN6)	Public Works (2.)	Roadmap
11.	Building Codes to Reduce Embodied Carbon in Commercial and Multifamily Buildings (BN4)		Roadmap Sustainability Outreach (5.)
12.	Enliven Mountain View (Native plants and Oak trees) (BT1)	Parks Department	

Sustainability Outreach: Integrated in Chief Sustainability Office via new online tools, commercial outreach, and advocacy

Adopt a decarbonization policy for buildings (**B1**)							**Policy**	**12 yrs.**	
Recommendation name							Type	Duration	
269,264 *	**$380K**	**$0**	**n/a**	●○○	●●●	●●○	●●○	●○○	●●●
MT CO2e reduction 2018-2030	City's Net Cost	Incremental Net Cost	Net cost per MT CO2e reduction	Easy to implement	Easy to measure	Private investment leverage	Local economic benefits	Other environmental benefits	Health benefits

** Total CO2e saved by the Buildings and Land Use recommendations that are enabled by this recommendation (BE1, BE4, BE9, BE12, BN1, BN3, BN4, BN6)*

Problem description

Silicon Valley Clean Energy (SVCE) provides Mountain View with carbon-free electricity. Mountain View's next steps in reducing GHG emissions from buildings are to focus on reducing the natural gas consumption in the operation of buildings as much as feasibly possible and to address the embodied carbon in buildings and construction practices. The aim is to have nearly zero carbon emissions from all buildings in 2050, which means most of buildings need to be zero carbon or sequester more carbon than they produce. Only a small percentage can continue to use natural gas.

Gas fueled appliances in buildings have a life expectancy of 12- 20 years, though some commercial appliances are in use for longer. Buildings themselves will be in place for an average of 50 years. Therefore, the most critical time to implement change to meet our 2050 goals and beyond is in the years before 2030. In addition, by 2050, commercial space is expected to increase by 22% and multifamily units are expected to increase by 55% above 2015 levels. The City of Mountain View can significantly reduce emissions from this new construction and major remodels.

Recommendation

1. Use the absolute targets lined out in the Climate Protection Roadmap (2015) and per capita targets of recommendation M-13 as **targets for natural gas consumption** reduction in the building sector and report on them publicly via a dashboard.
2. Commission a Building Baseline Study and create a **Roadmap** on how to get to low-carbon buildings by 2050. This can be done with consultant support as well as input from an advisory council consisting of professionals and the public

To achieve the long-term targets:

3. **Initiate and support fuel switching initiatives**, including but not limited to the following recommendations of ESTF-2: Incentives for all-electric and high-performance buildings (BN3), new codes for all-electric buildings (BN1), incentives for residential fuel-switching (BE1), electrification leadership (BE12), and differential utility tax (BE9).
4. **Densify** the building stock. The task force supports the City's efforts in building high density multifamily housing [10], with the focus on affordable housing near transit (BN8).
5. Initiate and support **gas efficiency** improvements in buildings, including but not limited to the following recommendations of ESTF-2: New codes for all-electric buildings (BN1), manage the GHG budget as carefully as the financial budget (M1), LEED Platinum standard for all new city buildings (BN6), and energy efficiency for existing buildings (BE4).

6. Initiate reductions in GHG emissions due to **building material,** vegetation, and construction practices. Examples include but are not limited to the following recommendations of ESTF-2: Embodied carbon (BN4), new codes for all-electric buildings (BN1), consumption-based emissions inventory (W16), and enliven Mountain View with native plants (BT1).
7. **Coordinate the effort** with Silicon Valley Clean Energy, non-profits like Clean Coalition and Carbon Free Silicon Valley, and other cities in the Bay Area. One outcome of this should be a publicly available knowledge base for electrification of residential and commercial buildings (M10) and a coordinated outreach effort via the Sustainability Office (O1, O3, O2A, and O2B).

SWOT analysis

Strengths:

- Clear targets and a clear roadmap supported by an advisory council
- Plan beyond 2030 towards the 80% reduction goal of 2050
- If no natural gas infrastructure were to be needed, this would avoid methane leaks as well as costly maintenance and replacement

Weaknesses:

- Constrained staff time and limited resources
- Electrification of buildings will lead to an underutilized gas grid, which potentially leads to higher costs to the remaining gas customers. They may be unlikely or unable to electrify their equipment, either because they are not the owners of the equipment, they cannot afford the upgrade, or there is not yet a viable different solution for the equipment.

Opportunities and co-benefits:

- Improved indoor air quality and health of building occupants
- Reduced risk from natural gas in earthquake and fires

Threats:

- Natural gas industry

Municipalities where already implemented

Nearly Zero Carbon Roadmap: Stockholm (fossil fuel free by 2040) [2], European Union [3], Minnesota State [5], Architecture2030 Challenge Participating Cities [4], San Jose [6], Palo Alto [7], Berkeley [8]

Dashboards: Los Altos [13], San Jose [14]

Funding sources

CEC programs, CUPC programs, BAAQMD, SVCE, taxes/bonds/fees [10]

Assumptions and uncertainty

Assumptions with High Uncertainty:

- Funding sources for fuel switching other than SVCE
- Funding sources from tax and other outcomes from the funding study

Assumptions with Low Uncertainty:

- SVCE as a partner for the electrification of buildings

Author Ines Koch

Detailed analysis

Environmental analysis

No GHG reductions were attributed to this recommendation. The setting of targets and the development of a roadmap will not achieve any GHG reductions on their own. It will amplify the GHG reductions of the other recommendations, but this will not be quantified here.

Rec. 1: Gas Consumption Targets: The calculation of per capita gas consumption targets crystallizes the need to halve the consumption by 2030 compared to 2015 levels and to achieve less than a quarter of 2015 levels by 2050. This is a big challenge, since gas in homes is mainly used for space (37%) and water heating (49%) [1] and both appliances have life-spans of up to 20 years.

Therefore, whenever one of these appliances comes up for replacements, it will need to be switched out for a carbon-free alternative (such as a heat pump powered by renewable electricity). This is made even more challenging since the California Appliance Saturation Study (2009) indicates that homeowners consider high-efficiency hot water heaters to be much less important than other energy efficiency measures.

Per capita gas reduction targets can be easily calculated for specific types of users and communicated to business owners and residents as they directly relate to the energy bill. A public dashboard [13] additionally helps the city to communicate to the public and professionals the successes and the barriers the city encounters. It monitors the successfulness of the program.

Year		Absolute Target MTCO2e	Per Capita target MTCO2e/SP (4.33% reduction/year)	Estimated Service Population (SP)	MTCO2e
2005		121,136 (actual)	0.997 (actual)	121,532 (actual)	121,136 (actual)
2015		109,663 (actual)	0.66 (actual)	166,375 (actual)	
2020	15% -20%	102,966 - 96,909	0.51	183,671	94,245
2025	26%	89,641	0.41	199,823	82,176
2030	37%	76,316	0.33	221,708	73,073
2035	48%	62,991	0.26	-	n.a.
2040	58%	50,877	0.21	-	n.a.
2045	69%	37,552	0.17	-	n.a.
2050	80%	24,227	0.14	-	n.a.

B1 Table 1: GHG Absolute Targets (CPR) and per capita targets per Recommendation M13, calculated **for total gas consumption** with baseline year 2005. Assumption: BAU data, gas conversion factor for 2005: 5315.72 MT CO2e / Million Therms, and for 2015 + future years: 5320.66 MT CO2e / Million Therms

Rec. 2.: Roadmap: Many US cities have all-electric roadmaps, including Berkeley, San Jose, and Palo Alto. Goals range from achieving near-zero fossil fuel consumption in buildings to phasing out fossil fuels entirely by as early as 2030 and as late as 2050.

A roadmap is created with the input of an advisory council consisting of developers, energy efficiency companies, architects, environmentalists, public representatives, business representatives, researchers, and planning departments. It defines realistic targets and strategies on how to get there. The continued support of a consultant with expertise in electrification of buildings and implementation of ordinances will be crucial to move forward.

The City would commission a **Building Baseline Study of Mountain View** as input for the development of the roadmap and the development of the natural gas reduction and building outreach program [15]. The baseline assessment should provide [16]:

- an overview of Mountain View's building stock, including vintage
- energy use characteristics of existing buildings, also in comparison to the state average
- stock turnover, permit data analysis (replacement rates for key energy-using equipment including furnaces, air-conditioners, windows, roofs and water heaters; rate of major renovations, additions and remodels for existing buildings, including number of permits and type of permits)
- buildings without gas meters (analysis of PG&E and permit data)
- key opportunities for voluntary and mandatory measures for achieving the City's electrification targets. For example: types of housing, which have their space heating accessible to the outside and therefore can more easily switch to a heat pump.

Recs. 3-7.: Referencing other recommendations of this task force which lead to low-carbon buildings.

Densification: Multifamily units have about half the energy consumption of single family units [10]. This is due to two effects: a) less building area through which heating and cooling energy will be lost, since much of it is shared with other units; and b) smaller unit size, which leads to a compact heat distribution system and less equipment such as lighting and other devices.

Coordination with other entities in the Bay Area:

Silicon Valley communities face similar environmental sustainability challenges: GHG reduction despite growth of employee and resident populations; transformation of neighborhoods and commercial zones; GHG reduction of municipal operations; and retrofitting of the existing building stock under great time pressure.

The implementation cycle of ESAP 1, 2, and 3 over 10 years (2008- 2017), and the many General Plan Greenhouse Gas Reduction Program Action Items which have not been implemented since 2012, indicate that existing efforts are insufficient to get Mountain View on target fast enough to achieve the required GHG reductions by 2030 and 2050 respectively.

To increase effectiveness and to lower the burden on the City of Mountain View, this task force strongly encourages coordinated efforts with other cities in Silicon Valley and with local, regional and national organizations (for example, BAAQMD, Statewide Energy Efficiency Collaborative [SEEC), SVCE, Sustainable Silicon Valley, local green builders and architects, Acterra, Clean Coalition, Carbon Free Mountain View, Passive House, BayREN, and Urban Sustainability Directors Network].

The following examples show the impacts a coordination can have:

- Currently, suppliers of heat pump hot water heaters often do not have them in stock, which will make an emergency switch-out of equipment impossible. A coordinated effort between several cities could make this technology more attractive to suppliers. For GHG reductions in buildings, it is extremely necessary that all failing equipment can be easily and quickly exchanged for a heat pump.
- Local NGO's and government organizations could provide information and electrification support via webinars, pilot demonstrations, and open houses across all Bay Area cities. It would be easy for the City of Mountain View to highlight those opportunities to interested residents and employers. The City can also help obtain funding for electrification projects.

Cost analysis

	$ Consultant	$ FTE	$ expenses
Cost for roadmap and baseline study	$240,000 for 2-year project	8 × 1 month 8 × 15,000 = $120,000	Input forums/ advisory council $20,000
SUM	$380,000		

Financing options [17], [18]

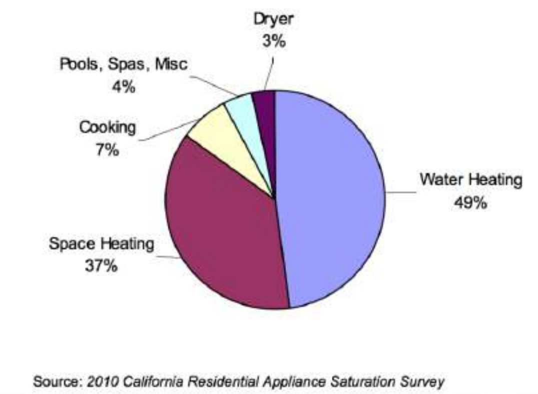
Scale analysis

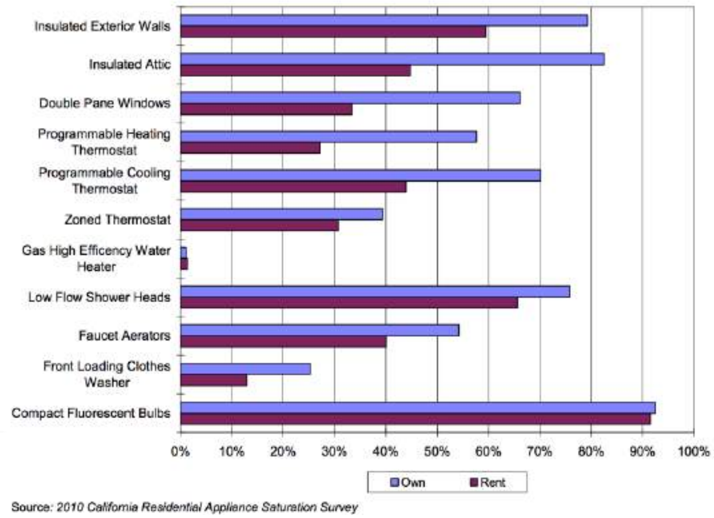
Mountain View's efforts can spread to the Bay Area via the coordination with other cities. Many of the building recommendations benefit from collaboration with other cities to reduce the cost of required studies, share the costs for information gathering, and create greater impact on the supply chain of equipment (as well as needed changes in construction, installer, developer and architect processes).

B1 References

Gas Consumption Targets: The electrification target is part of the zero-carbon goal (see below)

[1] 2009 California Appliance Saturation Study Executive Summary, p. 9 and p. 35.: http://www.energy.ca.gov/2010publications/CEC-200-2010-004/CEC-200-2010-004-ES.PDF





Nearly zero carbon goal:

[2] Stockholm - Fossil Fuel Free City by 2040: http://www.c40.org/case_studies/cities100-stockholm-becoming-fossil-fuel-free-by-2040

[3] European Union – 2050 low carbon economy- "Emissions from houses and office buildings can be almost completely cut – by around 90% in 2050. Energy performance will improve drastically through: passive housing technology in new buildings, refurbishing old buildings to improve energy efficiency, substituting electricity and renewables for fossil fuels in heating, cooling & cooking. Investments can be recovered over time through reduced energy bills."
https://ec.europa.eu/clima/policies/strategies/2050_en#tab-0-0

[4] Architecture 2030 challenge: http://architecture2030.org/

- All new buildings, developments and major renovations shall be designed to meet a fossil fuel, GHG-emitting, energy consumption performance standard of 70% below the regional (or country) average/median for that building type.
- At a minimum, an equal amount of existing building area shall be renovated annually to meet a fossil fuel, GHG-emitting, energy consumption performance standard of 70% of the regional (or country) average/median for that building type.
- The fossil fuel reduction standard for all new buildings and major renovations shall be increased to 80% in 2020; 90% in 2025; and carbon-neutral in 2030 (using no fossil fuel GHG emitting energy to operate).

These targets may be accomplished by implementing innovative sustainable design strategies, generating on-site renewable power and/or purchasing (20% maximum) renewable energy.

Cities that adopted the challenge:
http://architecture2030.org/2030_challenges/adopters/adopters_govt_local/

[5] Minnesota State bonded projects- new and major remodels – B3MN: No building energy consumption from carbon producing fuel by 2030 http://www.b3mn.org/2030energystandard/

[6] San Jose – Climate Smart San Jose – pages 93-95: total building electrification
http://www.sanjoseca.gov/DocumentCenter/View/75035

[7] City of Palo Alto – Buildings Baseline Study and Roadmap for Zero Net Energy Buildings
https://www.cityofpaloalto.org/civicax/filebank/documents/63492

City of Palo Alto – Roadmap picture: https://www.cityofpaloalto.org/civicax/filebank/documents/49883

City of Palo Alto – Sustainability Implementation Plan 2018-2020 – page 7 on building energy – total building electrification: https://www.cityofpaloalto.org/civicax/filebank/documents/63141

[8] City of Berkeley – electrification of buildings as part of Deep Green Building Initiative
https://www.cityofberkeley.info/Clerk/City_Council/2016/09_Sep/Documents/2016-09-13_Item_39_Berkeley_Deep_Green.aspx

Energy Efficiency Measures:

[9] ***City of Mountain View General Plan Greenhouse Gas Reduction Program (2012, https://www.mountainview.gov/civicax/filebank/blobdload.aspx?blobid=10700)***

and General Plan Action Items (March 2018)
http://laserfiche.mountainview.gov/Weblink/0/edoc/213771/EPC%202018-03-21%20Item%206.2%20Staff%20Memo-Exhibit%201%20(General%20Plan%20Action%20Items%20List,%202018).pdf

[10] California SB350 target (2015): Doubling Energy Efficiency Savings from 2015-2030

http://www.energy.ca.gov/sb350/doubling_efficiency_savings/

Energy efficiency measures as Distributed Energy Resource (DER):
https://www.arb.ca.gov/html/fact_sheets/2030_energyefficiency.pdf

Densification:

[11] City of Mountain View Housing Element, part of General Plan 2030 – Goal 1, Policy 1.4: Provide higher density housing near transit, in downtown, near employment centers, and within walking distance of services. https://www.mountainview.gov/civicax/filebank/blobdload.aspx?BlobID=15284

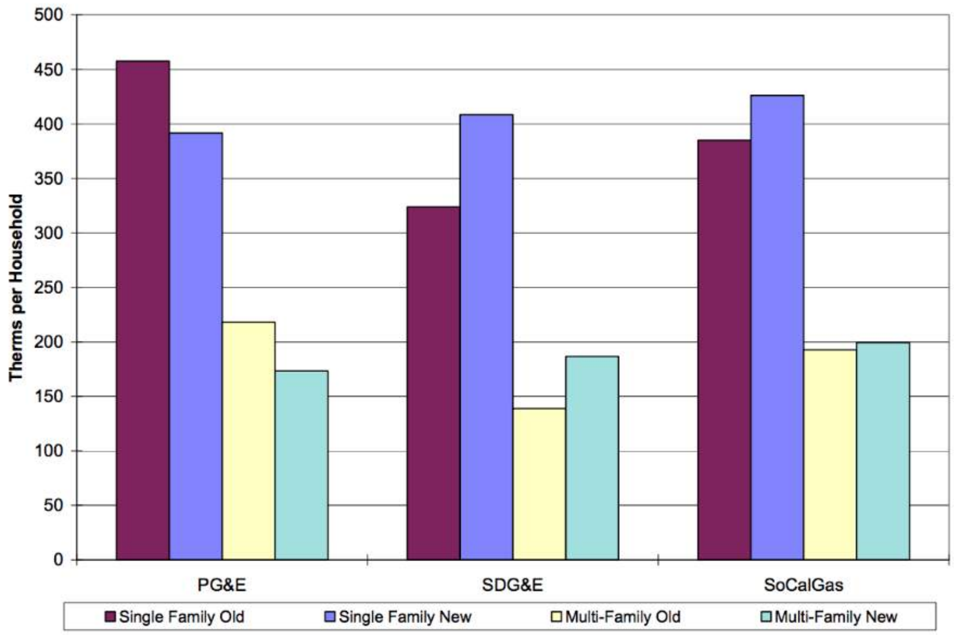
[12] Multi-family versus Single-Family Detached Homes Energy Use

http://michaelsenergy.com/briefs/multi-family-versus-single-family-detached-homes-energy-use/

Residential Energy Consumption Survey:

https://www.eia.gov/consumption/residential/data/2009/index.php?view=consumption

2009 California Appliance Saturation Study Executive Summary, p30.:
http://www.energy.ca.gov/2010publications/CEC-200-2010-004/CEC-200-2010-004-ES.PDF



Source: *2010 California Residential Appliance Saturation Survey*

Dashboards:

[13] Los Altos Environmental Resources dashboard
https://www.losaltosca.gov/environmentalcommission/page/environmental-resources-dashboard
[14] San Jose dashboard - planned - page 150
http://www.sanjoseca.gov/DocumentCenter/View/75035

Baseline Building Study:
[15] Building Baseline Study Palo Alto:
https://www.cityofpaloalto.org/civicax/filebank/documents/63492
[16] DNV-GL work plan presentation for Palo Alto's Building Baseline Study:
https://www.cityofpaloalto.org/civicax/filebank/documents/60700

Financing decarbonization of buildings:

[17] City of San Jose – Climate Smart 2.0 – a people-centered plan for a low carbon future – many different funding and financing options listed, p. 140-145:
http://www.sanjoseca.gov/DocumentCenter/View/75035

[18] Berkeley –financing for Deep Green Building Initiative – Appendix 4a7 - special parcel tax recommended https://www.cityofberkeley.info/Clerk/City_Council/2018/03_Mar/Documents/03-12_Agenda_Committee_Packet.aspx

Create financial and non-financial incentives for new above-code buildings (**BN3)**							**Policy**	**3 yrs.**	
Recommendation name							Type	Duration	
18,442	**$216K**	**n/a**	**$11.71**	●●○	●●○	●●○	●●○	●●○	●●○
MT CO_2e reduction 2018-2030	City's Net Cost	Incremental Net Cost	Net cost per MT CO2e reduction	Easy to implement	Easy to measure	Private investment leverage	Local economic benefits	Other environmental benefits	Health benefits

Problem description

Mountain View's building decarbonization goals and implementation of related policies will require certain incentives given the innovative nature of new requirements for buildings. The city of Mountain View offers certain incentives such as streamlined permitting for projects in North Bayshore (see BN3 Appendix); these incentives could be extended to other new buildings committing to emissions mitigation. There are about 10,000 new residential units and 4.4 million square feet of commercial construction planned in MV for the next 12 years. While we recommend developing mandatory ordinances to control emissions from these new buildings, incentives are a powerful way to motivate new construction to have lower emissions (and to promote other sustainability measures) while these ordinances are being developed.

Recommendation

We recommend that the city extend the North Bayshore (NBS) incentives to voluntary green new construction in other parts of the city and develop a range of incentives for sustainable building design with high potential of reducing greenhouse gas emissions. We also recommend **monitoring** neighboring cities for additional incentive programs to attract green developers and efficient building projects.

Structural incentives

1. **Expedited permitting and plan review** for above-code projects, such as listed in the NBS Precise Plan (see BN3 Appendix BN3 Table 1), so that review time is approximately halved.
2. **Extend the density and height bonuses** planned for NBS to all new buildings meeting these criteria in Mountain View.

Financial Incentives

1. **Reduce plan check fees and permit fees** by **50%** lower than standard fees (for a ZNE building proposed in the budget; mentioned in ESAP-3, #4)

Other incentives

1. **Job site signs** – City green building construction job site signs could be made available for builders to help distinguish their projects from others. This would serve as a billboard to inform the general public of the builder's commitment to environmentally responsible building and the long-term health of the community [2].
2. **Directory of participating designers and builders** – Participating architects, designers and builders could be listed and published in promotional materials. The listing would be on the city website and included in green building information packets at public events.

3. **Green building excellence award series (commercial, industrial, and schools].** A Green Building Program Participant List could be posted on the City website. A City of Mountain View building seal of approval could be posted during and prior to the site's construction. [3]
4. **Investigate independent incentives for sustainable material use,** environmental product declarations, and construction debris management and waste diversion. See "Reduce embodied carbon in building construction and maintenance (**BN4**)" for related impact information.

SWOT analysis

Strengths:

- It can be implemented quickly and leverages existing staff efforts
- During an expedited permitting process, time saved is money saved
- Green building excellence award winners can provide tours of their buildings and thus inspire more green buildings

Weaknesses:

- City will experience some revenue loss from changes in permitting fees

Opportunities and co-benefits:

- None identified

Threats:

- None identified

Municipalities where already implemented

- San Diego, San Francisco [4] [5], Arlington, Chandler, Minnesota, and Phoenix

Assumptions and uncertainty

Assumptions with High Uncertainty: None**.**

Assumptions with Low Uncertainty:

1. At least 1% of the new housing units will reduce 80% of their energy use to earn the incentives each year.
2. At least 25% of the new commercial and industrial square footage will reduce energy use by 80% to earn the incentives each year
3. To enable expedited permitting, the city can allow delays in permits for conventional construction.

Author Chirjiv Anand

Detailed analysis

Environmental analysis

Assumptions:

1. Commercial and industrial sectors will make more use of the incentives than the residential sector.
2. At least 1% of the new housing units will reduce 80% of their energy use to earn the incentives each year.
3. At least 25% of the new commercial and industrial (C&I) square footage will reduce 80% of its energy use to earn the incentives each year.

BN3 Table 1. GHG emissions savings from incentives development.

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
New housing units added each year	580	593	660	730	806	829	848	865	885	969	1064	1163
1% of this housing unit	6	6	7	7	8	8	8	9	9	10	11	12
MT CO2e from electricity	7	6	6	6	6	6	6	7	7	7	7	7
MT CO2e from natural gas	467	471	475	479	483	487	492	496	500	504	509	513
Total MT CO2e from housing units	474	477	481	485	489	493	498	503	507	511	516	520
BAU emissions from 1% of the units	5	5	5	5	5	5	5	5	5	5	5	5
80% reduction in emissions in 1% of units	1	1	1	1	1	1	1	1	1	1	1	1
Res emissions reduced	4	4	4	4	4	4	4	4	4	4	4	4
Non-residential units added each year in million sq.ft	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
25% of the non-res sq.ft. (in millions)	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
MT CO2e from electricity	88	89	91	93	95	97	99	101	104	106	108	110
MT CO2e from natural gas	1003	1020	1037	1055	1072	1091	1109	1128	1147	1167	1187	1207
Total MT CO2e from C&I sq.ft.	1091	1109	1128	1148	1167	1188	1208	1229	1251	1273	1295	1317
BAU emissions from 25% of the C&I sq.ft	273	277	282	287	292	297	302	307	313	318	324	329
80% reduction in emissions in 25% of the sq.ft	55	55	56	57	58	59	60	61	63	64	65	66
Non-residential emissions reduced	218	222	226	230	233	238	242	246	250	255	259	263

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
TOTAL EMISSIONS REDUCED VIA INCENTIVES ANNUALLY	222	226	229	234	237	242	246	250	254	259	263	268
Cumulative emissions reduced via incentives	222	448	677	911	1148	1390	1635	1885	2139	2398	2661	2929
TOTAL EMISSIONS REDUCED VIA INCENTIVES (2019-2030)	18442											

Cost analysis

1. Fees are based on valuations. This recommendation assumes a building value of $500,000 for all buildings to calculate fees.
2. 10 commercial construction projects per year are assumed to cover 100,000 square feet.
3. Cost for job site signs is assumed at $7,332, based on about 20 signs. (Cost reference: https://www.megaprint.com/jobsite-graphics.php)
4. A directory of participating designers and builders may be updated annually and may take up to 5 hours of work per year estimated at $90/hr., to cost $5,400 from 2019-2030.
5. Green building excellence award series is estimated to cost up to $5,000 per year, in addition to time required for evaluation of participating buildings.
6. Investigating independent incentives for sustainable material use: an initial investigation is estimated to cost $45,000, assuming a 3-month work period.
7. Revenue lost is estimated in BN3 Table 1 (details in BN3 Tables 2 and 3), and $/MT are based on these numbers.

BN3 Table 1. Revenue lost from providing reduced permitting and plan check fees.

		Revenue lost	
Incentive	**One-time cost**	**Residential (3 years)**	**Commercial (3 years)**
Reduced permit & plan check fees		$75,611	$123,750

BN3 Table 2. Revenue loss from new residential buildings.

Costs from reduced permit & plan check fees	Residential			Total 3-year revenue loss
	2019	2020	2021	
No. of permits	6	6	7	
Revenue lost from reduced permit & plan check fees	$23,925	$24,461.25	$27,225	**$75,611**
Fees per permit & plan review (conventional residential)	$8,250			
50% reduction in fees	$4,125			

BN3 Table 3. Revenue loss from new commercial buildings.

Costs from reduced permit & plan check fees	Commercial			Total 3-year revenue loss
	2019	2020	2021	
No. of permits	10	10	10	
Revenue lost from reduced permit & plan check fees	$41,250	$41,250	$41,250	**$123,750**
Fees per permit & plan review (conventional non-residential)	$8,250			
Permit costs after 50% reduction in fees	$4,125			

Cost reference for permits- Mountain View

a. https://mountainview.gov/civicax/filebank/blobdload.aspx?BlobID=24760
b. https://www.pca.state.mn.us/sites/default/files/2-13.pdf

BN3 References

[1] City of Miami, "Miami Public Benefits Program, Miami 21, Sec. 3.14": http://www.miami21.org/PDFs/Article3-General_to_Zones-2008-April.pdf.

[2] City of Scottsdale, "Builder Incentives," 2018:

http://www.scottsdaleaz.gov/green-building-program/incentives.

[3] City of Chandler, "City of Chandler Green Building Program": http://www.chandleraz.gov/default.aspx?pageid=874.

[4] San Diego County: https://www.sandiegocounty.gov/content/dam/sdc/pds/docs/pds613.pdf.

[5] City of San Francisco: https://sfenvironment.org/article/larger-projects-commercial-amp-multifamily/priority-permitting.

BN3 Appendix:

1. Some high-performance building options to consider under requirements- net positive energy homes; Exceed LEED platinum checklist; At least 150 Green Points intent; Living building Challenge certification intent or Petal recognition intent; Passive house certification intent or EnerPHIT certification.) [1]

BN3 Appendix Table 1. Existing density bonus program.

Commercial		
Transfer of development (up to 0.25 FAR)		
(FAR	**Incentive**	**Requirement**
1.25	1 Additional FAR bonus (up to 0.25 FAR)	Higher-performing green building
		Transfer of development
		Zero net green building
		Public benefit or district improvement project
1.0	Earn one of the following FAR bonuses (up to 0.25 FAR)	Higher performing green building
		Public benefit or district improvement project
		Zero net green building
0.75	Earn the LEED BD+C Platinum or Alternative green building FAR bonus (up to 0.3 FAR)	See BN3 Figure 1 in BN3 Appendix
0.45	All projects shall	Meet the applicable standards in the land use and design chapter **and** meet the green building standards described in the green building and site design chapter

BN3 Figure 1. Non-residential higher-performing green building FAR bonus for North Bayshore.

Residential projects that voluntarily choose to participate in the North Bayshore Density Bonus Program shall implement the following green building measures. The City will regularly review these standards to ensure they reflect advances in green building and technology improvements.

Table 30: Green Building Measures

Performance Area	Minimum Performance Required
Minimum Green Building	120 points GreenPoint Rated
Water Use	Install Energy Star appliances (CalGreen voluntary)
Landscape Design	Reduction of heat island effect (CalGreen voluntary), including but not limited to strategies such as green roofs, high-reflectance roof and paving materials, and vegetation shading over paved areas.
Energy	Submeter, or other appropriate technology that can track individual energy use, for each residential unit (LEED for Homes)

BN3 Figure 2. Residential green building standards for NBS density bonus program.

Appendix B:
Residential Green Building Standards for the North Bayshore Density Bonus Program

Residential projects that voluntarily choose to participate in the North Bayshore Density Bonus Program shall implement the following green building measures. The City will regularly review these standards to ensure they reflect advances in green building and technology improvements.

Table 30: Green Building Measures

Performance Area	Minimum Performance Required
Minimum Green Building	120 points GreenPoint Rated
Water Use	Install Energy Star appliances (CalGreen voluntary)
Landscape Design	Reduction of heat island effect (CalGreen voluntary), including but not limited to strategies such as green roofs, high-reflectance roof and paving materials, and vegetation shading over paved areas.
Energy	Submeter, or other appropriate technology that can track individual energy use, for each residential unit (LEED for Homes)

Update green building code to move towards low-carbon buildings **(BN1)**							**Manda-tory**	**Permanent**	
Recommendation name							Type	Duration	
54,283	**$367K**	**$5.86M**	**$6.78**	●●○	●●○	●●○	●●○	●●○	●●○
MT CO_2e reduction 2019-2030	City's Net Cost	Incremental Net Cost	Net cost per MT CO2e reduction	Easy to implement	Easy to measure	Private investment leverage	Local economic benefits	Other environmental benefits	Health benefits

Note: Definitions of all underlined terms are provided in the BN1 Appendix.

Problem description

Now that Mountain View purchases carbon-neutral electricity, about 99% of GHG emissions from residential buildings and 94% of GHG emissions from commercial buildings are from natural gas use. To achieve the local and state level GHG emission reduction targets, MV's Green Building Code (MVGBC) needs to be stricter than the California building standards code (Title 24) and be tailored to the local emission reduction requirements. Title 24, 2019 will be stricter than the current MVGBC [1].

Recommendation

Move towards high-efficiency buildings beyond state building standards (Title 24, part 6)

MVGBC should be renewed every three years (per ESAP-3 #32), monitoring the changes proposed in each Title 24 update (also every 3 years) and aiming to always surpass Title 24. This can be done by adopting or developing mandatory local codes such as reach codes and CALGreen **Tiers 1 and 2** that allow energy use reduction by 15-30% (via Tiers) beyond state's mandatory measures.

We also recommend amending MVGBC's certification-related requirements, such as "meet the intent of 70 GreenPoint Rated," to require the most energy-efficient options of LEED and GreenPoint Rated [1] and adopting or developing reach codes that allow buildings to go beyond the state mandates. There should be all-electric reach codes:

1. **Adopt the existing reach code** on low-rise residential new construction: All-electric design – CALGreen – Voluntary Tiers 1 and 2, for areas with no gas lines [2].
2. **Develop a reach code to mandate use of clean energy for all purposes** (electrical appliances and installation of EV chargers) in residential and commercial **new buildings** by 2025, in areas with existing gas lines [code details in BN1 Appendix].
3. **Develop a reach code for existing homes that supports all-electric-ready design** when a building undergoes remodeling or retrofitting. Making a building all-electric-ready costs the owner a small (5-10%) additional percentage on top of their remodeling or retrofitting costs.

Other ordinances to adopt:

1. **Adopt a reach code to mandate solar for non-residential new construction** (ESAP-3, #5) [code details in BN1 Appendix], to help with GHG reductions in cases where electrification is not found cost-effective and as a result cannot be approved as a mandate. Adoption of a solar mandate will also help with renewable grid capacity.

SWOT analysis

Strengths:

- A net savings of $9 per month was reported for Palo Alto homes after electrification [3].
- The city can be better prepared for upcoming state code changes every 3 years.
- Adoption of a reach code will help the city dictate the direction of future construction.
- Cost-effectiveness studies for the reach code are funded by PG&E.
- GHG saving via these code implementations will be applicable far beyond 2030.

Weaknesses:

- The uncertainty of the net cost could range from $60 in savings to $60 in costs per month [3].
- Additional electricity consumption from electrification is charged at the highest tier of the residential rate. Rate structure changes may benefit electrification efforts.
- Studies with standard efficiency appliances (as required by code for the cost-effectiveness studies) will not help to achieve 100% electrification in multi-family and commercial constructions, due to code penalties from the compliance software. The city would need to work with CEC in changing the code to allow higher-efficiency equipment for analysis.

Opportunities and co-benefits:

- Rise in sale of electric appliances and use of local labor for electrical appliance installations.
- Increased safety (no gas pipeline bursts during earthquakes, less fire risk).
- Improved indoor air quality.

Threats: No threats identified.

Municipalities where already implemented

1. All-electric reach code – Palo Alto (study session completed with council for single-family detached homes) [3][4]
2. Solar mandate – Palo Alto [4], Mountain View has also finished a solar options analysis in 2018.
3. Low-Rise Residential new construction: All-electric design – CALGreen – Voluntary Tiers 1 & 2 – Applied in Climate Zones 2, 12 & 13 [1]

Funding sources SVCE, PG&E

Assumptions and uncertainty

Assumptions with High Uncertainty:

- It will be possible to achieve 100% electrification in all new buildings by 2025.
- Cost-effectiveness and feasibility is being assumed for all new building types.
- Major renovations are not included in the analysis.

Assumptions with Low Uncertainty:

- In an all-electric scenario, the **increase in electricity demand is assumed** to grow by 0.9% in the residential sector and 1.7% in the commercial sector annually. These were BAU assumptions for annual natural gas growth.
- It is assumed that the current opt-out ratio will remain.
- It could take an **estimated 2 years** to develop and adopt the reach codes and then more time to outreach before they are implemented. This recommendation therefore assumes that the city may be able to mandate **all-electric buildings** starting 2025.

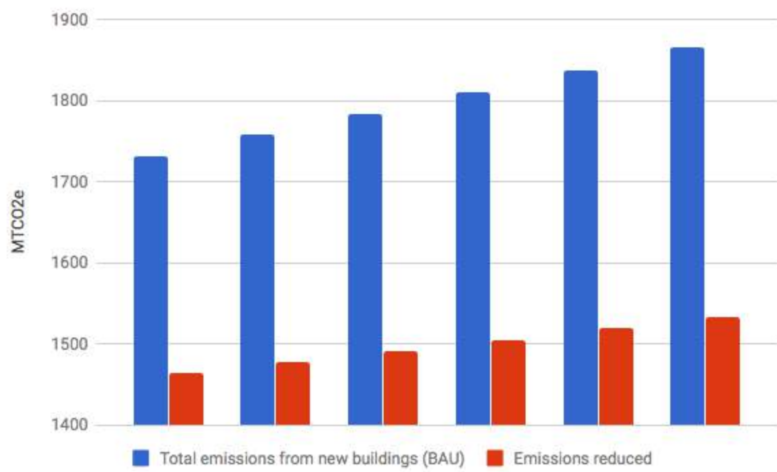
Author Chirjiv Anand

Detailed analysis

Environmental analysis

Emissions reduced from all-electric reach code for new buildings with existing gas lines

Considering all the assumptions, a reduction of 31,294 MTCO2e in BAU emissions from new buildings can be achieved from adopting an all-electric mandate for new buildings from the years 2025-2030.



BN1 Figure 1. GHG emission reductions from all-electric new buildings [Details in BN1 Appendix].

Other expected GHG savings

1. The savings from adoption of an **all-electric code with no gas lines requirement** will result in GHG savings which have **not been included in this analysis** but are expected to be very low, considering MV may not have any space without gas lines. This is however, a recommended step to not miss any opportunity to reduce GHG emissions.
2. Savings from use of solar have not been calculated, assuming that the proposed **solar mandate** will be used along with other high-efficiency measures to receive reductions like an all-electric scenario.
3. GHG savings from Tier 1 & Tier 2 adoption in new buildings were analyzed using the assumptions for **Tier 2** emissions reduction in addition to the modified requirement for certification intent, resulting in additional GHG savings of 11,583 MTCO2e. These calculations were applied to new buildings only from 2019-2025 (assuming the all-electric mandate will be implemented by 2025).
4. GHG savings from retrofitting of existing buildings have also been analyzed because of an all-electric design mandate for new buildings. Estimated savings are 11,406 MTCO2e from 2025-2030.

Cost analysis

1. The **development and approval of the all-electric reach code,** including the cost-effectiveness study, is estimated to take about 2 years. We estimate a part-time consultant would be required to work at $90,000/year. [**2-year cost = $180,000**].
2. A **net incremental cost** for homeowners is assumed to be $25 per month [3]. A net incremental cost for commercial construction has not been calculated, due to lack of a published estimate and the varied nature of commercial buildings and related electrical appliances. A net incremental cost based on these assumptions was estimated at **$5,860,206.**

3. It is assumed that **MVGBC review and update** including adoption of CALGreen tiers will be a recurring task (every three years), and one part-time consultant would be required to work on this. We estimate the pay to be **$180,000 for each 3-year period**.
4. A **solar mandate** for non-residential buildings would need about 1-2 years to implement. We estimate a part-time consultant would be required at $90,000/year. [2-year cost = $180,000].
5. **SVCE** may develop an electrification program depending on the changes in Title 24, 2019. This may help the city avoid certain costs [5].

BN1 References

[1] City of Mountain View, Mountain View Green Building Code (MVGBC), (n.d.).

[2] California Energy Codes and Standards, Performance based ordinances, (n.d.). http://localenergycodes.com/content/performance-ordinances.

[3] The City of Palo Alto, Discussion of Results of Cost-Effectiveness Evaluation of Electrification Options for Appliances and Passenger Vehicles in Single Family Residential Homes, Palo Alto, 2015. https://www.cityofpaloalto.org/civicax/filebank/documents/47998.

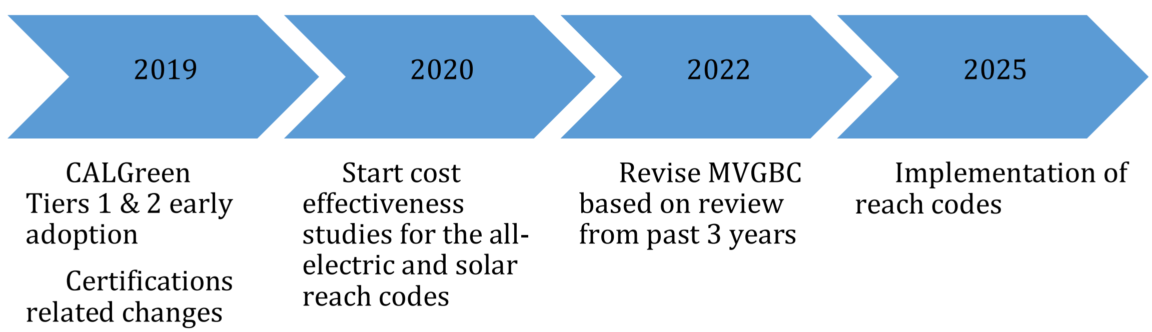
[4] The City of Palo Alto, Palo Alto Electrification Final Report, Palo Alto, 2016. https://www.cityofpaloalto.org/civicax/filebank/documents/55069.

[5] Energy Star, National, State, and local governments leveraging ENERGY STAR® (Updated January 22, 2016), 2016. https://www.energystar.gov/sites/default/files/tools/ES_Government-Factsheet_012216.pdf.

BN1 Appendix:

1. **CALGreen Tiers**

The proposed prioritization and timeline for this recommendation is presented in BN1 Figure 1. An **early adoption of CALGreen tiers** in 2019 is recommended for reduction of emissions earlier in the timeline. Typically, the CALGreen measures and the tiers would be adopted in 2020 (one year after the code is released).



BN1 Figure 2. Steps in this recommendation to be taken between 2019 and 2030.

2. **All-electric reach codes**
   - The city will need to perform a cost-effectiveness study to confirm that it is fiscally responsible to do this reach code.
   - The city is recommended to hire a consultant such as ID360 or DNV GL to do the study, or work with local energy reach codes contacts, through the process with the code cycles.

Residential

1. Require all-electric if feasible and cost effective
2. Require an all-electric enabling design for all residential construction if all-electric is currently infeasible
3. Require minimum 200/400A service for all new residential construction to size the electric panel so that it can support an all-electric house

Commercial & Multi-Family

1. Require all-electric for new small office and multi-family if cost effective
2. Explore requiring annual energy benchmarking (ENERGY STAR reporting) for new commercial construction exceeding 10,000 square feet [5]

3. **Solar mandate for non-residential construction**
   1. Comply with base code and install a 5 kW or larger PV system (City of Palo Alto[50], City of Brisbane) OR
   2. Comply with base code and install at least 2 Watts / sq. ft. (city of Santa Monica example) OR
   3. Develop a table of a variety of system size requirements tailored to sq. ft. of conditioned space, like the City of Fremont [51]
4. **Outreach & incentives**
   1. Highlight MV's all-electric construction statistics on the website and use public input forums to learn about any challenges with adopting all-electric buildings. Highlight **all-electric building statistics** for MV on the city website. This work could be charged on an hourly basis at $90/hr., once a year after implementation of the all-electric mandate [cost from 2026 - 2030 = $1800, on a 5 hrs./ year basis].
   2. **Public input forums** could cost about $6,000 if planned biannually for a 3-year duration, spanning from after the code is approved to the initial implementation stages.
   3. **Provide incentives** relevant to residential as well as commercial sectors, such as streamlined permitting, planning permit fee waiver, and bonus floor area ratio (FAR). (Please see recommendation BN3 for further details on incentives.)

[50] https://www.youtube.com/watch?v=GO9kk6_aBZ4&feature=youtu.be
[51] https://fremont.gov/DocumentCenter/View/35511/Mandatory-Solar-Requirement

5. Environmental analysis calculation details

BN1 Table 1. Emissions from all new buildings from the BAU scenario.

Baseline								
	All buildings			New buildings				
Year	Electricity based emissions (MTCO2e)	Natural gas based emissions (MTCO2e)	Total emissions from (MTCO2e)	No. of new residential construction unit added each year	Emissions from new residential construction only (MTCO2e)	Million sq.ft of commercial added each year	Emissions from new commercial construction only (MTCO2e)	Total emissions from new buildings (BAU)
2025	36210	124,691	160,901	848	498	0.4	1233	1731
2026	36,311	126,315	162,626	865	503	0.4	1255	1758
2027	36,425	127,962	164,387	885	507	0.4	1277	1784
2028	36,521	129,633	166,154	969	511	0.4	1299	1810
2029	36,629	131,329	167,958	1,064	516	0.4	1322	1838
2030	36,739	133,048	169,787	1,163	520	0.4	1345	1865

BN1 Table 2. Emissions from new buildings in the all-electric scenario.

All-electric recommendation result							
	No. of new residential construction unit added each year	Emissions from new residential construction only (MTCO2e)	Million sq.ft of commercial & Industrial added each year	Emissions from new commercial construction only (MTCO2e)	Total emissions from new constructions (MTCO2e)	Emissions reduced	Cumulative reduction in emissions (MTCO2E)
2025	848	7	0.4	261	268	1464	1464
2026	865	7	0.4	273	280	1478	2941
2027	885	7	0.4	285	292	1492	4433
2028	969	7	0.4	298	305	1505	5938
2029	1,064	7	0.4	312	318	1519	7457
2030	1,163	7	0.4	326	332	1532	8989
							31222

Existing buildings retrofit analysis

Assumptions:

1. 0.1% of the existing residential buildings and 1% of commercial space are assumed to be retrofitted each year.
2. 30% reduction in emissions is achieved via retrofitting and obtaining an all-electric ready design where possible.
3. 10,000 sq. ft. = 1 commercial unit.

BN1 Table 3. Summary of calculations of GHG savings.

	2025	**2026**	**2027**	**2028**	**2029**	**2030**	Total savings
Total Residential units	41,334	42,199	43,084	44,053	45,117	46,280	
Newer residential constructions starting (These will benefit via all-electric code for new buildings)	848	865	885	969	1,064	1,163	
Older residential considered for analysis	40,486	41,334	42,199	43,084	44,053	45,117	
Residential units retrofit each year	*40*	*41*	*42*	*43*	*44*	*45*	
BAU emissions residential electricity	603	610	617	623	630	637	
BAU emissions from natural gas	58,322	58,828	59,328	59,832	60,341	60,854	
Total BAU emissions from residential	58,925	59,438	59,945	60,455	60,971	61,491	
Emissions reduced via new buildings reach code	492	496	500	504	509	513	
Existing residential building emissions	58,433	58,942	59,445	59,951	60,462	60,978	
Emissions from only building being remodeled BAU	58	59	59	60	60	61	
30% reduction in these emissions	41	41	42	42	42	43	
Total Commercial space (Mil. Sq ft)	28.7	29.1	29.4	29.8	30.2	30.5	
Newer commercial constructions	0.4	0.4	0.4	0.4	0.4	0.4	
Older commercial space	28.3	28.7	29.0	29.4	29.8	30.1	
Commercial units retrofit every year	0.28	0.29	0.29	0.29	0.29	0.30	
BAU emissions C&I electricity	4272	4366	4462	4560	4460	4763	
BAU C&I natural gas	66359	67487	68634	69801	70988	72195	
Total BAU emissions from commercial	70631	71853	73096	74361	75448	76958	
Emissions reduced via new buildings reach code	972	982	992	1001	1322	1019	
Existing commercial building emissions	69659	70871	72104	73360	74126	75939	
Emissions from only building being remodeled BAU	697	709	721	734	741	759	
30% reduction in these emissions	488	496	505	514	519	532	
Total reductions (MTCO2E)	529	537	546	555	561	574	
Cumulative reductions (MTCO2E)	529	1,066	1,612	2,168	2,729	3,303	**11,406**

Certifications and CALGreen Tiers

Assumptions

1. A 15% reduction in emissions is assumed compared to BAU with Tier 1 adoption (and an additional 15% reduction is assumed with adoption of the most energy efficient options of LEED and GreenPoint Rated).
2. A 30% reduction in emissions compared to BAU in Tier 2 and an additional 15% reduction with adoption of the most energy efficient options of LEED and GreenPoint Rated.
3. Savings are calculated only from 2019 to 2025, assuming the all-electric code will be in place by 2025.

BN1 Table 4. Emissions saved with Tier 1 adoption.

BAU	**New Housing units**	290	593	660	730	806	829	Total savings
	Emissions from new housing units (Electricity)	3.3	6	6.2	6.2	6.3	6.4	
	Emissions from new housing units (Nat. Gas) MTCO2e /MWH Res.	233.5	471	475	479	483	487	
	Total emissions from new residential buildings	**236.8**	**477**	**481.2**	**485.2**	**489.3**	**493.4**	
	New Commercial Space (in Mil Sq.ft)	0.2	0.4	0.4	0.4	0.4	0.4	
	Emissions from new C& I space (Electricity)	43.95	89.3	91.2	93.1	95.1	97.2	
	Emissions from new C& I space (Natural gas)	502	1020	1037	1055	1072	1091	
	Total BAU C&I buildings emissions	**545**	**1,109**	**1,128**	**1,148**	**1,167**	**1,188**	
	Total emissions from new buildings (BAU)	**782**	**1,586**	**1,609**	**1,633**	**1,656**	**1,682**	
Tier 1	**Total emissions from new buildings (TIER 1) +GreenPoint Rated changes**	548	1110	1127	1143	1159	1177	
	Emissions saved	235	476	483	490	497	504	
	Cumulative savings (MTCO2E)	235	711	959	973	987	1,001	4,865

BN1 Table 5. Emissions saved with Tier 2 adoption.

	Tier 2 - 30% + Most energy efficient LEED and GreenPoint Rated strategies- 15%							Total savings
		2019	**2020**	**2021**	**2022**	**2023**	**2024**	
BAU	**New Housing units**	290	593	660	730	806	829	
	Emissions from new housing units (Electricity)	3.3	6	6.2	6.2	6.3	6.4	
	Emissions from new housing units (Nat. Gas) MTCO2e /MWH Res.	233.5	471	475	479	483	487	

	Total emissions from new residential buildings	**236.8**	**477**	**481.2**	**485.2**	**489.3**	**493.4**	
	New Commercial Space(in Mil Sq.ft)	0.2	0.4	0.4	0.4	0.4	0.4	
	Emissions from new C&I space (Electricity)	43.95	89.3	91.2	93.1	95.1	97.2	
	Emissions from new C&I space (Natural gas)	502	1020	1037	1055	1072	1091	
	Total BAU C&I buildings emissions	**545**	**1,109**	**1,128**	**1,148**	**1,167**	**1,188**	
	Total emissions from new buildings (BAU)	**782**	**1,586**	**1,609**	**1,633**	**1,656**	**1,682**	
Tier 2	**Total emissions from new buildings (TIER 2)**	469	952	966	980	994	1009	
	Emissions saved (MTCO2E)	313	635	644	653	663	673	
	Cumulative savings (MTCO2E)	313	947	1,591	2,245	2,907	3,580	**11,583**

List of definitions

1. **Title 24** of the California Code of Regulations, known as the California Building Standards Code or just "Title 24," contains the regulations that govern the construction of buildings in California. http://www.dgs.ca.gov/dsa/Programs/progCodes/title24.aspx
2. **Reach codes** are a set of statewide optional construction standards for energy efficiency that exceed the requirements of the state's mandatory codes.
3. The California Green Building Standards are referred to as **CALGreen**. These standards are part 11 of Title 24. The CALGreen Code is a comprehensive and uniform regulatory green building code for all new residential, commercial, hospital and school buildings, ensuring that every new building in California is built using environmentally advanced construction practices. http://www.title24express.com/what-is-title-24/calgreen-building-code/
4. A key component of the **CALGreen code** is a **two-tiered system** designed to allow local jurisdictions to adopt codes that go beyond the state mandatory provisions. The two tiers contain measures that are more stringent than the mandatory measures and include an increased reduction in energy usage by 15 or 30 percent. The tiers are designed to become mandatory when adopted by a local jurisdiction. They then fall under the local building department's inspection process. http://www.title24express.com/what-is-title-24/calgreen-building-code/

Measure effectiveness of housing near transit **(BN8)**							**Policy**	**2019 on**	
Recommendation name							Type	Duration	
18,560	**$90k**	**$0**	**$4.85**	●●●	●●●	●●●	●○○	●●○	●●○
MT CO2e reduction 2018-2030	City's Net Cost	Incremental Net Cost	Net cost per MT CO2e reduction	Easy to imple-ment	Easy to measure	Private investment leverage	Local economic benefits	Other environmental benefits	Health benefits

Problem description

The City has a general policy of building housing near transit as outlined in the General Plan. However, the City does not measure the effectiveness of this policy. In addition, building more housing raises overall greenhouse gases (GHG)s if driving patterns are unchanged. Some studies show building below market-rate (BMR) housing near transit is highly-effective at reducing GHG because people greatly reduce their driving. (1) Yet the land with the most concentrated transit (downtown Mountain View) sells at a premium so there is pressure to build more expensive housing there. Some developers of higher-end housing claim that they offer incentives to tenants and that most tenants use transit, but there is no measurement of these claims.

Recommendation

According to a Transform study (1):

- "Lower Income households drive 25-30% fewer miles when living within 1/2 mile of transit than those living in non-TOD [transit-oriented development.] When living within HCD's [housing community developments] 1/4 mile of frequent transit they drove nearly 50% less.
- Higher Income households drive more than twice as many miles and own more than twice as many vehicles as Extremely Low-Income households living within 1/4 mile of frequent transit. This underscores why it is critical to ensure that low-income families can live within 1/4 mile of transit."

We recommend using the California Department of Housing and Community Development (HCD) TOD Housing-Program funds point-system (2) to evaluate TOD. The point-system is outlined below. We also recommend all new TOD developers that want Floor Area Ratio (FAR) bonuses have a target of VMT for residents of that development that is 30% lower than the average VMT in Mountain View as of 2021. This is the target intended by using HCD's point-system.

We estimate it will take one full-time equivalent employee six months at a cost of $90,000 to go through the entire point-system and make it Mountain View specific and align both the point-system and VMT target with existing City TOD development processes. We assume if done correctly, staff can rate a proposed development and assess its likelihood of reaching the VMT target as they go through the usual TOD process. Assuming this is the case, it will add a negligible amount of staff time to the TOD process.

We will also assume no incremental cost because TOD that meets the HCD point-system qualifies for numerous grants and loans that decrease costs. We will assume that as it is the case today, most TOD developers will want FAR bonuses and these increase revenue from selling or leasing the property.

We recommend this become policy in 2019 and we estimate the first of these properties will be built in 2021. At first, the percentage of the population living in TOD under this policy will be small. However, up to 9,850 units of housing are approved for building in North Bayshore (NBS), which is slated to become transit-oriented. Therefore, much of the new housing slated to be built in Mountain View will be TOD. Business-as-usual (BAU) population growth is a constant 1.7% a year. For ease of analysis, we will estimate over half the new population will live in TOD by 2021; 1% of the population will live in TOD, rising by 1% a year. We will also assume that this recommendation reduces VMT by 20% from current VMT.

SWOT analysis

Strengths:

- Allows building more TOD while also decreasing overall GHGe.
- Motivates developers to create a property that truly reduces VMT.
- More low-income housing means fewer workers driving long commutes.
- It allows the City to show that building housing near transit does in fact reduce GHGs.

Weaknesses:

- Some developers may not want to build housing if they truly must reduce VMT.
- Outside of TOD areas, much of the Bay Area is still much easier to travel to via car.
- Some affordable-housing funding such as 25% of Cap and Trade funding, is tied to Disadvantaged Communities. (3)

Opportunities and co-benefits:

- Following the point-system makes it more likely the TOD will qualify for grants and loans.
- It gives an advantage to BMR, and TOD that encourage biking, and walking.
- Fewer VMT reduces other environmental pollutants besides GHG.
- Alternatives to driving usually involve biking or walking, which have health benefits.
- Mountain View will attract more developers who want to build TOD.

Threats:

- Pushback from developers due to the point-system, setting VMT targets, and more advantages for BMR housing.
- Cuts in transit outside of Mountain View.
- HCD may change its point-system.

Concept drawing from Mountain View's North Bayshore Plan.

Funding sources TOD Housing Program (2)

Assumptions and uncertainty

Assumptions with High Uncertainty:

- Developers can recoup their incremental costs through grant, loans and increased revenue from selling or leasing.

Assumptions with Low Uncertainty:

- Measurement and incentives changes behavior.
- Developers are interested in TOD that is measured.

Author Thida Cornes

Detailed analysis

The California Department of Housing and Community Development (HCD) Transit-Oriented Development (TOD) Housing Program funds are "based on features that reduce GHG and vehicle miles traveled (VMT).

- Consistent with Infill and TOD Objectives of Regional Planning Efforts (30 points): Developments must be consistent with regional planning efforts, local plans, and specific plans and be located in areas targeted for infill and transit-oriented development. All awardees in the second round scored full points.
- Quality of Transit System and Transit Station (90 points): Transit service must offer travel times equal to or better than automobile travel and must provide real time schedule information to riders. Awardees in the second round scored 66 to 90 points.
- Access to Services (15 points): Developments must be located within a half mile of at least ten distinct amenities (grocery stores, schools, parks, etc.) that enable residents to avoid the use of a car to meet basic needs. All awardees in the second round scored full points.
- Discounted Transit Passes (5 points): Developments must offer free or discounted transit passes (no more than half of retail cost) to each lower income household for the term of the program loan (55 years). All awardees in the second round scored full points.
- Innovative Parking Reduction Strategies (25 points): Developments must feature parking shared between various uses, such as residential and retail (5 points); offer dedicated parking spaces for car-sharing vehicles (5 points); and offer minimal residential parking (10 points). Residents pay for parking separately from monthly rent payments (except where prohibited by federal law) (5 points). All awardees in the second round scored full points.
- Biking and Walking Friendly Features (25 points): The main walking route between the transit station and the development must have small street blocks, street lighting after dark, ADA compliant sidewalks, and safe street crossings. The transit station must have waiting areas with seating, lights, shelter, and bicycle facilities. All awardees in the second round scored full points.
- Serves Households at Lower Income Levels (30 Points): Developments must provide dedicated units that are affordable to lower income households, who are most likely to take transit and less likely to own a car. All awardees in the second round scored full points.

The remaining points are awarded based on the readiness of the development for construction, the amount of additional capital it can leverage, the developer's track record of successful completion of infill and TOD, and community support for the development."

Environmental analysis

The City estimates 18.7 VMT per-person per-day with 347 days per-year. This would be 6488.9 VMT per-person per-year. The current expectation for NBS is a 20% reduction in VMT. However, despite various VMT reduction measures, the Shoreline NBS gateway is almost at-capacity. Many claims about reducing VMT in NBS TOD are predicated on the assumptions that the residents of NBS TOD will work in NBS and thus naturally reduce VMT. However, of the estimated 30,000 Mountain View residents that work, only 7,000 work in Mountain View. Therefore, estimating that half of the residents of NBS TOD work in Mountain View is a much more generous estimate than current trends. In addition, TOD is slated to be built in other areas of Mountain View, which have no VMT targets. Therefore, without this recommendation, we estimate TOD will only achieve a 10% reduction in VMT per TOD resident per-year. This recommendation with an evaluation system and a target VMT of 30% reduction for all TOD will result in an additional 20% reduction in VMT which would be 1249.89 per-person per-year. The average MT CO_2 per VMT goes down each year due to higher Corporate Average Fuel Economy (CAFE) standards.

Year	Resident Population	% of population in TOD	Residents in TOD	Total VMT saved	BAU MT C02 per VMT	MT CO2 saved
2021	84,809	1%	848	1,100,634	0.000328236	361
2022	86,251	2%	1,725	2,238,696	0.000318518	713
2023	87,717	3%	2,632	3,415,121	0.000308870	1,055
2024	89,208	4%	3,568	4,630,894	0.000299335	1,386
2025	90,725	5%	4,536	5,887,055	0.000289909	1,707
2026	92,267	6%	5,536	7,184,536	0.000281552	2,023
2027	93,836	7%	6,569	8,524,494	0.000274076	2,336
2028	95,431	8%	7,634	9,907,875	0.000267452	2,650
2029	97,149	9%	8,743	11,347,023	0.000261597	2,968
2030	98,995	10%	9,900	12,847,373	0.000261597	3,361
						18,560

Cost analysis

Make point-system Mountain View-centric and align with existing process	6 Months at $15,000 per month	$90,000
Cost/MT		$4.85

Scale analysis As building codes and TOD changes, the City may need to update its point-system. The City should consider how to increase the HCD points for existing TOD. Some of the points such as Discounted Transit Passes, Innovative Parking Reduction Strategies, and Biking and Walking-Friendly Features could be added after the TOD is already built either by the City or by working with the TOD owner.

BN8 References

1. "Why creating and preserving affordable homes near transit is a highly effective climate protective strategy" [52]
2. TOD Housing programs: http://www.hcd.ca.gov/grants-funding/active-funding/index.shtml
3. Cap and Trade Affordable Housing Fund: http://calhsng.org/ahsc/
4. Affordable Housing in Transit-Oriented Developments: Impacts on Driving and Policy[53]:

[52] http://www.transformca.org/transform-report/why-creating-and-preserving-affordable-homes-near-transit-highly-effective-climate

[53] https://ncst.ucdavis.edu/wp-content/uploads/2015/10/NCST-TO-027-Boarnet-Bostic-Affordable-TOD-White-Paper_FINALv2.pdf

Incentivize switching residential HVAC and water heaters from natural gas to electricity **(BE1)**							**Voluntary, Educational**	**12 yrs.**	
Recommendation name							Type	Duration	
73,100	**$100K**	**$0**	**$1.37**	○○○	●●●	○○○	●○○	●●●	●●●
MT CO_2e reduction 2018-2030	City's Net Cost	Incremental Net Cost	Net cost per MT CO2e reduction	Easy to implement	Easy to measure	Private investment leverage	Local economic benefits	Other environment al benefits	Health benefits

Problem description

Natural gas is a fossil fuel, used widely in space heating and cooling, as well as in water heating systems. Upon combustion it produces carbon dioxide (CO_2), carbon monoxide (CO), and nitrogen oxides (NOx), contributing significantly to air pollution and GHG emissions. Natural gas does emit 50 to 60 percent less carbon dioxide (CO_2) than coal and oil per unit of energy delivered; however, natural gas use has many upstream impacts, including water consumption, water pollution, and earthquakes caused by hydraulic fracturing [1]. Finally, the drilling, extraction, and transportation of natural gas can result in leakage of methane (CH_4), a GHG with 86 times the global warming potential of CO_2 over a 20-year time frame [2]. On average, natural gas has a 5.1% leakage rate from well to fixture for California end-users [2]. In the Bay Area, independent research has confirmed that CH_4 leaks in Oakland and San Francisco are higher than the leakage rate recorded officially by PG&E. These findings prompted the 2014 passage of California Senate Bill 1371, "Natural Gas Leakage Abatement" [3].

Over 80% of California residents use natural gas for **space heating/cooling** and **water heating** [4]. In Mountain View, per 2015 Community Greenhouse Gas Emissions Inventory, the total amount of natural gas used annually for residential purposes is 53,598 MT CO_2e [5]. Out of this amount, approximately 86% is used for space heating/cooling and water heating [4]. This translates to 46,094 MT CO2e or **6% of all Mountain View's GHG emissions**. Thus, converting natural gas fuel to clean-sourced electricity is a key for Mountain View to reach its GHG targets.

Recommendation

Collaborate with SVCE (Silicon Valley Clean Energy) and BAAQMD (Bay Area Quality Management District) to fund the following incentives:

- $500 - $2000 rebate per customer to assist in the cost of purchasing and installing electric/heat pump hot water heaters ($500 for electric and $2000 for heat pump type).
- $3500 rebate per customer to assist in the cost of purchasing and installing space heating/cooling systems.

Establish a fund estimated at $10,000 per year to:

- Hold public education workshops to explain the conversion process and its positive impacts in Mountain View and other communities. Post all pertinent information on the city's website.
- Establish a list of trained and certified local installers to provide guidance and services for the conversion process. Make this list available to the public at MV Building/Permitting Department.

SWOT analysis

Strengths:

Reducing residential natural gas use represents a major opportunity to not only reduce MV's GHG emissions, but also to improve indoor air quality.

Reducing NG use may positively impact communities near extraction and transportation pipelines, with reduced water contamination and fewer artificial earthquakes.

Weaknesses:

- Current adoption for conversion programs is low (0.1% in neighboring cities), due mainly to the high cost of purchasing and installing new systems.
- Payback period is typically more than 5 years, which is not attractive to many residents.

Opportunities and co-benefits:

- When electric space heaters and electric or heat pump water heaters are combined with rooftop solar PV systems, incremental heating costs are lower than with NG systems.
- Partial and eventually total conversion from gas to electricity means the ability to cap gas lines, reducing the risk of fires caused by ruptured gas pipes during earthquakes.

Threats:

- Natural gas extractors and providers, as well as manufacturers of gas-dependent systems and technologies, may argue against policy changes that diminish their business share [6].
- Heat pump hot water heaters are a fairly new technology that may require extra space and electric panel modifications, which may deter some residents.

Municipalities where already implemented BAAQMD - Point Reyes, Bolinas, Olema, Sausalito, Marin City, Kenwood, Calistoga and others: Residential rebate program. $750-$3500 offered per household to remove wood-burning stove or fireplace and install electric heat pump for space heating. [7]. This is a very successful program with a current waiting list for enrollment.

City of Palo Alto: Residential rebate program of $1500 to convert natural gas water heater to HPWH [8]. In addition to rebate, educational workshops, product information, and a list of trained service providers are offered.

Sacramento - SMUD (Sacramento Municipal Utility District): Residential rebate program of $1500 to convert natural gas water heater to HPWH, as well as $650 for electric HVAC system, and $800 for ductless mini-split space heating and cooling systems [9].

Funding sources In addition to **SVCE** and **BAAQMD**, the city may receive financial support from **CPUC (California Public Utilities Commission)**, which has issued and funded several renewable energy programs.

Assumptions and uncertainty

Assumptions with High Uncertainty: Funding for all or part of the rebate programs will be supported by SVCE and BAAQMD as both entities have allocations in their budgets to support such programs.

Assumptions with Low Uncertainty: It will be difficult to convince the public to invest time and money to convert when funding is not sufficient to cover the costs of purchasing and installing the new systems.

Author Hala Alshahwany

Detailed analysis

Environmental analysis

This recommendation assumes implementation of the incentive program by 2020, targeting conversion of natural gas to clean electricity in 5000 residential homes by 2030.

<u>I: Calculations for MT CO_2 reduction for years 2020 - 2030:</u>

MV natural gas GHG emissions per resident = 1.7 MT CO_2 per yr. [5]

1.7 MT CO_2 · 0.86 (% used in space & water heating) · 10 yrs. · 5000 homes = 73,100 MT CO_2

<u>II: Calculations for Natural Gas GHG emissions:</u>

MV total residential natural gas use = 10 M Therms or 53,598 MT CO_2 per year [5]

Following California natural gas usage breakdown [4]:

Water Heating = 49%

Space Heating = 37%

Stove/Oven = 7%

Spa/Pool = 4%

Dryer = 3%

Then water + space heating = 49% + 37% = 86% of total gas usage

10 M Therms · 0.86 = **8.6 M Therms natural gas used for space + water heating**

or 53,598 MT CO_2 · 0.86 = **46,094 MT CO_2 emitted from natural gas used for space + water heating**

For water heating only:

10 M · 0.49 = 4.9 M Therms

or 53598 · 0.49 = 26263.02 MT CO_2e

For space heating only:

10 M · 0.37 = 3.7 M Therms

or 53598 · 0.37 = 19831.26 MT CO_2e

Summary of MV Residential Natural Gas Use for Space & Water Heating (2015)

	Natural Gas (M Therms)	**Natural Gas (MT CO_2e)**
Water Heating	**4.9**	**26,263**
Space Heating	**3.7**	**19,831**
Space + Water Heating	**8.6**	**46,094**

MV Total Annual Emissions = 768,365 MT CO_2e [5]

MV Res. Natural Gas (space & water heating) % of total emissions = 46,094 / 768,3656 = 6% per yr

Cost analysis

All analysis below for hot water heaters uses US Department of Energy formulas and assumptions [10].

Energy Cost Comparison Between Natural Gas & Electric/HPHW Heaters:

Gas Estimated Annual Operating Cost = 365 · 0.4105 / efficiency factor x fuel cost ($/Therm)

(Example in MV gas hot water heater) = 365 · 0.4105 / 0.65 x $1.324 = **$304 gas op. cost/yr.**

Electric Estimated Annual Operating Cost = 365 · 12.03 / efficiency factor x fuel cost ($/kWh)

(Example in MV electric hot water heater) = 365 · 12.03 / 0.95 · $0.18 = **$832 electric op. cost/yr.**

(Example in MV HPWH) = 365 · 12.03 / 3.5 · $0.18 = **$226 HPHW op. cost/yr.**

Hot Water Heater Types / Operating Cost Comparison*

Model Type	Purchase Price	EF (Efficiency Factor)	Op. Cost per year
A) Natural Gas	**$500**	**0.65**	**$304**
B) Electric**	**$500**	**0.95**	**$832**
C) HPWH	**$2000**	**3.5**	**$226**

* Cost in table does not include electric panel update or space modifications to accommodate electric and HPWH heaters. These costs can be significant and are highly variable depending on the residential space.

** Note: although electric hot water heaters are not as efficient as HPWHs, converting to electric is still significant in reducing GHG emissions, especially when residential space cannot accommodate HPWH, and when it is combined with a rooftop solar PV system.

All calculations above assume incoming water at 58° F heated to 135° F, using 64.3 gal/day, and a 50-gal water heater, for an average household of 3 people. Efficiency factors are gas = 0.65, electric = 0.95, and HPWH = 3.5.

Payback Calculations Example:

Payback (years) switching from A to B = additional cost of B / annual operating cost saving for B

Payback of switching gas to HPWH = (2000 - 500) / (304 - 226) = 19 years

Note: No cost analysis is available for space heating.

Scale analysis

This recommendation assumes implementation by 2020 with the success conversion rate increasing as time goes on and as public education and awareness accelerate. The target is to convert 5000 homes by year 2030 from natural gas to clean electricity.

BE1 References

[1] Union of Concerned Scientists

https://www.ucsusa.org/search/site/natural%20gas%20problems#.WvOfpi-ZNQM

[2] Naomi Wentworth (Government Sustainability Consultant) publication "Lifecycle Natural Gas Leakage Quantification Recommendation – February 2018"

http://www.aqmd.gov/docs/default-source/clean-air-plans/air-quality-management-plans/2016-air-quality-management-plan/life-cycle-analysis-working-group/neat-WG3-commentletter.pdf

[3] California Legislative Information

https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201320140SB1371

[4] 2009 California Residential Appliance Saturation Study

http://www.energy.ca.gov/2010publications/CEC-200-2010-004/CEC-200-2010-004-ES.PDF

[5] 2015 Community Greenhouse Gas Emissions Inventory - MV City Staff

https://mountainview.gov/civicax/filebank/blobdload.aspx?BlobID=26094

[6] American Gas Association

https://www.aga.org/sites/default/files/ea_2015-05_appliancecompare2015.pdf

[7] BAAQMD

http://www.baaqmd.gov/grant-funding/residents/wood-smoke-rebate

[8] City of Palo Alto

https://www.cityofpaloalto.org/gov/depts/utl/residents/resrebate/smartenergy/heat_pump_water_heaters/heat_pump_water_heater_pilot_program.asp

[9] Sacramento (SMUD)

https://www.smud.org/en/Rebates-and-Savings-Tips

[10] US Department of Energy

https://www.energy.gov/energysaver/estimating-costs-and-efficiency-storage-demand-and-heat-pump-water-heaters

Encourage installation of EV chargers in existing multi-unit dwellings **(BE7)**	**Educational, Voluntary**	**5 years**	
Recommendation name	Type	Duration	

15,614	**$255K**	**$0**	**$16.30**	●○○	●●○	●●○	●○○	●○○	●○○
MT CO2e reduction 2018-2030	City's Net Cost	Incremental Net Cost	Net cost per MT CO2e reduction	Easy to implement	Easy to measure	Private investment leverage	Local economic benefits	Other environmental benefits	Health benefits

Problem description

Many people who own gasoline-powered vehicles do not have convenient access to EV charging stations (EVCs) and therefore cannot switch to using EVs. People who live in multi-unit dwellings do not have direct control over whether EVCs get installed where they live.

Getting more EVCs installed in parking lots and parking garages of existing multi-unit dwellings would enable many people, such as those mentioned above, to switch from gas powered vehicles to EVs, and would thereby reduce Mountain View's CO2e emissions significantly.

Recommendation

Develop and implement a program to encourage installation of EV charging stations (EVCs) in parking lots and parking garages of existing multi-unit dwellings. The program should do the following, using consultants and staff where appropriate:

- Gather information that would be useful to building owners and managers to encourage and help them to install EVCs. This would include creating documents describing a diverse set of local installations (to show how different sites solved different issues). These documents could also describe programs and companies that facilitate installation of EVCs by aiding, planning, installation, maintenance, billing, financing, and/or subsidies.
- Develop working relationships with funding and assistance programs offered by organizations such as Bay Area Air Quality Management District, SVCE, PG&E EV Charge Network, and Electrify America.
- Develop working relationships with charging vendors such as Chargepoint, EverCharge and others. Chargepoint provides installation, user billing, and maintenance for multi-unit dwellings. EverCharge has products to share limited power capacity of a site among multiple vehicle chargers.
- Do a siting survey to identify high opportunity buildings (those with parking lots and parking garages with zero or insufficient EVCs). Identify above programs and companies most appropriate to work with owners of each site. Also identify sites where simpler options may be sufficient, such as installing 120v or 240v outlets at parking spots and letting EV owners use portable chargers. Put all buildings surveyed into a database to assist in outreach and follow-up.
- Do outreach to the owners, managers, and condominium associations of high opportunity buildings to encourage and help them to install EVCs. Use relationships with and knowledge of funding/assistance programs and charging vendors to help owners/managers. Also, where appropriate, inform them about simpler options such as adding electric outlets at parking spots.

- Identify barriers to installation and operation of EVCs and find methods to overcome them. Use knowledge built up as program proceeds to recommend how to streamline the process in the city.
- Measure program results by counting the number of EVC installations at sites assisted by the program and comparing to goals. Near the end of the program, evaluate remaining unmet demand and recommend what kind of program may be needed next.

SWOT analysis

Strengths:

- Commercial installers and programs currently underway can assist with EVC funding, installation, maintenance, operation and electricity use billing.
- There is unmet demand for EVCs among residents of multi-unit dwellings.

Weaknesses:

- Site owners may need to upgrade electricity service capacity and panel.
- EVC installation hurdles: expense, complexity of process, choosing billing technique.
- Effort needed for maintenance and enforcement of parking and EVC usage rules.
- Multi-unit dwellings with fixed parking spaces per unit may not make efficient use of EVCs (they may be idle when parking space is not used, or charging is not needed).

Opportunities and co-benefits:

- Loyalty of satisfied EV users to their housing complex that provides EVCs.
- People using EVs can save money over gas vehicles due to lower maintenance/fuel costs.
- Availability of EVCs may make lower-cost used EVs usable by more people.
- Reduced exhaust fumes in garages and parking lots.
- Costs of program may be reduced if resources shared with Recommendation T3 (Develop a plan for expanding EV charging infrastructure in the public right-of-way and on publicly owned property) if both recommendations are implemented at same time.

Threats:

- Uncertainty about receptiveness of building owners and managers to city outreach.

Municipalities where already implemented

- City of Palo Alto Utilities offers ongoing rebates[54] per multi-family building of $3K per charger (up to 75% of cost), for up to 6 chargers.
- Many cities, counties, and organizations are offering incentives - see DriveClean.CA.gov.[55]

Funding sources

Funding sources for beneficiaries of this program are summarized in the Detailed Analysis section below.

Assumptions and uncertainty

Assumptions with High Uncertainty: Number of EVCs installed annually due to this program.

Assumptions with Low Uncertainty: None.

Author David Paradise

54 https://www.cityofpaloalto.org/gov/depts/utl/residents/sustainablehome/electric_vehicles/default.asp
55 https://www.driveclean.ca.gov/pev/Incentives.php?submit=submit&bev=1

Detailed analysis

Below are the elements of the recommendation stated earlier, but with bullet items added to provide more detail:

Gather information that would be useful to building owners and managers to encourage and help them to install EVCs. This would include creating documents describing a diverse set of local installations (to show how different sites solved different issues) and describing programs and companies that facilitate installation of EVCs (by providing assistance, planning, installation, maintenance, billing, financing, and/or subsidies). Develop working relationships with funding/assistance programs and charging vendors mentioned below. Examples:

- PG&E EV Charge Network[56]: Incentives for EVC installation in 10 or more contiguous spaces.
- Electrify America[57]: 10-year program to install subsidized EVCs as part of VW settlement.
- Identify companies that run networks of EV chargers and have a variety of installation and operation choices. Two examples are Chargepoint[58] and Tesla Charging Partners[59].
- EverCharge[60]: Services for wirelessly controlling many EVCs to share limited available power.
- Compile list of additional local EVC installers.
- Compile case studies of different building types where EVCs were installed.
- Incentives from local carbon-free electricity provider Silicon Valley Clean Energy[61] (they are still in the process of developing their incentive programs).
- Financing and incentive programs for charging equipment (searchable on DriveClean.CA.gov)[62].
- Exchange information, such as that mentioned above, with neighboring cities.

Do a siting survey to identify high opportunity buildings (those with parking lots and parking garages with zero or insufficient EVCs). Identify above programs and companies most appropriate to work with owners of each site. Also identify sites where simpler options may be sufficient, such as installing 120v or 240v outlets at parking spots and letting EV owners use portable chargers. Put all buildings surveyed into a database to assist in outreach and follow-up. The survey could be done through a combination of these methods:

- Find locations of multi-unit dwellings from city or other databases.
- Call building owners and managers to establish appropriate contacts and ask about availability of, interest in, and knowledge of EVCs.

[56] https://www.pge.com/en_US/business/solar-and-vehicles/your-options/clean-vehicles/charging-stations/ev-charge-network.page
[57] https://www.electrifyamerica.com/our-plan
[58] https://www.chargepoint.com/
[59] https://www.tesla.com/charging-partners
[60] https://evercharge.net/
[61] https://www.svcleanenergy.org/
[62] https://www.driveclean.ca.gov/pev/Incentives.php?submit=submit&bev=1

- Look at publicly available map images and/or visit sites in person and note the presence or lack of EVCs. Save images and photos to database to assist in re-gaining familiarity when doing further outreach.
- Update information into a database in a structured way to keep track of all information gathered and of ongoing status of contact with owners and managers of sites.

Do outreach to the owners, managers, and condominium associations of high-opportunity buildings to encourage and help them to install EVCs. Use knowledge of funding and assistance programs and charging vendors. Where appropriate, inform owners and managers about lower cost options such as adding electric outlets at parking spots.

- Contact the owners and managers of high-opportunity sites and explain resources, costs, and benefits of installing EVCs. Give in-person presentations, where it would be helpful, and follow up regularly.
- Provide a simple web page with pointers to resource documents assembled in first phase of program, such as examples of diverse sites where EVCs were installed and lists of programs and companies mentioned earlier.

Identify barriers to installation and operation of EVCs and find methods to overcome them. Use knowledge built up as program proceeds to recommend how to streamline the process in the city.

- Research best practices for cities to encourage and support EVC installation.
- Observe issues encountered by multi-unit dwelling owners and managers installing and operating EVCs.
- Work with city staff, if appropriate, to remove barriers.

Measure program results by counting the number of EVC installations at sites assisted by the program and comparing to goals. Near the end of the program, evaluate remaining unmet demand and recommend what kind of program may be needed next.

The following table summarizes the assumptions and Environmental, Cost and Scale analysis:

Assumptions (Program is active for 5 years, but results measured through 2030 because installed EV chargers continue to be used and reduce emissions)														
5	New Sites in Year 1; 10 New Sites in Year 2, 15 in Year 3, 20 in Year 4, 25 in Year 5.													
4	Number new EV chargers installed per site (average)													
3	Number Electric Vehicles purchases enabled per new EV charger													
6489	Miles affected (driven electric instead of gas) per EV in use per year													
		2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	
Number new sites (per year)		5	10	15	20	25	0	0	0	0	0	0	0	
New EV Chargers installed at new sites		20	40	60	80	100	0	0	0	0	0	0	0	
Cumulative EV Chargers in use		20	60	120	200	300	300	300	300	300	300	300	300	
Electric Vehicles in use (per year)		60	180	360	600	900	900	900	900	900	900	900	900	
Miles Affected (per year)		389340	1168020	2336040	3893400	5840100	5840100	5840100	5840100	5840100	5840100	5840100	5840100	
BAU MTCO2e / Mile (Gas/Diesel)		0.0003474	0.0003380	0.0003282	0.0003185	0.0003089	0.0002993	0.0002899	0.0002816	0.0002741	0.0002675	0.0002616	0.0002564	
MT CO2e reduction (per year)		135	395	767	1240	1804	1748	1693	1644	1601	1562	1528	1498	
MT CO2e reduction (summed over 12 years)														15614
City costs for initial site survey		$30,000												
City costs for staffing (1/4 FTE)		$45,000	$45,000	$45,000	$45,000	$45,000	$0	$0	$0	$0	$0	$0	$0	
City costs (summed over 12 years)														$255,000

An assumption to help make the program cost-effective is that the part of the program that has city costs only lasts for 5 years, during which time it leads to new EV charger installations. But the CO2e emissions reductions benefits from those EV chargers continue for many years thereafter (in this case throughout the measurement period, which is through the year 2030).

Environmental analysis

The table in the *Detailed analysis* section above used the following assumptions:

5	New Sites in Year 1; 10 New Sites in Year 2, 15 in Year 3, 20 in Year 4, 25 in Year 5.
4	Number new EV chargers installed per site (average)
3	Number Electric Vehicles purchases enabled per new EV charger
6,489	Miles affected (driven electric instead of gas) per EV in use per year

An assumption is that the number of new installation sites grows each year. It starts with five new sites installed in Year 1, and it increases yearly until 25 new sites are established in Year 5. This anticipated growth rate is due to factors such as the following:

- Ongoing outreach contributing to decisions to install EVCs.
- Increased demand from residents over time for electric vehicles due to growing awareness from seeing greater numbers of EVs and EVCs in the community.
- Delays of 1 to 2 years for sites that apply for and receive subsidies or assistance through the larger installation programs.
- Property managers who implement successful programs or see other people install EVCs become comfortable more quickly with the process and decide to install more EVCs.

Utilizing Business as Usual (BAU) transportation numbers, which factor in trips of all distances related to Mountain View, each vehicle is expected to travel an average of 18.7 miles per day for 347 days each year – a total of 6,489 miles per year.

It is assumed that each new site has on average four chargers:

- This number may vary widely, but typically multiple chargers would be installed at once to cost effectively take advantage of the electrical and other infrastructure work needed and to support a reasonable percentage of residents who share a parking lot or parking garage.
- For calculation purposes, we assume that Level 2 EVCs are installed. These require a 240-volt electricity supply and can charge a recent model EV in less than one hour if it drives an assumed typical distance of 18.7 miles per day.
- In some cases, a site may choose to only provide support for Level 1 EV Charging (which is lower capacity than Level 2 and therefore requires longer vehicle charging times). A site would do this either to save costs, or because it has limited electrical capacity. Level 1 chargers only require a 120-volt electricity supply. The least-cost Level 1 option is for the site to provide a standard electrical outlet into which the EV owner can plug in their portable charging cable that is sold with the vehicle. Alternatively, the site could install EV chargers that look the same as Level 2 EVCs but can only supply Level 1 charge (these could be networked to enable per usage billing and/or to manage total electrical use if the site capacity was limited).

It is assumed that each Level 2 EVC supports on average three electric vehicles:

- One vehicle may charge during the day, one in the evening, and one overnight.
- In some circumstances, the number of vehicles supported could be greater, such as when there is:

- A reservation system that allow tighter scheduling times for vehicles.
- Good communication among residents sharing the charging location.
- Good practices of people only occupying the parking spot while actively charging.

- In some circumstances, the number of vehicles supported could be fewer, such as when there are fixed parking locations for each resident. A solution to this would be to place an EVC such that the charging cable can reach multiple parking spots.

The table in the Detailed Analysis section also assumed a rate of 0.0003474 Metric tons of emissions of CO2e per vehicle mile traveled in 2019 (for gasoline or diesel vehicles). If an electric vehicle replaces a gas/diesel vehicle and travels 6489 miles in a year, it reduces emissions by about 2.25 MTCO2e (6489 × .0003474) in 2019. In the subsequent years, these numbers are extrapolated over the 2030-time horizon with yearly BAU emissions per vehicle mile traveled (labeled "BAU MTCO2E/Mile" in the table).

The "MT CO2e reduction (per year)" values in the table are the product of the "BAU MTCO2e/Mile" times the "Miles Affected (per year)". The Miles Affected are due to all the electric vehicles enabled by chargers installed under the program.

Cost analysis

The table in the *Detailed analysis* section assumed the following city costs:

- $30,000 for the initial site survey of multi-unit dwellings where EVCs could be installed. This could be done by a consultant or staff member. Even if this is not enough money to complete the survey, the person running the ongoing program mentioned in the next bullet could continue doing the survey on a part-time basis, spending as much time as was deemed necessary to reach the goals for the program.

- $45,000 each year, from Year 1 through Year 5, for the outreach and assistance program. This could be done by a consultant or staff member. For maximum efficiency and continuity, it would be best if either one person ran the whole program or if the multiple people running it kept up-to-date data on all contacts with building owners and managers.

Scale analysis Refer to the Environmental Analysis section.

Related Recommendations and Policies

This recommendation (BE7) focuses on getting more EVCs in parking lots and parking garages of *existing* multi-unit dwellings. Here a few notes regarding other recommendations from the task force and existing policies for *new* buildings:

- Recommendation T3 from the Transportation working group is titled "Develop a plan for expanding EV charging infrastructure in the public right-of-way and on publicly owned property." T3 focuses on getting EVCs installed on streets and in public parking places. Implementation of T3 could provide additional support for residents of multi-unit dwellings, especially if EVCs were installed near such buildings. Staffing and information gathering for implementation of T3 could also be shared with recommendation BE7 to reduce costs.
  - Recommendation T6 from the Transportation working group is titled "Restrict Parking to Encourage and Fund Alternative Modes. "For multi-unit residences, if parking is billed separately as recommended in T6, EV users could be billed at a different rate for the right

to use parking spots with EV chargers which might allow lower cost (non-networked) to be used.
    - Proceeds from paid public parking could be a funding source for recommendation BE7.
- Regarding *new* buildings:
    - Mountain View's building code already contains requirements for installation of EVCs on the property of new buildings or buildings undergoing major remodels. Mountain View should continue to evaluate and strengthen these codes over time.

BE7 References

1. Silicon Valley Clean Energy (Mountain View's primary electricity provider) web page explaining that the electricity it provides is carbon-free: www.svcleanenergy.org/faqs

2. 2017 studies by Electrify America [63](program to install EVCs as part of VW settlement) - Cycle 1 California [64]ZEV Investment Plan, and the Supplement[65] to the California ZEV Investment Plan.

3. 2017 UCLA Luskin School of Public Affairs report: Overcoming Barriers to Electric Vehicle Charging in Multi-unit Dwellings: A Westside Cities Case Study [66]: http://innovation.luskin.ucla.edu/content/overcoming-barriers-electric-vehicle-charging-multi-unit-dwellings-westside-cities-case-study

4. 2012 BAAQMD Bay Area and Monterey Bay Regions PEV Local Best Practices Document[67].

5. 2011 Study: Ready-Set-Charge-California-EV-Communities-Guide[68] (includes discussion of streamlining permitting).

6. The City of Palo Alto offers rebates for EV Chargers For Organizations[69] . It also offers the Home Efficiency Genie[70] service, which encourages and assists with beneficial energy-related behaviors. It is administered by CLEAResult.com,[71] which may be a useful resource if Mountain View considers implementing such a program.

7. 2017 Workshop on EV adoption and EV charging through RICAPS (Regionally Integrated Climate Action Planning Suite) and San Mateo County Energy Watch Program: http://www.smcenergywatch.com/sites/default/files/RICAPS_Webinar_7_25_17_MasterSlideDeck_V3.pdf

---

63 https://www.electrifyamerica.com/our-plan
64 https://www.electrifyamerica.com/downloads/get/51603
65 https://www.electrifyamerica.com/downloads/get/1019583
66 http://innovation.luskin.ucla.edu/content/overcoming-barriers-electric-vehicle-charging-multi-unit-dwellings-westside-cities-case-stud
67 http://www.baaqmd.gov/~/media/files/strategic-incentives/ev-ready/best-practices-document-final-online1-pdf.pdf?la=en
68 https://www.prospectsv.org/wp-content/uploads/2016/11/Ready-Set-Charge-California-EV-Communities-Guide.pdf
69 https://cityofpaloalto.org/gov/depts/utl/residents/sustainablehome/electric_vehicles/ev_chargers_for_organizations.asp
70 https://www.cityofpaloalto.org/gov/depts/utl/residents/programs/home_efficiency_genie/default.asp
71 https://www.clearesult.com/

8. 2017 Peninsula Advanced Energy Community (PAEC), "Final Economic Benefit-Cost Analysis of Electric Vehicle Charging Infrastructure," http://www.clean-coalition.org/site/wp-content/uploads/2018/01/PAEC-Task-3.16-Final-BCA-of-Electric-Vehicle-Charging-Infrastructure-01_wb-17-Oct-2017.pdf

9. 2018 Peninsula Advanced Energy Community (PAEC) and Clean Coalition: "Supercharging the buildout of electric vehicle charging infrastructure," http://www.clean-coalition.org/resources/paec-evci-webinar/

10. Statewide non-profit Veloz is doing outreach to grow EV ridership. Case studies for multi-unit dwellings and businesses and other resources can be found here: http://www.veloz.org

11. Chargepoint Multi-Family Services: https://www.chargepoint.com/products/multi-family-home-service/

Adopt a revenue-neutral differential utility tax encouraging low-carbon energy use **(BE9)**							**Manda-tory**	**Ongoing**	
Recommendation name							Type	Duration	
18,279	**$175K**	**$0**	**$9.60**	●○○	○○○	●○○	○○○	●○○	●○○
MT CO_2e reduction 2018-2030	City's Net Cost	Incremental Net Cost	Net cost per MT CO2e reduction	Easy to implement	Easy to measure	Private investment leverage	Local economic benefits	Other environmental benefits	Health benefits

Problem description

Now that over 84% of Mountain View businesses, residences, and municipal buildings are serviced by Silicon Valley Clean Energy, which delivers 100% GHG-free electricity, the GHG emissions from buildings in Mountain View are mostly from natural gas. Mountain View currently has a 3% utility tax that applies to the cost of electricity and natural gas purchased. There is an opportunity to create a differential in the tax rate between electricity and natural gas. This would provide an economic incentive to use less natural gas and to replace natural gas appliances with alternatives (such as electric appliances and passive heating designs).

Recommendation

1) Work with other cities, state agencies, and PG&E to enable Mountain View to implement a lower Utility User Tax (UUT) on electricity and to raise the Utility User Tax on natural gas to hasten the replacement of natural gas appliances with electric appliances.
2) Increase Mountain View's UUT to roughly 12% on natural gas and reduce the tax on electricity to 2%. This would be done on a revenue-neutral basis. One possibility is to phase in the natural gas tax increase in three stages each separated by two years, raising the tax from its current 3% to 6%, then 9%, and finally to 12%. We advise studying and implementing the tax changes independently for commercial customers versus residential customers, since their usage patterns are quite different. The implementation for each of these two groups of customers should be revenue-neutral (e.g., commercial customers should not pay more overall while residents pay less overall). This should be accompanied by outreach to low-income families promoting existing energy assistance programs.
3) When natural gas consumption falls to 50% (and later 75%) from the year that the change takes effect, the tax should be recalculated to maintain a consistent revenue stream.

SWOT analysis

Strengths:

- Provides an incentive to eliminate natural gas usage that can be replaced with electricity.
- Implementation cost is modest.
- Groundwork has been laid by other local cities such as Berkeley and Albany.
- Local research is available that calculates price sensitivity on natural gas use.
- Supports other electrification program efforts to reduce natural gas emissions.
- Overall effect is revenue-neutral for the city.

Weaknesses:

- Impossible to track the specific impact on emissions.
- Some customers will see overall energy bills increase and others will see them decrease. Most residential customers will see their overall bills increase.

- The uncertainty of tax changes every two years may be unsettling to some residence and businesses. However, since electricity usage is currently the dominant revenue stream, the changes in the tax are likely to be small.
- Slight increase in revenue seasonality, with more gas revenue in winter.

Opportunities and co-benefits:

- Improve the impact of other electrification and fuel switching programs by providing the correct price signal regarding GHG pollution from natural gas.
- Increase the economic feasibility of building all-electric buildings and transitioning from natural gas-fired equipment to electrically-powered equipment.
- Minor benefit for residence and businesses using electric vehicles, since the electricity tax would be reduced.

Threats: Pushback from PG&E on timeliness and ease of implementation.

Municipalities where already implemented Berkeley (May 24, 2017) and Albany (December 19, 2016) passed resolutions requesting PG&E to make changes to enabling a differential tax on electricity and natural gas. (1) (8)

In July 2017, Palo Alto Utility increased the cost of natural gas that it sold by including the cost of carbon offsets. This raised the cost by roughly 4%. (2)

Pasadena is the only California city that currently has different tax rates[72] on electricity and natural gas. It has a 7.67% rate on electricity and a 7.9% rate on gas. (3) Pasadena runs its own electric utility.

Minneapolis increased fees[73] on both natural gas and electricity in January 2018 to help reduce GHG emissions. The increased fees cost a typical homeowner roughly $7 per year, and the city plans to spend the $2 million in new revenue on climate and energy programs. (4)

Funding sources The Berkeley report indicated a $500,000 to $800,000 cost for PG&E for system changes. Working with other cities as well as with the CPUC will be important to motivate PG&E and to cover this cost.

Per recommendation, $50,000 should be committed to a fund to pay for changes in the PG&E system. This commitment would help bring other cities to the table to support the effort.

Assumptions and uncertainty

Assumptions with High Uncertainty:

- There is no research to indicate the impact on longer-term fuel switching choices. However, this would likely improve the impact of the other recommendations on GHG reductions, and this potential positive impact was not included in the estimated GHG reduction metric.

Assumptions with Low Uncertainty:

- Residential consumers reduce their NG usage by 2% when price increases by 10%, based on California data (5). Since we would reduce the electricity tax by 1%, this could have additional positive impacts in moving people to use electricity (not calculated here).
- This policy would affect residential and commercial natural gas equally through 2030.
- California's Low-Income Home Energy Assistance Program will continue. (6)

Author: Mike Balma

[72] http://www.uutinfo.org/uutinfo_city_info/pasadena/uutinfo_pasadena.htm
[73] http://www.startribune.com/minneapolis-is-using-electric-bills-to-fight-climate-change/464650183/

Detailed analysis

Environmental analysis

According to research (5) from UC Berkeley's Haas School of Business, a 10% increase in gas prices decreased natural gas usage by 2%. Increasing natural gas prices by 9%, it is reasonable to assume a 1.8% reduction in the baseline natural gas GHG emissions for residential, commercial and industrial sources. The Haas study was done for California end users with data from investor-owned utilities, including PG&E.

The actual impact of this proposed policy is likely to be higher than 1.8%, since the Haas research only looked at short-term behavior changes and only looked at the price changes for natural gas. A long-term commitment to the price differential will incentivize users to make economic choices favoring cleaner electrical appliances over natural gas appliances. Space and water heating appliances have a 10- to 25-year life, and the price differential for natural gas will encourage users to replace natural gas appliances with electric appliances such as heat pumps.

The CO2e in 2021 for natural gas is 118,422 MT, based on BAU Emissions Estimates version 2. It was assumed that the reduction in natural gas was linear as the change in the tax increased from 3% to 6%, to 9% and finally to 12%. In 2025, when the 12% rate begins, this is estimated to reduce natural gas use by 1.8% (which would equal a reduction of 2,244 MT CO2e in 2025). The cumulative reduction is estimated to be 18,279 MT CO2e over 9 years. See BE9 Table 4.

Cost analysis

Based on a table provided by Ann Trinh to Steve Attinger, Mountain View Sustainability Manager, dated 10/30/17, the combined tax revenue from electricity and natural gas is $ 4,319,978 for 2015-16.

Based on the 2015 GHG inventory, it is estimated that the electricity tax portion of the revenue accounts for $3,549,000 and the natural gas portion accounts for $506,000. See attached spreadsheet. Based on this revenue allocation, increasing the natural gas tax to 12% and reducing the electricity tax to 2% would be revenue neutral. See BE9 Table 1 in BE9 Appendix.

A referendum will be needed for the tax changes even though the change would be revenue neutral. The funds from the tax would be used in the same manner as they are today, and they would not be used for a specific purpose, so a simple majority would be required for passage. The referendum would be done at the same time as a general election or primary to minimize costs.

We estimate $50,000 for cost sharing of the billing changes. $20,000 was allocated for the incremental cost of a referendum and $30,000 was allocated to implement the multiple phases. $30,000 was included for surveying residences for the referendum and for marketing costs.

$45,000 was allocated for outreach to promoting existing energy assistance programs to low income residences, spread over the first three years of implementation. The total cost of the program would be $175,000, and the total annual spending is found in BE9 Table 5.

Cost to End Users

While the revenue to the city is expected to stay the same in this proposal, some customers will see a change in their overall energy bill. Commercial customers use over three times as much electricity as residential customers while using about the same total amount of natural gas (see BE9 Table 3). As such, commercial customers are expected to have a slight reduction in their total annual energy bill.

The average monthly cost for a residence, when the full 12% tax on natural and 2% tax on electricity is implemented in 2025, is estimated to increase by $1 to $1.26 in the summer and $4.45 to $4.70 in the winter depending on the zip code (BE9 Table 2). The average annual net increase is estimated to be $32.72 to $35.79, based on 2015 rates. This is based on a Comparative Analysis of Utility Services & Rates in California using 2015 data (9).

Scale analysis

Once implemented, this would impact every residence and business in Mountain View. Scaling is a key strength of this recommendation.

Natural gas is not subject to state sales taxes that apply to most goods, even though natural gas is a physical product. This information may help in the rollout of the changes.

BE9 References

1. Berkeley, CA resolution, May 24, 2017: Resolution requesting that PG&E's Billing System Allow the Utility User Tax (UUT) to Reflect Greenhouse Gas Pollution: https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0ahUKEwiwhO_uhcfZAhXClFQKHf05D2YQFggpMAA&url=https%3A%2F%2Fwww.cityofberkeley.info%2FClerk%2FCity_Council%2F2017%2F07_Jul%2FDocuments%2F2017-07-25_Item_26_Resolution_Requesting_that_PGandE.aspx&usg=AOvVaw1HzWwAwVmUAqognuWN47eK
2. Palo Alto includes carbon offsets in price of natural gas to create a carbon neutral product: www.cityofpaloalto.org/gov/depts/utl/residents/sustainablehome/carbon_neutral/default.asp
3. Pasadena differential tax rate: www.uutinfo.org/uutinfo_city_info/pasadena/uutinfo_pasadena.htm
4. Minneapolis differential tax rate to promote reduction in CO2 emissions: www.startribune.com/minneapolis-is-using-electric-bills-to-fight-climate-change/464650183/
5. Energy Institute at Haas research and article on "How Much Do Residential Consumers Respond to the Price of Natural Gas?": https://energyathaas.wordpress.com/2018/02/05/how-much-do-residential-consumers-respond-to-the-price-of-natural-gas/
6. California's Low-Income Home Energy Assistance Program: www.benefits.gov/benefits/benefit-details/1540
7. Mountain View revenue from utility tax: www.californiacityfinance.com/index.php#UUT
8. Albany, CA resolution, December 19, 2016: www.albanyca.org/home/showdocument?id=28965
9. Comparative analysis of utility services & rates in California, study and interactive map, 2015: www.cpuc.ca.gov/uploadedFiles/CPUC_Public_Website/Content/About_Us/Organization/Divisions/Policy_and_Planning/PPDComparativeAnalysisofUtilityServicesRatesinCAFinal.pdf http://arcg.is/1xlfLjw ; map arcg.is/1xlfLjw

BE9 Appendix

BE9 Table 1. Mountain View revenue collected through utility tax in 2015-16 and proposed changes

	2015-16	2015-16 Utility Tax	Proposed Change	2025 Proposed Utility Tax
Total utility tax collected*	$ 4,319,978		$4,324,000	
- Electricity (est)	$3,548,000	3%	$2,370,000	2%
- Natural gas (est)	$506,000	3%	$1,954,000	12%

* Data source for tax revenue is an email from Ann Trinh to Steve Attinger dated 10/30/17

BE9 Table 2. Impact of proposed utility tax changes on residential energy bills in 2025

Mountain View residential energy bills*	Average monthly bill 94040	Average monthly bill 94041	Monthly Impact (est.) 94040	Monthly Impact (est.) 94041
Electricity				
- Summer Bill ($)	67.34	71.54	(0.67)	(0.72)
- Winter Bill ($)	76.24	68.77	(0.76)	(0.69)
Natural Gas				
- Summer Bill ($)	21.51	19.02	1.94	1.71
- Winter Bill ($)	60.73	57.14	5.47	5.14
Combined Gas & Electric				
- Summer Bill ($)			1.26	1.00
- Winter Bill ($)			4.70	4.45
- Annual Bill			$35.79 (per year)	$32.72 (per year)

* Interactive map of California energy bills (9)

BE9 Table 3. Mountain View electricity and natural gas breakout by user category

Electricity breakout by user category	
Residential MWH	20%
Commercial MWH	64%
Direct Access MWH	16%
Natural gas breakout by user category	
Residential therms	49%
Commercial therms	51%

BE9 Table 4. Emissions reduction estimates

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Total MT CO2e from Natural Gas*	118K	120K	122K	123K	125K	126K	128K	130K	131K	133K
Natural Gas %	6%	6%	9%	9%	12%	12%	12%	12%	12%	12%
Impact %	.6%	.6%	1.2%	1.2%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%
Impact of reduction	711	720	1,458	1,477	2,244	2,274	2,303	2,333	2,364	2,395
Cumulative impact	711	1,430	2,888	4,365	6,610	8,884	11,187	13,520	15,884	18,279

* Based on BAU Estimates for Natural Gas v.2

BE9 Table 5. Estimated Implementation Costs ($1000s)

	2020	2021	2022	2023	2024	2025	Total
Billing changes	50						50
Referendum	20						20
Referendum survey & outreach	30						30
Implementation		20		5		5	30
Low income outreach		15	15	15			45
Total	120	35	15	20	0	5	175

Increase efficiency of existing buildings through voluntary programs and city ordinances **(BE4)**						Outreach, Policy		2019-2030	
Recommendation name						Type		Duration	
70,000	**$1.8M**	**$1.6M**	**$48**	●○○	●●○	●●●	●●●	●○○	●○○
Make MT CO2e reduction 2018-2030	City's Net Cost	Incremental Net Cost	Net cost per MT CO2e reduction	Easy to implement	Easy to measure	Private investment leverage	Local economic benefits	Other environmental benefits	Health benefits

Problem description

New buildings are becoming increasingly efficient through building codes and appliance standards, however, 80% of Mountain View homes were built before California's statewide energy code, Title 24 [1] was implemented in 1977. While Mountain View's emissions from electricity usage have reduced significantly with Silicon Valley Clean Energy (SVCE), greenhouse gas emissions (GHGe) from natural gas usage in buildings are approximately 110,000 MT CO2 annually [2] (~ 15% the 2015 GHG Inventory) and is projected to increase with the City's growing resident and service population[3]. Additionally, as electricity demand increases from electrification of vehicles and appliances, energy-efficiency and demand management become even more important[4]. Energy-efficiency and fuel switching will both need to be key strategies in decarbonizing energy use in buildings.

Recommendation

1) **Increase impact of voluntary energy-efficiency programs through additional staff and outreach funding.** Energy-efficiency programs and incentives are already available from PG&E, Silicon Valley Energy Watch, and BayREN. How could Mountain View leverage these platforms to get ALL eligible households and businesses to participate?

2) **Consider energy-efficiency ordinances to address the City's existing building stock.** Voluntary programs will not be enough for the City to meet its GHG reduction goals. Leading cities have passed mandatory ordinances to require energy audits and address low hanging fruit such as building tune-ups or retrocommissioning. We recommend that Mountain View consider the following ordinances, coordinating regionally:
    - **Energy audits or retrocommissioning for commercial buildings**. Energy audits inform future capital investments and opportunities for energy and cost savings. Retrocommissioning addresses performance of existing equipment (primarily HVAC and control systems).
    - **Time-of-sale energy audits** to disclose building performance information to future buyers, and inform the energy savings potential of future renovations
    - **Energy audits for rentals and leases** to disclose building performance information to future tenants, and to address minimum energy-efficiency

SWOT Analysis

Strengths

- This recommendation aligns with goals already established in Mountain View's General Plan to achieve 15% energy savings in 40% of the City's buildings by 2030.

- SB350 doubled the State's energy-efficiency goals by 2030, pushing for more innovation to address energy savings in existing buildings.

Weaknesses

- Dealing with non-compliance with ordinances can be time consuming. The City should identify reasonable strategies and engage stakeholders in this discussion.
- Building owners may pass on costs of energy upgrades to renters. Funding and incentives should be identified for low-income households.

Opportunities

- AB802 requires energy benchmarking and public disclosure for buildings > 50,000 SQ FT state-wide starting June 2018. This data can be leveraged to streamline delivery of city ordinances. City staff can focus on buildings with the most usage.
- Energy-efficiency measures, while requiring upfront investment, reduces energy costs over time, and increases real estate value of properties[5]. Cost savings from energy-efficiency measures can in some cases provided funding for fuel switching when bundled as part of a larger energy retrofit.[6]
- BayREN's 2018-2015 business plan includes increasing the use of "green labeling" programs and improving transparency through disclosure on MLS listing services, as well as support services to local governments developing policies for energy assessments at time of sale and rental housing inspection.[7]

Threats

- Potential opposition from residential and commercial building owners on building efficiency ordinances. However, there is now strong precedent in major cities.

Municipalities where already implemented

- **Energy audits or retrocommissioning (RCx) for commercial buildings**: San Francisco, Los Angeles, Seattle, New York City, Orlando, FL all have ordinances to require periodic energy audits or RCx for commercial buildings.
- **Time of sale audits** are required in City of Berkeley and City of Portland[8]. Massachusetts is considering home energy scoring state-wide at time of sale[9].
- **Energy audits and minimum energy-efficiency for rental housing**: Boulder Smart Regs requires landlords to conduct audits and meet minimum efficiency requirements.[10] Austin, Texas requires energy audits for multifamily properties, with disclosure requirements to potential tenants and buyers. Properties consuming more than 150% of average use per square foot are required to meet minimum energy retrofits.[11] The European Union Energy Performance of Buildings Directive requires all member states to implement building ratings and disclosure laws at time of sale or lease.[12]

Funding sources - There may be opportunities to collaborate with BayREN and Silicon Valley Energy Watch on pilot voluntary programs. Fees could provide funding to cover a portion of the ongoing administrative costs of ordinances.

Assumptions – Overall incremental cost for upgrades to property owners is assumed to be zero in the recommendation summary table since cost-effective energy-efficiency retrofit measures will payback over time, however ordinance compliance fees are included.

Author Emily Chueh (as a citizen volunteer, and not as an employee of CLEAResult)

Detailed analysis

Most of natural gas usage in residences is water and space heating. The most cost-effective energy-efficiency measures to address natural gas usage in homes are typically: increased insulation, reducing air leakage in the building envelope, installing low-flow shower heads and faucet aerators, switching to energy and water efficient appliances, and installing smart thermostats.

In commercial buildings, natural gas usage is primarily due to space heating. Better management of a building's operations and maintenance through better controls and retrocommissioning are typically considered the low-hanging fruit. Energy audits inform longer-term capital plans to replace major HVAC components during renovations or on equipment failures.

For each major building sector, Mountain View needs to identify barriers and opportunities to increase the reach of existing energy-efficiency efforts through more aggressively leveraging voluntary programs, and ordinances.

The City General Plan from 2018 already has specific targets % of homes and buildings that have undergone energy retrofits. This sets a precedent for a metric that can be used to track progress over time.[13]

General Plan Action Items (2018)

Measure E-1.1: Residential Energy-efficiency Retrofit (2012)
EPC's Ongoing General Plan Action Item List (2018): #311, #312

Progress Indicators	Year
+ 15% of existing single family residential units and 15% of multi-family residential units perform cost-effective energy efficiency package improvements (e.g., insulation, duct sealing, AC refrigerant recharge)	2020
+ 40% of existing single family residential units and 35% of multi-family residential units perform cost-effective energy efficiency package improvements (e.g., insulation, duct sealing, and AC refrigerant recharge)	2030

Measure E-1.2: Non-Residential Energy-efficiency Retrofit
EPC's Ongoing General Plan Action Item List (2018): #313, #314

Progress Indicators	Year
+ 15% of existing non-residential buildings perform cost-effective energy efficiency package improvements (e.g., ceiling insulation, cool roofs, duct sealing, Energy Management System upgrades)	2020
+ 40% of existing non-residential buildings perform cost-effective energy efficiency package improvements (e.g., ceiling insulation, cool roofs, duct sealing, and Energy Management System upgrades)	2030

Measure E-1.5: Smart Grid (2012)
EPC's priority list item # 136 and #137 (2018)

Progress Indicators	Year
+ 25% of new residential units and non-residential buildings implement a smart grid retrofit, reducing electricity consumption by 6% + 5% of existing residential units and non-residential uses implement a smart grid retrofit, reducing electricity consumption by 5%	2020
+ 50% of new residential units and non-residential buildings implement a smart grid retrofit, reducing electricity consumption by 6% + 25% of existing residential units and non-residential uses implement a smart grid retrofit, reducing electricity consumption by5%	2030

Monitoring of Measures (chapter 5 GGRP):
Reporting of Progress Indicators

The Community Development Department will coordinate measure evaluation on the same schedule as the communitywide inventories, and summarize the progress towards meeting the GHG reduction goal in a report that describes:

- Estimated annual GHG reductions in 2020
- Achievement of progress indicators
- Participation rates (where applicable)
- Remaining barriers to implementation

1) Increase impact of voluntary energy-efficiency programs through additional staff and outreach funding.

Mountain View has demonstrated leadership in the past with the Energy Upgrade Mountain View program (2011-2014) that achieved 16% natural gas savings with 2,000 participants, averaging 16% natural gas and 5% electricity savings (710 MT CO2e per year).[14] That program was unique for Mountain View, and made possible through ARRA funds. Mountain View, again, needs to creatively engage the City through a collective effort to reach its GHG reduction goals.

The City should have at least one full-time employee (FTE) City staff allocated to coordinate local program offerings and collaborate on increasing outreach and penetration.

Tasks for this staff member could include:

- Collaborate with local non-profits, such as Acterra and Sustainable Silicon Valley to increase participation and find opportunities for grant and pilot funding (perhaps implement Energy Upgrade Mountain View 3.0).
- Seek funding opportunities to increase incentives for natural gas reduction. Collaborate with regional cities and the county to identify opportunities to pool resources.
- Develop an educational program to offer training around green leases to commercial tenants. Work towards supporting all tenants to request green leases from their building owners (City of Denver Lease for Efficiency Challenge[15]).
- Track participation in exiting energy-efficiency programs (PG&E, BayREN, SVCE, Silicon Valley Energy Watch) and collaborate on tailoring programs to align with Mountain View goals.

Voluntary measures will not be enough for the City to meet its GHG reduction goals. To expand the reach of energy-efficiency programs and measures to the rest of the building stock, especially buildings before Title 24, it is recommended that the City consider ordinances that will require energy audits and low-cost efficiency measures to reduce natural gas usage.

2) **Energy audits or retrocommissioning for commercial buildings**: Require energy audits, retrocommissioning, or building tune-ups every five years for buildings over 50,000 SQ FT

City of San Francisco's Existing Commercial Building Ordinance already requires this. City of San Jose is currently undergoing the stakeholder engagement process to evaluate a commercial building energy audit ordinance.

While energy audits don't directly save energy, they guide future investment planning and timing. Retrocommissioning and building tune-ups address operational and maintenance issues with a building, especially HVAC systems, typically achieving 16% of energy savings on existing buildings. Typical payback for projects is about one year for existing buildings. Typical costs for commissioning are $0.30 per square foot for existing buildings. [16]

Energy audits and retrocommissioning would be done by third-party energy service providers.

- Ordinance to require Energy Audits and Retrocommissioning in buildings above 50,000 SQ FT every five years
- Require sites above a certain threshold (e.g. energy use intensity less than state average) be required to conduct energy audits or retrocommissioning every five years, and implement
- Encourage commercial building operators to participate in free building operator training offered by PG&E

- Consider lightweight operational review through smart meter remote energy audits for small and medium sized commercial buildings between 10,000 and 50,000 square feet.
- Mountain View should specifically coordinate with energy audit providers and require that energy audits also provide information about potential fuel switching opportunities.
- Mountain View should coordinate with other cities to coordinate on common guidelines, requirements, data collection, and qualifying service providers

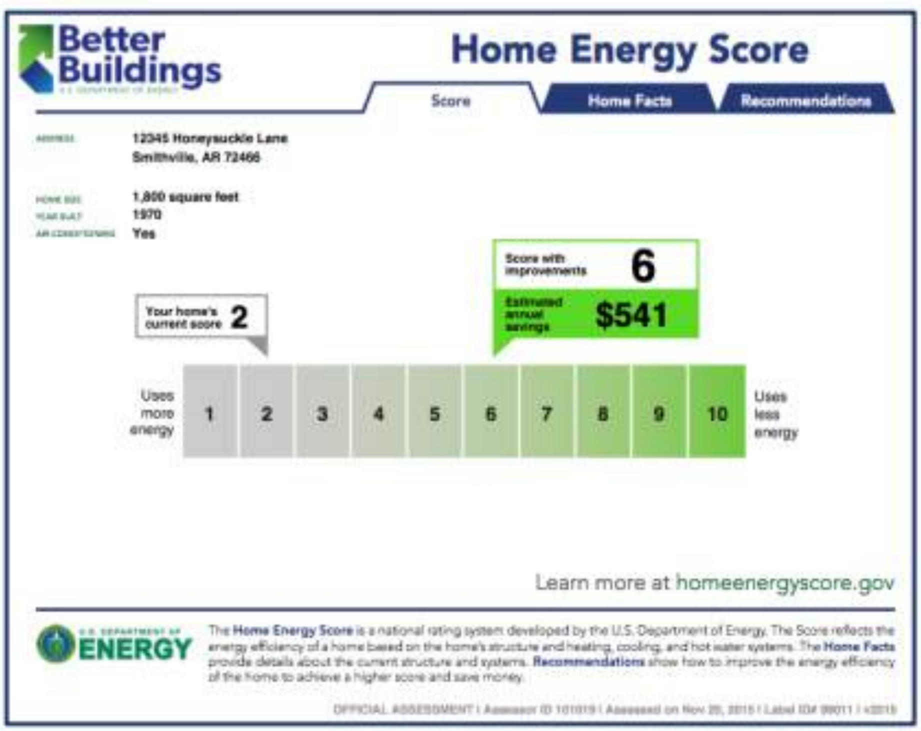
3) **Time of sale audits:** Require energy audits and disclosure for buildings at time of sale for both residential and commercial buildings.

City of Berkeley's Building Energy Savings Ordinance (BESO) requires all buildings over 600 SQ FT to conduct energy assessments to be conducted for both residential and commercial buildings, upon time of sale. Deferrals can be made to transfer compliance responsibility to the buyer.

Mountain View should consider similar legislation, coordinating with regional cities, and BayREN to standardize requirements and guidelines, and eventually stream home energy score data into MLS real-estate databases.

While energy audits do not directly save energy, they do provide potential home buyers with information that can guide future investments and energy costs.

Berkeley utilizes the Home Energy Score system developed by DOE. Mountain View should coordinate with regional organizations StopWaste and BayREN on qualifying assessors, as well as maximizing conversions from energy audits to actual energy savings projects.
Costs for Home Energy Scores are in the range of $150 to $250.

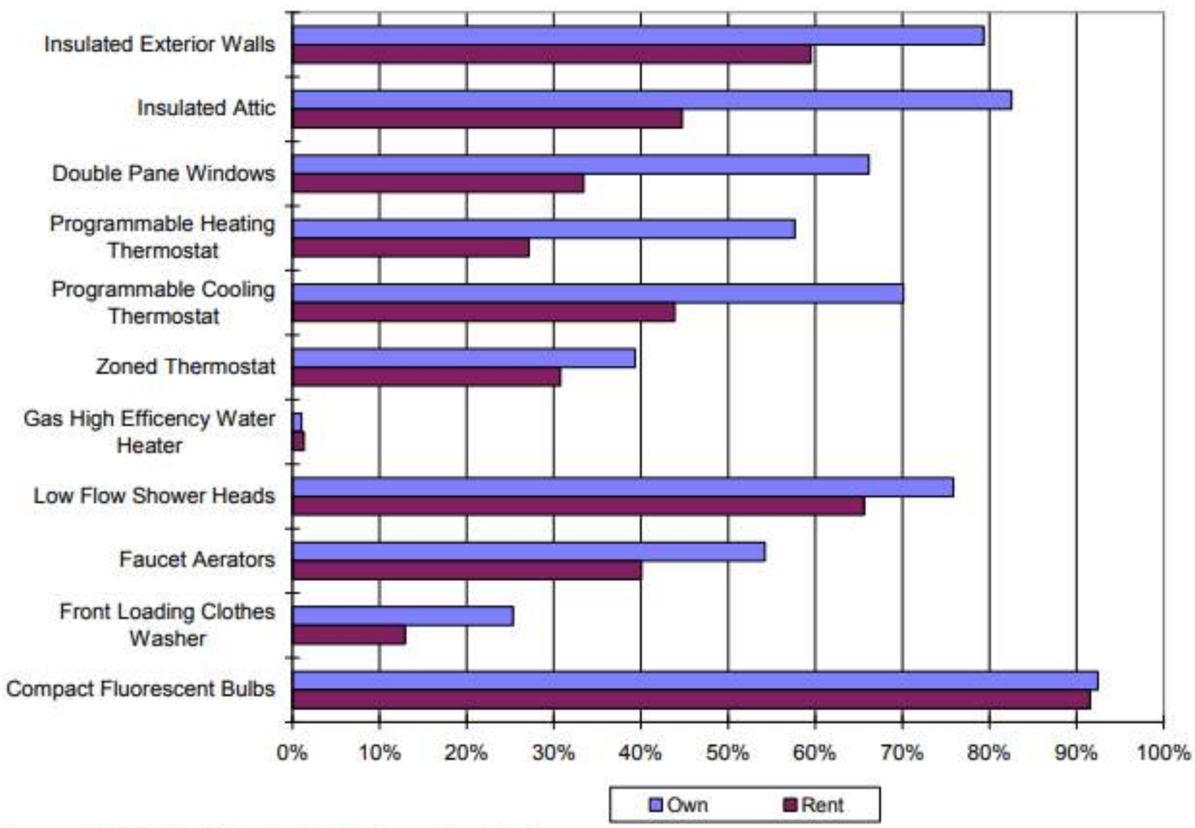


BE4 Figure 1. US DOE Better Buildings Home Energy Score asset rating system[1].

4) **Energy audits and minimum energy-efficiency for rental housing**: Require energy audits and minimum energy-efficiency measures for rental housing units

According to the CEC 2009 Residential Appliance Saturation Survey, there is a significant gap in adoption of energy-efficiency measures based on owner-occupied vs tenant-occupied homes. Mountain View homes are 60% renter-occupied. As Mountain View gains additional information from time of sale ordinances, the goal would be to expand into requiring energy audits on rental housing to address the gap in adoption of energy-efficiency in rental homes.

Figure ES-36: Energy Efficiency Measures by Ownership



Source: *2010 California Residential Appliance Saturation Survey*

Figure from CEC California 2009 Residential Appliance Saturation Survey [17]

The **City of Boulder SmartRegs** program is an example of a local ordinance that requires residential landlords to conduct energy audits and meet minimum energy-efficiency requirements. This was implemented through ARRA funds, required significant incentives and program implementation costs, but successfully reached 20,000 rental homes.

Austin, Texas has a similar program for multi-family homes over 5 units, but rather than identify a prescriptive list of mandatory measures, homes with energy usage per square foot above 150% of average are required to implement energy-efficiency reduction measures to reduce energy usage by 20%. The most common measures include duct sealing, insulation, and solar screens or window film. Rebates are provided by the utility.[18]

Environmental analysis

City staff to increase participation and leverage existing programs (2019-2030):

Energy Upgrade Mountain View achieved 16% natural gas savings amongst 1,200 participants (an average 62 therms and 301 kWh per year) of mostly single-family homes. 14% of all single-family homes registered for the program.[19]

If Mountain View promotes existing voluntary energy-efficiency programs, we can use savings from Energy Upgrade Mountain View as a baseline. Scaling the results up due to increased participation from 2020 to 2030, it would lead to roughly 75,000 therms savings per year for residential. The assumption is that this mostly affects owner-occupied housing units.

Energy-efficiency and retrocommissioning ordinance for commercial buildings (2020-2030):

Energy savings from Retrocommissioning range from 5-20%. Energy audits inform property managers of energy and cost savings opportunities during for future upgrades.

The assumption is that 25% of the commercial energy use would fall under buildings within the SQ FT size range to be required to comply (> 50,000 square feet), roughly 200 buildings in Mountain View.

High-level assumptions:

- Roughly 200 buildings in Mountain View > 50,000 square feet
- Assume these buildings account for 25% of total commercial natural gas usage in Mountain View
- Mountain View natural gas usage for commercial sector was roughly 10M therms in 2015 (data provided by City as part of Task Force Business as Usual model)
- 25% of those buildings are low usage, and can be waived
- 25% are already well-operated, and can be waived
- 50% of buildings need to comply with ordinance, and can achieve 16% average savings for natural gas (16% based on LBNL average)

Potential to reach roughly 200,000 therm savings annually (with five years ramp-up time from start of ordinance to reach compliance and address measures). Savings are assumed to persist for remaining years since audits or RCx will need to be redone every 5 years.

Time of sale audits (2021-2030):

According to Zillow, roughly 600 homes are sold in Mountain View every year. Energy audits upon time of sale can inform future renovation plans. Assuming half of these buildings are ones that were not already included in the voluntary program count, and roughly assuming the same scale of potential savings (60 therms/year), this would affect roughly 18,000 therms annually.

Energy audits and minimum energy-efficiency for rental housing (2022-2030):

City of Boulder estimates that costs to reach compliance through upgrades to be on average $3,000 per rental unit. The most typical measures being insulation. Project costs in California will likely be higher than in Colorado, however the measure mix will also be slightly different due to the milder climate and building stock differences. Annual energy savings averaged 20 therms and 98 kWh per unit.[20]

Assumption for Mountain View is half the natural gas savings due to the milder climate and a different measure mix, at 10 annual therms per rental unit. 60% of Mountain View's housing units are rentals, approximately 20,000 units, achieving annual savings of 200,000 therm savings annually from 2025-2030 once sites are given time to come into compliance (equivalent to approximately 2,000 MT CO2e annually).

Cost analysis

City staff to increase participation and leverage existing programs (2019-2030):

Assumption here is that one FTE at $180,000 / year will be required from 2019-2021, then half FTE for remaining years until 2030. From a cost savings perspective, if Mountain View can identify potential grant sources, additional incoming funds could potentially provide supplemental program budget.

Energy-efficiency and retrocomissioning ordinance for commercial buildings (2020-2030):

Assumption here is that one half FTE at $90,000 / year will be required from 2019-2022, then ¼ FTE until 2030 to develop the program and provide ongoing support. A major assumption is that the program will benefit from being able to leverage Sate benchmarking data to optimize program design and delivery.

Time of sale ordinance for residential and commercial (2021-2030):

City of Berkeley estimates 1.5 FTE for the ongoing support of the BESO ordinance, which includes energy audits for commercial buildings based on fixed cycles, and energy audits for residential units at time of sale [21]. Funding is half covered through the general fund, and half covered through application filing fees (ranging from $79 for 1-4 unit dwellings to $240 for large buildings). The City of Berkeley population is larger than Mountain View (120,000 vs 78,000), so the estimate for Mountain View staff is scaled down to 1 FTE.

According to Zillow, there were 6,000 home sales in the City of Mountain View between March 2008 and March 2018, averaging roughly 600 home sales a year. [22]

Assumption here is that 1/2 FTE at $90,000 / year will be required from 2021-2024, then ¼ FTE for remaining years until 2030 to process ordinance submissions. From a cost savings perspective, if Mountain View can identify potential grant sources, additional incoming funds could potentially provide supplemental program budget. Fees from the submissions can cover roughly cover costs of the program.

Energy-efficiency ordinance for rental units (2022-2027):

Simplistic cost assumptions are based on City of Boulder SmartRegs in Colorado. Energy-efficiency upgrades cost an average of $3,000 per unit to the landlords.[23]

From 2015 estimates provided by the City, Mountain View had roughly 35,000 housing units[24]. According to Bay Area census stats, roughly 60% of Mountain View's housing units are renter-occupied [25]. An ordinance that addressed rental units would impact roughly 20,000 rental units in Mountain View.

Assumptions are that incentives will be leveraged through energy-efficiency programs, and the City's costs will be administrative. Building owners will be given a five-year timeline to comply based on the complexity of energy-efficiency measures identified.

Assumption here is that 1 FTE at $180,000 / year, through the five-year program, between 2022-2027.

Summary of staffing costs

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Cumulative
City Staffing costs													
1) City staff and outreach to increase participation in voluntary measures (1 FTE first three years, scale down to 1/2 FTE)	$ 180,000	$ 180,000	$ 180,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	**$ 1,350,000**
2) Energy audit or retrocommissioning required for buildings > 50,000 every 5 years, starting 2020 (assume 1/2 FTE for 3 years, then 1/4 FTE for remainder years)		$ 90,000	$ 90,000	$ 90,000	$ 45,000	$ 45,000	$ 45,000	$ 45,000	$ 45,000	$ 45,000	$ 45,000	$ 45,000	**$ 630,000**
3) Energy audits required at time of sale for buildings > 600 square feet, starting 2021 (1/2 FTE for 3 years, scale down to 1/4 FTE for remaining years)			$ 90,000	$ 90,000	$ 90,000	$ 45,000	$ 45,000	$ 45,000	$ 45,000	$ 45,000	$ 45,000	$ 45,000	**$ 585,000**
4) Rental units - energy audits - 5 year program 2022-2027. Assume roughly 20,000 total rental units in MV.				$ 180,000	$ 180,000	$ 180,000	$ 180,000	$ 180,000					**$ 900,000**
Total Staffing costs	**$ 180,000**	**$ 270,000**	**$ 360,000**	**$ 450,000**	**$ 405,000**	**$ 360,000**	**$ 360,000**	**$ 360,000**	**$ 180,000**	**$ 180,000**	**$ 180,000**	**$ 180,000**	**$ 3,465,000**

Summary of revenue to City from ordinance fees

Revenue to city from fees	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Cumulative
2) Energy audit or RCx for buildings > 50,000 sq ft, every 5 years, starting 2020. Assume 200 buildings above 50,000 sq ft in MV. Assume 25% are low usage, assume 25% meet alternative compliance pathways. Each year, one fifth of 100 buildings comply. Avg fee $200/bldg.			$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000	**$ 200,000**
3) Time of sale energy audits for buildings > 600 SQ FT, starting 2021 (600 homes/year @ $60 each, 150 commercial/year @ $200 each)				$ 66,000	$ 66,000	$ 66,000	$ 66,000	$ 66,000	$ 66,000	$ 66,000	$ 66,000	$ 66,000	**$ 594,000**
4) Rental unit energy audit 2022-2027 - residential and commercial < 50,000 sq ft (fee waived for below market) - assuming 15,000 above market residential and 1,500 total commercial units, given 5 years to comply, fee avg $30/residential, $150/commercial					$ 165,000	$ 165,000	$ 165,000	$ 165,000	$ 165,000				**$ 825,000**
Total fees	**$ -**	**$ -**	**$ 20,000**	**$ 86,000**	**$ 251,000**	**$ 251,000**	**$ 251,000**	**$ 251,000**	**$ 251,000**	**$ 86,000**	**$ 86,000**	**$ 86,000**	**$ 1,619,000**

Summary of costs to property owners to implement energy audits and RCx ordinances

Costs to property owners to implement energy audits			2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	
2) Energy audit or RCx for buildings > 50,000 sq ft, every 5 years, starting 2020. Assume 200 buildings above 50,000 sq ft in MV. Assume 25% are low usage, assume 25% meet alternative compliance pathways. Each year, one fifth of 100 buildings comply. Avg RCx cost with upgrades $20000/bldg.			$2,000,000	$ 2,000,000	$2,000,000	$2,000,000	$2,000,000	$ 2,000,000	$2,000,000	$2,000,000	$ 2,000,000	$ 2,000,000	**$ 20,000,000**
3) Time of sale energy audits for buildings > 600 SQ FT, starting 2021 (600 homes/year @ $200 each for Home Energy Scoring, 150 commercial/year @ $2000 each for energy audit)				$ 420,000	$ 420,000	$ 420,000	$ 420,000	$ 420,000	$ 420,000	$ 420,000	$ 420,000	$ 420,000	**$ 3,780,000**
4) Rental unit energy audit 2022-2027 - residential and commercial < 50,000 sq ft (fee waived for below market) - assuming 15,000 above market residential and 1,500 total commercial units, given 5 years to comply, fee avg $30/residential, $100/commercial					$ 120,000	$ 120,000	$ 120,000	$ 120,000	$ 120,000				$ 600,000
Total fees	**$ -**	**$ -**	**$2,000,000**	**$ 2,420,000**	**$2,540,000**	**$2,540,000**	**$2,540,000**	**$ 2,540,000**	**$2,540,000**	**$2,420,000**	**$ 2,420,000**	**$ 2,420,000**	**$ 24,380,000**

Summary of natural gas and GHG reductions

Annual natural gas savings (therms)	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	
1) Increased residential voluntary program participation (assuming 1000 homes in first year, 60 therms per home per year, then additionally adding 25% new participating homes each subsequent year)	60,000	75,000	93,750	117,188	146,484	183,105	228,882	286,102	357,628	447,035	558,794	2,553,968
Increased commercial voluntary program participation, utilizing AB802 data to target high energy buildings to implement deep retrofits. Assume 2% of commercial building natural gas usage per year, reduced by 50%		100,000	200,000	300,000	400,000	500,000	600,000	700,000	800,000	900,000	1,000,000	5,500,000
2) Energy audit and RCx every 5 years (assume 100 commercial buildings > 50,000 sq ft, saving avg 16% natural gas). Assume 25% of C&I energy usage from commercial buildings > 50,000 SQ FT. In 2005, roughly 10 million therms for all of commercial in MV. Assumine 25% for buildings > 50,000 sq ft. 5 years to ramp in.		40,000	80,000	120,000	160,000	200,000	200,000	200,000	200,000	200,000	200,000	1,600,000
3) Time of sale energy audit - Residential. Assuming 50% of sites are inspired to save 15% natural gas. Average residential therm usage 290 annual therms in 2015. Assume 600 home sales/year from Zillow data.			13,050	26,100	39,150	52,200	65,250	78,300	91,350	104,400	117,450	587,250
Time of sale energy audit - small commercial. Assuming 50% of sites inspired to save 15% of natural gas. Assume 75% of C&I energy usage from smaller commercial buildings. In 2005, roughly 10 million therms for all of commercial sector in MV. Assume 5% turnover / year.			28,125	28,125	28,125	28,125	28,125	28,125	28,125	28,125	28,125	253,125
4) Rental unit energy audits. Assuming 50% of sites are inspired to save 15% natural gas. Average residential therm usage 290 annual therms based on Mountain View 2015 data. 18,000 sites, over 5 years.				78,300	156,600	234,900	313,200	391,500	391,500	391,500	391,500	2,349,000
Total therms savings	60,000	215,000	414,925	669,713	930,359	1,198,330	1,435,457	1,684,027	1,868,603	2,071,060	2,295,869	**12,843,343**
Total MT CO2e savings (assuming 5320.66 MTCO2/million therm)	319	1,144	2,208	3,563	4,950	6,376	7,638	8,960	9,942	11,019	12,216	**68,335**
Total cost savings from natural gas (assuming today's average $1.50/therm)	$ 90,000	$ 322,500	$ 622,388	$1,004,569	$1,395,539	$1,797,496	$ 2,153,185	$2,526,041	$2,802,904	$ 3,106,590	$ 3,443,803	**$19,265,014**

NOTE: additional electric cost savings were not modeled here since the focus has been on GHG emissions reductions from natural gas, but the combined natural gas and electric savings over time should payback the upfront audit and implementation costs for property owners.

Scale analysis

This recommendation is roughly aligned with the City's current goals of achieving cost-effective energy-efficiency measures in 40% of buildings by 2030 from Mountain View's General Plan, Measures E-1.1 and E-1.2. The focus of the environmental impact analysis is on GHG emissions savings from natural gas reductions, assuming an average of 15% natural gas usage reduction in participating buildings.

Further detail on municipalities with voluntary energy-efficiency programs or ordinances

Voluntary program examples:

- **City of Portland published a Green Tenant Improvement Guide**, "Creating a High Performing Workplace" that guides tenants to consider office space improvements that reduce energy usage and increases employee wellness and productivity.[26]
- **City of Denver's "Lease for Efficiency Challenge"** enrolled more than 90 participants, representing tenants 2.5 million square feet of commercial real-estate to commit to asking their

property managers the energy star score of their building. Participants also received recognition for taking energy-efficiency leasing steps, potentially saving tenants 12-14 cents per square foot on existing agreements. New Energy Efficient Leases can save tenants 15-60 cents per square foot.[27]

Municipal ordinance examples:

- A **local energy code is being adopted for the City of Chico to require common sense, cost-effective whole-home energy upgrades during a major remodel**. This energy code is being expanded to other climate zones in California and would be available for Mountain View to adopt as a reach goal.
- **City of Portland Home Energy Score** ordinance requires public disclosure of home energy scores for single-family homes. Costs of home scoring ranges from $150 to $250.[28]
- **Boulder Building Performance Ordinance,** adopted in Oct 2015, requires annual benchmarking and public disclosures, as well as energy and building tune-up assessments every ten years. Cost-effective measures are required to be implemented within two years of the study. One-time lighting measures are also required. [29]
- **Seattle's Building Tune-Up Program** requires buildings with 50,000 SQ FT or more of non-residential space to work with qualified energy service providers to conduct building assessments, and address corrective actions identified. Alternative compliance pathways are offered for high performing buildings that are already certified through LEED O+M, Living Building, or high Energy Star scores. Mid-size buildings (< 100,000 SQ FT) are offered additional technical support and financial incentives. [30]Typical savings achieved are 5-15% but can be more with further energy-efficiency efforts. Building Tune-up projects typically payback in less than 3 years. The program receives grant support from Department of Energy. Incentives are provided by Seattle City Light. [31]
- **Los Angeles, CA - Existing Building Energy and Water Efficiency (EBEWE) ordinance** – Buildings over 20,000 SQ FT are required to benchmark water and energy usage annually. Benchmarking data is publicly disclosed. Energy audits or retrofits are required every 5 years. A fee of $183 is required for building owners as part of submittal. Exemptions are provided to high performing buildings, or those that have undergone recent energy savings measures. Extensions are provided to buildings that are undergoing financial hardship. [32]
- **Orlando, FL - Building Energy and Water Efficiency Strategy (BEWES)** ordinance requires building benchmarking. Buildings with scores below national average are required to complete free energy audits every 5 years.[33]
- **New York City Local Law 87 requires energy audits and retrocommissioning** for buildings over 50,000 SQ FT once every 10 years as part of the Greener, Greater Buildings Plan.
- **City of San Jose** is currently engaging stakeholders in the consideration of an energy benchmarking disclosure and energy audit ordinance.
- **City of Austin Energy Conservation Audit and Disclosure (ECAD)** ordinance requires owners of multi-family properties with five or more units to conduct period energy audits, and to disclose reports to prospective tenants (or existing tenants on lease renewals)[34]

BE4 References

1. Mountain View Greenhouse Gas Reduction Plan

2. ESTF Business as Usual estimates

3. Based on Mountain View Task Force Business as Usual model

4. "Energy-efficiency to reduce residential electricity and natural gas use under climate change" study published in Nature Magazine (May 2017) models an increase of residential electricity demand of 41-87% by 2060 for LA County, but also identifies the potential for aggressive energy-efficiency policies to keep this increase as low as 28%. https://www.nature.com/articles/ncomms14916

5. https://www.washingtonpost.com/realestate/study-finds-that-energy-efficient-homes-often-command-higher-prices/2012/07/19/gJQAF4MiwW_story.html?utm_term=.32beaf056bc7

6. DNV GL and Clean Coalition Economic Benefit-Cost Analysis of Energy-efficiency and Fuel Switching Measures http://www.clean-coalition.org/site/wp-content/uploads/2018/01/PAEC-Task-3.14_Final-Economic-BCA-of-Energy-Efficiency-and-Fuel-Switching_School-Building-02_wb-19-June-2017.pdf

Feb 2018 University of California Strategies for Decarbonization: Natural Gas – energy-efficiency measures could provide funding for biogas purchases https://www.nceas.ucsb.edu/files/research/projects/UC-TomKat-Replacing-Natural-Gas-Report_2018.pdf

7. BayREN Energy-efficiency Business Plan 2018-2025 - https://abag.ca.gov/bayren/documents/BayREN_BusinessPlan_20170123_PDFA.pdf

8. City of Portland Home Energy Report disclosure ordinance at time of sale took effect January 2018 - https://www.portlandoregon.gov/bps/71421

9. https://www.mass.gov/news/baker-polito-administration-files-legislation-to-improve-residents-access-to-home-energy

10. City of Boulder SmartRegs Program-to-Date Progress Report from March 31, 2018 - https://bouldercolorado.gov/plan-develop/smartregs-progress

https://www-static.bouldercolorado.gov/docs/Copy_of_SmartRegs_Dashboard__Q1_2018-1-201804050938.pdf

11. The Future of Building Energy Rating and Disclosure Mandates: What Europe Can Learn from the United States – Institute for Market Transformation – 2018 - https://www.imt.org/wp-content/uploads/2018/02/7.5IEECBPaper33.pdf

12. http://web.mit.edu/energy-efficiency/docs/EESP_Nadkarni_BuildingPerformanceDisclosure.pdf

13. http://laserfiche.mountainview.gov/Weblink/0/edoc/213771/EPC%202018-03-21%20Item%206.2%20Staff%20Memo-Exhibit%201%20(General%20Plan%20Action%20Items%20List,%202018).pdf

14. Energy Upgrade Mountain View – Final Report

15. https://www.denvergov.org/content/denvergov/en/environmental-health/environmental-quality/Energize-Denver/Lease-for-Efficiency-Challenge.html

16. Evan Mills, LBNL 2009 Building Commissioning: A Golden Opportunity for Reducing Energy Costs and Greenhouse-Gas Emissions - http://cx.lbl.gov/2009-assessment.html

17. California Energy Commission 2009 Residential Appliance Saturation Survey http://www.energy.ca.gov/2010publications/CEC-200-2010-004/CEC-200-2010-004-ES.PDF

18. https://austinenergy.com/ae/energy-efficiency/ecad-ordinance/for-multifamily-properties/faqs

19.https://onedrive.live.com/view.aspx?cid=428E7D625E39DE0E&resid=428e7d625e39de0e%21265&app=WordPdf

20. https://www-static.bouldercolorado.gov/docs/Boulder_Building_Performance_Infographic_FINAL-1-201510201708.pdf

21. Email correspondence with Catherine Campbell-Orrick, City of Berkeley, regarding implementation of the Berkeley BESO ordinance, March 30, 2018

22. Sales quantity data was pulled from Zillow Research - https://www.zillow.com/research/data/ - "Sale-Counts_City.xls" was downloaded on 5/28/2018 from the geographic cuts by city

23. https://www-static.bouldercolorado.gov/docs/Boulder_Building_Performance_Infographic_FINAL-1-201510201708.pdf

24. As documented in Task Force Business as Usual estimates

25. http://www.bayareacensus.ca.gov/cities/MountainView.htm

26. https://www.portlandoregon.gov/bps/article/285215

27. https://www.denvergov.org/content/denvergov/en/environmental-health/environmental-quality/Energize-Denver/Lease-for-Efficiency-Challenge.html

28. https://www.portlandoregon.gov/bps/71421

29. https://www-static.bouldercolorado.gov/docs/Boulder_Building_Performance_Infographic_FINAL-1-201510201708.pdf

30. https://www.seattle.gov/Documents/Departments/OSE/OSE_BTU_FACT_SHEET_101117.pdf

31. https://www.seattle.gov/Documents/Departments/OSE/TUPA-Info-Sheet-Nov2016.pdf

32. https://www.betterbuildingsla.com/the-law

33. https://www.usgbc.org/articles/new-year%E2%80%99s-resolution-21-us-communities-benchmark-data-0

34. https://austinenergy.com/ae/energy-efficiency/ecad-ordinance/for-multifamily-properties/for-multifamily-properties

Use city buildings to demonstrate leadership in electrification and energy efficiency (**BE12**)						**City Operations**	**12 yrs.**		
Recommendation name						Type	Duration		
820 MT	**$522K Saved**	**$0**	**$637 Saved**	●●●	●●●	●○○	●○○	●○○	●○○
MT CO2e reduction 2018-2030	City's Net Cost	Incremental Net Cost	Net cost per MT CO2e reduction	Easy to implement	Easy to measure	Private investment leverage	Local economic benefits	Other environmental benefits	Health benefits

Problem description

Mountain View needs to encourage commercial developers and building owners to reduce need-emissions from existing buildings to meet its climate goals. As such, Mountain View should lead by example to reduce City building emissions. This can generate financial savings and lead to a better understand of the technologies and processes that help reduce building emissions.

Recommendation

1) Evaluate City buildings for reducing emissions with deep-energy efficiency and electrification retrofits. The evaluation should include whether the technologies can be duplicated in multiple City buildings and whether they could be used as a case-study.
   - As part of the evaluation, investigate the feasibility of reducing municipal building emissions by 80% by 2030 based on 2005 emissions. This is roughly a 50% reduction in natural gas use since the electricity used is now 100% GHG free.
2) Implement deep-energy efficiency and electrification retrofits on buildings which reduce natural gas emissions by at least 10% over 2015 levels, provide positive net-savings and support broader adoption.
3) Increase the annual Energy Efficiency Capital Improvement Program funds and provide more consistency in funding year-over-year to ensure ongoing ability to implement retrofits.

SWOT analysis

Strengths:

- Emissions reductions are easily measured
- The implementation is within the City's control
- Actions can be self-funding based on a local study
- This action demonstrates Mountain View's leadership for the business community and allows it to lead by example regarding building electrification retrofits

Weaknesses:

- Upfront-investment can be significant
- Disruption to operations in selected buildings

Opportunities and co-benefits:

- Health benefits can be an additional benefit for employees and those using the building when doing a retrofit. For example, greater use of natural lighting can reduce eye strain. A tighter building envelope can reduce drafts and provide a more even temperature.
- Increase City staff familiarity with technologies which will be used in new commercial construction to meet California's law requiring new commercial buildings to be Zero Net Energy (ZNE) starting in 2030. http://www.cpuc.ca.gov/ZNE/

Threats: None identified

Municipalities where already implemented

- Palo Alto has a goal for the municipal operations to be carbon neutral by 2030. (4)
- Hayward requires all new and existing municipal building stock to be ZNE by 2025 (3).
- San Mateo County requires all new municipal buildings to be ZNE (4).
- Fremont has a pilot-program implementing micro-grids for three fire stations.

Funding sources

The investments in energy efficiency can be self-funding given the average payback for all actions is less than six years based on DNV-GL* study of different office building types (1). The energy-efficiency savings can help fund the electrification efforts which may have longer paybacks. City staff estimated the ten-year cost saving from building energy-efficiency measures and Photovoltaics (PV) installations at $1,150,000 (BE12 Appendix C, BE12 Table 1). * DNV GL is an international accredited registrar and classification society headquartered near Oslo, Norway.

PG&E provides free energy audits.

Mountain View currently has an Energy Efficiency Capital Improvement Program which ranges from $80,000 to $160,000 per year. This provides a base of funding; however, the inconsistency of the funds does not allow for a sustained effort.

California Energy Commission (CEC) funds may be available for leading-edge pilot programs. For example, the City of Fremont is using CEC funds for its micro-grid pilot program for its fire stations and emergency services.

Assumptions and uncertainty

Assumptions with High Uncertainty:

- It's uncertain how applicable the DNV-GL analysis is to the specific municipal buildings in Mountain View.

Assumptions with Low Uncertainty:

- The analysis used environmental conditions for Redwood City which should be very similar to Mountain View.

Author Mike Balma

Detailed analysis

Environmental analysis

The emissions from Mountain View buildings and facilities was 2737 MT CO2e in 2005. A reduction of 80% by 2030 would reduce annual emissions to 547 MT CO2e. In 2015, City buildings and facilities had already reduced emissions to 2496 MT CO2e. In that year, Mountain View buildings used 196,075 therms and 7498,704 kWh. If emissions were reduced to 547 MT by 2030, it would reduce emissions by 830 MT CO2e per year in 2030. This offers the upper limit of what might be achieved if Mountain View achieved an 80% reduction by 2030. See *Appendix C from 2015 Local Government Operations Green House Gas Emissions Inventory presented at CESC meeting March 15, 2018*.

Based on a more-modest goal of retrofitting six office buildings and four fire stations, roughly 105 MT of CO2e emissions would be reduced based on the DNV-GL analysis. In this analysis, the energy-reductions for each sample office building was reduced by 120,674 kWh and the natural gas use was reduced by 1183 therms (34,654 kWh). For each fire station, natural gas was estimated to be reduce by 2893 therms (87,404 kWh) as seen in the DNV-GL charts in BE12 Appendix B. This represents an annual emissions-reduction of 101 MT CO2e per year starting in 2026. Emissions-reductions are assumed to occur in the year following the retrofit. The total emissions-reduction from the representative office and fire stations is estimated to be 820 MT CO2e over 12 years, see BE12 Table 1.

BE12 Table 1: Emissions Reduction from Energy Retrofits to City Buildings

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Total
Office Buildings retrofit (cumulative)	0	1	2	3	4	5	6	6	6	6	6	6	
Tons CO2 Saved		0	6	13	19	25	31	38	38	38	38	38	282
Fire Stations retrofit (cumulative)	0	1	2	3	4	4	4	4	4	4	4	4	
Tons CO2 Saved		0	16	32	47	63	63	63	63	63	63	63	538
												101	820

Cost analysis

$20,000 has been set aside to for additional research to investigate the cost and feasibility to reduce natural gas emissions by 50% by 2030. There are reports from PG&E and Syserco completed in 2015 that may should be updated to focus on natural gas reductions.

DNV-GL completed a study in 2017 analyzing commercial building types in Redwood City focusing on deep-energy efficiency and electrification. This was funded by the CEC. It indicates paybacks for implementing these retrofits range from 4.6 to 10.7 years depending on the building type. See BE12 Table 2.

BE12 Table 2. DNV-GL study with Clean Coalition – Savings Compaision by Building Type.

Office	59	22	5.4
Municipal (fire station)	84	39	4.6
Retail	64	21	9.3
Multifamily	64	27	6.9
School	60	26	10.7

Energy efficiency before and after: Five modeled types of buildings
Source: PAEC report, Final Economic Benefit-Cost Analysis of Energy Efficiency and Fuel Switching Measures

The best payback in the study, implementing all the efficiency and electrification actions excluding electrification of hot water, was for fire stations followed by office buildings. Heat-pump hot-water heaters could be added to completely electrify the building with the savings from the other actions paying for the eliminating natural-gas use.

The cost and emissions number in this recommendation assumes that four of Mountain View's five fire stations can be retrofitted and that six office buildings will be retrofitted through 2025. An office building may be a good site for public demonstration to avoid fire station operations.

It was assumed that one office building and one fire station per year would be retrofit starting in 2020.

The study estimated that an office building would have an initial cost of $116,712 after rebates with an annual savings of $21,465. And the fire stations would have an initial cost of $80,049 after rebates with an annual savings of $17,537. See BE12 Appendix A for details.

Over twelve years, the net benefit for Mountain View is estimated to be almost $542,000 for all retrofits. This return is after covering the initial investments of roughly $1,020,000 as seen in BE12 Table 3 and in the appendices below.

BE12 Table 3. Cost and Savings Estimates for Energy Upgrades and Electrification of Mountain View Buildings.

	Office buildings	Fire stations	Total
Cost/building	$116,712	$80,049	
Number of buildings	6	4	
Total cost	$700,272	$320,196	$1,020,468
Annual savings/building	$21,465	$17,537	
Total Savings over 12 years	$965,925	$596,258	$1,562,183
Net over 12 years			**$ 541,715**

Scale analysis

The city is in control of the rollout. DNV GL analysis assumes replacement of major appliances at end-of-life. Since major appliances have a 20-year life, buildings with appliances upgraded in the past eight years may not be appropriate for replacement over the next 12 years.

BE12 References

1) DNV GL study "Economic Benefit-Cost Analysis of Energy Efficiency and Fuel Switching Measures for Commercial Buildings" for Clean Coalition funded by DED's Electric Program Investment Charge (EPIC) program as part of "The EPIC Challenge: Accelerating the Deployment of Advanced Energy Communities." http://www.clean-coalition.org/paec-ee-fuel-switching-reports/
2) 2015 Local Government Operations Green House Gas Emissions Inventory presented at CESC meeting March 15, 2018 http://laserfiche.mountainview.gov/WebLink/0/edoc/213743/CESC%20Meeting%20Packet%20-%203-15-18%20-%20FINAL.pdf
3) Hayward ZNE policy for Municipal Buildings by 2025 www.hayward-ca.gov/discover/news/dec16/city-hayward-adopts-zero-net-energy-goal
4) Palo Alto Building Baseline Study and Roadmap to Zero Net Energy Buildings, February 2018 www.cityofpaloalto.org/civicax/filebank/documents/63492

BE12 Appendix A: Office Building Energy Reduction by End Use (DNV-GL analysis)

EEM	Heating - Nat Gas (kWh)	Heating - -Elec (kWh)	Cooling (kWh)	Fans (kWh)	Pumps (kWh)	Hot water -Nat Gas (kWh)	Hot water -Elec (kWh)	Int. Lights (kWh)	Ext Lights (kWh)	Plug Loads (kWh)	Annual Energy Use (kWh)
0-Baseline	26,659	0	15,922	36,627	80	8,059	0	48,164	7,293	48,164	**190,968**
1-LEDs	39,800	0	15,445	33,947	118	8,059	0	12,844	4,796	48,164	**163,174**
2-BMS	24,235	0	14,475	36,627	80	8,059	0	48,164	7,293	48,164	**187,097**
3-Phantom Loads	29,126	0	15,910	35,926	86	8,059	0	48,164	7,293	40,137	**184,701**
4-Windows	6,030	0	8,633	22,108	17	8,059	0	48,164	7,293	48,164	**148,467**
5-Insulation	13,997	0	12,024	31,363	40	8,059	0	48,164	7,293	48,164	**169,104**
6-AC	26,659	0	12,987	36,627	80	8,059	0	48,164	7,293	48,164	**188,032**
7-Heating	0	8,631	15,922	9,478	0	8,059	0	48,164	7,293	48,164	**145,712**
8-Hot Water	26,659	0	15,922	36,627	80	0	2,095	48,164	7,293	48,164	**185,004**
9-All EEMs	0	2,462	4,203	3,756	0	0	2,095	12,844	4,796	40,137	**70,294**

BE12 Appendix B1. Office Building Economic Analysis (DNV-GL)

0-Baseline	71,236	0	17,015	33,733	225	16,168	0	62,979	7,639	62,979	**271,976**
1-LEDs	104,220	0	16,587	29,149	345	16,168	0	16,795	4,733	62,979	**250,976**
2-BMS	64,760	0	15,468	33,733	225	16,168	0	62,979	7,639	62,979	**263,953**
3-Phantom Loads	74,963	0	17,008	33,201	237	16,168	0	62,979	7,639	56,071	**268,266**
4-Windows	61,901	0	14,948	32,533	195	16,168	0	62,979	7,639	62,979	**259,342**
5-Insulation	12,127	0	11,575	42,539	34	16,168	0	62,979	7,639	62,979	**216,041**
6-AC	71,236	0	13,878	33,733	225	16,168	0	62,979	7,639	62,979	**268,838**
7-Heating	0	16,885	16,589	33,731	0	16,168	0	62,979	7,639	62,979	**216,970**
8-Hot Water	71,236	0	17,015	33,733	225	0	4,204	62,979	7,639	62,979	**260,011**
9-All EEMs	0	6,253	7,898	28,578	0	0	4,204	16,795	4,733	56,071	**124,532**

Table 6: Economic analysis – EEM analysis

Energy Efficiency Measures (EEMs)	EEM Analysis				
	Capital Cost	Incentives Available	Incremental Operations & Maintenance	Annual Energy Cost Savings ($/yr)	System Life (years)
1-LEDs	$26,760	$3,853	$0	$9,172	13
2-BMS	$4,000		$180	$435	15
3-Phantom Loads	$1,500		$0	$1,970	15
4-Windows	$70,392		$0	$5,959	30
5-Insulation	$10,213		$0	$2,660	30
6-AC	$2,000		$0	$694	20
7-Heating	$2,000		$0	$5,416	20
8-Hot Water	$4,000	$300	$0	-$187	20
9-All EEMs	$120,865	$4,153	$180	$21,645	20.4

BE12 Appendix B2. Fire Station Economic Analysis (DNV-GL)

Table 6: Economic analysis – EEM analysis

Energy Efficiency Measures (EEMs)	EEM Analysis				
	Capital Cost	Incentives Available	Incremental Operations & Maintenance	Annual Energy Cost Savings ($/yr)	System Life (years)
1-LEDs	$26,760	$2,697	$0	$11,496	13
2-BMS	$4,000	-	$180	$614	15
3-Phantom Loads	$1,000	-	$0	$1,615	15
4-Windows	$23,464	-	$0	$1,137	30
5-Insulation	$12,422	-	$0	$1,513	30
6-AC	$2,000	-	$0	$741	20
7-Heating	$2,000	-	$0	-$1,109	20
8-Hot Water	$12,000	$900	$0	-$375	20
9-All EEMs	$83,646	$3,597	$180	$17,537	20.4

BE12 Appendix C: Cumulative Cost Savings of Major Sustainability Projects 2008-2017

Area	10-Year Cumulative Savings[1]
Landfill Microturbines	$1,000,000
Building Energy Efficiency	$900,000
Streetlight Upgrades	$425,000
Green Team Initiatives	$350,000
Solar PV Installations	$250,000
TOTAL	**$2,925,000**

Table 1: Total and Percent Change in Greenhouse Gas Emissions, 2005, 2010, 2015

Sector	2005 GHGs (MT CO_2e)	2005 GHGs (%)	2010 GHGs (MT CO_2e)	2010 GHGs (%)	2015 GHGs (MT CO_2e)	2015 GHGs (%)	Change 2005-2010 (%)	Change 2010-2015 (%)	Change 2005-2015 (%)
Buildings and Facilities	2,736	15.4%	2,637	17.4%	2,496	21.2%	-3.6%	-5.3%	-8.8%
Public Lighting	640	3.6%	591	3.9%	447	3.8%	-7.7%	-24.4%	-30.2%
Water Transport	377	2.1%	219	1.4%	225	1.9%	-41.9%	2.6%	-40.4%
Wastewater Treatment	134	0.8%	96	0.6%	-12[5]	0.0%	-28.4%	-112.9%	-109.2%
Solid Waste Landfill	9,531	53.6%	7,226	47.7%	4,368	37.2%	-24.2%	-39.5%	-54.2%
Vehicle Fleet	1,722	9.7%	1,761	11.6%	1,744	14.8%	2.3%	-0.9%	1.3%
Gov't Gen. Solid Waste	495	2.8%	604	4.0%	394	3.3%	22.0%	-34.8%	-20.5%
Employee Commute	2,148	12.1%	2,018	13.3%	2,091	17.8%	-6.1%	3.6%	-2.7%
TOTAL	**17,783**	100.0%	**15,152**	100.0%	**11,753**	100.0%	**-14.8%**	**-22.4%**	**-33.9%**

Note: *Numbers may not add to total due to rounding.*

Table 3: Electricity and Natural Gas Consumption at City Facilities, 2010 and 2015

	Electricity (kWh)			Natural Gas (therms)		
Facility	**2010**	**2015**	**Percent Change**	**2010**	**2015**	**Percent Change**
Civic Center (City Hall and Center for the Performing Arts)	1,640,306	1,922,396	17.2%	41,187	61,691	49.8%
Police/Fire Administration Building	1,186,586	1,200,105	1.1%	20,036	21,571	7.7%
Mountain View Sports Pavilion	989,534	402,491	-59.3%	3,585	6,618	84.6%
Library	982,890	1,270,019	29.2%	9,853	12,915	31.1%
Municipal Operations Center	747,202	746,889	-0.0%	21,473	14,370	-33.1%
Senior Center	452,160	356,769	-21.1%	12,669	9,957	-21.4%
Community Center	339,520	444,876	31.0%	6,964	8,981	29.0%
Minor Facilities	286,791	229,262	-20.1%	695	530	-23.7%
Fire Stations	285,313	329,903	15.6%	14,101	13,547	-3.9%
Eagle Park Building and Pool	261,560	201,213	-23.1%	45,000	31,905	-29.1%
Other Community Services Facilities	200,434	238,468	19.0%	15,538	10,075	-35.2%
Whisman Sports Center	182,960	156,303	-14.6%	4,888	3,915	-19.9%
TOTAL	**7,555,256**	**7,498,704**	**-0.7%**	**195,989**	**196,075**	**0.0%**

Require LEED Platinum for city-owned new construction or major renovation (**BN6**)	**Municipal**	**2018-2030**
Recommendation name	Type	Duration

5,340	**634K**	**0**	**$119**	●●○	●○○	●●○	●●○	●●●	●●○
MT CO2e reduction 2018-2030	City's Net Cost	Incremental Net Cost	Net cost per MT CO2e reduction	Easy to implement	Easy to measure	Private investment leverage	Local economic benefits	Other environmental benefits	Health benefits

Problem description

The City of Mountain View does not currently have a key differentiator to set it apart in terms of its leadership in sustainable building. If the City were to set an ambitious green building target for public building, it could help to inspire residents and business owners within the City to pursue similarly ambitious goals. Also, having showcase sustainability building projects would allow the City to "walk the talk" around sustainability and would provide opportunities for the City to demonstrate sustainability learnings, expertise, and tours to the public both within and outside the City. Currently the City only requires LEED Silver certification for all new municipal City-owned buildings and renovation projects over 5,000 square feet. There is only one City-owned LEED building, the 5,000 square foot LEED Gold certified Fire Station #5.[74] Showing a public commitment to LEED Platinum for City-owned buildings will help to send a signal to the developer market, helping to encourage developers in the North Bayshore area to also commit to LEED Platinum as support of its available Floor Area Ratio (FAR) bonus.

Recommendation

The City of Mountain View should update its current policy requiring LEED-Silver certification for all new public construction and renovation projects over 5,000 square feet and instead require LEED v4 Platinum certification for all new City-owned buildings and renovation projects over 5,000 square feet. King County, Washington[75] and the City of Greensburg, Kansas[76] are the only other two municipalities (as far as is known, in the world) that have required that all of their new city construction meets LEED-Platinum requirements. The City of Mountain View could position itself as the third municipality in the world to require LEED Platinum and should conduct a marketing campaign aligned with championing and gaining awareness around its North Bayshore FAR bonus incentives to gain attention around this goal.

SWOT analysis

Strengths:

- This goal is relatively straightforward; it has been done by other cities, but still provides an opportunity for the City to show leadership at a relatively incremental cost against existing building construction processes. The City has already adopted a policy around requiring LEED Silver for its own City-owned buildings so to require LEED Platinum would just be building off an existing target.

[74] https://archinect.com/firms/project/2495243/mountain-view-fire-station-no-5-leed-gold/97796145
[75] https://www.usgbc.org/articles/best-class-king-county-wa-leads-platinum-example
[76] https://www.usgbc.org/articles/rebuilding-and-resiliency-leed-greensburg-kansas

- The City is already a relative leader when it comes to LEED in the private sector, as the City has nearly 90 LEED-Certified buildings, including a few already that are LEED-Platinum certified and a couple that are the latest version of LEED.
- Google's nearly one-million sq. ft. new construction project, Charleston East, will be LEED v4 Platinum certified, which could work in support of a City target of LEED Platinum.
- Aligns with the North Bayshore FAR Bonus of LEED Platinum

Weaknesses:

- There aren't many new City-owned buildings slated for construction or major remodel in the City of Mountain View in the coming years and the GHGe results will most likely occur more from the secondary benefit of trainings being held in these buildings, others being inspired by these buildings, and the general positive exposure and awareness from the City making this kind of commitment.

Opportunities and co-benefits:

- The City will have an opportunity to make an announcement and gain positive publicity and attention around sustainability if the City of Mountain View commits to pursuing LEED Platinum for all its own new construction or major renovation facilities. If the City has LEED Platinum facilities, City staff will have opportunities to speak at conferences and gain additional partners around sustainability for the City of Mountain View. Often, to achieve LEED Platinum certification you must attempt innovative pathways around efforts that will ultimately reduce the City's GHGe such as renewable energy production on site, or in moving to more transit-oriented development.

Threats:

- Vital that the City market this ambitious decision to inspire others to do the same

Municipalities where already implemented, if known

- King County, Washington
- Greensburg, Kansas

Funding sources, if known

General public/private partnerships could be pursued with cities and businesses sharing in this goal

Assumptions and uncertainty

Assumptions with High Uncertainty:

- Existing energy use and emissions for the two buildings studied in the City of Mountain View (The Rengstorff Aquatic Center and the Rengstorff Park Tennis Building)
- Whether there will be other large developers that will want to be part of the "halo effect" of pursuing LEED Platinum for large offices

Assumptions with Low Uncertainty:

- LEED as a third-party standard will continue to be the most prevalent and well-recognized

Author

Lauren Sparandara (submitting as a volunteer citizen and not a Google representative)

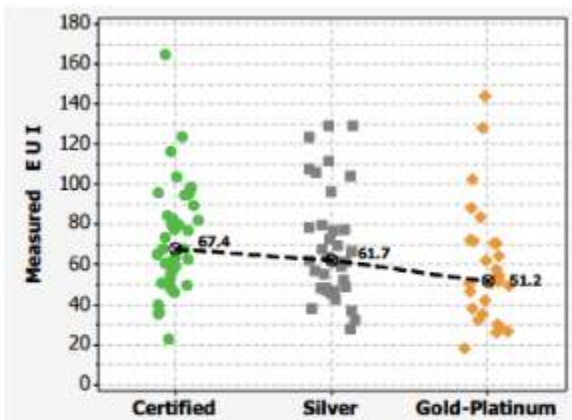
Detailed analysis

Environmental analysis

The study "Efficacy of LEED-certification in reducing energy consumption and greenhouse gas emission for large New York City office buildings" (2013), which analyzed 2011 energy data from 953 New York City office buildings (308 million SF), states that "These data provide no evidence that LEED certification, except at the Gold level, is moving NYC toward its goal of carbon neutrality." LEED Platinum buildings were not included in that study, but it was helpful to understand that the Certified and Silver level brought no GHGe savings but that Gold and higher did bring GHG savings. (Scofield, 2013)

Within a given LEED level, there is a great deal of variability in environmental benefits and energy savings. However, the figure below shows that the average energy performance improves with higher levels of certification. The Energy Use Intensity (EUI) savings shown below are what is used to show savings within the savings calculations above.

Measured Energy Use Intensity (EUI) by LEED NC Rating System (New Buildings Institute, 2008)



Cost analysis

A study of 33 LEED buildings stated the "average reported cost premium varied by LEED Certification level" (Kats, 2003). This study seems to be one of the most conservative studies available and shows the highest premium for LEED Platinum. Most likely those costs could go down significantly but they were used in the absence of better data for the purposes of this study.

Average Cost Premium by LEED Certification Level (Buildings and Schools) (Kats, 2003)

However, it should be noted that "from a life-cycle savings standpoint, savings resulting from investment in sustainable design and construction dramatically exceed any additional upfront costs." (Kats, 2003). Below is an example Net Present Value (NPV) calculation per Kats (2003). You can see from the chart below that projects that are certified Gold and Platinum have the highest NPV. These NPV total values include aspects beyond just GHGs and so weren't used in the top table in this recommendation. However, they are included as a helpful reference.

Net Present Value (NPV) of Green Building Costs and Benefits (Kats, 2003)

Category	20-year NPV
Energy Value	$5.79
Emissions Value	$1.18
Water Value	$0.51
Waste Value (construction only) - 1 year	$0.03
Commissioning O&M Value	$8.47
Productivity and Health Value (Certified and Silver)	$36.89
Productivity and Health Value (Gold and Platinum)	$55.33
Less Green Cost Premium	($4.00)
Total 20-year NPV (Certified and Silver)	**$48.87**
Total 20-year NPV (Gold and Platinum)	**$67.31**

Scale analysis

When looking at the City's capital-improvement projects in the City of Mountain View, one can start to make some very rough assumptions around costs and benefits. The City would need to go into much greater detail to determine actual GHG savings. The current Capital Improvement Program only goes until 2022 so we would need to have the next planning cycle to get us to 2030. However, we have looked at one capital project as an example occurring between now and 2022 and made assumptions around the GHGe available if this project pursued LEED Platinum versus Silver.

Capital Improvement Program Analysis of Switch to LEED Platinum from LEED Silver Requirement (Reference:[77] Capital Improvement Program, Adopted FY 2017-18, Planned FY 2018-19 Through FY 2021-22)

Planned Project and Description	Years
Project 13-38 and 21-39: Rengstorff Aquatic Center Replacement, Design Description: Design and construct the replacement of the existing Rengstorff Park Aquatics Center building and pool. This project includes a construction of the replacement for the existing Aquatics building and pools to provide a modern, energy efficient and code-compliant facility that will provide greater aquatic program services to the public. It also includes a new electrical service to the building. The project includes the construction of a shade structure and various amenities on the pool deck. The proposed replacement building will continue to include public restrooms that are accessed from the outside of the Aquatics building.	2017-2018 2020-21

[77] https://www.mountainview.gov/civicax/filebank/blobdload.aspx?BlobID=23704

The total cost to go from LEED Silver to LEED Platinum for the 6,500-sq. ft. Rengstorff Aquatic Center is estimated very conservatively to be $765,513. However, per the Kats study, a significant assumption can be made that buildings source-energy will decrease by 17% from its LEED-Silver baseline, and therefore the project's full GHG savings from 2018-2030 could be as much as 207 MT. However, if the projects were to draw additional attention to the City of Mountain View and three large-developer office spaces decided to pursue LEED Platinum, then the total GHG savings could be as much as 5,340 MT. It is also possible that with greater attention paid to the City because of its announcement around pursuing LEED-Platinum Certification, there would also be greater financing opportunities provided to the City, as more parties wanted to be part of making the City of Mountain View the most sustainable it can be.

Costs and Savings Calculations for the Rengstorff Aquatic Center to pursue Platinum vs. Silver

First LEED costs for the Aquatics Center to Pursue Platinum vs. Silver

(Data Assumptions: City of Mountain View, "Capital Improvement Program," Adopted FY 2017-18, Planned FY 2018-2019 through FY 2021-22 for Aquatics Center Budget. Using (Kats, 2003) study to assume premiums for LEED levels.)

Total budget for Aquatics Center with Silver	**Silver premium**	**Budget for project if project did not pursue LEED Silver**	**LEED Platinum Premium**	**Project at LEED Platinum**
$18,000,000	$379,800	$17,620,200	$1,145,313	$18,765,513
		Cost to go from LEED Platinum from LEED Silver	$765,513	

Energy and Carbon Savings for the Aquatics Center to Pursue Platinum vs. Silver

(Data Assumptions: Energy-use values modeled off DNV GL's information on Eagle Park Building and Pool from 2015. ASSUMPTION: The Rengstorff Park Aquatic Center has a similar energy-use profile as the Eagle Park Building and Pool. LEED-energy cost-savings taken from (New Buildings Institute, 2008) study)

	kWh	**Therms#**	**C02**
Rengstorff Park Aquatic Center	201,213	31,905	169.0965
LEED Silver New NC Energy Use	160,970	25,524	
LEED Platinum Savings	27365	4339	**23**
2021 Energy Price	0.32	1.27	
Operational Cost Savings to City	8712	4773	$13,484.96

Aquatic Center Operational Cost Savings over 2019-2030 Planning Window

(Data assumption: Cost of energy goes up each year)

	Est.	Est.	Est.	Est.	Est.	Est.	Est.	Est.	Est.	Est.	Est.	Est.	
	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Total
Platinum at Rengstorff Aquatic Center (instead of Silver)													
Cost to City	$ -	$ -	$ 765,513	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 765,513
Operational Energy Savings		$ -	$ -	$ 13,485	$ 13,755	$ 14,030	$ 14,310	$ 14,597	$ 14,888	$ 15,186	$ 15,490	$ 15,800	$ 131,541
Net	$ -	$ -	$ (765,513)	$ 13,485	$ 13,755	$ 14,030	$ 14,310	$ 14,597	$ 14,888	$ 15,186	$ 15,490	$ 15,800	
Cumulative Net	$ -	$ -	$ (765,513)	$ (752,028)	$ (738,273)	$ (724,244)	$ (709,933)	$ (695,337)	$ (680,448)	$ (665,262)	$ (649,772)	$ (633,972)	
First cost for building				$ 765,513									
First year savings				$13,485									

However, if one assumes that private developers in the City of Mountain View are further inspired by the City's own LEED-Platinum target for City-owned buildings and if one assumes that three developer projects voluntarily pursued LEED-Platinum certification, perhaps in conjunction with the North Bayshore Precise Plan FAR bonus targets, instead of LEED-Silver certification, then the total CO2 saved could be 5,340 MT. Calculations below regarding the private developer calculations and assumptions.

Energy and carbon savings for a large office development to pursue Platinum vs. Silver

(Energy-use values modeled off Apple's new spaceship campus. Assumption: These new developments have a similar energy-use profile as the Apple spaceship campus. LEED energy cost savings taken from (New Buildings Institute, 2008) study.)

	kWh	Therms#	CO2
Private Developers Pursue Platinum instead of LEED Silver at Large (over 1 million SF) Office Building	23,979,783	296,699	1572.5047
LEED Silver New NC Energy Use	19,183,826	237,359	
LEED Platinum Savings	3261250	40351	**214**
2021 Energy Price	0.32	1.27	
Operational Cost Savings to Developer	$1,038,260	$44,386	$1,082,646

CO2 savings for Aquatic Center and three large developer projects to pursue Platinum over Silver

	Est. 2019	Est. 2020	Est. 2021	Est. 2022	Est. 2023	Est. 2024	Est. 2025	Est. 2026	Est. 2027	Est. 2028	Est. 2029	Est. 2030	Total
Rengstorff Park Aquatic Center - LEED Platinum			0	0	0	0	0	0	0	0	0	0	
Tons CO2 Saved		0	0	23	23	23	23	23	23	23	23	23	**207**
3 Developer Projects - LEED Platinum					3	3	3	3	3	3	3	3	
Tons CO2 Saved		0	0	0	642	642	642	642	642	642	642	642	**5133**
Total Per Year				23	665	665	665	665	665	665	665	665	
												Total CO2 Saved with Developer	**5,340**

The assumption is that there is no cost to the City for additional developers to pursue Platinum over Silver but that there is CO2 savings. Therefore, the total net cost per MT of CO2e becomes $119.

BN6 References

City of Mountain View Council Report, "Adopt Green Building Standard for Public Projects", 2009

City of Mountain View, "Capital Improvement Program," Adopted FY 2017-18, Planned FY 2018-2019 through FY 2021-22

DNV GL study "Economic Benefit-Cost Analysis of Energy Efficiency and Fuel Switching Measures for Commercial Buildings" for Clean Coalition funded by DED's Electric Program Investment Charge (EPIC) program as part of "The EPIC Challenge: Accelerating the Deployment of Advanced Energy Communities." http://www.clean-coalition.org/paec-ee-fuel-switching-reports/

Fowler, Kim; Rauch, Emily; Henderson, Jordan; and Kora, Angela, "Reassessing Green Building Performance: A Post Occupancy Evaluation of 22 GSA Buildings," Pacific Northwest National Laboratory, 2011

Kats, Greg, Leon Alevantis, Adam Berman, Evan Mills, and Jeff Perlman, "The Costs of Financial Benefits of Green Buildings" California's Sustainable Building task force, 2003

King County Green Building Certification Study, 2018 (Study is not yet published, King County employees emailed to Lauren before official release)

Kusiemko, Jeff, "Do LEED Buildings Perform? Indeed They Do!", 2014

Scofield, John, "Efficacy of LEED-certification in reducing energy consumption and greenhouse gas emission for large New York City office buildings" 2013

Turner, Cathy and Mark Frankel, "Energy Performance for LEED for New Construction Buildings," U.S. Green Building Council, 2008

Winters, Dan, "GRESB 2015 Results: Global Real Estate Industry Significantly Reduces Carbon Footprint," 2015

Reduce embodied carbon in building construction and maintenance (**BN4**)	**Policy, Outreach**	**2019-2030**
Recommendation name	Type	Duration

29,000	**$1.9M**	**$300K**	**$76**	●○○	●●○	●●●	●●●	●●○	●○○
MT CO2e reduction 2018-2030	City's Net Cost	Incremental Net Cost	Net cost per MT CO2e reduction	Easy to implement	Easy to measure	Private investment leverage	Local economic benefits	Other environmental benefits	Health benefits

Note: The MT CO2e reduction and resulting net cost are calculated using the CBI method of measurement.

Problem description

Significant progress has been made through appliance standards and building codes[78] to reduce the operational energy use of our built environment. However, much less emphasis has been made to influence the embodied energy and total lifecycle footprint of our buildings. It has been estimated that the construction sector contributes 23% of the global greenhouse gas emissions (GHGe)[79], and the manufacture of cement is estimated to be 5% of global emissions[80].

The "Embodied Energy" of a building is typically defined as the non-renewable energy required in the raw material extraction, processing, manufacture, transport, and construction of a building, also referred to as "cradle-to-gate". These emissions are not currently accounted for in Mountain View's GHG inventory but pose a significant near-term impact on the City's total environmental footprint.

Mountain View has significant new construction planned in upcoming years. The North Bayshore area alone has been zoned to support up to 3.6 million square feet of office space, and 10,000 new multi-family housing units [81] (roughly 5 million square feet). This would be approximately 290,000 MT of carbon emissions from the material extraction through construction phases, not including new construction and remodels in other parts of the city. If spread out over the next ten years, this adds around 5% of Mountain View's annual GHG emissions in 2015.

In addition to the initial embodied energy from new construction, there is also significant impact from the recurring embodied energy from the maintenance and replacement of materials or building systems during the lifetime of the building[82]. Recurring embodied energy can often be equivalent to the initial embodied energy over the lifetime of a building.

---

[78] https://ei.haas.berkeley.edu/events/docs/K.%20Novan.pdf - Residential Building Codes Do Save Energy: Evidence From Hourly Smart-Meter Data Kevin Novan∗, Aaron Smith† and Tianxia Zhou‡ March 3, 2017

[79] Carbon Emissions of Global Construction Sector https://www.sciencedirect.com/science/article/pii/S1364032117309413

[80] http://blogs.ei.columbia.edu/2012/05/09/emissions-from-the-cement-industry/

[81] Mountain View North Bayshore Precise Plan - https://www.mountainview.gov/civicax/filebank/blobdload.aspx?BlobID=24426 - The project proposes to amend the Mountain View 2030 General Plan to allow an increase in residential uses, consistent with the proposed revisions to the Precise Plan.. The proposed residential uses would be in the central portion of the Precise Plan area and would have a 2030 General Plan land use designation of either North Bayshore Mixed- Use or Mixed-Use Center. The existing North Bayshore Residential Uses Boundary would be removed from the General Plan land use map.

[82] Definition of Initial and Recurring Energy:

Recommendation

Mountain View should play a leadership role in tracking and reducing the embodied energy of new construction and renovations through increasing awareness of the embodied energy of buildings through pilot projects and workshops and collaborating with major developers in the city. The City should require LCA reporting as part of new construction in commercial buildings, starting with sites qualifying for Green Building Floor Area Ratio (FAR) Bonuses. We should adopt building codes for building life-cycle performance and encourage reduce, reuse, and recycle of materials and buildings themselves. Lastly, Mountain View should collaborate regionally to increase the value of construction waste and encourage deconstruction and reuse over demolition

SWOT analysis

Strengths: Reduces front-loaded GHG impacts before buildings are even occupied.

- US Green Building Council LEED v4 offers credits for whole building lifecycle assessment; CalGreen, the California green building code, includes an optional lifecycle assessment path
- CA state passed AB262, Buy Clean CA, which requires state contracts to disclose lifecycle emissions of eligible materials starting January 2019.

Weaknesses:

- Lifecycle assessment methodologies (LCA) are complex and can lean heavily on assumption when data is not available. Developers typically do not invest in LCA analysis unless required to.
- Standards for material labeling, for example Environmental Product Declarations (EPD's) are still emerging. It can be difficult to collect reliable information on source materials from suppliers.

Opportunities and co-benefits:

- Marketing / brand benefits to builders and developers for deep green practices
- May identify opportunities for cost savings and improved design practices
- Opportunity to grow market for low-impact products and suppliers and material reuse
- Increasing use of LCA will foster innovation in tools, standards, and databases used
- Increased material and building reuse can reduce construction waste

Threats: Unknown.

Municipalities where already implemented

- Vancouver: a requirement for LCA to be submitted is part of rezoning permit submissions.
- State of CA. passed AB262, "Buy Clean California".
- The Netherlands requires embodied carbon reporting at the building permit stage.
- France offers incentives for voluntarily meeting embodied and net-zero targets.
- Sweden requires lifecycle assessments in large transportation projects
- Belgium, France, Germany, Netherlands have Environmental Product Disclosure databases.

Assumptions and uncertainty A LCA study by University of Washington estimates the initial embodied carbon of commercial buildings to be on average 75 lbs. CO_2e per sq. ft. [83]

Author Emily Chueh

---

https://www.canadianarchitect.com/asf/perspectives_sustainibility/measures_of_sustainablity/measures_of_sustainablity_embodied.htm

[83] https://www.washington.edu/news/2017/04/20/toward-greener-construction-uw-professor-leads-group-setting-benchmarks-for-carbon-across-life-of-buildings/

Detailed analysis

The North Bayshore (NBS) Precise Plan already specifies higher building performance standards for new-construction commercial buildings to qualify for the Green Building FAR Bonus, but also specifies that performance standards be reviewed and revised to reflect advances in green building. The City can build upon this already progressive incentive for NBS commercial green buildings, and push developers towards more transparency and knowledge sharing of green structural and material choices, as well as push for this standard in more buildings throughout the city.[84]

The city can build upon this in stages:

- 2019-2020: **Stakeholder engagement and regional collaboration**
  - Organize stakeholder workshops, bring in external experts such as International Living Future Institute, who administer the Living Building Challenge
  - Collaborate regionally on emerging construction material standards and disclosures
  - County of Marin, City and County of San Francisco have staff researching ordinances to reduce material impacts in new construction and existing buildings[85]
  - Regional organizations include: Stop Waste, Ecological Building Network, EPA Region 9 Deconstruction Working Group
  - West Coast Climate Forum and Materials Management Forum has developed purchasing toolkits for asphalt and cement
  - Collaborate regionally ways to increase material reuse through improving the quality of construction waste materials and tear-downs, and encouraging deconstruction (rather than demolition)
  - Collaborate with innovative developers in Mountain View (Google, LinkedIn, etc.)
  - Identify existing buildings that are the best candidates for deep energy efficiency retrofits and renovations as alternatives to new construction
- by 2021: **Voluntary measures to qualify for developer incentives** for Commercial buildings (for example, increased Floor Area Ratio limits)
  - Submitting an LCA with new construction and major retrofit plans for commercial (collaborate with major developers to encourage transparency and public disclosure to increase public knowledge base and awareness)
  - Meeting LEED v4 life cycle component points
  - Meeting prescriptive measures for material choices (for example if EPD's are available for concrete, setting a threshold)
  - Addressing interior reuse (for example San Francisco's carpet policy)
  - Addressing the Living Buildings Challenge "Red list" for toxins (already in NBS Plan)
- by 2023: **Mandatory policies built into local Green Building Code for all Commercial Buildings**
  - The city to provide educational and consulting services to residential and commercial to influence at design stage
  - Explore the use of “streamlined LCA” tools for both residential and commercial
  - Require LCA submission with new construction and major retrofit plans for buildings above a certain sq. ft.
  - Require meeting updated LEED life cycle component points (refreshed)

[84] The Mountain View North Bayshore Precise Plan Green Buildings FAR Bonus currently requires: LEED Platinum BC+D, 85% construction debris diversion, and FSC certified wood

[85] Conversations with Eden Brukman from San Francisco Department of Environment, and Alice Zanmiller, from County of Marin

Strategies to reduce the embodied energy in buildings include:

- Use of materials with lower embodied energy, including reused and recycled materials both during the initial construction phase, as well as during renovations.
- Better design and more efficient construction practices
- Refurbishment of existing buildings, and extending building lifetimes
    - Meeting prescriptive measures for material choices (refreshed)
    - Consider guidelines and mandates for residential new construction and major retrofits that address material choices
- by 2025: **Set lifecycle reduction goals for new building construction 20% below benchmark**
    - As data is collected, consider setting specific benchmark reduction goals for new construction buildings

Expanded List and of Municipalities addressing Embodied Carbon through Legislation

- The City of Vancouver has adopted a requirement for lifecycle assessments to be submitted as part of rezoning permit submissions as part of their broader Zero Emissions Building Plan[86]
- The State of California passed AB262, "Buy Clean California" in 2017[87]. By 2019, state agencies (CalTrans, the UC's, and CSU's) will set a maximum acceptable Global Warming Potential value for each category of materials in state contracts. The acceptable thresholds will be reviewed and made more aggressive in three-year cycles as industry improvements and eligible materials become available. State contractors will be required to submit Environmental Product Declarations for materials used in fulfillment of contracts. The materials that will be regulated included: steel, rebar, flat glass, and mineral wool board insulation. This shifts purchase decisions away from being purely based on cost and directs funds towards materials manufactured under more stringent standards.[88]
- The State of Oregon Department of Environmental Quality has been researching the benefits and challenges of product-level environmental footprints. Oregon DEQ has developed a tool for Oregon concrete manufacturers to calculate the carbon footprint of their concrete mixes, to support Environmental Product Disclosures (EPD's).[89]
- San Francisco Department of the Environment has adopted a sustainable carpet purchasing requirement for city buildings that set minimum thresholds on recycled content, require cradle to cradle certification, prohibits several known hazardous compounds, and requires the use of carpet tiles for easy replacement and waste reduction. [90]
- San Francisco Department of the Environment collaborated with East Bay regional organization Stop Waste to study strategies to increase the quality and resale value of construction waste materials. The study reviews eleven common recycled-content feedstocks used in building materials in the local Bay Area market. [91]

---

[86] http://vancouver.ca/files/cov/zero-emissions-building-plan.pdf

[87] California AB262 Buy Clean California legislation to require state agencies to set maximum Global Warming Potential thresholds for building materials, and to require Environmental Product Disclosures submissions as part of contract bids - https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201720180AB262

[88] http://www.citywatchla.com/index.php/los-angeles-for-rss/14123-buy-clean-bill-would-swing-climate-change-battle-to-ca-construction-projects

[89] http://www.oregon.gov/deq/mm/Pages/Product-Footprint.aspx and http://www.ocapa.net/oregon-concrete-epds

[90] https://www.sfapproved.org/san-franciscos-new-carpet-regulation-pushing-boundaries-green-products

[91] http://www.stopwaste.org/resource/optimizing-recycled-content-building-materials-2015 - Optimizing Recycling: Criteria for Comparing and Improving Recycled Feedstocks in Building Products - A Collaboration between StopWaste and the Healthy Building Network with support from the San Francisco Department of the Environment - 2015

- City of Portland implemented a deconstruction mandate for single-family homes. Prior to ordinance, there was only one deconstruction firm. After the ordinance, there are now 18. Some of these were already-existing demolition companies that completed the training and received certification, however some are newly formed businesses. [92]
- Berkeley has elements of addressing embodied energy in their Deep Green Buildings Initiative
- The County of Marin and City and County of San Francisco have dedicated staffing researching ordinances for reducing embodied carbon and toxicity in the built environment.

In Europe, several countries have significant voluntary or mandated performance standards for embodied carbon in buildings:

- France offers building labels and incentives for reaching embodied carbon and net zero thresholds. The voluntary program is expected to become mandatory in 2020.
- The Netherlands requires embodied carbon reporting for new residential and commercial projects as part of the permitting process.
- In Germany, lifecycle assessment is required for federal projects, awarding points in comparison to a benchmark. A voluntary program for the private sector works similarly.
- In Sweden, large transportation projects are required to disclose embodied carbon impacts, with incentives for savings below target thresholds.
- In the UK, green building rating programs include lifecycle assessment, and performance targets for embodied carbon have been set for residential buildings. [93]

Environmental analysis

A "Total Carbon Study – Case Study of DPR Construction San Francisco Office Building" by the Ecological Building Network, Integral Group, and Siegel & Strain Architects assumes embodied emissions to be 50 lbs. per square foot for residential buildings, and 75 lbs. CO_2e per square foot for commercial buildings. These assumptions were based on a benchmarking study of the initial embodied carbon of more than 1,000 buildings by the Carbon Leadership Forum, from the University of Washington Department of Architecture. [94]

Mountain View's North Bayshore area is zoned to support 10,000 multi-family units and 3.6 million sq. ft. of commercial development.

To estimate the sq. ft. for the 10,000 multi-family units, it was assumed:

- 70% of the units were 1-bedroom units at average 325 sq. ft. (the Precise Plan states 70% of the units between 300 and 350 sq. ft.)
- 30% of the units will be 2-3-bedroom units (Square footage was not found, so was assumed to be 1,000 sq. ft. per unit
- 10,000 units total * ((70% * 300 sq. ft.) + (30% * 1,000 sq. ft.))
- Roughly 5 million sq. ft. in multi-family new construction

[92] Bay Area Deconstruction Working Group meeting notes, and conversation with EPA Region 9 Timonie Hood

[93] https://www.naturallywood.com/sites/default/files/documents/resources/embodied_carbon_in_construction_and_infrastructure_-_international_policy_review.pdf

[94] Benchmarking data of 75 lbs. per square foot for commercial buildings and https://www.ecobuildnetwork.org/projects/total-carbon-study

Total new construction is estimated to be 8.6 million sq. ft. (3.6 for commercial and 5 million for multi-family). Since the North Bayshore plan for multi-family is high-rise, the embodied energy for commercial buildings was used for both categories of buildings.

Total Initial Embodied Energy Estimation = 8.6 million sq. ft. * 75 lbs. CO2e per sq. ft. embodied energy * (.000453592 metric tons / lbs.) = 290,000 metric tons CO2e

It is estimated that embodied emissions could be reduced by 20-30% using today's technology and available materials. [95]

If building policies are enacted by 2025 to require low-impact material and design choices, a simplistic estimation of scale out would be that this could impact 50% of the new construction footprint.

Total Initial Embodied Energy * 20% (reduction potential) * scale of impact (assuming 50% of buildings) = 290,000 metric tons CO2e * 20% * 50% = 29,000 metric tons savings potential

Time-value of GHG emissions reductions

As new construction buildings become increasingly efficient and approach Zero Net Energy (ZNE), operational energy use impacts of code buildings will decrease. The impacts of embodied energy become then even more important. Given the time-criticality of GHG impacts, the lifecycle impacts of embodied energy in the construction and pre-construction stage have an even more impact on near-term GHG emissions than operational energy use, especially for high-efficiency buildings.

"http://carbonleadershipforum.org/download/1135/ - Time Value of Carbon by Larry Strain

Reducing embodied emissions by 20 - 30%, is feasible right now using readily available materials and current technologies. Reducing material quantities, particularly high volume, heavy materials such as concrete and steel, and high emission materials such as metals and plastics, is particularly effective. Ways to achieve this include designing more efficient structural systems, minimizing waste, more efficient construction processes, and minimizing energy and emission intensive materials such as aluminum and glass curtain walls. Using local, low embodied emission materials can reduce embodied carbon emissions even further. These materials are generally closer to their natural state -- stone, clay, wood, straw – although when they aren't close to the building site, transportation emissions can be a significant impact, which can reduce the efficacy of using these materials. There are also materials that sequester atmospheric carbon - plant based materials, including wood and agricultural bi-products, lock up GHG's that would otherwise be released when the material biodegrades or is burned, and there are emerging technologies for creating cementitious binders and aggregates from CO2e captured from power plants, steel plants and other industrial smokestacks. Materials that sequester carbon theoretically can be used to create carbon neutral or even carbon negative buildings."

LCA tools and certification systems

There are a plethora of tools, standards, and databases for lifecycle analysis, with differing methodologies and scopes, which adds to the complexity. Some certifications, including LEED have included elements of embodied energy and lifecycle impacts, rewarding points for existing building preservation, use of recycled materials, environmental product disclosures, and whole-building lifecycle assessments. However, LEED v4 provides various pathways to achieve certification, and may not be strict and specific enough to address embodied energy impacts.

[95] http://www.carbonleadershipforum.org/2017/02/09/the-time-value-of-carbon/

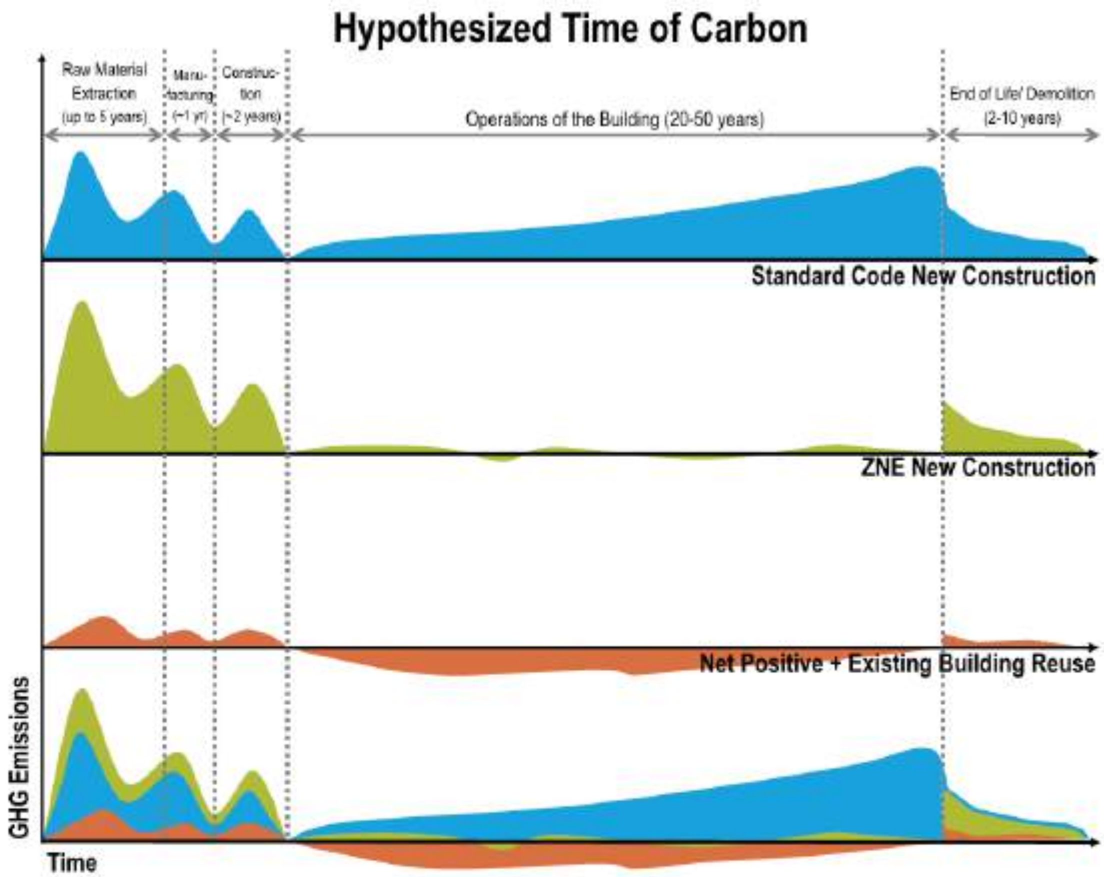
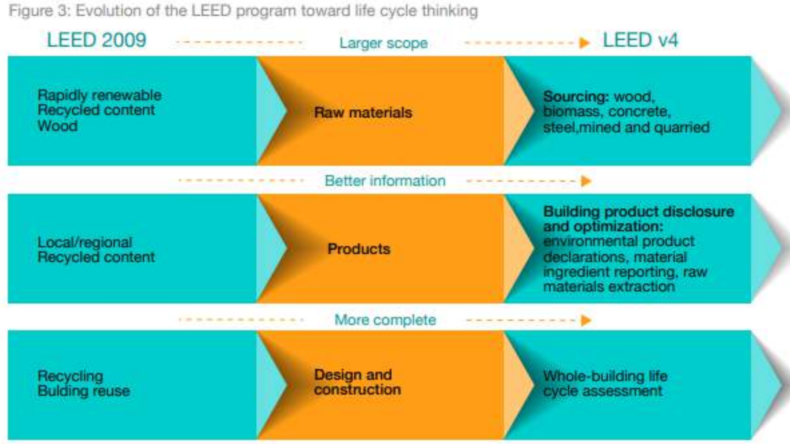


Figure 1. Rough order of magnitude evaluation in the Total GHG emissions released over time (Cradle to Gate) related to buildings - comparing Standard code-compliant new construction, Zero Net Energy (ZNE) new construction, vs. Net Positive existing building reuse. [96]

Table 1: Examples of major instruments currently available on the market

Rating systems	BREEAM, LEED, Living Building Challenges, HQE, EDGE, GRESB, Green Star, WELL Building Standard, DGNB, NZEB, BOMA 360, Green Globes, HERS, National Green Building Standard, BEAM, CASBEE, Pearl Rating System for Estidama, etc.
Standards & Initiatives	AEC Design Transparency, EeBGuide, SBA Common Metrics, the Global Alliance for Buildings and Construction, the Green Building Alliance, CEN/TC 350, Energy Star, Passive House
LCA databases	Quartz Database, Ökobau.dat, INIES, GIGA
Tools	Tally, Athena Impact Estimator, Athena EcoCalculator, ELODIE, EDGE Self-Assessment Tool

Figure 3: Evolution of the LEED program toward life cycle thinking



[97]

[96] https://www.ecobuildnetwork.org/images/pdfs/The_Total_Carbon_Study_FINAL_White_Paper_published_20151113.pdf

[97] World Business Council for Sustainable Development (WBCSD) – The Business Case for the Use of Life Cycle Metrics in Construction and Real Estate

New innovations in "streamlined" lifecycle assessment tools have also been developed make lifecycle assessments more available to a wider audience.

- Athena Impact Estimator
- Tally Environmental Impact Tool estimates embodied environmental impact, is an application that integrates with Autodesk's Revit tool, used by architects and engineers for building modeling.
- MIT has developed a streamlined LCA methodology for residential buildings to estimate embodied carbon to identify key parameters early in the design stage. [98]

Early stakeholder engagement should include evaluations of the various tools available and testing out more light-weight estimation tools that could be used by larger builder, architect, and homeowner community to guide early decision making.

Reducing Waste Increasing the reuse and recycled material content in new construction would have the additional benefit of reducing the construction debris in the waste stream. A waste characterization and recovery potential study by the City of Palo Alto identified that 90% by weight of the C&D waste stream going to Zanker is recyclable.

Figure 18. Material Recoverability, Zanker Delivered Mixed C&D

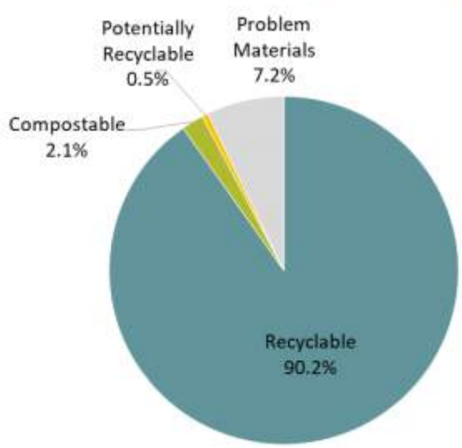


Table 19. Top Six Material Types, Zanker Delivered Mixed C&D

Material	Est. Percent	Est. Tons
Painted Gypsum	33.0%	3,699
Clean Wood	19.9%	2,231
Clean Gypsum	14.1%	1,585
Clean Engineered Wood	11.8%	1,320
Inerts	4.0%	449
Clean, Flattened, Uncoated OCC	3.7%	417
Total	86.5%	9,700

[99]

[98] Streamlined Embodied LCA of Residential Buildings – MIT Concrete Sustainability Hub – Research Brief – Issue 4, 2015 http://cshub.mit.edu/sites/default/files/documents/4%20CSHub%20Research%20Brief%20-%20Iss.%204%202015%20-%20Buildings%20LCA.pdf

[99] https://www.cityofpaloalto.org/civicax/filebank/documents/63577 - City of Palo Alto 2017 waste characterization study

Cost analysis

Cost to the City to research and implement the ordinances:

- 1 FTE (or equivalent consulting support) to engage in regional collaboration, stakeholder engagement, grant writing, ordinance development, conduct outreach from 2019-2030 (estimated at $180,000/year for fully-loaded salary and benefits)
- Funding for stakeholder engagement and training from institutions such as ILFI (International Living Future Institute) to provide stakeholder engagement and educational workshops (roughly $4,000 per workshop, 4 per year). $16,000/year

Total cost from 2019 to 2029 (not scaling for inflation, wage increases, etc..): $1.9 million

Cost to Commercial Developers

Lifecycle assessment costs vary depending on size and complexity of buildings. The City of Vancouver accepts the LEED v4 whole-building lifecycle assessment credit, which allows the use of "streamlined" LCA tools such as Athena Impact Estimator. Based on a conversation from a lifecycle assessment professional in Vancouver, costs for simplified lifecycle analysis is roughly $5,000 for low-rise buildings (six stories or less), and $15,000 for larger buildings (30 stories or higher). [100]

If we assume Mountain View will have 20 new large construction commercial buildings over 100,000 square feet from 2025-2030, at an average cost of $15,000 each, this would have a total developer cost of $300,000 for lifecycle assessment costs.

It is assumed that cost-equivalent choices for low-impact materials will be available within the 2030 timeframe. Researched funded by the European Union has indicated that new kinds of cement, created with low-carbon binders can both reduce carbon impacts as well as lower costs. [101]

Scale analysis

A very simplistic scale-out assumption:

- 20% of the lifecycle impacts could be reduced through cost-equivalent lower impact material and design choices within the 2030 timeframe.
- If building codes are enacted to require lower-impact construction by 2025, this could impact roughly 50% of new commercial construction currently slated for North Bayshore.

[100] Email with Rob Sianchuk, Environmental Lifecycle Assessment Consultant in Vancouver, Canada - May 2018

[101] European Commission – CORDIS – Community Research and Development Information Service https://cordis.europa.eu/article/id/400001-embodied-energy_en.html

Enliven Mountain View with native plants and oak trees **(BT1)**					**Outreach**		**Ongoing**		
Recommendation Name					Type		Duration		
49	**$180K**	**0**	**$3673**	●○○	●●○	●○○	●●○	●●●	●●○
MT CO_2e reduction 2018-2030	City's Net Cost	Incremental Net Cost	Net cost per MT CO2e reduction	Easy to implement	Easy to measure	Private investment leverage	Local economic benefits	Other environmental benefits	Health benefits

Problem description

Mountain View today bears little resemblance to the oak woodlands, oak savannahs, and chaparral that dominated the landscape prior to European settlement. Most of the native forests in what is now Silicon Valley were felled before 1900 to make way for agriculture[1]. With each subsequent wave of urban development, more of the region's ecological history is lost. Incorporating elements of native vegetation into Mountain View's current landscape can, among many other benefits, assist with climate change mitigation and adaptation.

Recommendation

Mountain View should aim to increase the amount of canopy cover and the number of trees in the city, emphasizing native species. Along with the CO2e savings represented by carbon sequestration in the vegetation, this recommendation can further climate adaptation in Mountain View by providing shade, reducing storm runoff, and augmenting wildlife migration corridors. Other ancillary benefits include promoting biking and walking, fostering city pride, and improving the public's connection with nature.

Specific actions to take are as follow:

1. Organize outreach programs to encourage property owners and businesses to plant native species, especially oaks (which used to represent about 80% of all trees in the valley[1]). Work with Canopy, the Wildlife Center of Silicon Valley, Santa Clara Valley Open Space Authority, and others for support and funding. Use the *Re-oaking Silicon Valley* guide from San Francisco Estuary Institute.
2. Build a more resilient landscape and more connected communities by creating sections of native plants and trees on public property. This could be done by replacing a small, select number of street parking spots and by utilizing existing open spaces in Cuesta Park and other city parks.
3. Amend Measures E-1.8 (require the planting of one mature building shade tree to accompany each new single-family residential unit) and Measure CS-1.1 (Expand existing tree planting efforts: plant 4,000 new trees by 2020, and 6,000 by 2030) from the 2012 Greenhouse Gas Reduction Program. They should include a goal of 50% of all the new trees to be native species.
4. Require new developments and major renovations to include landscaping of an area equivalent to 5% of the building's square footage. The city has a goal of increasing canopy cover by 22.7% by 2030, as detailed in the Community Master Tree Plan. This recommendation aims to assist this goal by setting aside extra space for trees. Businesses could accomplish this using green roofs[6]. The city should encourage the use of native species, including oaks where possible.

5. Refer to the forthcoming Santa Clara County Regional Conservation Investment Strategy (SCCRCIS) for municipal buildings and incorporate it into the development approval process. This tool will be an assessment of conservation priorities and would help to consolidate and align efforts for the larger ecosystem. Using the strategies in the SCCRCIS, Mountain View could implement them wherever practical, to help support natural ecosystems.

SWOT analysis

Strengths:

- According to *Re-oaking Silicon Valley*[1], "over 45 years, a coast live oak street tree will sequester more carbon than many other common urban trees including sweetgum, London planetree, and magnolia (the three most common street trees in Silicon Valley."
- Native plants are more resilient to drought and can help cultivate our city character.
- Using new spaces for the natural environment within our built environment can foster innovation and beautification.

Weaknesses:

- Implementing this plan would lead to more encounters between the public and nature, so outreach will need to reflect this as well. For example, acorn woodpeckers can drill into the sides of houses, so netting and other strategies can be used.
- Oaks can take up a lot of space, so they would be best suited for open areas, which is limited.
- Mountain View's current GHG emissions inventory does not include the sequestration effects of trees and plants, so this recommendation makes little impact on the numbers.

Opportunities and co-benefits:

- Trees help mitigate the heat island effect through transpiration and by providing shade. They also reduce storm water management costs and clean the air.
- According to the report *The State of California's Street Trees*[2], "The effect of street trees on property values is the single largest benefit in California"
- People go outside more on shaded streets, which will help the sense of community.

Threats:

- Public may oppose the repurposing of parking spaces.
- Businesses may oppose having to spend more creating and maintaining their landscaping.

Municipalities where already implemented Emphasizing pedestrians, bikers, and street trees: Tempe, Arizona (https://www.downtowntempe.com/_files/docs/6recommendations--implementation-streetscapes.pdf)

Assumptions and uncertainty

Assumptions with High Uncertainty:

- Total carbon sequestration for period 2018-2030

Assumptions with Low Uncertainty:

- Environmental benefits of oak trees

Author Jada Ho

Detailed analysis

Environmental analysis

As Mountain View's population is growing, the amount of available land is decreasing rapidly. Although the city may want to expand the amount of canopy cover and plants, both of which can sequester carbon, there is very little space to build new parks. Repurposing parking spaces would help the city reach its progress indicator (to plant 4,000 trees by 2020 and 6,000 trees by 2030) in Measure CS-1.1. By repurposing parking spaces closer to other oaks, the city would be able to group oaks. Native oaks are a foundation to supporting many other native species. A group of oaks provides more benefits to wildlife, as most species need more than one tree in close proximity.

Many of the trees planted around Mountain View are prone to drought. Native oaks are more resilient, as "they can match their biomass to available resources, literally becoming smaller or larger match trends in conditions" (from *Carbon Sequestration in Oak Woodlands*[3]).

Not all oaks are ideal for urban settings, but the Blue Oak (*Quercus douglasii*) is relatively low-maintenance[4] and has also been approved by the city of Fremont to be planted as a street tree.[5]

Santa Clara County Regional Conservation Investment Strategy (SCCRCIS) is currently in its public commenting period in the California Department of Fish and Wildlife (CDFW) approval process. The Santa Clara Valley Habitat Agency states that "Once approved, entities can use SCCRCIS to guide voluntary investment in conservation actions, including habitat protection, restoration, and enhancement. The program enables project proponents to enter into Mitigation Credit Agreements (MCAs) with CDFW so that the conservation actions can generate mitigation credits that can be used to offset the impacts of public infrastructure, development, and other projects."

Measure CS-1.1 expects to plant 6,000 new trees by 2030, and Mountain View's Master Tree Plan has a very ambitious canopy goal. Because this recommendation aims only to encourage the widespread use of native plants and trees, and since Mountain View already plans to plant more trees, in order to determine the additional metric tons of greenhouse gas emissions sequestered by this recommendation, one would have to determine the amount of greenhouse gases that would be sequestered by non-native plants and subtract that from the amount sequestered by native plants. Each species sequesters carbon at different rates; therefore, quantifying sequestration by non-native and native plants *in general* would be nearly impossible to predict. These greatly simplified calculations provide only the amount of CO_2 sequestered by blue oaks from 2018 to 2030.

Sequestration was calculated for 3,000 blue oaks, which would be half of Mountain View's planned planting of 6,000 new trees by 2030. Since trees sequester different amounts of carbon each year as they mature, these calculations assume that 250 blue oaks would be planted each year for a total of 3000 new blue oaks by 2030. Carbon sequestration rates for blue oaks were taken from the U.S. Department of Energy's "Method for Calculating Carbon Sequestration by Trees in Urban and Suburban Settings" and used to generate the table below (BT1 Appendix 1).

Each row below the year (Row 4 through 15) corresponds to a group of 250 blue oaks planted in a certain year and details the amount of carbon sequestered by that cohort in each year in pounds (lbs.).

Row 17 shows Row 4 as a function of the carbon sequestration rate (in pounds per tree) for each year of maturity, multiplied by a group of 250 oaks.

Row 19 shows the total amount of carbon sequestered in pounds for each year.

Row 20 is the total amount of carbon sequestered in pounds for the period 2019 through 2030.

Row 21 is the total amount of carbon sequestered in metric tons (MT) for the time period 2019 through 2030 (which is the amount of CO_2 savings associated with this recommendation).

This leaves us with an incomplete conclusion for these reasons:

- Not all the native plants and trees will be blue oaks, so the actual CO_2 savings will be different, and potentially lower.
- 49 MT of CO_2 represents the total carbon sequestration of the native trees, not the additional amount resulting from this recommendation. The implementation of this recommendation would lead to a much smaller net impact.
- This calculation also assumes a best-case scenario for all the trees. Sudden oak death and other pests/diseases would cause the actual number amount of carbon sequestered to be lower.

While these assumptions may appear to discourage the idea of planting more trees, they also emphasize that carbon sequestration within Mountain View's city boundaries cannot be a stand-alone solution. Trees have the potential to fight climate change, but they will not be able to keep up with the current rate of emissions, and therefore the city needs continue reducing emissions in major sectors such as transportation and buildings.

Cost analysis

This recommendation needs staff time for outreach. Additional staff time will be needed when the SCCRCIS is published. Some outreach can be outsourced by the city to organizations like Canopy; city staff could instead focus on assisting and partnering with other organizations' current efforts. We estimate that this would require approximately 1-month FTE per year. If one month of staff time costs $15,000, then over 12 years this recommendation would cost $180,000.

CS-1.1 and E-1.8 are already approved, so staff time and costs associated with planting trees was not added on this recommendation.

Scale analysis

This recommendation is following Mountain View's previously set goals of planting 6,000 trees by 2030, as outlined in Measure CS-1.1.

BT1 References

[1]Re-oaking Silicon Valley, San Francisco Estuary Institute-Aquatic Science Center, published August 2017

http://www.sfei.org/sites/default/files/biblio_files/Re-Oaking%20Silicon%20Valley%20SFEI%20August%202017%20med%20res_B.pdf

[2]The State of California's Street Trees, USDA (Dr. E. Gregory McPherson, Dr. Natalie van Doorn, and John de Goede)

https://www.fs.fed.us/psw/topics/urban_forestry/documents/20150422CAStreetTrees.pdf

[3]Carbon Sequestration in Oak Woodlands, UCANR (Tom Scott)

http://ucanr.edu/sites/oak_range/Californias_Rangeland_Oak_Species/Coast_Live_Oak/

[4]Blue Oak, Calscape, California Native Plant Society

http://calscape.org/Quercus-douglasii-(Blue-Oak)

[5]Approved Street Tree List, City of Fremont

https://fremont.gov/DocumentCenter/View/3835/Approved-Street-Trees-List

[6] "Soak up the Rain: Green Roofs." US Environmental Protection Agency. https://www.epa.gov/soakuptherain/soak-rain-green-roofs

Additional resources

How Urban Landscapers Use Native Plants to Create Habitats for Wildlife

http://www.audubon.org/news/how-urban-landscapers-use-native-plants-create-habitats-wildlife

Sustainable Landscape: The Numbers Speak for Themselves

https://www.smgov.net/uploadedFiles/Departments/OSE/Categories/Landscape/garden-garden-2013.pdf

Case study conducted in the City of Santa Monica between traditional landscaping techniques and the use of native plants for landscaping.

Model Native Plant Landscape Ordinance Handbook

https://www.law.ufl.edu/_pdf/academics/centers-clinics/clinics/conservation/resources/model_native_plant.pdf

Shows how a mandate can be enacted by a city for the planting of native plants or trees. Two of the cities that have such a mandate are Scottsdale, AZ and Jacksonville, FL. If a mandate could be established for corporate and commercial development grounds to plant native trees that sequester high levels of CO_2, this may also be feasible in the City of Mountain View despite the lack of undeveloped space.

Why Cities Have to Care About Native Plants: Across the U.S., groups are working to fend off invasive species by helping local ones take root

https://www.citylab.com/life/2016/05/the-case-for-native-plants/480345/

What Is So Great About Native Plants?
https://emswcd.org/native-plants/native-plant-benefits/

Santa Clara Valley Green Gardener Program

http://www.mywatershedwatch.org/residents/green-gardener-program/

There are already residential outreach programs within Santa Clara County. The City of Mountain View could coordinate with Santa Clara County to help implement these programs in Mountain View.

The economics of native plants in residential landscape designs

https://static1.squarespace.com/static/52a213fce4b0a5794c59856f/t/5413523ae4b0fb5c3b4acc6a/1410552378657/HelfandParknassauer06.pdf

Discusses the challenges of installing native gardens and concludes that residents are willing to spend the extra money to install them because they see the benefits for the long run. If the City of Mountain View puts time and effort in an outreach program for instructing residents on the benefits of native plants and trees, then most of the money being spent is going to be done on behalf of the residents, not the City. Creating rebate programs for residents for this purpose would be helpful, though.

BT1 Appendix 1

1 **Given that 3,000 new oaks are planted by 2030 -> 250 new oaks per year**

2												
3	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
4	475	675	875	1075	1525	1775	2025	2275	2550	2800	3075	3375
5		475	675	875	1075	1525	1775	2025	2275	2550	2800	3075
6			475	675	875	1075	1525	1775	2025	2275	2550	2800
7				475	675	875	1075	1525	1775	2025	2275	2550
8					475	675	875	1075	1525	1775	2025	2275
9						475	675	875	1075	1525	1775	2025
10							475	675	875	1075	1525	1775
11								475	675	875	1075	1525
12									475	675	875	1075
13										475	675	875
14											475	675
15												475
16												
17	250*1.9	250*2.7	250*3.5	250*4.3	250*6.1	250*7.1	250*8.1	250*9.1	250*10.2	250*11.2	250*12.3	250*13.5
18												
19	475	1150	2025	3100	4625	6400	8425	10700	13250	16050	19125	22500
20												107825
21												~48.91

CO_2 sequestration each year by trees planted in 2019
CO_2 sequestration each year by trees planted in 2020
CO_2 sequestration each year by trees planted in 2021
so on...

Total # of oak trees (planted from 2019 onwards)

Total amount of carbon sequestered (lbs.) each year
Total amount of carbon sequestered by newly planted oak trees from 2019-2030 (lbs.)
Total amount of carbon sequestered by newly planted oak trees from 2019-2030 (metric tons)

Chapter 4: Circular Economy Recommendations

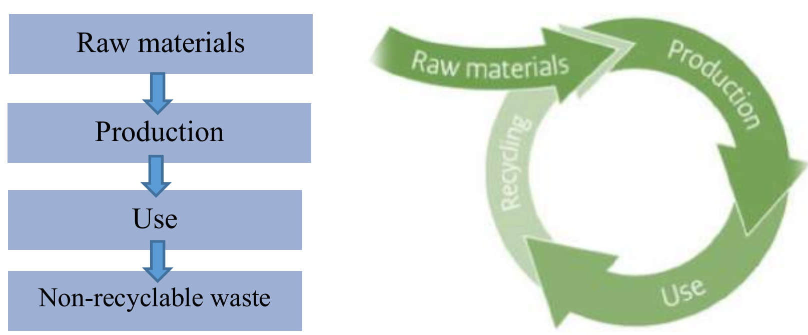
We model an economy as a system of resource inputs, their uses, and their outputs. A traditional economy is linear: “make, use, dispose.” In a circular economy, we keep resources in use for as long as possible, extract the maximum value from them while in use, then recover and regenerate products and materials at the end of their service life. We also measure the impact of a circular economy impact differently than that of a linear economy.

The kinds of GHG emissions that Mountain View measures make up less than half of the emissions that residents and businesses are responsible for. Air travel, the foods we eat, and the many other items we buy and consume all generate substantial emissions in other locations. The consumption-based inventory approach gives equal attention to those non-local sources of emissions. They are harder to measure, but due to their magnitude, they cannot simply be ignored. Consumption-based emissions are also easier for most people to reduce, especially renters. Even better, most of the steps a person can take to reduce consumption-based emissions will also save them a substantial amount of money.

CE Figure 1. Material flow in linear and circular economies.

Linear Economy Circular Economy

.



Although Mountain View is very far from being a circular economy, this economy is in alignment with Mountain View’s sustainability goals:

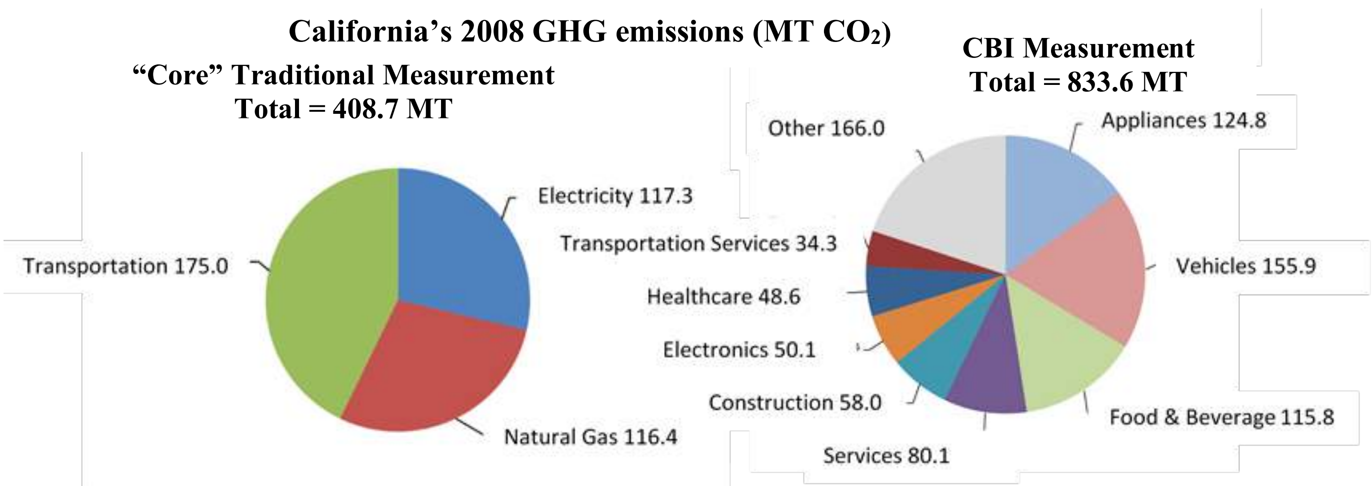
> *“Through the Environmental Sustainability Program, Mountain View envisions ‘a thriving community where residents and businesses actively consider the environmental impact of their daily activities and strive to leave the world better than they found it.’*
>
> *Toward this goal, Mountain View engages with residents, businesses, and municipal staff to collaboratively develop policies and implement programs that reduce carbon emissions and other environmental impacts. Together, the City and community can transform Mountain View into a model of sustainable development in support of a resilient Bay Area. As described in the 1987 United Nations Brundtland Commission Report, sustainable development ‘meets the needs of the present without compromising the ability of future generations to meet their own needs.’”*[102]

Our working group started out with a focus on zero waste as the “Water, Waste, Off-road and Other” category of GHG emissions. As we researched and developed recommendations, we came to realize that zero-waste was only a part of the equation; we need to look at a bigger picture and plan accordingly.

[102] https://www.mountainview.gov/depts/comdev/sustain/default.asp

For a long time, our economy has been "linear". This means that raw materials are used to make a product, and after its use any waste (e.g., packaging) is thrown away. In an economy based on recycling, materials are reused. For example, waste glass is used to make new glass and waste paper is used to make new paper. To ensure that in the future there are enough raw materials for food, shelter, heating and other necessities, our economy become more circular. That means looking at the life-cycle of what we use and measuring GHGs from a life-cycle perspective.[103]

Pending Legislation: AB 2726 (February 15, 2018). The State Air Resources Board is the state agency charged with monitoring and regulating sources of emissions of greenhouse gases. **This bill would require the state board to establish and maintain an inventory of emissions of greenhouse gases on a consumption-based accounting basis.** The Legislature finds that recent studies show that measures of carbon dioxide accounting differ substantially when computed on a consumption basis, which considers emissions of greenhouse gases associated with products consumed within a region rather than on a production basis, giving a more accurate picture of a region's contribution to the emissions of greenhouse gases. We can see from the graph below that the GHG emissions from the CBI are more than twice that of the traditional "core" GHG inventory.



"Think globally, act locally" has been an urgent environmental rallying cry since the 1970s. We feel that the implementation of our recommendations reflects this same holistic view.

Recommendations listed by priority:

W16 Adopt a consumption-based inventory (CBI)

W9 Ban single-use disposable plastic food ware

W12 Encourage sustainable landscaping

W15 Anaerobic digester: waste-to-energy

W1 Collaborate to solve recycling crisis

W2 Adopt "Green Monday"

W5 Implement composting in multi-family units

---

[103] https://www.government.nl/topics/circular-economy/from-a-linear-to-a-circular-economy

Adopt a consumption-based emissions inventory for Mountain View's GHG accounting (**W16**)							**Process**	**Ongoing**	
Recommendation name							Type	Duration	
396,154	$167,400	n/a	$2.36	●●○	●○○	○○○	○○○	●○○	●○○
MT CO2e reduction 2018-2030	City's Net Cost	Incremental Net Cost	Net cost per MT CO2e reduction	Easy to implement	Easy to measure	Private investment leverage	Local economic benefits	Other environmental benefits	Health benefits

Note: The MT CO2e reduction and resulting net cost are calculated using the CBI method of measurement.

Problem description

Every purchase that we make is "embedded" with greenhouse gases. Conventional inventories, such as the one used by the City of Mountain View, assign emissions to geographic regions based on the location of their release. However, a Consumption Based Emissions Inventory (CBI) makes the consumers of goods and services accountable for the emission of greenhouse gases (GHGs) from the production and distribution of those commodities. The economy of Mountain View is highly global due in part to the high-tech presence; this leads to increased consumption of goods, services, and travel activities.

Much of our collective carbon footprint is related to our consumer behavior. In 2009, the U.S. EPA estimated that 42% of domestic emissions were from the provision of goods and food produced nationally. However, we do not capture this with our current measurement process. When CBI is used, a more comprehensive picture of emissions emerges, providing the opportunity to reduce GHGs which are not identified in the standard core measurement system.

Recommendation

There are two methods of analyzing greenhouse gas (GHG) emissions across a community. Each approach offers a different lens through which to see what emissions a city is responsible for and provides a method of determining which areas of focus are most appropriate in establishing policies to minimize these emissions. Mountain View currently uses a core emissions approach, which looks at direct emissions from a geographical perspective. We recommend Mountain View add a second method, consumption-based emissions, which employs a life cycle perspective that includes gases emitted globally due to demand for goods and services generated within city limits.

The consumption-based emissions approach provides a more thorough portrayal of the emissions for which the community is responsible and holds the potential to inspire deeper emissions reductions. Mountain View should begin tracking the consumption-based emissions that are currently outside the scope of the task force. This includes our recommendations W1: Collaborate to build a local resource-conversion processing center; W2: Promote Green Monday; and W9: Ban single-use disposable plastic foodware.

SWOT analysis

Strengths:

Including consumption-based emissions in Mountain View's inventory gives a more accurate measurement of how our actions impact not only our community, but also our planet. Input from the community indicated strong public support for recommendations which are not covered under the core-GHG inventory. CBI emissions help illustrate the strong link between consumption and climate-change and provides a platform for addressing consumption in climate-action planning efforts. Specifically, this method of analysis provides a basis for designing local programs that reduce emissions through targeting carbon-intensive consumption categories and lifecycle phases with the highest emissions. It supports shifts in consumption to those with lower emissions and informing outreach campaigns to change consumer behavior. The use of a CBI can provide a more holistic approach to sustainability in Mountain View. Additionally, getting a picture of the total inventory is useful as we can focus on remediation for the newly-identified waste. Oakland, CA, identified building materials as a large part of their CBI; it is easy to assume that Mountain View would similarly identify building materials and begin to measure the GHGs associated with those materials and how recycling/reuse will reduce their GHG emissions.

Weaknesses:

Most municipal CBIs rely on estimates of consumption, and these estimates are imprecise. They do not typically record actual changes resulting from municipal sustainable consumption initiatives. Also, cities wishing to develop their own CBI may find it difficult to obtain useful data and access to the necessary expertise. This is an area of innovation and is not yet common practice

Opportunities and co-benefits

- **What we buy matters.** In the Portland analysis, consumption of food, goods and services accounted for 53% of all consumption-based emissions.
- **Lifecycle stage is important.** Portland reported that on average, 56% of emissions were from the production of goods and services while 31% come from the use phase.
- **Goods vs. services.** Goods have greater carbon intensity than services per dollar spent, but carbon intensity can vary greatly. CBI can help identify these to enable action plans.

Municipalities where already implemented: CBI is gaining traction among local, regional and state governments such as San Francisco, CA; Portland, OR; Eugene, OR; King County, WA; Oakland, CA; and the State of Oregon. See more details under the section *Environmental analysis*.

Funding sources: Sustainability budget.

Assumptions and uncertainty

Assumptions with High Uncertainty: Although formal research does not yet provide concrete answers on the intersections between social equity and sustainable consumption, several unintended consequences can arise from overlooking equity in sustainable consumption projects or from misunderstanding the intersections that are recognized, especially assumptions relating to financial status. It is also uncertain as to how soon the results of some of our recommendations would be captured (i.e., elimination of single-use plastics will make an impact, but as this is not currently being measured, it may take some time to see the benefits of using CBI).

Assumptions with Low Uncertainty: Both CBI and core emission results are estimates. Both are based on calculations of the average emission intensities of fuels, industry self-reporting on emissions from production, or elaborate systems for approximating the number of vehicle miles traveled and the average fuel efficiency of those vehicles. Since climate change is a global issue that requires solutions on a global scale, CBI allows Mountain View to understand and address how our activities create emissions around the world.

Author Jane Horton

Detailed analysis

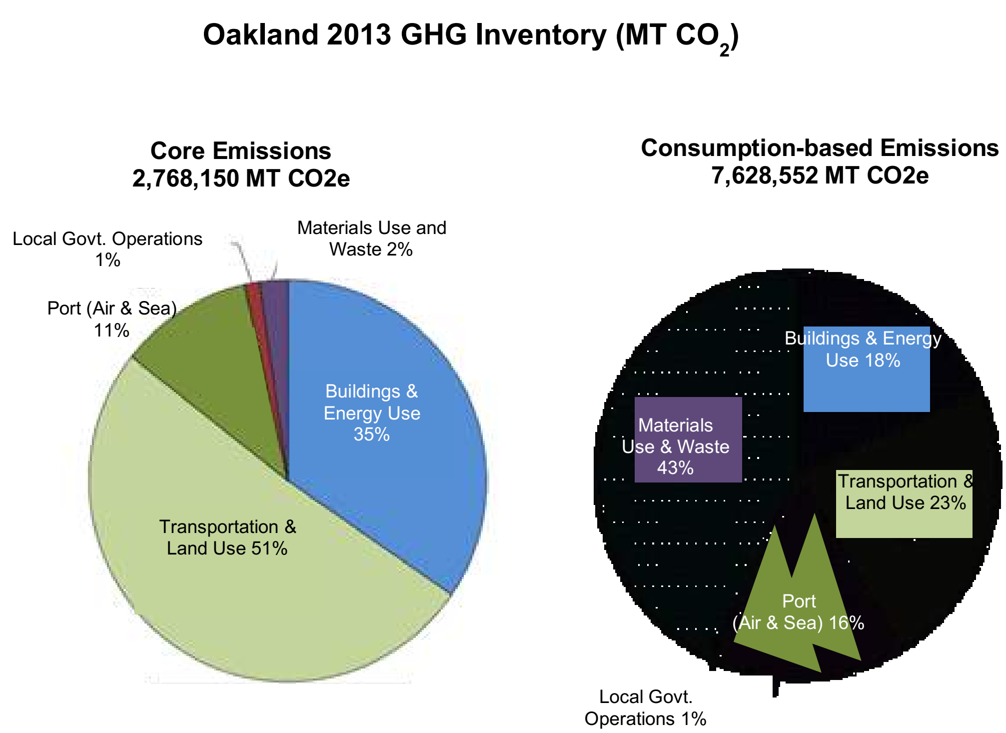
Environmental analysis

The City of Oakland established a solid foundation for climate policymaking by determining where most of the city's emissions come from by using a CBI GHG-emissions inventory. Their first CBI was for data year 2013 (published in report form in 2016). "The 2016 Oakland GHG Emissions Inventory is among the few in the world that have incorporated the consumption of the city's goods and services, including upstream elements of resource extraction, processing, manufacturing, and transportation, as well as downstream impacts from waste management, in their carbon footprint. The city created GHG inventories for the 2005, 2010, and 2013 calendar years with the assistance of academic and NGO partners. By analyzing emissions back to the city's baseline year of 2005, the inventory makes it easy to compare life-cycle impacts over time."[104]

The baseline (2005) emissions associated with Oakland are 2.9 million metric tons when using the core inventory methodology, but 8.9 million metric tons using CBI. Life-cycle emissions account for up to 65% of the total GHG-emissions associated with transportation, buildings, and waste. CBI provides the analysis, quantification, and perspective for city leaders and the public to understand which efforts are the most effective in reducing emissions.

Oakland's approach of analyzing the entire life-cycle of goods and services consumed within its jurisdiction, not just what happens in Oakland, takes a holistic look at this challenge and sets the framework for accurate decision-making of how to reduce its global emissions footprint.

The following charts show the contrasts in measurements between core and CBI. CBI includes many more categories than core; in all instances we see that transportation and energy take up less of the pie when more categories are included.



[104] http://www2.oaklandnet.com/oakca1/groups/pwa/documents/report/oak059097.pdf

The following includes several other cities and the contrast between core and CBI. We can see that CBI added between 50% and 78% emissions to what the core method tracks; the average is 62%.

Community	Total emissions from Core inventory* (MT CO2e)	Total emissions from CBI (MT CO2e)	Difference	%	Avg. %
Portland, OR	7.9 million	15.8 million	7.9	50%	
San Francisco, CA	8.5 million	21.7 million	13.2	61%	
King County, WA	23.4 million	55 million	31.6	57%	
Oakland, CA	2.9 Million (2005)	8.9 million (2005)	7	79%	
*Methodologies and emissions counted may vary by community					62%

If we extrapolate just one year of Mountain View's data, and show a 62% increase, this is how 2020 would look:

Community	Projected 2020 Core Emissions from BAU (MTCO2e)	Projected CBI (62% Increase) (MTCO2e)	Difference	%
Mountain View, CA	649,433	1,045,587	396,154	62%

We do not know exactly what categories the 396,154 MTCO2e estimated increase would come from, but it would certainly include construction materials, air travel, food, and goods. Whatever the source, this CBI will provide a clearer picture of Mountain View's true GHG emissions and associated mitigation opportunities. If we can reduce these newly-tracked emissions by even 5%, that would show a decrease in 2020 of 19,800 MT CO2e. If we average the cost for the ten years to be $16,740 annually, then 2020 would cost about $.85 per MT CO2e.

Many U.S. states conduct GHG inventories to inform their climate change planning efforts. Oregon found that CBI-based emissions were 47% higher than those released in-state. This finding implied that Oregon's contribution to global GHG-emissions were considerably higher than core-based methods suggested. The CBI highlighted the role of goods and services more than core-based methods and opened new opportunities for state and local government partners to reduce GHG emissions. [105]

For example, the International Council for Local Environmental Initiatives (ICLEI) now includes consumption-based accounting in its U.S. protocol for community inventories, and new methodologies are emerging, such as the tools from the CoolClimate Network. [106]

Because our modern economy is highly integrated and global in scale, a significant portion of the goods and services consumed are produced in other states or nations. A CBI is especially relevant for analyzing the GHG footprint of people in affluent regions, such as the San Francisco Bay Area, where the high level of income enjoyed by many households leads to increased consumption of goods and services, as well as more spending on leisure activities such as vacation travel.

Adopting CBI is in alignment with the City of Mountain View's Sustainability Vision[107]: "Through the Environmental Sustainability Program, the City envisions '***a thriving community where residents and***

[105] https://pubs.acs.org/doi/abs/10.1021/es203731e
[106] http://rael.berkeley.edu/old_drupal/node/18
[107] https://www.mountainview.gov/depts/comdev/sustain/default.asp

businesses actively consider the environmental impact of their daily activities and strive to leave the world better than they found it.'

Toward this goal, the City engages with residents, businesses, and municipal staff to collaboratively develop policies and implement programs that reduce carbon emissions and other environmental impacts. Together, the City and community can transform Mountain View into a model of sustainable development in support of a resilient Bay Area. Sustainable development *'meets the needs of the present without compromising the ability of future generations to meet their own needs.'"*

Co-benefits

Significant health benefits can be realized from implementation of a city's CO_2 reduction goals and programs stemming from the inventory, including reductions in other pollutants that adversely affect air quality. Once we have the information about our CBI and the opportunities to further reduce GHGs, the City will be able to use outreach and education to motivate behavior change. For GHGs directly through the City, there can be purchasing changes and outreach to modify habits and behaviors of these GHGs which were not previously tacked.

Cost analysis

Oakland's experience with CBI: The first time was difficult, as staff were building the methodology. In the 2013 Inventory, no one on staff had done CBI, so there was a long learning curve. In addition, they had to re-create 2005 and 2010 inventories in the *ClearPath* software[108] to ensure that the results were comparable. Implementation added 60-75% to their time in the first year. The follow-up was much easier; once they had worksheets and formulas established, the inventory took only 20-25% as much time. They do their CBI in-house, using fellows and interns for most of the analysis.

Oakland's first inventory (2013 data year) was about 1,200 staff hours. The second year was around 400 hours. 2015 was much simpler as they were only doing one data year, and the first inventory was set up with a spreadsheet that auto-populates all formulas and automatically compares results.

Mountain View's projected cost is based on a comparison of population and percentage of time. (Mountain View's population is ~18% of Oakland's). We estimate the time taken to capture CBI in Mountain View would be ~60% of Oakland's original costs; there are now precedents and resources available which were not available when Oakland did their first CBI.

Staff hours to implement CBI	Hourly rate	2020 Costs	2021 Costs	2022 Costs	2023 Costs	2024 Costs	2025 Costs	2026 Costs	2027 Costs	2028 Costs	2029 Costs	2030 Costs	$ Total Costs
720	$90	$70,200											$64,800
240	$90		$23,400										$21,600
100	$90			$9K	$9K	$9K	$9K	$9K	$9K	$9K	$9K	$9K	$81,000

$167,400

References

http://www2.oaklandnet.com/oakca1/groups/pwa/documents/report/oak059097.pdf

https://sfenvironment.org/sites/default/files/fliers/files/sf_consumption_based_emissions_inventory.pdf

https://sfenvironment.org/carbon-footprint

http://www.baaqmd.gov/research-and-data/emission-inventory/consumption-based-ghg-emissions-inventory

https://www.sei-international.org/mediamanager/documents/Publications/Climate/sei-wp-2012-05-reducing-ghgs-consumption.pdf

[108] http://icleiusa.org/clearpath/

Adopt a citywide ban on single-use disposable plastic foodware **(W9)**							**Ordinance**	**Perman-ent**	
Recommendation name							Type	Duration	
22,500	**$213k**	**Unknown**	**Unknown**	●●○	○○○	○○○	●○○	●●●	●○○
MT CO2e reduction 2018-2030	City's Net Cost	Incremental Net Cost	Net cost per MT CO2e reduction	Easy to implement	Easy to measure	Private investment leverage	Local economic benefits	Other environ-mental benefits	Health benefits

Note: MT CO2e reduction is calculated using consumption-based inventory methods.

Problem description

Plastic pollution and climate change are parallel global emergencies. For our society to move away from a reliance on fossil fuels and reduce the greenhouse gas (GHG) emissions associated with them, we must also reduce our production and consumption of plastic products. Market research shows that use of single-use disposable plastic items is increasing. These convenience items all generate GHGs during production, manufacture, transport and ultimately disposal; millions of tons of plastic are now contaminating our oceans and threatening wildlife.

The City of Mountain View has already demonstrated its commitment to responsible waste management with the production of a new Draft Zero Waste Policy in 2018, which directs the city's efforts to "principles of life-cycle analysis…focusing our attention on more than just recyclability" and commits to "reduce the proliferation of plastic food service ware and packaging in daily commerce." We recommend embracing this policy to create a plastic-free Mountain View where alternative, sustainable options are available, and everyone can make conscious choices over their plastic consumption.

Recommendation

The City of Mountain View should implement an ordinance prohibiting the sale and distribution of single-use disposable plastic foodware in all retail food establishments where food is sold to go.

Items that would no longer be used in the City of Mountain View include: Disposable plastic straws (alternatives available on request); **disposable plastic stir sticks; disposable plastic utensils; disposable plastic cups (hot and cold); disposable plastic to-go food containers.**

This ordinance will apply to restaurants, grocery stores, farmers' markets, food trucks, special events and any other business or event where food is sold to go.

SWOT analysis

Strengths: This recommendation supports policy Item 6 of the City of Mountain View Draft Zero Waste Plan 2018 which requires the city to "reduce the proliferation of plastic food service ware and packaging in daily commerce, to the extent practicable." It will also reduce fossil fuels used in the production and transportation of plastic products, and it will reduce waste going to landfill, which is a source of CH_4 GHG production. Furthermore, it will reduce plastic waste contaminating marine habitats.

Weaknesses: It is essential to consider people who rely on straws and pre-packaged food. Straws are a successful example of assistive technology for millions of people with diverse abilities. Removing some of these products, particularly ubiquitous straws, may disproportionately affect these members of our community. It is necessary that alternatives are provided to ensure this need is met.

A large part of the carbon footprint associated with the consumption of single-use plastic items is not captured in the current City of Mountain View GHG inventory. Only GHGs associated with plastic waste disposal are captured at present; therefore, a large portion of the GHG reductions achieved through the implementation of this recommendation will not be reflected in the current inventory. However, it is important to note that should Mountain View begin measuring GHG's using a consumption-based emissions inventory where the entire life-cycle of goods and services is considered, the measurable impact of this recommendation would increase.

Opportunities and co-benefits: Mountain View can show it is a progressive global environmental leader. Decreased litter in our community protects wildlife. Involving some of the larger employers in Mountain View could provide a valuable opportunity to demonstrate a consciousness shift away from the use of single-use plastic foodware and develop important relationships for education and outreach to the service population of Mountain View. There would be an opportunity to work with local or start-up manufacturers/retailers of certified biodegradable products.

Threats: Possible resistance from local businesses. It is not the intention of this recommendation to put any financial or other strain on local businesses, therefore, thoughtful consideration of all stakeholders is essential.

Municipalities where already implemented

Plastic pollution is a topic of growing interest, and the movement to reduce plastic consumption is gaining momentum. See W9 Appendix 1 for US and worldwide examples of similar single-use plastic restrictions.

Funding sources

Rethinkdisposable.org, created and implemented by the Clean Water Fund, offers partnership opportunities and is currently engaging with food businesses, institutions, and consumers throughout California to help them reduce disposable takeout food and beverage packaging at the source to reduce waste and save money. They are already working with local jurisdictions including the City of Sunnyvale, City of Cupertino, City of San Jose, San Mateo County, and City of San Francisco. This would be an ideal partnership for the City of Mountain View.

Enforcement should be strongly considered. Penalties for non-compliance should be issued as a last resort; however, monies collected through fines could be used to fund continuing education and outreach to businesses and institutions helping them transition to more sustainable alternatives. As an example, San Francisco currently issues fines of up to $500 for non-compliance with recycling and composting ordinances.

Assumptions and uncertainty

Assumptions with High Uncertainty: Life Cycle Analysis (LCA) studies of food service ware including greenhouse gas metrics are limited and variable in quality.

The numbers of single-use plastic items consumed in Mountain View can only be estimated using high-level information.

Reducing plastic consumption will reduce global GHG emissions.

Assumptions with Low Uncertainty: None.

Author

Heather Lamont

Detailed analysis

Environmental analysis

Environmental concerns

Plastic is made from petroleum, a non-renewable resource, and the large majority (91%) of plastic worldwide is not recycled[109]. Instead, it ends up in landfills or as litter in the environment. In the United States alone, 500 million disposable plastic straws are used every day. Laid end to end, this would wrap around the circumference of the earth two-and-a-half times and is enough to fill 127 school buses every single day. 50 billion paper coffee cups are used each year in the US. Most paper cups contain an internal plastic coating which renders them unsuitable for recycling, and they end up in landfill. Not only do these disposable products consume energy, generate GHG emissions, and take up space in landfills, they pose serious risks to wildlife (especially marine life) if not properly disposed of.

Bioplastics and PLA

Bioplastics and bio-based plastics are made from renewable feed stocks (biomass), like the leftover pulp from harvesting sugarcane. However, this feedstock does not determine its compostability or biodegradability; the molecular structure does. Therefore, using the word "bioplastic" does not tell you anything about its performance in the environment nor its recyclability.

Bio-based plastics are produced from monomers derived from biomass, such as fermenting plant carbohydrates into ethylene, which can then be polymerized into polyethylene (PE). PET, the plastic polymer commonly used for water bottles, is made the same way. Although nearly all PET water bottles are made from fossil fuel-derived plastic, PET can also be made from biomass, and is called bio-PET. Bio-PET, bio-PP, or bio-PE are no different than PET, PP or PE; the feedstock is just from a different origin. Importantly, none of them are compostable or biodegradable.

Bio-derived plastic is a mixture of plastics derived from both feedstocks, modern plants and fossil fuels. Having some of the feedstock come from modern plants allows companies to advertise with words like "green" and "natural". One example is the "Plant Bottle", a product from Coca Cola. Derived from up to 30% plant material and 70% or more other feedstocks, it is still 100% polyethylene. While the plant bottle is recyclable, it is not biodegradable or compostable.

Biopolymers, the truly biodegradable plastics, are made from a natural substance, such as chitin or cellulose, polylactic acid (PLA) made from plants, or the polymer polyhydroxyalkanoate (PHA), which is naturally produced by bacteria. PHA and PLA are the most common commercially used bioplastics for consumer goods. But these biopolymers, while considered compostable, are only designed to be composted in industrial compost facilities.

So, which ones are biodegradable or compostable? Bio-based and bio-derived plastics are neither, so they need to enter the recycling stream, and they must be labeled in a way that doesn't mislead the public.

[109] https://news.nationalgeographic.com/2017/07/plastic-produced-recycling-waste-ocean-trash-debris-environment/

When we talk about biodegradation, we mean that the polymer can be naturally broken down into smaller molecules (such as CO_2, CH_4, and H_2O) by microbial digestion. Biopolymers like PHA and PLA are biodegradable but have very specific conditions where degradation happens. These conditions are not found in soil, home compost bins. or the marine environment; rather, they must be broken down in an industrial compost facility. Therefore, appropriate labeling of waste collection bins and public education and outreach is essential to ensure correct disposal.

GHG Calculations

	CO2MTe	2020	2025	2030	TOTAL
Initial implementation cost		$40,000.00			
Annual cost			$17,280.00	$17,280.00	
Total cost 2020-2030					$212,800.00
Resident population (BAU)		83,391	90,725	98,995	
Worker populations (BAU)		100,280	109,098	122,713	
Worker pop + (Residential pop/2)		141,976	154,461	172,211	
Hot cup 16oz (no. used daily)	0.000044	59629.7	64873.4	72328.4	
Cold cup 32oz (no.used daily)	0.00007	20282.2	22065.8	24601.5	
Clamshell (no. used daily)	0.000024	20282.2	22065.8	24601.5	
Plastic straw (no.used daily)	0.0000027	217222.5	236324.6	263482.1	
Hot cup CO2MTe/per day		2.6	2.9	3.2	
Cold cup CO2MTe/day		1.4	1.5	1.7	
Clamshell CO2MTe/day		0.5	0.5	0.6	
Plastic straw CO2MTe/day		0.6	0.6	0.7	
Hot cup CO2MTe/per year		957.7	1041.9	1161.6	
Cold cup CO2MTe/per year		518.2	563.8	628.6	
Clamshell CO2MTe/year		177.7	193.3	215.5	
Plastic straw CO2MTe/year		214.1	232.9	259.7	
Total CO2MTe/yr for all four		1867.6	2031.8	2265.3	
Total CO2MTe/yr 2020-2030					22500.0
Assumptions:					
1. Avg 0.42 coffee cups / person-day (greenfuture.io/amp/recycling/coffee-cup/)					
2. Estimate 1 cold cup per person per week (Task Force best estimate)					
3. Estimate 1 clamshell per person per week (Task Force best estimate)					
4. 2015 US avg 1.53 straws / person-day (www.ecocycle.org/bestrawfree/faqs)					

GHG calculation breakdown

Carbon footprint of a 16 oz. low-density polyethylene (LDPE) coated paperboard hot cup was calculated at 987 lb. CO^2 eq per 10,000 average weight cups (converted to 0.44 MTCO2e per 10,000 cups). This calculation accounted for CO2e contributions related to process emissions, fuel-related emissions, and end-of-life management of foodservice products (Franklin Associates, 2011).

Carbon footprint of a 32 oz. LDPE-coated paperboard cold cup was calculated at 1555 lb. CO2e per 10,000 average weight cups (converted to 0.70 MTCO2e per 10,000 cups) This calculation accounted for CO2e contributions related to process emissions, fuel-related emissions, and end-of-life management of foodservice products (Franklin Associates, 2011).

Carbon footprint of a sandwich sized general purpose polystyrene (GPPS) foam clamshell take-out container was calculated at 529 lb. CO2e per 10,000 average weight clamshells (converted to 0.24 $MTCO^2e$ per 10,000 clamshells). This calculation accounted for CO2e contributions related to process emissions, fuel-related emissions, and end-of-life management of foodservice products (Franklin Associates, 2011).

Carbon footprint of 1 kg of polypropylene (PP) plastic straws was calculated at 4.06 kg CO2e (converted to 0.0041 MTCO2e). This was calculated using a LCA technique and included manufacturing and transport of raw materials, straw manufacture, transportation to customer and final disposal via landfill or incineration (Boonniteewanich et al, 2014). An average plastic straw weighs 0.65g.

Calculation examples -

2015 worker population of MV: 89,125

2015 resident population: 77,250

38,625 (half of resident population) + 89,125 (worker population) = 127,750

500 million straws used in US per day

US population is 325.7 million

1.53 straws per person per day (US average)

127,750 * 1.53 straws = 195,457.5 straws per day in MV (2015)

50 billion coffee cups used in US per year

136,986,301 coffee cups per day

US population 325.7 million

0.42 coffee cups per person per day (US average)

127,750 * 0.42 cups = 53,655 cups per day in MV (2015)

Health concerns associated with plastic foodware and microplastics

Plasticizers with estrogenic activity, such as bisphenol A (BPA), have been reported to have potential adverse health effects in humans, including reproductive endocrine disorders and neurobehavioral problems (Mesnage et al., 2017). BPA is one of the best-studied endocrine disrupting chemicals (EDCs), with more than 75 out of 91 published studies showing associations between BPA exposure and adverse human health effects as of May 2013. The replacement of BPA with other organic compounds, for example Bisphenol S (BPS), has grown in the wake of environmental and health concern surrounding BPA, but new research suggests Bisphenol S may not be any safer.

Concerns over microplastic contamination in plastic bottled water have also recently been widely publicized in the media during 2018. Research undertaken at Freedonia State University of New York tested 259 individual bottles of water across 11 brands and found 93% of bottled water showed some sign of microplastic contamination (Mason, S.A., Welch, V. and Neratko, J). Although the research has not yet been through scientific peer review, it has raised enough questions and concerns that the World Health Organization has announced a review into the potential risks of plastic in drinking water.

Alternatives to single-use plastic

While recycling and composting are preferred to landfill, the most sustainable alternative to single-use items is a reusable item. Research has shown that through improvements in dishwashing energy efficiency and changes in the electrical grid, such as Silicon Valley Clean Energy, reusable cups now have lower environmental impacts than disposable cups (Clean Water Fund/ReThink Disposable). Studies have shown that washing reusable water containers (glasses and bottles) has a far lower potential global warming impact than recycling single-use water bottles, concluding reuse is far superior to recycling.

The most sustainable alternative to a single-use plastic straw is simply not to use a straw. However, for those who do wish to use a straw, biodegradable paper straws are a simple alternative. There are also several reusable options now available, such as metal, silicone, glass and bamboo. Why not switch to compostable plastic straws? While compostable plastic straws are good in theory, they can be disposed of incorrectly by individuals when there is a lack of information on public composting practices. Compostable plastic straws are no better than regular plastic straws when they get into the marine environment. They are designed to break down in compost facility conditions, not sea water. That is why we recommend switching to paper straws or reusable, not compostable plastic straws.

As discussed in the section above regarding Bioplastics and PLA, not all products that are advertised as biodegradable and compostable actually break down in a standard composting facility. Therefore, it is recommended that in situations where a reusable item cannot be used, the next best alternative is a compostable product that has been certified by the Biodegradable Products Institute (http://products.bpiworld.org/).

Existing Mountain View ordinance banning polystyrene food service ware

Expanded polystyrene foam (EPS) is a form of plastic that has been identified as a distinctive litter concern because it crumbles easily into small pieces, is lightweight, and is easily windblown into streets and waterways that flow into the bay and eventually the ocean. It is difficult for street sweepers and cleanup volunteers to collect. The particles are mistakenly ingested by birds, fish, and wildlife, causing reduced food consumption and impaired digestion. Urban runoff pollutants attach to the particles and, if ingested by wildlife, can cause reproductive failure, disease, or death. Effective 1st July 2014, the City of Mountain View adopted an ordinance that prohibits food providers from dispensing food and beverages prepared on the premises for “dine-in” or “take-out” to customers using polystyrene “foam” food service ware. This ordinance has generally been considered successful and not overly burdensome to retailers; lessons could be learned from its implementation.

Public consultation and outreach to local business and employers

Support for this recommendation was overwhelmingly positive during public information events. Discussions with employers and local restaurants in Mountain View provided important insight which has been incorporated into this report. The most significant concern was increased cost, and this will need to be addressed through extensive outreach and thoughtful stakeholder engagement and by ensuring sustainable alternatives to single-use plastic products be sourced at comparable prices. Many local businesses are already moving towards compostable products, and this behavior change is gaining momentum. Ensuring the infrastructure is in place to cope with an increase in compostable material will be important, as will public education to ensure correct disposal receptacles are used.

Suggestions were also made for a city grant or reimbursement to encourage business participation in a pilot study and a program of external recognition such as a "straw-free" or "green business" award.

Cost analysis

Implementation Cost

The cost to the City to implement this Ordinance is estimated to be in the region of $40,000 with an ongoing cost of $17,280 per annum.

During the planning and implementation of their "Sustainability Ordinance," Santa Cruz County utilized a local non-profit to undertake outreach at a cost of $10,500 and estimated staff costs at $7,500 (total cost $18,000). For the purposes of this exercise, a conservative estimate of $40,000 has been used to cover this initial implementation, with the most significant portion of that money expected to go towards stakeholder engagement.

Providing extensive support and education to local businesses throughout the introduction and implementation of this Ordinance will be vital to its success. (For example, a list of alternatives to plastic straws can be found at the following website: https://thelastplasticstraw.org/resources/.) Including local stakeholders at the earliest stage of the process is recommended. This outreach will involve an initial cost (included above) followed by a continuing staff cost to ensure best practice is being used as technology and products advance (estimated at $17,280/year based on two staff days per month).

Incremental Cost

There will likely also be an initial cost to businesses associated with changing suppliers and purchasing new products; however, this may be offset by a reduced ongoing waste disposal cost. The table below gives a brief cost comparison of some readily available compostable alternatives and single-use disposable plastic/plastic lined paper items. This comparison shows that the compostable alternatives do cost more; however, it is envisaged that with extensive outreach and collaboration between the city, local stakeholders, and suppliers, cost-efficient and sustainable supply chains can be established.

	Compostable products				Single-use plastic
	PLA*	Bagasse*	"Ingeo" renewable, plant-based biopolymer*	"World Centric" certified compostable**	Plastic/ Plastic lined paper**
Cold Cup (16oz)	-	-	$0.14	$0.09	$0.07
Hot Cup (12oz)	-	-	$0.11	$0.07	$0.05
Straws (single)	-	-	$0.01	-	$0.004
Clamshell (6x6x3")	$0.28	$0.19	-	$0.09	$0.08

* http://biomasspackagingstore.com/

** https://www.costcobusinessdelivery.com/food-service-disposables.html

Scale analysis

Although a citywide implementation of this ordinance is the preferred option, undertaking a preliminary 6-month pilot involving 10-20 local restaurants and businesses would provide useful feedback and allow any initial concerns and issues to be addressed prior to complete roll-out. A pilot would allow testing of available products to ensure they work for both the consumer and the business, allow opportunity for innovation, and provide case studies for successful implementation.

The examples listed above show that this type of initiative can be implemented on any scale, from an individual business to an entire country.

W9 References

Boonniteewanich, J., Pitivut, S., Tongjoy, S., Lapnonkawowa, S. and Suttiruengwong, S. (2014) Evaluation of carbon footprint of bioplastic straw compared to petroleum based straw products. Energy Procedia, Vol.56, pp518-524.

Better Alternatives Now. B.A.N List 2.0. 5 Gyres (November 2017). https://static1.squarespace.com/static/5522e85be4b0b65a7c78ac96/t/5acbd346562fa79982b268fc/1523307375028/5Gyres_BANlist2.pdf

Dormer, A., Finn, D.P., Ward, P., and Cullen, J. (2013) Carbon footprint analysis in plastics manufacturing. Journal of Cleaner Production, Vol.51, pp133-141.

Franklin Associates (2011). Life cycle inventory of foam polystyrene, paper-based, and PLA foodservice products (Prepared for the Plastic Foodservice Packaging Group) https://plasticfoodservicefacts.com/Life-Cycle-Inventory-Foodservice-Products

San Francisco Bay Area National Parks Science and Learning http://www.sfnps.org/aquatic_life

https://www.cleanwater.org/campaign/rethink-disposable

Literature Review and Inventory. Greenhouse Gas Impacts of Disposable vs Reusable Foodservice Products. January 2017. Clean Water Fund/ReThink Disposable.

Mesnage, R., Phedonos, A., Arno, M., Balu, S., Corton, J.C and Antoniou, M.N. (2016) Transcriptome Profiling Reveals Bisphenol A Alternatives Activate Estrogen Receptor Alpha in Human Breast Cancer Cells. Toxicological Sciences, Volume 158, Issue 2, pp431–443. https://doi.org/10.1093/toxsci/kfx101

Harnato, M. (2013). A Comparative Life Cycle Assessment of Compostable and Reusable Takeout Clamshells at the University of California, Berkeley

Mason, S.A., Welch, V. and Neratko, J. Synthetic polymer contamination in bottled water. State University of New York at Fredonia. https://orbmedia.org/sites/default/files/FinalBottledWaterReport.pdf

https://www.upi.com/Science_News/2016/08/09/Study-Plastic-chemical-BPS-damages-egg-cells/3961470772115/

http://www.seattle.gov/util/forbusinesses/solidwaste/foodyardbusinesses/commercial/foodpackagingrequirements/

http://www.uigi.com/co2_quantity_convert.html Used for CO^2 data conversion

Advocacy websites for further reading: https://www.strawlessocean.org; http://surfrider.org; http://rethinkdisposable.org; http://thelastplasticstraw; http://saveourshores.org; http://www.plasticpollutioncoalition.org; https://www.cawrecycles.org; and www.strawfree.org.

W9 Appendix 1. Municipalities where already implemented

USA

Berkeley, CA. In April 2018 Major Jesse Arreguín announced "Disposable-Free Dining", new legislation which would require that Berkeley restaurants use reusable dishes and takeout food are from a pre-approved list of recyclables.

Carmel-by-the-sea, CA. Phased ordinance implemented. By April 22, 2018, all disposable food service ware provided to customers by restaurants and food vendors shall be biodegradable/compostable, or recyclable.

Davis, CA. Environmentally Acceptable Food Packaging Ordinance and Beverage Straw Ordinance (Straw on Request) passed and will be implemented September 1, 2018.

Malibu, CA. Plastic straws, utensils and stirrers banned from June 1, 2018.

Manhattan Beach, CA. Polystyrene Ordinance and "Bring your Own" Campaign implemented 2014.

San Francisco, CA. Environment Code - Food Service and Packaging Waste Reduction Ordinance implemented Jan 1, 2017.

Santa Cruz County, CA. Sustainability Ordinance which bans all single-use plastic foodware implemented Jan 1, 2017.

San Luis Obispo, CA. Straws Upon Request Ordinance implemented March 1, 2018.

Seattle, WA. Plastic straws and single-use plastic utensils banned from July 1, 2018.

Worldwide

BBC. The British Broadcasting Association has announced a three-step plan to remove single-use plastic from their operations by 2020. It is estimated that BBC staff and visitors use 2 Million plastic cups/year.

Costa Rica. Nationwide ban all single-use plastics (straws, bottles, cutlery, cups and bags) by 2021.

France. Nationwide ban on plastic plates, cups and utensils by 2020.

McDonalds. The international fast food giant announced they are phasing out plastic straws starting with a pilot in 1,300 locations in the UK offering straws only on request and introducing paper straws in May 2018.

Taiwan. Single-use plastic items to be phased out by 2030 starting with plastic straws and plastic bags which will be banned by 2019 and disposable food containers and utensils banned by 2020.

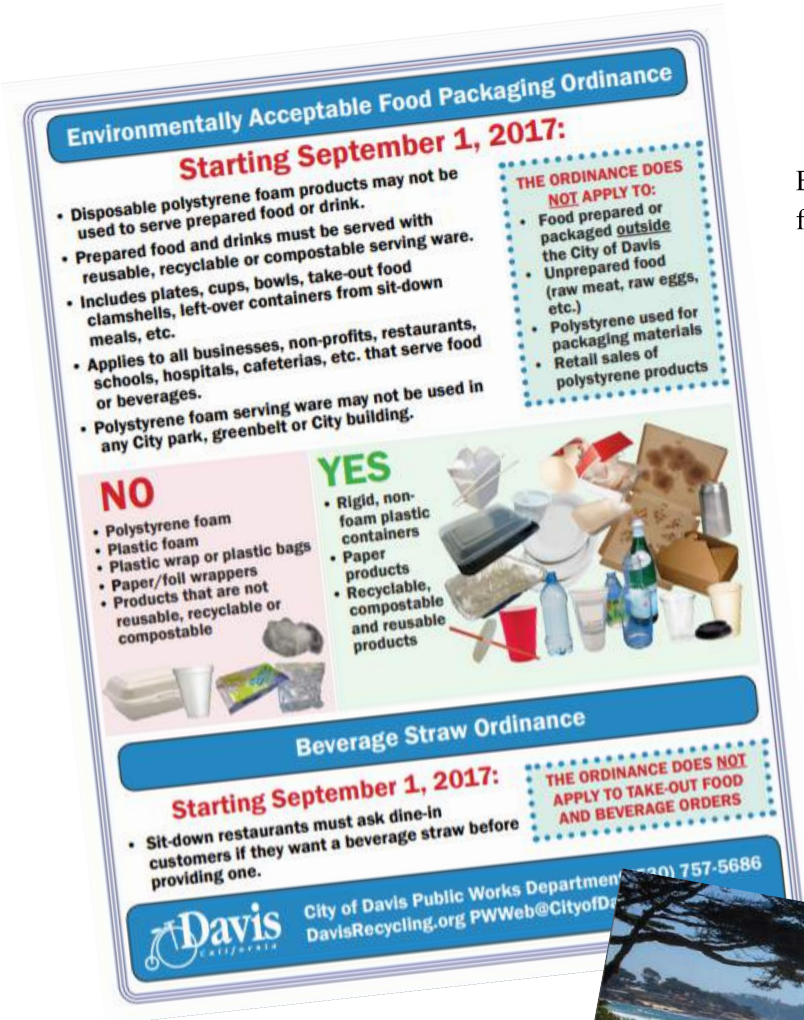
Scotland. Nationwide ban on plastic straws by the end of 2019.

South African food chain Ocean Basket. Nationwide ban on plastic straws in 168 restaurants from 2018.

2018 Hong Kong Rugby Sevens tournament "Green Sevens" campaign provided straws on request and replaced plastic straws with paper straws (in conjunction with non-profit The Last Straw)

Breakdown of specific plastic items included in municipalities listed in W9 Appendix 1.

	Straws	Utensils	Stirrers	Cups	Clamshells/ to-go containers	Plates
Berkeley, CA	x	x	x	x	x	
Carmel-by-the-Sea, CA	x	x	x	x	x	
Davis, CA	x			x	x	x
Malibu, CA	x	x	x			
Manhattan Beach, CA	x	x	x			
San Francisco, CA	x	x	x	x	x	x
Santa Cruz County, CA	x	x	x	x	x	
San Luis Obispo, CA	x					
Seattle, WA	x	x				
BBC		x		x	x	
Costa Rica	x	x		x		
France		x		x		x
McDonalds (UK pilot)	x					
Taiwan	x	x			x	
Scotland	x					
Ocean Basket, SA	x					



Example of outreach information from Davis, California

Example of business outreach by Carmel-by-the-Sea, California

Implement a sustainable landscaping program in Mountain View **(W12)**						**Voluntary & mandatory (2023)**		**12 years**	
Recommendation name						Recommendation type		Duration	
5,770	**$307K**	**$173K**	**$160**	●○○	●●○	●○○	●○○	●●●	●●●
MT CO2e reduction 2018-2030	City's Net Cost (1000's)	Incremental Net Cost	Net cost per MT CO2e reduction	Easy to implement	Easy to measure	Private investment leverage	Local economic benefits	Other environment al benefits	Health benefits

Problem description

Lawn care currently creates local pollution with inefficient two-stroke gas engine equipment, including mowers, blowers, trimmers and chain saws. This pollution includes CO_2, ROG (Reactive Organic Gases), NOx (nitrogen oxides that are most relevant for air pollution), and particulate matter, as well as significant noise pollution (13).

According to Edmonds Research, "A consumer-grade leaf blower emits more pollutants than a 6,200-pound 2011 Ford F-150." The two-stoke blower generates 23 times more carbon monoxide and nearly 300 times more non-methane hydrocarbons than the truck (1, 22). According to Michael Benjamin at the California Air Resources Board, "In just three years' time, the biggest single ozone polluter in the state is going to be all this gardening equipment" (2).

Recommendation

Encourage sustainable landscaping through an Integrated Sustainable Landscaping Program and lead by example with city operations.

- **Lawn replacement** - encourage lawn replacement or reduction by leveraging existing sustainable landscape workshops and incentive programs when available.
- **Sustainable landscape care** - encourage composting to reduce fertilizers and encourage the use of Integrated Pest Management to reduce pesticides (leveraging existing programs).
- **Electrification of landscape and garden equipment** – provide outreach to home owners, high-tech business and landscape professionals to encourage transition to electric or manual tools. Work with regional partners such as Bay Area Air Quality Management Board (BAAQMD) and suppliers to create a group-buy or trade-in program with a focus on leaf blowers and mowers. In addition, the city should maintain a list of sustainable landscape care companies.

Develop and execute a plan to transition Mountain View City landscape equipment to electric equipment by 2030. Require city contractors to comply.

Work toward a ban on gas-powered leaf blowers for implementation in 2023 and evaluate a potential ban on gas-powered mowers for implementation in 2025.

SWOT analysis

Strengths:

- Reduces GHG emissions and other significant pollutants locally, including noise pollution as well as reducing water consumption.

- Sustainable landscape care and lawn replacement programs leverage existing city and county programs. Mountain View supports South Bay Green Gardens which provides workshops around the South Bay (17). See other leveraged programs (23,24).
- Electric landscape equipment has improved significantly with reduced cost and weight.
- Education on new technology will ease the transition to electric equipment and make the option of banning gas-powered blowers and mowers more viable.

Weaknesses:

- Incentives for trade-in of gas-powered landscape tools do not currently exist in this area.
- Existing investments in gas-powered landscape and garden equipment will slow the move to electric-powered equipment.

Opportunities and co-benefits:

- The pollution reductions in Mountain View will directly benefit resident and worker health including a reduction in asthma and even premature death in people with heart or lung disease. See 2006, EPA Report with summary in *W12 Appendix A*.
- Reduction in noise levels will increase residence and worker qualify of life.
- Reduced water consumption will occur for those removing lawns.

Threats: Lawn care professionals may resist an outright ban.

Municipalities where already implemented

Palo Alto in 2005 (14), Los Gatos 2015 (15) and Los Altos (16) have implemented gas-powered leaf blower bans. Their experience can be leveraged in equipment selection and group purchase opportunities.

Model program for commercial landscape tool exchange program has been implemented in Contra Costa and Alameda Counties managed by BAAQMD (13). A residential program in Southern California managed by South Bay Air Quality Management District was also implemented (12).

South Pasadena transitioned 41 acres of city property to all-electric equipment which entailed getting buy-in from, and training of, over 25 landscape crew professionals, to successfully address initiate hesitations about potential operational impacts. They worked with American Green Zone Alliance (AGZA) (21).

The South Coast Air Quality Management District, which covers Orange County, has held a leaf blower buy-back program since 2006 for professional gardeners which has put more than 12,000 reduced-noise and lower-emissions leaf blowers in the hands of professional gardeners (22).

Funding sources

Santa Clara County Water District offers rebates for lawn replacement (6).

Potential funding from BAAQMD for trade-in programs of gas powered tools for electric powered tools.

Assumptions and uncertainty

Assumptions with High Uncertainty:

Availability of rebates/incentives for trading in gas powered tools.

Assumptions with Low Uncertainty:

Existing programs for lawn replacement and composting can be leveraged.

Author Mike Balma

Detailed analysis

Environmental analysis

The BAAQMD had a program in the East Bay to replace gas landscape and garden equipment with electric-powered tools. Funds for the trade-in program came from a settlement. The environmental impact from this project was used to assess this recommendation.

Bay Area Air Quality Management District Program in Alameda and Contra Costa

Four areas of impact were estimated, including:

- Lawn replacement
- Gas landscape equipment replacement
  - resident and small business
  - landscape professional and large business
- Mountain View Operations switch to electric equipment

It was assumed that all the energy for the electric equipment would come from Silicon Valley Clean Energy (SVCE), 100% GHG-free.

Here are the estimates of the changes for each area starting in 2019. See detailed calculations in *W12 Appendix B*.

- Lawn replacement (ten lawns each year through 2030 for a total of 120 lawns)
- Gas-powered landscape equipment replacement
  - resident switch (ten home owners or small businesses in first year increasing by two in successive years as the technology improves for a total of 252 properties)
  - landscape professional (three professionals or large businesses in first year increasing by one in successive years as the technology improves for a total of 102.)
- Mountain View Operations switch to electric equipment (one tool replaced each year, starting in 2019, increasing by one in each successive year). It's estimated that 78 tools will be replaced through 2030. Mountain View already uses electric leaf blowers for some areas.
- Both the COy and the NOx pollutants were accounted for in the GHG emissions. While the NOx emissions are far less per tool, NOx has a CO_2 equivalent 310 greater than CO_2, per www.icbe.com/emissions/calculate.asp (7). It was also assumed that when a lawn is replaced that leaf blowing would occur 50% less often.

Below in W12 Table 1 are the results of the analysis by program area. The cumulative CO_2 reduction in Mountain View is estimated to be 1052 MT through 2030. Most of the emissions reductions is estimated to come from large businesses and landscape professionals who switch from gas-powered equipment. Total off-road emissions are roughly 2000 MT per year in 2015. Successful implementation of this program estimates a 11% annual reduction in 2030. There is considerable upside if the high-tech business community supports the program more aggressively and if a mandatory ordinance is enacted.

W12 Table 1. Emissions reductions from voluntary program (see detailed calculations in *W12 Appendix B*).

	Annual CO2e reduction in 2030 (MT)	Cumulative CO2e (MT) reduction through 2030
Lawn replacement	5	34
Gas landscape equipment replacement - resident switch	15	79
Gas landscape equipment replacement - professional/large business switch	137	696
Mountain View Operations	52	244
Total	209	1052

Additional pollutants such as Reactive Organic Gases (ROG) and ultra-fine Particulate Matter (PM) are also reduced by this program and directly affect the health of residents, those who work in Mountain View, and particularly the landscape professionals who are constantly exposed to the emissions (4, 13, 19). California officials said that the contamination from running a top-selling leaf blower for just one hour matches the emissions from driving a 2016 Toyota Camry for 1,100 miles, the distance from Los Angeles to Denver (5). Electric and manual landscape equipment also offers lower noise levels.

With more people working from home and as the population ages, the reduced air and noise pollution provides significant local environmental benefits in addition to the reductions in global warming impact.

W12 Table 2. Summary of benefits from sustainable landscaping program.

	GHG NOx, PM & ROG	Water	Noise	Fertilizer & Pesticides	Green Waste
Lawn replacement	↓	↓	↓	↓	↓
Sustainable Landscape care	↓	↓		↓	↓
Landscape equipment electrification	↓		↓		

Impact of ban on selected gas-powered landscape equipment

It is estimated that 4688 MT CO2e could be reduced with an ordinance banning gas-powered leaf blowers in 2023. An additional 2982 MT CO2e could be reduced through 2030 if a ban on gas-powered mowers started in 2025. However, since a ban on mowers is only to be investigated, this emission reduction was not included in the metrics for this recommendation. W12 Table 3 provides the estimates for emissions reduction based on percentage of systems reduced in each year. It was assumed that 45% of the emissions from lawn and garden were from leaf blowers and 45% were from lawn mowers. The remaining 10% is assumed to come from gas-powered tools such as chain saws and trimmers.

The total combined cumulative emissions reduction for the voluntary program are 1082 MT and the leaf blower ordinance 4688 MT CO2e is 5770 MT CO2e.

W12 Table 3: Emissions Reductions from Leaf Blower Ordinance 2023 and Mower Ordinance 2025.

Impact of ordinance in 2023 & 2025		**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
MT CO2e from Lawn & Garden (BAU v2)		1,998	2,018	2,038	2,059	2,080	2,101	2,122	2,143	2,165	2,187	2,209	2,231
Emission after voluntary reductions		1,996	2,013	2,030	2,047	2,063	2,078	2,093	2,107	2,121	2,135	2,147	2,159
Leaf Blower emissions	45%	898	906	913	921	928	935	942	948	954	961	966	972
Mower Emissions	45%	898	906	913	921	928	935	942	948	954	961	966	972
Percent reduction from blower ordinance						20%	30%	40%	60%	75%	85%	90%	90%
Reduction from leaf blower ordinance						186	281	377	569	716	816	870	875
Cumulative CO2 reduction - leaf blower ordinance in 2023						186	466	843	1,412	2,128	2,944	3,814	4,688
Percent reduction from mower ordinance								20%	30%	40%	60%	75%	85%
Reduction from mower ordinance in 2025								188	284	382	576	725	826
Cumulative CO2 reduction from mower ordinance								188	473	855	1,431	2,156	2,982

Cost analysis

The program consists of four components, including the City migration plan as described below.

1) Additional workshops that cover lawn removal and replacement with native species and workshops on moving to electric or manual landscape equipment. Five additional workshops per year are estimated to cost $2,500 leveraging existing workshop providers and industry partners.

2) Information (brochure, case study and web content) on the impact of gas-powered landscape equipment. The outreach materials are estimated to cost $5,000 in the first year and then $2,000 to update every year through 2030.

3) Program management and outreach to Mountain View commercial businesses to both general high-tech employers and landscape professionals. This is estimated to require 10% of a full-time employee. Consultants could be used for some of this work. Cost is estimated to be $18,000 per year for five years.

4) Developing a plan for City Operations to move to electric landscape equipment will require staff time. It is unclear how much additional effort this will require. For this analysis, the cost of the electric equipment was estimated to be $1000 more than the cost of a professional landscape tool (riding power mower used as base from Consumer Reports 2018 study (9)). It was also assumed that the cost of an electric landscape tool would be lower by 10% per year and would equal the

cost of a gas-powered tool in ten years. Replacing 78 landscape tools over 12 years is estimated to cost the City $20,800 more. Group-purchase opportunities could lower the upfront costs further.

This cost analysis does not include the savings in fuel and maintenance costs which Consumer Reports estimates could cover the incremental cost in less than ten years based on 2018 costs (9).

Consumer Reports 2017 did a cost-analysis of electric mowers versus gas mowers for residential use. The incremental $250 cost of an electric mower was calculated to pay back through lower fuel and maintenance costs over a 1ten-year period. (8) Consumer Reports ratings in 2018 indicate an incremental cost close to $100 which cuts this payback time significantly. The price change from 2017 to 2018 for comparable products shows the potential for significant reductions over time for electric-powered landscaping equipment.

Electric riding-mowers are also now available (9). This Consumer Reports article also highlights tips for minimizing fertilizer and water use based on cutting grass higher and mulching (10). These practices should be encouraged as part of a Green Landscaping Program. Todaysmower.com also did an analysis in 2017 of a residential riding-mower which resulted in a five-year payback for the incremental cost. (11)

The California South Coast Air Quality Management District completed a study in 2013 which showed that landscape equipment performed well versus gas-powered equipment. (12).

W12 Table 4. Anticipated program costs.

Costs ($1000)		2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Total
- Brochure	$5 K in first year	5	2	2	2	2	2	2	2	2	2	2	2	27
-Workshops	$2.5 K per year	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	30
- Staff management & outreach		18	18	18	18	18								90
MV Operations (not including savings)		1.0	1.8	2.4	2.8	3.0	3.0	2.8	2.4	1.8	1.0	-	(1.2)	20.8
- Subtotal														
Ordinance banning gas-powered equipment				40		15	15	15						85
- Enforcement resource								9	9	9	9	9	9	54
													Cumulative Total	307

Costs for Mandatory Program

A study is recommended in 2021 to evaluate a mandatory program to eliminate the use of gas-powered landscaping equipment with a focus on leaf blowers targeting 2023 and mowers in 2025. This would look at the cost-impact of banning leaf blowers and mowers including the social cost of the CO2 emissions, the health costs attributed to other pollutants including noise pollution and any legal issues. We estimate the cost of the study at $40,000 which is included in the mandatory portion of the cost section in the summary statistics as seen in W12 Table 3 above.

It is assumed that leaf blowers and mowers will be equal in cost-effectiveness by 2023 and 2025 respectively. Implementation cost is estimated at $45,000 spread over 2023 through 2025 for outreach. $9,000 per year is allocated for enforcement starting in 2025 as seen in W12 Table 3 above.

Net cost to the public for the leaf blower ban is estimated to be $173,000. This is based on the remaining depreciated value a $400 leaf professional blower with a seven-year useful life. It was estimated that there are 2971 gas-powered leaf blowers in Mountain View in 2018, based on BAAQMD estimates that there are 258,000 gas-powered leaf blowers in the Bay Area. The number of gas-powered leaf blowers in Mountain View is expected to go down to 2164 units with the introduction of a voluntary trade-in program and with the announcement of a gas-blower ban; see W12 Table 5 below.

W12 Table 5. Net cost to public of gas-powered leaf blower ban.

Net Cost to public for leaf blower mandate						mandate starts
	2018	2019	2020	2021	2022	2023
% purchasing Electric due to mandate announcement		10%	10%	20%	50%	100%
- electrics blowers purchased for use in MV		42	42	85	212	424
Remaining gas blowers	2,971	2,928	2,886	2,801	2,589	2,164
% with electric due to other city mandates		25%	25%	30%	50%	60%
gas leaf blowers in MV		2196	2164	1961	1294	866
Average depreciated life remaining						50%
Ave cost of professional leaf blower						$400
Cost imposed to comply with mandate						$ 173,149

Net cost to the public for a potential mower ban is estimated to be roughly $1,208,800. This is based on the remaining depreciated value of a professional riding-mower at $3,000 and a gas-powered push mower at $400, each with a ten-year useful life. It was assumed that 20% of the mowers would be riding-mowers and 80% would be push-mowers. It was estimated that there are 2971 gas-powered mowers in Mountain View in 2018 ,assuming the same number of mowers as leaf blowers, based on analysis from BAAQMD. The number of gas-powered mowers is expected to go down to 2305 units with the introduction of a voluntary trade-in program and outreach efforts. This net incremental cost has not been included in the total net incremental cost metric since this recommendation involves the investigation of a mower ordinance rather than specifying implementation. Environmental benefits were also not included.

W12 Table 6. Net cost to public of gas-powered lawnmower ban.

								potential mower ordinance starts
Incremental cost to public for mower mandate	2018	2019	2020	2021	2022	2023	2024	2025
% purchasing Electric due to mandate announcement		0	0%	10%	20%	30%	50%	100%
- electric mowers purchased for use in MV			-	30	59	89	149	297
Remaining gas mowers**	2971	2961	2929	2,899	2,840	2,751	2,602	2,305
% with electric due to other city mandates*		0	0	0	0	5%	5%	5%
gas mowers in MV		2961	2929	2899	2840	2613	2472	2190
Average deprecated life remaining								60%
Percent of movers - riding								20%
Percent of movers - push								80%
Ave cost of professional mower								$3,000
Cost imposed to comply with mandate - riding								$ 788,363
Cost of push mower								$ 400
Cost imposed to comply with mandate - push mower								$ 420,460
Total net cost for mower ordinance in 2025								$ 1,208,824

* assumes one nearby city bans gas-powered mowers in 2023

** assumes same number of gas-powered mowers as leaf blowers in MV

Scale analysis

The attached chart indicates the impact of the various programs. The key to scaling the program would be outreach to the high-tech business community who can influence equipment manufactures and landscape professionals.

The impact of lawn replacement can be tracked through the rebate programs. The impact from City Operations would be easy to measure. Large companies who make the switch could also be tracked to a lesser extent with good outreach. Residential and landscape professionals who make the switch will be more difficult to monitor. However, if the city maintains a list of landscaping professionals who offer sustainable services, this could be a useful metric.

If a mandatory program were implemented, the scale of the emissions reduction would increase dramatically.

Leveraging existing programs for sustainable gardening will help jump-start the program. A list of green gardeners is maintained by nonprofit WatershedWatch (18) and Bay Friendly/Rescape (23). UC Master Gardeners offers information composting and Integrated Pest Management (24)

W12 References

1. A 2011 test by the car experts at Edmunds showed that "a consumer-grade leaf blower emits more pollutants than a 6,200-pound 2011 Ford F-150 SVT Raptor.[110]" The company subjected a truck, a sedan, a four-stroke and a two-stroke leaf blower to automotive emissions tests and found that under normal usage conditions, the two-stroke engine emitted nearly 299 times the hydrocarbons of the pickup truck and 93 times the hydrocarbons of the sedan. The blower emitted many times as much carbon monoxide and nitrogen oxides as well. The four-stroke engine performed better than the two-stroke, but still far worse than the car engines.

2. According to Michael Benjamin at the California Air Resources Board, in just three years' time, the biggest single ozone polluter in the state is going to be all this gardening equipment.

3. Resolutions passed by the state medical societies of New York[111] and Massachusetts[112] highlighting health risks

4. Perhaps most worrisome, the gas engines release high concentrations of microscopic ultrafine particles (0.1 microns), as recently confirmed in tests commissioned by FairWarning. Ultrafine particles are unregulated, but scientists increasingly believe they are a danger. That threat is particularly true for landscaping workers, but also a potential concern for other adults and children who are exposed. www.seattleglobalist.com/2017/09/25/leaf-blowers-flagged-as-polluters-possible-health-threat/68802
"The smaller the particle, the deeper it can be inhaled into the lungs, and the more potential it has then to cause health problems" such as lung cancer, heart disease[113], strokes, asthma and

[110] https://www.edmunds.com/about/press/leaf-blowers-emissions-dirtier-than-high-performance-pick-up-trucks-says-edmunds-insidelinecom.html
[111] https://www.quietcommunities.org/resolution-gas-leaf-blowers/
[112] https://www.quietcommunities.org/massachusetts-medical-society-leaf-blowers/
[113] https://oehha.ca.gov/air/press-release/press-release-air/study-finds-long-term-exposure-ultrafine-particle-air-pollution

other respiratory ailments, said Jo Kay Ghosh, an epidemiologist and the health effects officer for the South Coast Air Quality Management District, a pollution control agency covering much of smoggy Southern California. Ultrafine particles also can pass through cell membranes and slip into the bloodstream. oehha.ca.gov/air/press-release/press-release-air/study-finds-long-term-exposure-ultrafine-particle-air-pollution

5. California officials said that the contamination from running a top-selling leaf blower for just one hour matches the emissions from driving a 2016 Toyota Camry for 1,100 miles, the distance from Los Angeles to Denver. The pollutants in the leaf blower-versus-car comparisons are oxides of nitrogen *and reactive organic gases.* This story was reported by FairWarning (http://www.fairwarning.org), a nonprofit news organization based in Pasadena, Calif., that focuses on public health, consumer and environmental issues. www.arb.ca.gov/msprog/offroad/sore/sm_en_fs.pdf
Santa Clara Water District Landscape Rebate Program https://www.valleywater.org/saving-water/landscaping/landscape-rebate-program
6. Emissions calculator for NOx http://www.icbe.com/emissions/calculate.asp and http://sustainability.ucdavis.edu/local_resources/docs/onlinedocs/rdc/appendix-c-ghg-appendix.pdf
7. Consumer Reports 2017 report on gas and electric mowers https://www.consumerreports.org/push-mowers/electric-lawn-mowers-that-rival-gas-models/
8. Consumer Reports 2018 report on gas and electric mowers including ratings https://www.consumerreports.org/products/push-mower/ratings-overview/
9. https://www.consumerreports.org/lawn-garden/improve-your-landscape-without-all-the-work/
10. https://todaysmower.com/is-owning-a-ryobi-rm480e-electric-riding-mower-cost-effective/
11. South Coast Air Quality Management District 2013 study on landscape equipment capabilities. www.arb.ca.gov/msprog/aqip/demo/demo%20final%20reports/scaqmd_final_report.pdf
12. Bay Area Air Quality Management District Commercial Lawn & Garden Equipment Exchange Program, www.baaqmd.gov/grant-funding/businesses-and-fleets/lawn-and-garden
13. Palo Alto residential leaf blower ban, 2005 www.cityofpaloalto.org/news/displaynews.asp?NewsID=671&TargetID=96
14. Los Gatos residential, commercial, industrial leaf blower ban, 2015 www.losgatosca.gov/2059/Leaf-Blower-Ordinance
15. Los Altos ban of portable gasoline-powered *leaf* blowers, 2007 library.municode.com/ca/los_altos/codes/code_of_ordinances?nodeId=TIT6HESA_CH6.16NOCO_6.16.070PRAC
16. South Bay Green Gardens www.southbaygreengardens.org/
17. Watershed Watch, www.mywatershedwatch.org/residents/green-gardener-program/find-a-green-gardener
18. Lifespan of leaf blowers and mowers; https://www.lawnsite.com/threads/lets-talk-life-span.409888/
19. Health Impacts of Leaf Blowers: lincolntown.org/DocumentCenter/View/6597/Leaf-Blower-Summary-Report-to-the-Lincoln-Board-of-Health_February-2014
20. American Green Zone Alliance (AGZA) www.agza.net/blog/2017/10/7/scaqmd-clean-air-awards
21. Mountain View Voice Article, “Air District Report: Leaf blowers present health risk, 2015; mv-voice.com/news/2015/08/24/more-than-hot-air
22. Bay Friendly / Rescape program; maintain a list of landscapers who have completed their training: https://rescapeca.org
23. UC Master Gardeners Program on integrated pest management: mgsantaclara.ucanr.edu/

W12 Appendix A: Health impacts of air pollution

Smog

Ground level or "bad" ozone is not emitted directly into the air but is created by chemical reactions between oxides of nitrogen (NOx) and volatile organic compounds (VOC) in the presence of sunlight. Ozone at ground level is a harmful air pollutant, because of its effects on people and the environment, and it is the main ingredient in "smog." Breathing ozone can trigger a variety of health problems, particularly for children, the elderly, and people of all ages who have lung diseases such as asthma.

Breathing ozone can:

- Make it more difficult to breathe deeply and vigorously
- Cause shortness of breath, and pain when taking a deep breath
- Cause coughing and sore or scratchy throat
- Inflame and damage the airways
- Aggravate lung diseases such as asthma, emphysema, and chronic bronchitis
- Increase the frequency of asthma attacks
- Make the lungs more susceptible to infection
- Continue to damage the lungs even when the symptoms have disappeared
- Cause chronic obstructive pulmonary disease (COPD)

Particulate pollution

Particle pollution (also called particulate matter or PM) is the term for a mixture of solid particles and liquid droplets found in the air. Some particles, known as primary particles are emitted directly from a source, such as construction sites, unpaved roads, fields, smokestacks or fires. Others form in complicated reactions in the atmosphere of chemicals such as sulfur dioxides and nitrogen oxides that are emitted from power plants, industries and automobiles. These particles, known as secondary particles, make up most of the fine particle pollution in the country.

Particulate Matter is associated with:

- Premature death in people with heart or lung disease
- Nonfatal heart attacks
- Irregular heartbeat
- Aggravated asthma
- Decreased lung function
- Increased respiratory symptoms, such as irritation of the airways, coughing or difficulty breathing
- Reduced visibility (haze) in many parts of the U.S., including many of our national parks and wilderness areas
- Lake and stream acidification

Source: EPA Report: 2006; www.epa.gov/mobile-source-pollution/how-mobile-source-pollution-affects-your-health#mobile%20sources

W12 Appendix B: Emissions reductions from landscaping equipment trade-in program

Program	(MT/eq)	% of total impact	2019	2020	2021	2022	2023	2024	2025	2026
Lawn replacement			10	10	10	10	10	10	10	10
- Cumulative			10	20	30	40	50	60	70	80
Personal										
- leaf blowers	0.01	50%	0.05	0.10	0.15	0.20	0.25	0.30	0.35	0.40
- lawn mowers	0.01	100%	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8
Electric landscape equipment use change										
Personal			10	12	14	16	18	20	22	24
- Cumulative			10	22	36	52	70	90	112	136
- leaf blowers	0.01		0.1	0.22	0.36	0.52	0.7	0.9	1.12	1.36
- lawn mowers	0.01		0.1	0.22	0.36	0.52	0.7	0.9	1.12	1.36
Professional/Business			3	4	5	6	7	8	9	10
- Cummulative			3	7	12	18	25	33	42	52
- leaf blowers	0.23		0.69	1.61	2.76	4.14	5.75	7.59	9.66	11.96
- lawn mowers	0.23		0.69	1.61	2.76	4.14	5.75	7.59	9.66	11.96
MV Operations			1	2	3	4	5	6	7	8
- Cumulative			1	3	6	10	15	21	28	36
- Annual impact	0.23		0.23	0.69	1.38	2.3	3.45	4.83	6.44	8.28

Program	(MT/eq)	% of total impact	2027	2028	2029	2030	Total	CO2(MT)	NOX impact (1.91X CO2)	Cumulative Total	2030 CO2e Annual reduction	
									1.91			
Lawn replacement			10	10	10	10	120					
- Cumulative			90	100	110	120	780					
Personal												
- leaf blowers	0.01	50%	0.45	0.50	0.55	0.60	4	12	22	34	5	
- lawn mowers	0.01	100%	0.9	1.0	1.1	1.2	8					
Electric landscape equipment use change												
Personal			26	28	30	32	252					
- Cumulative			162	190	220	252	1352					
- leaf blowers	0.01		1.62	1.9	2.2	2.52	14	27	52	79	15	
- lawn mowers	0.01		1.62	1.9	2.2	2.52	14					
Professional/Business			11	12	13	14	102					
- Cummulative			63	75	88	102	520					
- leaf blowers	0.23		14.49	17.25	20.24	23.46	120	239	457	696	137	
- lawn mowers	0.23		14.49	17.25	20.24	23.46	120					
								278	531	809	156	Community
MV Operations			9	10	11	12	78					Subtotal
- Cumulative			45	55	66	78	364					
- Annual impact	0.23		10.35	12.65	15.18	17.94	84	84	160	244	MV impact	
										1052	< cumulative total	

Recommendation name	Recommendation type	Duration
Partner with Palo Alto to install anaerobic digesters to produce clean energy **(W15)**	**Educational, Incentive, Voluntary**	**Perman-ent**

MT CO2e reduction 2018-2030	City's Net cost	Net incremental cost	Net cost per MT CO2e reduction	Easy to implement	Easy to measure	Private investment leverage	Local economic benefits	Other environmental benefits	Health benefits
8,304	**$11.4M**	**$0**	**$275** [114]	●○○	●○○	●○○	●●○	●●●	●●○

Problem description

Mountain View's wastewater is treated at the Regional Water Quality Control Plant (RWQCP) in Palo Alto. The wastewater solids (biosolids) are incinerated in multiple hearth furnaces. The CO_2 emitted from the incinerators is not currently captured, nor is the heat energy. The flue gas from the incinerators is cleaned in an afterburner followed by a wet scrubber with a packed bed and multiple venturi scrubbers before discharging to the atmosphere.

Organic material from food waste and compostable waste collected by Mountain View's partial food waste and organics composting program is currently composted. All the abovementioned organic waste is a rich potential energy source for production of methane and subsequently heat and power. Methane can be produced in anaerobic digesters, and if we did this it would have a large beneficial impact on Mountain View's and Palo Alto's emissions.

Recommendation

Mountain View should partner with Palo Alto to achieve the benefits of anaerobic digestion for both cities.

We propose anaerobic digestion (or any other advanced-treatment methods that can both treat wastewater and capture organics for energy) of the wastewater solids and the organic material from the compost-collection program (food waste, fats, oil, grease, yard waste, all other biodegradable organic material.)

- Component 1: Wastewater sludge treated by anaerobic digestion and the subsequent generation of combined heat and power (CHP)
- Component 2: Food waste digested anaerobically, thus diverting it from landfills

SWOT analysis

Strengths:

- Anaerobic digestion produces energy and reduces GHG emissions.
- Keeps food waste out of landfills.
- Food waste collected in Mountain View would be transported a short distance to Palo Alto, a much shorter and less expensive distance than is currently the case.

[114] See Cost Analysis Section for a note on why this figure is computed differently than in most other recommendations.

Weaknesses:

- Need for space to build digesters.
- Potential odor issues in wastewater plants.

Opportunities and co-benefits:

- Helps reduce the amount of sludge produced after wastewater treatment.
- Produces a valuable product for soil amendments after digestion.

Threats:

- High capital cost.
- Local resistance due to perceived nuisances such as odor and the need for real estate. Palo Alto has considered this in the past and the threats listed above have been the main deterrents for implementing this or similar technologies.

Municipalities where already implemented

- Several successful anaerobic digestion programs, with or without food waste digestion programs, are run in California, including East Bay Municipal Utility District (EBMUD) and Orange County Sanitation District in Southern CA (OCSD). Similar programs are also used in other US states.

Funding sources

Cal Recycle grants.

Assumptions and uncertainty

Assumptions with High Uncertainty:

- Specific information regarding the current wastewater treatment processes to calculate emissions from each wastewater treatment process is limited; high-level assumptions are used at each stage.

Assumptions with Low Uncertainty:

- Anaerobic digestion is a known technology with proven results for GHG reduction and energy production.

Author Gavi Subramanian

Detailed analysis

Assumptions

1. The biosolids from Mountain View constitute 37% of the entire flow going to the RWQCP. The estimated average biosolids loading-rate for Mountain View is 0.19 pounds per capita per-day (ppcd).

2. The per capita biosolids loading-rate does not change over time in the time frame considered because wastewater characteristics are expected to remain constant.

3. Details of individual wastewater-treatment components and their power consumption for all the treatment options are not available, and developing separate GHG estimates would unnecessarily complicate the analysis. Therefore, based on the flows and wastewater characteristics, a ratio of the total emissions pertaining to Mountain View`s wastewater and the resulting numbers were used.

4. The current Business as Usual (BAU) emissions from wastewater cannot be compared with the numbers here, owing to potentially different estimation methods and assumptions considered.

5. Assumptions for current GHG emissions include: Wastewater treatment; thickening prior to digestion; digestion; dewatering after digestion; gas production; hauling of digested solids.

6. W15 Table 1 contains other assumptions as used by the wastewater plant in Palo Alto:

A. Dewater and Haul (Off-site hauling of raw sludge – no digestion):

i. Synagro Central Valley Compost Facility

ii. Kirby Canyon Landfill Facility

B. Onsite Processing Solutions (with truck haul to land application, or landfill alternative daily cover):

i. Mesophilic Anaerobic Digestion with Biogas-Fueled Combined Heat and Power

ii. Dewatering and Thermal Drying/Gasification

RWQCP only proposes to treat the wastewater, thicken the sludge, and haul out the wet sludge to these different landfills/compost facilities in the area, hence contributing to GHG emissions arising from transportation.

W15 Table 1: Anthropogenic Greenhouse Gas Emissions Analysis Assumptions

Parameter	Unit	Value
Mass per Truck Load	tons	22
Fuel Economy	miles per gallon	6.3
Days of CHP Recovered Heat Use in Palo Alto	days	120
CO_2e Generated from Purchased Power Emission Factor	kg CO_2/MWh	299.4
CO_2e Generated from Natural Gas	kg CO_2/MMBtu	53.02
CO_2e Generated from Diesel Fuel	kg/gallon	10.21
CO_2e Generated from Landfilling Biosolids	g CO_2e/dry kg biosolids	390

CH_4 = methane; CO_2 = carbon dioxide; CO_2e = equivalent carbon dioxide; g = grams; kg = kilograms; MMBtu = million British thermal units; MWh = megawatt-hour

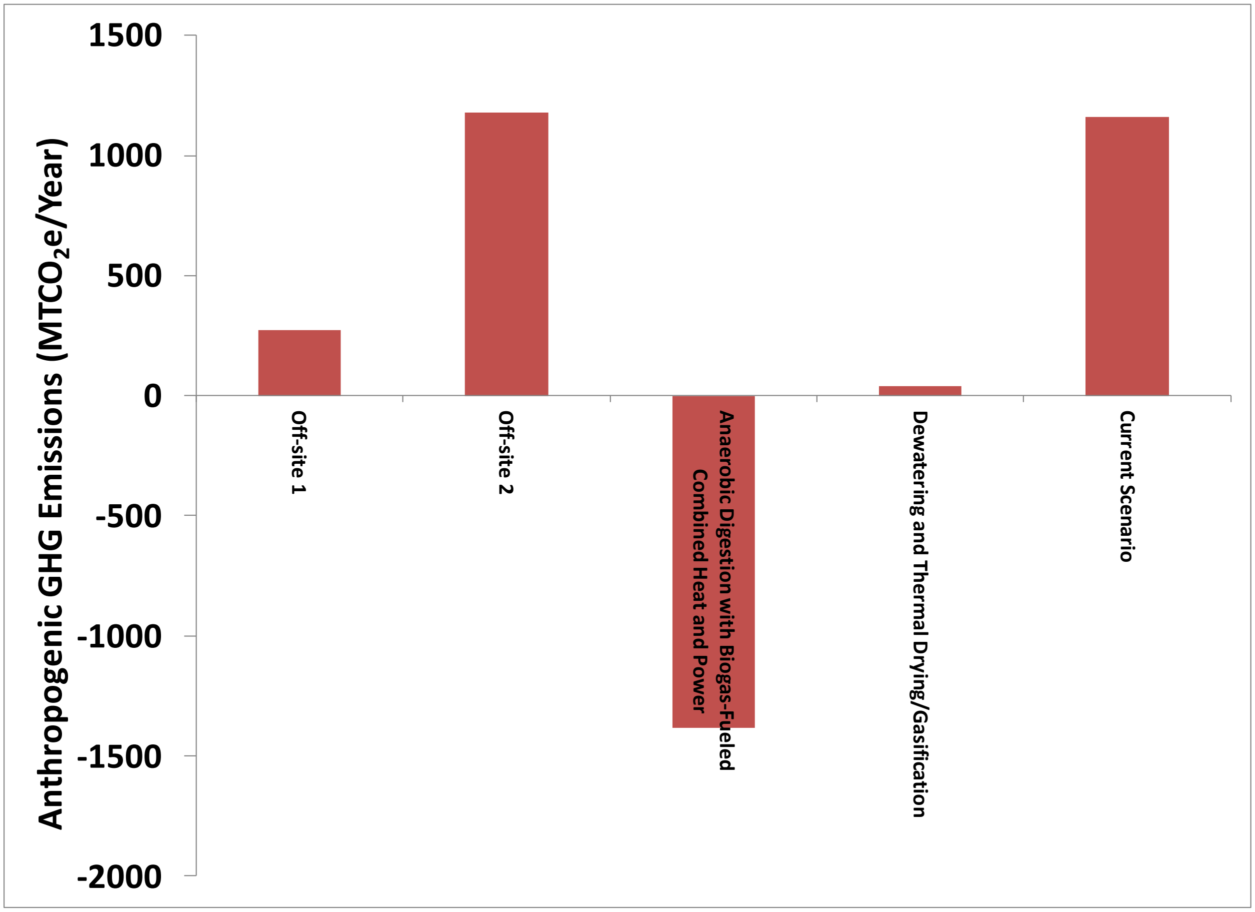
Environmental analysis

W15 Table 2 discusses the emissions as well as the power generated from the various alternatives. W15 Figure 1 (next page) is a representation of this data.

W15 Table 2. Emissions and Power Generated from the Various Alternatives

Alternative	Net Energy	Anthropogenic GHG Emissions	Hauling Miles (truck miles/year)	Trucks from RWQCP
	(MWh/year) (Energy Produced minus Energy Demand)	(MT CO_2e/year)		(vehicles/year)
Current Scenario (only incineration) *	-5,703	1,162		
Off-site hauling options				
Dewater and haul to Synagro Central Valley Compost Facility (Off-site 1)	-979	271	118,294	515
Dewater and Haul to Kirby Canyon Landfill (Off-site 2)	-477	1,180	34,960	515
On-site treatment options				
Anaerobic Digestion with Biogas-Fueled Combined Heat and Power	5,123	-1,384	51,642	287
Dewatering and Thermal Drying/Gasification	-130	38	1,585	23

* Currently, the flue gas from the incinerators is cleaned in an afterburner followed by a wet scrubber with a packed bed and multiple venturi scrubbers before discharging to the atmosphere.



W15 Figure 1. Summary of GHG emissions from different disposal methods for organic waste.

Note: Negative net energy represents net energy consumed, while positive net energy represents net energy produced. Negative GHG emissions represent a reduction in emissions, while positive GHG emissions represent an increase in emissions.

MT CO_2e/year = metric tons equivalent carbon dioxide per year.

Cost analysis: The chart below shows an estimate of Mountain View's portion of the staff costs to lead the process of setting up the plant that we have described.

Outreach / Collaboration / Research / hours	Hourly rate	2025 Costs	2026 Costs	2027 Costs	2028 Costs	2029 Costs	$ Total Costs
600	$90	$54,000	$54,000	$54,000			$162,000
400	$90				$36,000	$36,000	$72,000
Studies / misc.				$25,000	$25,000		$50,000
							$284,000

A high-level cost estimate to install digesters and biogas fueled CHP (combined gas and power units) would be of the order of $30,000,000. This cost would be expected to be shared among cities or funded by a tax. If Mountain View's share were 37% (the same as our share of the wastewater processed at RWQCP) that would come to $11,100,000 of capital costs.

There would, of course, be operational costs, which we cannot easily estimate. There would also be revenue from the sale of the energy produced. We do not have the expertise to estimate these either.

As show in W15 Table 2, such a plant could reduce GHGs attributed to Mountain View's waste stream by 1,384 MT per year. If we assume the plant becomes operational at the beginning of 2024, then in the 6 years through 2030 it would reduce emissions by 8,304 MT. This is the number we have put in the "top box" of this recommendation. However, to calculate the $/MT we use the assumption that the plant's useful life is 30 years. Over that span the plant will eliminate emissions of 41,520 MT. We used that figure, along with the cost of $11.384 million, to derive the estimated cost per MT of $275.

W15 References

1. California Air Resources Board (CARB). 2008. Climate Change Scoping Plan. Pursuant to AB 32-The California. Global Warming Solutions Act of 2006. http://www.arb.ca.gov/cc/scopingplan/document/_adopted_scoping_plan.pdf. December. Accessed January 2018.
2. Carollo Engineers. 2012. City of Palo Alto Long-Range Facilities Plan for the Regional Water Quality Control
3. Plant Final Report.
4. CH2M HILL. 2014. Preliminary Design Report: Dewatering Truck/Loadout Facility for the Regional Water
5. Quality Control Plant. Prepared for the City of Palo Alto, California. August.
6. CH2M HILL. 2014. Palo Alto Regional Water Quality Control Plant Biosolids Facility Plan. Prepared for the City of Palo Alto, California. October.
7. City of Palo Alto. 2013. Request for Proposals to Establish an Energy/Compost Facility or Export Food Scraps, Yard Trimmings, and Biosolids. February.
8. EPA. (2014). Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2012. Washington, DC: U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. Retrieved from: http://www.epa.gov/osw/nonhaz/municipal/pubs/2012_msw_dat_tbls.pdf
9. EPA. (2011). Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2009. Annex 2. April. (EPA publication no. EPA 430-R-11-005.) U.S. Environmental Protection Agency, Office of Atmospheric Programs. April. Retrieved from: http://epa.gov/climatechange/emissions/usinventoryreport.html.

Lead collaboration among Bay Area cities to develop a solution to overseas recycling crisis (**W1**)						**Collaboration, leadership**		**Ongoing**	
Recommendation name						Recommendation type		Duration	
unknown	**$309K**	**unknown**	**unknown**	○○○	○○○	○○○	●○○	●●●	●○○
MT CO2e reduction 2018-2030	City's Net cost	Net incremental cost	Net cost per MT CO2e reduction	Easy to implement	Easy to measure	Private investment leverage	Local economic benefits	Other environmental benefits	Health benefits

Problem description

The international recycling market was thrown into instability in January 2018 when China officially banned imports of most common types of recycling and lowered the amount of contamination that is acceptable in the material to be received[115]. China's ban covers imports of 24 kinds of solid waste, including unsorted paper and the low-grade polyethylene terephthalate used in plastic bottles.

Many of the products that have been shipped overseas for decades, including up to half of all mixed paper, plastics, and metals, have been piling up in temporary storage areas in California. In February of 2018, 290 tons of recyclables in Sacramento County were dumped into landfill. A visit to the SMART Station in Sunnyvale in the same month confirmed that recyclables are also beginning to stockpile there.

Relying on countries like India, Malaysia, or Vietnam to receive our recycling may seem to be the easiest solution. But waiting to ship our recycling to different destinations wastes the opportunity for improvements and innovations locally. These other countries will need to build increased capacity, so we can continue business as usual. This could leave Mountain View and neighboring cities with no clear end in sight for what will happen to their recycling.

But the core of the problem lies in that we are a city flush with cash, with some of the best innovators in the world, and we are still sending tons and tons of recyclable waste to the landfill. Instead, we have the opportunity to take a leadership role and set an example of a city investing in doing the right thing for the next generation.

Recommendation

A collaboration between Bay Area cities and businesses to solve for a recycling solution is now critical. With the creative minds and innovators in Silicon Valley, Mountain View should be able to lead in partnering with other cities to solve this problem, perhaps ultimately lobbying at a state level for California to build new processing centers domestically. The lack of a destination for recycled products is an opportunity to improve our recycling capacity at home. Domestic companies have traditionally been non-competitive with Chinese prices for most types of recycling, but the new ban could facilitate a breakthrough. One possible solution that might be considered is building a local (within ~200 miles) recycling center ,especially if cities, businesses, and entrepreneurs work together to ensure a better-quality waste stream.

If a new facility is to be built, another option is a "Waste-to-Energy" plant that would eliminate landfill and generate power. CalRecycle[116] lists processing facilities in California by location and type of plastics

[115] https://www.mercurynews.com/2018/03/27/opinion-california-shouldnt-throw-away-recycling-opportunity/
[116] http://www.calrecycle.ca.gov/FacIT/Facility/Search.aspx?ActivityID=30%2c31

processed. We could partner with HDPE Processing Center in Lodi, CA, to ship plastics to their facilities. Partnering with the Peninsula Recycling Company in Turlock could be worth exploring.

Again, this recommendation is not to focus on a specific solution but to recommend that Mountain View facilitate a collaborative multi-city endeavor to solve the recycling problem. We can leverage cities, businesses, universities and others to come up with a long-term sustainable solution. The expectation would be that partnerships would form between cities, much like with Silicon Valley Clean Energy, and that with many minds working on this, a practical solution would be created.

SWOT analysis

Strengths: Tackling the recycling issue domestically is socially responsible. China's ban was driven by the high environmental and health risks that people, including children, were exposed to when receiving and sorting our recycling, due to contamination with hazardous waste. This can be the opportunity to build an innovative long-term solution that would address not only recycling but also landfill.

Weaknesses: For this to happen, Mountain View should have adequate sustainability staffing, which it currently lacks. Collaboration and outreach are vital for this to happen. It will take years to implement these changes.

Opportunities and co-benefits: Processing recycling locally would reduce the need for manufacturers to create new plastics. This progress toward a closed-loop economy, in which manufacturers build new products with reused materials, would be a powerful tool for reaching California's climate goals.

"*What we have before us are some breathtaking opportunities disguised as insoluble problems*," said John Gardener, former Secretary of Health, Education, and Welfare. Bay Area engineers, entrepreneurs, and policymakers could use the impending recycling problems to turn this adversity into an opportunity.

Mountain View's contracts with Recology and the SMART Station are due for review and renewal in 2020 and 2021.

Threats: The biggest threat is overseas markets undercutting pricing, which gives a temporary respite but offers no long-term sustainable solution.

Municipalities where already implemented, if known: Lodi, CA: HDPE is currently being recycled in Lodi. Waste incineration is popular in Europe, where nearly one-quarter of all municipal solid waste is incinerated. France has 126 waste-to-energy plants, while Germany has 121 and Italy 40. The Reppie project in Ethiopia is an example of countries collaborating to solve the recycling/trash crisis.

Funding sources, if known: CalRecycle's loan and grant programs are designed to encourage exactly this sort of innovation. This also could reach the state level and be funded by California.

Assumptions and uncertainty

Assumptions with High Uncertainty: The revenue from recovered materials will offset the costs of collecting and separating the waste.

Assumptions with Low Uncertainty: Landfill and recycling can be managed in new ways; there is a huge opportunity awaiting.

Authors Jane Horton, Hala Alshahwany

Detailed analysis

Environmental analysis

Many cities around the country celebrated Earth Day by highlighting their recycling programs, but the industry is grappling with multiple threats: The value of recovered waste products has plummeted over the past five years, the amount of effort and energy required to extract them has risen, and foreign markets have made it difficult to send recycling overseas.

A new local recycling center would be in alignment with Mountain View's Zero-Waste Plan, which seeks to further reduce the per capita disposal rate for both residential and commercial waste. In addition, the City has set a goal of reducing greenhouse gas emissions twenty percent below 1990 levels by 2020. This also addresses climate change by including waste reduction strategies to reduce carbon emissions. Local control and tighter standards will create a higher diversion rate and help us reduce transportation-related emissions. It also guarantees that we will not have disruption in our recycling programs.

The current trend to switch to electric vehicles, including large trucks used to transport waste, will make it possible for recyclables to be transported within California without producing direct GHG emissions. This is a direct contrast with the concept of taking our materials to the Port of Oakland and shipping them overseas. The environmental impact of shipping includes **greenhouse gas emissions, acoustic pollution, and oil pollution.** The International Maritime Organization (IMO) estimates that CO_2 emissions from shipping were equal to 2.2% of the global anthropogenic emissions in 2012.[117]

- **Ballast water** discharged by ships can have a negative impact on the marine environment. Ballast water discharge typically contains a variety of biological materials, including plants, animals, viruses, and bacteria. These materials often include non-native, nuisance, invasive, exotic species that can cause extensive ecological and economic damage to aquatic ecosystems.
- **Noise pollution** ships can travel long distances, and marine species who may rely on sound for their orientation, communication, and feeding, can be harmed by this sound pollution.
- Marine mammals, such as whales and manatees, risk being **struck by ships**, causing injury and death. One notable example of the impact of ship collisions is the endangered North Atlantic right whale, of which 400 or less remain. The *San Jose Mercury News* reported in May 2018 that two dead whales washed up in the San Francisco Bay, both showing injuries from ship propellers.[118]
- **Exhaust gases** from ships are a significant source of air pollution, both for conventional pollutants and greenhouse gases. **Air pollution** is generated by diesel engines that burn high sulfur content fuel oil, also known as bunker oil, producing sulfur dioxide, nitrogen oxide, and particulates, in addition to carbon monoxide, carbon dioxide, and hydrocarbons. Diesel exhaust has been classified by EPA as a likely human carcinogen. EPA recognizes that emissions from marine diesel engines contribute to ozone and failure to meet air quality standards, as well as adverse health effects associated with ambient concentrations of particulate matter and visibility, haze, acid deposition, and eutrophication and nitrification of water.

Of total global air emissions, shipping accounts for 18 to 30 percent of the nitrogen oxide and nine percent of the sulfur oxides. Sulfur in the air creates acid rain, which damages crops and buildings.

---

[117] https://en.wikipedia.org/wiki/Environmental_impact_of_shipping#cite_note-1
[118] https://www.mercurynews.com/2018/05/18/dead-whale-washes-up-in-oakland-estuary/

Cost analysis

Cost is unknown and dependent on the capacity and the cities and businesses that would collaborate in this effort. If this can be advanced to a state project, then the costs could be borne by the state of California. However, the chart below shows an estimate of what costs might look like:

Staff hours of Outreach / Collaboration / Research / Ongoing processes	Hourly rate	2020 Costs	2021 Costs	2022 Costs	2023 Costs	2024 Costs	$ Total Costs
600	$90	$54,000	$54,000	$54,000			$162,000
400	$90				$36,000	$36,000	$72,000
Funding for studies / misc.				$25,000	$25,000	$25,000	$75,000
							$309,000

Scale analysis

Globally there are many examples of new and innovative solutions to turning trash and recyclables into clean energy. There are also existing facilities in California; however, it may be ideal to have one-stop processing instead of sending materials to many different locations.

Current legislative efforts

SB 168 (Wieckowski) Minimum Recycled Content - Next Step: Assembly Natural Resources Committee. SB 168 requires CalRecycle to establish minimum recycled content standards for beverage containers. While Californians are proud of their recycling efforts, most are unaware that while our collection for recycling rates are high, much of the materials are in fact exported overseas for recycling. Half of PET beverage containers collected for recycling are still exported out of state, and out of the country to China, Vietnam and elsewhere. **This bill will increase the amount of plastic recycling in-state, meet consumers' basic expectations for buying recycled products, and create parity with the other container minimum recycling laws.**

AB 2766 (Berman) Plastic Market Development - Next Step: Assembly Appropriations Committee. This bill would reinstate California's successful Plastic Market Development (PMD) program for an additional five years. Prior to sunsetting on December 31, 2017, the PMD program ensured that between 75-80% of all plastic bottles were collected, processed, and manufactured into new products right here in California – providing quality in-state jobs, conserving natural resources, and keeping product-associated greenhouse gas emissions low.[119]

[119] https://www.cawrecycles.org/legislation/

W1 References

http://www.calrecycle.ca.gov/recycle/

https://www.usatoday.com/story/news/politics/2017/04/20/weak-markets-make-consumers-wishful-recycling-big-problem/100654976/

https://www.unenvironment.org/news-and-stories/story/ethiopias-waste-energy-plant-first-africa

https://en.wikipedia.org/wiki/Environmental_impact_of_shipping

https://en.wikipedia.org/wiki/Waste-to-energy

https://www.africawte.com/

http://cambridge-industries.com/

https://factfinder.census.gov/faces/nav/jsf/pages/community_facts.xhtml

https://www.thebalance.com/plastic-recycling-facts-and-figures-2877886

http://www.scmp.com/comment/insight-opinion/article/2126098/24-reasons-why-chinas-ban-foreign-trash-wake-call-global

https://sfenvironment.org/news/press-release/mayor-lee-announces-san-francisco-reaches-80-percent-landfill-waste-diversion-leads-all-cities-in-north-america

Pass a resolution to support “Green Monday” **(W2)**							**Resolution**	**Ongoing**	
Recommendation name							Type	Duration	
115,803	**$78,580**	**0**	**$0.68**	●●●	●●○	○○○	●●○	●●●	●●●
MT CO2e reduction 2018-2030	City’s Net Cost	Incremental Net Cost	Net cost per MT CO2e reduction	Easy to implement	Easy to measure	Private investment leverage	Local economic benefits	Other environmental benefits	Health benefits

Note: MT CO2e reduction and resulting net cost are calculated using the CBI method of measurement.

Problem description

Americans’ appetite for meat and dairy takes a toll on the environment and the climate. In 2016, 9,000,000,000 (nine billion) factory-farmed animals were slaughtered in the USA for food.[120] Producing all this meat and dairy generates greenhouse gases, as well as large amounts of toxic manure and wastewater that pollute groundwater, rivers, streams and, ultimately, the ocean. The production of 2.2 lbs. of beef causes about 29.2 lbs. of CO_2. This is the same quantity of CO_2 that is released in the combustion of 1.6 gallons of gasoline.

Recommendation

The City of Mountain View should pass a resolution to support “Green Monday” by encouraging the eating of plant-based foods once a week. Mountain View should provide outreach and partnerships with Green Monday (http://greenmonday.org) to implement a scheduled rollout of Green Monday, which is a voluntary global movement with a simple message: once a week, eat plant-based food.

SWOT analysis

Strengths: Green Monday provides information, news, recipes and free promotional materials to help individuals, schools, restaurants, hospitals, food companies and entire communities to start each week with a commitment to eating healthy, environmentally-friendly, meat-free meals. At public forums and other outreach events conducted by this Task Force, Mountain View residents showed concern that there is not more education about the connection between factory farming, eating meat, and global warming.

Weaknesses: While meat consumption can be a large part of an individual’s consumption-based carbon footprint, it is not part of Mountain View's current non-consumption-based inventory. The data referenced in this recommendation assumes a consumption-based inventory (i.e., it considers the end-to-end carbon footprint of different diets, not just what might be created within Mountain View).

Opportunities and co-benefits: Restaurants may lower their costs by not purchasing meat for one day a week, and they may lower their risk of cross-contamination on the days when meat is not prepared in their kitchens. Data shows that 30% of Americans are trying to reduce their meat consumption.

Threats:

- Possible resistance from restaurants, industry representatives, and farm lobby groups.
- Public perception that plant-based diets are incomplete.
- Americans consume 60% more meat than Europeans, and the global appetite for meat is exploding. From 1971 to 2010, worldwide production of meat tripled to around 600 billion

[120] https://awfw.org/factory-farms/

pounds. At this rate, production will double by 2050 to approximately 1.2 trillion pounds of meat per year, requiring more water, land, fuel, pesticides and fertilizer and causing significant damage to the planet and global health.

Municipalities where already implemented

Factory Farming Awareness Coalition's Director of Strategic Partnerships has been working on Green Monday in meetings with members of the Berkeley City Council. FFAC is also working with Multnomah County in Portland; they are incorporating Green Monday into their Climate Action Plan 2020 update.

As of 2014, results of a survey by market research company Ipsos showed that 1.6 million Hong Kong people, or 23% of the city's total population, embrace Green Monday - an increase of 18% from 2012, and over 1,000 restaurants in Hong Kong are offering their menus. In 2015, Green Monday launched "Green Common" in Hong Kong to empower the community with food choices that are sustainable, innovative, wholesome and responsible.

Green Monday and a parallel organization, Meatless Monday, are now active in more than 44 countries and continue to grow. Representatives from different nations are finding innovative ways to make meatless and vegetarian dishes part of their everyday culture, customs and cuisine. A sampling of participating countries is listed in the W2 Appendix.

Funding sources

Sustainability budget; additionally, Vegfund.org[121] will partially fund vegan food samples at outreach and education events.

Assumptions and uncertainty

Assumptions:

- Resident populations eat all meals in Mountain View over the course of the week (seven days).
- 50% of the worker population is having one meal over the course of five days.

Assumptions with Low Uncertainty:

- A study of British people's diets was conducted by University of Oxford scientists and found that meat-rich diets resulted in 7.2kg of carbon dioxide emissions. In contrast, both vegetarian and fish-eating diets created about 3.8kg of CO2 per day, while vegan diets produced only 2.9kg. The research analyzed the food eaten by 30,000 meat eaters, 16,000 vegetarians, 8,000 fish eaters and 2,000 vegans. [122]

Author Jane Horton

---

[121] http://www.vegfund.org/
[122] https://link.springer.com/article/10.1007%2Fs10584-014-1169-1

Detailed Analysis

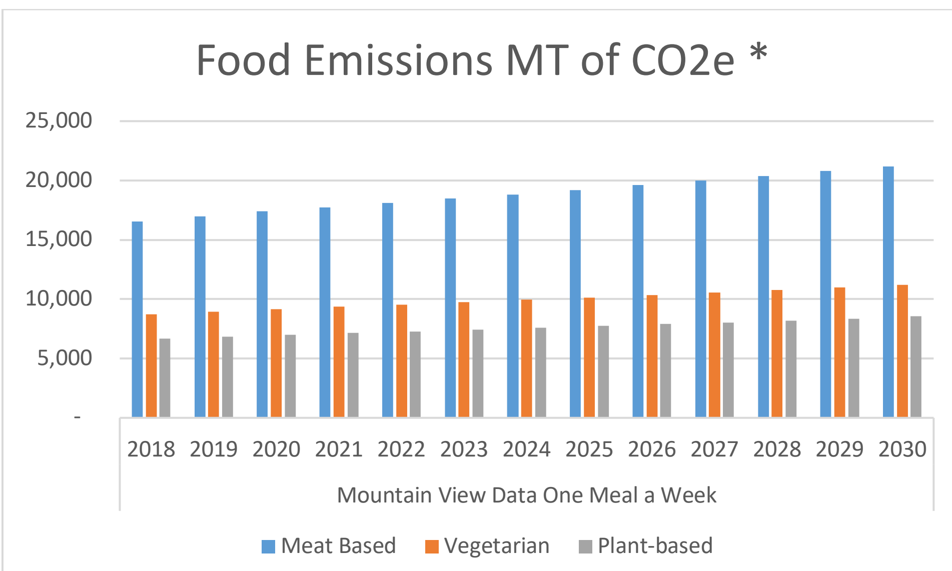
Environmental analysis

Green Monday cites references from the United Nations that the livestock industry and factory farming are the number one contributor to the world's carbon footprint. Meat production also consumes a disproportionate amount of water and land resources, which directly jeopardizes food security and environmental sustainability.

The chart below shows the comparison of carbon emissions based on eating three different diets just one day a week, one meal a week, from 2018-2030. This is based on the projected resident and service worker population growth of Mountain View. The data shows that if no diet changes are made, and meat-based meals continue, the MT CO2e in Mountain View will be 245,230 for one meal a week over the span of 12 years. For vegetarian meals, the carbon emissions will be 129,427, a savings of 115,803 MT. For vegan meals one meal a day, one day a week, the MT of CO2e saved will be 146,457.[123]

	MT CO2e	MT CO2e savings
Meat Based	245,230	0
Vegetarian	129,427	115,803
Plant-based	98,773	146,457

Based on projected population growth, the chart below shows the contrast in CO2e emissions. This compares one day a week, one meal a week, for the year, for meat-based meals, for vegetarian meals, and for plant-based meals. Being meat-free one day a week is an easy way to reduce consumption-based GHG emissions. (See W2 Table 1 in the W2 Appendix for the details of the analysis.)



Health benefits of Green Monday

Reduce heart disease and stroke: Fruits and vegetables help fight cardiovascular disease. Eating no meat on Mondays encourages people to increase vegetable, fruit, whole grain, and legume intake.

[123] https://drive.google.com/drive/u/0/folders/1SY8HCy3il5YUGHgQbmk5CNTH7xOOpoyr

Lower cancer risk: Red meat or processed meat may increase the risk of colorectal cancer. Having a diet rich in vegetables and fruits may lower the risk of cancer.

Prevent diabetes: Diets low in processed meat and high in plant-based foods may reduce the risk for type 2 diabetes. Adding more greens to a diet can help maintain a healthy weight, which is a key factor in preventing type 2 diabetes.

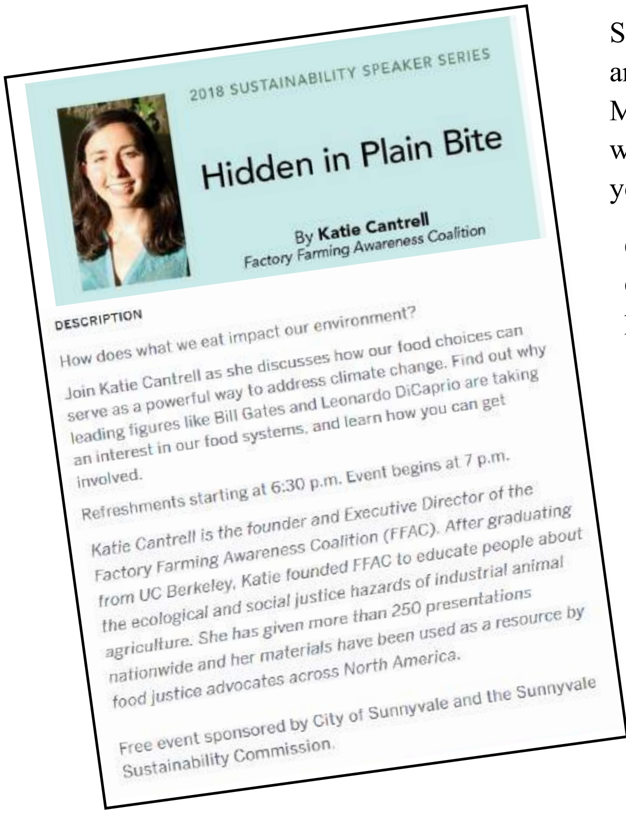
Prevent obesity: Because greens are rich in fiber, those who eat vegetarian diets have a lower risk of obesity. As obesity may lead to other health issues, Green Monday may help maintain a healthy weight.

Cost analysis: The suggested process includes the following:

Action	Resources	Cost
Year One: City partners with *Green Monday (GM)* in outreach to Castro St. eateries to introduce *GM* and guide restaurants through process. *GM* provides promotional materials, training, recipes, plus some volunteers to assist. Promotional materials are posted on Castro St., and *The Voice* runs ads. Two presentations by *GM* to public including food samples	-Staff time 12 hours a month -Food -*MV Voice*	$12,960 $300 $600
Year Two: GM officially rolls out on Castro St. Restaurants feature weekly plant-based special. "Punch-cards" made available – after ten punches, then $5 off meal (200 total); Ads in *MV Voice*	Staff time 12 hours a month Punch card offset *MV Voice*	$12,960 $1000 $400
Year Three: Reach out to Hong Kong to form *GM* Sister City (great media opportunity to have international partnership). Start a week-long competition between restaurants "Best Veg Option" & repeat annually. *GM* table at Art & Wine Festival – restaurants feature samples; repeat annually	-Staff time one day month -*MV Voice*	$8,640 $400
Year Four: Outreach to San Antonio Center eateries to introduce *GM* and guide restaurants through process. Promotional materials are posted in San Antonio Center & *The Voice* runs ads. Two presentations to public including food samples	-Staff time one day month -Food - *MV Voice*	$8,640 $300 $400
Year Five: Roll out of GM at San Antonio Center. Restaurants feature weekly plant-based special. "Punch-cards" made available at San Antonio Center – after ten punches, then $5 off meal (200 total)	-Staff time four hours a month -Punch card offset -*MV Voice*	$4,320 $1000 $400
Year Six: Continue limited outreach to Castro St. and San Antonio Center. Mountain View to encourage plant-based foods at City-sponsored events.	-Staff time four hours a month -*MV Voice*	$4,320 $400
Year Seven: Continue limited outreach to Castro St. and San Antonio Center. Mountain explore hosting Plant-based food festival.	-Staff time four hours a month -*MV Voice*	$4,320 $400
Year Eight: Continue limited outreach to Castro St. and San Antonio Center. Mountain hosts a Plant-based food festival.	-Staff time four hours a month - *MV Voice*	$4,320 $400
Year Nine: Continue limited outreach to Castro St. and San Antonio Center. Consider plant-based festival based on success of previous year	-Staff time four hours a month -*MV Voice*	$4,320 $400
Year Ten: Continue limited outreach to Castro St. and San Antonio Center.	-Staff time two hours a month -*MV Voice*	$2160 $300
Year Eleven: Continue limited outreach to Castro St. and San Antonio Center.	-Staff time two hours a month -*MV Voice*	$2160 $300
Year Twelve: Continue limited outreach to Castro St. and San Antonio Center.	-Staff time two hours a month -*MV Voice*	$2160 $300

Sustainability staff will be needed to coordinate with Green Monday. Green Monday is available to help train and assist in the process of adopting the switch to plant-based food once-a-week. They provide posters, literature, stickers, and assistance in implementing. The budget request for twelve years is $78,580. **The net cost per MT CO2e reduction is $0.68** under a consumption-based inventory.

The punch-cards would be used the first six months as part of the rollout. This helps track engagement and carbon savings. Green Monday volunteers would answer questions, provide literature and statistics, and encourage activities such as competitions and/or tracking to get Green Monday rolling.



Sacramento currently hosts a week-long competition among local restaurants for the "Best Veg" option. Mountain View could model theirs after Sacramento, which includes a plaque and bragging rights for the year.

Oakland hosts an annual plant-based food festival, and Green Monday involvement could help Mountain View host a similar festival.

Scale analysis

This has already been proven to be scalable to whole cities on a global scale; see W2 Appendix.

W2 References and Footnotes

http://waterfootprint.org/en/water-footprint/product-water-footprint/water-footprint-crop-and-animal-products/

https://foodtank.com/news/2013/12/why-meat-eats-resources/

https://www.motherjones.com/environment/2014/07/american-meat-consumption-changing-better/

https://www.ffacoalition.org

http://greenmonday.org/

http://www.meatlessmonday.com

http://www.gracelinks.org/library/resizer.php?src=/images/hor_8651.jpg&w=600&h=300&zc=1&q=100

https://www.theguardian.com/environment/2014/jul/21/giving-up-beef-reduce-carbon-footprint-more-than-cars

https://link.springer.com/article/10.1007%2Fs10584-014-1169-1

https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator

https://www.patientfirst.com/blog/health-benefits-of-meatless-monday.aspx?PostId=195&tabid=819

W2 Appendix: Municipalities implementing Green Monday

In 2009, Ghent, Belgium, became the first non-U.S. city to promote a citywide meat-free day. Shortly thereafter, Paul McCartney introduced the U.K. to "Meat-Free Mondays."

Below is a partial list of places where Green Monday or Meatless Monday have programs:

1. Australia: Meat Free Mondays is an initiative of Do Something! started in 2013.
2. Belgium: Meat Free Monday Belgium is a project of Planete Vie.
3. Bhutan: In Bhutan, Meatless Monday is known as "Jangsem Monday."
4. Bolivia: Lunes sin Carne was launched in Bolivia in January 2014.
5. Brazil: In Brazil, Segunda Sem Carne was founded in 2009.
6. Chile: Vegetarianos Chile runs their national Lunes sin Carne movement.
7. Croatia: The Croatian Meatless Monday program is led by Animal Friends Croatia. The capital Zagreb was the first city to officially support Meatless Monday.
8. Denmark: Meat Free Monday Denmark was started in 2012; Kødfri Mandag brought Meatless Monday to three universities in Denmark.
9. France: In France, Meatless Monday has been appropriated as "Jeudi Veggie".
10. Germany: In Germany, "Donnerstag ist Veggietag" was launched in 2010.
11. Holland: In Amsterdam, the Zuidas Meatless Monday Campaign launched in 2014.
12. Honduras: Lunes sin Carne campaign in Honduras is led by national nutrition leaders.
13. Hong Kong: In Hong Kong, Meatless Monday is part of the "Green Monday" movement. *Green Monday* has support from organizations, schools, government and the Hong Kong International Airport Authority. As of 2014, results of a survey by market research company Ipsos showed that 1.6 million Hong Kong people, or 23% of the city's total population, embrace *Green Monday* and over 1,000 restaurants in Hong Kong are offering their menus.
14. Hungary: Earth Day Foundation brought Meatless Monday to Hungary.
15. Iran: Meatless Monday was introduced to Iran in 2013 through the Omega Research Team.
16. Israel: Meatless Monday Israel was launched in 2012. In 2014 a report showed that 20.8% of Israelis have adopted the initiative since it was launched.
17. Italy: Lunedì No Meat campaign launched November 2014 in Sicily.
18. Jamaica: Meatless Monday launched in 2010 through Kingston Kitchen.
19. Japan: Veggie Monday Japan is an initiative launched in 2010, currently backed by The Ethical Vegan Society of Japan.
20. Korea: Korea's robust website delivers a simple and inspiring message: "When you do not eat meat one day a week, you are an environmentalist."
21. Kuwait: Meatless Monday Kuwait is an initiative of the nutrition department in Kuwait Cancer Control Center.
22. Luxembourg: Meat Free Monday Luxembourg launched in May 2015.
23. New Zealand: Meat Free Monday New Zealand, supported by the Berrysmith Foundation.
24. Norway: The Meatless Monday's mission? Saving the world.
25. Perú: "Lunes sin Carne", Meatless Monday Peru was launched in 2014.
26. Philippines: "Luntiang Lunes" led by Dr. Custer C. Deocaris.
27. Portugal: In Portugal, Meatless Monday known as Sem Carne, was founded in 2009.
28. Singapore: The Green and Healthy Monday campaign was launched in 2016 as "a free, easy and fun way to make a positive difference in the world."
29. Slovakia: The Slovak Vegan Society established Green Monday in the spring of 2016.

30. South Africa: South Africa launched Meat Free Monday in 2011.
31. Spain: Spain's movement launched in 2011.
32. Sri Lanka: Meatless Monday Campaign in Sri Lanka draws on the successful worldwide campaigns of Meatless Monday.
33. Sweden: The Swedish Meatless Monday campaign is a grassroots effort.
34. Taiwan: Taiwan's Meat Free Monday program was founded in 2009.
35. Togo: Food For Life Togo successfully launched Lundi sans viande in May 2016.
36. U.K.: Launched in the UK by Paul, Mary, and Stella McCartney in 2009.

"World Health Summit Sits Down to Table for Meatless Monday:" The positive impact of Meatless Monday was high on the menu at the eighth annual World Health Summit in Berlin, Germany, October 2016.

"Climate Change and the Global Diet": Meatless Monday at the COP21 climate summit. In December of 2017, representatives from more than 200 nations gathered to discuss and decide the future of climate change and the fate of our planet. While many proposals aimed to help reduce climate change, it is impossible to reach the COP21 goals without including meat consumption in the equation.

W2 Table 1. Calculations and assumptions.

MEAT-BASED DIET	2018	2030	
Resident Population	81,978	103,968	From BAU
Monday Resident Meal Emissions (Kg of CO2E)	10,128,546	12,845,454	(Resident Population) x (Meat CO2 daily emmissions x .33) x (52 days) Resident population eating one meal a day one day a week
Worker Population	103,663	135,362	From BAU
Monday Worker Meal Emissions (Kg of CO2E)	6,403,885	8,362,123	(Worker Population x .5) x (Meat CO2 daily emmissions x .33) x (52 days) 1/2 of work population eating one meal a day one day a week
Monday Service Population Meals Emissions (Kg CO2e)	16,532,431	21,207,577	Annual CO2 from residents and 1/2 worker population eating one meat-based meal a week
PLANT-BASED (VEGETARIAN) DIET			
Resident Population	81,978	103,968	From BAU
Monday Resident Meal Emissions (Kg of CO2E)	5,345,621	6,779,545	(Resident Population) x (Vegetarian CO2 daily emmissions x .33) x (52 days) Resident population eating one meal a day one day a week
Worker Population	103,663	135,362	From BAU
Monday Worker Meal Emissions (Kg of CO2E)	3,379,828	4,413,343	(Worker Population x .5) x (Vegetarian CO2 daily emmissions x .33) x (52 days) 1/2 of work population eating one meal a day one day a week
Monday Service Population Meals Emissions (Kg CO2e)	8,725,450	11,192,888	Annual CO2 from residents and 1/2 worker population eating one vegetarian-based meat a week
PLANT-BASED (VEGAN) DIET			
Resident Population	81,978	103,968	From BAU
Monday Resident Meal Emissions (Kg of CO2E)	4,079,553	5,173,864	(Resident Population) x (Vegan CO2 daily emmissions x .33) x (52 days) Resident population eating one meal a day one day a week
Worker Population	103,663	135,362	From BAU
Monday Worker Meal Emissions (Kg of CO2E)	2,579,343	3,368,077	(Worker Population x .5) x (Vegan CO2 daily emmissions x .33) x (52 days) 1/2 of work population eating one meal a day one day a week
Annual Service Population Meals Emissions (Kg CO2e)	28,635,325	36,316,542	Annual CO2 from residents and 1/2 worker population eating one meat-based meat a week
Monday Service Population Meals Emissions (Kg CO2e)	6,658,896	8,541,941	Annual CO2 from residents and 1/2 worker population eating one vegan-based meat a week

Expand Mountain View's composting program to all residential and commercial properties (**W5**)	**Mandatory**	**Perman-ent**
Recommendation name	Type	Duration

91,837	**$225K**	**Unknown**	**$2.45**	●○○	●●●	○○○	●○○	●●○	○○○
MT CO_2e reduction 2018-2030	City's Net Cost	Incremental Net Cost	Net cost per MT CO2e reduction	Easy to implement	Easy to measure	Private investment leverage	Local economic benefits	Other environmental benefits	Health benefits

Problem description

"*The generation of waste, and the placement of materials in waste disposal facilities such as landfills, negatively impacts human health, wastes natural resources, and transfers liabilities to future generations*." Mountain View City Council 2018 Zero Waste Policy (Draft).

Food scraps comprise approximately 35 percent of a household garbage cart. When food scraps are disposed of alongside general municipal solid waste, they inevitably end up in landfill where they decompose and produce methane, which is a significant greenhouse gas. If food scraps and food-soiled paper are separated at source, for example, in a designated compost cart, they can be collected along with yard trimmings, and transferred to a compost facility which gives them a second useful life as compost for landscape growers.

In July 2017, the City of Mountain View started "The Curbside Food Scraps Program" for residents with curbside waste collection service (individual carts), including single-family homes, row-houses, townhomes, mobile homes, and small multi-family complexes (1-8 units). A similar program to include large multi-family properties was to be piloted in 2018, however, it has not started, at the time of this recommendation.

Recommendation

The Curbside Food Scraps Program should be expanded to include all residential and commercial properties in Mountain View.

SWOT analysis

Strengths:

- Keeping food scraps and food-soiled paper out of the landfill not only reduces greenhouse gas emissions but also turns these resources into useful compost.
- The City has already had several years of experience successfully implementing a curbside composting program.

Weaknesses:

- Large multi-family complexes and apartment buildings can pose a logistical difficulty in terms of compost storage and collection.
- Determining how multi-family properties pay for the composting service could be challenging. The cost of the current curbside food scraps program is part of a "bundled" rate that includes collection and service of all individual carts (waste, recycling, compost)

plus street sweeping, SMaRT station buy-back and drop-off, and many other additional waste-related services.

Opportunities and co-benefits:

- This measure would help the city achieve Zero Waste Policy (Draft) Item 1: "*Work to reduce the amount of waste generated and disposed of by Mountain View employees, businesses and residents with a goal that 80 percent of materials are diverted from landfill by 2020 and 90 percent by 2030*." Currently, the City's diversion rate is estimated at 76 percent.
- There is an opportunity to include composting in the city code for new buildings (for example, a dedicated compost chute alongside trash and recycling).
- There is an opportunity to collaborate with other local cities, particularly MV's SMaRT station partner cities, as there may be an economy of scale to be harnessed.
- There are currently five companies in MV that already have a successful "invitation-only" composting service through Recology / City of MV. Intuit, Google, and Microsoft are three of those participants. Food scraps are weighed daily so that the diversion rate can be calculated. For LEED-certified buildings, this is a great way to help companies reach their diversion rate goals. An assumption is that large companies in Mountain View would cooperate and would welcome the opportunity to have a compost program in conjunction with the city.

Threats:

- Potential pushback from property management companies.
- Waste stream contamination is already an issue for recycling. High level commitment to education and outreach is essential to ensure the success of this program.
- There is a high turnover of tenants in multi-family complexes and apartments, therefore, continual outreach and education will be required to ensure all residents understand how to separate their waste streams.
- Retrofitting collection equipment or finding space for additional carts may prove challenging.

Municipalities where already implemented

Examples listed in W5 Appendix 1.

Funding sources

Funded through utility rates.

Assumptions and uncertainty

Assumptions with High Uncertainty: Staff time required to plan and implement; program costs.

Assumptions with Low Uncertainty: GHG emission savings.

Authors Heather Lamont and Varun Rathi

Detailed analysis

Environmental analysis

A spreadsheet containing detailed environmental analysis of potential GHG emission reductions possible through expansion of the existing composting program to include multi-family homes is included in W5 Appendix 2.

Cost analysis

The cost of the current food scraps program for residents residing in single-family dwellings subscribed to curbside service is estimated to result in a 5 percent rate increase (e.g. $1.60 per month for a 32-gallon cart in 2018-19) for residents with curbside service (individual carts). The curbside service rate is a "bundled" rate and includes the collection and processing of all individual carts (garbage, recycling, and compost), as well as street sweeping, three free On Call Plus clean up appointments, household hazardous waste events, confidential shredding events, home compost workshops, access to the Mountain View Recycling Center and the SMaRT Station buy-back and drop-off services, utility billing, and many more services that residents have come to enjoy. The cost increase is due to an increase in truck routes, as cart collection is now weekly.

Extrapolating these costs to the individual residents of a multi-family apartment will depend on a variety of factors and cannot be calculated within the scope of this recommendation. Allocation of appropriate staff time to implement this program is essential; therefore, the cost discussed below is the cost to the city regarding implementation.

Staff months of outreach, collaboration, research, and implementation	Monthly rate ($)	2020 costs ($)	2021 costs ($)	2022 costs ($)	Total costs ($)
6 months	15,000	90,000	90,000		
3 months	15,000			45,000	
					225,000

Additional outreach and education should also be expected on an ongoing basis once the program is established to ensure the appropriate wastes are being placed in the compost collection carts. This may go beyond current staff resource capabilities and would require additional funding.

Scale analysis

We recommend the City undertake a pilot program to evaluate collection methods and charging options.

W5 References

https://lbre.stanford.edu/pssistanford-recycling/composting/food-and-compostable-material-collection

Organic Waste Management in Apartments, Final Report (2005) Environmental Research Technological Development and Innovation (ERTDI) Programme.

https://www.epa.ie/pubs/reports/research/waste/ERTDI%20No71_WEB%20final-with-cover.pdf

https://mountainview.gov/depts/pw/includefood/includefood/default.asp

https://sfenvironment.org/sites/default/files/fliers/files/sfe_zw_mandatory_factsheet.pdf

W5 Appendix 1: Municipalities where already implemented

Brescia, Italy. Implemented organic food waste collection from 110,000 households (30% low-rise, 70% high-rise, 3–10 floors). Utilized communal collection points: 2,400-liter bins for organic waste with collection three times per week.

Los Altos, CA. Mission Trail Waste Systems provides residential, commercial, and industrial collection services for garbage, recycling, and organics for the City of Los Altos, which includes multi-family complexes. The recycling and organics collection service is provided for no additional charge to multi-family residential complexes. Detailed information is available on their website: http://www.missiontrail.com/LosAltos/multifamily-recycle-organics.html.

Nightingale Estate, London, UK. Implemented organic food scraps collection from 17 estates of high-rise apartments, total 6,500 households. Weekly door-to-door collection. Won National Recycling Awards 2004 – Best Community Project and Won Composting Association Awards 2004 – Best Community Initiative.

San Francisco, CA. All residents of San Francisco are required by the San Francisco Mandatory Recycling and Composting Ordinance to keep their recyclables, compost and trash separate. Property owners/managers, including of apartments, condos, TICs, food establishments, and events are required to provide color-coded, labeled bins in convenient locations: blue for recycling, green for composting, and black for trash. The ordinance also requires that education must be provided to tenants, employees, contractors, and janitors regarding what goes in each bin. Food vendors that provide disposable food service ware or to-go containers must provide blue, green, and black bins for use by customers and visitors. These must be placed in the establishment, near a main exit.

Stanford University, CA. Currently, Stanford requires food and compostable material collection service at the following locations: all dining halls and graduate and student managed housing on campus, residence halls, campus cafés/restaurants, medical school kitchens, faculty-staff housing, 2 elementary schools, 2 nursery school, Stanford Stadium, Maples Pavilion, other athletics venues, and special events.

W5 Appendix 2: Detailed environmental analysis of potential GHG emission reductions

		Actual	Actual	Actual	Est.	Est.	Est.
HOUSING & POPULATION	**Formula Used**	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
Resident Population		70,629	74,066	77,250	85,290	94,167	103,968
Single Family Units		13,100	14,300	14,771	15,241	15,644	15,884
Multifamily Units		**18,817**	**18,484**	**18,939**	**22,931**	**26,996**	**31,296**
Mobile Homes		1,231	1,097	1,097	1,097	1,097	1,097
Total Housing Units		33,148	33,881	34,807	39,269	43,737	48,277
Persons per Housing Unit		2.13	2.19	2.22	2.17	2.15	2.15
# of People in Multifamily Units	C7*C11	40,094	40,407	42,033	49,805	58,123	67,398
Assume 50% participation	50%*C13	20,047	20,204	21,016	24,902	29,062	33,699
Total Daily Trash Generated by Multifamily Units (lbs.)	C14*2.87	57,534	57,984	60,317	71,470	83,407	96,716
Total Annual Trash Generated by Multifamily Units (lbs.)	C14*365	21,000,077	21,164,275	22,015,761	26,086,513	30,443,454	35,301,488
Compostable Trash Sent to Landfill (lbs.)	35%*C15	7,350,027	7,407,496	7,705,516	9,130,280	10,655,209	12,355,521
Compostable Trash Sent to Landfill (MT)	C17/2204.62	3,334	3,360	3,495	4,141	4,833	5,604
CO2e EMISSIONS							
Emissions from compostable waste going to landfill with no gas collection (MTCO2e)	C18*1.47	4,901	4,939	5,138	6,088	7,105	8,238
Emissions from compostable waste going to landfill with gas collection but no energy recovery (MTCO2e)	C18*0.37	1,234	1,243	1,293	1,532	1,788	2,074
Emissions from compostable waste going to landfill with gas collection and energy recovery (MTCO2e)	C18*0.21	700	706	734	870	1,015	1,177
REDUCTIONS POSSIBLE							
Fertilizer Production Displacement Credit (MTCO2e)	C18*0.03	100.02	100.80	104.86	124.24	144.99	168.13
Total Emission Reductions (MTCO2e)	**C21 + C25**	**5,001**	**5,040**	**5,243**	**6,212**	**7,250**	**8,407**

Chapter 5:
Outreach, Regional Collaboration, and Advocacy Recommendations

90%

of Mountain View citizens are concerned about climate change

67%

are ***extremely*** concerned

The Outreach, Regional Collaboration, and Advocacy Working Group, made up of eight dedicated people, has spent the last several months working with our community. We have hosted over 130 people at formal public input forums, met several hundred people at the Farmer's Market, Arbor Day, the Family Parade and at corporate Earth Day events at Google, NASA, and Fenwick & West, and conducted an online survey that reached over 900 people who live and/or work in Mountain View.

We received many great ideas, most of which are incorporated throughout this report. We are proud that our community is informed, and we are pleased that this report is reflective of community needs. But what impressed us most of all is the incredible passion for Mountain View's future, for more and better sustainability information, and the demand for aggressive environmental protections in all areas of our community. Mountain View residents love this city. Even those who have lived here more than 50 years embrace change, but all request that the City step up its environmental game.

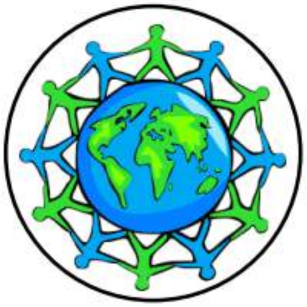
As one resident told us at our forum on April 30, 2018, "It's time that Mountain View shows the residents, and the world around us, that it actually means business when it comes to sustainability." We agree.

We also put in motion the kind of partnerships required for regional collaboration and advocacy and proved that a hunger exists for more and better collaboration. We met with County Supervisor Joe Simitian's office, who expressed desire to work with Mountain View on a regional workshop, bringing together all sustainability advocates in the region. We met with the office of Assemblyman Marc Berman. We met countless non-profits, such as Friends of CalTrain, corporate sustainability-related teams, such as from Waymo and Google, and online outreach tool providers, among many others. The message is clear: everyone in the broader community sees Mountain View as a leader and wants to work with us. But building and maintaining those relationships requires people.

Three things are clear to us from our work:

1. An entire community requests more and better sustainability programming and outreach.
2. Our community, including residents and workers, along with every potential regional partner we met, wants much more interaction and collaboration with Mountain View city government.
3. Most people we spoke with were disheartened by Mountain View's current investment in sustainability, concerned about the lack of aggressive and innovative climate change protection measures, and eager to see change in the future.

Our recommendations listed by priority



O1 Create a new Sustainability Office for Mountain View

O2A Implement a residential and business outreach initiative

O2B Provide community engagement tools to facilitate household-level GHG reductions

O3 Conduct annual summit to review and track county, state, and federal sustainability actions

Our recommendations are unique in this report, because our recommendations are the enablers that make the other recommendations implementable. O1 and O2A allow these recommendations to get adopted successfully and on schedule. Without them, the other recommendations in this report are impossible to achieve. O2B further enhances the City's ability to reach and engaged with residents. O3 helps Mountain View understand and prepare and influence the legislation that impacts us.

We believe that the recommendations from our working group are vitally necessary for the City of Mountain View to be able to engage with regional partners and the community at large. All five of the working groups agree that recommendation **O1 – creating a new Sustainability Office – is the most important recommendation in the entire report.**

Create a new Sustainability Office for Mountain View (**O1**)							**Staffing**	**12 yrs.**	
Recommendation name							Type	Duration	
Unknown	**$6.5M**	**$0**	**Unknown**	●●○	●●○	●○○	●●○	●●●	●○○
MT CO_2e reduction 2018-2030	City's Net Cost	Incremental Net Cost	Net cost per MT CO2e reduction	Easy to implement	Easy to measure	Private investment leverage	Local economic benefits	Other environmental benefits	Health benefits

Problem description

The City has not made major changes to the Sustainability Office since its inception in 2008, despite the city's phenomenal growth and missed carbon emissions goals [1]. In order to achieve its carbon emissions goals, the City needs an adequate number of staff with the right skills and experience to implement the recommendations the ESTF-2 makes (and to implement other programs our city's environment needs). In fact, without the staffing recommended here, very few of the ESTF-2 recommendations can be implemented, and those that are implemented may be dramatically delayed.

To succeed, the City will need to use both internal outreach across the City departments (which will help implement and enforce the recommendations) and public outreach to all residents. Strong regional collaboration will also be essential. However, this is not obtainable under the City's present staffing levels for sustainability initiatives. Adopting ESTF-2 requirements without elevating the Sustainability Office and adding staff will leave emissions reduction efforts even further behind.

Recommendation

Being in Silicon Valley, we have the potential to create novel and disruptive sustainability programs that positively impact our entire community. Sustainability is one of Mountain View's four areas of focus, and it should receive Silicon Valley-style innovation and effort.

The city should create a new Sustainability Office headed by a Chief Sustainability Officer (CSO). By January 2019, the office should be staffed with a CSO, a Sustainability Manager/Coordinator, two Sustainability Analysts, and a Sustainability Specialist, for a total of five full-time staff members. We also recommend the creation of a permanent resident advisory body, reporting to this office. The Sustainability Office requires an annual increase of $540,000 over the current City's Sustainability budget. The CSO should report to the City Manager.

The new office will ensure sustainability reaches all corners of Mountain View:

- Businesses, including small businesses
- Daytime-only population
- Renters and multi-family unit residents
- Non-English-speaking residents and workers
- Economically disadvantaged residents and workers

SWOT analysis

Strengths:

- The City is aware of the need for more community and regional outreach and collaboration, and sustainability is one of four key focus areas of the City.

- A CSO reporting to the City Manager will have the leverage for internal collaboration and outreach needed to implement the ESTF-2 recommendations across the City, and external leverage to build outside partnerships and collaborations.

Weaknesses:

- Mountain View is fiscally conservative, and this is a new, "moonshot" level request.

Opportunities and co-benefits:

- The CSO role will give Mountain View regional credibility and visibility in the sustainability community, providing support and opportunity for Mountain View to achieve its goals, including the awarding of grants.
- The Sustainability Office will have far greater reach than implementing the recommendations of this report. Beyond GHG, the office can look comprehensively at issues such as air pollution, water usage, jobs-housing balance, and zero waste.
- The Sustainability Office can support an ongoing task force, advisory board, or committee to further its work and create a bridge to the public.
- The Sustainability Office can build ongoing, permanent regional relationships at the city, county, regional level, and with businesses and NGOs.
- The Sustainability Office will be able to reach the entire community, which existing staff currently does not have the resources to reach.

Threats:

- The city council needs to fully buy into the long term support this Office needs.
- Silicon Valley's job market is highly competitive, and the CSO role is highly specialized. The internal-external facing combination is a unique skill set, and potentially hard to find.

Municipalities where already implemented

Palo Alto has a CSO with high visibility, Gil Friend. His visibility and focus has allowed Palo Alto to bring in $350k in grant money for sustainability in 2017 alone. San Jose has a CSO, Kerrie Romanow, whose position enabled her to integrate the city's climate plan into the general San Jose plan. Other cities such as Berkeley have a large Energy and Sustainability staff. Davis, Santa Monica, Austin, TX, and even Westminster, CO (population 114,000) are also leaders, and many have a Chief Sustainability Officer. Having a CSO is not related to a city's size, but rather to a city's resolve to prioritize sustainability.

Funding sources

Initial funding would come from the city budget. Future funding for specific programs may come from grants, corporate initiatives, and other innovative sources once staff exists to pursue these sources.

Assumptions and uncertainty

Assumptions with High Uncertainty:

- The City Council supports sustainability strongly enough to enact this recommendation.

Assumptions with Low Uncertainty:

- Successful implementation of ESTF-2's recommendations require the revitalization of the Sustainability Office and a CSO to lead it.

Author IdaRose Sylvester

Detailed analysis

The moral imperative

Big problems require big ideas and big commitments. In ten years, it will be too late to decide that sustainability was, in fact, a big enough problem to invest in a decade ago. At some point, digging out from our missed objectives and rushing to catch up becomes almost impossible. Today is that tipping point.

In the task force's sustainability survey, which reached 938 residents, 90% said they were concerned or quite concerned (67%) about global warming. 90% of the survey respondents said that tackling sustainability issues is a joint effort between the City and the community; almost nobody felt that residents are empowered and required to do this work themselves. This city-community collaboration is a critical aspect of building an informed, engaged, and positive community, especially when new measures are required that may change consumer behavior or require partnerships with corporations and other entities.

Public input

Members of the task force held two formal public input events, participated in five community events, and joined three corporate events, as well as conducting an online survey. Not only did these efforts prove that a small army (seven of us leading an effort that routinely required an additional 10-20 task force members to staff) is needed to routinely reach the public, it provided consensus on what the public wants and needs from the City. Over and over, we heard that outreach around sustainability was not adequate, and we heard that the public is frustrated by desiring to do more but not knowing what to do. As well, many residents were concerned that certain sustainability ideas (for example, multi-dwelling unit composting) could not take off without substantial support from the City.

The public, both residents and businesses, have made it clear: they need more and better outreach, including on existing programs, and they need more innovative, broad sustainability measures to enable their actions (more composting, better bike lanes, reduction of single-use items, development of pedestrian-only areas, information and programs to support electrification, and many more). None of this is possible under the current staffing limitations.

The need for a centralized Sustainability Office

Creating a Sustainability Office, headed by a highly visible Chief Sustainability Officer, enables Mountain View to have a consistent, effective sustainability policy throughout the City. The CSO can support cross-functional efforts across departments, such as Transportation, Planning, and Public Works, enabling and supporting their work. At the same time, the CSO would ensure Mountain View follows a consistent sustainability plan, with a common vision, and common metrics and measurement. The CSO can enable Mountain View to also have a voice at the regional level, enabling public and private partnerships. Mountain View's CSO could also bring in considerable financial resources via grants: in Palo Alto, in FY 2017, the CSO was responsible for raising $350,000 in grants. The CSO's visibility and credibility enabled this. (3)

Members of the task force have developed roles and responsibilities for a Sustainability Office that has comprehensive duties beyond ESTF-2 recommendations. It is imperative to point out, as seen in Recommendation O3, that over 25 recommendations require extensive support from the Sustainability Office(in the form of public or private partnerships, and public outreach in the form of mailers, events, campaigns, and other actions) over the next several years. The Office will first need to analyze and prioritize these recommendations, followed by creating an implementation plan, then by execution. This is in addition to all current responsibilities, such as carbon emissions inventories, CPR and ESAP-3 implementation, and existing outreach, across a range of CO2e and other sustainability initiatives.

Sustainability Office roles

- **Chief Sustainability Officer** (**CSO**) (new). The CSO is Mountain View's advocate for sustainability, who weaves sustainability through all relevant City operations, helping the entire City execute a cohesive, centrally managed plan, with centrally managed messaging and execution. The role is also responsible for strategic relationships with Mountain View's largest corporations and regional partners (including private, NGO, and government), and has the credibility, and the clout, to work with these high-powered players.
- **Sustainability Manager** (similar in level of visibility to Steve Attinger's Coordinator role today). The Manager will drive the day-to-day high ROI, high visibility tactical actions of the Office. Efforts will include small and midsize business (SMB) outreach and partnerships, stakeholder analysis, legislative advocacy, and day-to-day management of regional partnerships (such as with SVCE, NGOs, and local and regional governments). The partnerships will help drive implement and outreach for sustainability programs. In the first few years of this role, a minimum of 25% of this person's time will be taken by helping analyze and implement ESTF-2 recommendations.
- **Sustainability Analyst** (like the temporary Analyst role today). This is a data-driven position, with the primary function of managing an annual carbon emissions inventory. The Analyst will also create metrics and measure the efficacy of Mountain View's sustainability programs. Where possible, the analyst will also interface with other groups and agencies on data collection and analysis.
- **Sustainability Analyst** (new). This role drives financial support for the work of the Sustainability Office, identifying and writing grant proposals, identifying and applying for other money (from private partners, government agencies, contests, etc.). This role also helps support the messaging, business plan, and funding roadmap for the office.
- **Sustainability Specialist** (like the role the Climate Corps Fellow has played). This position is similar to the industry standard "Sustainability Outreach Coordinator." This person manages all small and large-scale outreach events, from presence at local events (Arbor Day, Earth Day, school talks), to larger public events (public input forums, presentations). This person is also responsible for all sustainability communications, from mailers to social media. The Specialist will build and maintain relationships with constituent groups. This person enables the "public face" of sustainability in Mountain View. Ideally, the specialist would have working knowledge of Spanish or Chinese. Especially in the first few years of this position, this role would focus on

helping implement the recommendations of ESTF-2, which might include an additional element of helping to manage specific consumer programs (such as education on heat pumps).

- **Advisory Body**. Many cities have a permanent, standing advisory body, usually in the form of a commission, to support the sustainability work of the city. Nearby, this includes Fremont, Sunnyvale, Cupertino, and Menlo Park. In almost all cases, these groups assist in developing ongoing sustainable policies and programs. They also help measure success of existing programs and do hands-on implementation support for policies (in the form of partnership identification, regional advocacy, and resident engagement).

  The task force recommends that a volunteer EnviroCorps group be established, managed by the advisory body or the Sustainability Office, that engages knowledgeable and active residents as needed. We envision the EnviroCorps as a group that can be called on an ad hoc basis to support outreach on and implementation of specific programs. Our current task force has members versed in such areas as EV purchasing, heat pump installations, solar installations, green landscaping, waste management, and community engagement methods, and many are interested in taking part in such a program to share their expertise. The advisory board and EnviroCorps would play an invaluable role in designing and implementing outreach for the recommendations in this report.

Please see O1 Appendix 1 for a visualization of one way the Sustainability Office could be structured.

Environmental analysis

Mountain View GHG levels in 2015 did not decrease to the level required to meet CA climate goals (1). ESTF-2 is being developed to move Mountain View to the 2030 goal. This is a reduction of a 37% reduction of the 2005 level of 695,631 metric tons, a reduction of 257,383 MTs. Since virtually all our recommendations require community and/or business outreach or regional collaboration to implement successfully, staffing increases are required. Some recommendations will not be implemented at all without additional staff. While measuring the direct impact of this recommendation is challenging, it is an enabling recommendation that makes other recommendations succeed.

The additional staff we are recommending can also impact other areas of sustainability the City must focus on, such as solid waste reduction, water efficiency, green space, heat island reduction, and air and particulate pollution abatement. Climate change adaptation would also be addressed by this office. Measuring the impact in these other areas is beyond the scope of this report, but the Sustainability Office, as designed here, will be able to treat sustainability holistically and make major progress on all Mountain View's environmental issues while also improving health, quality of life, and a sense of community.

We cannot overstate that **our other recommendations will be impossible to implement without this staffing**. The City's strategic focus on sustainability must be backed by a budget to match.

Cost analysis

The cost for adding a Chief Sustainability Office, plus two additional full-time staff, is $540K. This assumes a staff cost of $180,000 per person. The cost between 2019 and 2030, 12 years, is a total of $6.48M. (The $180,000 is an average; that some will get more and some less.)

The budget for programmatic outreach is separately detailed in recommendation O2A, Residential and Business Outreach Initiative. It is imperative to note the outreach detailed in that recommendation depends on having the staff to manage the partnerships, collaborations, and direct outreach detailed in O2A.

Scale analysis

Currently the Mountain View Sustainability team is made up of one full-time employee (an Environmental Sustainability Coordinator), along with a consultant analyst (term ending July 2018), and a Climate Fellow (term ending in July 2018). This team is too small to properly address the remaining actions in ESTF-1, let alone do the work required by ESTF-2 recommendations.

Focusing on sustainability is not just an environmental issue, it is also a social justice and community development issue. Along with missing its overall CO2e emissions reduction goals, the City has been unable to effectively reach large sections of the Mountain View community, including non-English speakers, the economically disadvantaged, renters, the alternatively housed, students, business owners, and sustainability departments of larger corporations. Over 25% of the population of Mountain View speaks Spanish or Chinese at home, and 50% report not speaking English very well. That alone represents 10,000 residents who are currently not being adequately reached by English-only outreach[124]. Among them, and among the economically disadvantaged, sustainability programs are often not promoted nor tailored to meet unique needs (for example, via additional economic support).

10 years ago, Mountain View's hiring of an Environmental Sustainability Coordinator was considered pioneering (2). In 2008, the residential population was less than 74,000 people, and is now 78,000. The daytime population in 2008 was just 59,000, compared to today's 96,000. Total service population has grown from 131,000 to 178,000 in just 10 years, putting a massive strain on the Sustainability Office, but the office has not grown proportionally to address these changes.

In 2025, the total service population will be 200,000, and in 2030, it will be 220,000. Between 2008 (when the Sustainability Office was founded) and 2030 (the end of the period that all our recommendations are to be implemented), the service population increases by a greater number than the City's total current residential population.

It is time to be pioneering once again in 2018, and rebuild the Sustainability Office, starting with a high-level, internal- and external-facing Chief Sustainability Officer. This CSO can make sustainability a central value throughout Mountain View while providing credibility to leverage efforts outside the city. Without this, the rest of the recommendations in this report will be essentially impossible to implement.

[124] Statistical Atlas: https://statisticalatlas.com/place/California/Mountain-View/Languages

Sustainability is our moral imperative; it is demanded by our residents; and it is required to achieve our emissions reductions and other environmental goals. The Sustainability Office, staffed and elevated in importance, is what we need.

O1 References

(1) http://laserfiche.mountainview.gov/weblink//0/edoc/213743/CESC%20Meeting%20Packet%20-%203-15-18%20-%20FINAL.pdf

(2) https://www.mv-voice.com/news/2008/01/28/steve-attinger-pioneers-new-role-as-environmental-coordinator

(3) https://www.cityofpaloalto.org/civicax/filebank/documents/55929

O1 Appendix: Organizational chart of new Sustainability Office

<table>
<tr><td colspan="3" align="center">City Manager</td></tr>
<tr><td colspan="3">Chief Sustainability Officer (CSO)
The strategist, visionary, partnership developer</td></tr>
<tr><td colspan="3">Manager/Coordinator
The tactician, the day-to-day implementer, manager, driver</td></tr>
<tr><td>Analyst
Data focused</td><td>Analyst
Tactical execution</td><td>Specialist
Outreach focused</td></tr>
<tr><td colspan="3" align="center">Advisory Body</td></tr>
</table>

Implement a residential and business outreach initiative **(O2A)**						**Outreach**	**2019-2030**		
Recommendation name						Type	Duration		
Unknown	**$3.6M**	**$0**	**Unknown**	●●○	●○○	●○○	●○○	●●●	●○○
MT CO2e reduction 2018-2030	City's Net Cost	Incremental Net Cost	Net cost per MT CO2e reduction	Easy to implement	Easy to measure	Private investment leverage	Local economic benefits	Other environmental benefits	Health benefits

Problem description

We are missing an opportunity to empower residents and businesses in their efforts or intentions to environmentally sustainable. We are also missing the opportunity to get valuable feedback from them on the issues they face in fulfilling these intentions to be environmentally sustainable. Based on nine months of outreach work, we have learned that Mountain View residents are unaware of the efforts that the city has been making to improve the environmental well-being of its residents. The recommendations we are suggesting, such as paid downtown parking and a ban on single-use plastics, can be considered dramatic changes to consumer behavior. They will increase the need – and the opportunity – to reach out to our community.

Recommendation

The City of Mountain View needs to have a Residential and Business Outreach Program that empowers its residents and businesses to take actions that improves their environment and the environmental sustainability of the City of Mountain View. There are many existing opportunities, along with new ones coming from this task force, that will require outreach to both residents and businesses to be successful. More information on these measures are provided in the Scale Analysis section. This recommendation is tightly coupled with O1; the staffing of O1 is required to make this recommendation succeed.

SWOT analysis

Strengths:

- This outreach strengthens the community and empowers individuals to want to act on their own instead of seeing City initiatives and regulations as nuisances that the city throws at them. This engagement is required to make the connection between an existing problem and seeing themselves as part of the solution to it.
- Over the last nine months, seven members of the Outreach, Regional Collaboration, and Advocacy working group have proven significant demand and enthusiasm for outreach activities, and have successfully beta-tested several outreach methods, from formal public workshops, to informal presence at events, to an online survey. Demand is high for information and participation in the process.

Weaknesses:

- Measuring the precise impact of outreach can be challenging. Measuring impact on high level sustainability efforts, such as attendance of Mountain View events, has long term and hard to qualify impact. Project specific measures (such as EV education to encourage purchases) can, however, lead to quantifiable impact.

Opportunities and co-benefits:

- This engagement between the City of Mountain View and its residents creates a pride in them that will compel them to become more participatory rather than apathetic.
- Residents and businesses are more compelled to accept change (such as a single-use ban) when they understand overall sustainability objectives, are educated on the need for specific changes, and feel included in all steps of the process.
- Outreach will stretch well beyond CO_2e reduction, and include other sustainability issues, such as waste reduction and water usage. Initiatives focused on dietary changes (such as eating less meat) will have significant health benefits. Initiatives focused on canopies and green spaces will increase quality of life and air quality. Initiatives that help businesses “go green” have a proven record of increasing profit.

Threats:

- The degree of engagement of the public might be limited or interest may decrease over time.
- Inadequate staffing prevents high quality and ongoing engagement, which is necessary to make major progress. See staffing levels necessary in recommendation O1.

Municipalities where already implemented

The Cities of Sunnyvale, Pleasanton and Palo Alto have community outreach programs to educate their communities on ways to make a positive environmental impact. (1) (5) (6)

Santa Barbara County and Salt Lake City have implemented business programs. (7) (8)

The City of San Jose has implemented a website to support businesses being environmentally conscious.

Funding sources

The budget of the Sustainability Office, potentially with some additional support from grants, when sufficient staff from the Sustainability Office can support obtaining this source of funding.

Assumptions and uncertainty

Assumptions with High Uncertainty:

- We don’t know how many people will actively engage in sustainability outreach measures.

Assumptions with Low Uncertainty:

- We know that there are many people interested in learning more and doing more to improve their own and the City’s sustainability.
- Without significant investment in ongoing outreach, the recommendations we are suggesting will take longer to implement, have lower adoption, and sustainability runs the risk of being a burden, not an opportunity. In the long run, it would render future initiatives harder to take.

Authors IdaRose Sylvester, Gema Wood, Amanda Rajapaksa, John Jensen

Detailed analysis

Environmental analysis

ESTF-2 is being developed to move Mountain View to the 2030 goal. This is a reduction of 37% from the 2005 level of 695,631 Metric Tons CO2e, i.e., a reduction of 257,383 MTs. Since virtually all of our recommendations require community and/or business outreach or regional collaboration to implement, let alone succeed, staffing increases are required. These programs cannot be implemented under current staffing levels, and we cannot assume "someone else" will do the work, be it another City department or some outside collaborator. As one of Mountain View's core values, sustainability must be a centralized function, with control, metrics, measuring, relationships, and messaging centralized to one office. While we cannot easily measure the CO2e reduction benefits of this recommendation, we do know that slow, inadequate implementation of our recommendations will dramatically lower their impact. In other cases, several of our recommendations cannot be implemented without outreach, and the current staff is fully utilized and will not be able to implement them.

Additionally, new measures, such as SB 100, may require stricter standards, and in turn may require even more outreach and collaboration.

Along with CO2e reductions, a larger outreach effort will enable additional environmental benefits, such as waste reduction, pollutant reduction, better and more green space and tree canopy and wiser household decisions at the individual level (from reduced car usage to reduction of chemical usage in the house, even to organic, local and sustainable food production). With a large influx of new residents each year, both as the City expands, and especially as our rental population turns over, a need to educate newcomers about sustainability is always a significant task.

Cost analysis

The total budget recommendation for the new Sustainability Office is $750,000, for a Chief Sustainability Officer, plus two additional full-time staff members. Our assumption is that each new full-time employee has a fully loaded cost of $180,000, for a total staff cost of $540,000. That leaves $210,000 for various non-staffing expenses for outreach programs, partnerships, and other activities for implementing these recommendations between 2018 and 2025. Note that programs, not staff time per se, are the basis of this budget.

Additionally, we recommend an investment in general outreach for sustainability, to help ingrain sustainability as a core value in Mountain View's community and to address areas beyond the scope of our recommendations (such as water usage and waste reduction). Our costs for this work are like the current budget for outreach and related programs.

Because Mountain View's community is multilingual, with 40% of households speaking another language other than English at home, and many of those not speaking English very well, it is imperative that outreach programs provide translation and consider cultural considerations, which will add somewhat to programming costs. Additional emphasis should be made on reaching renters, businesses, the economically disadvantaged (for whom many programs are a burden), seniors and students. Each subgroup needs some customized outreach.

The suggested annual budget is listed below. This outreach budget is in line with our neighbor, Palo Alto, a city with a total service population of just 110,000. Mountain View's service population is 60% larger, and growing far more rapidly, with new residential and commercial developments.

In the table below, we divide annual costs for outreach required for successful implementation of our recommendation, and for general, ongoing outreach. Many of the general outreach activities will also bolster and support education, awareness and buy-in for specific recommendations, but they cannot replace recommendation-specific outreach for the most complex recommendations.

The total budget recommendation is $300,000/year, for 12 years, for a total of $3.6M.

Measures specific to business outreach

The business outreach program would first reach out to businesses to meet with a sampling of facility managers or owners (whomever is the most appropriate individual in the company). Next, the Business Outreach Team would have to determine what kind of collaboration would be feasible and what customization might be needed for various sectors (large businesses, small businesses, high tech, low-tech, restaurants as examples of possible sectors). As a result, from those meetings surveys would be a good tool to reach other businesses in the target business sectors. This may involve separating some sectors and joining others.

Surveys need to assess:

- the level of interests in environmental sustainability (ES)
- how much the company is dedicating to ES, in man-hours and budget (considering % of total budget or cumulative dollars)
- number of employees
- number of customers visiting business site (for service businesses)

Distribute surveys to the sectors.

Once results from the surveys have been received, determine focus based on ROI and willingness of target sector to participate.

- Dedicate 40 hours per-month by staff to manage efforts, by assigning priorities amongst existing staff or increasing staff to take this on. This may require hiring additional staff.

Scale analysis

The following table highlights recommendations requiring extensive programmatic outreach to be enacted. Where costs have been estimated, costs have varied from $5k-40k per year, and most programs have outreach for at least 5 years, often in the form of ongoing consumer education, following a significant launch.

Each of the recommendations listed below needs a strong central Sustainability Office to drive the outreach, either directly with the support of the Sustainability Office, or in the form of partnerships. With increased staffing, partnerships can be formed and managed with many collaborators. Among them are Acterra, Silicon Valley Clean Energy, various NGOs, health provider networks, regional agencies and officials (such as BAAQMD), and various local community groups. Also, a central source is needed to ensure program and partner success, as partnerships will add to the complexity of outreach, and Mountain View needs to manage outcomes of its programs.

Implement group-buy programs to expand personal EV adoption (**T2**) • Pilot a group purchase program of EV chargers/ vehicles/ bicycles for MV residents and businesses • Southwest Energy Efficiency Project – handbook re: implementation, outreach, etc. • Outreach and advertising
Expand EV charging infrastructure on public property and right-of-ways **(T3)** • Perform a survey to identify high opportunity sites • Encourage public DCFC infrastructure with ownership, installation, and operation by third parties • For residential and workplace, focus on low-cost installations via grants and utility-funded installs • Improve public signage for EV charging infrastructure • Encourage vendors to install charging in city parks and other public places
Support bicycling as a primary mode of transportation **(T5)** • Require or incentivize employers and multi-family property managers to offer secure bike parking • Programs through employers and TMAs to encourage and incentivize bike transportation • Improved signage • Online and print resources to highlight low-stress bike routes and assist with trip planning • Continued encouragement of biking to school through the VERBS program
Restrict parking to encourage and fund alternative modes (**T6**) • Work with neighboring cities to implement paid parking throughout Santa Clara and San Mateo Counties • Outreach to residents regarding permits • Outreach to businesses regarding perceived impact

Expand transportation demand management (TDM) to all of Mountain View **(T7)**

- Use TDM commitments to help provide both pooled transportation and ongoing TDM outreach services city-wide, including for residents, small employers, and visitors
- Provide incentives to existing commercial property owners to adopt TDM
- Implement a pilot TDM outreach program targeted to residents
- Performing commuter surveys
- Assisting businesses with Commute Trip Reduction programs
- Outreach activities and educational materials to promote alternative modes of transportation to employees or residents
- Providing information kiosks about local transit options

Encourage installation of EV chargers in existing multi-unit dwellings **(BE7)**

- Gather information that would be useful to building owners/ managers to encourage them to install EVCs – including details about programs and companies that would facilitate process
- Work with Bay Area Air Quality Management District, SVCE, PG&E, and charging vendors to implement programs for multi-family and multi-tenant commercial buildings
- Implement outreach and education programs geared towards owners and managers of high opportunity sites
- Implement outreach and education programs geared towards residents, employees, and customers of such sites

Adopt a revenue-neutral differential utility tax encouraging low-carbon energy use **(BE9)**

- Work with other cities, state agencies, and PG&E to enable MV to implement a lower Utility User Tax on electricity and to raise the Utility User Tax on natural gas to hasten the replacement of natural gas appliances
- Outreach to low income families promoting existing energy assistance programs during the first three years of implementation

Incentivize switching residential HVAC and water heaters from natural gas to electricity **(BE1)**

- Collaborate with SVCE and BAAQMD to fund incentives for residential building owners to convert space heating/ cooling and water heating systems
- Hold public education workshops to explain the conversion process and its positive impacts
- Maintain a list of trained local contractors and service providers
- Establish a link in city's website to include all the information above, clearly explained in text and demonstrated in videos
- Informational sheet regarding the incentives in city's utility bill to make public aware of these programs on an ongoing basis

Update green building code to move towards low-carbon buildings (**BN1)**

- Educate the public on electrification, via web-based resources, ongoing or new energy efficiency outreach efforts, including incentives availability and highlights of MV's all-electric construction statistics

Reduce embodied carbon in building construction and maintenance (**BN4**)

- Increase awareness of the initial and recurring embodied energy of buildings
- Collaborate regionally to increase the value of construction waste and encourage deconstruction and reuse over demolition
- Collaborate regionally on emerging construction material standards and disclosures
- Provide educational and consulting services to residential and commercial to influence at design stage

Adopt a decarbonization policy for buildings (**B1**)

- Coordinate with local NGO's and government organizations to provide information and electrification support via webinars, pilot demonstrations, and open houses

Enliven Mountain View with native plants and oak trees **(BT1)**

- Organize outreach programs to encourage property owners and businesses to plant native species
- Collaborate with organizations for support and funding

Lead collaboration among Bay Area cities to develop a solution to overseas recycling crisis **(W1)**

- Collaboration with cities and businesses to build new processing centers domestically

Pass a resolution to support "Green Monday" (**W2)**

- Coordinate with FFAC, Green Monday, and Meatless Monday for the process of adopting Green Monday – FFAC to come on-site to deliver at least one presentation
- On-going education for Green Monday

Adopt a citywide ban on single-use disposable plastic foodware **(W9)**

- Partnership opportunities, engaging with food businesses, institutions, and consumers throughout California
- Continued education and outreach to businesses and institutions to help them transition to more sustainable alternatives

Implement a sustainable landscaping program in Mountain View **(W12)**

- Expand sustainable landscape workshops
- Encourage composting and reducing/ eliminating fertilizers and pesticides
- Outreach to homeowners, high tech businesses, and landscape professionals to encourage transition
- Work with regional partners such as BAAQMD and suppliers to create a group buy or trade-in program along with maintaining a list of sustainable landscape care companies
- Education on new technology to ease the transition to electric equipment and make the option of banning gas-powered landscape equipment more viable and sustainable
- Information (brochure, case study, and web content) on the impact of gas powered landscape equipment
- Outreach to the high-tech business community who can influence manufacturers and landscape professionals

Conduct annual summit to review and track county, state, and federal sustainability actions (**O3**) ● Sponsor an annual sub-regional summit to discuss pending sustainability legislation and provide discussions on potential positions ● Update city website and provide method for residents to receive notifications on the changes in status of legislation that City Council members receive
Provide community engagement tools to facilitate household-level GHG reductions (**O2B**) ● Contract with community-based organization like Acterra to provide outreach or hire a Climate Corps AmeriCorps fellow to focus solely on organizing and implementing the community engagement effort ● Education on personal and household greenhouse gas emissions and how to identify and pursue specific actions ● Pilot one or two MV resident focus groups (to ensure tool is responsive to resident feedback) ● Pre- and post- community survey and program evaluation
Eliminate emissions associated with Direct Access electricity by 2025 (**M4**) ● Encourage DA customers to buy enough unbundled RECs to offset their electricity-related emissions ● Publicly recognize DA customer companies whose electricity is 100% GHG-free, including celebration event hosted by Mayor, plaques and a proclamation ● Encourage DA customers to renegotiate their DA contracts to source all electricity from GHG-free sources ● Outreach directly to energy managers of large businesses in the city
Implement a knowledge resource for electrification & other sustainability actions (**M10**) ● Presentation at outreach events including representatives from heat pump manufacturers ● Participation at events like openings of Electric Buildings (e.g. 430 Forest in Palo Alto, CA) ● Webinars, website, printed documents ● Publicize at Earth Day and other events

O2A References

(1) Sunnyvale Environmental Services Facebook page
https://www.facebook.com/SunnyvaleEnvironmentalServices

(2) City of Cuyahoga Falls Environmental Awareness & Education Resources
http://www.cityofcf.com/environmental-awareness-education-resources

(3) City of Watsonville - Conservation Outreach & Education
https://www.cityofwatsonville.org/672/Conservation-Outreach-Education-Program

(4) Keep Cincinnati Beautiful - Environmental Education

http://www.keepcincinnatibeautiful.org/programs/environmental-education/e.html

(5) City of Sunnyvale Facebook Page https://www.facebook.com/SunnyvaleEnvironmentalServices

(6) City of Pleasanton Sustainability Best Practices Activities http://www.ca-ilg.org/sites/main/files/file-attachments/pleasanton_final.pdf

(7) Green Business Program of Santa Barbara County - www.greenbizsbc.org/

(8) Salt Lake City has an e2 Business Program - www.slcgreen.com/e2-business-program

(9) Grants for Small Business to Improve the Environment by Kenneth Black- Chron.com - smallbusiness.chron.com/grants-small-business-improve-environment-14807.html

(10) U.S. Small Business Administration - Environmental Grants & Loans - www.sba.gov/content/environmental-grants-loans-0

(11) The Comprehensive Business Case for Sustainability - https://hbr.org/2016/10/the-comprehensive-business-case-for-sustainability

(12) Santa Clara County Green Business Program - https://www.sccgov.org/sites/rwr/greenbiz/Pages/Green-Business.aspx

(13) City of San Jose Environment page for Business http://www.sanjoseca.gov/Index.aspx?NID=1441

Provide community engagement tools to facilitate household-level GHG reductions (**O2B**)							**Outreach**	**12 yrs.**	
Recommendation name							Type	Duration	
29,940	**$1.6M**	**n/a**	**$54.76**	●●●	●●○	●●○	●●○	○○○	○○○
MT CO_2e reduction 2018-2030	City's Net Cost	Incremental Net Cost	Net cost per MT CO2e reduction	Easy to implement	Easy to measure	Private investment leverage	Local economic benefits	Other environmental benefits	Health benefits

Problem description

40% of U.S. emissions come directly from household actions, such as electricity use, home heating, car and air travel, dietary choices, and waste disposal. If everyone in the U.S. took five basic actions, we could reduce these direct impacts by 40%. There are additional household emissions created through purchasing and services, providing an opportunity for even further emissions reductions.

Many households need help in figuring out their own carbon footprint and assessing what actions they are willing and able to take to address climate change. To facilitate substantial change in consumer behavior, the average household in Mountain View needs a tool that 1) allows them to easily calculate their carbon footprint; 2) enables them to develop a plan of actions their household members can voluntarily take; 3) provides the consumer information needed to implement planned action; and 4) tracks neighborhood and community progress in reducing CO2e.

Recommendation

Provide community engagement tools to facilitate household-level GHG reductions. There are two important components to the helping households in Mountain View address climate change: 1) a software platform that provides the four components described above; and 2) direct community outreach that facilitates the actual use of a software platform to facilitate specific actions to reduce GHG emissions.

After **reviewing seven different software platforms**, we have **identified 15 features** we recommend that should be part of the community engagement tool in Mountain View. These are detailed in O2B Appendix A. We strongly **recommend** the **Community Climate Solutions Go CO2e Free** software platform. Of the seven, it comes the closest to meeting the key features. Households can utilize Community Climate Solutions to come up with their own plan of action they can take to address climate change.

The community engagement goal is for 50% of all Mountain View households to take at least one action to reduce GHG emission by 2030, which will require significant investment in community outreach and engagement. We recommend the City of Mountain contract with two different community-based organizations to accomplish this. First, a community-based organization like Acterra could utilize the Community Climate Solutions software platform to provide outreach to Mountain View's households through schools, neighborhood associations, faith-based organizations, tenant associations, etc.

Alternatively, the City of Mountain View could hire a Climate Corps AmeriCorps fellow each of the next four years to focus solely on organizing and implementing the community engagement effort managed by the recommended Chief Sustainability Officer.

Cool Block is a community engagement tool that utilizes social support of neighbors to achieve behavior change at scale of the neighborhood, with the objective of reaching 400 blocks or about 4,000 Mountain View households over a 4-year period. It involves training block leaders (who invite ten households in a block) to nine topical meetings on disaster preparedness, climate change actions, water conservation, neighborhood safety and community building over a 4-5-month period. We recommend that Cool Block utilize the Community Climate Solutions software platform for calculating household GHG emissions and developing and tracking a household plan. More information on Community Climate Solutions and Cool Block can be found in O2B Appendix B.

SWOT analysis

Strengths:

- The combination of Community Climate Solutions with a local community-based organization and Cool Block provides significantly different approaches in achieving an effective outreach effort to 50% of Mountain View households. The different approaches will appeal to different market segments in Mountain View.
- Community Climate Solutions and Cool Block are both willing and able to tailor program specifics to the diverse needs of the Mountain View community. Both provide significant opportunities for education and information on how to identify and pursue specific actions to reduce household climate change

Weaknesses:

- Providing good information and education on personal and household greenhouse gas emissions is often not good enough to motivate behavior change. Many renters may feel that they do not have enough control over their carbon footprint to participate fully in any community engagement effort.

Opportunities and co-benefits:

- The outreach infrastructure developed for this recommendation could potentially be utilized to help facilitate the outreach and implementation efforts of many of the other recommendations of ESTF-2. See O2B Appendix A for details.

Threats:

- City procurement process typically releases a request for proposal and selects a single bidder based on objective criteria. Multiple contracts and vendors are needed for this ambitious community engagement effort.

Municipalities where already implemented

- Cities of Fremont, San Francisco, Los Angeles, City of Chula Vista, Palo Alto, Menlo Park, San Leandro and San Luis Obispo have adopted community engagement tools.

Funding sources

- Cool Block has multiple purposes other than greenhouse gas emissions and should be funded through multiple City departments but administered through the recommended CSO office. The Community Climate Solutions / community-based organization contracts should be part of the CSO budget.

Author: Cliff Chambers

Detailed analysis

Environmental analysis

The impact of community engagement tools can be very high. Cool Block's target is a 25% GHG emission reduction. Community Climate Solutions believes it is realistic for a participating household to achieve a reduction of two metric tons of CO2e annually. This assumption is based on a single-family home, whereas Mountain View has a high proportion of multiple family dwelling units, and we estimate an average of 1.2 metric ton reduction can be achieved for those units. Our estimate for mobile homes is one metric ton reduction. Both Community Climate Solutions (CCS) and Cool City Challenge by Cool Block are in the early stages of development and there has not been rigorous analysis of actual GHG reductions through the availability of these community engagement tools.

The recommendation includes four years of intensive community outreach starting in 2019. We are estimating that 13,000 Mountain View households can be reached. At this stage, we are estimating a maintenance level of continued effort, but we are also anticipating diminishing returns of metric ton reduction. For single-family homes, the estimated metric ton reduction is reduced from 2 to 1.25 in 2023 and then to 1 in 2026 and 0.75 in 2029. Similar diminishing returns are expected for multi-family dwelling units and mobile homes. Of course, these are highly uncertain estimates, but diminishing return over time seems inevitable.

Community Climate Solutions' content management system can be tailored to promote and help implement many of the ESTF-2 recommendations. For example, if T2 for a group electric car buyer program is adopted by ESTF-2, this could be one of the added actions to the Community Climate Solutions site. The cost analysis incorporates the fact that this recommendation includes several of the other task force recommendations.

Below is a summary of the estimated metric ton reductions and overall cost effectiveness of the two program elements and pre/post evaluation after two years of implementation. The cost analysis includes additional assumptions on the cost estimation.

O2B Table 1. Summary of MT CO2e, Net Cost, and Cost Effectiveness.

2019 to 2030	CCS/ CBO	Cool Block	Pre/Post Evaluation	Total
City of Mt. View Net Cost	$814,500	$575,000	$250,000	$1,639,500
MT CO2e reduced	20,215	9,725	0	29,940
Cost per metric ton reduced	$40.29	$59.13	0	$54.76

O2B Appendix C includes O2B Tables 3 and 4, which provide the calculations for the above summary chart.

It is not known how much of the household actions can be attributed to the community engagement process compared to other actions recommended as part of the ESTF-2 process. This attribution can be more accurately evaluated in the pre- and post-survey and evaluation process. For now, the average reductions are all attributed to either the Cool Block effort or the Community Climate Solutions.

Both CCS and Cool Block include consumption-based actions and reductions in air travel that are not included in the ICLEI protocol. Additional consumption-based actions can be tailored to the specifications of Mountain View. Based on the input of ESTF-2 task force members, more consumption-based actions should be added. At the back end of both tools, the contract with CCS should specify that tracking of the metric ton reductions include an ICLEI action category and a total metric ton reduction.

Cost analysis

Community Climate Solutions has a base price of $2,500 for start-up plus $6,000 annually. They will tailor specific action items for about $500-$1000 per action item. Based on input from the community input forum on April 30, 2018, there is a strong desire for action specifically tailored for Mountain View. A useful feature of Community Climate Solutions is their content management system that enables the tailoring of implementation steps specifically for Mountain View. The budget includes $5,000 for actions prior to start-up and five additional actions per year for four years, starting in FY 2019/20. The contract with either a local community-based organization, hiring of a 0.5 FTE city staff person, or a full time Climate Corps fellow is assumed at $90,000 per year.

The cost of the Cool Block program is more complicated because it is much broader than the reduction of GHG emissions. It includes an introductory meeting and one meeting focusing on each of eight topical areas with two focused on GHG reductions. The total cost for the first year is $100,000, with the cost shared between Cool Blocks at $50,000, and Supervisor Simitian’s office at $25,000, and the City of Mountain View at $25,000. Since 25% is devoted for GHG emissions, we have utilized the $25,000 as the net Mt. View cost. For three additional years, the total Cool Block cost increases to $200,000 per year, but according to Cool Block, the sharing arrangement would remain the same and is included for the first four years. The $200,000 cost would “include 2 FTE plus website refinement” (2). Although the cost details would need to be worked out after 2023, for cost estimation purposes, it is assumed this community engagement effort would continue to 2030, at a MV cost of $50,000 per year.

If City staffing resources are too limited to implement both Community Climate Solutions and Cool Block at the same time, it is highly recommended that the City of Mountain View start with the Community Climate Solutions software platform and the staffing necessary to tailor the program specifically to Mountain View’s needs. The budget could include one or two Mountain View resident focus groups to ensure that the tool is responsive to the resident feedback from the April 30, 2018 forum.

A pre- and post- community survey would be implemented (2019 for the pre-implementation survey, and late 2021 or early 2022 for the post-implementation survey) to evaluate the community engagement process after two full years of implementation. The statistically valid pre- and post-surveys and program evaluation, conducted by an independent market research firm, are estimated to cost $125,000 each, enabling detailed analysis by market segment. The pre-survey will provide a baseline for the specific actions that Mountain View households have taken that are aligned with recommendations of ESTF-2. The post-survey will determine how many households are aware of the community effort to have individual household take actions to reduce their carbon footprint. The post-survey would also help determine if one or both community engagement efforts should be continued, modified or terminated.

Scale analysis

The scaling starts with an initial community engagement effort for two years utilizing both outreach approaches. Beyond that period, the two recommended contracts would need to be evaluated and a determination made to continue both or to discontinue one. For purposes of the cost and metric ton reduction, it is assumed that both programs are continued to 2030.

The objective for a Community Climate Solutions (CCS) / community-based organization is to have 9,300 households take individual actions over a four-year period, starting in FY 2019/20. Given the growth in residents, this is approximately 24% of the 38,851 housing units expected in Mountain View by 2022. (3) It would start with 1,300 participating households the first year and add approximately 2,600 participating households the second through fourth years. Participating households are those who signed up with CCS and have completed one metric ton reduction actions. The level of effort will be evaluated after the two-year evaluation period.

Cool Block's Cool City Challenge starts out with a 15-25 block pilot to better understand the local environment (e.g., the City's resources, NGOs, population makeup) and to figure out a scaling strategy. Cool Blocks works on the principle that if they can reach 25% of the target audience ("early adopters" and the first part of the early majority), social innovation can achieve a tipping point and begin diffusing on its own momentum. Our goal then is to embed the Cool Block social technology on this critical mass of blocks and build the capacity of the City to continue the process of scaling the program to the rest of the community. Given Mountain View's population, Cool Block anticipates reaching a total of approximately 400 blocks (about 25%) over four years. The goal would be to have 8,000 households participate in taking at least one GHG emission reduction action by 2030.

Therefore, it is estimated that the employment of both community engagement efforts can have a total of approximately 24,000 Mountain View residents implement at least one metric ton reduction action by 2030. This is 52% of the 46,280 Mountain View households expected in 2020.

O2B References

(1) US Environmental Protection Agency*: Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2016.* Executive Summary: https://www.epa.gov/sites/production/files/2018-01/documents/2018_executive_summary.pdf

The five big actions are (1) Choose 100% green electricity; (2) Choose electric vehicle or alternative transportation; (3) Choose electric heat pump water and space heating and electric appliances; (4) Reduce or offset air travel; and (5) Eat lower down the carbon chain.

(2) May 7, 2018 email from Sandra Slater to Cliff Chambers.

(3) According the American Community Survey, there are 32,047 households in Mountain View.

Detailed information on Community Climate Solutions involved a detailed review of their website, a presentation, and several emails and detailed phone discussions with Lisa Altieri, founder of Community Climate Solutions.

Detailed information on Cool Block involved a detailed review of their website and presentation and several emails with Sandra Slater, Northern California Director of Cool City Challenge.

O2B Appendix A Desired Features of Community Engagement Software Platform

The author reviewed the following community engagement tools and carbon footprint calculators to determine which features a Mountain View community engagement tool should have:

- Environmental Protection Agency
- Nature Conservancy
- CoolClimate Network

- Carbon footprint calculator
- Global Footprint Network: Ecological footprint calculator
- Community Climate Solutions
- Cool Block

The following are recommended features for the City of Mountain community engagement software platform. Community Climate Solutions is recommended due to its sound data analytics, graphic interfaces, and customizable information and knowledge base.

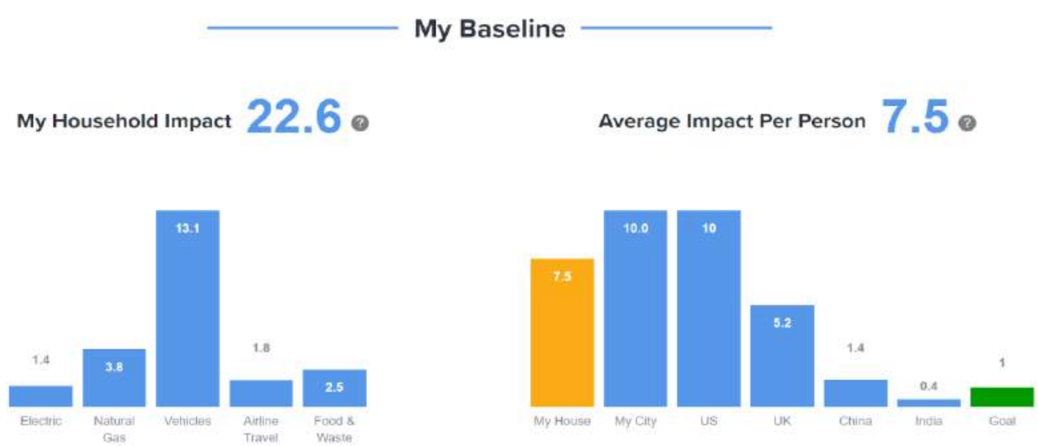
1. Ease and accuracy in creating your household's carbon footprint profile.

Community Climate Solutions has easy to use drop-down menus with the ability to upload PG&E information. It takes about 15 minutes.

2. Discovering household and per capita impact by sector in a simple, graphically appealing manner.

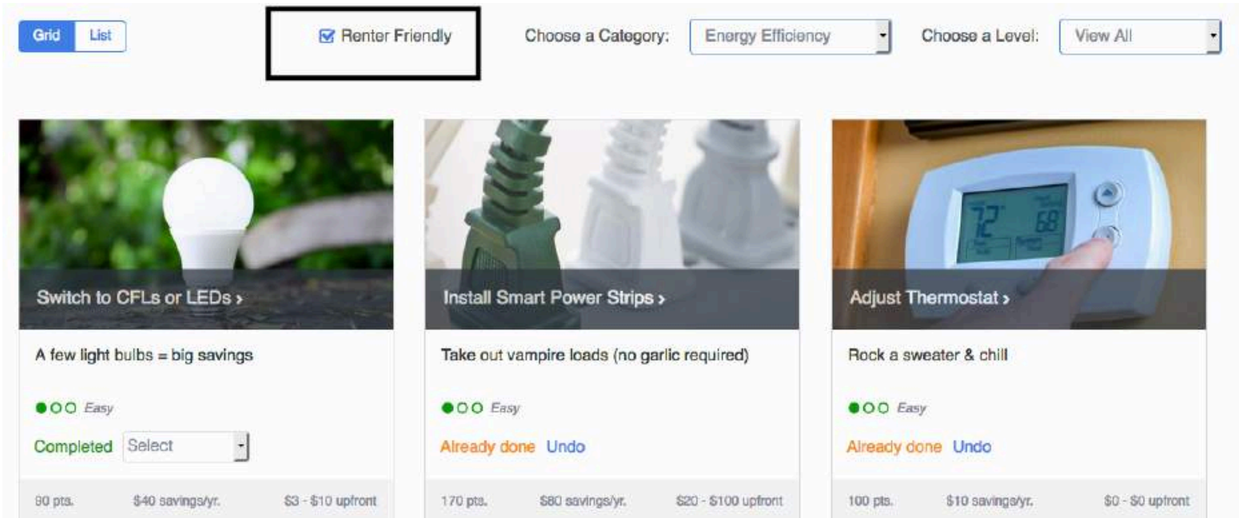
The graphic below, in addition to showing to showing the per capita bar chart, shows where their household is on the bell curve. See below on the need to tailor items specifically for Mountain View.

Source for this and subsequent images: Community Climate Solutions.

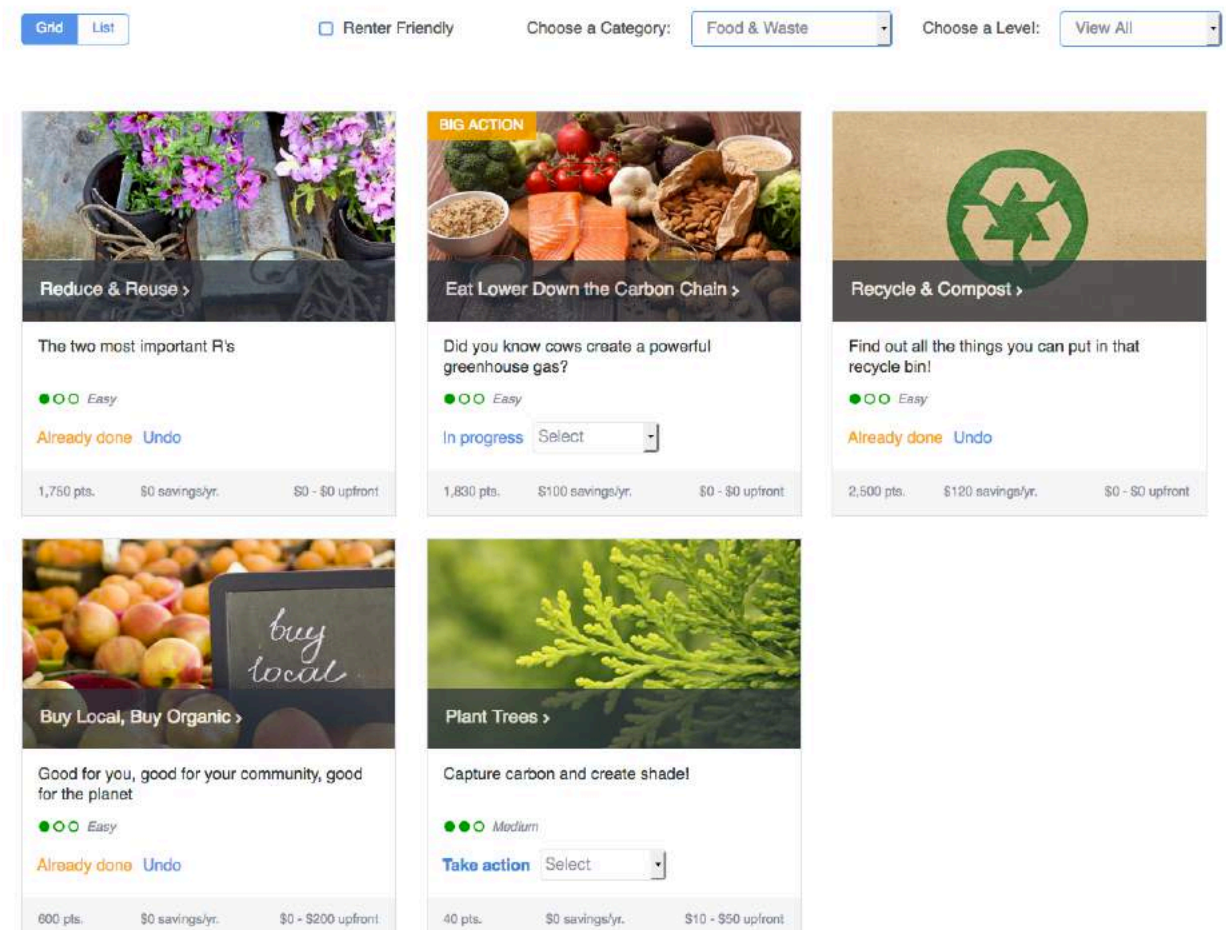


3. Gives credit to action household has already taken

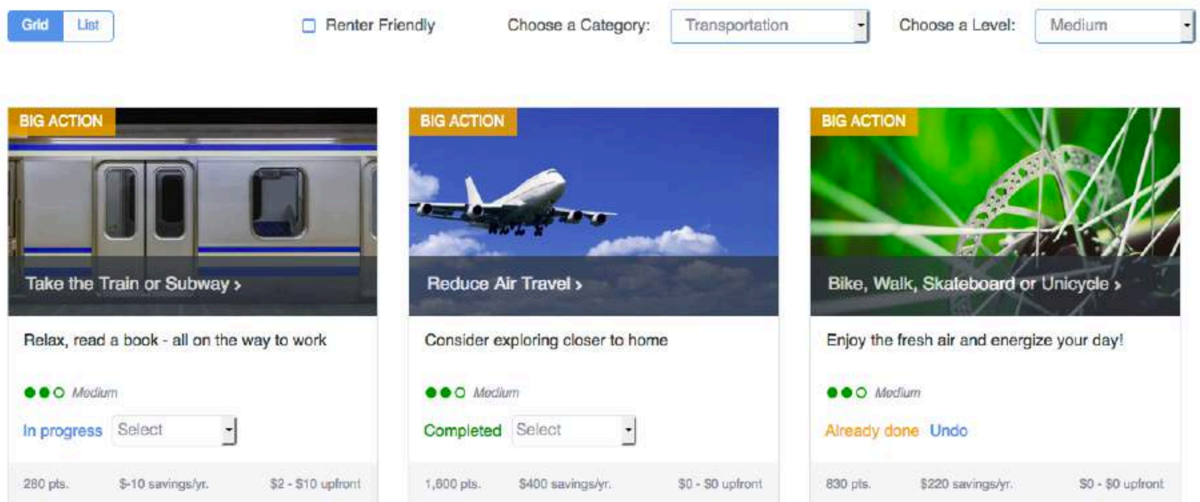
4. Renter friendly relevant actions



5. Finding actions to reduce personal and household GHG emissions. The actions should include consumption-based actions. *(Food and waste: we can add additional actions.)*



6. Ability to tailor actions specifically for Mountain View
Participants at the April 30, 2018 public forum stressed the need to be able to tailor specific actions available in Mountain View. Both Cool Block and Community Climate Solutions have stressed a willingness and ability to respond to this important feature requirement.

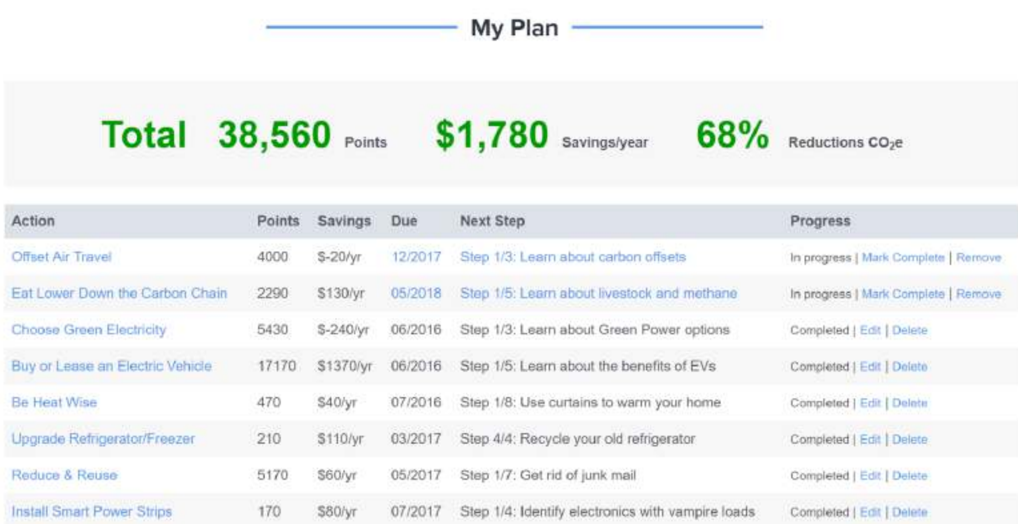


There are 11 specific transportation actions, including the three above that are considered "Big Actions." We can change "Take the Train or Subway" to "Take Caltrain for Peninsula Trips." Instead of "Take the Bus," we can say "Use the Expanded and More Frequent Community Shuttle," or any other top priority actions of the Transportation Working Group.

7. Suggested actions based on entry of household energy profile and actions already completed. This was a suggestion from ESTF-2 members, and Community Climate Solutions is developing the algorithm to develop this capability soon.

8. Action tips and background knowledge base: The action tips and implementation can be tailored with the CCS content management system so that a City of Mountain View resident knows what steps to take, the permit process, and potentially a listing of local contractors that can install the system. These easy how-to-purchase guidelines are extremely useful

9. Developing tailored household plan

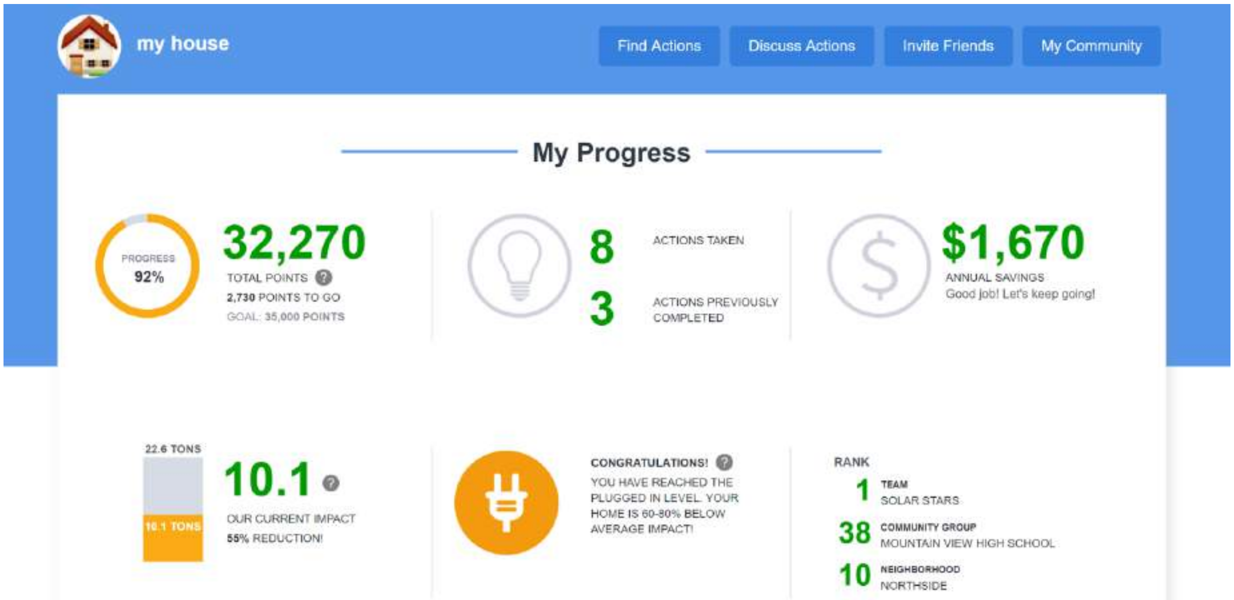


My Plan

Total 38,560 Points $1,780 Savings/year 68% Reductions CO_2e

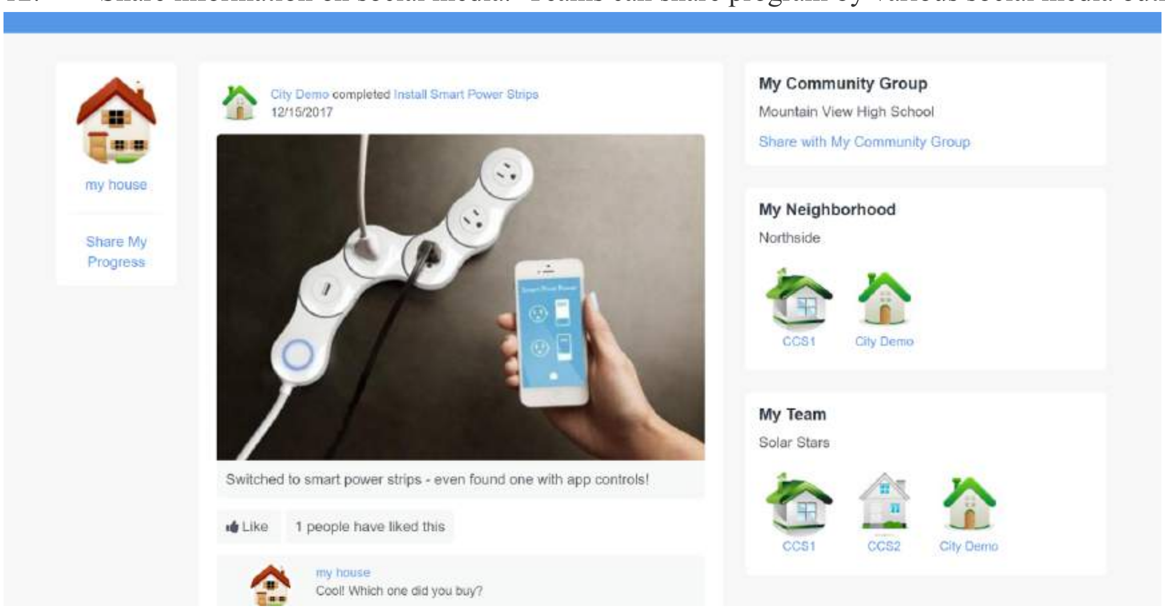
Action	Points	Savings	Due	Next Step	Progress
Offset Air Travel	4000	$-20/yr	12/2017	Step 1/3: Learn about carbon offsets	In progress | Mark Complete | Remove
Eat Lower Down the Carbon Chain	2290	$130/yr	05/2018	Step 1/5: Learn about livestock and methane	In progress | Mark Complete | Remove
Choose Green Electricity	5430	$-240/yr	06/2016	Step 1/3: Learn about Green Power options	Completed | Edit | Delete
Buy or Lease an Electric Vehicle	17170	$1370/yr	06/2016	Step 1/5: Learn about the benefits of EVs	Completed | Edit | Delete
Be Heat Wise	470	$40/yr	07/2016	Step 1/8: Use curtains to warm your home	Completed | Edit | Delete
Upgrade Refrigerator/Freezer	210	$110/yr	03/2017	Step 4/4: Recycle your old refrigerator	Completed | Edit | Delete
Reduce & Reuse	5170	$60/yr	05/2017	Step 1/7: Get rid of junk mail	Completed | Edit | Delete
Install Smart Power Strips	170	$80/yr	07/2017	Step 1/4: Identify electronics with vampire loads	Completed | Edit | Delete

10. User dashboard to track household progress



11. Track neighborhood and community progress. The community challenge page can be organized to show results by neighborhood associations or by different school-based teams. Different blocks in the Cool Block program can also be show at their discretion. The graphic below shows a sample page of cumulative community actions.

12. Share information on social media. Teams can share program by various social media outlets.



13. Marketplace to purchase actions. Community Climate Solutions is adding a marketplace where consumers can actually purchase carbon offets for airline travel, CFL and LED lightbulbs, etc.

14. Spanish version: Community Climate Solutions is adding a Spanish version of the program.

15. App version: Community Climate Solutions is developing an app so that individuals, including students, can track progress. This will be particularly important for tracking challenges between companies, high schools, and neighborhood associations.

O2B Appendix B. Background on Recommended Vendors

Community Climate Solutions' GO CO2 Free platform, https://www.communityclimate.org/

This is a comprehensive online community platform designed to engage and empower individual households on climate and sustainability actions. GO CO2 Free provides cities the ability to easily scale efforts and accelerate local emissions reduction and sustainability programs.

The GO CO2 Free platform provides cities a robust, high quality, easy-to-use tool to engage residents with information and resources on specific actions they can take to lower their impact and help meet city goals. The platform also incorporates gamification and social tools to motivate action. It has a responsive design and works for computer, tablet, and mobile devices. Development of an app version for Android and IOS is underway. The platform is offered as a subscription service to cities or community organizations.

Community Climate Solutions has been implemented, or is in the process of being implemented, in 17 cities and counties from Hawaii to Virginia.

Cool Block's Cool City Challenge, https://coolblock.org/cool-city-challenge

According to Cool Block, in California there have been over 100 climate action plans adopted by local cities over the past few years. Implementation and community engagement has been a weak link. The purpose of the Cool City Challenge is to seize this opportunity by bringing to scale its behavior change and community engagement methodology based on 25 years of research in over 200 cities worldwide.

Fundamentally, this is a systems problem spanning multiple issues: people's attitudes and behaviors, how people view and use energy, technology choices and cost, existing policies and incentives, market acceptance, and larger social norms and values. Traditional approaches to climate change mitigation that focus on technology, policy, and markets often neglect the human factors essential to their acceptance. And we must equip individuals with the will and means to effectively address climate change in the short run while we still have time to act. *The Cool Block* program uses the social support of neighbors to achieve behavior change at scale in a city and then across cities around the world.

Cool City Challenge also empowers the local government, civic organizations, and local businesses, enabling a whole system solution with the legs to bring this solution to scale community-wide. This behavior change methodology is based on twenty-five years of research that has demonstrated how a peer-support system, combined with recipe-style actions set in the context of a structured program and compelling community vision, can move residents and all local actors to take and sustain action over time. The Cool City Challenge has been implemented to date in Palo Alto, San Francisco and Los Angeles.

While there may be some overlap in households that are reached, both approaches together are anticipated to have 50% of Mountain View households take at least one action to reduce GHG emissions. The partnership between CCS and a community-based organization is best suited for challenges among schools, neighborhood associations, and other community groups such as Boy Scouts and Girl Scouts. Cool Block targets specific blocks for community building and requires a commitment for attending eight meetings over a 4.5-month period. Some residents in Mountain View might not be interested in participating in a neighborhood association or school-based challenge but would not mind meeting with their neighbors to act on a broader array of emergency preparedness, carbon footprint reduction, water conservation and community building initiatives. Both are recommended for concurrent implementation to appeal to different market segments.

O2B Appendix C

O2B Table 3. GHG Emission Reductions and Cost Forecasts for Community Climate Solutions / Community-Based Organization.

	Est. 2019	Est. 2020	Est. 2025	Est. 2030
Blocks Participating	25	125	50	50
Households Participating	250	1250	500	500
Single Family Units (45%)	113	563	225	225
Multifamily Units (45%)	113	563	225	225
Mobile Homes (10%)	25	125	50	50
Total Households Reached	250	1250	500	500
Cumulative Total	250	1,500	5,500	8,000
Annual C02e Reductions/MT C02e reduction per household/year				
Single Family Units	2	2	1.25	0.75
Multifamily Units	1.25	1.25	1	0.5
Mobile Homes	1	1	0.75	0.25
Annnual MT C02e reductions	391	1,953	544	294
Cumulative Reductions	391	2,344	7,881	9,725
Costs				
County Supervisor Office	$ 25,000	$ 50,000		
Cool Block Subsidy	$ 50,000	$ 100,000		
City of Mountain View Cost	$ 25,000	$ 50,000	$ 50,000	$ 50,000
Annual Total Costs	$ 100,000	$ 200,000	$ 50,000	$ 50,000
Cumulative Total	$ 100,000	$ 300,000	$ 850,000	$ 1,100,000
Cumulative Mountain View	$ 25,000	$ 75,000	$ 325,000	$ 575,000
Summary				
Mountan View Net Cost	$ 575,000			
MT CO2e reduced	9,725			
Cost per metric ton reduced	$ 59.13			

O2B Table 4. Cool Block Greenhouse Gas Emissions and Costs Forecast 2019-2030.

Program	Est. 2019	Est. 2020	Est. 2025	Est. 2030
1. **Community Climate Solutions/Community Based Organziation**				
Household reached %	3.5%	7.0%	2.0%	2.0%
Single Family Units	527	1,060	310	315
Multifamily Units	725	1,485	494	589
Mobile Homes	38	77	22	22
Annual Household reached	1,290	2,622	826.68	925.60
Cumulative Total	1,290	3,913	11,730	16,145
Annual C02e Reductions/MT C02e reduction per household/year				
Single Family Units	2	2	1.25	0.75
Multifamily Units	1.25	1.25	1	0.5
Mobile Homes	1	1	0.75	0.25
Annnual MT C02e reductions	1,999	4,054	899	536
Cumulative Reductions	1,998.94	6,053	16,996	20,215
Costs				
Start-Up	$ 7,500	$ 5,000		
Licensing	$ 6,000	$ 6,000	$ 6,000	$ 6,000
CBO or CC Fellow	$ 90,000	$ 90,000	$ 45,000	$ 45,000
Annual Total Costs	$ 103,500	$ 101,000	$ 51,000	$ 51,000
Cumulative Mt. View Costs	$ 103,500	$ 204,500	$ 559,500	$ 814,500
City of Mountain Net Cost	$ 814,500			
MT CO2e reduced	20,215			
Cost per metric ton reduced	$ 40.29			

Conduct annual summit to review and track county, state, and federal sustainability actions (**O3**)							**Outreach**	**12 yrs.**	
Recommendation name							Type	Duration	
Unknown	**$504K**	**$0**	**Unknown**	●●●	●○○	○○○	○○○	○○○	○○○
MT CO_2e reduction 2018-2030	City's Net Cost	Incremental Net Cost	Net cost per MT CO_2e reduction	Easy to implement	Easy to measure	Private investment leverage	Local economic benefits	Other environmental benefits	Health benefits

Problem description

Mountain View City staff presents a legislative platform to the City Council each year. This platform primarily identifies priority issue areas rather than specific legislation. The priority issue area designations are driven by input from various City of Mountain View departments and then adjusted as necessary by City Council when they review the platform.

Although City staff receive updates on legislation from the League of California Cities, National League of Cities, and other sources, the decision to take positions on and/or follow various pieces of legislation is usually driven by City Council Members or by department staff who are aware of specific items that are important to their departments. When legislation is deemed consistent with the Council's direction on the platform, staff (usually at the department level) develop a draft letter for all of Mountain View City staff to review and process for the Mayor to sign. When there is insufficient Council policy direction related to a piece of legislation, staff needs to bring it to City Council for approval to take a position.

The current process for reviewing all legislation, including environmental sustainability legislation, is generally staff-driven and offers little opportunity for public comment or review. The exception is when staff brings a piece of legislation to City Council for approval to take a position. Often, individual advocates meet with a City Council member to see if there would be support for a particularly important piece of legislation.

Given that many of the most important actions that drive greenhouse gas emission reductions are facilitated through state and federal legislation, it is important for Mountain View to consider and engage in these legislative processes as thoughtfully and transparently as possible. Examples include AB 32 and SB 375 at the state level, and CAFE standards at the federal level.

Recommendation

The City of Mountain View should sponsor an annual sub-regional summit for northern Santa Clara County cities, including Palo Alto, Mountain View, Los Altos, Los Altos Hills, Sunnyvale, Cupertino and Santa Clara. The purpose would be to discuss pending sustainability legislation at the county, state, and federal levels, and to discuss potential positions on the legislation. The summit would include State Assembly, State Senate, Board of Supervisors, representative City Council members and the public. Since state legislation is introduced in January and February, the sub-regional summit would ideally take place in March. Following the annual summit, an agenda item would be scheduled for the full City Council to determine which pieces of environmental sustainability legislation City Council would like to support. The City of Mountain could contract with a community-based organization like Acterra or Sustainable Silicon Valley to handle the organization, logistics and promotion of the annual forum.

It is further recommended that City staff be assigned to track and provide key updates to the City Council and relevant city departments on relevant legislative actions and amendments. City staff can utilize existing resources such as SVCE's Manager of Regulatory and Legislative Effectiveness to aid with the tracking process. City residents should be able to sign up on the City website to receive notifications on the changes in status of legislations that City Council members receive. It is important that such notification be sent when the bill is introduced into committee, has pending vote, or is amended.

Finally, we suggest that this recommendation also be included in all future ESAP updates.

SWOT analysis

Strengths:

- Provides a forum with legislators that would include robust public participation.
- Helps develop a better understanding of the pros and cons of pending environmental sustainability legislation at the county, state, and federal level.
- Provides an open and transparent process for notifying both City Council and residents about the status of important environmental policies and mandates that could directly and indirectly impact Mountain View and the region.

O3 Weaknesses:

- The timing of the sub-regional summit would work well for state legislation, but federal and county legislation is episodic, so the timing could be off

Opportunities and co-benefits:

- This would provide the opportunity for sub-regional collaboration (at the state, county, and local level) on environmental sustainability issues.

Threats:

- There is the potential for the recommended focus of environmental sustainability to be broadened to other legislative issues, potentially diluting the effectiveness of the recommendation.

Funding sources

None needed. This would become part of the existing responsibility of the city staff member assigned to legislative tracking.

Assumptions and uncertainty

Assumptions with High Uncertainty:

- It is not known if existing city staff are able to add the annual summit and tracking of City Council supported legislation to their current role in tracking priority issues areas.

Author(s): Cliff Chambers and Bruce Naegel

Detailed analysis

Environmental analysis

State and federal legislation, including AB 32, SB 32, SB 350, SB 375, and SB 1275, among others (1), have been game-changers in addressing greenhouse gas emission reductions in Mountain View. One of the reasons that business-as-usual (BAU) projections of greenhouse gas emission decline over time is because of the state and federal legislation that is already in place.

Cost analysis

It is assumed that the formalized legislative tracking and notification program will take an additional 0.10 FTE City of Mountain View staff per year, or approximately $18,000 per year. The costs for contracting to another organization, doing logistics, and promoting the annual summit is estimated at $24,000 per year. Starting in 2019, the 12 years through 2030 would cost $42,000 × 12, or $504,000.

The $10,000 per year should be used in part to ensure robust public participation. For example, the California Climate Action Network has found that "providing reliable and objective information helps residents understand the causes, impacts and solutions to climate change. Involving the public in the development of climate change policies and programs builds community awareness and support for local actions that reduce greenhouse gas emissions, including their co-benefits." (2)

Scale analysis

There is no scaling associated with this recommendation.

Although we have not been able to identify municipalities engaging in this exact type of summit, there are many examples of productive and positive summits involving multiple cities or counties with similar goals. For example, in 2010, counties in Florida united to form the Southeast Florida Regional Climate Change Compact. The Compact was formed to coordinate mitigation and adaptation activities across county lines. It calls on the counties to (among other things) work cooperatively to develop annual legislative programs, jointly advocate for state and federal policies and funding, help the region pull in one direction and speak with one voice, and meet annually at a Leadership Summit to mark progress and identify emerging issues. (3)

O3 References

(1) California Climate Change Legislation: http://www.climatechange.ca.gov/state/legislation.html
In addition, the following are examples of organizations that regularly track environmental sustainability legislation:

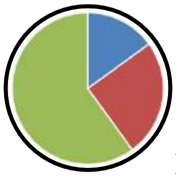
350.org: http://legislative.350bayarea.org/bills

California Natural Resources Defense Council: https://www.nrdc.org/california

(2) Institute for Local Government, California Climate Action Network, *Involving the Public in Climate Change Action – Ten Case Stories* (May 2009): http://www.ca-ilg.org/sites/main/files/file-attachments/resources__ce_case_stories_all_in_one_6.pdf

(3) Southeast Florida Regional Climate Change Compact: http://www.southeastfloridaclimatecompact.org

Chapter 6: Measurement and Metrics Recommendations



Below, we briefly describe each of the five Measurement and Metrics Working Group recommendations (M1, M2, M13, M4, and M10).

M1 covers these key areas:

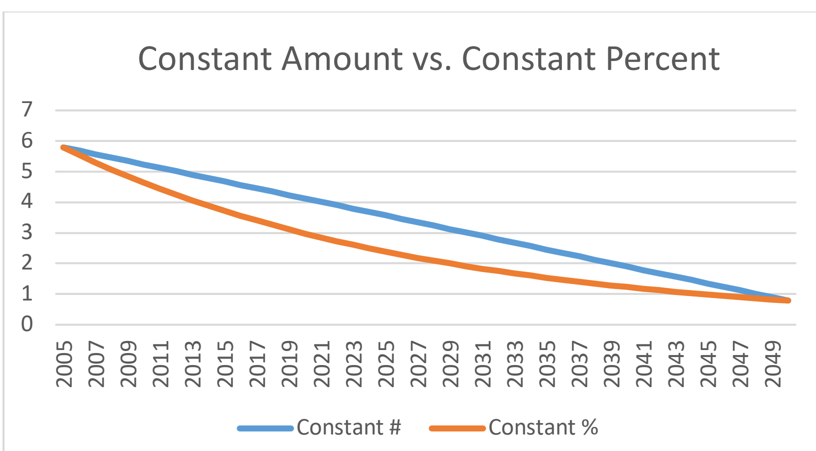
- The GHG level reporting process should provide preliminary GHG levels by March 31 (June 30?) of the following year to ensure timely responses.
- The GHG targets or "goals" should have consequences not meeting specified GHG levels.
- If a specific GHG level is lower than the goal for a specified period, the difference between the "goal" GHG level and the actual GHG level can be "banked".
- If a specific GHG level is higher than the "goal", the difference (actual -goal) must be compensated for by either:
    - Withdrawing credits from the "bank"
    - Purchasing Certified Carbon Offsets (1)

M2 describes "Per Capita" levels as the main criteria for GHG reduction

One can measure the compliance to California's climate bills (e.g. SB 32, AB 32, SB 350) in one of two ways. The first method is on an absolute basis of reduction overall for a city. The BAAQMD approved using per capita criteria for climate compliance. Per capita measurements make target levels more understandable on a personal basis. They also are more appropriate than absolute measurements for cities where the population is growing faster than the California average (e.g., Mountain View).

M13 shows how to calculate the curve of compliance and extends M2.

The curve for Mountain View GHG reduction starts at 5.79 MT GHG per capita in 2005 and should drop to 0.79 MT per capita in 2050. One can plot a straight line between these two points to get intermediate values by subtracting 5/45=1/9 MT from each previous value. One can also subtract 4.3% from the previous year's value to get the next value, ending up at the same value in 2050. The benefit of the constant percentage method is that it is more aggressive in savings at the beginning of the cycle where it is easier to get reductions in GHG emissions. It is progressively harder as one gets closer to the goal. See the graph below plotted for the values for the constant number vs. constant percentage subtraction.



M4 addresses the carbon content in direct supplied electricity.

About 16% of the energy purchased in Mountain View is purchased directly from energy suppliers. California lists a high carbon content for Mountain View's direct energy purchases. However, three of the largest Mountain View companies who buy directly are buying 100% carbon neutral energy (Google, Linked In, and Microsoft).

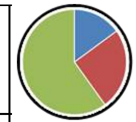
The first action in the M4 recommendation is to work with state agencies to determine the true carbon content of directly-supplied electricity to Mountain View. The second action is to convince customers who are being supplied direct electricity to move to 100% carbon neutral electricity.

M10 covers the creation of a knowledge base for sustainability topics.

Replacing existing building gas water heaters with electric heat pump water heaters is not straightforward. This conversion can be expensive. There are many unknowns that need to be addressed. There are pockets of knowledge on the subject but no real single "go to" place to answer questions and ease the conversion process. This is also true for other sustainability upgrades, such as EV charger support, new building sustainability, water conservation, etc.

This recommendation is to provide a centralized knowledge base for this information. SVCE (Silicon Valley Clean Energy) may be the one to provide this service as part of their plan to install 150 heat pump water heaters in homes.

(1) https://www.green-e.org/glossary, "Certified Carbon Offsets"

Manage Mountain View's emissions budget as carefully as its financial budget (**M1**)							**Mandatory, permanent**	**2019-2030**	
Recommendation name							Type	Duration	
256,220	**$1.4M**	**$0**	**$5.66**	●●○	●○○	○○○	○○○	○○○	○○○
MT CO_2e reduction 2018-2030	City's Net Cost	Incremental Net Cost	Net cost per MT CO2e reduction	Easy to implement	Easy to measure	Private investment leverage	Local economic benefits	Other environmental benefits	Health benefits

Problem description

It is almost impossible to manage a process if it is not being monitored frequently and if acceptable performance is not properly defined. There are several ways in which Mountain View's management of its greenhouse gas emissions (GHGe) reduction process can be improved.

One way is by setting the proper targets – ones that are challenging, yet achievable, and which will remain relevant during times of economic growth as well as contraction. Recommendation M4 focuses on that issue and recommends that Mountain View make "GHG emissions per capita" its primary target. Recommendation M13 proposes that Mountain View establish new per capita emission targets for every year through 2050 and that each year's target decline by a constant percentage from the previous year's target.

Another important component of good management is measuring results at appropriate intervals. In the April 24, 2018 City Council meeting there was strong support for measuring our GHG emissions every year, and we thank the Council for its leadership on this important issue. We look forward to the implementation of annual GHG inventories. However, even after annual inventories have been implemented, two problems with the management of the GHG reduction process will remain.

First, there has typically been a delay of 20-28 months between the end of the year for which emissions are being measured and the release of the emissions inventory. We can and should do better.

Second, there are no consequences if the city fails to achieve its emissions targets. There should be consequences for failure and rewards for success. This recommendation offers ideas on how to do that.

Recommendation

Mountain View should manage the community's emissions budget as carefully as it manages the city's financial budget.

Specifically, this means:

1. The emissions reporting process should be streamlined so that a **good estimate** of prior year emissions is available no later than March 31 – in time to be an input to the City's budgeting process – and **results** are reported by September 30 if possible.
2. In years when emissions are less than the budget, the difference should be "banked."
3. In years when emissions exceed the budget, the City should tap into its "emissions bank" and/or purchase enough carbon offsets make up for the emissions budget variance.

SWOT analysis

Strengths:

- By reporting results rapidly, we maximize the time available to take corrective action.
- By implementing consequences that are aligned with the success or failure of our GHG reduction efforts, we ensure that the City will manage emissions more carefully.

Weaknesses:

- The availability of final emissions numbers depends on when PG&E and SVCE release their annual emission factors. PG&E releases its figures between 3 and 15 months after the end of the year being measured. However, PG&E's market share is now so low (under 4%) that the timing of the release of their emissions factor is much less important than it was prior to the launch of SVCE. SVCE's emissions factor is zero or close to it.
- Carbon offsets are somewhat controversial within the environmental community.

Opportunities and co-benefits:

- Paying for offsets (in years when emissions exceed budget) should help focus attention on, and investment in, local programs that are even more cost-effective.

Threats:

- Buying verified carbon offsets may result in criticism from some environmentalists who question the validity, and even the morality, of purchasing verified offsets.

Municipalities where already implemented

Palo Alto and Los Altos Hills have annual goals and publish per capita emissions annually. Palo Alto purchases carbon offsets for all the natural gas used in the community, not just the gas used by municipal operations.

Funding sources

The costs of this recommendation will come from the City Sustainability Department budget. Silicon Valley Clean Energy (SVCE) intends to provide each of the cities in its service territory, including Mountain View, with annual emissions inventory data that covers buildings (electricity, natural gas) and transportation. The transportation numbers will be generated using the Metropolitan Transportation Commission (MTC) model. The MTC model is used by almost all other cities except Mountain View. Mountain View will want to continue using the Fehr and Peers model for Transportation emissions because it is believed to be more accurate. The cost of doing this is included in this recommendation.

Assumptions and uncertainty

Assumptions with High Uncertainty:

- How Mountain View's actual GHG emissions will compare to its emissions budget in future years.
- The price of carbon offsets in the future.

Assumptions with Low Uncertainty:

- The current price range of carbon offsets.
- Whether SVCE will continue to perform annual GHG inventories for its member cities.

Author(s) Bruce Karney and Bruce Naegel

Detailed analysis

Environmental analysis

We will look at the environmental impact of each component of this recommendation separately.

1) **The emissions reporting process should be streamlined so that a good estimate of prior year emissions is available no later than March 31 – in time to be an input to the City's budgeting process – and results should be reported by September 30 if possible.**

We believe that having more timely data will lead to more timely reduction plans which will, in turn, lead to lower emissions than would otherwise be the case. We estimate that faster reporting will cut emissions by 0.2% each year compared to BAU – 16,220 MT.

2) **In years when emissions are less than the budget, the difference should be "banked."**

Banking emissions has no direct environmental impact.

3) **In years when emissions exceed the budget, the City should tap into its "emissions bank" and/or purchase enough carbon offsets to make up for the emissions variance.**

Let us assume that despite our best efforts to control emissions, we are not as successful as we hoped, and we overshoot our budgeted emissions by an average of 20,000 MT per year from 2019-2030. (This is 3.2% of our Business as Usual forecast for the period). We would then need to buy 240,000 MT of offsets, and these would reduce our reported GHG emissions.

Cost analysis

We will also look at the cost impact of each component of this recommendation separately.

1) **The emissions reporting process should be streamlined so that a good estimate of prior year emissions is available no later than March 31 – in time to be an input to the City's budgeting process – and results should be reported by September 30 if possible.**

Changing the timing of the final report is not expected to have a significant impact on its cost but adding the new March estimate is predicted to cost roughly $5,000 per year or $60,000 for 2019-2030.

Running the Fehr and Peers model to assess local transportation emissions is currently an expensive process requiring the expertise of consultants. We will assume that the cost is $50,000 per year, or $600,000 for 2019-2030. The actual cost could be significantly higher or lower.

2) **In years when emissions are less than the budget the difference should be "banked."**

"Banking" emissions has no direct cost.

3) **In years when emissions exceed the budget, the City should tap into its "emissions bank" and/or purchase enough carbon offsets to make up for the emissions variance.**

According to a recent EnergySage article[125], the average cost of a carbon offset was $3.30/MT in 2016.

Again, assume that despite our best efforts to control emissions, we are not as successful as we hoped and overshoot our budgeted emissions by an average of 20,000 MT per year from 2019-2030. The cost of offsetting those emissions would be $3.30/MT x 20,000 MT/year × 12 years = $792,000. Clearly, the future cost of offsets could be higher or lower than $3.30/MT and the average size of the overshoot could

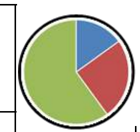
[125] https://www.energysage.com/alternative-energy-solutions/carbon-offsets/costs-and-benefits-carbon-offsets/

be smaller or larger than 20,000 MT. These would change the total cost associated with this recommendation, but the average cost per metric ton would still be quite low compared to most of the task force's other recommendations.

M1 References

The 2014 *Global Protocol for Community-scale Greenhouse Gas Emissions Inventories* (GPC) specifically acknowledges that communities may use credits that they purchase to reduce their reported emissions. The paragraph below comes from Page 141 (page 143 of the PDF file) of the GPC at http://www.iclei.org/fileadmin/user_upload/ICLEI_WS/Documents/Climate/GPC_12-8-14_1_.pdf

> **Use of transferable emissions units**
>
> Cities may designate a portion of their mitigation goals to be met using transferable emissions units such as offset credits generated from emissions reduction projects. To ensure transparency and prevent "double counting" of emissions reductions, cities shall document any sold GHG offsets from projects located within the inventory boundary as well as any credits purchased from projects located outside of the city boundary for goal attainment. These shall be reported separately (see Section 4.4).

Set GHG reduction targets according to per capita goals based on service population (**M2**)	**Policy**	**Perm-anent**	
Recommendation name	Type	Duration	

Unknown	**$15K**	**$0**	**Unknown**	●●●	●○○	○○○	○○○	○○○	○○○
MT CO2e reduction 2018-2030	City's Net Cost	Incremental Net Cost	Net cost per MT CO2e reduction	Easy to implement	Easy to measure	Private investment leverage	Local economic benefits	Other environmental benefits	Health benefits

Problem description

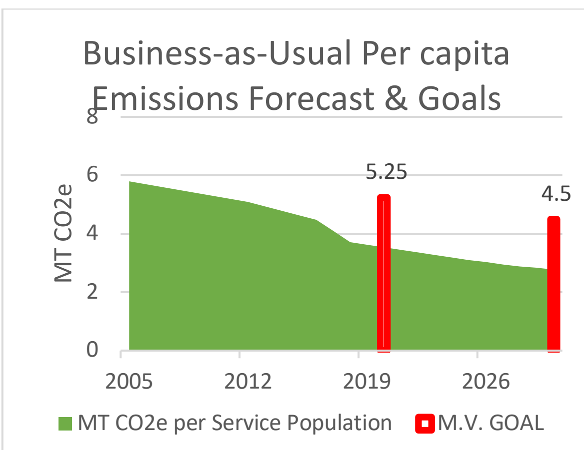
Mountain View's emissions can be expressed as:

(Total Emissions = Per Capita[126] Emissions) × (Service Population)

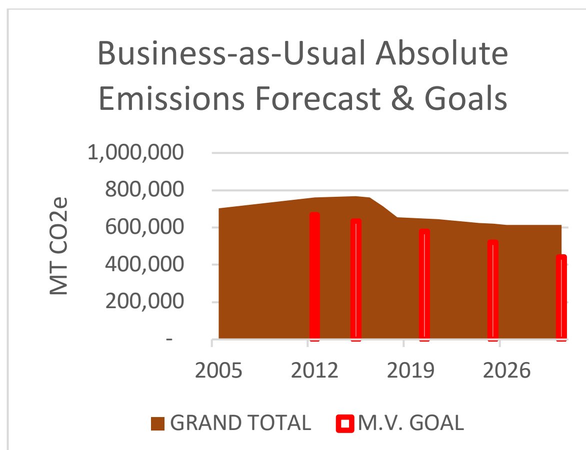
The City Council has established goals for both total emissions and per capita emissions.

Over the last decade Mountain View has made good progress in reducing per capita emissions. As of 2015 emissions were 4.62 metric tons (MT) per capita. As shown in M2 Figure 1, that was much lower than our goal for 2020 and nearly as low as our goal for 2030.

Despite the good news on the per capita level, Mountain View's service population has grown so rapidly – 37% from 2005 to 2015 – that our total emissions have increased, as shown in M2 Figure 2. Total emissions were 21% above the council-adopted 2015 goal, the most recent year for which we have data.



M2 Figure 1



M2 Figure 2

Recommendation

Mountain View's GHG reduction targets should emphasize per capita emissions, not absolute goals. As we will show in the Detailed Analysis section, once we have developed per capita goals for each year, we can derive citywide absolute goals for any possible future service population. We recommend abandoning the idea that Mountain View should have absolute goals not linked to changes in population.

126 In this document, "**per capita**" always means "**per service population**," **not** "**per resident**." Service population is the sum of the number of residents and the number of individuals employed in Mountain View. As of 2015 the service population was 166,375. The 2018 estimate is 176,824.

SWOT analysis

Strengths:

- The recommendation focuses attention on "per capita" emissions, which is something that the average person can relate to; they can also figure out if their own emissions are higher or lower than the City's goals. If they are higher, individuals and families may be motivated to reduce them.
- Consumption-based GHG metrics, which include things like air travel and food choices, are also most meaningfully described on a per capita basis. Focusing attention on per capita emissions will help make it clear that the things that ICLEI's protocol tracks represent only one quarter to one half of a household's carbon footprint.
- Because per capita goals are independent of the size of our service population they will provide a consistent path against which to measure our progress no matter how much – or in which direction – our service population changes.

Weaknesses:

- This recommendation may be seen, erroneously, as a step backwards in Mountain View's commitment to GHG reduction.

Opportunities and co-benefits:

- Once we shift focus to reducing emissions per capita, it will become clear that rapidly increasing our housing stock will help Mountain View meet its GHG goals.

Threats:

- It is possible that future state laws will require cities to set and achieve absolute GHG reduction goals instead of per capita goals. (No such legislation is yet on the horizon.)

Municipalities where already implemented

Most cities measure both absolute and per capita emissions. San Jose's current Climate Action Plan emphasizes per capita goals over absolute goals.

Funding sources

Changing the goals is not expensive and funding for the necessary staff time should come from the sustainability department budget.

Assumptions and uncertainty

Assumptions with High Uncertainty:

- Mountain View's future service population.

Assumptions with Low Uncertainty:

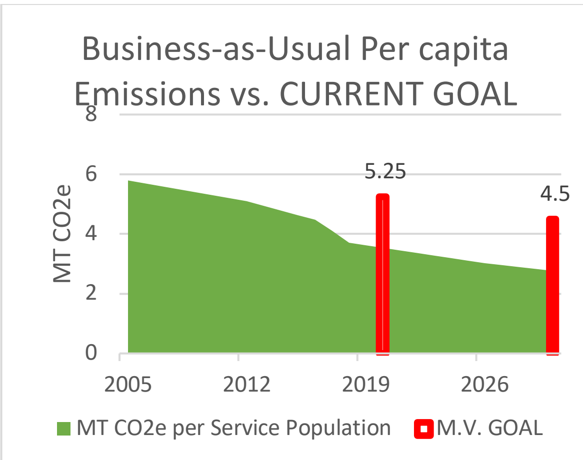
- The per capita emissions by year that will be required for Mountain View to meet California's GHG reduction goals.

Author Bruce Karney

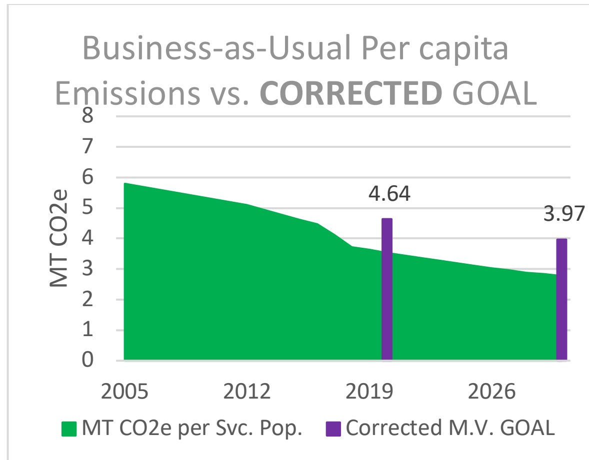
Detailed analysis

Background

Our current per capita goals, show in M2 Figure 3, were set using an **incorrect estimate of 2005 emissions**. Until 2018, the City believed that emissions in 2005 were 6.4 metric tons per capita. A recent revision established that emissions in 2005 were really 5.79 MT per capita. Based on our new understanding of 2005 emissions, our per capita goals should be 11.7% lower. They should be 4.64 MT in 2020 and 3.97 MT in 2030 as shown in M2 Figure 4. The City has not updated its per capita goals since they were originally set as part of the 2012 *Greenhouse Gas Reduction Program* (GGRP), and it should do so.



M2 Figure 3.



M2 Figure 4.

Environmental analysis

We cannot predict whether changing the City's emphasis to per capita measurements will reduce GHG emissions; hence, we use the term "unknown." This means we cannot predict the magnitude of the impact, not that we expect there to be no impact. From an environmental perspective, the biggest drawback of absolute goals is that they encourage "no-growth" or "slow-growth" policies. If Mountain View curtails residential growth, emissions assigned to us will probably be **less** than in the Business as Usual (BAU) case, but emissions in other cities will **rise even more** because lengthy commutes to jobs in Mountain View will become more necessary. The net result will be even worse for the planet. Basing our goals on per capita emissions will keep us focused on the right path to truly protect the environment.

Cost analysis

There are no significant costs associated with changing the definition of our GHG reduction goals. We estimate that one person-month of staff time would be required and the cost of this is estimated to be $15,000.

Scale analysis

This recommendation is framed at the city-wide level.

M2 References

See the footnotes.

Why are our emissions targets inconsistent with each other?

Mountain View has two sets of GHG targets. One set is expressed as absolute percentage reductions from emissions in the base year of 2005. The other is expressed as desired reductions in per capita emissions based on "service population."

Both targets were adopted long before the release of the revised GHG inventory for the year 2005 in 2018 (see M2 Appendix 1). It determined that emissions in 2005 were 11.7% less than had previously been reported. This methodological revision did not affect the per capita targets, but it did affect the per capita baseline.

The revision showed that emissions in 2005 were 5.79 MT/SP, not 6.4 MT/SP. Furthermore, our most recent emission inventory determined that emissions in 2015 were 4.62 MT/SP - not much higher than the 2030 target of 4.2 MT/SP. Thanks to the rollout in 2017 of Silicon Valley Clean Energy's GHG-free electricity to 98% of PG&E's accounts there is no question that per capita emissions in 2017 were less than the 2030 target. Therefore, the per capita targets -- as currently defined -- are **no longer useful** because they do not encourage continued emission-reduction efforts.

Therefore, we believe that the City needs to take a fresh look at its emissions targets, or, as another recommendation suggests, at its emissions **budget**, where the term "budget" implies that there will be tangible consequences in years when the desired emissions reduction is not achieved.

Following is a brief history of Mountain View's GHG targets.

History of Mountain View's emission targets

First absolute targets

In November 2009 the City released its first estimate of what greenhouse gas (GHG) emissions had been in 2005. The figure was reported as 796,987 MT CO2e. Based on the 2005 GHG inventory and on the statewide targets that existed at the time, the City Council adopted the voluntary absolute targets shown below in late 2009. [127]

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

Because they are "absolute" targets they do not allow emissions targets to increase due to faster than expected population or job growth.

Additional absolute targets

In 2015 the City Council adopted additional absolute emissions targets for 2025 through 2045.

- 26% below 2005 baseline level by 2025
- 37% below 2005 baseline level by 2030
- 48% below 2005 baseline level by 2035
- 58% below 2005 baseline level by 2040
- 69% below 2005 baseline level by 2045

[127] City of Mountain View Climate Protection Roadmap, September, 2015, Page 2, http://mountainview.gov/civicax/filebank/blobdload.aspx?BlobID=19516

First per capita targets

The following two paragraphs from the September 2015 *Climate Protection Roadmap* (CPR) explain how per capita targets came to be adopted. (This took place between the time of the first absolute targets and the additional absolute targets mentioned in the preceding sections.).

> "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*. 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. During development of the GGRP, it became clear that **it would be very difficult to achieve the adopted communitywide 2020 emission reduction target due to high levels of future development and emissions growth, and the general political and economic infeasibility of implementing aggressive emission reduction policies and programs**. For this reason, the City chose 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."

At the time the *Climate Protection Roadmap* was written, it was reported that Mountain View's emissions in 2005 had been 6.4 MT CO2e/SP. The authors of the CPR estimated that if Mountain View did nothing, emissions per SP would fall to 6.1 MT by 2020 and 6.0 MT by 2030.[128] These were the BAU estimates. Therefore, the GGRP recommended the following targets for 2020 and 2030:

- 5.1-5.4 MT/SP/Year by 2020 (15-20% below 2005's level and 10-15% below the BAU estimate)
- 4.5 MT/SP/year by 2030 (30% below 2005's level and 25% below the BAU estimate)

It is worth pointing out that while we have absolute targets for every fifth year through 2050, we only have per capita targets for 2020 and 2030. This is one reason why per capita targets have gotten much less attention than absolute targets. When we released our 2015 GHG reduction inventory, there was no 2015 per capita target to compare it to. We believe there should be per capita targets for every year.

Changes in population estimates from 2012 to 2018

M2 Table 1 shows the resident and worker projections used in the GGRP and the more recent forecast developed by the ESTF's Measurement and Metrics Working Group, in consultation with City Planning staff. The current estimate is based on the recently-adopted North Bayshore Precise Plan and other major

[128] Mountain View Greenhouse Gas Reduction Program, August, 2012, Page 3-7 http://www.mountainview.gov/civicax/filebank/blobdload.aspx?blobid=10700

projects in the development pipeline. Note that the actual population in 2015 was almost as high as the 2030 estimate used in the GGRP. Even more startling, **employment in 2015 was already 10% higher** than the GGRP estimate for **2030**.

M2 Table 1. Population estimates from the GGRP and the ESTF-2 BAU forecast.

	GGRP Estimate (2012)			Current ESTF-2 Business as Usual Forecast (2018)			**% change from 2012 to 2018**
Year	Population	Employment	Service Population	Population	Employment	Service Population	**Service Population**
2015	No estimate	No estimate	No est.	77,250	89,125	166,375	
2020	79,670	68,816	148,486	83,391	100,280	183,671	**+24%**
2030	86,331	80,818	167,149	98,995	122,713	221,708	**+33%**

Simply put, current city plans envision **a dramatically different future for Mountain View** than what was being planned in 2009, 2012, or even 2015.

Estimated emissions vs. absolute targets

M2 Table 2. 2015 emissions based on the latest available data.

Year	Service Population	Total Emissions (MT CO2e)	Emissions Target (MT CO2e)[129]	Total Emissions as a % of Target	Emissions per Service Pop. (MT)
2015	166,375	768,336	633,647	121%	4.62

Conclusions

If Mountain View's population was expected to grow at the same rate as California's population, it would make sense for Mountain View to have absolute reduction targets that are the same as the state's absolute targets[130]. However, Mountain View has recently grown much faster than the state and is expected to continue to do so in the future.

Just as it was hard in 2012 to predict Mountain View's growth in 2015, it is hard for us in 2018 to predict the city's growth by 2020 and beyond. However, we know that the City's emissions will be strongly correlated with the size of its service population. Therefore, the City should focus on setting and achieving aggressive per capita emission targets. Absolute emissions levels and absolute emissions targets should be secondary metrics.

Implementation steps

1) Make per capita emissions the cities Key Performance Indicator for GHG emissions and have a per capita emissions target for every year.

[129] 633,647 = 90% of revised 2005 emission estimate = 90% of 704,054

[130] The State's targets are reductions relative to 1990. The 2020 target is for emissions to be equal to 1990's. By 2030 the target is to be 40% below 1990's level and by 2050 to be 80% below the 1990 level.

2) Replace the current absolute goals with annual "total emissions goal ranges" through 2050. These should be established by multiplying the per capita target for the year by the high and low estimates of service population. Every few years the goal ranges should be adjusted based on updated forecasts of future service population.

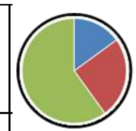
M2 Appendix 1: Original and Revised 2005 GHG Estimates

M2 Table 5. Original and revised GHG emission estimates for 2005.

Emission Sector	**Original** Estimate of 2005 Emissions (MT CO2e)	**Revised** Estimate of 2005 Emissions (MT CO2e)	Percent Change
Building Energy	295,562	295,562	0%
Transportation	474,180	374,077	-21.1%
Waste	11,183	12,325	+10.2%
Water	9,502	15,529	+63.4%
Off-Road Mobile	6,561	6,561	0%
TOTAL	**796,987**	**704,054**	**-11.7%**

The original methodology for estimating 2005's transportation emissions was reviewed in 2017 and determined to have been based on a flawed methodology. The revised methodology assigned fewer Vehicle Miles Travelled (VMT) to Mountain View residents and workers in 2005. Adjustments were also made to the emissions from waste and water.

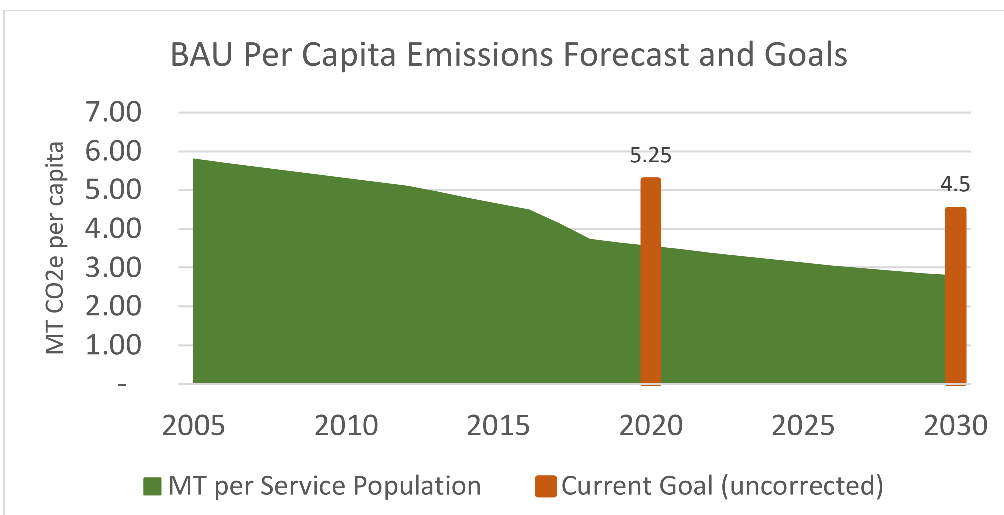
The new methodology was also applied retroactively to the 2012 emissions estimate. It was also used to develop the 2015 emissions estimate that was first reported in late 2017.

Set annual GHG reduction targets for Mountain View that decline by a constant percentage (**M13**)							**Policy**	**Permanent**	
Recommendation name							Type	Duration	
0	**$30K**	**$0**	**N/A**	●●●	●○○	○○○	○○○	○○○	○○○
MT CO_2e reduction 2018-2030	City's Net Cost	Incremental Net Cost	Net cost per MT CO2e reduction	Easy to implement	Easy to measure	Private investment leverage	Local economic benefits	Other environmental benefits	Health benefits

Problem description

As explained in our previous recommendation M2 ("Set GHG reduction targets according to per capita goals based on service population (**M2)**"), per capita[131] targets should be used to guide Mountain View's deep decarbonization efforts. Only per capita targets align with the City's strategy of adding substantial amounts of new housing to mitigate the affordability and congestion crises.

As shown in M13 Figure 1, the City has established per capita targets only for two years: 2020 and 2030. It should establish per capita targets for **every** year from now until 2050, and those targets should be consistent with California's state-level goals. There are two reasons why it appears that we are doing much better than our targets. The first is that the targets were set too high because of an error in calculating our GHG emissions in 2005. Correcting that error would reduce the targets by 11.7% to 4.64 in 2020 and 3.97 MT in 2030. The second reason is that we did make progress from 2005-2015, and the rollout of SVCE's 100% GHG-free electricity in 2017 has taken a big bite out of our per capita emissions.



M13 Figure 1. Comparison of BAU GHG forecasts and current per capita goals.

We believe that emissions targets should be set so that the level of difficulty they present is **the same** from year to year. The only way to do that is to make the percentage reduction from the prior year's target

[131] In this document, "per capita" always means "per service population." Service population equals the sum of the number of Mountain View residents and the number of individuals who work in Mountain View.

the same from each year. In view of impending population growth, it would be a serious mistake to set reduction targets based on constant annual **amounts** rather than constant annual **percentages**.

Recommendation

Mountain View should establish new annual per capita GHG reduction targets that decline by a constant percentage. The specific annual targets we recommend are listed in M13 Appendix 1. They are slightly more aggressive than the City's current absolute targets when those targets are translated into per capita terms, so they do not imply any backpedaling on the City's commitment to GHG reduction.

SWOT analysis

Strengths:

- Establishing annual targets through 2050 demonstrates that the City is serious about reducing per capita emissions in the long term.
- Having goals that decline by a constant annual percentage will prevent us from pushing the most challenging reductions into the 2040s. They will motivate the City, its businesses, and its residents to apply equal effort every year to reduce emissions.
- Because per capita goals are decoupled from the growth rate of our service population, they will provide a consistent path against which to measure our progress no matter how much – or in which direction – our service population changes.

Weaknesses:

- This recommendation may be seen, erroneously, as a step backwards in Mountain View's commitment to GHG reduction.

Opportunities and co-benefits:

- Once we establish annual per capita targets, it will become clear that rapidly increasing our housing stock helps Mountain View meet its GHG goals.

Threats:

- It is possible that future state laws will require cities to set and achieve absolute GHG reduction goals instead of per capita goals. (No such legislation is yet on the horizon.)

Municipalities where already implemented

Most cities measure both absolute and per capita emissions and have goals for both. For example, San Jose's Climate Action Plan has aggressive per capita goals.

Funding sources

The necessary staff time should be paid for by the Sustainability department's budget.

Assumptions and uncertainty

Assumptions with High Uncertainty:

- None

Assumptions with Low Uncertainty:

- Whether the proposed targets are properly aligned with the State's goal of an 80% reduction by 2050 compared to statewide emissions in 1990.

Author Bruce Karney

Detailed analysis

Environmental analysis

Setting the proper targets is an essential part of managing any process. Another essential part of process management is to establish feedback loops that describe what will happen if the target **is met** and if it **is not met**. Recommendation M1 ("Manage Mountain View's emissions budget as carefully as its financial budget **(M1)**") was written to describe the management processes that can be set up once we have well-crafted annual targets. M1 describes the consequences of meeting, or not meeting, our annual targets.

In our opinion, this recommendation (M13) will have no measurable environmental impact if recommendation M1 is not also adopted and implemented. Therefore, we are not ascribing any emissions reduction to M13. If M1 and M13 are both adopted, we ascribe all the emissions reductions – more than 250,000 MT – to M1. Without establishing annual goals, M1 cannot be implemented, and the potential it offers for emissions reductions will be lost.

Cost analysis

Establishing new per capita targets will require staff time for analysis and preparation for briefing the Council. We estimate that two person-months will be required at a cost of $30,000.

Scale analysis

This recommendation is framed at the city-wide level.

Why constant percentage reduction targets are better

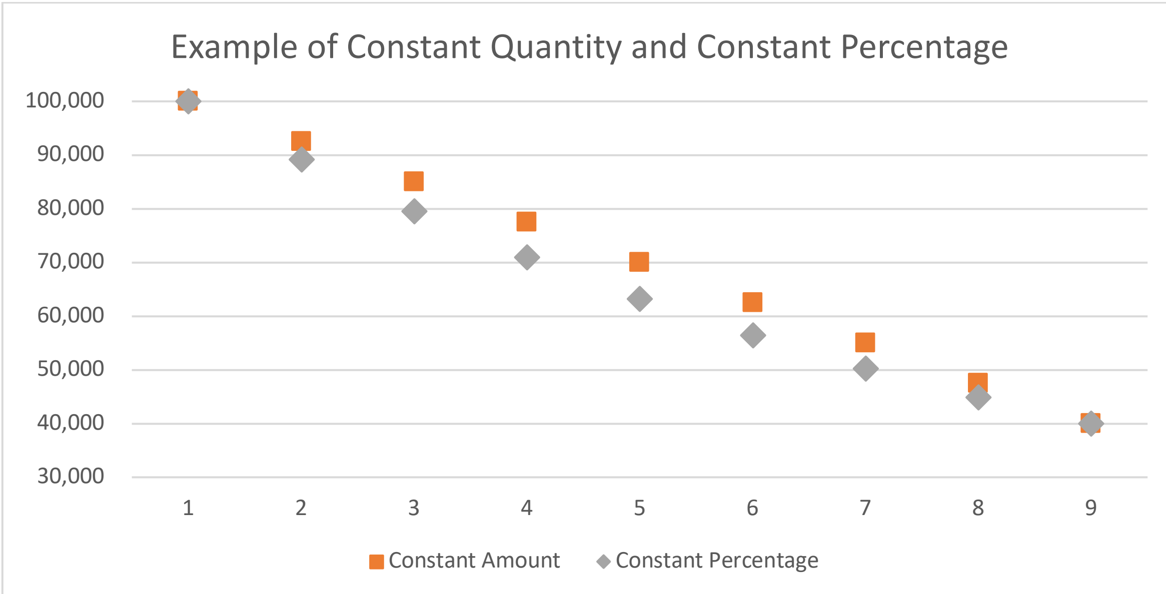
Mountain View's absolute reduction goals decline by a constant **quantity** each year. They were the starting point for establishing the existing per capita goals. Constant quantity annual reductions may seem equitable, but they require huge and potentially unachievable reductions in the last years of the program.

M13 Table 1 is a simple example that shows how this works. Suppose emissions were 100,000 MT in Year 0 and the goal is to reduce them to 40,000 MT by Year 8. The constant quantity approach is shown in rows 2 and 3, and the constant percentage approach is shown in rows 4 and 5. Note the cells highlighted in red italics. Under the Constant Quantity approach, the percentage reduction in Year 8 (15.8%) is more than twice the percentage reduction in Year 1 (7.5%). That is not equitable nor practical. Contrast that with the Constant Percentage approach, where the required percentage reduction is the same each year. Constant percentage targets are **fairer** and **more achievable**.

M13 Table 1. Comparing constant quantity reduction goals to constant percentage reduction goals.

Year	1	2	3	4	5	6	7	8
Const. Quantity Target	92,500	85,000	77,500	70,000	62,500	55,000	47,500	40,000
% below prior year	*7.5%*	*8.1%*	8.8%	9.7%	10.7%	12.0%	*13.6%*	*15.8%*
Const. Percent Target	89,178	79,527	70,921	63,246	56,401	50,297	44,854	40,000
% below prior year	10.8%	10.8%	10.8%	10.8%	10.8%	10.8%	10.8%	10.8%

We can visualize the difference in a graph. See M13 Figure 2, below.



M13 Figure 2. Graphical comparison of constant quantity and constant percentage targets.

Translating California's 80% absolute reduction into per capita terms

California's 2020 goal is for emissions to be no higher than they were in 1990. Because Mountain View does not have emissions data for 1990, State law allows us to use our 2005 emissions as a proxy.

California's 2050 goal is for emissions to be 80% less than in 2020.

Between 2020 and 2050 the state's population is expected to grow by 20.7%.[132] Its service population is expected to grow slightly more slowly[133] – by 18.5%. The difference is because a higher fraction of the population will be out of the labor force in 2050 than in 2020, due to an increase in the percentage Californians over age 65.

Because of population growth, California will need to reduce **per capita** emissions by **more than 80%** between 2020 and 2050 to meet its ambitious GHG reduction goals. M13 Table 2 shows the relevant numbers.

[132] Population data from the California Dept. of Finance http://www.dof.ca.gov/Forecasting/Demographics/Projections/documents/P_PressRelease.pdf
[133] Labor Force participation data from http://www.labormarketinfo.edd.ca.gov/data/Top-Statistics.html#LFP and unemployment data from https://www.bls.gov/data/ were used to estimate the number of workers. In future years a 5% unemployment rate was assumed, along with a decline in labor force participation of 1/10 of a percent per year.

M13 Table 2. California emissions targets expressed in absolute and per capita terms.

	Col. 1	Col. 2	Col. 3	Col. 4	Col. 5
Year	California Resident Population (Millions)[6]	California Service Population (Millions)[7]	California Emissions Target (Millions of MT CO2e)[8]	California Emissions Target per Resident (MT CO2e)	California Emissions Target per Service Pop. (MT CO2e)
2005	35.56	57.65	478	13.44	8.29
2020	40.74	64.53	431	10.59	6.68
2050	49.16	76.48	86	1.75	1.13
Change from 2005 to 2050	+ 38.2%	+ 32.7%	- 82.0%	- 87.0%	- 86.4%
Annualized rate of change from 2005 to 2050	+ 0.72%	+ 0.63%	- 3.74%	- 4.43%	- 4.33%

The key part of M13 Table 2 is the figure in the last row of Column 5. It shows that to meet the state's emissions target for 2050, the annual rate of decrease from 2005 onward must be 4.33% on a per capita basis. (As always in this document, per capita means "per service population.)

Conclusions

If Mountain View's population were expected to grow at the same rate as California's population, it would make sense for Mountain View to have targets that were the same as the state's absolute targets[134]. However, Mountain View has recently grown much faster than the state and is expected to continue to do so in the future.

M13 Table 3 in M13 Appendix 1 and M13 Figure 3 show the targets we propose that the City Council adopt. They start at 5.79 MT/SP (metric tons per capita of service population) in 2005 – which was the actual level of emissions in that year – and decline by 4.33% per year. The resulting targets for key years are:

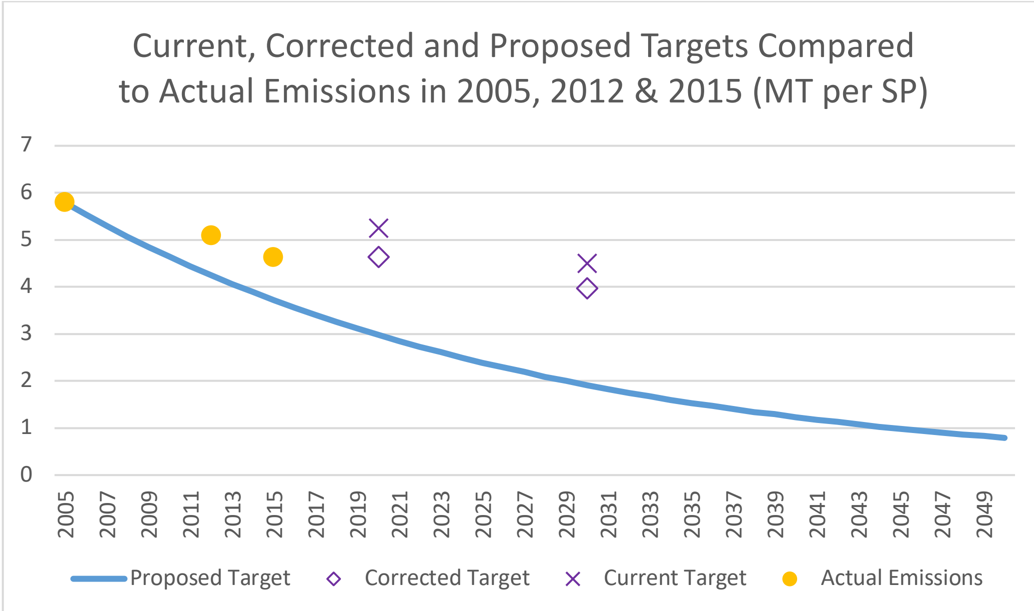
2.98 MT per capita in 2020

1.91 MT per capita in 2030

1.23 MT per capita in 2040

0.79 MT per capita in 2050

[134] The State's targets are reductions relative to 1990. The 2020 target is for emissions to be equal to 1990's. By 2030 the target is to be 40% below 1990's level and by 2050 to be 80% below the 1990 level.



M13 Figure 3. Proposed targets compared to current targets and actual emissions

All the targets by year are shown in M13 Appendix 1 and compared to both the current per capita goals and the absolute goals expressed on a per capita basis. M13 Appendix 1 uses the service population forecast from ESTF2's Business as Usual projection.

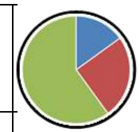
It is worth noting that the 2050 goal of 0.79 MT/SP is 70% of California's statewide 2050 goal of 1.13 MT/SP. Mountain View's 2005 per capita emissions were also 70% of California's 2005 emissions. We can have lower emissions than an average California community because of our lack of highly polluting industries, our exceptionally mild climate, and our relatively small average dwelling size.

M13 Appendix 1: M13 Table 3. Recommended per capita emission targets by year.

Year	Per Capita Target from *GGRP* (MT SP)	Corrected Per Capita Target[135]	Mtn. View's Absolute Target expressed in per capita terms[136]	Recommended Per Capita Target (MT/SP)	Actual Per Capita Emissions (MT/SP)	Recommended Target as a % of 2005 emissions
2005				**5.79**	5.79	100%
2006				**5.54**		95.7%
2007				**5.30**		91.5%
2008				**5.07**		87.6%
2009				**4.85**		83.8%
2010				**4.64**		80.1%
2011				**4.44**		76.7%
2012			4.48	**4.25**	5.09	73.4%
2013				**4.06**		70.2%
2014				**3.89**		67.1%
2015			4.09	**3.72**	4.62	64.2%
2016				**3.56**		61.5%
2017				**3.40**		58.8%
2018				**3.26**		56.2%
2019				**3.12**		53.8%
2020	5.1 to 5.4	4.64	3.28	**2.98**		51.5%
2021				**2.85**		49.3%
2022				**2.73**		47.1%
2023				**2.61**		45.1%
2024				**2.50**		43.1%
2025			2.70	**2.39**		41.3%
2026				**2.29**		39.5%
2027				**2.19**		37.8%
2028				**2.09**		36.1%
2029				**2.00**		34.6%
2030	4.5	3.97	2.09	**1.91**		33.1%
2031				**1.83**		31.6%
2032				**1.75**		30.3%
2033				**1.68**		29.0%
2034				**1.60**		27.7%
2035				**1.53**		26.5%
2036				**1.47**		25.4%
2037				**1.40**		24.3%
2038				**1.34**		23.2%
2039				**1.29**		22.2%
2040				**1.23**		21.2%
2041				**1.18**		20.3%
2042				**1.13**		19.4%
2043				**1.08**		18.6%
2044				**1.03**		17.8%
2045				**0.99**		17.0%
2046				**0.94**		16.3%
2047				**0.90**		15.6%
2048				**0.86**		14.9%
2049				**0.83**		14.3%
2050				**0.79**		13.6%

[135] Corrected targets are 11.7% less than current targets to adjust for the error in estimating 2005 emissions, and the 2020 target is expressed as the midpoint of the range, for the sake of simplicity.
[136] Calculated using historical population data for 2005-2015 and ESTF-2's estimated service populations for 2016-2030. No ESTF-2 estimates were made for years after 2030.

Eliminate emissions associated with Direct Access electricity by 2025 (**M4**)	**Educational, ordinance**	**Perm-anent**
Recommendation name	Recommendation	Duration



250,672	**$135K**	**$0**	**$0.54**	●●○	●●○	●○○	○○○	○○○	○○○
MT CO2e reduction 2018-2030	City's Net Cost	Incremental Net Cost	Net cost per MT CO2e	Easy to implement	Easy to measure	Private investment leverage	Local economic benefits	Other environmental benefits	Health benefits

Problem description

Direct Access (DA) is a state policy that lets some large commercial and industrial customers purchase electricity directly from privately-owned electricity providers (Electric Service Providers, or ESPs) instead of from the local utility or Community Choice Aggregator. Some DA buyers are motivated primarily by saving money while others use DA contracts to decarbonize their electricity purchases. In the Business as Usual (BAU) forecast, emissions from DA electricity will comprise five percent of Mountain View's emissions from 2018-2030.

As explained in the Environmental Analysis section, DA emissions are estimated at the county level and then allocated to the cities. There are good reasons to believe that Mountain View's allocation is **far** higher than our actual DA emissions. By understanding the actual emissions tied to the DA customers located here, we should be able to report lower levels of DA emissions. Our recommendation also includes steps to offset or eliminate whatever DA-related emissions are taking place.

Recommendation

Mountain View should eliminate emissions associated with DA-electricity by 2025. To do this, a series of steps should be followed:

Step 1: Starting in 2018, the City should seek voluntary annual disclosure of energy consumption and carbon content from each DA customer. This will make it possible to have an accurate understanding of how much those companies are contributing to the City's emissions.

Step 2: Starting in 2019, senior City staff should encourage DA customers who are not already buying 100% GHG-free electricity to buy enough unbundled renewable energy certificates (RECs) to offset their electricity-related emissions. The City should publicly recognize the DA customer companies whose electricity is 100% GHG-free either though their purchases or by acquiring RECs. A celebration event hosted by the mayor and involving plaques and a proclamation would be appropriate.

Step 3: Starting in 2019 and continuing through 2030, city staff should encourage DA customers to renegotiate their DA contracts to source all their electricity from GHG-free sources.

Ideally, these three steps will result in the elimination of GHG emissions related to DA within several years. They will also provide sufficient documentation so that in future GHG inventories Mountain View will not have to estimate DA emissions using an allocation based on county-wide data. We will be able to use actual data gathered from companies that operate here.

Step 4: If necessary, the City should add a fee to business licenses issued after 12/31/2024. This fee would apply to companies that purchase DA electricity but cannot demonstrate that the electricity they buy is at least 95% GHG-free. (Some "eligible renewable" sources of electricity emit small amounts of GHG.) The fee would $10-20 per MWh that are not from GHG-free sources.

SWOT analysis

Strengths:

- High impact
- Low cost to the city
- Low cost to DA customers
- Only a small number of companies will need to do anything differently
- Many DA customers may be "green" already, but we just don't have the evidence to prove that

Weaknesses:

- Privacy concerns may make it difficult for the City to find out who the DA customers are
- DA customers may resist sharing the requested or required information

Opportunities and co-benefits:

- By reaching out directly to the energy managers at some of the largest businesses in the City, we will create an opportunity for dialog about innovative ways to reduce non-electricity-related emissions by those firms.

Threats:

- ESPs may see this recommendation as a threat to their profitability (although we don't believe it will be) and will push back against its implementation

Funding sources

Sustainability Department budget

Assumptions and uncertainty

Assumptions with High Uncertainty:

- The degree to which DA customers will voluntarily disclose the information requested in Step 1
- The true GHG emissions from DA electricity for Mountain View companies

Assumptions with Low Uncertainty:

- That there are only a small number of DA customers in Mountain View

.

Author Bruce Karney

Detailed analysis

Environmental analysis

Mountain View Sustainability Analyst Margie Suozzo provided an explanation of how the DA emissions were calculated for the City's 2015 GHG Inventory. The sentence in italics explains the allocation method that determined Mountain View's reported GHG emissions.

> *The DA electricity emissions factor comes from eGRID CAMX (WECC), which represents a primarily California regional emission factor. It is much higher than PG&E's emissions factor. The source used for the inventory was eGRID 2014v2 for CAMX and the emission factors are as follows:*
>
> *568,600 lbs. CO_2/GWh*
> *33.1 lbs. CH_4/GWh*
> *4. lbs. N_2O/GWh*
>
> *More recent numbers (from Nov. 2015) are even higher. See page 3 at this URL:*
> *https://www.epa.gov/sites/production/files/2015-12/documents/emission-factors_nov_2015.pdf*
>
> *650,310 lbs. CO_2/GWh*
> *31.1 lbs. CH_4/GWh*
> *5.7 lbs. N_2O/GWh*
>
> *Note that DA kWh itself is obtained from the California Energy Commission (CEC) by county.* ***For both residential and commercial electricity loads, the ratio of DA kWh to Utility kWh for the county is applied to the Mountain View kWh to compute our city's DA load for the residential and commercial sectors.*** *It is to these data that the emissions factors above are applied.*

The key question that needs to be answered is: Do the DA customers in Mountain View **really** purchase electricity from sources that produce more GHGs per GWh than PG&E? If not, what needs to happen to accurately understand the emissions attributable to local DA customers?

This is especially important in Mountain View because Google, the City's largest employer by far, has purchased 100% renewable electricity since 2017.[137]

LinkedIn, our second-largest employer, states on its web site[138] that "in 2015 we participated in the American Business Act on Climate initiative sponsored by the White House. We pledged to a path toward powering our global operations with 100% renewable energy."

Microsoft, the City's third-largest employer, has been carbon-neutral since 2012.[139]

---

[137] "In 2016 [Google] marked 10 years of operating as a carbon neutral company and announced that we'll reach 100% renewable energy for our global operations in 2017. When we committed to being carbon neutral in 2007, we knew that aggressive energy-efficiency initiatives, renewable energy, and carbon offsets would all be critical to our ongoing strategy, and over time we've learned and innovated across these areas in ways we couldn't have imagined a decade ago." Source: https://environment.google/projects/environmental-report-2017/

[138] See https://linkedinforgood.linkedin.com/practicing-responsibly/environmental-sustainability

[139] See https://www.microsoft.com/en-us/environment/carbon/

Our BAU forecast for DA emissions is 31,334 MT per year. We will assume that we can reduce emissions by 20% of that figure each year starting in 2021 as shown in the table below. The resulting reduction compared to the BAU forecast is 250,672 MT CO2e.

Year	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
DA Emissions (MT CO2e)	31,334	31,334	25,067	18,800	12,534	6,267	0	0	0	0	0	0
Reduction (MT CO2e)	0	0	6,267	12,534	18,800	25,067	31,334	31,334	31,334	31,334	31,334	31,334

Cost analysis

Costs to Mountain View

We estimate that two person-months will be needed to accomplish Step 1. Another two person-months will be needed for Step 2. We estimate that Step 3 will require one person-month per year for five years.

Using a fully loaded cost estimate of $15,000 per person-month, total cost for these three steps is estimated at $135,000 for nine person-months.

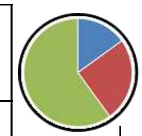
We believe that Step 4 will not be necessary, so we are leaving it out of the cost estimate.

Costs to DA customers

This cost cannot be measured due to lack of data on contract prices, but we can estimate it. We believe that DA customers will be able to procure GHG-free electricity for the same price as electricity that isn't GHG-free. The reason we believe this is that Silicon Valley Clean Energy (SVCE) can provide 100% GHG-free electricity at a price that is six percent lower than PG&E's price for their standard offering of 68% GHG-free power. This demonstrates that the cost of new contracts for GHG-free power is already very competitive. (Note that SVCE's mix includes 50% hydro from the Pacific Northwest and 50% California-eligible renewables. The price of California renewables is higher than the price of out-of-state hydro. ESPs can also procure power from these hydro resources if their customers demand it.)

M4 References

List of Electric Service Providers in California: http://cpuc.ca.gov/esp/

Implement a knowledge resource for electrification & other sustainability actions (**M10**)	**Outreach**	**2 years**	
Recommendation name	Type	Duration	

722	**$30K**	**$0**	$38.86	●●○	●○○	●●●	●●●	○○○	○○○
MT CO2e reduction 2018-2030	City's Net Cost	Incrementa l Net Cost	Net cost per MT CO2e reduction	Easy to implemen t	Easy to measure	Private investment leverage	Local economic benefits	Other environmental benefits	Health benefits

Problem description (eliminating building natural gas usage)

To reduce greenhouse gases (GHGs), we need to stop using natural gas for heating and cooking. The highest natural gas usage in this area is water heating (50% of the total gas bill on average). Converting natural gas water heaters to heat pump water heaters is the most efficient way to eliminate the GHGs from water heating However, upgrading from gas water heaters to heat pump water heaters is a challenge with many unknowns.

Problem description (beyond existing building electrification)

There are other sustainability activities that benefit from a sustainability knowledge base. New-building construction needs access to information to create all electric buildings. Replacing existing gas appliances (space heating, induction cooking, and clothes dryers) is another area requiring a knowledge base. There is also a need for knowledge on addressing consumption-generated GHG.

Recommendation

Mountain View should partner with Silicon Valley Clean Energy (SVCE) and other agencies to collect and disseminate knowledge about beneficial electrification. Mountain View needs to partner with someone who can help provide this service. SVCE's CEO (Girish Balachandran) is developing a program to upgrade 150 existing residences with Heat Pump Water Heaters (HPWHs). To do that effectively, we need a knowledge base. SVCE would be responsible for maintaining and creating the database. Mountain View's responsibility would be in the form of providing facilities for extended outreach to the community.

We are investigating if this database can be extended to cover other related subjects. Topics include heat pump space heaters, electric vehicle (EV) information, and electric appliance replacement. A centralized location for all the information would be a great benefit and minimize maintenance costs. The need for this goes beyond two years.

The 150 homes in the pilot program will provide data for accelerating HPWH adoption. The GHG savings should be reflected in recommendations such as BE1. Mountain View may see 30% of the funding or 30% of 150 homes (45 homes). Adoption will have to grow beyond that.

SWOT analysis

Strengths:

- We are in the early phases of electrifying buildings (replacing the existing gas appliances with electric ones). We need an active way to address electrification of buildings.
- The knowledge that exists is distributed. Consolidating it makes it more useful.

Weaknesses:

- This work is at the early stages of deployment.
- It is dependent on SVCE winning the award from BAAQMD

Opportunities and co-benefits:

- SVCE has indicated interest in addressing this need. If they do, Mountain View's part of this will be to monitor and use the information.

Threats: Specifically, against replacing gas water heaters with HPWHs.

- The threat for electrification is the gas industry.
- When a gas pipeline delivers fewer Therms the cost per Therm goes up.
- Gas companies will continue to push gas distribution (like PG&E). In contrast, SCE has released a white paper on meeting climate goals by moving to electricity aggressively.

SVCE submitted their request for $500K to BAAQMD on May 11, 2018. SVCE has indicated they are to receive input back by July 2018. We will not know before then about how SVCE plans to address this.

Municipalities where already implemented

SVCE (Silicon Valley Clean Energy) is rolling out a program to replace gas water heaters with heat pump water heaters. This program called "Future Fit Home" will drive the main component of this effort.

Funding sources

The programs will be funded by SVCE's cash flow and from BAAQMD (if SVCE wins part of the grant).

Assumptions and uncertainty

Assumptions with High Uncertainty:

- Will SVCE get the grant from BAAQMD?

Assumptions with Low Uncertainty:

- If this is popular, we will need to see how to extend it.

Author Bruce Naegel

Detailed analysis

Proposed format and outreach

- Requirements for outreach are similar for existing building upgrades, new building requirements, and other sustainability topics.
- Most of this will be supplied by SVCE for their Existing Buildings program to upgrade homes from gas water heaters to heat pump water heaters.
- The key to this will be optimized search tools to make it easy for the user to find the data. The data must be organized so that a customer can find the data required. This means the user-interface must be a key investment.
- The project could include a way to extend the knowledge base for topics other than for heat pump water heaters, including:
    - Title 24, 2019 and updates
    - Local building codes
    - EV regulations and tips
    - Consumption-Based Inventory information on food, material recovery, air travel
    - Consumer involvement information
- Components could include
    - Web site
    - Printed documents
    - Presentation at outreach events (like the one held in Palo Alto on April 24 put on by Passive House, CA)
        - Representatives for 4 heat pump manufacturers
        - Equipment shown in the room

Benefit analysis

Acceleration of Adoption for Existing Building Upgrades.

Natural gas water heaters use an average of 22 therms per month of gas. Each therm burned results in 11.7 pounds of CO2e, which equates to 257 pounds or 0.117 metric tons per month. We believe that if Mountain View had the knowledge base described here, we could accelerate the adoption of HPWH in 10% of the 11,000 owner-occupied properties in the city. We estimate that the knowledge base would enable these 1,100 residents to install a HPWH six months sooner than they otherwise would have. Conservatively, we do not propose that this recommendation will cause anyone to install a HPWH who wouldn't have done so without the Knowledge Base. Therefore, our estimate of impact is: 1100×0.117 MT $\times 6 = 772$ MT.

Cost analysis

- If the program is run by SVCE, the costs for Mountain View relate to those costs for information tied to outreach.

Cost analysis / SVCE

- If SVCE is addressing this, then assume Mountain View is dedicating 14 hours / month × 24 months = $29.6K in outreach and other efforts for publicizing beyond what SVCE will do.
- Outline of component groups required for upgrade or new installation. This is to provide context on what will be discussed.

- Cost for replacement components
  - Heat Pump Water Heater
  - Heat Pump Space Heater (Heat Pump HVAC)
  - Electric Dryer (Heat pump or resistive)
  - Induction Stove
  - Electric Oven
  - Electric fireplace
- Cost for installation
  - Plumbing as required to remove existing Gas appliances
  - Electrician for new wiring (wiring, conduit, junction boxes, PG&E)
  - Installation of new replacement parts

Scale analysis A set of documentation methods as listed above providing information not easily obtained will help to scale the operation more quickly than it would scale otherwise.

M10 References

https://www.edison.com/home/our-perspective/clean-power-and-electrification-pathway.html
This reference shows how SCE believes we need to get to CA climate goals.
BAU Emissions Estimates April 16 Rev 2 (Metrics and Measurement Group)
This is a listing for the baseline GHG content.

https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=CF
This site has census information for Mountain View.

https://naturalgaslocal.com/states/california/mountain-view/#usage
This reference shows how to calculate the amount of leaked natural gas

https://drive.google.com/drive/folders/1VpCfjoyHM-_Nlmn5poQgtIoSZpXU8xDt

https://sciencing.com/how-7918141-calculate-gas-loss-pipe.html

Chapter 7: Business as Usual (BAU) Forecasts

Introduction

The BAU forecasts were created to answer the question: what will happen to emissions in the future if Mountain View does nothing other than what is already planned? The BAU forecasts give us a baseline against which to compare the estimated impact of implementing each of our recommendations.

Some trends, such as increasing the number of residents and employees, will increase the community's overall emissions. Others, like more stringent federal fuel economy standards for passenger vehicles, will lower them. Some trends may increase *total* emissions while lowering *per capita* emissions.

We started the process by estimating each of these key variables for the years 2016 to 2030.

1. Resident population
2. Worker population
3. Service population (which is just the sum of residents and workers)
4. Single-family housing units
5. Multi-family housing units
6. Mobile home housing units
7. Total housing units (the sum of the three variables above)
8. Square footage of office/industrial buildings
9. Square footage of "other commercial" buildings

To make these estimates, we started with historical data, typically for 2005-2015 that was provided to us by the City or obtained from US Census databases. The task force's Measurement and Metrics team then relied on their understanding of how Mountain View was likely to grow in the future to develop the estimates for each year from 2016 to 2030.

Once we had agreed on estimates for the nine variables listed above, three of the working groups estimated future emissions from all the GHG sources that make up the City's carbon footprint as measured using the ICLEI protocol.

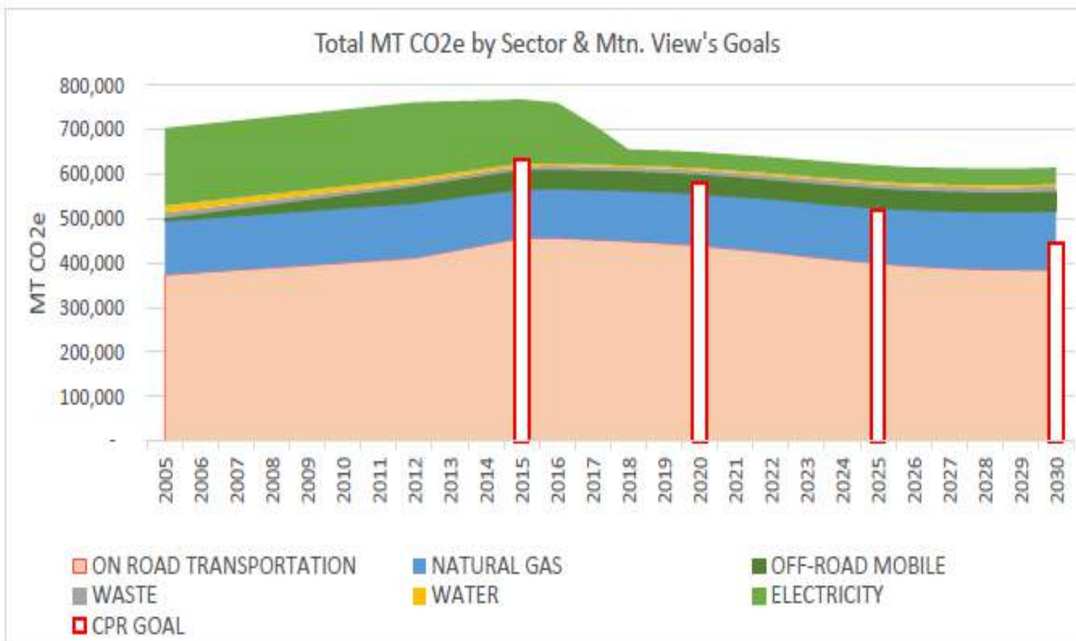
- The Transportation Group estimated emissions from cars and trucks and medium and heavy on-road vehicles;
- The Buildings and Land Use Group estimated emissions from natural gas and electricity;
- The Circular Economy Group estimated emissions from solid waste, water treatment, water pumping, construction equipment, and lawn and garden equipment.

These estimates were discussed in meetings of the Measurement and Metrics Working Group. They were also vetted by the steering committee and ultimately voted on and approved by the entire task force. They are presented within this report as a PDF file, but the actual Excel file is available online at[140] https://drive.google.com/drive/u/0/folders/1S48T7UNtgfg4eLNAh1Ap98nuDEpwGfpO

[140] https://drive.google.com/drive/u/0/folders/1S48T7UNtgfg4eLNAh1Ap98nuDEpwGfpO

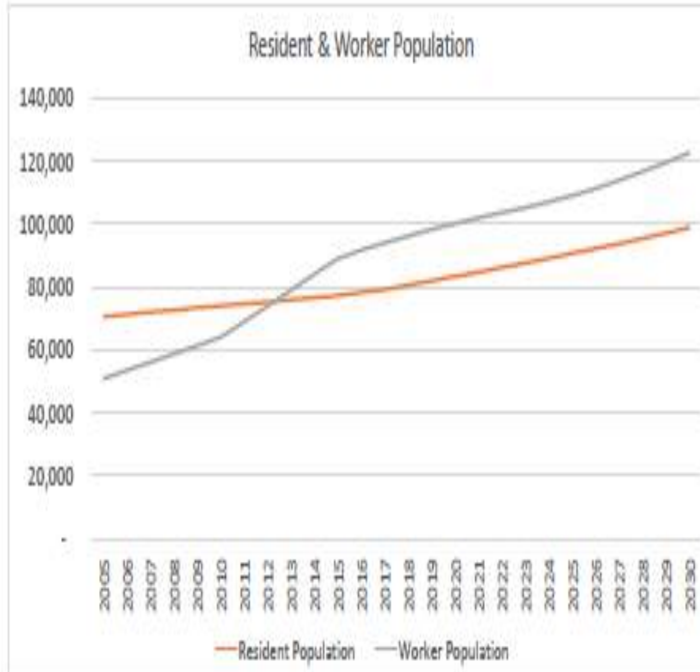
FINAL BUSINESS AS USUAL EMISSIONS FORECAST (MT CO2e)	Actual 2005	Actual 2012	Actual 2015	Est. 2016	Est. 2017	Est. 2018	Est. 2019	Est. 2020	Est. 2021	Est. 2022	Est. 2023	Est. 2024	Est. 2025	Est. 2026	Est. 2027	Est. 2028	Est. 2029	Est. 2030
ELECTRICITY	174,426	170,496	143,113	137,301	89,953	35,557	35,645	35,734	35,825	35,918	36,013	36,111	36,210	36,311	36,415	36,521	36,629	36,739
NATURAL GAS	121,136	124,154	109,663	111,072	112,500	113,949	115,419	116,910	118,422	119,956	121,512	123,090	124,691	126,315	127,962	129,633	131,329	133,048
BUILDING ENERGY	295,562	294,650	252,776	248,372	202,454	149,506	151,064	152,644	154,248	155,875	157,526	159,201	160,901	162,626	164,377	166,154	167,957	169,787
PASSENGER-LIGHT VEHICLES	309,162	358,379	413,676	412,849	409,610	406,008	401,327	395,717	388,596	380,694	372,258	364,036	356,069	349,909	345,297	342,195	340,283	339,486
MEDIUM-HEAVY VEHICLES	64,915	53,339	43,244	43,589	43,545	43,359	43,384	43,312	43,609	43,805	43,375	43,474	43,577	43,687	43,853	44,055	44,280	44,565
ON ROAD TRANSPORTATION	374,077	411,718	456,920	456,438	453,155	449,367	444,711	439,029	432,205	424,499	415,633	407,510	399,646	393,596	389,150	386,250	384,563	384,051
WASTE	12,325	8,543	7,593	7,897	8,182	8,452	8,714	8,932	9,110	9,292	9,478	9,668	9,856	10,049	10,250	10,449	10,632	10,840
WATER	15,528	9,248	7,281	4,569	4,654	4,749	4,842	4,932	5,019	5,102	5,183	5,271	5,366	5,469	5,580	5,699	5,824	5,954
OFF-ROAD MOBILE	6,560	37,146	43,796	43,816	43,836	43,856	43,876	43,896	43,916	43,937	43,958	43,979	44,000	44,021	44,043	44,065	44,087	44,109
GRAND TOTAL	704,052	761,305	768,366	761,093	712,281	655,930	653,207	649,433	644,498	638,705	631,778	625,629	619,770	615,761	613,400	612,618	613,064	614,741
CPR Goal in Pct. (vs. 2005)			-10%					-17.5%	(goal is 15-20%)				-26%					-37%
CPR Goal in MT (vs. 2005)			633,647					580,843					520,998					443,553
GGRP Goal (MT per Serv. Pop)								5.25	(goal is 5.1-5.4)									4.5
MT CO2e per Service Population	5.79	5.09	4.62	4.47	4.11	3.71	3.62	3.54	3.45	3.36	3.27	3.19	3.10	3.02	2.95	2.89	2.83	2.77

CPR = Climate Protection Roadmap
GGRP = Greenhouse Gas Reduction Plan



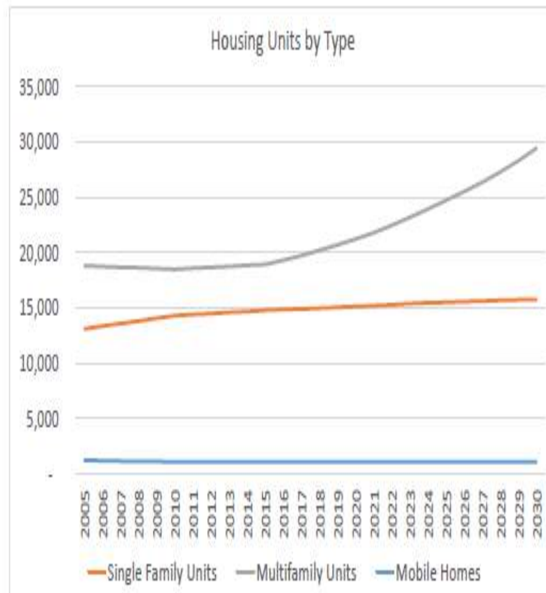
	Actual	Est.	Est.	Est.	Est.	Actual	Est.	Est.	Est.	Est.	Actual	Est.	Est.
ASSUMPTIONS & INPUTS	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Resident Population	70,629	71,316	72,004	72,691	73,379	74,066	74,703	75,340	75,976	76,613	77,250	78,396	79,278
Worker Population	50,903	53,535	56,166	58,798	61,429	64,061	69,074	74,087	79,099	84,112	89,125	91,741	94,035
Service Population	121,532	124,851	128,170	131,489	134,808	138,127	143,777	149,426	155,076	160,725	166,375	170,137	173,313
Res. Pop. Annual Growth		1.0%	1.0%	1.0%	0.9%	0.9%	0.9%	0.9%	0.8%	0.8%	0.8%	1.5%	1.1%
Worker Pop. Annual Growth		5.2%	4.9%	4.7%	4.5%	4.3%	7.8%	7.3%	6.8%	6.3%	6.0%	2.9%	2.5%
Service Pop. Annual Growth		2.7%	2.7%	2.6%	2.5%	2.5%	4.1%	3.9%	3.8%	3.6%	3.5%	2.3%	1.9%

	Est.	Est.	Est.	Est.	Est.	Est.	Est.	Est.	Est.	Est.	Est.	Est.	Est.
ASSUMPTIONS & INPUTS	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Resident Population	80,626	81,997	83,391	84,809	86,251	87,717	89,208	90,725	92,267	93,836	95,431	97,149	98,995
Worker Population	96,198	98,314	100,280	102,085	103,718	105,274	107,064	109,098	111,389	113,951	116,800	119,720	122,713
Service Population	176,824	180,311	183,671	186,894	189,969	192,991	196,272	199,823	203,656	207,787	212,231	216,869	221,708
Res. Pop. Annual Growth	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%	1.8%	1.9%
Worker Pop. Annual Growth	2.3%	2.2%	2.0%	1.8%	1.6%	1.5%	1.7%	1.9%	2.1%	2.3%	2.5%	2.5%	2.5%
Service Pop. Annual Growth	2.0%	2.0%	1.9%	1.8%	1.6%	1.6%	1.7%	1.8%	1.9%	2.0%	2.1%	2.2%	2.2%



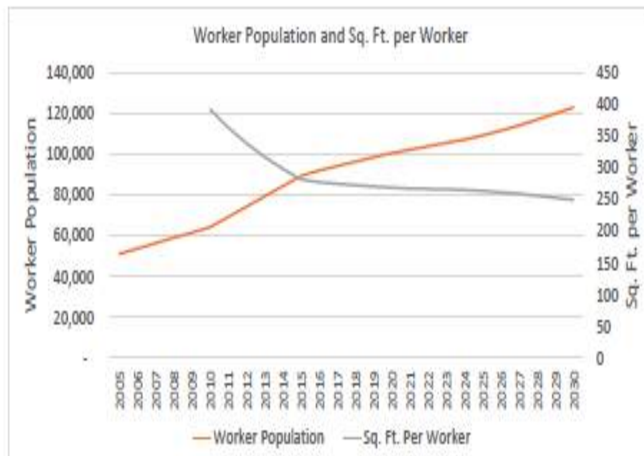
ASSUMPTIONS & INPUTS	Actual 2005	Est. 2006	Est. 2007	Est. 2008	Est. 2009	Actual 2010	Est. 2011	Est. 2012	Est. 2013	Est. 2014	Actual 2015	Est. 2016
HOUSING & POPULATION												
Resident Population	70,629	71,316	72,004	72,691	73,379	74,066	74,703	75,340	75,976	76,613	77,250	78,396
Single Family Units	13,100	13,340	13,580	13,820	14,060	14,300	14,394	14,488	14,583	14,677	14,771	14,845
Multifamily Units	18,817	18,750	18,684	18,617	18,551	18,484	18,575	18,666	18,757	18,848	18,939	19,318
Mobile Homes	1,231	1,204	1,177	1,151	1,124	1,097	1,097	1,097	1,097	1,097	1,097	1,097
Housing Units	33,148	33,295	33,441	33,588	33,734	33,881	34,066	34,251	34,437	34,622	34,807	35,260
Persons per Housing Unit	2.13	2.14	2.15	2.16	2.18	2.19	2.19	2.20	2.21	2.21	2.22	2.22
Jobs to Housing Unit Ratio	1.54	1.61	1.68	1.75	1.82	1.89	2.03	2.16	2.30	2.43	2.56	2.60

ASSUMPTIONS & INPUTS	Est. 2017	Est. 2018	Est. 2019	Est. 2020	Est. 2021	Est. 2022	Est. 2023	Est. 2024	Est. 2025	Est. 2026	Est. 2027	Est. 2028	Est. 2029	Est. 2030
HOUSING & POPULATION														
Resident Population	79,278	80,626	81,997	83,391	84,809	86,251	87,717	89,208	90,725	92,267	93,836	95,431	97,149	98,995
Single Family Units	14,919	14,994	15,069	15,144	15,220	15,296	15,372	15,447	15,517	15,579	15,635	15,682	15,723	15,754
Multifamily Units	19,704	20,197	20,702	21,220	21,804	22,458	23,188	23,942	24,720	25,523	26,352	27,274	28,297	29,429
Mobile Homes	1,097	1,097	1,097	1,097	1,097	1,097	1,097	1,097	1,097	1,097	1,097	1,097	1,097	1,097
Housing Units	35,720	36,288	36,868	37,461	38,121	38,851	39,657	40,486	41,334	42,199	43,084	44,053	45,117	46,280
Persons per Housing Unit	2.22	2.22	2.22	2.23	2.22	2.22	2.21	2.20	2.19	2.19	2.18	2.17	2.15	2.14
Jobs to Housing Unit Ratio	2.63	2.65	2.67	2.68	2.68	2.67	2.65	2.64	2.64	2.64	2.64	2.65	2.65	2.65

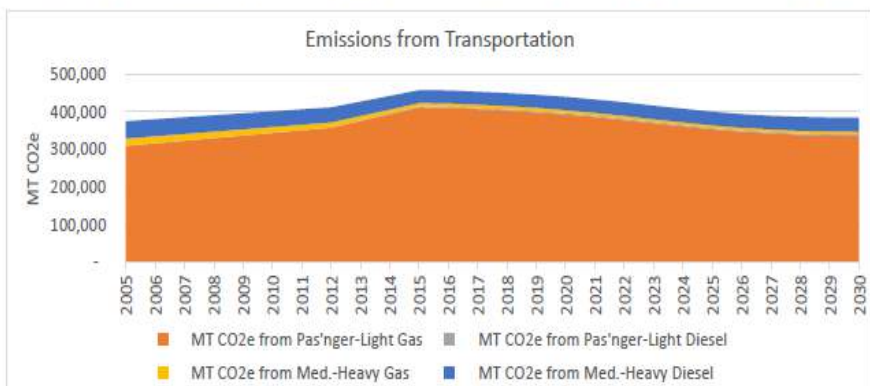


ASSUMPTIONS & INPUTS	Actual 2005	Est. 2006	Est. 2007	Est. 2008	Est. 2009	Actual 2010	Est. 2011	Est. 2012	Est. 2013	Est. 2014	Actual 2015	Est. 2016	Est. 2017
COMMERCIAL/INDUSTRIAL SPACE													
Worker Population	50,903	53,535	56,166	58,798	61,429	64,061	69,074	74,087	79,099	84,112	89,125	91,741	94,035
Office/Industrial (Million Sq. Ft.)						19.269	19.288	19.307	19.325	19.344	19.363	19.735	20.107
Other Commercial (Million Sq. Ft.)						5.791	5.771	5.750	5.730	5.709	5.689	5.682	5.674
Non-Residential (Million Sq. Ft.)						25.060	25.058	25.057	25.055	25.054	25.052	25.417	25.782
Office/Ind'l Added in Year (Sq. Ft.)							18,800	18,800	18,800	18,800	18,800	372,125	372,125
Other Com'l Added in Year (Sq. Ft.)							(20,400)	(20,400)	(20,400)	(20,400)	(20,400)	(7,375)	(7,375)
Non-Res Added in Year (Sq. Ft.)							(1,600)	(1,600)	(1,600)	(1,600)	(1,600)	364,750	364,750
Sq. Ft. Per Worker						391.19	362.78	338.21	316.76	297.86	281.09	277.05	274.17

ASSUMPTIONS & INPUTS	Est. 2018	Est. 2019	Est. 2020	Est. 2021	Est. 2022	Est. 2023	Est. 2024	Est. 2025	Est. 2026	Est. 2027	Est. 2028	Est. 2029	Est. 2030
COMMERCIAL/INDUSTRIAL SPACE													
Worker Population	96,198	98,314	100,280	102,085	103,718	105,274	107,064	109,098	111,389	113,951	116,800	119,720	122,713
Office/Industrial (Million Sq. Ft.)	20.479	20.852	21.224	21.596	21.968	22.340	22.712	23.084	23.456	23.829	24.201	24.573	24.945
Other Commercial (Million Sq. Ft.)	5.667	5.660	5.652	5.645	5.637	5.630	5.623	5.615	5.608	5.601	5.593	5.586	5.578
Non-Residential (Million Sq. Ft.)	26.146	26.511	26.876	27.241	27.605	27.970	28.335	28.700	29.064	29.429	29.794	30.159	30.523
Office/Ind'l Added in Year (Sq. Ft.)	372,125	372,125	372,125	372,125	372,125	372,125	372,125	372,125	372,125	372,125	372,125	372,125	372,125
Other Com'l Added in Year (Sq. Ft.)	(7,375)	(7,375)	(7,375)	(7,375)	(7,375)	(7,375)	(7,375)	(7,375)	(7,375)	(7,375)	(7,375)	(7,375)	(7,375)
Non-Res Added in Year (Sq. Ft.)	364,750	364,750	364,750	364,750	364,750	364,750	364,750	364,750	364,750	364,750	364,750	364,750	364,750
Sq. Ft. Per Worker	271.80	269.66	268.01	266.84	266.16	265.69	264.65	263.06	260.93	258.26	255.08	251.91	248.74



ASSUMPTIONS & INPUTS ON ROAD TRANSPORTATION	Actual 2005	Actual 2012	Actual 2015	Est. 2016	Est. 2017	Est. 2018	Est. 2019	Est. 2020	Est. 2021	Est. 2022	Est. 2023	Est. 2024	Est. 2025	Est. 2026	Est. 2027	Est. 2028	Est. 2029	Est. 2030
PASSENGER-LIGHT VEHICLES																		
Passenger-Light (Gas) VMT Growth				2.1%	1.7%	1.7%	1.5%	1.3%	1.1%	0.9%	0.8%	0.9%	1.0%	1.2%	1.4%	1.5%	1.7%	1.8%
Change in fuel use per mile travelled				-2.3%	-2.5%	-2.6%	-2.7%	-2.7%	-2.9%	-3.0%	-3.0%	-3.1%	-3.2%	-2.9%	-2.7%	-2.4%	-2.2%	-2.0%
GASOLINE POWERED																		
VMT (Millions of miles)	811.4	921.0	1068.6	1090.6	1109.0	1127.9	1144.9	1159.6	1172.2	1183.0	1192.6	1203.0	1214.7	1228.8	1245.5	1264.7	1285.6	1308.3
MT CO2e per million miles VMT	380.130	387.460	384.740	376.015	366.683	357.189	347.663	338.311	328.523	318.793	309.121	299.597	290.147	281.797	274.307	267.676	261.819	256.645
MT CO2e from Pas'nger-Light Gas	308,436	356,854	411,137	410,082	406,651	402,873	398,039	392,305	385,095	377,132	368,658	360,415	352,441	346,272	341,649	338,530	336,594	335,768
Passenger-Light (Diesel) VMT Growth				11.7%	9.7%	8.6%	7.5%	6.4%	5.4%	4.6%	4.0%	3.6%	3.3%	3.1%	2.9%	2.8%	2.7%	2.7%
Change in fuel use per mile travelled				-2.4%	-2.5%	-2.5%	-2.4%	-2.4%	-2.7%	-2.8%	-2.8%	-2.9%	-3.0%	-2.7%	-2.5%	-2.3%	-2.0%	-1.8%
DIESEL POWERED																		
VMT (Millions of miles)	2.021	3.936	7.259	8.108	8.892	9.660	10.384	11.045	11.644	12.182	12.667	13.121	13.555	13.970	14.373	14.776	15.178	15.582
MT CO2e per million miles VMT	359.228	387.449	349.773	341.268	332.771	324.534	316.641	308.918	300.670	292.399	284.203	275.970	267.650	260.344	253.809	248.037	243.049	238.609
MT CO2e from Pas'nger-Light Diesel	726	1,525	2,539	2,767	2,959	3,135	3,288	3,412	3,501	3,562	3,600	3,621	3,628	3,637	3,648	3,665	3,689	3,718
MEDIUM-HEAVY VEHICLES																		
Medium-Heavy (Gas) VMT Growth				-3.4%	-3.4%	-4.0%	-3.5%	-3.3%	-3.0%	-2.8%	-2.6%	-2.3%	-2.0%	-1.8%	-1.5%	-1.2%	-0.9%	-0.8%
Change in fuel use per mile travelled				0.6%	0.4%	0.3%	0.2%	0.3%	0.3%	0.3%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.1%	0.1%
GASOLINE POWERED																		
VMT (Millions of miles)	20.189	10.645	10.035	9.694	9.365	8.992	8.678	8.394	8.143	7.917	7.715	7.537	7.387	7.256	7.150	7.063	6.996	6.942
MT CO2e per million miles VMT	960.622	1255.237	981.863	987.621	991.564	994.440	996.889	999.762	1002.579	1005.431	1007.907	1010.216	1012.590	1014.884	1016.923	1018.689	1020.011	1021.464
MT CO2e from Med.-Heavy Gas	19,394	13,362	9,853	9,574	9,286	8,942	8,651	8,392	8,164	7,960	7,776	7,614	7,480	7,364	7,271	7,195	7,136	7,091
Medium-Heavy (Diesel) VMT Growth				2.7%	1.8%	1.4%	1.8%	1.5%	2.3%	2.0%	1.9%	1.2%	1.1%	1.1%	1.2%	1.2%	1.2%	1.2%
Change in fuel use per mile travelled				-0.8%	-1.1%	-0.9%	-0.8%	-0.9%	-0.8%	-0.9%	-2.5%	-0.5%	-0.5%	-0.5%	-0.4%	-0.4%	-0.4%	-0.3%
DIESEL POWERED																		
VMT (Millions of miles)	32.936	31.849	24.558	25.230	25.689	26.050	26.514	26.911	27.536	28.094	28.625	28.976	29.308	29.629	29.973	30.320	30.677	31.047
MT CO2e per million miles VMT	1382.105	1255.204	1359.679	1348.197	1333.606	1321.190	1309.987	1297.611	1287.224	1275.895	1243.633	1237.576	1231.643	1225.927	1220.498	1215.699	1210.809	1207.009
MT CO2e from Med.-Heavy Diesel	45,521	39,977	33,391	34,015	34,259	34,417	34,733	34,920	35,445	35,845	35,599	35,860	36,097	36,323	36,582	36,860	37,144	37,474
Total MT CO2e from On Road Transp.	374,077	411,718	456,920	456,438	453,155	449,367	444,711	439,029	432,205	424,499	415,633	407,510	399,646	393,596	389,150	386,250	384,563	384,051



ASSUMPTIONS & INPUTS	Actual 2005	Actual 2012	Actual 2015	Est. 2016	Est. 2017	Est. 2018	Est. 2019	Est. 2020	Est. 2021	Est. 2022	Est. 2023	Est. 2024	Est. 2025	Est. 2026	Est. 2027	Est. 2028	Est. 2029	Est. 2030
ELECTRICITY																		
Residential Electricity Growth				-5.2%	-1.4%	1.2%	1.2%	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%
Com'l & Ind. Electricity Growth				-5.2%	-1.4%	2.2%	2.2%	2.2%	2.2%	2.2%	2.2%	2.2%	2.2%	2.2%	2.2%	2.2%	2.2%	2.2%
Direct Access Electricity Growth				0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
MWh Residential	162,405	156,496	147,825	140,138	138,176	139,807	141,456	142,984	144,528	146,089	147,667	149,262	150,874	152,503	154,150	155,815	157,498	159,199
kg CO2e / MWh Residential *	223.56	202.94	178.24	178.24	100.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
MT CO2e Res	36,307	31,760	26,348	24,978	13,818	559	566	572	578	584	591	597	603	610	617	623	630	637
MWH Com'l & Industrial	503,351	508,366	479,303	454,379	448,018	457,964	468,131	478,523	489,146	500,006	511,106	522,452	534,051	545,907	558,026	570,414	583,077	596,021
kg CO2e / MWh Com'l & Ind. *	223.56	202.94	178.24	178.24	100.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00
MT CO2e C&I	112,528	103,170	85,431	80,989	44,802	3,664	3,745	3,828	3,913	4,000	4,089	4,180	4,272	4,367	4,464	4,563	4,665	4,768
MWH All Except DA (from SVCE)			625,665	594,594	586,266													
MWH All Except DA (city of MV)	665,756	664,862	627,128	594,517	586,194	597,771	609,587	621,507	633,675	646,095	658,773	671,714	684,924	698,410	712,176	726,229	740,575	755,220
MT CO2e All Except DA	148,835	134,930	111,779	105,967	58,619	4,223	4,311	4,400	4,491	4,584	4,680	4,777	4,876	4,977	5,081	5,187	5,295	5,405
MWH Direct Access	114,470	120,246	121,215	121,215	121,215	121,215	121,215	121,215	121,215	121,215	121,215	121,215	121,215	121,215	121,215	121,215	121,215	121,215
kg CO2e / MWh Direct Access	223.56	295.78	258.50	258.50	258.50	258.50	258.50	258.50	258.50	258.50	258.50	258.50	258.50	258.50	258.50	258.50	258.50	258.50
MT CO2e Direct Access	25,591	35,566	31,334	31,334	31,334	31,334	31,334	31,334	31,334	31,334	31,334	31,334	31,334	31,334	31,334	31,334	31,334	31,334
Total MT CO2e from Electricity	174,426	170,496	143,113	137,301	89,953	35,557	35,645	35,734	35,825	35,918	36,013	36,111	36,210	36,311	36,415	36,521	36,629	36,739

Notes

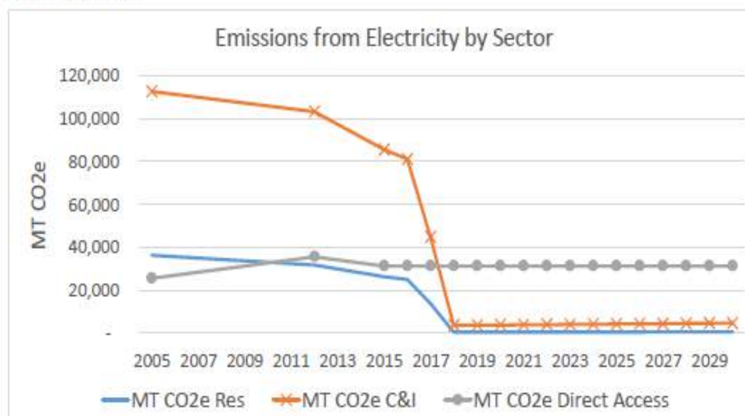
* Assumes GHG-free electricity from SVCE with 2% opt-out for residential and 4% opt-out for non-residential.

SVCE rolled out in mid-2017.

References

Community GHG Emissions Inventories, 2005 and 2012; City of MV, Climate protection road map -2015

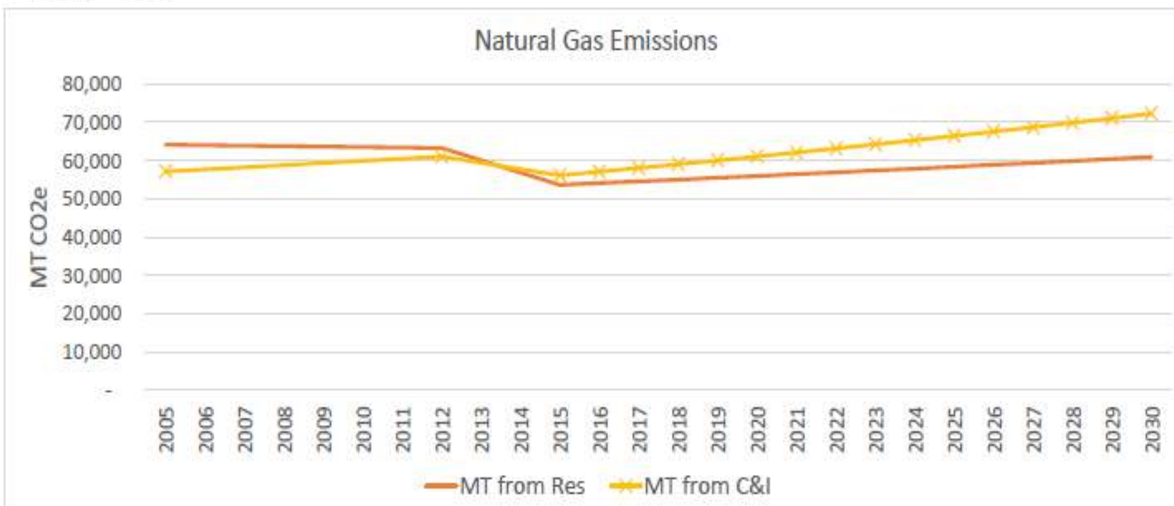
Mountain View Greenhouse gas reduction program



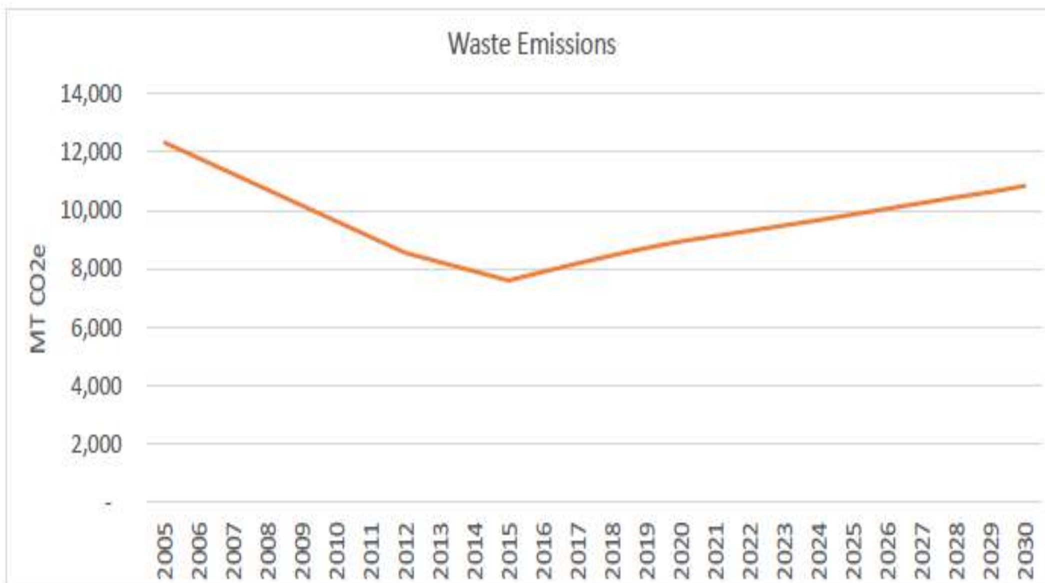
ASSUMPTIONS & INPUTS	Actual 2005	Actual 2012	Actual 2015	Est. 2016	Est. 2017	Est. 2018	Est. 2019	Est. 2020	Est. 2021	Est. 2022	Est. 2023	Est. 2024	Est. 2025	Est. 2026	Est. 2027	Est. 2028	Est. 2029	Est. 2030
NATURAL GAS																		
Residential Nat. Gas Growth				0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%
Com'l & Ind. Nat Gas Growth				1.7%	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%
Therms Residential (Millions)	12.052	11.912	10.074	10.159	10.246	10.333	10.420	10.509	10.598	10.688	10.779	10.871	10.963	11.057	11.150	11.245	11.341	11.437
MT CO2e/Million Therms	5315.72	5307.17	5320.66	5320.66	5320.66	5320.66	5320.66	5320.66	5320.66	5320.66	5320.66	5320.66	5320.66	5320.66	5320.66	5320.66	5320.66	5320.66
MT from Res	64,065	63,219	53,598	54,054	54,513	54,976	55,444	55,915	56,390	56,870	57,353	57,840	58,332	58,828	59,328	59,832	60,341	60,854
Therms Com'l & Indust. (Millions)	10.738	11.453	10.537	10.716	10.899	11.084	11.272	11.464	11.659	11.857	12.058	12.263	12.472	12.684	12.900	13.119	13.342	13.569
MT CO2e/Million Therms	5314.86	5320.44	5320.66	5320.66	5320.66	5320.66	5320.66	5320.66	5320.66	5320.66	5320.66	5320.66	5320.66	5320.66	5320.66	5320.66	5320.66	5320.66
MT from C&I	57,071	60,935	56,065	57,018	57,987	58,973	59,976	60,995	62,032	63,087	64,159	65,250	66,359	67,487	68,634	69,801	70,988	72,195
Total MT CO2e from Natural Gas	121,136	124,154	109,663	111,072	112,500	113,949	115,419	116,910	118,422	119,956	121,512	123,090	124,691	126,315	127,962	129,633	131,329	133,048

Residential	
Heating & cooking	-0.20%
Natural gas used for generation of electricity	0
Energy efficiency retrofits	-0.30%
Title 24	-0.50%
Retrofits	-0.10%

Commerical	
Heating & cooking	0.10%
Natural gas used for generation of electricity	0
Energy efficiency retrofits	0

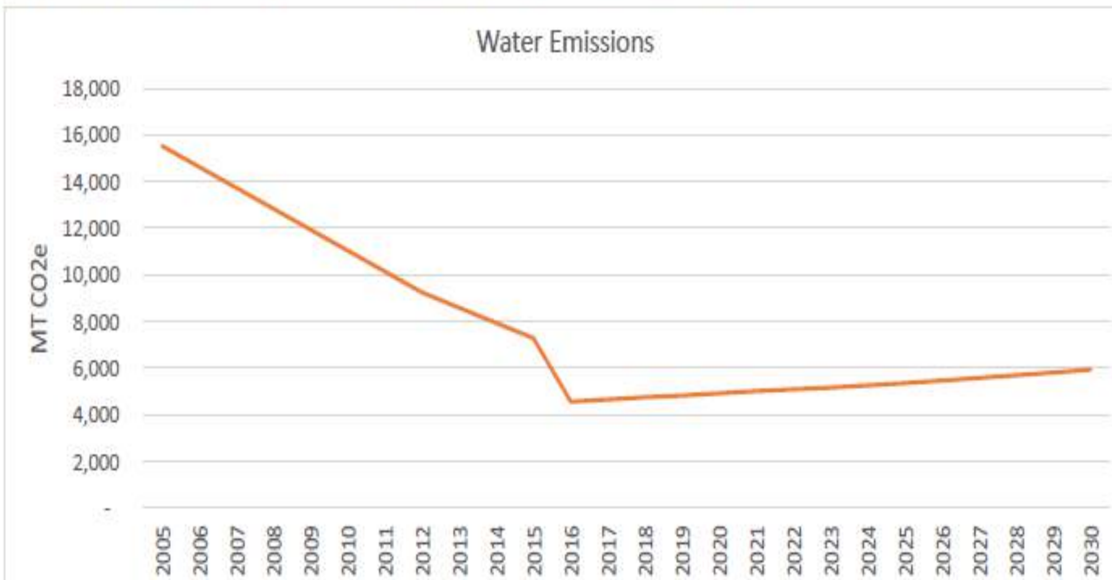


ASSUMPTIONS & INPUTS	Actual 2005	Actual 2012	Actual 2015	Est. 2016	Est. 2017	Est. 2018	Est. 2019	Est. 2020	Est. 2021	Est. 2022	Est. 2023	Est. 2024	Est. 2025	Est. 2026	Est. 2027	Est. 2028	Est. 2029	Est. 2030
WASTE																		
Solid Waste Growth				4.0%	3.6%	3.3%	3.1%	2.5%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	1.8%	2.0%
Alternate Daily Cover Growth				4.0%	3.6%	3.3%	3.1%	2.5%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	1.8%	2.0%
Solid Waste (Tons)	53,850	53,515	53,620	55,765	57,772	59,679	61,529	63,067	64,328	65,615	66,927	68,266	69,597	70,954	72,373	73,785	75,076	76,540
MT CO2e per ton of solid waste	0.227	0.135	0.135	0.135	0.135	0.135	0.135	0.135	0.135	0.135	0.135	0.135	0.135	0.135	0.135	0.135	0.135	0.135
MT CO2e from Solid Waste	12,248	7,224	7,238	7,528	7,799	8,057	8,306	8,514	8,684	8,858	9,035	9,216	9,396	9,579	9,770	9,961	10,135	10,333
Alternate Daily Cover (Tons)	246	4,205	1,130	1,175	1,218	1,258	1,297	1,329	1,356	1,383	1,410	1,439	1,467	1,495	1,525	1,555	1,582	1,613
MT CO2e per ton of A.D.C.	0.3153	0.3137	0.3142	0.3142	0.3142	0.3142	0.3142	0.3142	0.3142	0.3142	0.3142	0.3142	0.3142	0.3142	0.3142	0.3142	0.3142	0.3142
MT CO2e from Alt. Daily Cover	77	1,319	355	369	383	395	407	418	426	434	443	452	461	470	479	489	497	507
Total MT CO2e from Waste	12,325	8,543	7,593	7,897	8,182	8,452	8,714	8,932	9,110	9,292	9,478	9,668	9,856	10,049	10,250	10,449	10,632	10,840



ASSUMPTIONS & INPUTS	Actual 2005	Actual 2012	Actual 2015	Est. 2016	Est. 2017	Est. 2018	Est. 2019	Est. 2020	Est. 2021	Est. 2022	Est. 2023	Est. 2024	Est. 2025	Est. 2026	Est. 2027	Est. 2028	Est. 2029	Est. 2030
WATER																		
Water Demand Growth				2.26%	1.87%	2.03%	1.97%	1.86%	1.75%	1.65%	1.59%	1.70%	1.81%	1.92%	2.03%	2.14%	2.19%	2.23%
Wastewater Treatment Growth				2.26%	1.87%	2.03%	1.97%	1.86%	1.75%	1.65%	1.59%	1.70%	1.81%	1.92%	2.03%	2.14%	2.19%	2.23%
Water Demand (Mgal)	4,556	3,852	3,037	3,106	3,164	3,228	3,291	3,353	3,412	3,468	3,523	3,583	3,648	3,718	3,793	3,874	3,959	4,047
MT CO2e per Mgal of Demand	0.9622	0.6038	0.5377	0.5377	0.5377	0.5377	0.5377	0.5377	0.5377	0.5377	0.5377	0.5377	0.5377	0.5377	0.5377	0.5377	0.5377	0.5377
MT CO2e from Water Demand	4,384	2,326	1,633	1,670	1,701	1,736	1,770	1,803	1,834	1,865	1,894	1,926	1,961	1,999	2,039	2,083	2,129	2,176
Wastewater Treatment (Mgal)	3,768	2,828	2,323	2,376	2,420	2,469	2,518	2,564	2,609	2,652	2,695	2,740	2,790	2,844	2,901	2,963	3,028	3,096
MT CO2e per Mgal of Treatment	2.9575	2.4477	2.4313	1.2204	1.2204	1.2204	1.2204	1.2204	1.2204	1.2204	1.2204	1.2204	1.2204	1.2204	1.2204	1.2204	1.2204	1.2204
MT CO2e from Wastewater Trtmnt	11,144	6,922	5,648	2,899	2,953	3,013	3,072	3,130	3,185	3,237	3,289	3,344	3,405	3,470	3,541	3,616	3,695	3,778
Total MT CO2e from Water	15,528	9,248	7,281	4,569	4,654	4,749	4,842	4,932	5,019	5,102	5,183	5,271	5,366	5,469	5,580	5,699	5,824	5,954

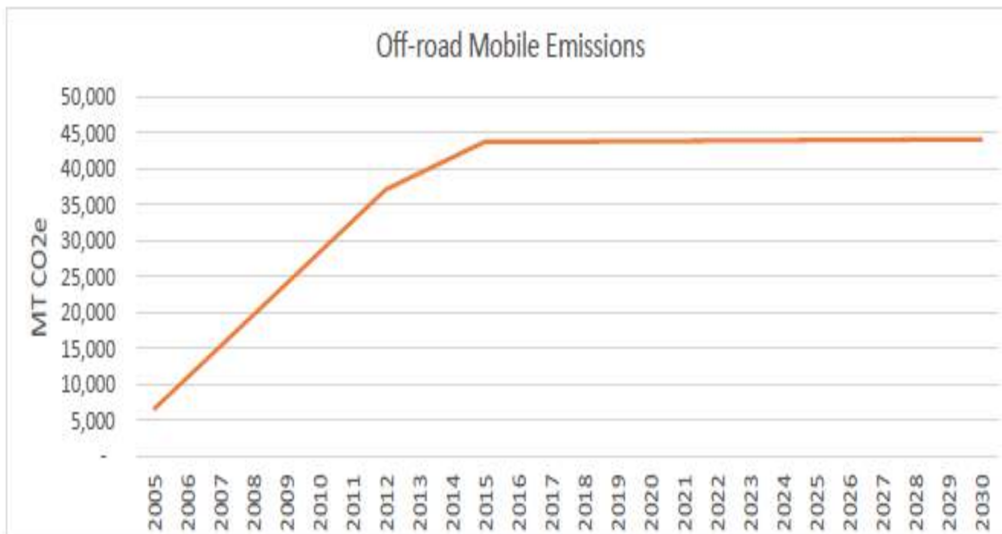
Assumptions: Changes in Water Demand and Wastewater Treatment are driven by changes in Service Population and the MT CO2e per Mgal remain constant at 2015 levels



ASSUMPTIONS & INPUTS	Actual 2005	Actual 2012	Actual 2015	Est. 2016	Est. 2017	Est. 2018	Est. 2019	Est. 2020	Est. 2021	Est. 2022	Est. 2023	Est. 2024	Est. 2025	Est. 2026	Est. 2027	Est. 2028	Est. 2029	Est. 2030
OFF-ROAD MOBILE																		
Construction Growth (1)				0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Lawn & Garden Equipment Growth (2)				1.0177%	1.0174%	1.0171%	1.0066%	1.0065%	1.0065%	1.0065%	1.0064%	1.0050%	1.0050%	1.0050%	1.0050%	1.0050%	1.0050%	1.0050%
MT CO2e from Construction	4,793	35,278	41,878	41,878	41,878	41,878	41,878	41,878	41,878	41,878	41,878	41,878	41,878	41,878	41,878	41,878	41,878	41,878
MT CO2e from Lawn & Garden	1,767	1,868	1,918	1,938	1,958	1,978	1,998	2,018	2,038	2,059	2,080	2,101	2,122	2,143	2,165	2,187	2,209	2,231
Total MT CO2e from Off-Road	6,560	37,146	43,796	43,816	43,836	43,856	43,876	43,896	43,916	43,937	43,958	43,979	44,000	44,021	44,043	44,065	44,087	44,109

1) Construction grows with added square footage increase - no increase through from 2016 to 2030 - see C&I space line 13

	2012	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
2) Lawn & Garden increases with single family unit growth, Housing tab, Row 6	1.0183	1.0180	1.0177	1.0174	1.0171	1.0066	1.0065	1.0065	1.0065	1.0064	1.0050	1.0050	1.0050	1.0050	1.0050	1.0050	1.0050



This page intentionally left blank

Chapter 8: Best Case Forecast and Summary Tables

This question naturally arises at the end of the task force's efforts: "If the City Council undertook **all of your recommendations**, would we be able to **meet our GHG reduction goals?"** The answer is **"Yes!"**

We did the analysis by interpolating between the goals that the City has set for 2015, 2020, 2025 and 2030 to estimate a goal for each year. Then we compared our **Business as Usual** (BAU) forecast to those goals and calculated the difference. See BCF Table 1. Under the BAU scenario, we predicted that Mountain View's emissions from 2018-2030 will **exceed our goals** by **1,316,987 Metric Tons**. That is 19% above our goal. There is no year in which we meet our goal, and the deviation grows year after year.

BCF Table 1. Goals compared to the BAU forecast.

Year	City Goal	BAU Forecast	Difference (MT)	Difference (%)
2018	601,965	655,930	53,965	9%
2019	591,404	653,207	61,803	10%
2020	580,843	649,433	68,590	12%
2021	568,874	644,498	75,624	13%
2022	556,905	638,705	81,800	15%
2023	544,936	631,778	86,842	16%
2024	532,967	625,629	92,662	17%
2025	520,998	619,770	98,772	19%
2026	505,509	615,761	110,252	22%
2027	490,020	613,400	123,380	25%
2028	474,531	612,618	138,087	29%
2029	459,042	613,064	154,022	34%
2030	443,553	614,741	171,188	39%
Total	**6,871,547**	**8,188,534**	**1,316,987**	**19%**

BCF Table 2 shows the emission reductions that we predict would occur if all our recommendations were implemented immediately. The grand **total of the emission reductions** (not including the Consumption reductions) is **1,358,301 MT**. If all these emission reductions are achieved, we would **meet the City's goa**l with a tiny bit of room to spare. However, in case we don't, one of our recommendations makes it possible for the City **to always be able to meet its goals**. That is recommendation M1, which calls on the City to purchase verified carbon offsets when it would otherwise fall short of its goals. Carbon offsets are an affordable way for the City to meet its emission goals. They currently cost about $3.30/MT and are one of the most cost-effective recommendations that we have proposed.

It will be up to current and future City Council members, city employees, and the residents and businesses of Mountain View to determine what will be accomplished in the next twelve years. We look to the future with optimism and determination. We know that these vitally important goals can be achieved if we all commit ourselves to the mighty effort that will be required.

BCF Table 2. Total GHG reductions (in MT CO2e) by sector. (Note: 304 MT are from the T4B pilot alone. If the pilot is successful and autonomous pooled ridesharing is fully deployed by 2023, T4B combined with T4A could reduce an additional 73,226 MT at a cost of $95.9M.)

Estimated MT of CO2e Reduced						
Rec. #	**Transport-ation**	**Buildings**	**Waste, Water, Other**	**Unspecified**	**Carbon Offsets**	**Consumption (CBI)**
T1	See below					
T2	16,803					
T3	143,000					
T4A	143,000	See note below				
T4B	304	See note below				
T5	88,105					
T6	61,549					
T7	3,100					
BE1		73,100				
BE4		70,000				
BE7		15,614				
BE9		18,279				
BE12		820				
BN1		54,283				
BN3		18,442				
BN6		5,340				
BN8		18,560				
M10		772				
M4		250,672				
W5			91,837			
W12			5,770			
W15			8,304			
M1				16,220	240,000	
O2B				29,940		
BT1						49
BN4						29,000
W2						115,803
W16						396,154
Total	**455,861**	**510,369**	**105,911**	**46,160**	**240,000**	**541,006**
Sum of Columns 2-5				**1,118,301**		
Sum of Columns 2-6					**1,358,301**	
Sum of Columns 2-7						**1,899,307**
These recommendations did not estimate a specific amount of GHG reduction						
B1	M2	M13	O1	O2A	O3	W1

BCF Table 3. Estimated cost per Metric Ton of CO2e reduction.

Cost per Metric Ton of CO2e Reduction						
Under $50/MT and > 50,000 MT				Under $50/MT and < 50,000 MT		
Rec. #	**Transport-ation**	**Buildings**	**Waste, Water, Other**	**Unspecified**	**Carbon Offsets**	**Consumption (CBI)**
T1	See below					
T2	$5.22					
T3	$4.62					
T4A	$787					
T4B	$328					
T5	$322					
T6	$0.00					
T7	$440					
BE1		$1.37				
BE4		$48.00				
BE7		$16.30				
BE9		$9.60				
BE12		**$637 saved**				
BN1		$6.78				
BN3		$12				
BN6		$119				
BN8		$4.85				
M10		$38.86				
M4		$0.54				
W5			$2.45			
W12			$160.00			
W15			$275			
M1				$36.99	$3.30	
O2B					$54.76	
BT1						$3,673
BN4						$76
W2						$0.68
W16						$2.36
These recommendations did not estimate a specific net cost per MT						
B1	M2	M13	O1	O2A	O3	W1 W9

BCF Table 4. Estimated net cost. (Note: because some recommendations could not estimate "Incremental Net Cost", the Total Net Cost is lower than if those estimates had been provided)

Estimated Net Cost of Recommendations

Rec. #	City Net Cost (K$)	Incremental Net Cost (K$)	Total Net Cost (K$)
B1	$380	$0	$380
BE1	$100	$0	$100
BE4	$1,800	$1,600	$3,400
BE7	$255	$0	$255
BE9	$175	$0	$175
BE12	-$522	$0	-$522
BN1	$367	$5,860	$6,227
BN3	$22	NA	$22
BN4	$1,900	$300	$2,200
BN6	$634	$0	$634
BN8	$90	$0	$90
BT1	$180	$0	$180
M1	$1,400	$0	$1,400
M2	$15	$0	$15
M4	$135	$0	$135
M10	$30	$0	$30
M13	$30	$0	$30
O1	$6,500	$0	$6,500
O2A	$3,600	$0	$3,600
O2B	$1,600	$0	$1,600
O3	$504	$0	$504
T1	$0	$0	$0
T2	$160	$0	$160
T3	$660	$0	$660
T4A	$405	$11,200	$11,605
T4B	$100	$0	$100
T5	$28,000	$0	$28,000
T6	-$135,000	$135,000	$0
T7	$1,500	Ongoing	$1,500
W1	$309	Unknown	$309
W2	$79	$0	$79
W5	$225	Unknown	$225
W9	$213	Unknown	$213
W12	$307	$173	$480
W15	$11,400	$0	$11,400
W16	$167	NA	$167
Total	**-$72,280**	**$154,133**	**$81,853**

BCF Table 5. Summaries of all of the ESTF-2 recommendations, organized first by working group (Transportation; Buildings and Land Use; Circular Economy; Outreach, Regional Collaboration, and Advocacy; and Measurement and Metrics) and then by priority (High, then Medium).

Priority	Start year	Rec #	Recommendation Name	MT CO2e reduction thru 2030	City Net Cost (thousands)	Incremental Net Cost (thousands)	NetCost per MT CO2e (dollars)
Transportation Recommendations							
HIGH	2018	**T1**	Revolutionize transportation in Mountain View				
HIGH	2020	**T4B**	Solve the local solo-trip problem: Pilot discounted pooled ridesharing	304*	$ 100		$ 328.00
HIGH	2022	**T4A**	Solve the local solo-trip problem: MV Shuttle 2.0 and 3.0	143,000	$ 405	$ 112,000	$ 787.00
MED	2019	**T6**	Restrict parking to encourage and fund alternative modes	61,549	$ (135,000)	$ 135,000	
MED	2018	**T5**	Support bicycling as a primary mode of transportation	88,105	$ 28,000		$ 322.00
MED	2019	**T3**	Expand EV charging infrastructure on public property and right-of-ways	143,000**	$ 660		$ 4.62
MED	2021	**T7**	Expand transportation demand management (TDM) to all of Mountain View	3,100	$ 1,500		$ 440.00
MED	2020	**T2**	Implement group-buy programs to expand personal EV adoption	16,803	$ 160		$ 5.22
Buildings and Land Use Recommendations							
HIGH	2019	**B1**	Adopt a decarbonization policy for buildings		$ 380		
HIGH	2018	**BN3**	Create financial and non-financial incentive for new above-code buildings	18,442	$ 216		$ 11.71

Priority	Start year	Rec #	Recommendation Name	MT CO2e reduction thru 2030	City Net Cost (thousands)	Incremental Net Cost (thousands)	NetCost per MT CO2e (dollars)
HIGH	2019	**BN1**	Update green building code to move towards low-carbon buildings	54,283	$ 367	$ 5,860	$ 6.78
MED	2019	**BE1**	Incentivize switching residential HVAC and water heaters from natural gas to electricity	73,100	$ 100		$ 1.37
MED	2019	**BN8**	Measure effectiveness of housing near transit	18,560	$ 90		$ 4.85
MED	2019	**BE9**	Adopt a revenue-neutral differential utility tax encouraging low-carbon energy use	18,279	$ 175		$ 9.60
MED	2020	**BE7**	Encourage installation of EV chargers in existing multi-unit dwellings	15,614	$ 255		$ 16.30
MED	2020	**BE4**	Increase efficiency of existing buildings through voluntary programs and city ordinances	70,000	$ 1,800		$ 25.71
MED	2019	**BE12**	Use city buildings to demonstrate leadership in electrification and energy efficiency	820	$ (522)		$ (637.00)
MED	2019	**BN6**	Require LEED Platinum for city-owned new construction or major renovation	5,340	$ 634		$ 119.00
MED	2020	**BN4**	Reduce embodied carbon in building construction and maintenance	(CBI ***) 29,000	$ 1,900	$ 300	$ 76.00
MED	2019	**BT1**	Enliven Mountain View with native plants and oak trees	49	$ 180		$ 3,673.00
Circular Economy Recommendations							
HIGH	2020	**W16**	Adopt a consumption-based emissions inventory for Mountain View's GHG accounting		$ 167		

Priority	Start year	Rec #	Recommendation Name	MT CO2e reduction thru 2030	City Net Cost (thousands)	Incremental Net Cost (thousands)	NetCost per MT CO2e (dollars)
HIGH	2020	**W9**	Adopt a citywide ban on single-use disposable plastic foodware	22,500	$ 213		
MED	2020	**W12**	Implement a sustainable landscaping program in Mountain View	5,770	$ 307	$ 173	$ 83.00
MED	2020	**W1**	Lead collaboration among Bay Area cities to develop a solution to overseas recycling crisis		$ 309		
MED	2020	**W2**	Pass a resolution to support "Green Monday"	(CBI ***) 115,803	$ 79		$ 0.68
MED	2020	**W5**	Expand Mountain View's composting program to all residential and commercial properties	91,837	$ 225		$ 2.45
MED	2025	**W15**	Partner with Palo Alto to install anaerobic digesters to produce clean energy	8,304	$ 11,400		$ 275.00
Outreach, Regional Collaboration, and Advocacy Recommendations							
HIGH	2018	**O1**	Create a new Sustainability Office for Mountain View		$ 6,500		
HIGH	2018	**O2A**	Implement a residential and business outreach initiative		$ 3,600		
MED	2019	**O2B**	Provide community engagement tools to facilitate household-level GHG reductions	30,000	$ 1,600		$ 55.00
MED	2021	**O3**	Conduct annual summit to review and track county, state, and federal sustainability actions		$ 504		

Priority	Start year	Rec #	Recommendation Name	MT CO2e reduction thru 2030	City Net Cost (thousands)	Incremental Net Cost (thousands)	NetCost per MT CO2e (dollars)
Measurement and Metrics Recommendations							
HIGH	2020	**M1**	Manage Mountain View's emissions budget as carefully as its financial budget	256,000	$ 1,400		$ 5.66
HIGH	2020	**M2**	Set GHG reduction targets according to per capita goals based on service population		$ 15		
MED	2020	**M13**	Set annual GHG reduction targets for Mountain View that decline by a constant percentage		$ 30		
MED	2021	**M4**	Eliminate emissions associated with Direct Access electricity by 2025	251,000	$ 135		$ 0.54
MED	2022	**M10**	Implement a knowledge resource for electrification & other sustainability actions	722	$ 30		$ 38.86

* T4A: 143,000 MT CO2e savings from pilot plus the full implementation, assuming it is implemented.

**T4B: 304 MT CO2 savings from the pilot alone. If it ramps up fully as described in its Detailed Analysis, the full program would save 216,530 MT by 2030 at a cost of $96 million.

The maximum expected combined savings of T4A and T4B by 2030 is 216,530 MT. As explained in the Transportation Recommendations, the goal is to ramp up local HOV transportation to replace a significant number of single-occupancy vehicle miles by 2030.

T4A and T4B both propose pilots for future local high-occupancy vehicle (HOV) transportation. The city is encouraged to pursue both pilots, to determine the best way forward.

*** Indicates that MT CO2e reduction is estimated with a Consumption-Based Inventory (CBI).