County of San Mateo

GHG Emissions Reductions Technical Appendix

prepared by

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Table of Contents

Tables

Figures

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1 Introduction

Section 15183.5(b)(1) of the California Environmental Quality Act (CEQA) Guidelines establishes several criteria which must be met in order to allow for CEQA streamlining and for climate action plans to be considered a "qualified GHG reduction plan". This Technical Appendix provides the information pursuant to Subsection (D) which states, "policies or a group of policies, including performance standards, that substantial evidence demonstrates, if implemented on a project-by-project basis, would collectively achieve the specified emissions level." This technical appendix is organized around three levels which include:

- **Sectors.** Sectors define the specific areas in which GHG reductions occur and include building energy; transportation; waste, and agriculture.
  - **Policy.** Policies define how GHG reductions will be achieved.
    - **Actions.** Each policy is driven by sets of actions that together support and generate the GHG reductions necessary to achieve the County's goals.

Policies and actions can be either quantitative or supportive and are defined as follows:

- **Quantitative**. These policies and actions have substantial evidence including case studies, calculations, or other substantial evidence that prove that the implementation of said policy/action will have a measurable GHG reduction when implemented. These policies/actions have been quantified based on this evidence and the reductions summed to show how San Mateo County will meet its 2030 and 2040 goals and exceed the state target established by Senate Bill (SB) 32 of 40 percent below 1990 by 2030 and work toward the long-term goal of carbon neutrality by 2040 which exceeds the 2045 goal established by Executive Order (EO) B-55-18.
- **Supportive.** These policies and actions may also be quantifiable and in most cases have substantial evidence to support their overall contribution to GHG reduction. However, due to one of several factors including a low GHG reduction benefit, indirect GHG reduction benefit, or simply a high level of difficulty in quantifying accurate GHG reductions, they have not been quantified and do not contribute directly to the expected GHG reduction goal and consistency with the state targets. Regardless, these policies/actions are critical to the overall success of the CAP.

Together the quantitative and supportive policies and actions listed below will help the County of San Mateo (County) reach their goal of reducing GHG emissions from 462,947 metric tons of carbon dioxide equivalents (MT CO_2e) in 1990 to 254,621 MT CO_2e by 2030 and net zero by 2040. This equates to a 45% reduction in GHG emissions by 2030. These goals exceed the requirements of SB 32 (a 40% reduction by 2030) and meets the intent of EO B-55-18. To reach this goal the County will need to reduce GHG emissions by 57,490 MT CO_2e below the adjusted forecast by 2030. This Technical Appendix provides the substantial evidence that the policies adopted in the CAP can be expected to allow the County to reach their 2030 goal and will provide substantial progress toward achieving long-term reduction toward meeting the GHG emissions reduction goal identified in the state's Executive Order (EO) B-55-18. Avoiding interference with, and making substantial progress toward, these long-term State targets is important as these targets have been set at levels that achieve California's fair share of international emissions reduction targets that will stabilize global

climate change effects and avoid the adverse environmental consequences described under Section 3.1.3, *Potential Effects of Climate Change* (EO B-55-18).

The County has also established a goal which exceeds EO B-55-18 and aims to achieve carbon neutrality by 2040. The policies identified in this CAP will lead to a significant reduction in GHG emissions and provide a foundation for achieving net carbon neutrality. Achieving carbon neutrality will require significant changes to the technology and systems currently in place including Electrification of the building and transportation systems, a shift to shared and active mobility, carbon neutral electricity, and waste reduction and diversion. The policies and actions developed to meet the 2030 goals are the foundations and establish the trajectory for this long-term transformation. However, the 2040 GHG emissions reductions quantified in this CAP are not yet enough to meet the long term 2040 goal. As the current policies and actions are implemented the County will gain more information, new technologies will emerge, and current pilot projects and programs will scale to the size needed to reach carbon neutrality. Furthermore, the State is expected to continue providing updated regulations and support once the 2030 target is achieved. Future CAP updates will outline new policies needed to ultimately achieve carbon neutrality.

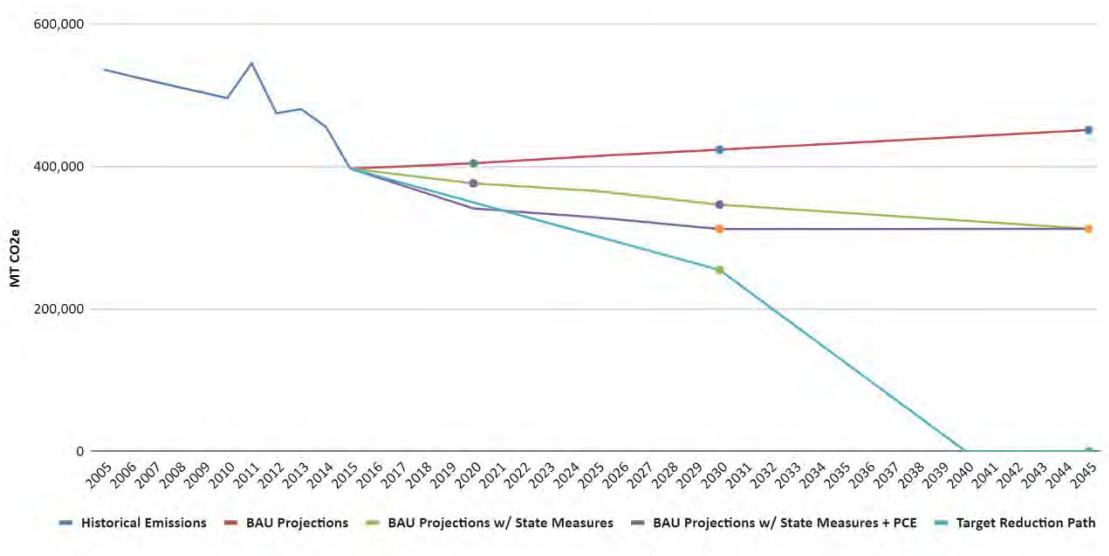
These actions will build on the success the County has already demonstrated by achieving their Assembly Bill (AB) 32 goal of returning to 1990 levels by 2020. The County achieved a GHG emissions level of 396,922 MT CO_2e in 2015. This is 66,025 MT CO_2e lower than their 1990 level, exceeding the AB 32 goal.[1]

[1] Please note, these emissions levels include agricultural emissions which were not included in the original inventory. Historic inventories were updated as part of the CCAP update process.

2 GHG Emissions Reduction Summary

Figure 1 below shows the historic GHG emissions trend for the unincorporated county of San Mateo (dark blue) as well as the business as usual (BAU) forecast based on the last complete GHG inventory (2015) and projected population growth (red). In addition, an adjusted forecast (green) and adjusted forecast with Peninsula Clean Energy (PCE)(purple) 100% carbon free electricity was also forecast (purple). The adjusted forecast includes the impact of current State legislation such as SB100, Title 24, and Advanced Clean Car regulations. The County's GHG emissions reductions targets were also graphed (light blue). The GHG emissions gap identified in the above section was calculated as the difference between the adjusted forecast with PCE and the targets. The County of San Mateo, in coordination with Cascadia Consulting Group, Rincon Consultants, Peninsula Clean Energy (PCE), the San Mateo County Transit District (SMCTD), and input from the local community has developed a suite of policies and specific actions to close this gap and achieve the GHG reduction targets. The total GHG emissions reduction of these policies is expected to be 58,508 MT CO_2e by 2030 and 282,073 MT CO_2e by 2045.

Figure 1 Estimated GHG Reduction and Target Pathway



Historical Emissions (dark blue): Shows historic emissions based on past inventories.
BAU Projections (red): Business-as-usual projections. Shows what would happen if everything stayed the same as it was in 2015 (electricity emissions factor, efficiency of cars, etc.) but city continued to grow.
Adjusted Forecast (green): Same as "BAU" but also incorporates key State policies (Clean Car Standards, RPS, ZNE buildings, organic recycling).
Adjusted Forecast with PCE (purple): Same as "Adjusted" but also incorporates impact of PCE at current participation rates.
Target Reduction Path (light blue): Estimated path needed to achieve the 2030 and 2040 emissions reduction targets.

A summary of the GHG emissions reduction by policy is included in Table 1. For a complete description of each policy and the contributing actions, please refer to the appropriate sector and policy below.

Table 1 Quantified GHG Emissions Reduction Policy Summary Table

Sector	Policy #	Policy	GHG Emissions Reduction Contribution
Energy	B-1	Electrify 100% of newly constructed buildings by 2021.	2030: 4,526 MT CO_2e 2040: 9,902 MT CO_2e
	B-2	Electrify 16% of existing buildings by 2030 and 100% by 2040.	2030: 19,611 MT CO_2e 2040: 123,666 MT CO_2e
	B-3	Use microgrids to generate local renewable energy and improve resiliency	Supportive
	B-4	Pursue integrated opportunities to address climate adaptation and mitigation	Supportive
Transportation	T-1	Increase zero-emission vehicle and equipment adoption to 18% by 2030 and 100% by 2040.	2030: 18,512 MT CO_2e 2040: 126,145 MT CO_2e
	T-2	Encourage urban density and the revision of parking standards, and support bicycle and pedestrian-friendly planning	2030: 1,592 MT CO_2e 2040: 2,231 MT CO_2e
	T-3	Implement programs for shared transit that reduce VMT	Supportive
Solid Waste	W-1	Reduce construction materials and waste	Supportive
	W-2	Reduce organics in the waste stream	2030: 6,367 MT CO_2e 2040: 6,551 MT CO_2e
	W-3	Reduce inorganic waste sent to landfills	Supportive
Working Lands	L-1	Identify new financing to scale carbon farming	Supportive
	L-2	Support technical assistance, education, and data collection efforts to scale climate beneficial agriculture	Supportive
	L-3	Secure access to key implementation infrastructure	Annual Sequestration: 2030: 7,900 MT CO_2e 2045: 13,577 CO_2e
	L-4	Address permitting barriers	Supportive
	L-5	Ensure agricultural lands are preserved for agricultural production	Supportive
	L-6	Support carbon sequestration on natural lands and urban green spaces	Supportive
Total[1]			2030: 58,508 MT CO_2e 2040: 282,073 MT CO_2e

Notes: 1. The total GHG emissions reduction contribution assumes moderate adoption of carbon sequestration policies and therefore yields a conservative total emissions reduction value.

Under each of the above policies are a number of actions that ensure establishment of mechanisms and supportive actions that will guide the County towards complete implementation of the actions.

2.1 Greenhouse Gas Emissions Reduction from Policies and Actions

This Technical Appendix presents an analysis of the GHG emissions reduction pathway to achieve the County's fair share of GHG emissions reduction necessary to support the state's achievement of the SB 32 GHG reduction goal and provide substantial progress to achieve the 2040 goal of carbon neutrality. The reduction policies and actions reflect local policy and document industry best practices for achieving deep decarbonization. The emissions reduction from the actions are calculated individually to identify which are most impactful for each policy and then combined to determine the total emissions reduction that can be achieved by the policy.

To assess the magnitude of GHG emissions reductions needed to provide a fair share GHG emission reduction and contribute to achieving the state's goals, the County developed a *business-as-usual scenario* GHG emissions forecast which assessed the impact of growth on the County's GHG emissions. From the *business-as-usual scenario*, a *legislative adjusted scenario* was developed which accounts for the impacts of state and federal policies on GHG emissions, to assess the GHG emissions reduction the County would be responsible for to meet the established GHG emissions reduction targets.[2] The GHG emissions forecast scenarios, targets, and emission reductions attained from the policies and actions are provided in Table 2.

Table 2 GHG Emissions Forecasts, Reduction Targets and Impact of Policies

GHG Emissions Scenario	2030 (MT CO_2e)	2040 Emission (MT CO_2e)
Business-as-Usual Scenario Forecast	423,396	435,543
Reductions from Current Legislation	111,285	122,895
Legislative Adjusted Scenario Forecast	312,111	312,648
Targets	254,621	0
Reductions from Policies	58,508	282,073
GHG Emissions after Reductions from Policies	253,603	26,855
Remaining Gap to Meet Targets	**Target Met (-1,018)**	**26,855[2]**
Percent Reduction Below Baseline (1990)	**45%**	**94%**

Notes: MT CO_2e = metric tons of carbon dioxide equivalent

The remaining gap to reach carbon neutrality in 2040 remains at 26,855 MT CO_2e. Even with the reach goals of electrifying 100% of buildings and 100% of vehicles by 2040, a gap remains as the result of emissions generated by offroad vehicles, wastewater, and waste generation. While the policies and actions identified in this CAP will lead to significant progress in reducing GHG emissions and provide a foundation for achieving net carbon neutrality, achieving carbon neutrality will require significant additional changes to the technology and systems currently in place at both the state and local level and will require further policies and programs that build on this plan. Future CAP updates will outline new policies needed to reach the ultimate target of carbon neutrality.[3]

[2] The County has identified targets for 2030 (40% below 1990 levels) and 2045 (carbon neutrality) that are consistent with the state's goals and are intended to establish a level, based on substantial evidence, below which the contribution to greenhouse gas emissions from activities covered by this CAP would not be cumulatively considerable.

[3] Consistent with AEP Climate Change Committee recommendations, SB 32 is considered an interim target toward meeting the 2045 State goal. Consistency with SB 32 is considered to be contributing substantial progress toward meeting the State's long-term 2045 goals. Avoiding interference with, and making substantial progress toward, these long-term State targets is important as these targets have

While this CAP does not provide the GHG emissions reduction necessary to achieve carbon neutrality by 2040, it does provide evidence-based actions from which the County can make substantial progress towards attaining this target. It also illustrates the that reaching carbon neutrality will require significant additional effort and support from the state and federal governments.

2.2 Greenhouse Gas Emissions Reduction Calculation Methodology

The analysis and emission reduction calculations for each of the policies of the CAP includes:

- Description of the methodology and assumptions for calculating GHG emissions reduction for applicable policies and actions, including reference to data sources.
- A summary table of each policy and the supporting actions
- A summary of the GHG reduction impact results of GHG emissions reduction calculations
- References and applicable data for quantifiable GHG emissions reduction

GHG emissions reduction calculations use conservative values to avoid over-representing the GHG emission reduction potential for any individual policies or action. Special care has been taken to avoid double counting GHG emissions reduction for policy and action by including potential double counting (such as additional solar PV related actions) as supportive.

been set at levels that achieve California's fair share of international emissions reduction targets that will stabilize global climate change effects and avoid the adverse environmental consequences described under Section 3.1.3, *Potential Effects of Climate Change* (Executive Order B-55-18).

3 Sector 1: Building Energy

3.1 Policy B-1: Transition to all-electric new construction

To reach carbon neutrality by 2040, a vast majority of buildings in the County, including those that have not yet been constructed, will need to be carbon neutral. Transitioning buildings from the consumption of natural gas to electricity can make the operations of these buildings carbon neutral through the use of PCE's carbon free electricity as well as SB 100 requirements for statewide carbon free electricity by 2045. A variety of studies have found that electrification of buildings, combined with renewable power generation is a potential path towards reaching carbon neutrality.[4] Additionally, the benefits in annual utility bill savings and decreased cost associated with the installation of natural gas meters and piping into new construction makes all-electric buildings more cost effective in some California Building Climate Zones; including in San Mateo.[5,6] As of September, 2020, San Mateo County became one of the 45+ jurisdictions to ban or disincentivize new construction with natural gas. See Table 3 for a full summary of the supporting actions associated with implementation of Policy B-1.

Performance Metrics

- Pass a new construction electrification ordinance by 2021 (Complete)

Table 3 Policy B-1 Actions

Action #	Action	Emissions Savings (MT CO_2e) 2030	2040
Quantitative Actions			
B-1.1a	Adopt an electrification ordinance/reach code to ban natural gas in new buildings while providing minimal exceptions to building types as necessary by 2021.[1]	4,526	9,902
Supportive Actions			
B-1.1	Support Planning and Building staff to implement existing reach code and ensure that the cost of permitting for all-electric projects does not exceed natural gas alternatives.	Supportive	
B-1.2	Partner with Bay Area Regional Energy Network (BayREN) and Peninsula Clean Energy (PCE) to develop a pilot for deploying heat pump water heaters in new single-family and multi-family construction or major remodel or addition projects.	Supportive	

[4] Williams, James et al., Pathways to Deep Decarbonization in the United States (San Francisco: Energy and Environmental Economics, 2014); Northeastern Regional Assessment of Strategic Electrification (Northeast Energy Efficiency Partnerships, 2017); Steinberg, Daniel et al., Electrification and Decarbonization: Exploring US Energy Use and Greenhouse Gas Emissions in Scenarios with Widespread Electrification and Power Sector Decarbonization (National Renewable Energy Laboratory, 2017).

[5] California Energy Codes and Standards. 2019. 2019 Cost Effectiveness Study: Low-Rise Residential New Construction. https://localenergycodes.com/content/2019-local-energy-ordinances/. Accessed May 25th, 2019.

[6] California Energy Codes and Standards. 2019. 2019 Nonresidential New Construction Reach Code Cost Effectiveness Study. https://localenergycodes.com/content/2019-local-energy-ordinances/. Accessed May 25th, 2019.

Action #	Action	Emissions Savings (MT CO_2e) 2030	2040
B-1.3	Partner with Peninsula Clean Energy (PCE) and Pacific Gas and Electric (PG&E) to identify locations for installing storage technology in tandem with renewable energy infrastructure. Prioritize public school sites and community college campuses as backup power centers and resiliency hubs.	Supportive	
B-1.4	Partner with PCE and Pacific Gas and Electric (PG&E) to identify locations for installing storage technology in tandem with renewable energy infrastructure. Prioritize community centers and libraries as backup power centers and resiliency hubs.	Supportive	
B-1.5	Work with PCE, BayREN, and other stakeholders to ensure that future ratemaking and rate-cases do not result in disproportionately high residential electricity rates for lower income residents.	Supportive	
B-1.6	Improve energy efficiency in new construction through enhancements in the building envelope (aspects such as insulation, windows, door seals, airflow, façade materials) by adopting a more aggressive climate zone in the building code.	Supportive	
B-1.7	Provide and promote accessible local workforce development opportunities related to building electrification. Create new partnerships and economic opportunities to provide maximum benefit in the form of employment opportunities for the local workforce, residents with barriers to employment, and communities most affected by climate change.	Supportive	

[1] The County adopted their New Building Electrification Ordinance in February of 2020 and was effective on September 9, 2020.

3.1.1 Methodology and Assumptions

Continuing to allow natural gas in new buildings would result in an increase of emissions sources through 2040, due to projected population increases in the County through 2040. Conversely, emissions from electricity use will be near zero by 2021 due to Peninsula Clean Energy and zero by 2045 due to SB 100.[7] The ordinance would lead to a mandatory reduction in natural gas consumption compared to baseline projections by replacing natural gas with electricity. Cost effectiveness studies have already been completed and found that all-electric construction is less expensive both to construct and on a lifecycle basis for residential construction in San Mateo County.[8] The quantified reduction associated with this policy was calculated as the difference between business as usual (mixed fuel buildings) and all-electric construction with predominantly carbon neutral electricity. An opt out rate of 3.5% was estimated to be conservative.[9] PG&E's estimated 2030 grid mix was used for the opt out usage.

The reduction calculations for this action assumed a baseline year of 2021, as natural gas use is not expected to increase due to new construction after the ordinance is implemented in 2021. Therefore, the difference between the 2021 estimated natural gas use and the estimate for the milestone year (2030 or 2040) natural gas use would be attributed to new construction. The difference between the year the ordinance is signed and the target year (2030, 2040, etc.) times the

[7] A small opt out rate of 3.5% and some direct access electricity keeps emissions from going to zero in 2021.

[8] https://explorer.localenergycodes.com/

[9] PCE's opt out rate is currently below 1% https://www.circlepoint.com/wp-content/uploads/2017/02/PCE-Case-Study.pdf

emission factor for natural gas (0.00532 MT CO_2e /therm) equals the GHG reduction potential of the action. Total emissions savings in 2030 and 2040 are shown for both residential and commercial development in Table 4.

Table 4 Policy B-1 GHG Emissions Reduction Calculation

Calculation Factor	2030	2040
Natural Gas Consumption Growth Beyond 2021 (therms)[1]	858,994	1,862,911
Natural Gas Emission Factor (MT CO_2e/therm)[3]	0.00532	0.00532
Natural Gas GHG Emissions Avoided (MT CO_2e)	4,566	9,902
Resulting Increase in Electricity Consumption (MWh) [4]	8,930	18,194
Electricity Emission Factor Assuming Implementation of Play E.1.(MT CO_2e/MWh)[5]	0.00482	0.000
Additional GHG Emissions from Increased Electricity Consumption (MT CO_2e)	41	0.1
Residential Savings Subtotal (MT CO_2e)$^-$	**4,526**	**9,902**

Notes: MT CO_2e = metric tons of carbon dioxide; kWh =-kilowatt-hour

Numbers may not sum due to rounding

[1] Natural gas consumption beyond 2025 is obtained from the *Legislative Adjusted* Forecast GHG Emissions estimates used to develop GHG reduction targets. Natural gas reductions are combined residential and commercial.

[2] Emission factors obtained from United States Environmental Protection Agency Emission Factors for Greenhouse Gas Inventories, Table 1. https://www.epa.gov/sites/production/files/2015-07/documents/emission-factors_2014.pdf.

[3] The resulting increase in electricity consumption estimates a three times increase in efficiency due to the improved efficiency of electric heat pumps and other electrical equipment of natural gas. Dennis, Keith. 2015. Environmentally Beneficial Electrification: Electricity as the End-Use Option. The Electricity Journal. 28(9). pp. 100-112. https://doi.org/10.1016/j.tej.2015.09.019

[4] Natural gas consumption converted to electricity using the conversion: 1 Therm = 29.3 kWh. https://dothemath.ucsd.edu/useful-energy-relations/

[5] Calculated by assuming PCE electricity with a 3.5% opt out rate to PG&E estimated emission rate.

3.2 Policy B-2: Electrify existing construction

To further the efforts of Policy B-2 in electrifying San Mateo County, the County intends to support the electrification of existing buildings through voluntary adoption of all electric appliances. To support implementation of the policy, the County will also conduct an existing building electrification study to identify potential other options for building electrification including time of replacement or time of retrofit ordinances. The study will identify the feasibility, costs, and equity concerns with more mandatory actions. This study will provide additional pathways to promote electrification beyond the voluntary policies identified here. See

Table 5 for a full summary of the supporting actions associated with implementation of Policy B-2.

Performance Metrics

- Electrify 16% of existing buildings by 2030
- Electrify 100% of existing buildings by 2040

Table 5 Policy B-2 Actions

Action #	Action	Emissions Savings (MT CO_2e) 2030	2040
Quantitative Actions			
B-2.1	Coordinate with PG&E, PCE, and the CPUC to eliminate all natural gas in unincorporated areas by 2040.	19,611	123,666
Supportive Actions			
B-2.2	Investigate regulatory pathways for converting existing buildings to all-electric. Conduct a feasibility analysis for options including but not limited to a point-of-sale or listing requirement, replacement on burnout requirement for gas powered appliances, and a ban of sale of gas fired equipment among others.	Supportive	
B-2.3	Partner with BayREN and PCE to develop a pilot for deploying heat pump appliance technology along with electric panel upgrades in large-scale retrofit opportunities in existing multi-family buildings, and other buildings such as homeless shelters and farmworker housing.	Supportive	
B-2.4	Perform a County-wide electrification opportunities assessment in partnership with PG&E and PCE to identify priority buildings and neighborhoods for targeted electrification incentives.	Supportive	
B-2.5	Accelerate uptake of energy efficiency programs by landlords and renters of both multi- and single-family households. Utilize findings from county-wide electrification opportunities assessment and partner with BayREN, PCE, the Department of Housing, and community-based organizations to deploy an electrification, energy efficiency, and environmental health pilot.	Supportive	
B-2.6	Partner with PG&E or PCE to set up on-bill or accessible financing solutions for electrifying buildings and/or local renewable installations, including offering low-interest loans.	Supportive	
B-2.7	Evaluate feasibility and equity-related concerns of a utility user fee increase that could fund electrification projects. If feasible, and if it will not accrue disproportionately to minority groups and historically underserved communities, partner with PG&E and PCE to implement.	Supportive	
B-2.8	Facilitate electrification of appliances (water heaters, space heaters, stoves and dryers) by expanding and improving targeted outreach for existing electrification programs and incentives.	Supportive	
B-2.9	Partner with the Department of Housing and local realtors to educate, engage, and incentivize building owners, and real estate and property management representatives to address split-incentive issues, with a focus on rental protection and minimizing cost increases for low-income renters.	Supportive	
B-2.10	Improve energy efficiency in large additions (400 square feet or larger) by adopting a higher climate zone in the building code that more accurately reflects anticipated climatic shifts. By responding to changes in climatic conditions, new energy efficiency building standards become cost-effective and can be adopted.	Supportive	
B-2.11	Expand the reach of the Green Business Program to support 10% more small and medium businesses and establish a GHG reduction goal specifically for unincorporated businesses.	Supportive	

3.2.1 Methodology and Assumptions

The 16% target for electrification of existing buildings by 2030 is based on the voluntary but incentivized replacement of natural gas fueled equipment with electric equipment, through strategic education and public outreach efforts by the County of San Mateo. The 2040 target of electrifying 100% of existing buildings assumes the adoption of an electrification ordinance banning the installation or replacement of natural gas burning equipment in any existing building and that majority of natural gas fueled equipment in the County will reach its operational end of life by 2040. The quantification of the 2030 target is based on the combined effect of a concerted voluntary effort by the County. The following studies provide substantial evidence that a 16% reduction in natural gas usage through Electrification is a reasonable goal by 2030.

Due to the recent updates to the CEC rules (three-prong test), over $1 billion dollars in funding is now available for electrification in California.[10] This major change will allow programs like BayREN and PCE, who currently distributes energy efficiency monies, to support electrification. BayREN has upgraded tens of thousands of units since 2013 and provided nearly 6 million dollars in direct implementation of energy efficiency programs. With the change to the three-prong test, these dollars will be available for electrification projects in support of San Mateo's goals.[11]

Electrification of space and water heaters is the best and cheapest way to reduce emissions from California's existing buildings through 2045 due to SB 100.[12] The largest barrier to implementation of this is high up-front capital costs.[13] Utility-offered incentives to offset these costs for the end-user are therefore among the most promising opportunities for updating this technology.[14]

The impacts associated with promotional and educational outreach for electrification have not been well documented due to the cutting-edge nature of the strategy. Electrification has only begun to gain popularity in California mostly due to the implementation of SB 100 and the expansion of community choice aggregations. While it is not clear how the community will respond to electrification, energy efficiency outreach has been conducted since as early as the 1970s and some research has been conducted on the effects of outreach and education on energy. One study in New York showed that out of the 8,991 people who participated in informational programs, 69% implemented the recommended practices.[15] Another research meta-analysis reviewed dozens of papers covering various energy efficiency, water efficiency, and waste outreach and found that education-only campaigns could produce between 10-12% energy savings.[16]

Electrification is a new idea and not well understood by the community. The education associated with this action as well as the Climate Action Plan itself will facilitate adoption of all-electric technologies. The County will conduct a CAP update between every 3 and 5 years to check progress and adopt more voluntary or potentially mandatory policies if necessary.

As a backstop to voluntary policies, the County would consider a mandatory ban on replacing gas appliances based on the results of the Building Electrification Study (Policy B-2, Action 4). This program would be contingent on cost effectiveness and equity considerations uncovered with the

[10] https://www.nrdc.org/experts/merrian-borgeson/ca-billion-efficiency-now-open-electrification

[11] https://docs.wixstatic.com/ugd/1ef210_88d6308fe95d42b3a4e7010cd8db4d91.pdf?index=true

[12] https://www.mdpi.com/2073-4433/10/8/435/htm

[13] California Center for Sustainable Energy. 2009. Solar Water Heating Pilot Program: Interim Evaluation Report.

[14] https://www.synapse-energy.com/sites/default/files/Decarbonization-Heating-CA-Buildings-17-092-1.pdf

[15] https://www.joe.org/joe/2009december/pdf/JOE_v47_6a6.pdf

[16] https://aceee.org/files/proceedings/2000/data/papers/SS00_Panel8_Paper10.pdf

study. However, if during the CAP update process (between 3 and 5 years) the County is not on track to reduce natural gas emissions, this policy would provide the additional reductions necessary.

Residential and commercial water heating accounts for 34% of natural gas use in buildings and 40% of natural gas use in buildings is from space heating.[17] The life expectancy of a natural gas hot water heater is approximately 10 years.[18] Therefore, if this ordinance is passed in 2025, the County should see a 34% decrease in natural gas use from hot water heater electrification by 2035. Natural gas furnace lifecycles are expected to be between 15-20 years with an average of 18 years.[19] Therefore, under this program the County would expect to see an additional 40% reduction in natural gas consumption by 2043, assuming these furnaces are phased out after the average 18 year life span. Assuming a linear replacement of existing HVAC and hot water heating equipment starting in 2025, the County should expect to see a 28% decrease in natural gas emissions from this mandatory ordinance by 2030. Therefore, the estimate of 16% is considered conservative. Total emissions reductions in 2030 and 2040 are shown for Policy B-2 in

Table 6.

Table 6 Policy B-2 GHG Emissions Reduction Calculations

Calculation Factor	2030	2040
Electrification Retrofit Goal	16%	100%
Natural Gas 2021 Baseline Consumption (therms)[1]	23,264,905	23,264,905
Natural Gas Reductions from Baseline (therms)	3,722,385	23,264,905
Natural Gas Emission Factor (MT CO_2e/therm)[2]	0.00532	0.00000
Natural Gas GHG Emissions Avoided (MT CO_2e)	19,787	123,667
Resulting Increase in Electricity Consumption (MWh) [3, 4]	36,355	227,221
Electricity Emission Factor (MT CO_2e/kWh)[5]	0.00482	0.000
Additional GHG Emissions from Increased Electricity Consumption (MT CO_2e)	175	1
Total Policy B-2 GHG Emissions Reduction (MT CO_2e) [6]	**19,611**	**123,666**

Notes: MT CO_2e = metric tons of carbon dioxide; kWh =-kilowatt-hour

Numbers may not sum due to rounding

[1] 2020 Baseline Natural Gas Consumption is obtained from the *Legislative Adjusted* Forecast GHG Emissions estimates used to develop GHG reduction targets. Total natural gas from residential and commercial is included. Due to the Electrification ordinance passed by the County, no new natural gas growth is assumed.

[2] Emission factors obtained from United States Environmental Protection Agency Emission Factors for Greenhouse Gas Inventories, Table 1. https://www.epa.gov/sites/production/files/2015-07/documents/emission-factors_2014.pdf.

[3] The resulting increase in electricity consumption estimates a three times increase in efficiency due to the improved efficiency of electric heat pumps and other electrical equipment of natural gas. Dennis, Keith. 2015. Environmentally Beneficial Electrification: Electricity as the End-Use Option. The Electricity Journal. 28(9). pp. 100-112. https://doi.org/10.1016/j.tej.2015.09.019

[4] Natural gas consumption converted to electricity using the conversion: 1 Therm = 29.3 kWh. https://dothemath.ucsd.edu/useful-energy-relations/

[5] The electricity emission factor assumes PCE electricity with a 3.5% opt out rate.

[6] Total GHG Emissions Reductions are calculated by subtracting the Additional GHG Emissions from Increased Electricity Consumption from the Natural Gas GHG Emissions Avoided.

[17] https://www.synapse-energy.com/sites/default/files/Decarbonization-Heating-CA-Buildings-17-092-1.pdf

[18] https://www.lowes.com/n/how-to/when-to-replace-a-water-heater

[19] https://www.thisoldhouse.com/ideas/how-long-things-last

3.3 Policy B-3: Use microgrids to generate local renewable energy and improve resiliency

Efforts under Policy B-3 are intended to increase the County's energy resilience rather than emission reductions. San Mateo County will work to increase electricity grid resilience through the generation and storage of local renewable energy. No GHG reductions were calculated as part of this policy, although added storage and renewable electricity will support lower electricity emissions overall. See Table 7 for a full summary of the supporting actions associated with implementation of Policy B-3.

Performance Metrics

- Install a solar and storage project in a community of concern
- Complete a microgrid pilot project
- Review and streamline permit process

Table 7 Policy B-3 Actions

		Emissions Savings (MT CO_2e)	
Action #	**Action**	**2030**	**2040**
Supportive Actions			
B-3.1	Use utility distribution system capacity maps to investigate the feasibility of siting and maintaining microgrid, solar or wind combined with storage, and other distributed energy resource project opportunities.	Supportive	
B-3.2	Establish microgrid pilot projects and distributed energy resources at critical facilities across San Mateo County (e.g., schools, hospitals, fire, police).	Supportive	
B-3.3	Support and enhance PCE's existing battery storage incentive program	Supportive	

3.4 Policy B-4: Pursue integrated opportunities to address climate adaptation and mitigation

Efforts under Policy B-4 aim to create policies that incorporate adaptation strategies into planning and development such as cool roof technology. By creating policies that incentivize using cool roof technologies, buildings will stay cooler and reduce their electricity demand for cooling. By focusing on public schools and community college districts that typically have greater roof area, the economic and electricity demand reduction benefits of cool roof technology will be maximized. A roof area of 100ft^2 utilizing cool white roofing technology can achieve a one-time offset of approximately 10 MT CO2e when compared to standard grey roofing.[20] Additionally, using cool roof technology can reduce electricity demand during peak demand hours, avoiding higher time of use charges, further increasing bill savings.[21] To facilitate this transition to cool roof technology, Policy B-5 emphasizes the need to provide technical support to implement these strategies, especially for facilities vulnerable to climate risks. Greenhouse Gas reductions were not quantified for this policy although utilizing cool roof technology will reduce emissions via reducing electricity demand for cooling. See Table 7 for a full summary of the supporting actions associated with implementation of Policy B-5.

Performance Metrics

- N.A

Table 8 Policy B-4 Actions

Action #	Action	Emissions Savings (MT CO_2e) 2030	2040
Supportive Actions			
1	Develop and adopt regulations or modify existing adopted regulations to require reroofing projects to meet or exceed the most current cool roof efficiency standards as determined by the California Energy Commission for Building Climate Zone 11 (or whichever zone deemed best).		Supportive
2	Explore electrification opportunities when developing adaptation strategies for housing and community facilities. Provide technical assistance and support to public schools and communities to plan for electrification of housing and community facilities vulnerable to climate risks.		Supportive

[20] Cool California. Roof Environment. California Air Resource Board. Accessed September 2021. https://coolcalifornia.arb.ca.gov/roof-environment

[21] Time of Use Rates. Peninsula Clean Energy. Accessed September 2021. https://www.peninsulacleanenergy.com/toutransition/

4 Sector 2: Transportation

4.1 Policy T-1: Increase electric vehicle adoption

A transition to zero-emission vehicles (ZEV) will play an essential role in the reduction of fossil fuel consumption needed for San Mateo, and California as a whole, to reach GHG reduction targets. San Mateo has established a 2030 target of having 18% of the passenger vehicle fleet be ZEV, and 100% by 2040, which aligns with the state target set by Governor Brown with Executive Order (EO) B-48-18.[22] [23] While the state and San Mateo cannot require the purchase of ZEVs, they can work to provide sufficient electric vehicle (EV) charging infrastructure to support ZEV adoption. As market trends continue to shift towards more ZEVs being purchased, San Mateo can facilitate this transition by the actions outlined in

[22] Executive Order B-48-18 provides a target of 5 million ZEVs to be in California's vehicle fleet in 2030. While this target does not provide what amount are to be passenger and light-duty vehicles, as compared to medium- and heavy- duty vehicles, it is assumed that 80% of ZEVs will be light-duty passenger vehicles, which is consistent with the previous target of 1.5 million ZEVs by 2030 (1.2 million of which are expected to be light-duty passenger vehicles, as shown in Figure 15 of the CARB 2016 *Mobile Sources Strategy*).

[23] This analysis does not directly account for EO N-79-20, which directs CARB to develop regulations to achieve 100% electric vehicle car sales in CA by 2035 & 100% ZEV medium/heavy-duty vehicles by 2045. These are ambitious goals will further support the achievement, and possible exceedance, of San Mateo County's goals.

Table 9.

Performance Metrics

- Adopt EV Charger Reach Code in 2020 (complete)
- 18% EV use by 2030 – DMV Data
- 1,759 new public and private EV chargers by 2030 – County Data[24]
- 100% EV use by 2040 – DMV Data

[24] Based on the governor's goal of having 1.5 million ZEVs and 250,000 public/private chargers in CA

Table 9 Policy T-1 Actions

Action #	Action	Emissions Savings (MT CO_2e) 2030	2040
Quantified Actions			
T-1.1[25]	Evaluate the energy and green building standards at each California Building Standards code cycle to ensure that building electrification and EV charging station requirements are sufficient to meet community needs and climate goals. Adopt local ordinances when the State's code does not keep pace with climate action in San Mateo County.	18,512	126,145
T-1.2	Install public EV charging stations, with an emphasis on daytime charging. Investigate options for shared EV charging, paired with solar and storage capacity.		
Supportive Actions			
T-1.3	Prepare an EV readiness plan to identify suitable, equitable, and cost-feasible opportunities for installation and maintenance of EV charging station locations throughout the County.	Supportive	
T-1.4	Collaborate with key partners such as PCE to conduct alternative fuel outreach, focusing on electric vehicles and lawn equipment.	Supportive	
T-1.5	Partner with City/County Association of Governments (C/CAG) and regional partners to develop a program to help transition private-use vehicles to zero emission vehicles at end of life, with a focus on supporting new EV purchases for low-income demographics.	Supportive	
T-1.6	Assess opportunities for a program to support the transition to electric leaf blowers.	Supportive	

[25] A reach code ordinance for EV charging infrastructure has already been adopted by the County.

4.1.1 Methodology and Assumptions

Although San Mateo County may not be able to take direct action that increases ZEV adoption, EO B-48-18 outlines EV charging infrastructure needs that would allow the state to reasonably reach its target of five million ZEVs on the road in 2030. EO B-48-18 indicates that 250,000 public charging stations installed by 2025 would support the desired EV adoption of 1.5 million EVs by 2025, which would equate to approximately one public EV charger for every 6 passenger vehicles on the road.[26] To meet the state target for ZEV public charging, this would equate to approximately 1,759 public and private EV charging stations in the Unincorporated County. The actual number and ideal locations for these EV charging stations would need to be further investigated through an EV Readiness Plan and Feasibility Study.

In addition to well-planned public charging stations, workplace and residential EV charging infrastructure would further support ZEV adoption. A 2015 report by Idaho National Laboratory, *Plugged In: How Americans Charge Their Electric Vehicles*, found that nearly 98% of all EV charging events occurred at home or work. In support of these findings, and to address the challenges faced by those who may not be able to install their own home chargers, adoption of an EV Readiness Reach Code would support increased infrastructure at new and existing commercial and multi-family residential developments. As of September 2020, San Mateo County adopted their EV charging infrastructure ordinance along with the electric building reach code.

GHG emission reductions from the adoption of ZEVs assumes that the collective impact of each action under this policy will incentivize and provide the infrastructure needed for the County to meet the ZEV adoption targets that align with, or exceed, state targets. The calculations assume that the 18% adoption rate in 2030 and 100% adoption rate in 2040 will result in an equivalent reduction in vehicle miles traveled (VMT) powered by fossil fuels, and emissions associated with these miles traveled would instead be accounted for in additional electricity use. The emission factors used in the *Legislative Adjusted* GHG Emissions Forecast assume that approximately 3.7% of total Passenger VMT in 2030 would be by ZEVs, and 4.53% in 2040.[27] Increasing ZEV adoption to 18% by 2030 and 100% by 2040 would reduce GHG emissions from fossil fuel combustion. The GHG emission reductions are applied after the VMT reductions attained by Policy T.2 and T.3 through increased public and shared transit and active transportation. This GHG reduction would be offset by electricity consumption which would generate a small amount of GHG emissions in the short term before 100% carbon free electricity is achieved in 2040 The calculations and assumptions used to estimate emission reductions from Policy T-1 are provided in Table 10.

[26] https://opr.ca.gov/planning/transportation/zev.html

[27] Emission factors for the *Legislative Adjusted* GHG Emissions Forecast were obtained from the California Air Resources Board (CARB) EMFAC2017 vehicle emissions model. The model was run for 2030 and 2040 for San Mateo County. https://arb.ca.gov/emfac/2017/

Table 10 Policy T-1 GHG Emissions Reduction Calculations

Calculation Factor	2030	2040
EV adoption target	18%	100%
Legislative Adjusted GHG Forecast Projected EV adoption	3.70%	4.53%
Effective Increase in EV Adoption Above Legislative Adjusted GHG Forecast[1]	14%	100%
Forecasted Passenger Vehicle VMT(VMT)[2]	418,900,156	436,334,640
Reduction in VMT from Fossil Fuel Combustion (VMT)[3]	59,902,722	436,334,640
Reduction in GHG Emissions from Fossil Fuel Combustion (MT CO_2e) [3]	18,610	126,379
Estimated 2020 Model Year Average Electricity Consumption (kwh/100 miles)[4]	34	34
Estimated Increase in Electricity Consumption Resulting from Increased EV Adoption (kWh)	20,366,926	148,353,778
Electricity Emission Factor from PCE and 3.5% opt out (MT CO_2e/kWh)	0.00000482	0.000001575687857
Additional GHG Emissions from Increased Electricity Consumption (MT CO_2e)	98	234
Total GHG Emissions Reduction	18,512	126,145

Notes: MT CO_2e = metric tons of carbon dioxide; kWh =-kilowatt-hour; VMT = vehicle miles traveled; EV = electric vehicle

Numbers may not sum due to rounding

[1] The Effective Increase in EV Adoption Above *Legislative Adjusted* GHG Forecast represents the increase above the legislative adjusted forecast (3.7%) needed to reach the target. The *Legislative Adjusted* GHG Forecast obtained EV adoption rates from the California Air Resources Board (CARB) EMFAC2017 vehicle emissions model. The model was run for 2030 and 2040 for San Mateo County. https://arb.ca.gov/emfac/2017/. The 2040 increase to 100% still accounts for the forecasted increase in EV and results in on-road vehicles being electric by 2040.

[2] Total Forecasted Passenger VMT and Total Forecasted Passenger Vehicle GHG Emissions account for the reductions in VMT and GHG emissions that would be realized upon full implementation of Policy T-2 and T-3.

[3] Reduction in GHG Emissions from Fossil Fuel Combustion are calculated as the reduction resulting from the increased adoption of EV above baseline EV adoption.

[4] The Estimated 2020 Model Year Average Electricity Consumption is used to convert the reduction of VMT from fossil fuel combustion to consumption by the increased adoption of electric vehicles. 2020 model year all electric vehicles, excluding Porsche make vehicles, consume an average 34 kWh per 100 miles. https://www.fueleconomy.gov/feg/powerSearch.jsp. Search Criteria: 2020 model year, All Electric vehicle type. Accessed May 21st, 2020.

4.2 Policy T-2: Encourage urban density and revision of parking standards, and support bicycle and pedestrian-friendly planning.

Reducing VMT means reducing the number of miles traveled and trips taken by on-road vehicles within the County. San Mateo County will reduce VMT by moving trips from single occupancy vehicles to shared and active mobility. To do this, the County must work to increase the ease of access to safe bicycle and pedestrian infrastructure while also planning for more density to reduce trip length. In addition to making it easier to bike, walk, and use transit, the County will also reduce parking requirements to further incentivize alternative forms of transportation. See Table 11 for a full summary of the supporting actions associated with implementation of Policy T-2.

Performance Metrics

- Reduce VMT by 3% compared to the forecast by 2030
- Complete and Implement Unincorporated San Mateo County Active Transportation Plan by 2030
- Install an additional 90 miles of bike lane by 2030 – County Data[28]

Table 11 Policy T-2 Actions

Action #	Action	Emissions Savings (MT CO_2e) 2030	2040
Quantified Actions			
T-2.1	Update the General Plan and Local Coastal Plan with neighborhood mixed use, commercial mixed use, industrial mixed use, and multi-family residential designations to enable mixed-used development.	1,592	2,231
T-2.2	Continue coordination and collaboration with the Planning and Building and Housing Department to update policies according to Housing Element updates to enable and promote affordable housing near transit.		
T-2.3	Pursue bicycle and pedestrian-friendly design by maximizing opportunities to implement traffic calming and complete streets measures into infrastructure projects. Identify opportunities to incorporate green infrastructure and pavement-to-parks concepts.[29]		
T-2.4	Update the County's Transportation Systems Management Ordinance to reflect updated regional policies, including but not limited to the San Mateo County Congestion Management Plan Transportation Demand Management Policy.		
T-2.5	Conduct interdepartmental coordination to develop and adopt local guidelines, policies, and tools to implement changes to the California Environmental Quality Act's transportation significance metric and criteria (SB 743).		
T-2.6	Support the implementation of the Active Transportation Plan by implementing priority pedestrian and bikeway projects, with a focus on those in historically underserved neighborhoods.		
Supportive Actions			
T-2.7	Collaborate with local and regional partners to study existing parking policies, practices, programs, and demand, and opportunities to support increased multimodal travel.	Supportive	

[28] 90 miles of bike lane is also the 2045 target

[29] Pavement-to-parks refers to the creative utilization of unpaved areas or underutilized paved areas in neighborhoods with less access to green space to create new pedestrian and pocket-park spaces. This facilitates traffic calming as well as pedestrian-friendly street environments.

Action #	Action	Emissions Savings (MT CO_2e) 2030	2040
T-2.8	Review and revise existing bike parking requirements if they are inadequate for current and future demand. In districts without current bike parking requirements, evaluate opportunities for developing them.	Supportive	

4.2.1 Methodology and Assumptions

Traffic Calming Actions

According to the Fehr and Peers VMT reduction estimates, traffic calming policies including complete streets can reduce VMT up to 1.7% for individual developments due to increased bike/pedestrian use. Since this will be applied to multiple developments and existing streets, the higher end estimate was used since a more complete system will be in place. Assuming complete streets at all new developments and 20 miles of existing streets (two miles per year) an estimated 0.07% of total VMT reduction is expected in 2030 and 0.15% VMT reduction in 2040.

Increased Diversity/Density

Fehr and Peers research suggests a 0% to 12% reduction in VMT from increased diversity. To conservatively estimate the impacts of increased diversity, an 8% reduction was taken from the projected increase in VMT from 2020 to 2030 in order to represent just new development. The result was an estimated 0.35% reduction in overall VMT.

Bicycle and Pedestrian Master Plan Buildout

It was assumed that the remaining 90 miles of bike lane would be added as part of implementing the Unincorporated San Mateo County Active Transportation Plan. This is based on the existing 2017 bike ped plan, although an updated plan. Based on CAPCOA guidance the County can expect to see a 0.075% increase in bike VMT per mile of bikeway added.[30] Based on the passenger commute VMT and the 0.075% VMT reduction an expected VMT reduction of 0.68% is expected. The calculations and assumptions used to estimate emission reductions from Policy T-2 are provided in Table 12.

Table 12 Policy T-2 GHG Emissions Reduction Calculations

Calculation Factor	2030	2040
Traffic Calming		
Target Reduction in Passenger Vehicle VMT	1.7%	1.7%
Forecasted Growth of VMT	18,617,284	38,628,846
Reduction in Passenger Vehicle VMT from Parking Maximums (VMT)	316,494	656,690
Percent VMT Reduction	0.07%	0.15%
Complete Streets Development		
Miles of Complete Streets Installed	20	40
Percent of County Roads	6.35%	12.70%
VMT Affected by Complete Streets Treatment	26,922,278	56,385,708
VMT Reduction	457,679	958,557

[30] http://www.capcoa.org/wp-content/uploads/2010/11/CAPCOA-Quantification-Report-9-14-Final.pdf

Percent of VMT Reduced	0.11%	0.22%
Bicycle and Pedestrian Master Plan Buildout		
New Bike Lane Installed (Miles)	90	90
Reduction in VMT per Mile of Bike Lane	0.01%	0.01%
Percent Reduction in VMT	0.68%	0.68%
VMT Reduction (VMT)	2,862,175	2,997,253
Total VMT Reduction	5,125,730	7,702,808
Emission Factor (EMFAC)	**0.0003107**	**0.0002896**
MT CO_2e Reduction	1,592	2,231

Notes: MT CO_2e = metric tons of carbon dioxide; VMT = vehicle miles traveled

4.3 Policy T-3: Implement programs for shared transit that reduce VMT

Although transit has the potential to significantly reduce VMT within San Mateo County, many of the actions that need to be taken including expanding transit service fall outside the direct control of the County. While the County will strive to support these activities, and partner with key stakeholders, no quantified reductions were applied as part of this policy to ensure a conservative estimate. See Table 13 for a full summary of the supporting actions associated with implementation of Policy T-3.

Performance Metrics

- N.A

Table 13 Policy T-3 Actions

Action #	Action	Emissions Savings (MT CO_2e) 2030	2040
Supportive Actions			
T-3.1	Work with partners to implement policies, programs, and pilot projects that support access to transit; for example, a first mile-last mile shuttle program or a school district-oriented transportation pilot. Prioritize efforts that provide access for households without access to a car, low-income disabled, senior, and racial or ethnic minority populations.	Supportive	
T-3.2	Support the transition of public and private buses and shuttles to zero emission vehicles.	Supportive	
T-3.3	Develop model policies for micro-mobility and shared transportation options (bike, scooter, and car share) that facilitate equitable access to mobility services and region-wide transit (first mile-last mile).	Supportive	
T-3.4	Facilitate transportation equity through targeted provision of programs and infrastructure that support low-income, disabled, senior, and racial or ethnic minority populations to take transit, walk, bike, and use ride- or car-share.	Supportive	
T-3.5	Explore opportunities for applying a tax on all transit network company trips (rides provided by commercial ride-hail companies and private transit services) that originate in San Mateo County to support transit and complete streets and safety improvements.	Supportive	

5 Sector 3: Waste

Sector 3 includes the waste reduction policies and actions. Policies in this sector focuses primarily on reduction of organics in the waste stream consistent with the State of California's short lived climate pollutants legislation (SB 1383). Additional supportive actions include non-organic waste reduction and construction material diversion.

5.1 Policy W-1: Reduce construction materials and waste

Table 18Table 3 includes the supporting actions associated with implementation of Policy W-1.

Table 18 Policy W-1 Actions

		Emissions Savings (MT CO_2e)	
Action #	**Action**	**2030**	**2040**
Supportive Actions			
1	Update the building regulations to require deconstruction surveys for single family home demolitions, allow 10 days for salvage and require waste management plans for renovations over $50,000.	Supportive	

5.2 Policy W-2: Reduce organics in the waste stream

Organic materials are the focus of the recent landmark legislation SB 1383 (Short-Lived Climate Pollutants: Organic Waste Reductions). Now in the final rulemaking stage, this new state law has the immediate goal of reducing organic waste sent to landfill and the ultimate objective of reaching statewide methane emissions reduction goals. Specifically, it sets a statewide goal for the reduction in organic waste to landfills – 50% by 2020 and 75% by 2025 – in addition to the recovery of 20% of edible food waste for human consumption. SB 1383 will require local governments to provide organics collection to all generators and require all generators to subscribe. It also has specific mandates for container systems, education and outreach programs, monitoring and contamination reporting, and enforcement of regulations. Full SB 1383 implementation will begin in 2022, allowing some time for jurisdictions to plan and prepare for achieving compliance.[31] See Table 19 for a full summary of the supporting actions associated with implementation of Policy W-2.

Performance Metrics

- Comply with SB 1383 requirements
- Reduce organics in the waste stream by 75% below 2014 levels by 2025
- Increase edible food recovery by 20% by 2025

[31] California Air Resources Board. (2017). Short-Lived Climate Pollution Reduction Strategy.

Table 19 Policy W-2 Actions

Action #	Action	Emissions Savings (MT CO_2e) 2030	2040
Quantified Actions			
W-2.1	Work with franchised haulers and waste authorities to ensure the goals of SB 1383, the Short-lived Climate Pollutant Reduction law, are met by 2025.	6,367	6,551
W-2.2	Implement an Edible Food Recovery Program for unincorporated areas as required under SB 1383. Increase the coverage of the Edible Food Recovery Program for densely populated, unincorporated areas, such as North Fair Oaks, and further assist food recovery organizations to increase pickup and redistribution.		
Supportive Actions			
W-2.3	Enhance recycling and composting outreach and technical assistance and investigate offering incentives to commercial and agricultural entities in unincorporated areas of San Mateo County.	Supportive	
W-2.4	Reduce the amount of organics in the landfill by pursuing additional opportunities to repurpose organic materials, which may include creating additional sites to the Countywide community compost collaborative, exploring development of a composting facility on the coast, and exploring feasible capital improvement projects for reducing organics in the waste stream, such as organics extraction presses and anerobic digesters.	Supportive	
W-2.5	Partner with agriculture-related organizations, public school and community college districts, local community-based organizations, and other stakeholders, to develop a home carbon sequestration and soil health education campaign for residents and training opportunities for landscape professionals, and local government parks and recreation staff.	Supportive	
W-2.6	Develop a local garden program to facilitate the creation of compost and promote the use of compost at community and school gardens. Prioritize schools serving low-income communities.	Supportive	
W-2.7	Partner with agriculture-related organizations, producers, and businesses to reduce and divert waste generated in the agriculture sector, including farms, ranches, and equestrian facilities through composting and biodigestion.	Supportive	

5.2.1 Methodology and Assumptions

The requirements and actions associated with SB 1383 have been developed to produce a 75% reduction in organics by the State of California.[32] The State's efforts towards such goals have been ongoing with previously enacted laws such as AB 341 and AB 1826 establishing commercial recycling requirements. The State recognizes that individual jurisdictions cannot achieve the goals of SB 1383 alone and therefore SB 1383 stipulates how waste generators and local governments must operate to achieve SB 1383 goals. Therefore, by taking the actions required, County of San Mateo can expect to achieve an equivalent reduction level. The emissions reductions associated with a 75% reduction in organics was calculated using the 2014 Waste Characterization Study for the County of San Mateo pursuant to the SB 1383 guidelines.[33] A 75% reduction to the City's organic waste stream was

[32] https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160SB1383

[33] https://www2.calrecycle.ca.gov/WasteCharacterization/

applied in 2025 and continued through 2030 and 2040. The reduced amount of organic waste was multiplied by the weighted average of the USEPA's emission factors for various organics from the Waste Reduction Model (WARM) based on the organic waste characterization (Emission Factor = 0.289 MT CO_2e/short ton of waste).[34] The calculations and assumptions used to estimate emission reductions from Policy W-2 are provided in Table 20.

Table 20 Policy W-2 GHG Emissions Reduction Calculations

Calculation Factor	2030	2040
Target Reduction in Landfilled Organics	75%	75%
Forecasted Waste Generation (tons)[1]	41,299	42,497
Organic Percentage	71%	71%
Forecasted Organic Waste Generation (tons)[2]	29,322	30172
Diverted Organic Waste (tons)[3]	21,992	22,629
Organics Waste Emission Factor (MT CO_2e/ton)[4]	0.2895	0.2895
Total GHG Emissions Reductions (MT CO_2e)	**6,367**	**6,551**

Notes: MT CO_2e = metric tons of carbon dioxide; kWh =-kilowatt-hour

[1] Forecasted waste generation is estimated as the forecasted service population multiplied by the per capita waste generation factor obtained from the 2016 inventory (0.5208 tons/service population)

[2] Data on the composition of the waste stream by waste type was not available for the County of San Mateo, therefore the Cal Recycle statewide average composition was used where ~59% of the waste stream is mixed municipal solid waste (MSW) and ~41% is organics.

[3] Diverted organics is based on the total forecasted organics generation multiplied by the targeted reduction.

[4] The emission factor for organics waste is the weighted average of emission factors for all organic materials listed in the U.S. EPA's WARM model Version 15 using the Cal Recycle 2014 Waste Characterization study prepared for California Regions (https://www2.calrecycle.ca.gov/WasteCharacterization/ResidentialStreams?lg=443&cy=19) for tonnage by waste type.

* Values may not add up due to rounding

5.3 Policy W-3: Reduce inorganic waste sent to landfills

Table 21Table 3 includes the supporting actions associated with implementation of Policy W-3.

Table 21 Policy W-3 Actions

		Emissions Savings (MT CO_2e)	
Action #	Action	2030	2040
W-3.1	Conduct outreach and engagement to inform businesses of current ordinances for reducing/regulating single-use product and shipping packaging and/or promoting reuse, such as food service ware, home meal delivery services, and other packaging.	Supportive	
W-3.2	Expand opportunities to provide funding and technical assistance to non-profit organizations, schools, and other entities to implement projects relating to reuse, source reduction, recycling, and composting.	Supportive	
W-3.3	Ensure that all County contracts and event permits require all third-party vendors provide and utilize compostable and/or reusable food service items to serve 50 or more people and provide recycling and composting infrastructure.	Supportive	

[34] The WARM model is a waste reduction model created by USEPA to help solid waste planners and organizations track and report GHG reductions from several different waste management practices. https://www.epa.gov/sites/production/files/2019-06/documents/warm_v15_organics.pdf

Action #	Action	Emissions Savings (MT CO_2e) 2030	2040
W-3.4	Partner with public institutions, private businesses, and nonprofits (like thrift stores) to develop and implement programs that encourage reduce and reuse.	Supportive	
W-3.5	Require extended producer responsibility[35] (EPR) when an option to advance greater EPR exists. Scale these efforts by partnering with public school and community college districts to determine if a similar effort or policy would be feasible.	Supportive	
W-3.6	Continue to collaborate with other local governments (for example, through the Bay Area Recycling Outreach Coalition) to implement a regional outreach and marketing campaign.	Supportive	
W-3.7	Expand educational offerings and resources for improving community resource conservation (addressing the "4Rs," reduce, reuse, recycle, rot) through existing and new offerings. Explore development of a Youth Conservation Corps program that would provide local mentorship, volunteer, internship, and/or employment opportunities for youth and young adults in the solid waste reduction field.	Supportive	
W-3.8	Provide and promote accessible local workforce development opportunities related to solid waste programs. Create new partnerships and economic opportunities to provide maximum benefit in the form of employment opportunities for the local workforce, residents with barriers to employment, and communities most affected by climate change.	Supportive	

[35] Extended producer responsibility is a "strategy to place a shared responsibility for end-of-life product management on producers, and other entities involved in the product chain, instead of the general public." (CalRecycle, 2020)

6 Sector 4: Working Lands

Sector 4 includes supportive policies to enhance and protect biodiversity and agriculture in the County. San Mateo County currently has approximately 28,500 acres in agricultural production, predominately comprised of grazed rangelands. Agricultural lands in San Mateo County have the potential to capture and store an additional 7,900 MT CO_2e (moderate adoption) - 13,500 MT CO_2e (high adoption) annually, based on existing practice implementation, crop types, and feedback from producers. These practices have a range of lifespans from one to twenty years, with carbon sequestration continuing over time. The estimated cumulative potential for carbon sequestration is 39,000 MT CO_2e (moderate adoption scenario) - 67,000 MT CO_2e (high adoption) by 2030, and 166,000 MT CO_2e (moderate adoption) - 282,000 MT CO_2e (high adoption) by 2045. These scenarios are based on producer adoption of 11 carbon beneficial land and soil management practices, with compost use providing the greatest potential for increasing carbon sequestration on agricultural soils. Policy L-1 through Policy L-6 would work together to facilitate adoption of new agricultural practices that cumulatively would increase carbon sequestration in the county. The quantification of these reductions is based on work completed by the Carbon Cycle Institute as part of the climate action planning process. Section 7 of this document includes the summary report, "A Landscape-scale Analysis San Mateo County Agricultural Lands: Carbon Sequestration Potential," authored by the Carbon Cycle Institute. This report documents the methods, assumptions, and results of analysis to estimate the carbon sequestration and climate mitigation potential of the San Mateo County agricultural lands.

6.1 Policy L-1: Identify new financing to scale carbon farming

Table 22 Policy L-1 Actions

		Emissions Savings (MT CO_2e)	
Action #	**Action**	**2030**	**2040**
L-1.1	Implement a County funding program, such as Santa Clara County's Agricultural Resilience Incentive, for farmers and ranchers to implement and maintain climate beneficial practices.	7,900	13,577
L-1.2	Support land partners to leverage private, and regional, state, and federal funding for producers' implementation of climate beneficial agricultural practices. Develop a program or mechanism for San Mateo County businesses, philanthropic institutions, and supportive community members to support local carbon farming projects.		
L-1.3	Where feasible, County-procured compost through SB 1383 compliance should be made available to farmers and ranchers at a reduced cost or for free.		
L-1.4	Explore opportunities for establishing a bulk purchasing program for cost savings, such as for cover crop seed.		
L-1.5	Assess potential of a communication or labeling program to raise awareness of climate beneficial agricultural practices of San Mateo County producers, potentially as part of As Fresh As It Gets. Assess potential of such program to increase revenue for producers.		

L-1.6	Assess and report the estimated public benefits and cost savings provided by climate beneficial agricultural practices to the agricultural and larger San Mateo County communities.

6.2 Policy L-2: Support technical assistance, education, and data collection efforts to scale climate beneficial agriculture in San Mateo County

Table 23Table 3 summarizes the supporting actions associated with implementation of Policy L-2.

Table 23 Policy L-2 Actions

		Emissions Savings (MT CO_2e)	
Action #	**Action**	**2030**	**2040**
1	Support land partners in providing technical assistance to agricultural producers to scale carbon farming and GHG reducing practices. Support adequate staffing for technical assistance providers to undertake outreach, planning, implementation, monitoring, and maintenance.	Supportive	
2	Support trials, research and monitoring by agricultural producers, land partners, and higher education institutions to refine local data on carbon sequestration and GHG reduction occurring from existing and new climate beneficial practices.	Supportive	
3	Support land partners in providing educational opportunities to assist producers in evaluating and adopting climate beneficial agricultural practices, including trainings and peer-to-peer learning opportunities.	Supportive	

6.3 Policy L-3: Secure access to key implementation infrastructure

Table 24Table 3 summarizes the supporting actions associated with implementation of Policy L-3.

Table 24 Policy L-3 Actions

Action #	Action	Emissions Savings (MT CO_2e) 2030	2040
L-3.1	• Support development of key infrastructure, such as a bulk purchasing program for cost savings for carbon farming. • Investigate feasibility of equipment share or low-cost rental program to increase access to essential equipment to facilitate carbon farming practices, such as compost spreader or no-till drill, and, if feasible, support and finance equipment purchasing, coordination and maintenance of such a program. Improve and increase the availability of high quality and affordable local agricultural compost. .	Supportive	
L-3.2	• Support work to improve irrigation efficiency and increase use of on-farm GHG reducing equipment and alternative energy, such as solar. • Fund chipping program to reduce annual burning of pruning waste. • Assist in the development of infrastructure that supports the local agricultural economy while reducing travel, such as development of agricultural services or markets in San Mateo County. • Support efforts that assist producers with agricultural waste reduction, reuse, and recycling. • Ensure that woody material removed for fuel load reduction projects be recycled into a beneficial use, such as compost or biochar. Investigate feasibility of procuring a mobile pyrolysis facility and establish shared funding mechanism for ongoing costs of repair and maintenance. • Partner with Pacific Gas and Electric (PG&E) and Peninsula Clean Energy (PCE) to assess the feasibility of establishing an incentive program that would help producers plan for and install solar panels and battery storage for on-farm operations. Partner with PG&E and PCE to provide producers with on-farm energy audits to identify energy efficiency opportunities and connect them to existing county and statewide energy upgrade programs, including incentives, rebates, and financing.	Supportive	
L-3.3	Develop a platform for tracking and reporting on climate goals and on-farm benefits of climate beneficial agricultural projects.	Supportive	

6.4 Policy L-4: Address permitting barriers

Table 25 summarizes the supporting actions associated with implementation of Policy L-4.

Table 25 Policy L-4 Actions

Action #	Action	Emissions Savings (MT CO_2e) 2030	2040
L-4.1	• Assess local permitting and ordinances to identify barriers to efficient and effective planning and implementation of climate beneficial agricultural practices. • Participate in statewide Cutting Green Tape initiative. • Engage in efforts to reduce regulatory barriers to efficient and effective climate beneficial agricultural practices. • Align local regulations to statewide streamlining permitting efforts for on-farm composting and climate beneficial agricultural practices.	Supportive	

6.5 Policy L-5: Ensure agricultural lands are preserved for agricultural production

Table 26 summarizes the supporting actions associated with implementation of Policy L-5.

Table 26 Policy L-5 Actions

Action #	Action	Emissions Savings (MT CO_2e) 2030	2040
L-5.1	Support efforts to improve access, tenure, and ownership for next generation and new and beginning farmers and ranchers.	Supportive	

6.6 Policy L-6: Support carbon sequestration on natural lands and urban green spaces

Table 27Table 3 summarizes the supporting action associated with implementation of Policy L-6.

Table 27 Policy L-6 Actions

Action #	Action	Emissions Savings (MT CO_2e)	
		2030	2040
L-6.1	• Explore opportunities to encourage and support ecological restoration efforts where feasible. • Explore opportunities to provide tribal access to land for indigenous agriculture and other cultural activities and events that are dedicated to tribal citizens as well as shared opportunities for members of the broader public to visit the land and learn about and tend native plants. Support development of accompanying place-based public education opportunities focused on local microclimates, indigenous plant communities, and land stewardship.	Supportive	
L-6.2	Develop strategies through diverse stakeholder participation for carbon sequestration and climate adaptation on natural lands and urban green spaces.		

7 Landscape-Scale Analysis: Carbon Sequestration Potential Report

Carbon Cycle Institute

Introduction

The purpose of this report is to document the methods, assumptions, and results of an analysis to estimate the carbon sequestration and climate mitigation potential of San Mateo County agricultural lands. The analysis was funded through a California Department of Conservation Local and Regional Planning Grant to assess the critical role rural working lands can play in regional planning for climate action and long-term resilience. The goal of this assessment is to support the County in estimating the potential contribution of working lands in meeting climate goals identified in its Climate Action Plan (CAP) and General Plan through increased carbon sequestration and avoided future emissions.

Enhancing photosynthetic carbon dioxide removal (CDR) from the atmosphere through enhanced management of our natural and working lands offers the largest available pathway to draw down atmospheric carbon. Unlike geoengineering approaches, with unknown and potentially negative side effects, enhancing terrestrial carbon increases food security, enhances ecosystem resilience, and has myriad additional positive benefits for human, environmental, and economic health.

The analysis builds on the Carbon Cycle Institute's carbon farming framework to assess carbon sequestration potential at the landscape-scale using best available data, modeling tools, expert opinion, and input from the agricultural community.

Carbon Cycle Institute, 245 Kentucky Street, Petaluma, CA 94952

Methods

The spatial extent of the study included all agricultural lands in the county as mapped through the California Department of Conservation, Farmland Mapping and Monitoring Program (2018 data). The goal of the Farmland Mapping and Monitoring Program (FMMP) is to provide consistent and impartial data to decision makers for use in assessing the status of and trends in California's agricultural land resources. FMMP county-level map data is updated every two years, utilizing aerial imagery, public review, and field reconnaissance. The FMMP agricultural land resources map data is divided into five (5) farmland mapping categories (see table below). In San Mateo County, 53,867 acres of agricultural land was mapped in 2018. Important farmland mapping categories and soil taxonomy terms can be found at the Department of Conservation website.[1]

Table 1. Agricultural Land Resources, 2018

San Mateo County Agricultural Land Resources, 2018 FMMP Data	Acres
Prime Farmland	1,717.00
Farmland of Statewide Importance	134.00
Unique Farmland	2,140.00
Farmland of Local Importance	697.00
Grazing Land	49,179.00
TOTALS	**53,867.00**

Mapped FMMP agricultural land resource data were used as the base layer for the study. The Grazing Land category was used to extract acreage by vegetation type, soils, riparian areas, and areas suitable for climate beneficial land management practices on county grazing land using the ArcGIS clip function. The other four FMMP farmland categories were combined to extract acreage of soil organic matter levels on county cropland using the ArcGIS clip function.

The study used the Conservation Lands Network (CLN 2.0)[2] Coarse Filter Vegetation GIS data layer and the Stream Valley GIS data layer to identify suitable areas for climate beneficial agricultural land management practices associated with specific vegetation types (e.g., grasslands) and/or location within a watershed (e.g., floodplains). The Natural Resources Conservation Service (NRCS) Soil Survey Geographic (SSURGO)[3] database was used to map soil types, soil organic matter levels, and land suitable for mechanical range seeding. Riparian areas were mapped using the County of San Mateo Information Services' Natural Features Geodatabase to map Streams and associated riparian buffers.[4]

The San Mateo County 2018 Crop Report provided the most current data for acres of broad crop types (i.e., row/truck crops, fruit and nut crops, and field crops). Acres of production for each crop type are provided in Table 2 below. This data was then used to model the climate mitigation benefits from the

[1] Important farmland mapping categories and soil taxonomy terms. Retrieved from: https://www.conservation.ca.gov/dlrp/fmmp/documents/soil_criteria.pdf
[2] Conservation Lands Network 2.0 GIS data. Retrieved from: https://www.bayarealands.org/maps-data/
[3] National Resource Conservation Service. SSURGO Web Database. Retrieved from: http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/survey/
[4] County of San Mateo Information Services. Retrieved from: https://isd.smcgov.org/gis-data-download

adoption of specific agricultural land management practices. The study relied primarily on the California Healthy Soils version of the NRCS COMET-Planner tool[5] for quantification of carbon sequestration and GHG emission reduction benefits associated with changes in agricultural land management practices, by crop type, on an annual per acre basis.

Table 2. County Crop Report Data, 2018

San Mateo County 2018 Crop Report Data	Acres
Truck Crops	1,944
Fruit and Nut Crops	287
Field Crops	1,050
Total	**3,281**

In addition to modeling the climate mitgation benefits associated with specific agricultural land management practices, a separate analysis was conducted to estimate additional soil carbon storage and water holding capacity by increasing soil organic matter to 5% on county cropland. The NRCS has suggested a soil organic matter content of 5% (2.5% SOC[6]) as an indicator of a "healthy" soil. This increase in soil organic carbon can be accomplished rapidly on individual acres through off-farm inputs of organic soil amendments, particularly compost, or more gradually through enhanced carbon capture through soil carbon enhancing practices on farm, or through a combination of these approaches.[7] Persistence of this carbon in the soil will depend upon ongoing soil management practices, including periodic additions of exogenous inputs, such as compost.

Carbon Sequestration Measures

Estimated carbon sequestration potential on San Mateo County agricultural lands was divided into two subcategories: grazing lands and croplands. Climate beneficial agricultural land management practices were selected based on current agricultural land uses and practices identified in nine carbon farm plans co-developed by agricultural producers and the San Mateo Resource Conservation District. A maximum CO_2e reduction potential was estimated using average carbon sequestration rates per practice multiplied by total available acreage for each agricultural land use.

Grazing Lands

For this study, five (5) carbon sequestration measures were selected specifically for grazing lands, while one measure was applied to all agricultural lands located within Stream Valleys (i.e., Silvopasture):

Prescribed Grazing: Managing the harvest of vegetation with grazing and/or browsing animals with the intent to achieve specific ecological, economic, and management objectives.

[5] http://comet-planner.com/
[6] Soil Organic Matter (SOM) is approximately 50% carbon (Pribyl 2010).
[7] Chambers et al 2016, Lal 2015, Ryals et al 2015, Swan et al 2014, Delonge et al 2013, Lal 2004.

Compost Application to Grazed Grasslands[8]: **Compost is applied to grazed rangeland.**

Range Planting: **Establishment of adapted perennial vegetation such as grasses, forbs, legumes, shrubs, and trees.**

Critical Area Planting: **Establishing permanent vegetation on sites that have, or are expected to have, high erosion rates, and on sites that have physical, chemical or biological conditions that prevent the establishment of vegetation with normal practices.**

Riparian Forested Buffer (50 ft width): **Riparian Forested Buffer establishment by replacing grasslands with unfertilized, woody plants or trees in areas located adjacent to and upgradient from watercourses or water bodies.**

Silvopasture: **Planting of trees and shrubs on grazed land, with the purpose of integrating forage and livestock production.**

Croplands

For this study, five (5) carbon sequestration measures were selected for croplands.

Cover Crops: **Grasses, legumes, and forbs planted for seasonal vegetation cover.**

Conservation Cover: **Establishing and maintaining perennial vegetation cover to protect soil and water resources on land retired from agricultural production or other lands needing permanent protective cover that will not be used for forage production.**

Compost Application to cropland: **Annual compost application assuming a C:N >11.**

Hedgerow Establishment: **Establishment of dense vegetation in a linear design to achieve a natural resource conservation purpose such as habitat for pollinators and providing substrate for beneficial invertebrates as a component of integrated pest management.**

Windbreak Establishment: **Single or multiple rows of trees or shrubs planted in linear configurations to increase carbon storage in biomass and soils and reduce soil erosion and evapotranspirative water loss from wind.**

Results

Agricultural lands in San Mateo County have the potential to capture and store an additional 46,679 metric tons of CO_2e annually based on producer adoption of ten (10) climate beneficial land management practices selected for this analysis (Table 3). Compost application to grazed grasslands and cropland provides the greatest potential for increasing carbon sequestration on agricultural soils; approximately 70 percent of estimated potential (32,221 MT CO_2e annually).

The carbon sequestration opportunities associated with agroforestry practices are underrepresented in this analysis, requiring additional field-scale assessments (e.g., opportunities for gully stabilization and windbreaks on rangeland, etc.) and outreach to the agricultural community.

[8] **Carbon sequestration rates associated with compost application to grazed grasslands was estimated using data from the following research: (Ryals et al 2015, Ryals and Silver, 2013, Delonge et al 2013, Conant et al 2001).**

Table 3. Estimated Carbon Sequestration Potential on County Agricultural Lands

Agricultural Practice:	Carbon Sequestration	Unit	Agricultural Land Use	Acreage Cap	Sequestration Potential (MT CO_2e per Year)
Range Planting	0.50	MT CO_2e/acre/year	Grazing Land	11,923.0	5,961.5
Prescribed Grazing	0.009	MT CO_2e/acre/year	Grazing Land	24,403.0	219.6
Critical Area Planting	2.00	MT CO_2e/acre/year	Grazing Land	82.6	165.2
Rangeland Compost Application	1.49	MT CO_2e/acre/year	Grazing Land	11,923.0	17,765.3
Riparian Forest Buffer 50-ft	5.77	MT CO_2e/acre/year	Grazing Land	369.0	2,130.0
Silvopasture - Stream Valleys	1.34	MT CO_2e/acre/year	Grazing Land Cropland	1,949.0	2,611.7
Annual compost application	4.38	MT CO_2e/acre/year	Row Crops	1,944.0	8,506.0
Cover Crops	0.40	MT CO_2e/acre/year	Row Crops	868.0	343.0
Annual compost application	4.49	MT CO_2e/acre/year	Fruit & Nut Crops	287.0	1,290.0
Cover Crops	1.62	MT CO_2e/acre/year	Fruit & Nut Crops	143.5	232.0
Annual compost application	4.44	MT CO_2e/acre/year	Pasture/Hay Field	1,050.0	4,660.0
Conservation Cover (2/3 of crop acreage)	2.93	MT CO_2e/acre/year	Fruit & Nut Crops	191.3	560.0
***Windbreaks** (5% of crop acreage)	9.03	MT CO_2e/acre/year	Cropland	164.0	1,481.0
***Hedgerows** (5% of crop acreage)	4.60	MT CO_2e/acre/year	Cropland	164.0	754.0
Total					**46,679.2**

Carbon Sequestration on Grazing Lands

According to the FMMP 2018 spatial data, there are 49,179 acres of grazing land in San Mateo County. For purposes of this study, only grazed grasslands (24,403 acres) were included in the analysis. As Table 4 below indicates, a onetime investment in range management improvements such as compost application, range planting, and agroforestry have annual GHG reduction benefits extending well into the future.

For example, a combination of compost application and range planting on all grazed grasslands suitable for such practices is estimated to result in a GHG benefit of 237,267 MT CO_2e at year 10, while replanting a 50-ft riparian buffer on 369 acres of land would result in a benefit of 21,300 MT CO_2e at year 10. The discussion below outlines the assumptions underlying estimated carbon sequestration benefits on county grazing lands.

Table 4. Estimated Carbon Sequestration Potential on Grazing Land

Agricultural Practices	Carbon Sequestration	Unit	Agricultural Land Use	Acreage Cap	Sequestration Potential (MT CO_2e per Year)	Sequestration Potential (MT CO_2e @ Year 10)
Range Planting	0.50	MT CO_2e/acre/year	Grazing Land	11,923.0	5,961.5	59,615.0
Prescribed Grazing	0.009	MT CO_2e/acre/year	Grazing Land	24,403.0	219.6	2,196.3
Critical Area Planting	2.00	MT CO_2e/acre/year	Grazing Land	82.6	165.2	1,651.6
Rangeland Compost Application	1.49	MT CO_2e/acre/year	Grazing Land	11,923.0	17,765.3	177,652.7
Riparian Forest Buffer 50-ft	5.77	MT CO_2e/acre/year	Grazing Land	369.0	2,130.0	21,300.0
Silvopasture - Stream Valleys	1.34	MT CO_2e/acre/year	Grazing Land Cropland	1,949.0	2,611.7	26,116.6
Total					**28,853.2**	**288,532.2**

Rangeland Management (prescribed grazing, range planting, rangeland compost application and critical area planting)

The study assumes that all 24,403 acres of grasslands within the FMMP 2018 Grazing Land category would be suitable for the *prescribed grazing practice*, with an annual climate mitigation benefit of 219.6 CO_2e. To identify areas of grazed grassland suitable for *range planting* and *rangeland compost application*[9], practices requiring vehicle and equipment operation, a Range Drill Suitability Soils Report in the NRCS SSURGO map database was used to map 11,923 potential acres. Additional field-scale assessments would be required to arrive at more accurate estimates for these practices, taking into consideration slope stability, vehicle and equipment access, and adequate protective distance from watercourses, native grasslands, and other habitat features of special concern.

Opportunities for *critical area planting*, the establishment of permanent vegetation on sites that have, or are expected to have, high erosion rates, and on sites that have physical, chemical or biological conditions that prevent the establishment of vegetation with normal practices, are unrepresented in this analysis. A field-scale assessment of gully erosion on rangeland in San Mateo County is recommended to better identify opportunities for additional critical area planting. Only 82.6 acres were included as suitable for this practice based on an extrapolation of data from carbon farm plans produced by the San Mateo Resource Conservation District.

Agroforestry (riparian forested buffers and silvopasture)

For the purposes of this analysis, agroforestry practice selection for grazing lands focused solely on riparian areas and stream valleys. Opportunities to restore *riparian forested buffers* were identified by using the buffer tool in ArcGIS. A 50-ft buffer width was applied to 112 stream miles on grazing lands in

[9] The 1.49MTCO2e/acre/yr sequestration factor used in the analysis was derived from research conducted in California grazed rangeland systems (Ryals et al 2015, Ryals and Silver, 2013, Delonge et al 2013).

the county. Acreage of vegetation types within the 50-ft buffer was then derived using the clip tool in ArcGIS (Table 5). Of the 1,532 acres within the 50-ft buffer, 369 acres were identified as suitable for tree and shrub planting.

Table 5. Restoration opportunities in riparian areas

50-ft Buffer on Grazing Lands		
Vegetation Type	**Acres**	
Grassland	**353**	**23%**
Cultivated Ag	**16**	**1%**
Urban/Residential	7	0%
Barren	3	0%
Water	2	0%
Shrub	564	37%
Trees	588	38%
Total	**1,532**	

Opportunities to enhance stream valleys through planting of shrubs and trees (silvopasture) utilized a similar methodology. The Conservation Lands Network (CLN 2.0) Stream Valley Data Layer was used to clip the CLN 2.0 Coarse Filter Vegetation Data Layer to identify areas suitable for tree and shrub establishment. The analysis identified 1,949 acres suitable for silvopasture establishment (Table 6).

Table 6. Silvopasture establishment in stream valleys

Stream Valleys (CLN 2.0)		
Vegetation Type	**Acres**	
Grassland	**1,949**	**44%**
Cultivated Ag	454	10%
Urban/Residential	62	1%
Barren	13	0%
Water	11	0%
Shrub	1,009	23%
Trees	946	21%
Total	**4,443**	

Carbon Sequestration on Croplands

For modeling the climate mitigation benefits associated with changes in cropland management, the analysis used data from the San Mateo County 2018 Crop Report. In 2018, there were 3,281 acres in crop production: 1,944 acres in row crops; 287 acres in fruit and nut crops; and 1,050 acres in field crops. The GHG reduction benefits from implementing the five (5) climate beneficial practices selected for the study are 17,826 MT CO_2e annually and 178,259 MT CO_2e at year 10 (Table 7).

Compost application to cropland provides the largest GHG reduction benefit in the analysis at 14,456 MT CO_2e annually. The analysis assumes annual applications of compost through year 10 for a GHG reduction benefit of 144,560 MT CO_2e.

The discussion below outlines the assumptions used for estimating additional carbon sequestration benefits on county croplands.

Table 7. Estimated Carbon Sequestration Potential on Cropland

Agricultural Practices	Carbon Sequestration	Unit	Agricultural Land Use	Acreage Cap	Sequestration Potential (MT CO_2e per Year)	Sequestration Potential (MT CO_2e @ Year 10)
Annual compost application	4.38	MT CO_2e/acre/year	Row Crops	1,944.0	8,506.0	85,060.0
Cover Crops	0.40	MT CO_2e/acre/year	Row Crops	868.0	343.0	3,430.0
Annual compost application	4.49	MT CO_2e/acre/year	Fruit & Nut Crops	287.0	1,290.0	12,900.0
Cover Crops	1.62	MT CO_2e/acre/year	Fruit & Nut Crops	143.5	232.0	2,320.0
Annual compost application	4.44	MT CO_2e/acre/year	Pasture/Hay Field	1,050.0	4,660.0	46,600.0
Conservation Cover (2/3 of crop acreage)	2.93	MT CO_2e/acre/year	Fruit & Nut Crops	191.3	560.0	5,600.0
***Windbreaks** (5% of crop acreage)	9.03	MT CO_2e/acre/year	Cropland	164.0	1,480.9	14,809.2
***Hedgerows** (5% of crop acreage)	4.60	MT CO_2e/acre/year	Cropland	164.0	754.0	7,540.0
Total					**17,825.9**	**178,259.2**

** COMET Planner Legacy Tool*

Cropland Management (cover crops, compost application, conservation cover)

For purposes of the study, it was assumed that all cropland would receive annual applications of compost. The study assumed a 50 percent adoption rate for cover cropping based on conversations with the San Mateo Resource Conservation District. The conservation cover practice, permanent cover with forbs and grasses, was applied to 2/3 of acreage in fruit and nut crop production representing row middles.

Hedgerows and Windbreaks

It was assumed that ten percent (10%) of cropland acres would be converted to hedgerows and windbreaks for a total of 328 acres. Both practices have multiple benefits to crop production, including wind protection resulting in decreased evapotranspirative water loss and wind erosion, and provision of pollinator habitat, in addition to carbon sequestration benefits.

Soil Carbon and Additional Water Holding Capacity

In addition to modeling climate mitigation benefits associated with specific agricultural land management practices as discussed above, a separate analysis was conducted to estimate additional soil carbon storage and water holding capacity by increasing soil organic matter to 5% on county cropland. Soil carbon values were calculated for cropland acres by intersecting spatial data from the FMMP 2018 cropland data layer and the NRCS SSURGO soils data to derive soil organic matter (SOM) levels for croplands. Of the 4,688 acres of farmland of importance (Table 8) used in the analysis, 150 acres had SOM levels above 5% and 125.90 acres had no data available, leaving 4,412 acres available for SOM increases.

Table 8. Farmland Mapping and Monitoring Program 2018, Cropland Acres

Land Class 2018 FMMP Data	Acres
Prime Farmland	1,717.00
Farmland of Statewide Importance	134.00
Unique Farmland	2,140.00
Farmland of Local importance	697.00
TOTALS	**4,688.00**

The analysis found that increasing SOM levels to 5% on all available croplands represented an additional 197,658 MT CO_2e stored in soils. Assuming a 1% increase in SOM equates to one-acre inch of increased water holding capacity (NRCS nd), increasing SOM to 5% on all available cropland soils yields a corresponding increase in soil water holding capacity of 1,953 acre-feet (Table 9).

Table 9. Increased Soil Carbon and Water holding Capacity (WHC) Data

Land Class (2018 FMMP Data)	Acres	MT CO2e @5% SOM	Total Acre-Inch WHC Increase	Total Acre-feet WHC Increase
Prime Farmland	1,717	68,946	8,585	715
Statewide Importance	134	6,347	670	56
Unique Farmland	2,140	95,051	10,700	892
of Local Importance	697	27,314	3,485	290
TOTALS	**4,688**	**197,658**	**23,440**	**1,953**

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