Climate Roadmap for a Healthier San Francisco

2023

SFMTA

SFMTA Climate Roadmap for a Healthier San Francisco

The SFMTA has identified six key strategies for a path toward realizing climate and mobility goals of reducing greenhouse gas emissions from transportation, shifting trips to low-carbon modes, accelerating adoption of electric vehicles and generating important community benefits.

1 Build a fast and reliable transit system

Transit improvements make transit more frequent, convenient and reliable and support economic vitality, environmental stewardship and equity.

2 Create a complete and connected active transportation network

A complete network of corridors that are attractive to all demographics for walking, biking and using scooters, wheelchairs and other small mobility devices connects neighborhoods and helps people take more zero-carbon trips better for the community and the environment.

3 Expand programs to communities that shift trips to transit, walking and bicycling

Transportation Demand Management can help to readjust the way people think about their mobility options, reducing congestion and improving transit reliability.

4 Manage parking resources more efficiently

Parking reform enables drivers to find a parking spot near their destination, encourages people to take transit, walk or bike by reflecting driving's true cost, increases funding for transit operations and supports people with fewer public options.

5 Accelerate adoption of zero-emissions vehicles

Electrification of vehicle trips helps to directly reduce GHG emissions from San Francisco's largest single source of them: cars and trucks.

6 Conduct impactful community engagement

Meaningfully engaging with communities helps the city understand and provide for their needs, and providing meaningful communications makes sure people are aware of their mobility options, both critical to addressing our climate emergency.

Disclaimer

SFMTA's Climate Roadmap for a Healthier San Francisco 2023 (Climate Roadmap) articulates six broad strategies to reduce greenhouse gas emissions from the transportation sector in alignment with the City's Climate Action Plan (2021). The Climate Roadmap does not approve, fund, or authorize implementation of any specific projects, which are intended to generate important community benefits such as health, equity, accessibility, safety and many others. Each implementation project or action will be reviewed and approved over time and follow protocols and best practices for adoption, which may require additional public review, review by City decision-makers, and/or environmental review under the California Environmental Quality Act. As a result of those reviews, there may be alternatives and mitigation measures developed that may be implemented as well.

Contents

Policy Background

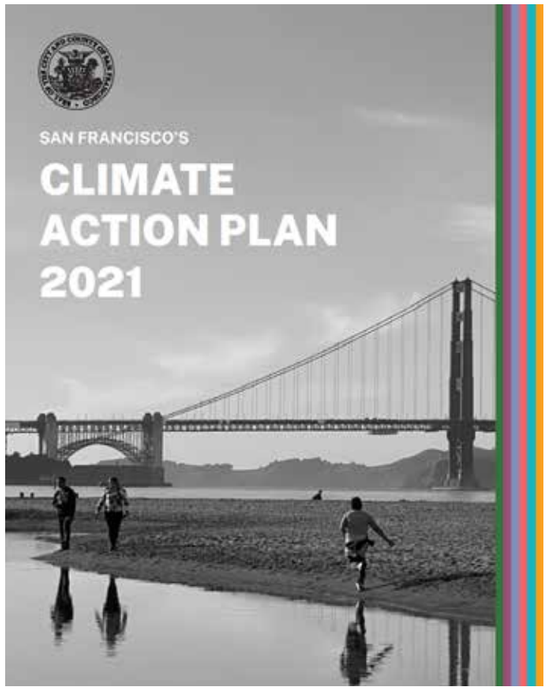
The SFMTA Climate Roadmap supports policies and plans passed by San Francisco voters, the Board of Supervisors, Mayor London Breed and the SFMTA Board of Directors.

2007: San Francisco voters passed Proposition A (2007), directing the SFMTA to issue a report every two years that identifies actions that can reduce greenhouse gas emissions while also describing the progress toward reducing greenhouse gas emissions from the transportation sector.

2019: The San Francisco Board of Supervisors passed Resolution 160-19 declaring a climate emergency. The resolution directed the city to consider "high-priority strategies to achieve deep emission reductions at emergency speed."

2021: In response to the climate emergency legislation, Mayor Breed and the San Francisco Department of the Environment released the San Francisco Climate Action Plan 2021 (CAP). The CAP is a multi-sector framework that aims to realize San Francisco's ambitious climate goals with a primary target of net-zero emissions by 2040. The Transportation and Land Use chapter of the CAP contains 44 actions the city must advance to reduce greenhouse gas emissions from the transportation sector.

2023: To align with the city's CAP and urgently advance priority actions, the SFMTA releases the Climate Roadmap, which identifies the highest-priority actions it must initiate in the next 5-7 years to rapidly reduce emissions and generate important community benefits such as health, equity, accessibility, safety and many others. Implementing the actions identified here will be a step toward realizing the city's climate goals and the vision established by the CAP.



Executive Summary

In San Francisco, transportation is one of the largest contributors to climate change, which has brought severe weather events such as flooding and wildfires to residents' doorsteps. Climate change undermines public health and disproportionately impacts communities of color and people with disabilities. Transportation makes up nearly half of all greenhouse gas emissions in San Francisco, and reductions in greenhouse gases from transportation have not kept pace with reductions from other sectors or the city's goals. **Given recent data and trends, the city will be decades behind its goals unless it takes urgent action.**

The city's Climate Action Plan provides a framework to meet the city's goals of net-zero greenhouse gas emissions by 2040, 80% of trips on low-carbon modes by 2030 and 100% of registered light-duty vehicles to be electric by 2040. To align with that plan and urgently advance priority actions, the SFMTA releases the Climate Roadmap, which identifies the highest-priority actions it must initiate in the next five to seven years to rapidly reduce emissions and generate important community benefits such as health, equity, accessibility, safety and many others. Implementing the actions will be a step toward realizing the city's climate goals and the vision established by the Climate Action Plan and amplified in the SFMTA Strategic Plan. The strategies are:

1. **Build a fast and reliable transit system** that will be everyone's preferred way to get around.
2. **Create a complete and connected active transportation network** that shifts trips from automobiles to walking, biking and other active transportation modes.
3. **Expand programs to communities that shift trips to transit, walking and bicycling**.
4. **Manage parking resources more efficiently** over time to charge the right price for every space.
5. **Accelerate adoption of zero-emissions vehicles (ZEVs)** and other electric mobility options, where motor vehicle use is necessary.
6. **Conduct impactful community engagement** and implement community-based transportation plans to ensure climate actions are addressing residents' needs.

The Climate Roadmap can help to realize the city's 2040 net-zero goals by reducing annual greenhouse gas emissions from cars and trucks by approximately 77% from 1990 levels by 2040.

This can only happen if the SFMTA begins to implement the actions within the next five to seven years, the city implements the other transportation and land use strategies in the Climate Action Plan, and the state and federal governments meet their fuel efficiency targets. San Francisco can close the remaining gap through a transformative approach of bold policies and strategic investments that generate community benefits.

Based on the community outreach, technical analysis and evaluation of individual actions and packages of actions, we recommend in the near-term through 2030 that the SFMTA fund the Climate Roadmap actions in the upcoming SFMTA 5-year Capital Improvement Program (CIP) cycles, with focus on increasing the SFMTA's work in priority actions such as: (1) gradually charge the right price for every on-street parking space by 2030 and (2) install 5,000 publicly available EV charging stations on city property by 2030. When paired with other work at the SFMTA, both parking and electrification are cost-effective ways to accelerate the city's work in climate action while generating community benefits.

The cost of implementing all the actions of the Climate Roadmap over the next 27 years, through 2050, would be approximately $24.4 billion in capital costs (2022 dollars). This is far beyond the SFMTA's capital budget for existing climate actions, which is currently $2.2 billion over a 5-year period and will require additional funding from all levels of government. But the payoff will be a future San Francisco with clean air, safe streets, public health, economic vitality, transportation excellence and racial equity.

Implementing the Climate Roadmap sets the SFMTA on a path toward realizing climate and mobility goals while generating important community benefits.

Through six strategies and corresponding actions, the Climate Roadmap lays out a plan for reducing greenhouse gas emissions from the transportation sector, outlines the associated community benefits, presents findings and recommendations and describes funding needs and opportunities.

Now is the time to act. By investing in this Climate Roadmap, we can take the next big step toward a healthy and equitable city.

Introduction

Climate, public health and racial justice crises have compounded and impacted San Franciscans in rapidly evolving ways. Due in no small part to past decisions, these compounding crises have a profound effect on San Francisco, which, as a leader in climate action, has the responsibility to urgently address the three crises together.

Three Overlapping Crises

The primary way we travel in San Francisco has been directly damaging the Bay Area environment. Cars and trucks emit the largest share of San Francisco's greenhouse gas emissions, and our reliance on them is fueling the climate crisis and harming our health. The fact that so many of us choose to drive when we have other options available is a significant driver of the heat waves, drought, wildfires and air pollution Californians have become all too familiar with. These extreme climate events degrade public health and increase the incidence of illnesses such as asthma. Their impacts are felt most strongly in communities of color which, because of centuries of oppression and disinvestment toward American Indian, Black, Latinx and other communities of color, have worse air quality and fewer transportation options.

We have to find another way.

The kind of shift our city needs—to get most of our residents using low-carbon modes of transportation—is not going to be easy. San Francisco was designed around car travel, and in California, cars are ingrained in our culture. In some communities, having a car is seen as a rite of passage into adulthood. In others, cars are a way of expressing one's personal identity. In others, they're a means of cultural expression.

It's also the reality that not everyone in San Francisco has the means or ability to leave the use of personal vehicles entirely. Some people with disabilities, older adults and people who have more complex travel needs that involve transporting children and goods will still need to use cars, at least for some of their trips.

That is why it's going to be crucial that everyone who does have the option of shifting to low-carbon travel—by transit, walking and rolling—start making that shift now. San Francisco—and cities throughout California—plan to construct more housing to address our state's affordable housing crisis, and we need to make sure we don't get an onslaught of additional traffic along with it.

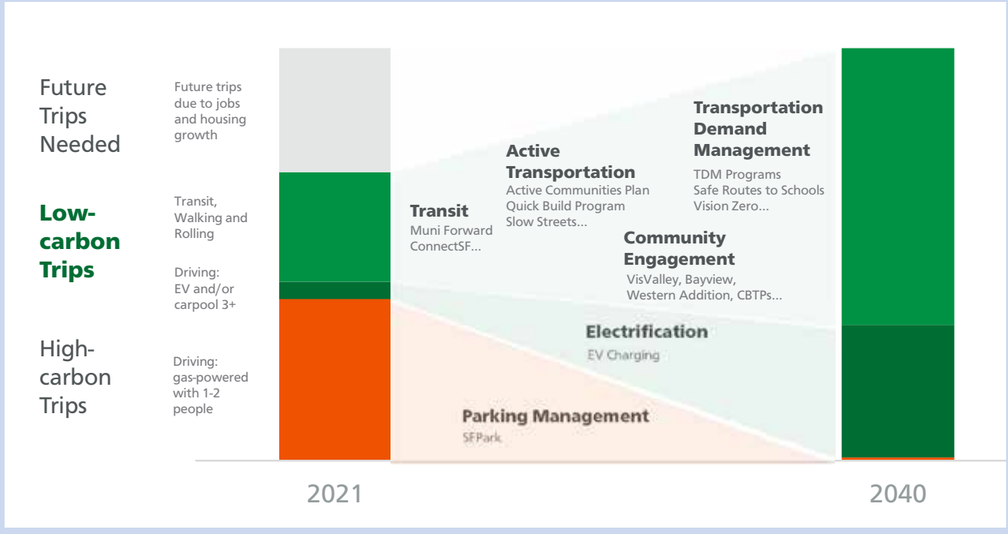
The Climate Roadmap describes the investments San Francisco needs to make in safe and reliable transit and active transportation to make that shift possible. It explains how we can lower barriers that prevent people from choosing low-carbon options, encourage ways to use them, and ask people who have other options but still use carbon-emitting vehicles to pay more fairly for their impact.

Making these changes will support families, small businesses and the vibrant community life that makes San Francisco an amazing place to be. They will enable us to take on not just the climate crisis but also the public health crisis that extreme weather events have compounded and the crisis of racism that has meant low-income communities of color bear the brunt of our climate emergency. This Climate Roadmap incorporates solutions to address all three of these crises in an integrated and comprehensive manner.

Making Low-carbon Travel the Preferred Option

Our current landscape has most trips by driving gas-powered vehicles with only one or two people. As we plan for growth and tackle the climate crisis, we need more people taking low-carbon modes, mostly by transit, walking and rolling but also by electric vehicles and vehicles with three or more people.

To get there, we need to invest more heavily in making low-carbon travel the preferred option.



Possible Scenario to get to Low-carbon Mode Share and Electrification Goals

Climate Goals

The SFMTA's vision is defined in its **Strategic Plan**: A city of diverse and vibrant neighborhoods seamlessly connected by safe, reliable and affordable transportation for all. This vision is intimately linked with the agency's climate and equity goals.

Racial equity is a core part of the SFMTA's vision. Racial equity is a set of social justice practices, rooted in a solid understanding and analysis of historical and present-day oppression, aiming toward a goal of equity for all. Specific to the transportation sector, racial justice demands that we recognize and reconcile injustices experienced by American Indian, Black, Latinx and other communities of color. We do this in part by centering race when we analyze the impacts of past policies and the potential impacts of future policies. Impacted communities must have the space and resources to envision and implement plans that actively work to address these issues.

"Climate change means a huge impact that is going to be given to my children. It will be a huge effect on the world, not just in the present time."

- Omari, Bayview

San Francisco's three primary transportation-related climate goals are defined in Chapter 9 of the Environment Code, which calls for:

1. **The city to reach net-zero emissions by 2040**. "Net-zero" is defined as a 90% reduction in greenhouse gases compared to 1990 levels. For transportation, the SFMTA seeks to achieve this goal by reducing greenhouse gasses from cars and trucks by 83% from 1990 levels. An 83% reduction from 1990 levels is approximately 1.8 million fewer metric tons of annual greenhouse gas emissions, measured in metric tons of carbon dioxide equivalent, or $mtCO_2e$, each year compared to 1990 levels, equivalent to the annual emissions of about 400,000 vehicles.
2. **Increase low-carbon trips to 80% of all trips to, from and within San Francisco by 2030**. Low-carbon trips are those taken by walking, biking, transit, electric vehicles and vehicles with three or more people.
3. **25% of all registered light-duty vehicles are electric by 2030, and 100% of all registered light-duty vehicles are electric by 2040**.

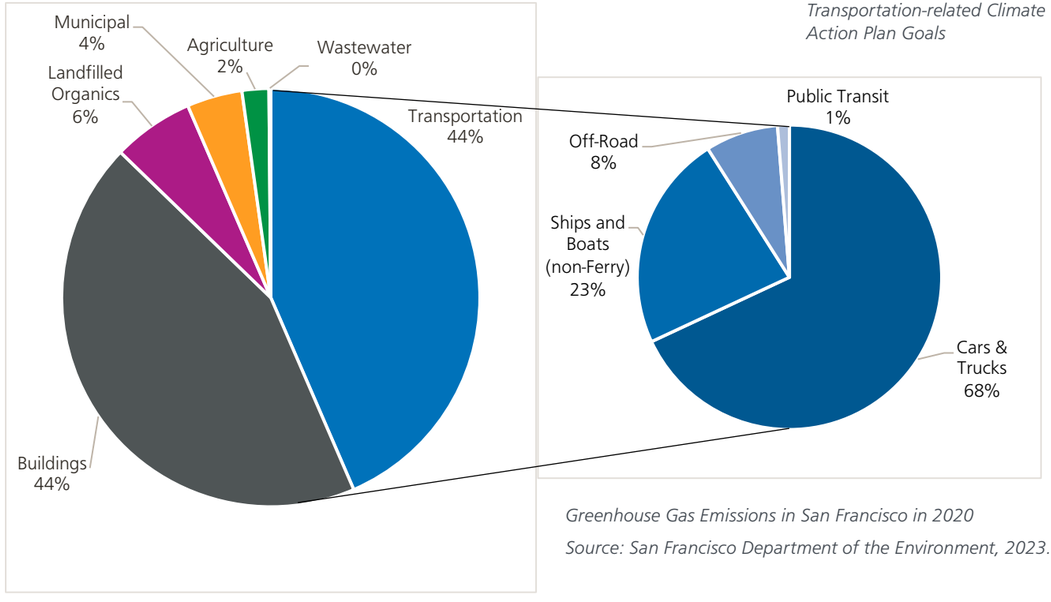
Transportation is extremely energy intensive, so it's no surprise that transportation is one of the largest contributors to greenhouse gas emissions in San Francisco at 44% the city's greenhouse gas emissions, of which over two-thirds are from cars and trucks.

83%
emissions reductions

80%
of trips on low-carbon modes

100%
light-duty electric vehicles

Transportation-related Climate Action Plan Goals



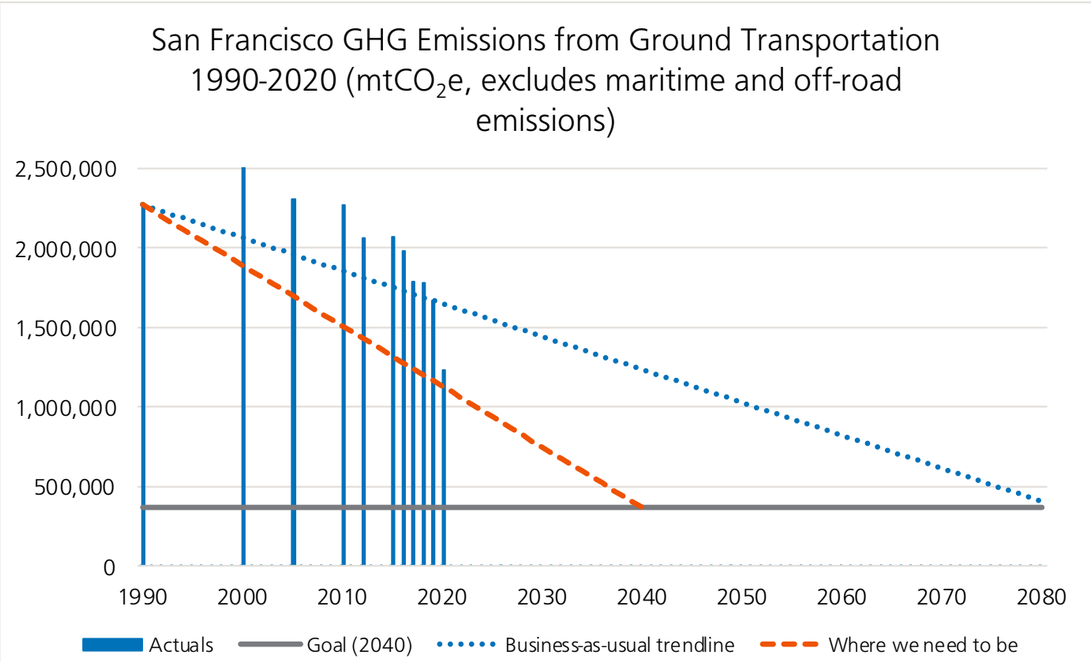
Greenhouse Gas Emissions in San Francisco in 2020

Source: San Francisco Department of the Environment, 2023.

Progress Toward our Goals

Goal 1: Net-Zero Greenhouse Gas Emissions by 2040

As of 2019, while San Francisco has reduced overall annual greenhouse gas emissions by 41% since 1990, it has only reduced annual greenhouse gas emissions from ground transportation (which includes cars, trucks and transit) by 26% since 1990, and reductions have slowed since 2017[1]. **Recent analysis indicates that if the trend in reductions from 1990-2019 were to continue, San Francisco wouldn't reach its greenhouse gas emissions reduction target from ground transportation until 2080, 40 years too late.**



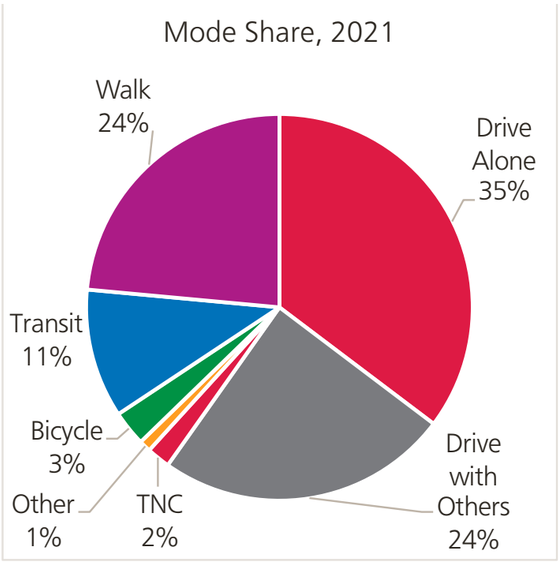
San Francisco Emissions from Cars, Trucks and Transit, 1990-2020 ($mtCO_2e$, excludes maritime and off-road emissions)

Source: San Francisco Department of the Environment, 2022.

[1]San Francisco Department of the Environment, 2022. Note: While the latest 2020 annual greenhouse gas emissions data from cars, trucks and transit is reflected above, 2020 was an anomaly. Recent evidence from a third-party source suggests that 2019, 2021 and 2022 travel patterns are more in line with the longer-term trends than 2020 travel patterns. Thus, since we do not have 2021 and 2022 data yet, we compared annual GHG emissions of 2019 rather than 2020.

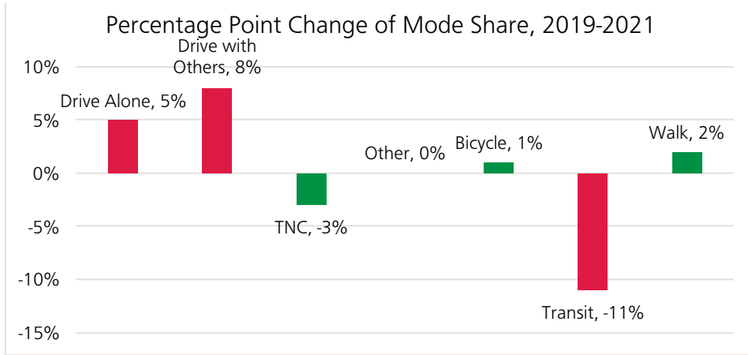
Goal 2: 80% of Trips on Low-Carbon Modes by 2030

In 2017, the city reached a mode share of 50% of trips made by transit, walking and bicycling. **However, the most recent data from 2021 indicates that the city is moving in the wrong direction, with more people driving alone and fewer people taking transit, partly due to the impacts of the COVID-19 pandemic.** From 2019 to 2021, the share of trips made by driving alone increased by 16% (from about 31% of all trips in 2019 to about 36% of all trips in 2021), and the share of trips made by transit dropped by 50% (from about 22% of all trips in 2019 to about 11% of all trips in 2021) all while total trips have remained relatively constant.



San Francisco Mode Share, 2021

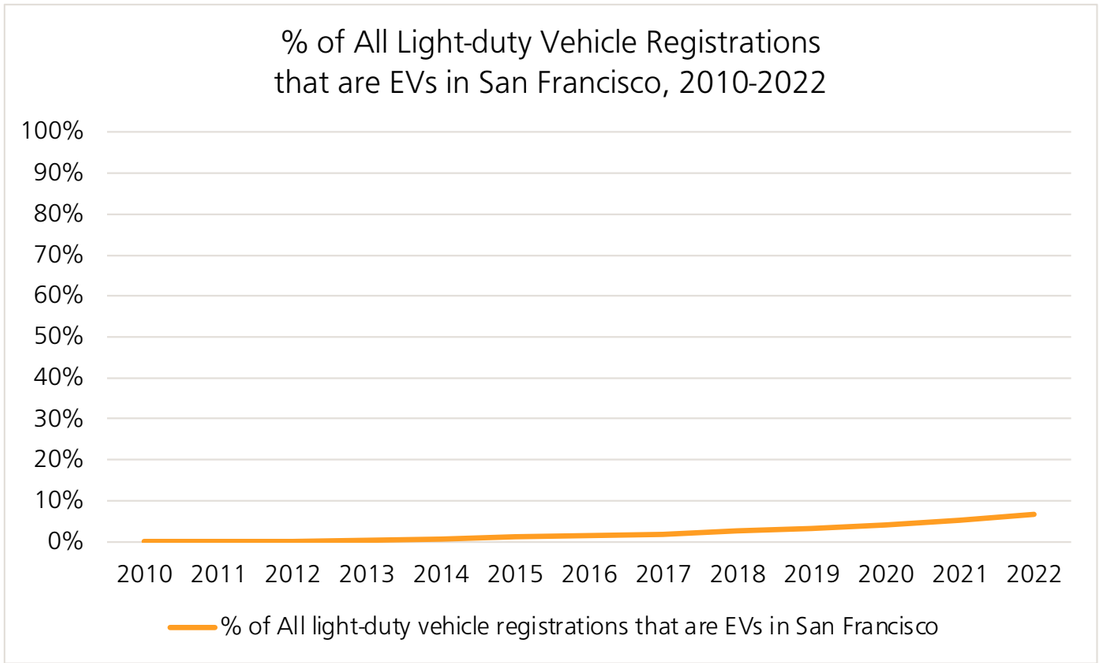
Source: SFMTA Travel Decision Survey 2021.



Percentage Point Change of Mode Share, 2019-2021

Goal 3: 100% of Light-Duty Vehicle Registrations are Electric Vehicles by 2040

Light-duty electric vehicle registrations are still low, but registrations are increasing. As of 2022, only 6.75% of all light-duty vehicles registered in the city were electric[1], but, in 2022, over 26% of new light-duty vehicles registered in the city were electric[2], getting us closer to our goal.



% of All Light-Duty Vehicle Registrations That Are EVs In San Francisco, 2010-2022. Updated in October 2023 with latest information.

Source: California Energy Commission (2023). Vehicle Population in California. Data last updated December 31, 2022.

[1]California Energy Commission (2023). Vehicle Population in California. Data last updated December 31, 2022. Retrieved in 2023 from https://www.energy.ca.gov/zevstats.

[2]California Energy Commission ZEV and Infrastructure Stats Dashboard (California ZEV sales shares accessed October 2023), https://www.energy.ca.gov/files/zev-and-infrastructure-stats-data?sort=desc&order=Name.

The SFMTA is a Climate Leader

The SFMTA has been taking decisive steps to reduce harmful pollution and emissions by using renewable energy to provide one of the cleanest public transit systems in the nation, expanding the protected bike network, making transit faster and more reliable through transit-only lanes and piloting parking reforms that reduce parking subsidies. These projects generate important community benefits such as improved air quality, safer conditions for the public and lay the foundation for a more equitable and affordable city. Since the city declared a climate emergency in 2019, the SFMTA has:

- Completed capital projects including the Central Subway, Van Ness Bus Rapid Transit, the Geary Rapid Project, phase one of the 16th Street Improvement Project, the first two sections of the L Taraval Improvement Project and 10 new or upgraded miles of transit-only lanes, resulting in large travel time and reliability improvements for riders.
- Expanded the city's bike network to 464 miles and implemented 43 miles of Slow Streets to create safe spaces for San Franciscans to travel and recreate without a car.
- Begun piloting zero emission battery-electric buses...and more!

The expansions and improvement of transportation options are imperative to addressing climate change because they allow people to get around without using carbon-intensive vehicles. But we must do more!

Community Benefits and Equity Practices

Community Benefits of Climate Action

It's not just about greenhouse gases. Though emissions reduction tends to be the primary focus of climate action, there are many other benefits of climate action that are equally important. The strategies and actions identified in this Climate Roadmap will improve **racial equity, air quality, safety, public health, economic vitality and travel experiences**. Indeed, generating these community benefits are motivating factors in their own right, and many align with city policies such as Transit-First and Vision Zero. Community benefits are most likely to be realized when actions are implemented together, alongside other important policies and programs, and at the appropriate scale.

Racial Equity
Targeted improvements to the overall transportation system have the potential to advance racial equity that repairs past harms rather than perpetuating them, especially when the community is part of the planning process.

Air Quality
Improvements in air quality will result from fewer vehicle miles traveled, especially those vehicles with internal combustion engines that emit tailpipe pollutants.

Safety
Less driving will also lead to fewer collisions, injuries and deaths on our streets. Feeling safer on foot, on bikes or rolling encourages more active means of getting around the city.

Public Health
Taking transit, walking and biking lead to better public health outcomes like reduced morbidity and mortality from improved air quality, increased physical activity and improved mental health. Public health improvements have a social as well as economic benefit, saving individuals and society millions of dollars.

Economic Vitality
Economic vitality will increase with fewer hours spent sitting in traffic, which can be expected with more trips – particularly commute trips – shifting to active transportation and public transit. Many climate actions can also result in direct personal savings from the ability to switch away from personal car ownership and can improve local commercial corridors.

Travel Experience
A more reliable and connected transit system is more enjoyable to ride, and alongside more walking and biking trips, moving from one part of San Francisco to another can simply become more efficient, safer, and more fun.

"I'm a nurse so we get patients that are asthmatic because of the pollution. I think they should make public transit like New York, where you can get anywhere with no issue."

- Maria, Daly City

Equity Practices

Any actions taken to reduce the climate crisis must advance racial and social equity, not undermine it. For each strategy, staff developed equity practices that should be integrated to reduce burdens and barriers and increase opportunities and benefits for American Indian, Black, Latinx, and other communities who have experienced oppression, including low-income communities and people with disabilities. The strategy-specific equity practices are partially listed with each strategy and in more detail in the appendix[1]. Additional details on equity practices will be developed in Phase 2 of the SFMTA Racial Equity Action Plan.

Strategies and Actions + **Equity Practices** = **More racially equitable outcomes and increased community benefits**

Equity Practices Lead to More Racially Equitable Outcomes and Increased Community Benefits

"Climate change is creating an ever-changing world that may not support us. I think it's being perpetuated by racist policymaking and divisions within cities because it's pretty evident in San Francisco where resources are lacking."

- Samantha (left), Lower Haight; Sunshine (right), Russian Hill, and Rudy (dog)

[1]See Appendix A: Racially Equitable Processes and Expanded List of Equity Practices for details.

The Moment for Action is Now!

The Climate Roadmap provides a framework for the SFMTA to implement priority actions found in the city's Climate Action Plan over the next five to seven years to reach the city's goals and to generate community benefits such as improved air quality, safety and public health. Through six strategies and corresponding actions, the Climate Roadmap lays out a plan for reducing gas emissions from the transportation sector, outlines the associated community benefits, presents findings and recommendations and describes funding gaps and opportunities.

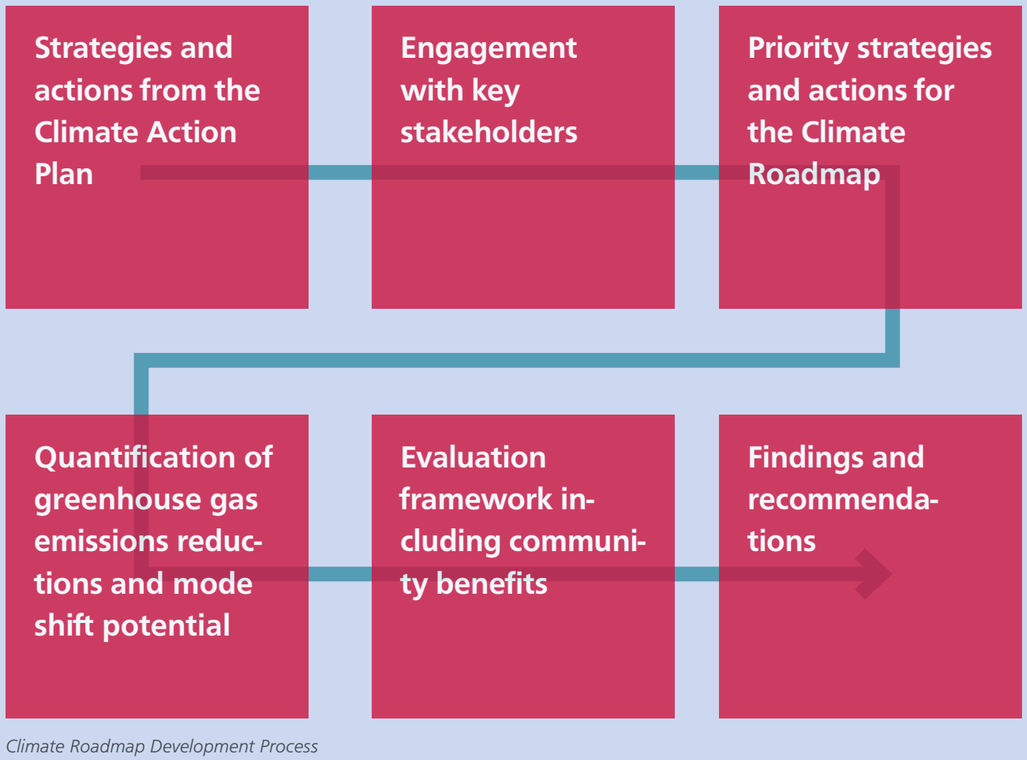
By implementing the Climate Roadmap, the city can also generate important community benefits such as improved air quality, safety, public health, economic vitality, travel experience and racial equity. Now is the time to act. By investing in this Climate Roadmap, we can take the next big step toward a healthy and equitable city.

Climate Roadmap Development Process

To develop the Climate Roadmap and its strategies and actions, staff identified priority strategies and actions from the Climate Action Plan 2021.

Staff shared the draft actions and strategies with community partners, technical experts and other stakeholders to gather feedback. A technical consultant evaluated the actions to quantify emissions reduction and mode shift potential through horizon year 2050 by using modeling and analytical tools such as San Francisco's SF-CHAMP travel demand model and assumptions from SFMTA and other city planning documents and the Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity prepared by the California Air Pollution Control Officers Association (CAPCOA). The technical consultant then mapped each action's potential annual and cumulative greenhouse gas emissions reduction relative to the 1990 baseline.

Staff assessed each action's relative cost-effectiveness based on planning-level cost estimates, relative impact of reducing greenhouse gas emissions and alignment with the SFMTA's values. Staff used this information to inform the findings and recommendations of the Climate Roadmap which were then shared with stakeholders and community partners before finalizing the report[1].



Climate Roadmap Development Process

[1]See Appendix B: Methodology Details for Quantifying and Packaging Greenhouse Gas Emissions Reductions and Mode Shift to Low-carbon Modes, Appendix C: Cost Estimates and Assumptions and Appendix D: Evaluation Framework and Matrices for details.

A Path Forward: Priority Strategies and Actions for the SFMTA

To put us on track to realizing these ambitious climate goals, the Climate Roadmap identifies **six key integrated strategies** that align with the city's Climate Action Plan which must be implemented in a coordinated and strategic manner. These six strategies are comprised of specific actions which must be implemented in the next five to seven years to achieve greenhouse gas emissions reductions, mode shift to low-carbon modes and generate community benefits. The six Climate Roadmap strategies are:

1. **Build a fast and reliable transit system** that will be everyone's preferred way to get around.
2. **Create a complete and connected active transportation network** that shifts trips from automobiles to walking, biking and other active transportation modes.
3. **Expand programs to communities that shift trips to transit, walking and bicycling**.
4. **Manage parking resources more efficiently** over time to charge the right price for every space.
5. **Accelerate adoption of zero-emissions vehicles (ZEVs)** and other electric mobility options, where motor vehicle use is necessary.
6. **Conduct impactful community engagement** and implement community-based transportation plans to ensure climate actions are addressing residents' needs.

The actions that make up the strategies are compiled into **three packages**, which we evaluated to inform our **findings and recommendations** focused on expanding our efforts to prioritize the most cost-effective actions at reducing greenhouse gas emissions while also planning for the long-term.

Below is a profile of the strategies, actions and equity practices for each of the strategies.

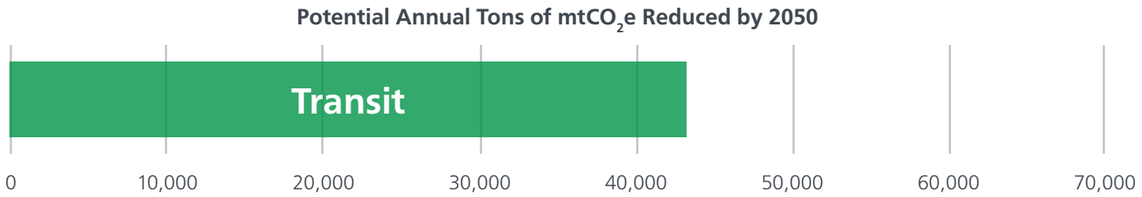
"The city should promote safer pedestrian crossings in order to create a safer environment for students to walk and promote electric vehicles so that society is less fossil fuel-dependent."

- Hiro, Lakeshore

Strategy 1: Build a fast and reliable transit system that will be everyone's preferred way to get around.

Transit improvements make transit more frequent, convenient and reliable and support economic vitality, environmental stewardship and equity.

GHG Reduction Potential of Strategy with Implementation by 2050: 42,960 Annual Tons of $mtCO_2e$ Reduced



Transit Annual GHG Reduction Potential of Strategy with Implementation by 2050

Equity Practices

The list below includes considerations that should be integrated into the engagement and implementation phase to advance racial equity when implementing Transit climate actions:

- Large transit projects may be seen as focused on people passing through the neighborhood, rather than people in the neighborhood. Investments should prioritize projects that improve transit reliability and access for SFMTA Equity Neighborhoods. To address those concerns, future investments should aim to tailor improvements to impacted communities and integrate the community into the planning process.
- New transit investments cost money to operate, but existing funding mechanisms do not fully cover the cost of operations. To address this, continue working with regional, state and federal policymakers to fund existing and future operations.

Community Benefits

Actions

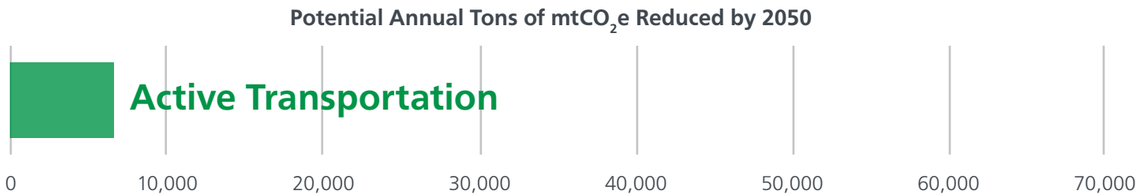
Climate Roadmap Action ID	Climate Roadmap Action Title	Climate Roadmap Action Description	Assumed Year that Action Starts Reducing Greenhouse Gas Emissions (For Modeling Purposes)	Approximate Full Build-out Capital Costs and Net Operating Costs through 2050 in Millions of 2022 Dollars
CR-1.1	Build the Five-minute Network	Fund and implement the Five-minute Network recommended by the ConnectSF Transit Strategy to expand access, increase capacity and create more reliable and frequent transit service.	2035	$9,020
CR-1.2	Modernize Muni Metro	Initiate major transit capital projects specified in the ConnectSF Transit Strategy, including Muni Metro Modernization.	2035	$700
CR-1.3	Initiate Geary Subway	Initiate major transit capital projects specified in the ConnectSF Transit Strategy, including a new Westside Subway along 19th Avenue and Geary.	2050	$20,000
CR-1.4	Initiate Central Subway Extension	Initiate major transit capital projects specified in the ConnectSF Transit Strategy, including Central Subway extension.	2040	$1,680
CR-1.5	Implement Muni Forward Improvements	Implement Muni Forward transit priority improvements, including new transit-only lanes, signal priority and stop improvements to increase capacity, reliability, frequency and safety for riders.	2026	$2,960
CR-1.6	Improve Transfers	Remove physical, logistical, and cost barriers to transferring between different transit lines and operators in the city.	2030	$45

Transit Actions

Strategy 2: Create a complete and connected active transportation network that shifts trips from automobiles to walking, biking and other active transportation modes.

A complete network of corridors that are attractive to all demographics for walking, biking and using scooters, wheelchairs and other small mobility devices connects neighborhoods and helps people take more zero-carbon trips better for the community and the environment.

GHG Reduction Potential of Strategy with Implementation by 2050: 5,816 Annual Tons of $mtCO_2e$ Reduced



Active Transportation Annual GHG Reduction Potential of Strategy with Implementation by 2050

Equity Practices

The list below includes considerations that should be integrated into the engagement and implementation phase to advance racial equity when implementing Active Transportation climate actions:

- Active transportation fulfills the needs of many, but not all, trips. To ensure transportation caters to everyone, listen and create other alternatives to driving for people of color, people with disabilities, older people, people who are low-income and for trips that biking might not be feasible. Ensure active transportation is only one out of many non-automobile options.
- Bicycle infrastructure is often seen as an indicator of gentrification in communities of color. To address that, develop and deploy strategies to preserve existing affordable housing and stabilize communities while also investing in transit, active transportation and other forms of non-automobile transportation. Develop processes that listen and are responsive to unique histories.
- Roads are not always designed to accommodate bicyclists of all ages, risk comfort and abilities, and people with disabilities have the most barriers to getting around by foot or bicycle. To address this, design the bike network to be safe for people of all ages and abilities who use it for both transportation and recreation.

Community Benefits

Actions

Climate Roadmap Action ID	Climate Roadmap Action Title	Climate Roadmap Action Description	Assumed Year that Action Starts Reducing Greenhouse Gas Emissions (For Modeling Purposes)	Approximate Full Build-out Capital Costs and Net Operating Costs through 2050 in Millions of 2022 Dollars
CR-2.1	Expand Bicycle Parking	Establish and fund a program that expands access to bicycling via more bike parking options (especially for people living in multifamily housing).	2026	$9
CR-2.2	Subsidize E-bikes	Establish and fund a program that expands access to bicycling via subsidies for electric bikes for low-income residents and engagement with communities to understand their active transportation needs and deliver projects that suit them.	2026	$6
CR-2.3	Pilot Mobility Hubs	Establish a mobility hubs pilot in five locations and create a citywide network of mobility hubs where people can access active transportation options at major transit stops and destinations.	2030	$6
CR-2.4	Expand the Bicycle Network	Expand the bicycle network by: a. Developing San Francisco's Active Communities Plan to improve and expand the active transportation network, policy and programming recommendations and personal mobility device guidelines with robust community input. b. Expanding and connecting the Slow Streets network to provide corridors that are attractive to all users for walking, biking, and using scooters, wheelchairs and other small mobility devices. c. Expanding and connecting the protected bikeway network to provide safe and continuous travel for people on bicycles and other small mobility devices.	2026	$898

Active Transportation Actions

Strategy 3: Expand programs to communities that shift trips to transit, walking and bicycling.

Transportation Demand Management can help to readjust the way people think about their mobility options, reducing congestion and improving transit reliability.

GHG Reduction Potential of Strategy with Implementation by 2050: 5,400 Annual Tons of $mtCO_2e$ Reduced

Transportation Demand Management Annual GHG Reduction Potential of Strategy with Implementation by 2050

Community Benefits

- Air Quality
- Public Health
- Safety
- Travel Experience

Actions

Climate Roadmap Action ID	Climate Roadmap Action Title	Climate Roadmap Action Description	Assumed Year that Action Starts Reducing Greenhouse Gas Emissions (For Modeling Purposes)	Approximate Full Build-out Capital Costs and Net Operating Costs through 2050 in Millions of 2022 Dollars
CR-3.1	Increase Engagement in Commute Benefits Ordinance Programs	Expand employer incentives to further reduce auto commutes through increasing engagement in commuter programs.	2026	$4
CR-3.2	Increase Share of Employers Offering Commute Subsidies	Expand employer incentives to further reduce auto commutes through increasing the share of employers offering subsidies to 50%.	2030	$3

Transportation Demand Management Actions

Equity Practices

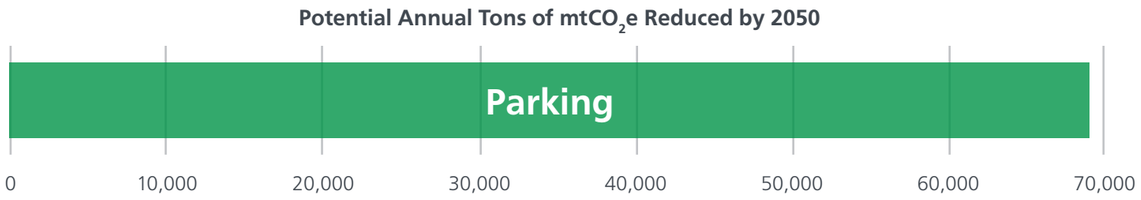
The list below includes considerations that should be integrated into the engagement and implementation phase to advance racial equity when implementing Transportation Demand Management climate actions:

- Employer incentive programs often prioritize office workers who commute downtown and not other workers. To address that, make sure the program considers all existing mobility options and ensures equitable access to all workers, including small businesses, contract workers, interns and service workers, including workers where transportation is essential to their work, not just office workers.
- Commutes are a large portion, but only a part, of all trips. When expanding transit and pricing parking, consider expanding discounts and exemptions to marginalized groups that may not have alternatives to the private automobile.

Strategy 4: Manage parking resources more efficiently with long-term goal of charging the right price for every space.

Parking reform enables drivers to find a parking spot near their destination, encourages people to take transit, walk or bike by reflecting driving's true cost, increases funding for transit operations and supports people with fewer public options.

GHG Reduction Potential of Strategy with Implementation by 2050: 69,002 Annual Tons of $mtCO_2e$ Reduced



Parking Annual GHG Reduction Potential of Strategy with Implementation by 2050

Equity Practices

The list below includes considerations that should be integrated into the engagement and implementation phase to advance racial equity when implementing Parking climate actions:

- Parking enforcement can have negative impacts upon marginalized groups. To address that, ensure parking enforcement activity does not disproportionately affect communities of color.
- Pricing parking may have disproportionate impacts upon people who cannot afford to pay for parking or lack robust alternative transportation options. To both manage parking more efficiently and incorporate racial equity-driven decision-making tools, improve communication around the extensive discount and waiver programs available for people with low-incomes and experiencing homelessness, consider reduced parking fees based on income, use increased fares to improve service and make the application process for discounts as easy as possible so it is not a barrier to access.
- Pricing should help increase access to non-automobile modes, not decrease access overall. As the city reforms its parking policies and practices, ensure non-automobile modes are available and reliable.

Community Benefits

Air Quality | Public Health | Safety | Economic Vitality | Travel Experience

Actions

Climate Roadmap Action ID	Climate Roadmap Action Title	Climate Roadmap Action Description	Assumed Year that Action Starts Reducing Greenhouse Gas Emissions (For Modeling Purposes)	Approximate Full Build-out Capital Costs and Net Operating Costs through 2050 in Millions of 2022 Dollars
CR-4.1	Expand Paid Parking on Sundays and Evenings	Expand paid hourly parking to Sundays and evenings to better manage parking and fund transit.	2026	($222)
CR-4.2/4.3	Gradually Charge the Right Price for Every On-street Space	Charge the right price for every on-street space by gradually converting all on-street parking spaces to paid through expanding the Residential Parking Permit program area and converting those areas to paid parking for visitors.	2026	($980) - ($8,750)
CR-4.4/4.5	Increase Residential Parking Permit Fees	Increase Residential Parking Permit fees to better manage parking and fund transit.	2026	($25) - ($80)

Parking Actions

Why Manage Parking Resources More Efficiently?

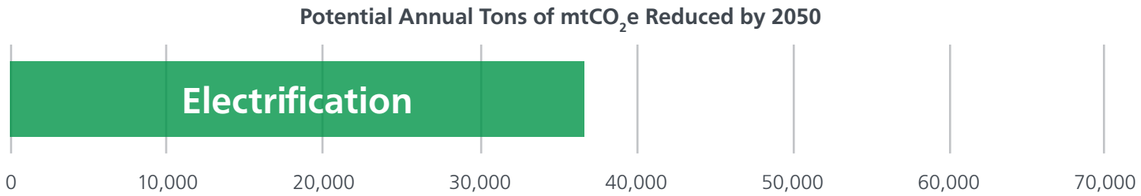
The vast majority of San Francisco's street and curb space is used for parking private cars, increasingly at odds with its need for public transportation. The City spends millions of dollars owning, maintaining and managing this space. Everywhere we provide "free" parking, we subsidize it and spend resources that could otherwise improve our transit system and make our streets safer. And this is just one of the costs of "free" parking, the city must also manage increased pollution and greenhouse gas emissions, reduced access for people and more traffic on our streets. Given the current fiscal crisis, a moment that jeopardizes our ability to run and maintain our critical transportation system, and our Climate Action, Transit First and Vision Zero goals, we cannot afford to subsidize driving and parking private cars. By employing our uniquely progressive Charter that dictates that parking revenues be used to fund the transit system, we can shift both our financial and climate futures.

We need to manage our parking differently and reduce or eliminate parking subsidies. We need to encourage those with the most means and ability to shift to transit, walking and rolling while reserving our resources to support more equitable infrastructure. Our resources must prioritize people who have been historically underserved and those with disabilities that may not have safe and convenient options walking and rolling and have no reasonable choice but to drive. In tandem with other strategies in the Climate Roadmap, parking reform helps us accomplish that—and it is one of the most cost-effective ways to transform our system so that it aligns with climate, mobility and health goals.

Strategy 5: Accelerate adoption of zero-emissions vehicles (ZEVs) and other electric mobility options, where motor vehicle use is necessary.

As we simultaneously work to electrify our transit system, we also work to electrify trips that require vehicles. Electrification of vehicle trips helps to directly reduce GHG emissions from San Francisco's largest single source of them: cars and trucks. More electric vehicle charging options make the transition more attractive to people and organizations.

GHG Reduction Potential of Strategy with Implementation by 2050: 37,200 Annual Tons of $mtCO_2e$ Reduced



Electrification Annual GHG Reduction Potential of Strategy with Implementation by 2050

Community Benefits

Air Quality | Public Health | Economic Vitality

Actions

Climate Roadmap Action ID	Climate Roadmap Action Title	Climate Roadmap Action Description	Assumed Year that Action Starts Reducing Greenhouse Gas Emissions (For Modeling Purposes)	Approximate Full Build-out Capital Costs and Net Operating Costs through 2050 in Millions of 2022 Dollars
CR-5.1	Expand EV Charging Stations	Expand charging stations to at least 10% of spaces in municipally owned parking lots, including three "fast-charging hubs" and explore curbside EV charging through a feasibility study.	2026	$161

Electrification Actions

What About Electrifying Our Buses?

The SFMTA has operated a network of zero-emission vehicles for nearly a century, consistently and proactively pursuing and implementing the latest in green transportation technologies. Transit is the climate "solution" and not a source of harmful emissions. In May 2018, the SFMTA announced its commitment to expanding its battery-electric bus fleet, starting with piloting battery-electric buses and investing in new technologies to modernize existing fleet and facilities. This pilot will help the SFMTA to be in compliance with state targets and goals.

Battery-electric buses are part of the solution. But while public transit accounts for more than a tenth of all trips since the pandemic, it accounts for only a fraction of a percent of all greenhouse gas emissions from transportation. Meanwhile, cars and trucks make up over two-thirds of all greenhouse gas emissions from transportation, and reductions in greenhouse gas emissions from cars and trucks have not kept pace with other sectors or our goals. That's why we focused this Climate Roadmap on rapidly expanding electrification of private vehicles through increased charging options.

Equity Practices

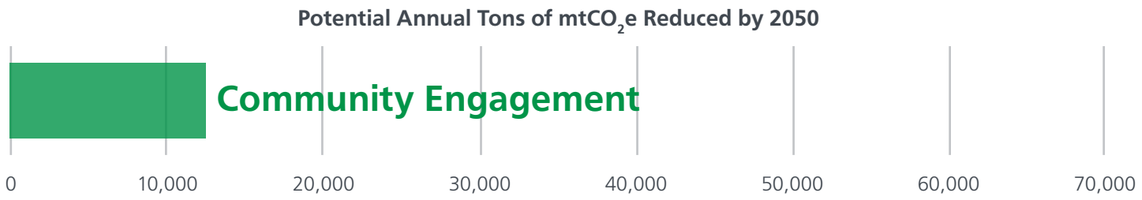
The list below includes considerations that should be integrated into the engagement and implementation phase to advance racial equity when implementing Electrification climate actions:

- Electric vehicle charging stations are often reserved for electric vehicles. To address the potential loss of parking, make sure those who do not have an electric vehicle have transportation options and are engaged throughout the planning process.
- Who benefits and who is burdened by new electric vehicle infrastructure highly depends on the location of charging infrastructure. Be considerate of community benefits and burdens when siting and expanding infrastructure.

Strategy 6: Conduct impactful community engagement and implement community-based transportation plans to ensure climate actions are addressing residents' needs.

Meaningfully engaging with communities helps the city understand and provide for their needs, and providing meaningful engagement makes sure people are aware of their mobility options, both critical to addressing our climate emergency.

GHG Reduction Potential of Strategy with Implementation by 2050: 12,800 Annual Tons of $mtCO_2e$ Reduced



Community Engagement Annual GHG Reduction Potential of Strategy with Implementation by 2050

Community Benefits

Racial Equity | Air Quality | Public Health | Safety | Economic Vitality | Travel Experience

Actions

Climate Roadmap Action ID	Climate Roadmap Action Title	Climate Roadmap Action Description	Assumed Year that Action Starts Reducing Greenhouse Gas Emissions (For Modeling Purposes)	Approximate Full Build-out Capital Costs and Net Operating Costs through 2050 in Millions of 2022 Dollars
CR-6.1	Develop and Implement Community Transportation Plans	Integrate climate action and health into the SFMTA's community engagement to understand needs, barriers and opportunities to taking low-carbon trips; develop community-based transportation plans to specific communities that have experienced the most harm; and launch a public awareness campaign, including messaging tailored to communities, with the goal of educating residents about the health, economic and environmental benefits of transit, active transportation and electric vehicles.	2026	$41

Community Engagement Planning Actions

Equity Practices

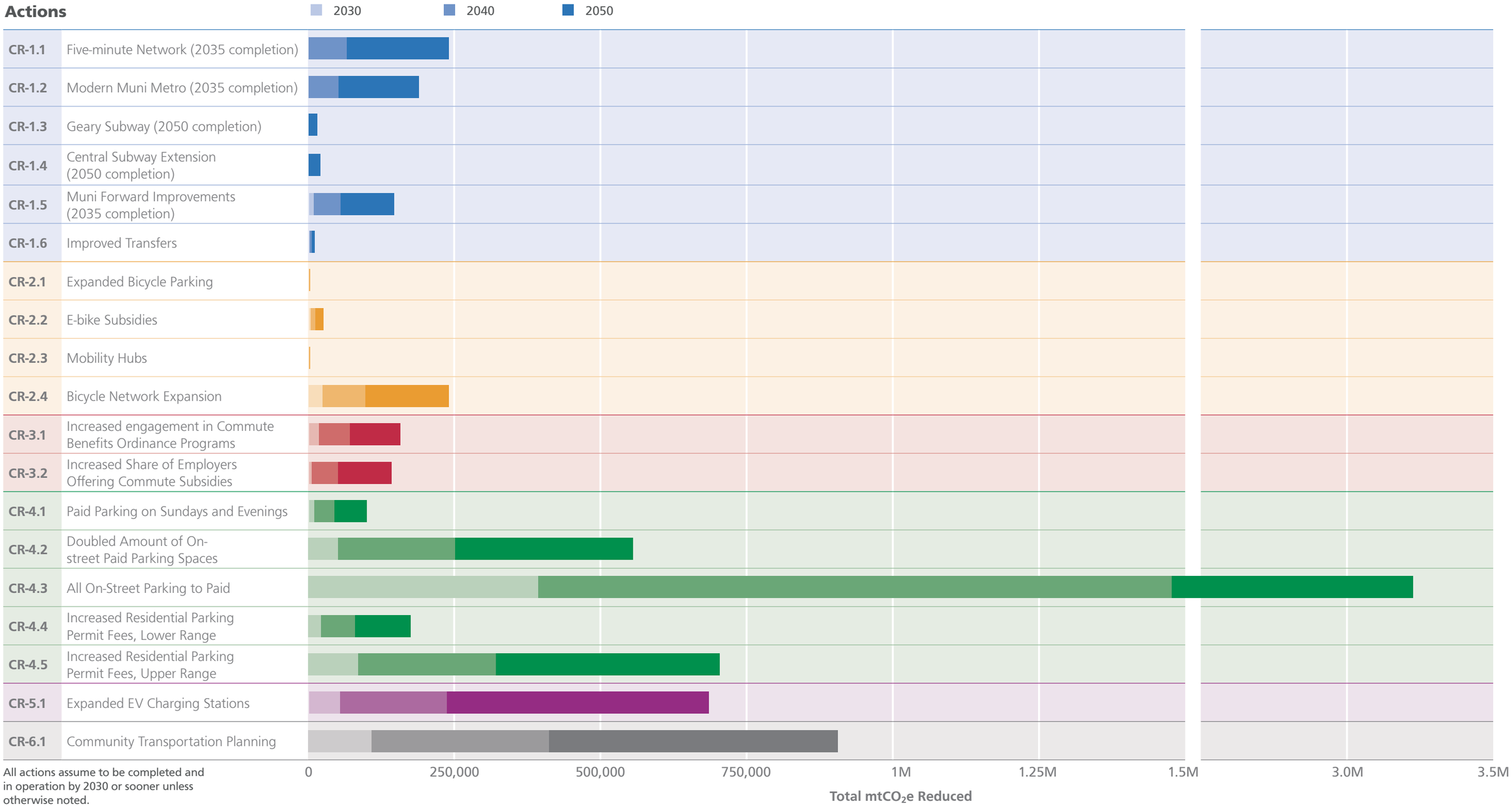
The list below includes considerations that should be integrated into the engagement and implementation phase to advance racial equity when implementing Community Engagement climate actions:

- Continue using the SFMTA Public Outreach and Engagement Team Strategy, the agency's initiative for meaningful public outreach and engagement.
- Train and build capacity through SFMTA Community Connections, a new program which will be a regular series of meetings led by the department's Racial Equity and Belonging team and open to the public where community leaders working toward social justice can give direction to projects and programs.

Evaluation and Key Findings

The following sections showcase how we evaluated the different Climate Roadmap actions, both individually and in packages, and describe the findings[1].

Total $mtCO_2e$ Reduced Through 2050



All actions assume to be completed and in operation by 2030 or sooner unless otherwise noted.

[1]See Appendix B: Methodology Details for Quantifying and Packaging Greenhouse Gas Emissions Reductions and Mode Shift to Low-carbon Modes, Appendix C: Cost Estimates and Assumptions, and Appendix D: Evaluation Framework and Matrix for details on the methodology, cost estimates, assumptions and the full evaluation framework matrix.

Actions Evaluation

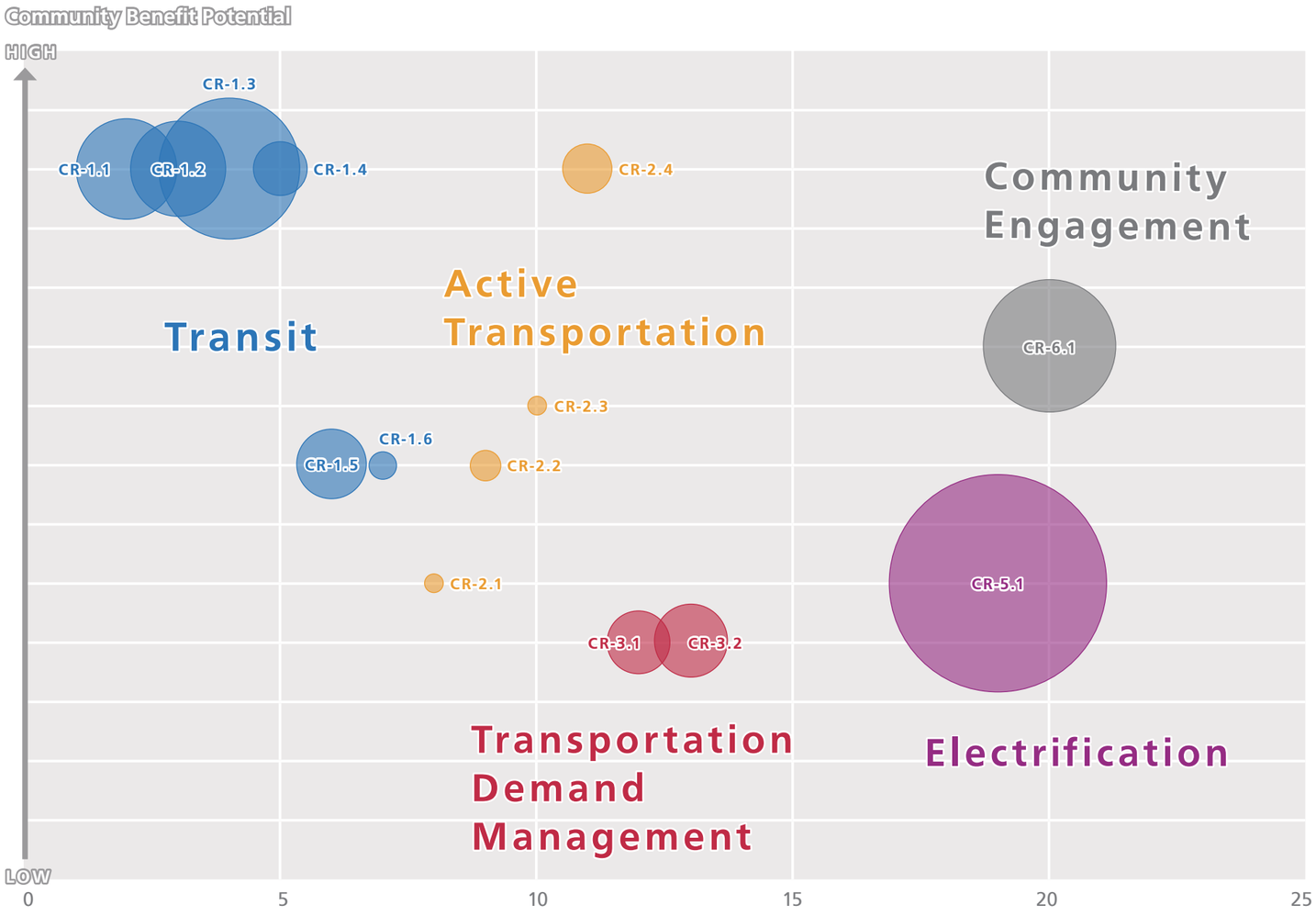
Each of the six strategies contains at least one action which was evaluated both quantitatively and qualitatively. The figures below illustrate the total greenhouse gas emissions reduction potential of each of the actions through 2050 and the annual $mtCO_2e$ reduced by community benefits tier and cost-effectiveness/revenue potential.

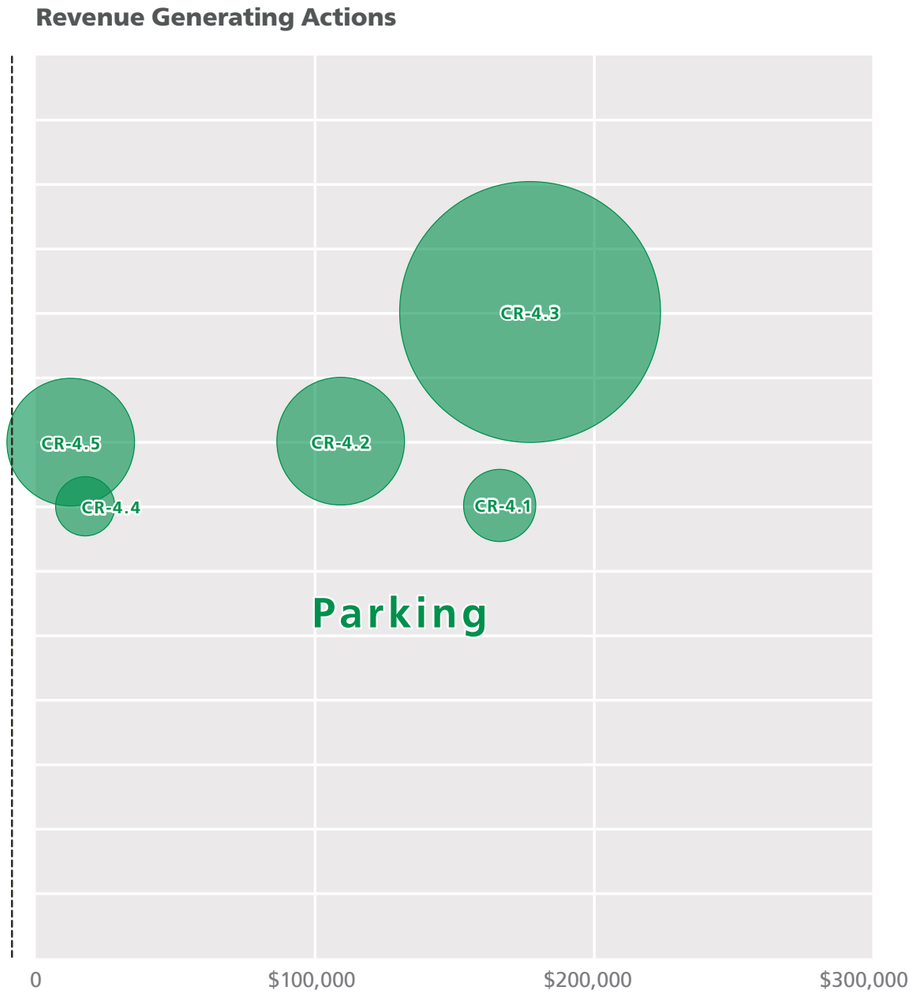
In addition to measuring annual greenhouse gas emissions reduced relative to 1990 baseline, we measured total greenhouse gas emissions through horizon year 2050 to better understand the compounding effects of taking climate action now as opposed to later.

Total Carbon Reduced Across All Actions Through 2050

Annual mtCO$_2$e Reduced by Community Benefits Tier and Cost-Effectiveness/Revenue Potential

We also wanted to compare the actions based on our three key metrics: (1) each action's total greenhouse gas emissions reduction potential through horizon year 2050 (represented by the size of the bubble), (2) each action's cost-effectiveness at reducing greenhouse gas emissions (represented by their relative position on the x-axis), and (3) their level of community benefits (represented by their relative position on the y-axis). Our findings show the different trade-offs–for example, the electrification action is more cost-effective at reducing greenhouse gas emissions than transit actions but generates fewer community benefits.



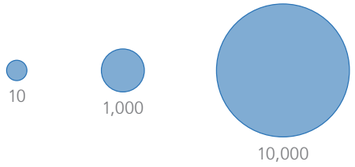


CR-1.1	Five-minute Network
CR-1.2	Modern Muni Metro
CR-1.3	Geary Subway
CR-1.4	Central Subway Extension
CR-1.5	Muni Forward Improvements
CR-1.6	Improved Transfers

CR-2.1	Expanded Bicycle Parking
CR-2.2	E-bike Subsidies
CR-2.3	Mobility Hubs
CR-2.4	Bicycle Network Expansion
CR-3.1	Increased engagement in Commute Benefits Ordinance Programs
CR-3.2	Increased Share of Employers Offering Commute Subsidies

CR-4.1	Paid Parking on Sundays and Evenings
CR-4.2	Doubled Amount of On-street Parking Spaces
CR-4.3	All On-street Parking to Paid
CR-4.4	Increased RPP Fees, Lower Range
CR-4.5	Increased RPP Fees, Upper Range
CR-5.1	Expanded EV Charging Stations
CR-6.1	Community Transportation Planning

Annual mtCO$_2$e Reduced by 2050



Annual mtCO$_2$e Reduced by Community Benefits Tier and Cost-Effectiveness/Revenue Potential

Lastly, we compared cost-effectiveness at reducing greenhouse gas emissions by comparing the approximate cumulative capital and net operating costs of all the actions through 2050 with the approximate cumulative greenhouse gas emissions reductions through 2050.

- **Tier 1: Very High** (Net revenue generating between $209M and $5,000M in revenue for every cumulative $mtCO_2e$ reduced through 2050)
- **Tier 2: High** (Less than $500M for every cumulative $mtCO_2e$ reduced through 2050)
- **Tier 3: Medium** (Between $4,500M and $40,000M for every cumulative $mtCO_2e$ reduced through 2050)
- **Tier 4: Lowest** (Between $70,000M and $1,000,000M for every cumulative $mtCO_2e$ reduced through 2050)

Cost-Effectiveness at Reducing Greenhouse Gas Emissions Tier by Action

Cost-Effectiveness Tier	Climate Roadmap ID	Climate Roadmap Action
Tier 1: Very High	CR-4.2/4.3	Gradually Charge the Right Price for Every On-street Space
	CR-4.1	Expand Paid Parking on Sundays and Evenings
	CR-4.4/4.5	Increase Residential Parking Permit Fees
Tier 2: High	CR-3.2	Increase Share of Employers Offering Commute Subsidies
	CR-3.1	Increase Engagement in Commute Benefits Ordinance Programs
	CR-6.1	Develop and Implement Community Transportation Plans
	CR-5.1	Expand EV Charging Stations
	CR-2.2	Subsidize E-bikes
Tier 3: Medium	CR-2.1	Expand Bicycle Parking
	CR-1.2	Modernize Muni Metro
	CR-2.4	Expand the Bicycle Network
	CR-1.6	Improve Transfers
	CR-1.5	Implement Muni Forward Improvements
	CR-2.3	Pilot Mobility Hubs
	CR-1.1	Build the Five-minute Network
Tier 4: Lowest	CR-1.4	Initiate Central Subway Extension
	CR-1.3	Initiate Geary Subway

Cost-Effectiveness at Reducing Greenhouse Gas Emissions Tier by Action

Findings from Actions Evaluation

1. Cumulative $mtCO_2e$ Reduced through 2050 Findings
   a. Actions that can be done on a shorter timeframe have compounding effects of taking climate action and are critical to realizing our goals sooner, including cost-effective actions in Parking, Electrification, Transit, Community Engagement, and Active Transportation.
   b. Parking actions and Transit actions result in the largest reduction of greenhouse gas emissions on an annual basis by 2050.
2. Community Benefits and Cost-Effectiveness Findings
   a. Actions that can be done at relatively low cost with higher greenhouse gas emissions reduction potential have the highest cost-effectiveness, including all the Parking actions, while actions that must be done at higher costs on a longer timeframe (and thus lower cumulative greenhouse gas emissions reduction potential), have the lowest cost-effectiveness, including some of the capital-intensive Transit actions.
   b. The Electrification action also produces significant annual reductions, though the analysis does not account for the lifecycle emissions associated with electric vehicles.
   c. When viewed over the decades, Parking actions produce the greatest total emissions reductions, both because of their annual emissions reduction potential and because they can be deployed much sooner than capital-intensive projects. Parking actions are also unique in that they generate enough revenue to more than account for their capital plus operating costs.
   d. The Community Engagement strategy produces the second most emissions reduction per dollars spent on an annual basis because they include relatively lower costs on a shorter timeframe.
   e. The Transit actions and the Active Transportation action to expand the bicycle network have the greatest impact on community benefits, even though they have medium and low cost-effectiveness.
   f. Commuter-oriented actions within the Transportation Demand Management strategy, meanwhile, yield relatively low community benefits and lower emissions reductions relative to other strategies but have high cost-effectiveness.

Climate Roadmap Packages

Investing in all the Climate Roadmap strategies and actions is crucial to reaching the city's goals, but we know decision makers often must make hard trade-offs in the near-term. To illustrate those trade-offs, we analyzed the Climate Roadmap in three distinct packages that help us understand the impact of investing in different types of actions across various timeframes:

Package A: **Capital Intensive**

- This package focuses on capital intensive infrastructure, particularly transit, active transportation and electric vehicle infrastructure.

Package B: **Program Intensive**

- This package focuses more on policies and programs including providing subsidies for e-bikes, increasing commuter benefit programs, and reducing parking subsidies.

Package C: **Do Everything**

- This package combines Packages A and B, investing in both infrastructure and programs, plus increases the scale of parking reforms.

Packages Overview

Below is an overview of which package(s) each action fits under.

CR Code	Climate Roadmap Action Title	Assumed Year that Action Starts Reducing Greenhouse Gas Emissions (For Modeling Purposes)	Approximate Full Build-out Capital Costs and Net Operating Costs through 2050 in Millions of 2022 Dollars	Package A: Capital-intensive	Package B: Program-intensive	Package C: Do Everything
CR-1.1	Five-minute Network	2035	$9,020	X		X
CR-1.2	Modern Muni Metro	2035	$700	X		X
CR-1.3	Geary Subway	2050	$20,000	X		X
CR-1.4	Central Subway Extension	2040	$1,680	X		X
CR-1.5	Muni Forward Improvements	2026	$2,960	X		X
CR-1.6	Improved Transfers	2030	$45	X		X
CR-2.1	Expanded Bicycle Parking	2026	$9	X		X
CR-2.2	E-bike Subsidies	2026	$6		X	X
CR-2.3	Mobility Hubs	2030	$6	X		X
CR-2.4	Bicycle Network Expansion	2026	$898	X		X
CR-3.1	Increase Engagement in Commute Benefits Ordinance Programs	2026	$4		X	X
CR-3.2	Increase Share of Employers Offering Commute Subsidies	2030	$3		X	X
CR-4.1	Paid Parking on Sundays and Evenings	2026	($222)		X	X
CR-4.2	Gradually Charge the Right Price for Every On-street Space, Lower Range (Note: mutually exclusive to 4.3 for modeling purposes)	2026	($980)	X	X	
CR-4.3	Gradually Charge the Right Price for Every On-street Space, Upper Range (Note: mutually exclusive to 4.2 for modeling purposes)	2026	($8,750)			X
CR-4.4	Increase Residential Parking Permit fees, Lower Range (Note: mutually exclusive to 4.5 for modeling purposes)	2026	($25)		X	
CR-4.5	Increase Residential Parking Permit fees, Upper Range (Note: mutually exclusive to 4.4 for modeling purposes)	2026	($80)			X
CR-5.1	Expand EV charging stations	2026	$161	X		X
CR-6.1	Community Transportation Planning	2026	$41		X	X
Approximate Full Build-out Capital Costs and Net Operating Costs through 2050 in Millions of 2022 Dollars			Cumulative Annual	$34,499 m $1,278 m	$(1,173 m) $(43 m)	$26,481 m $981 m

Packages Evaluation

We compared packages using quantitative and qualitative data. The figure below shows how the three packages reduced greenhouse gas emissions, shifted mode share and impacted each of the six community benefits being tracked, while accounting for the costs of each.

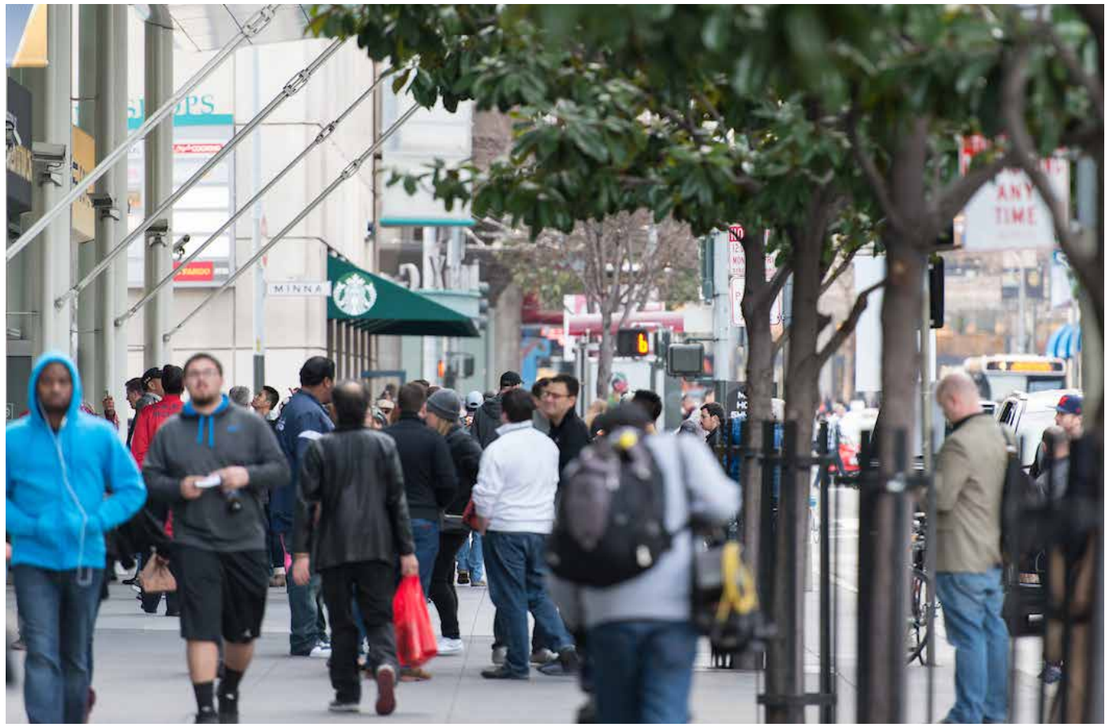
Analyzing the three separate packages allowed us to draw conclusions about actions that are capital-heavy versus those that are more programmatic, as well as how they work in tandem.

	PACKAGE A: CAPITAL	PACKAGE B: PROGRAMS	PACKAGE C: DO EVERYTHING
	Includes all the "capital-intensive actions (including all transit, all active transportation, and some parking actions) if we were to fully implement them by 2050	Includes all program-intensive actions (including all TDM, most parking actions, and all community programs actions) if we were to fully implement them by 2050	Includes both capital and program-intensive actions from both Packages A and B, plus more intense parking reform
Cumulative capital and operating cost (in millions) for full build-out by 2050	**$34,500** MILLION	**+$1,200** MILLION (REVENUE GENERATING)	**$26,500** MILLION
Cumulative greenhouse gas emissions reduction potential at full build-out by 2050 compared to business-as-usual (cumulative metric tons of CO_2)	**1,640,000** METRIC TONS	**1,200,000** METRIC TONS	**4,160,000** METRIC TONS
Dollars per metric ton of cumulative greenhouse gas emissions reduction potential at full build-out by 2050	**$21,000** PER METRIC TON	**+$1,000** PER METRIC TON (REVENUE GENERATING)	**$6,000** PER METRIC TON
Annual GHG emissions reductions from Climate Roadmap compared to baseline by 2040 (annual metric tons of CO_2)	**89,000** METRIC TONS	**50,000** METRIC TONS	**190,000** METRIC TONS
Annual GHG emissions reductions compared to 1990 baseline by 2040 (annual metric tons of CO_2), including all background reductions and non-SFMTA actions	**1,542,000** METRIC TONS	**1,527,000** METRIC TONS	**1,597,000** METRIC TONS
Low Carbon Mode Share	60% (2030) → 84% (2040)	62% (2030) → 83% (2040)	65% (2030) → 86% (2040)
Air Quality			
Public Health			
Safety			
Economic Vitality			
Travel Experience			
Racial Equity			

Package Evaluation Framework

Findings from Packages Evaluation

1. The "Programs" Package (B) has the lowest costs due to low capital investment and revenue generating potential, while delivering significant greenhouse gas emissions reductions and achieving the smallest mode shift. It falls short of the city's targets, however, and this package produces the weakest community benefits across packages.
2. The "Capital" Package (A) has a comparable mode share and total emissions reduction to the "Programs" package. Its high capital and operating costs mean that it is not very cost-effective at reducing emissions per dollars spent, though this package does deliver moderate community benefits.
3. The "Do Everything" Package (C), which essentially enacts all the strategy actions, achieves the most greenhouse gas emissions reductions annually and cumulatively by 2050. It does not reach the 80% low-carbon mode share goal by 2030, though it comes closer than the other packages and reaches this mark later in the decade. Although the package is not as cost-effective at emissions reduction as the "Programs" package, it does deliver the highest impact for community benefits.



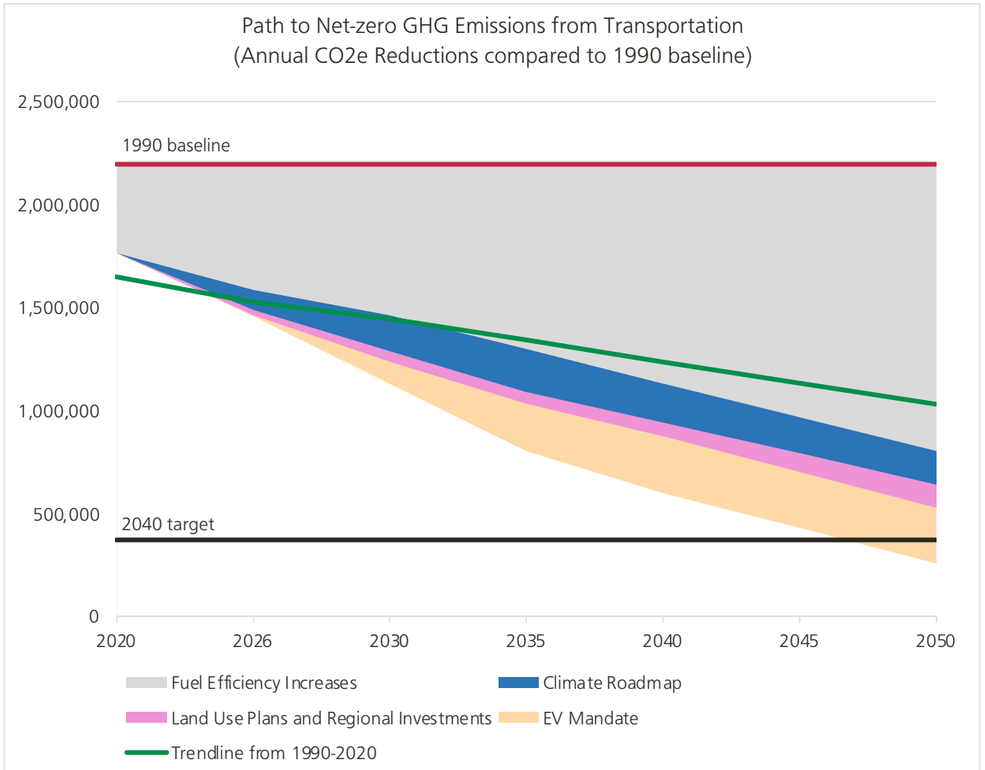
Key Findings

Given recent data and trends, the city will be decades behind its goals unless the SFMTA takes urgent action, including getting to net-zero greenhouse gas emissions from transportation, achieving 80% of all trips on low-carbon modes and other critical pieces of climate action that must happen, in addition to the actions identified in the Climate Roadmap.

Getting to Net-zero GHG Emissions from Transportation

1. The Climate Roadmap can help to realize the city's 2040 net-zero goals by reducing annual greenhouse gas emissions from cars and trucks by approximately 77% from 1990 levels.

2. This can only happen if the SFMTA begins to implement the actions within the next seven years, the city implements the other transportation and land use strategies in the Climate Action Plan, and the state and federal governments implement fuel efficiency measures.



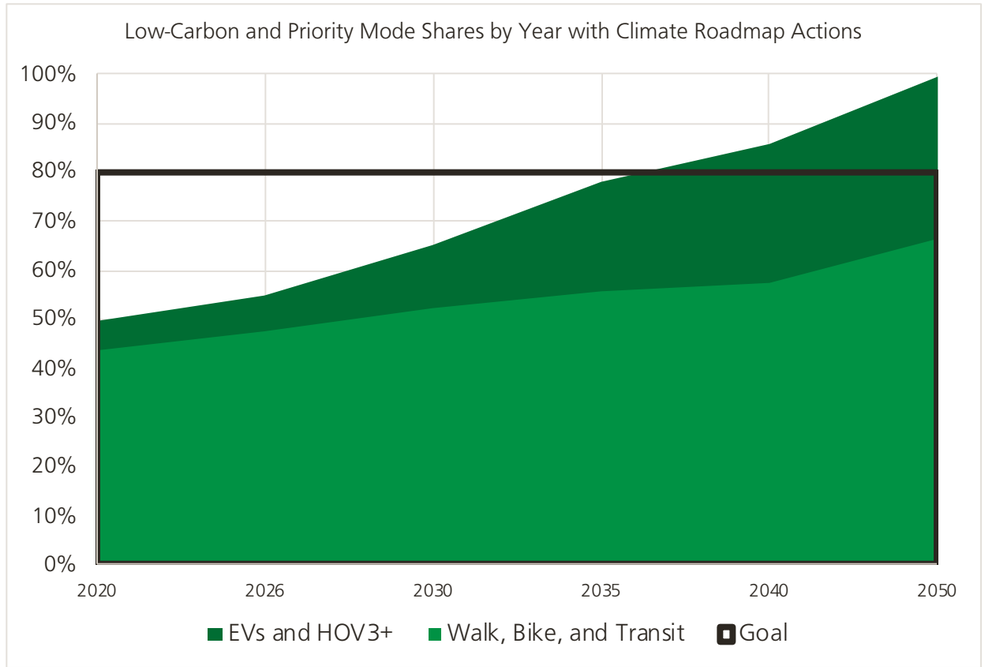
Path to Net-Zero GHG Emissions from Transportation (Annual $mtCO_2e$ Reductions Compared to 1990 Baseline)

Source: See Appendix B: Methodology Details for Quantifying and Packaging Greenhouse Gas Emissions Reductions and Mode Shift to Low-carbon Modes.

Low-carbon and Priority Mode Share

1. The Climate Roadmap helps the SFMTA get closer to meeting the city's 2030 mode share goal of 80% of trips made using low-carbon modes from about 50% of trips in 2022 to about 65% of trips by its goal year of 2030, just short of its goal.

2. The city eventually reaches an 80% low-carbon mode share sometime between 2035 and 2040, nearly a decade after its 2030 goal year. Of those trips, the majority is from trips made by transit, walking and bicycling, with remaining low-carbon trips from trips in vehicles with three or more people and electric vehicles.



Low-carbon and Priority Mode Shares By Year With Climate Roadmap Actions

Source: See Appendix B: Methodology Details for Quantifying and Packaging Greenhouse Gas Emissions Reductions and Mode Shift to Low-carbon Modes.

Other Critical Pieces of Climate Action:

1. Lastly, none of the drastic reductions in greenhouse gas emissions from transportation and mode shift to low-carbon modes would be possible without the city and region also maintaining infrastructure at a state of good repair, implementing congestion pricing to reduce vehicle traffic and fund transportation options, implementing the Housing Element to provide abundant housing and address environmental justice issues, building a new transbay tube, implementing the Downtown Extension and Caltrain Business Plan and meeting state goals of 100% EV sales by 2035.
2. **Investing in climate action requires the SFMTA to continue to work with housing, land use and regional planning efforts across the city and that the state and federal governments invest more heavily in transit, walking, bicycling and transportation electrification for the city to reach its goals.**

State of Good Repair	**Congestion Pricing**	**Housing Element**
Transbay Tube	**Downtown Extension and Caltrain Business Plan**	**State EV Goals of 100% EV Sales by 2035**

Other Critical Pieces of Climate Action for the SFMTA

We Can Get There: Case Studies from Global Cities

The Climate Roadmap finds that we can get close to, but not reach, our goals by the respective goal years. Therefore, staff looked at how similarly sized cities of Copenhagen, Bogota and Singapore have reached high low-carbon mode shares that surpass San Francisco's goals[1]. **San Francisco would need a transformative approach–in both bold policies and strategic investments, in addition to the actions of the Climate Roadmap, to match the mode shares of those cities.** For example:

If San Francisco were to have the _____ (Fill in)	that _____ (Fill in) has,	it would reduce an additional _____ (Fill in) beyond the Climate Roadmap,	reaching a _____ (Fill in) reduction in annual GHG emissions from cars, trucks and transit compared to 1990 levels.	How?
28% bike mode share	Copenhagen, Denmark	**109,000** metric tons	78%	Investments in high quality bicycle and pedestrian infrastructure.
53% transit mode share	Singapore	**370,000** metric tons	90%	Investments in transit, integrated land use approach, limiting roadway capacity of automobiles.
36% transit & 46% walk mode share	Bogotá, Colombia	**217,000** metric tons	83%	Investments in an extensive network of bus rapid transit lines and neighborhood-centric land uses.

We Can Get There: Case Studies from Global Cities

[1]See Appendix E: Transformative Vision for details.

Funding Needs and Opportunities

If San Francisco is to realize any of the benefits described in this Climate Roadmap, funding the priority actions in the Climate Roadmap is critical. Going forward, staff will aim to integrate the Climate Roadmap actions into the SFMTA capital and operating budget processes. This includes integrating the cost estimates from the Climate Roadmap into the SFMTA 20-year Capital Plan, which is the SFMTA's financially unconstrained list of capital needs for the next 20 years, and the 5-Year Capital Improvement Program (CIP), which is the financially constrained list of capital projects for the next 2-5 years.

The analysis indicates that over the next 27 years through 2050, implementing all actions of the Climate Roadmap would cost approximately $24.4 billion of capital costs (2022 dollars) from both the city and all levels of government and approximately $2.1 billion in net operating costs (which accounts for revenue) for a total of $26.5 billion in capital and net operating cost, or an average of $902 million in annual capital costs and $79 million in net operating costs over 27 years[1]. On the capital side, most capital needs come in the form of major transit, active transportation and electric vehicle infrastructure. On the operating side, new revenues, largely from managing parking, would add revenue compared to past projections, which can exceed new capital and operating costs of parking and help close the funding need in the long-term.

Cost Estimates (in 2022 dollars)	Cumulative or Annual	A: Capital-intensive	B: Program-intensive	C: Do Everything
Cumulative capital cost estimates through 2050	Cumulative	$24,134 million	$28 million	$24,356 million
	Annual Average	$894 million	$1 million	$902 million
Cumulative net operating cost estimates through 2050	Cumulative	$10,365 million	$(1,202 million)	$2,124 million
	Annual Average	$384 million	$(45 million)	$79 million
TOTAL	Cumulative	$34,499 million	$(1,173 million)	$26,481 million
	Annual Average	$1,278 million	$(43 million)	$981 million

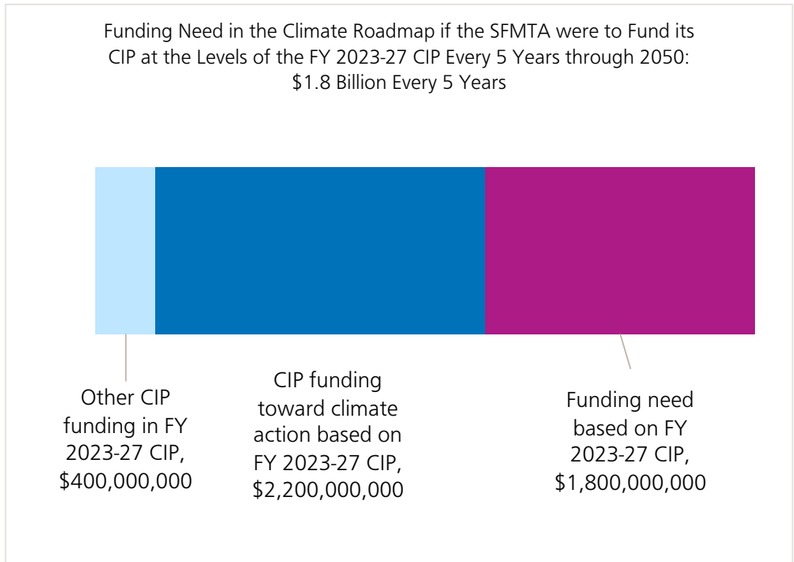
Cost Estimates by Package

[1]See Appendix C: Cost Estimates and Assumptions for details.

We should be putting more money and resources into transportation projects. Prioritizing where our government spends money is important."

- Walter

Of the $24.4 billion in capital costs, the SFMTA would need to spend approximately $8 billion in capital expenditures in the next seven years through FY 2030. Although $2.2 billion of the $2.6 billion in the 5-year Capital Improvement Program (CIP) for FY 2023-27 covers some of the costs of the Climate Roadmap, there is still a funding need between what the SFMTA is currently funding in the CIP and what the SFMTA needs to fund to fulfill the Climate Roadmap. Consistent with past SFMTA studies, if the SFMTA were to continue to fund its CIP at about $2.2 billion toward climate action every five years through 2050, it would still be about $11 billion short in capital funding to cover the remaining capital costs of the Climate Roadmap (equivalent to a $1.8 billion shortage every five years).



Funding the Climate Roadmap: Additional ~$1.8 Billion Every 5 Years Beyond Current Funding

Most of the funding need is already reflected in the SFMTA 20-year Capital Plan and the SFMTA's T2050 forecast, which forecasts the SFMTA's funding needs and revenue projections. New actions that are not in the 20-year Capital Plan or T2050 include: improved transfers (physical, logistical and cost); e-bike subsidies; mobility hubs pilot; expanded commuter benefits programs; increased paid parking spaces, times and rates; and expanded community-based transportation planning. The new actions cost between $28 million-$300 million in capital costs over the next seven years, requiring new revenue in addition to what is already needed in the 20-year Capital Plan.

While San Francisco invests heavily in transit, walking, biking and other forms of low-carbon travel choices to support the city's climate action goals, it is not enough. The actions in the SFMTA Climate Roadmap will likely rely on funding from local, regional, state and federal sources. It will take political will at all levels to acknowledge the urgency of the climate crisis and adequately fund the priority projects that will generate important community benefits.

A 2022 report "Funding San Francisco Climate Action" from the UC Berkeley Center for Law, Energy, and the Environment called on the city to leverage existing revenue sources that are not currently being applied to climate action; develop new revenue and financing mechanisms such as bonds, taxes and fees at the local and regional level that account for equity; create innovative measures like special districts and grant opportunities and access state and federal grant funds[1]. Of all the funding, state and federal funding is crucial to funding the Climate Roadmap. For example, the SFMTA utilized the U.S. Department of Transportation New Starts Grant Program to fund the Central Subway project and is receiving funds from the Infrastructure Investment and Jobs Act of 2021 and the Inflation Reduction Act of 2022. The State of California's 2022-2023 budget also allocated billions in new funding for climate initiatives over five years, and the SFMTA could benefit from future state funds. The SFMTA continues to acquire and advocate for new funding and will partner with local, regional, state and federal partners to secure the funding in the years ahead.

[1]Center for Law, Energy & the Environment, UC Berkeley Law, 2022. "Funding San Francisco Climate Action". https://www.law.berkeley.edu/research/clee/research/climate/california-climate-action/funding-sf-cap/

Recommendations

Near-term Recommendations through 2030	
	Fund the Climate Roadmap actions in the upcoming SFMTA 5-year Capital Improvement Program (CIP) cycles, with focus on increasing the SFMTA's work in priority actions such as:
	Gradually charge the right price for every on-street parking space by 2030
	Install 5,000 publicly available EV charging stations on city property by 2030

Near-term Recommendations from the Climate Roadmap

Based on a technical analysis and evaluation of individual actions and packages of actions, we recommend in the near-term through 2030: Fund the Climate Roadmap actions in the upcoming SFMTA 5-year Capital Improvement Program (CIP) cycles, with focus on increasing the SFMTA's work in priority actions such as: (1) gradually charge the right price for every on-street parking space and (2) install 5,000 publicly available EV charging stations on city property by 2030.

When paired with the other work at the SFMTA, including, but not limited to, expanding transit priority of Muni Forward, implementing community-based transportation plans, and expanding bikeways and Slow Streets, both parking and electrification are two of the most cost-effective and most impactful ways to accelerate climate action.

No single action has greater impact on reducing greenhouse gas emissions than charging the right price for every on-street parking space. Pricing parking yields the highest annual emissions reductions, the greatest cumulative reductions and significant community benefits. Additionally, it is the most cost-effective action because it creates revenue that goes right back into transit. By shifting trips and funding transit, we can increase access while supporting more equitable transportation.

The installation of new electric vehicle charging stations on city property is also a very cost-effective strategy for bringing down greenhouse gas emissions, with a significant potential for annual reductions.

The SFMTA will also continue to invest in maintaining its infrastructure in a state of good repair and work with housing, land use and regional efforts like implementing the Housing Element and advancing the congestion pricing study, which are critical pieces to tackling the climate crisis.

Implementation and Monitoring

The SFMTA's Strategic Plan has a robust performance framework which will be used to help monitor the implementation of the Climate Roadmap. Furthermore, SFMTA will work with the San Francisco Department of the Environment to report on progress toward implementing the Climate Action Plan, including tracking metrics based on data, engagement with stakeholders and other conditions, in addition to tracking the transportation mode share and percent of trips taken on low-carbon modes.

"Rising temperatures, hotter climates and more droughts impact my health."

- Martha, Bayview

Conclusion

Addressing climate change is a monumental task, one of the greatest challenges facing our society today. Implementing the Climate Roadmap sets the SFMTA on a path toward realizing climate and mobility targets while generating important community benefits. Going forward, it will be critical to develop community support and political will which needs to come from the ground up, from passionate and engaged residents and workers of San Francisco who envision a greener and healthier city for themselves and for generations to come. Meaningfully reducing emissions will fundamentally transform the way we live, work and get around, and we have our roadmap and know how to get there: one step at a time.

Let's get started!

"Climate action means caring about climate change and getting vehicles down to zero emissions."

- Sabrina, Bayview

Appendices

Appendix A: Racially Equitable Processes and Expanded List of Equity Practices

Injustice on Communities of Color

Centuries of oppression and racist decision-making toward American Indian, Black, Latinx and other communities of color have forced marginalized communities to carry the brunt of our climate emergency. Government and other institutions implemented redlining and deed restrictions and built highways through communities of color, such as in the Fillmore and all along US-101 and I-280 freeways, displacing members of communities of color in large numbers. These actions, whether intentional or not, led to worse air quality and fewer transportation options than other areas of the city that had the power and influence to prevent such outcomes. As a result, communities of color are exposed at much higher rates to environmental hazards. Vehicle traffic, transportation storage and industrial land uses are concentrated in the neighborhoods they live in, particularly in the Bayview where some areas are in the 92nd percentile of most vulnerable communities to pollution in California[1]. As climate change will only exacerbate these disparities, strategies to combat the climate emergency must intentionally also include strategies to advance racial equity to reverse past, current and future harms.

Racially Equitable Processes

Given the deeply inequitable history of transportation policy and its intimate connection with the unsustainable greenhouse gas emissions of today's transportation sector, it is critical that we bring racial equity to the forefront of this discussion of climate action. To approach climate action in a way that repairs past harms rather than perpetuates them, we practice racially equitable processes that lead with race to support racially equitable outcomes:

The SFMTA leads with race and centers intersectionality to support more racially equitable outcomes. To guide our process, we looked to the agency's vision for racial equity outlined in the SFMTA Racial Equity Policy, which commits the SFMTA to advancing racial equity in everything it does to support all users of the transportation system and get people where they need to go safely, freely and reliably.

Climate action requires holistic thinking about systems and cannot be looked at in a vacuum. It is not enough to strive to reduce total greenhouse gas emissions alone; it requires looking at the disproportionate negative impacts that our current systems, including our transportation system, have on specific communities due to systemic racism and the intersection of identities, including ability, housing status, sexual orientation, gender identity and others.

Therefore, **climate action requires engaging with and prioritizing the needs of the least engaged and the most impacted** because those with the least power have suffered the biggest impacts of the climate crisis. This includes frequent community outreach, education and engagement to identify needs and priorities and conduct an assessment on the benefits, burdens and opportunities of project implementation.

Climate action requires repairing harms of marginalized communities from the transportation sector. This means proactively ensuring climate actions can increase life, livelihood and liberation for American Indian, Black, Latinx and other communities experiencing racism or oppression. By using racial equity-driven decision-making, we can align projects with the priorities of marginalized groups.

Climate action requires advancing racial equity using data-driven and compliance approaches. For example, equity data standards, monitoring, and evaluation can help track demographic information of who is impacted and engaged, what a communities' needs are, and how to inform priority improvements.

To accomplish the above, **climate action requires regular, culturally specific, and multi-lingual communication** to engage people about the progress toward the Climate Roadmap and develop comprehensive understandings of people's travel choices.

Expanded List of Equity Practices

The list below includes practices that should be integrated into the engagement and implementation phases of each action to minimize adverse racial equity impacts and advance racial equity. Staff developed the list through staff workshops to be used as a starting point for the SFMTA's racial equity and climate action work.

Equity Practices for Strategy 1: Build a Fast and Reliable Transit System

- Large transit projects may be seen as focused on people passing through the neighborhood, rather than people in the neighborhood. Investments should prioritize investments that improve transit reliability and access for SFMTA Equity Neighborhoods. To address those concerns, future investments should aim to tailor improvements to impacted communities and integrate community into the planning process.
- New transit investments cost money to operate, but existing funding structures do not fully cover the cost of operations. To address this, continue working with regional, state, and federal policymakers to fund operations, regional coordination, and alternative revenue sources allowing for reduced fares.
- For all transit investments, consult community leaders to prioritize investments that benefit marginalized communities. Conduct surveys across the city to better understand community concerns and priorities for infrastructure, including non-transit infrastructure that may be impacted or could be created by the transit investment.
- Goals of the city may be different than goals of community. To address this, aim to align common goals and implement community-responsive solutions.
- Construction may negatively impact businesses. To address that, create financial programs to help businesses who might experience negative financial impacts.

Equity Practices for Strategy 2: Create a Complete and Connected Active Transportation Network

- Active transportation fulfills the needs of many, but not all, trips. To ensure transportation caters to everyone, listen and create other alternatives to driving for people of color, people with disabilities, older people, people who are low-income and for trips that biking might not be feasible. Ensure active transportation is only one out of many non-automobile options.
- Bicycle infrastructure is often seen as an indicator of gentrification in communities of color. To address that, develop and deploy strategies to preserve existing affordable housing and stabilize communities while also investing in transit, active transportation and other forms of non-automobile transportation. Develop transportation planning processes that listen and understand community resources and services to be responsive to unique histories.
- Roads are not always designed to accommodate bicyclists of all ages, risk comfort, and abilities, and people with disabilities have the most barriers to getting around by foot or bicycle. To address this, design the bike network to be safe for people of all ages and abilities who use it for both transportation and recreation.
- Mobility services are an opportunity to create local jobs. To do that, consider local jobs requirements for mobility companies via permit programs.
- Safety of active transportation is dependent on how people drive. To address safety impacts, expand safety education programs for all road users, such as at schools, community and senior centers, television, internet, and radio advertisements, training for drivers of large vehicles, and more.
- Expanding the bike network should connect communities and destinations. To ensure this, evaluate and expand the bike network to serve destinations visited by marginalized groups.

Equity Practices for Strategy 3: Expand Programs to Communities that Shift Trips to Transit, Walking and Bicycling

- Employer incentive programs often prioritize office workers who commute downtown and no other workers. To address that, make sure the program considers all existing mobility options and ensures equitable access to all workers, including small businesses, contract workers, interns, and service workers, including workers where transportation is essential to their work, not just office workers.
- Commutes are a large portion, but only a part, of all trips. When expanding transit and pricing parking, consider expanding discounts and exemptions to marginalized groups that may not have alternatives to the private automobile.

Equity Practices for Strategy 4: Manage Parking Resources More Efficiently

- Parking enforcement can have negative impacts upon marginalized groups. To address that, ensure parking enforcement activity does not disproportionately affect communities of color.
- Pricing parking may have disproportionate impacts upon people who cannot afford to pay for parking or lack robust alternative transportation options. To both manage parking more efficiently and incorporate racial equity-driven decision-making tools, improve communication around the extensive discount and waiver programs available for people with low-incomes and experiencing homelessness, consider reduced parking fees based on income, use increased fares to improve service and make the application process for discounts as easy as possible so it is not a barrier to access.
- Pricing should help increase access to non-automobile modes, not decrease access overall. As the city reforms its parking policies and practices, ensure non-automobile modes are available and reliable.
- Many people may not know that the SFMTA uses its parking revenue to fund transit operations to encourage more people to take transit instead of drive. To address that, create a public campaign to let people know where parking fares and fines go.

Equity Practices for Strategy 5: Accelerate Adoption of Electric Vehicles

- Electric vehicle charging stations are often reserved for electric vehicles. To address the potential loss of parking, make sure those who do not have an electric vehicle have transportation options.
- Who benefits and who is burdened by new electric vehicle infrastructure highly depends on the location of that infrastructure. Be strategic of where EVs are located and aware of who benefits at each location. Off-street, on-street, residential areas, parks and commercial areas have different users and uses.
- Safety and vandalism of electric vehicle infrastructure may be an issue. Consider safety around the stations by using lighting and siting in well used locations.

Equity Practices for Strategy 6: Conduct Impactful Community Engagement

- Continue using the SFMTA Public Outreach and Engagement Team Strategy, the agency's initiative for meaningful public outreach and engagement.
- Train and build capacity through SFMTA Community Connections, a new program which will be a regular series of meetings led by the department's Racial Equity and Belonging team and open to the public where community leaders working toward social justice can give direction to projects and programs.

Appendix B: Methodology Details for Quantifying and Packaging Greenhouse Gas Emissions Reductions and Mode Shift to Low-carbon Modes

Overview

This memorandum informs the SFMTA's Climate Roadmap process by clarifying and quantifying the impact of proposed strategies on mode split and greenhouse gas (GHG) emissions and grouping proposed strategies into thematic "packages". This memorandum provides an overview of the quantification and packaging process and the data resources and assumptions used.

Strategy Definition

The SFMTA developed a list of strategies for their Climate Roadmap based on the City of San Francisco's Climate Action Plan. These were refined for the purpose determining effectiveness. For example, transit projects were reallocated to isolate their individual contributions to greenhouse gas reductions. Other strategies, like improving transit transfers and improving enforcement of curb regulations, are important for the running of an efficient transportation system, but do not have easily quantifiable impacts and so are not presented here.

Where absent from the original list, specific targets and goals have been added based on feasibility and effectiveness. This includes specific assumptions around bikeway mileage, bicycle parking and subsidies, electric vehicle (EV) charging stations, and transportation demand management (TDM) targets. Most notably, this analysis set assumptions for expanding the price of on-street parking and extent of priced on-street parking. These two approaches to parking management are each presented as two mutually exclusive options – one less intensive (increase parking pricing by 25%; double the number of paid public parking spaces in the city) and one more intensive (double parking pricing; make all on-street parking in the city paid[2]). These options are meant to inform the ability of various levels of parking management to influence City emissions and mode split goals and do not reflect any current SFMTA parking policy.

Finally, this analysis incorporates external strategies which are outside of the SFMTA's control, as shown in the table at the end of Appendix B. These include San Francisco-specific actions led by other agencies (downtown cordon pricing; 2022 Housing Element Update), regional transit improvements (Link21 Transbay Tube; Caltrain Business Plan and Downtown Extension (DTX)), and statewide legislative goals like 100% of vehicles sales being electric by 2035.

Strategy Effectiveness

The strategy effectiveness analysis relies largely on vehicle miles traveled (VMT) and GHG reduction methodologies detailed in the Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity, prepared by the California Air Pollution Control Officers Association (CAPCOA), herein referred to as the Handbook[3]. Where possible, the analysis relies on local data sources over statewide assumptions, including:

- 2019 SFMTA Travel Decision Survey
- 2012 California Household Transportation Survey (CHTS)
- 2019 American Community Survey (ACS) data
- SF-CHAMP inputs and model runs from the 2022 SF Housing Element Update
- 2022 Bay Area Parking Census by SPUR and the Mineta Transportation Institute
- San Francisco vehicle registration data
- SFMTA 2019 Bike Program Report
- SFMTA ConnectSF program goals and assumptions
- Van Ness Bus Rapid Transit (BRT) travel time improvements

In addition to analyses based on the Handbook, some strategy effectiveness was determined through other means:

- Goals and previous analyses conducted for transit projects, such as ConnectSF, Link21 Transbay Tube, and Caltrain Business Plan and DTX
- Custom approaches for bicycle parking and e-bike subsidies, based on available research
- California legislative goals and analysis for electric vehicle adoption

Strategy Timing

In addition to the effectiveness of strategies, assumptions were made around the timeline of strategy implementation. Six horizon years were used to approximate the year benefits are first accrued (partial completion) and the year that maximum benefits are accrued (full completion). These years were 2022, 2026, 2030, 2035, 2040, and 2050. All strategies were assumed to be complete by 2050, even if their timeline is uncertain.

Where available, timelines were based on the plans of the SFMTA or other bodies; this was particularly the case for transit projects. In the absence of such information, the year of full completion was often set to 2030 to align with the SFMTA's mode split goal horizon year if such completion was deemed feasible. Where the year of partial completion and full completion differ, intermediate levels of completion were interpolated to provide a level of effectiveness estimate for each year.

External Strategies

Strategy	Description	Year Benefits Begin (Partial Completion)	Year of Full Completion	Emissions Reduction at Completion*
Cordon Pricing	Implement downtown cordon pricing per SFCTA's 2019 proposal.	2050	2050	27,800
Housing Element densification	Continue to meet housing production goals in the SF Housing Element	2026	2050	60,700
No further increase in residential parking supply	New development must result in no net new parking.	2026	2050	5,600
Link21 Transbay Tube	Future construction of a second transbay tube	2050	2050	16,700
DTX + Caltrain Business Plan Service Levels	Completion of Downtown Extension and full implementation of Caltrain Business Plan	2030	2030	4,000
100% EV Sales by 2035	State legislation requiring that 100% of passenger vehicles sales be EVs by year 2035. State also adopts aggressive actions to help phase out older gasoline-powered vehicles, resulting in 98% of passenger fleet being EV by 2050	2026	2050	268,000

External Strategies

Source: SFMTA; Fehr & Peers
** In annual tons of $mtCO_2e$ reduced at completion*

Strategy Packages

The strategies listed were grouped into three different "packages" based on common themes. The three packages are:

- Package A: Capital Investment – strategies focus on capital improvements like transit projects, bikeway investments, and EV charging facilities
- Package B: Programs and Operations – strategies focus on programmatic improvements like TDM, e-bike subsidies, transit frequency improvements, and parking policy
- Package C: Do Everything – Includes all strategies, including the more effective version of mutually exclusive strategies

All three packages include all External Strategies. Package definitions are presented below.

Climate Roadmap Packages

	Strategy	Package A: Capital Investment	Package B: Programs and Operations	Package C: Do Everything
Strategy 1: Fast and Reliable Transit				
CR-1.1	Five-Minute Network	X		X
CR-1.2	Modern Muni Metro	X		X
CR-1.3	Geary Subway	X		X
CR-1.4	Central Subway Extension	X		X
CR-1.5	Muni Forward transit priority improvements3	X		X
CR-1.6	Improved Transfers	X		X
Strategy 2: Active Transportation				
CR-2.1	Expand Secure Bicycle Parking	X		X
CR-2.2	Provide Generous e-Bike Subsidies		X	X
CR-2.3	Mobility Hubs	X		X
CR-2.4	Bicycle Network Expansion	X		X
Strategy 3: Transportation Demand Management				
CR-3.1	Increase Engagement in Commute Benefits Ordinance Programs		X	X
CR-3.2	Increase Share of Employers Offering Commute Subsidies		X	X
Strategy 4: Parking				
CR-4.1	Expand paid hourly parking to Sundays		X	X
CR-4.2	Gradually Charge the Right Price for Every On-street Space, Lower Range (Note: mutually exclusive to 4.3 for modeling purposes)	X	X	
CR-4.3	Gradually Charge the Right Price for Every On-street Space, Upper Range (Note: mutually exclusive to 4.2 for modeling purposes)			X
CR-4.4	Increase Parking Pricing at by 25% in existing metered spaces (Note: later changed to "Increase Residential Parking Permit Fees, Lower Range")		X	
CR-4.5	Double Parking Pricing in existing metered spaces (Note: later changed to "Increase Residential Parking Permit Fees, Upper Range")			X
Strategy 5: Electric Vehicle Charging				
CR-5.1	Expand EV charging stations	X		X
Strategy 6: Community Engagement				
CR-6.1	Community Transportation Planning		X	

Climate Roadmap Packages

Source: Fehr & Peers

Package Effectiveness

The effectiveness of each package was assessed on three metrics: total daily GHG emissions reduction, total low carbon mode share, and total priority mode share.[4] For GHG emissions, the reduction for a given year was assessed relative to the projected emissions for the same year without any climate roadmap or external strategies. Each of the three metrics was assessed in two years: the target year for the City's goal and 2050. For the GHG emissions reduction goal, the City target year is 2040 and for the low carbon mode share goal, the City target year is 2030. Priority mode share does not have a City goal, but is presented in 2030 for comparison with the low carbon mode share.

Climate Roadmap Package Effectiveness

Metric (Year)	City Goal		Baseline / No Action	Package A: Capital Investment	Package B: Programs and Operations	Package C: Do Everything
Total Daily GHG Reduction Compared to 1990 Baseline (2040)	90%		48%	70%	70%	73%
Total Low Carbon Mode Share (2030)	80%		54%	60%	62%	65%
Total Priority Mode Share (2030)	n/a		42%	46%	47%	52%
Total Daily GHG Reduction Compared to 1990 Baseline (2050)	90%		63%	88%	88%	88%
Total Low Carbon Mode Share (2050)	80%		62%	99%	99%	99%
Total Priority Mode Share (2050)	n/a		41%	59%	57%	67%

Climate Roadmap Package Effectiveness

Source: Fehr & Peers

Assumptions and Methods

This technical appendix shows the assumptions, sources, and methods for calculating the carbon effectiveness of each measure. Most methods are taken from the CAPCOA Handbook, with adjustments to any assumptions for which the SFMTA provided more San Francisco-specific data. In instances where other methods or data sources were used, they are cited within this section.

General Principles

Baseline VMT was taken from SF-CHAMP, the City's travel demand forecasting model, using model runs prepared for the San Francisco Housing Element 2022 Update Environmental Impact Report. Baseline VMT reflects the model runs prepared for 2020 Existing, 2035 No Action, and 2050 No Action. Interim study years were linearly interpolated. SF-CHAMP presents VMT on an average weekday basis; this was annualized using a factor of 365 when necessary.

VMT was converted into GHG using custom emissions factors for each horizon year, derived from taking baseline VMT and baseline transportation-sector GHG from the 2018 Climate Action Plan Transportation and Land Use Climate Change Mitigation Analysis prepared by Cambridge Systematics. Even with no action by the SFMTA, fuel efficiency improvements and shifts to EVs are expected to result in less GHG per VMT per year.

To assess the additional effects of EV-promoting measures, additional improvements to emission factors were developed based on gradual movement toward a 98 percent EV fleet by 2050[5]. This represents a highly aggressive goal and would require an unprecedented level of vehicle "turn-over" (i.e., replacement of older vehicles with newer vehicles); however, this goal aligns with the intent behind the State's mandate of 100% electric vehicle sales by 2035.

Because of this aggressive adoption of electric vehicles, VMT reductions become less effective at reducing GHG over time, as the average vehicle emits less GHG per VMT. This does not account for the lifecycle emissions of personal vehicles and this analysis as a whole applies only to personal vehicle travel with an origin or destination in San Francisco to focus on the measures within direct control by the SFMTA. Therefore, this analysis does not include measures related to freight, commercial vehicles, or trips that "pass-through" San Francisco, nor does it account for VMT generated by those sources.

Strategy 1: Fast and Reliable Transit

Effectiveness of Strategies 1.1, 1.2, 1.3, 1.4, and 1.5 was calculated by evaluating all the planned ConnectSF improvements using standardized and widely accepted transit demand elasticities taken from the 2021 CAPCOA Handbook. Specifically, the following CAPCOA Strategies were applied:

- T-25: Extend Transit Network Coverage (applies to Strategies 1.3, 1.4)
  Overall citywide transit coverage was assumed to increase by 5 percent compared to existing conditions. This includes both spatial coverage and temporal coverage (i.e., more service hours on more routes, as well as new stops such as stations on the planned rail extensions).
- T-26: Increase Transit Service Frequency (applies to Strategies 1.1, 1.2)
  Overall, the 31 percent of routes anticipated to see frequency improvements through the Five-minute Network are anticipated to run 34 percent more frequently.
- T-27: Transit-Supportive Roadway Treatments (applies to Strategy 1.5)
  Overall, 31 percent of routes are anticipated to see at least some supportive roadway treatments. Based on service improvements on Van Ness Avenue, routes with these improvements are expected to see a 22 percent decrease in travel times.
- T-28: Provide Bus Rapid Transit (applies to the combination of Strategies 1.1 and 1.5)

The combination of increased frequency and reduced travel times has an additional benefit. Citywide, 36 percent of routes are expected to be considered BRT following improvements; BRT services are expected to attract 25 percent more riders than non-BRT services. Care was taken to not double count, as most routes converting to BRT are also anticipated to see short-term service or infrastructure improvements.

Applying these measures resulted in a total VMT reduction due to ConnectSF of 7.4 percent citywide. To assess each individual action, this total reduction was prorated based on the expected ridership increases by 2050 for each action item, as presented in the December 2021 Transit Strategy.

CR-1.1: Five-minute Network

As noted above, effectiveness of Strategies 1.1, 1.2, 1.3, 1.4, and 1.5 was calculated by evaluating all the planned ConnectSF improvements using the elasticities taken from the 2021 CAPCOA Handbook.

CR-1.2: Modern Muni Metro

As noted above, effectiveness of Strategies 1.1, 1.2, 1.3, 1.4, and 1.5 was calculated by evaluating all the planned ConnectSF improvements using the elasticities taken from the 2021 CAPCOA Handbook.

CR-1.3: Geary Subway

As noted above, effectiveness of Strategies 1.1, 1.2, 1.3, 1.4, and 1.5 was calculated by evaluating all the planned ConnectSF improvements using the elasticities taken from the 2021 CAPCOA Handbook.

CR-1.4: Central Subway Extension

As noted above, effectiveness of Strategies 1.1, 1.2, 1.3, 1.4, and 1.5 was calculated by evaluating all the planned ConnectSF improvements using the elasticities taken from the 2021 CAPCOA Handbook.

CR-1.5: Muni Forward Improvements

As noted above, effectiveness of Strategies 1.1, 1.2, 1.3, 1.4, and 1.5 was calculated by evaluating all the planned ConnectSF improvements using the elasticities taken from the 2021 CAPCOA Handbook.

CR-1.6: Improved Transfers

This measure is expected to improve overall travel times for transit riders transferring between BART and Muni Light Rail or Muni Bus along the Market Street corridor. Fehr & Peers estimates that this would result in a time savings of up to five minutes for individuals making this transfer, and an average total transit travel time of 45 minutes[6]. Based on BART access surveys at stations along the corridor, approximately 1.5 percent of transit trips involve this transfer[7]. Finally, information from CAPCOA Strategy T-28 indicates that the elasticity of transit ridership with respect to total travel time is 0.40, and that 50 percent of new transit trips would shift from driving.

Strategy 2: Active Transportation

CR-2.1: Expanded Bicycle Parking

Expanded bicycle parking is intended to encourage bicycle use through providing secure storage. Community focus groups in Portland, OR found that 35 percent of low-income people considered a lack of secure storage options a barrier to bicycling[8]. Assuming that additional bike parking could help encourage bicycle ownership, around 56 percent of people who bicycle do so always or usually[9]. Fehr & Peers and the SFMTA assumed that 5,000 additional secure spaces are available citywide with this program, and that each bicycle space has potential to influence bicycle acquisition for one person, as well as resulting in up to one additional bicycle trip per day compared to no action, and that each additional bicycle trip represents a 14 percent reduction in VMT by an individual cyclist[10].

CR-2.2: E-bike Subsidies

Based on data from five Colorado e-bike programs, e-bike recipients use their e-bike for 14.5 percent of all travel[11]. The average modeled person miles of travel by San Franciscans is 17.2 miles per day. This measure also assumes that 50 percent of e-bike trips are shifted from a private vehicle, and 5,000 e-bikes are provided through the program.

CR-2.3: Mobility Hubs

Mobility hubs are intended to result in an effective reduction in transit travel times by improving access to individual transit centers / key transfer points with service improvements such as timed transit transfers and physical improvements such as docked bikeshare stations or carshare vehicles. Additional bikeshare access has a 0.06% reduction on neighborhood VMT, based on the CAPCOA Handbook (Strategy T-22B). Given the unknown nature of all features that this would include, bikeshare access was used as a proxy applied to the SF-CHAMP VMT of five locations near likely mobility hub locations to illustrate the improved reliability from dockless to docked bikeshare program. Fehr & Peers then included an estimated effectiveness multiplier of 4.0 to account for additional services provided that are not yet well-studied.

CR-2.4: Bicycle Network Expansion

The VMT reduction due to bicycle network expansion was estimated using CAPCOA Measure T-20: Expand Bicycle Network. This assumes that the current bicycle network includes 464 miles of bikeways, which will increase to 762 miles of bikeways by 2040 based on input from the SFMTA. The current bicycle mode share in San Francisco is 2%, and the average bicycle trip length is 1.88 miles (compared to 5.19 miles for the average vehicle trip).

Strategy 3: Transportation Demand Management

CR-3.1: Increase Engagement in Commute Benefits Ordinance Programs

This measure calculates the benefits of active outreach and potential incentive programs that could help the City will increase overall participation in Commute Benefits Programs. Currently, 23 percent of people working in San Francisco work at an employer subject to either the City or Regional commute benefits requirements[12]; this measure sets a target of increasing this to 50 percent of all employees working at an employer offering commute benefits. At this level, this would include pre-tax deductions, and would not require additional subsidies.

CR-3.2: Increase Share of Employers Offering Commute Subsidies

This measure calculates the benefits of active outreach and potential incentive programs (or City-sponsored subsidy programs) where the share of employers offering subsidized transit benefits (rather than allowing for pre-tax transit deductions only) would increase from 19 percent of participating employers[13] to 75 percent of participating employers.

Strategy 4: Parking

Strategies CR-4.1, CR-4.2/4.3, and CR-4.4/4.5 all use CAPCOA Strategy T-24: Implement Market Price Public Parking to estimate reductions

These strategies fall into two categories: strategies that increase the number of parking spaces in the city that require payment (CR-4.1, CR-4.2/4.3) and strategies that increase the price of parking at existing meters (CR-4.4/4.5). Both categories use a price elasticity of parking demand, with the assumption that a reduction in parking demand has a 1:1 relationship to a reduction in vehicle trips and VMT. For all measures, rather than using the default price elasticity of parking demand (-0.4), Fehr & Peers used an alternative elasticity for situations where no alternative parking is available (-0.2)[14] to reflect that alternative, lower-priced parking options are unavailable.

Coverage-Based Strategies

For CR-4.1 and CR-4.2/4.3, Fehr & Peers estimated the existing share of VMT from trips ending in a paid parking area, compared to all trips in the City. Fehr & Peers performed this analysis by planning district (from the SF Housing Element 2022 Update EIR) using SF-CHAMP data to extract VMT, and SFMTA parking meter location data to assess what share of each district was within a paid parking area.

Parking meter coverage was estimated using SF-CHAMP VMT data by neighborhood and comparing it to the percentage of parking spaces in that neighborhood that are metered (via combining SFMTA parking data with the Bay Area Parking Census). Under existing conditions, the percentage of VMT traveling to or from paid parking areas ranged from 2% in the Planning Department's South Bayshore district to 55% in Downtown.

For coverage-based strategies, Fehr & Peers applied the parking price elasticity to a 100% "increase" in cost across an increased percentage of spaces. For CR-4.1, Sunday/Evening metering, Fehr & Peers and the SFMTA assumed a 14% increase in coverage hours. For CR-4.2, Fehr & Peers assumed that the share of VMT in a paid parking area doubled for each zone, as the number of spaces doubles. And finally, for conversion of all on-street parking to paid parking, Fehr & Peers designate each area as increasing its coverage area to 100%.

Price Change Strategies

For CR-4.4 and CR-4.5, Fehr & Peers assumed the same level of VMT occurring in paid parking zones and applied the price elasticity of parking demand (-0.2) to either a 25 percent increase in price (CR-4.4) or a 100% increase in price (CR-4.5).

Strategy 5: Electric Vehicle Charging

CR-5.1: Expand EV charging stations

This measure assumes that each residential charging station reduces 3.39 $mtCO_2e$ per year, and each public or non-residential charging station reduces 6.77 $mtCO_2e$ per year.[15] This estimate is based on the installation of 1,000 new residential charging stations (through grants or subsidies) and 5,000 new public charging stations.

Strategy 6: Community Engagement

CR-6.1: Community Transportation Planning

This measure uses CAPCOA Strategy T-23: Provide Community-Based Travel Planning to estimate reductions. This includes conducting hands-on, personalized outreach to a wide variety of households in many different communities to provide information, incentives, and support, resulting in an average 12 percent reduction in VMT for participating households. This estimate assumes that outreach would occur Citywide.

Appendix C: Cost Estimates and Assumptions

Cost Estimate

This section provides conceptual, planning-level capital and net operating cost estimates, which are included in the Climate Roadmap evaluation and provide a starting point for further study of each action. Cost estimates and funding needs are based off the 20-year Capital Plan, the 5-year Capital Improvement Program, other SFMTA planning documents and the SFMTA's Transportation 2050 model which accounts for capital and operating needs, projected revenues and funding needs from FY 2023 to FY 2050. Here are the factors and cost estimates:

- **CR Action ID**: Climate Roadmap Action Code
- **Climate Roadmap Action Title**: Title of the Climate Roadmap Action
- **Assumed Year that Action Starts Reducing Greenhouse Gas Emissions (For Modeling Purposes)**: The approximate year that staff assumed the action would be completed, based on existing planning documents or estimates, used for modeling greenhouse gas emissions reductions and mode shift potential
- **Assumed Year to Hit Maximum Greenhouse Gas Emissions Reduction Rate (For Modeling Purposes)**: The approximate year that staff assumed the action would hit its maximum greenhouse gas emissions reduction rate, used for modeling greenhouse gas emissions reductions and mode shift potential
- **Approximate Full Build-out Capital Costs and Net Operating Costs through 2050 in Millions of 2022 Dollars**: Conceptual, planning-level capital costs and net operating costs for full build-out of the specific action by 2050 in millions of 2022 dollars
- **Approximate 7-year Capital Costs and Net Operating Costs through 2030 in Millions of 2022 Dollars**: A subset of the full build-out costs by 2050; conceptual, planning-level capital costs and net operating costs in the next seven years by 2030 in millions of 2022 dollars

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Cost Estimates by Action

CR Action ID	Climate Roadmap Action Title	Assumed Year that Action Starts Reducing Greenhouse Gas Emissions (For Modeling Purposes)	Assumed Year to Hit Maximum Greenhouse Gas Emissions Reduction Rate (For Modeling Purposes)	Approximate Full Build-out Capital Costs and Net Operating Costs through 2050 in Millions of 2022 Dollars	Approximate 7-year Capital Costs and Net Operating Costs through 2030 in Millions of 2022 Dollars
CR-1.1	Five-minute Network	2035	2035	$9,020	$292
CR-1.2	Modern Muni Metro	2035	2035	$700	$408
CR-1.3	Geary Subway	2050	2050	$20,000	$5,185
CR-1.4	Central Subway Extension	2040	2040	$1,680	$659
CR-1.5	Muni Forward Improvements	2026	2035	$2,960	$1,076
CR-1.6	Improved Transfers	2030	2030	$45	$45
CR-2.1	Expanded Bicycle Parking	2026	2026	$9	$8
CR-2.2	E-bike Subsidies	2026	2026	$6	$2
CR-2.3	Mobility Hubs	2030	2030	$6	$6
CR-2.4	Bicycle Network Expansion	2026	2030	$898	$898
CR-3.1	Increase Engagement in Commute Benefits Ordinance Programs	2026	2030	$4	$1
CR-3.2	Increase Share of Employers Offering Commute Subsidies	2030	2035	$3	$0
CR-4.1	Paid Parking on Sundays and Evenings	2026	2030	($222)	($65)
CR-4.2/4.3	Gradually Charge the Right Price for Every On-street Space	2026	2030	($8,750) to ($980)	($2,375) to ($266)
CR-4.4/4.5	Increase Residential Parking Permit Fees	2026	2030	($80) to ($25)	($23) to ($7)
CR-5.1	Expand EV charging stations	2026	2050	$161	$82
CR-6.1	Community Transportation Planning	2026	2030	$41	$12

Cost Estimates by Action

Cost Estimates Assumptions

All cost estimates are in 2022 dollars from FY 2023 to FY 2050.

CR Action ID	Climate Roadmap Action Title	Capital Cost Assumptions	Operating Cost Assumptions
CR-1.1	Build the Five-minute Network	ConnectSF Transit Strategy: 5-minute network: $5.0 million/mile ~ 99.7 miles, 10-minute network: $2.5 million/mile ~ 93.4 miles	Escalated FY19 operating expense per vehicle revenue mile from NTD reporting, multiplied by mileage, and required service per hour, 18 hours per day, annualized, multiplied by 15 years
CR-1.2	Modernize Muni Metro	ConnectSF Transit Strategy	None, assumed neutral operating costs
CR-1.3	Initiate Geary Subway	ConnectSF Transit Strategy: 9.6-10 miles total. Does not include non-San Francisco portions of Link21	None, assumed non-SFMTA operating costs
CR-1.4	Initiate Central Subway Extension	ConnectSF Transit Strategy: 1.2 miles total	Same methodology as 1.1, only difference is using escalated LRV operating expense per revenue mile. Also different duration of expense.
CR-1.5	Implement Muni Forward Improvements	2021 Capital Plan: $2.5 million/mile ~ 93.4 miles	Same methodology as 1.1, different mileage, different duration
CR-1.6	Improve Transfers	Costs not available. Used SFMTA/BART canopy agreement for all four combination BART/Muni Metro stations as proxy.	None, assumed too small to quantify
CR-2.1	Expand Bicycle Parking	2021 Capital Plan: 5,000 new Bicycle and Scooter Parking spaces Bike stations have a unit cost of $1,000,000/station, bike lockers $12,063/locker, bike racks $1,000/rack.	None, assumed too small to quantify
CR-2.2	Subsidize E-bikes	80% subsidy per e-bike = $1,000 each	Cost of bikes, half FTE of a planner 4
CR-2.3	Pilot Mobility Hubs	MTC Mobility Hubs Playbook, page 113; SFMTA's application for MTC Mobility Hubs was approximately $385K, which only included bike storage and plus $40K to provide complementary placemaking. Also included EV charging assumptions.	1 Planner 4 for five years

Cost Estimates Assumptions

CR Action ID	Climate Roadmap Action Title	Capital Cost Assumptions	Operating Cost Assumptions
CR-2.4	Expand the Bicycle Network	Neighborway Network (which is one step up from Slow Streets) $1,675,000 per mile based on Wiggle Green Corridor cost estimates. Includes: • 1 new traffic signals per mile as $1,000,000 each • 1 new RRFB per mile at $200,000 each • 4 concrete islands, diverters, and/or traffic circles per mile at $30,000 each • 8 speed humps per mile at $10,000 each • 4 curb extensions per mile at $50,000 each Signing and striping at $75,000 per mile Estimated 135 miles of neighborways Protected Bike Lane Network $4,000,000 per mile based on recent 7th St and 8th St protected lanes. Includes: • 4 transit boarding islands per mile at $100,000 each • 2 signal modifications per mile at $250,000 each • 2 new traffic signals per mile at $1,000,000 each • Signing and striping $600,000 per mile • 20 concrete barriers, islands and pedestrian refuges per mile at $30,000 each Estimated 180 miles of protected bike lanes	
CR-3.1	Increase Engagement in Commute Benefits Ordinance Programs	None, operating heavy only	Half FTE 9174 Manager 4 for 27 years
CR-3.2	Increase Share of Employers Offering Commute Subsidies	None, operating heavy only	Half FTE 9174 Manager 4 for 27 years
CR-4.1	Expand Paid Parking on Sundays and Evenings	None, operating heavy only	Escalated net revenue estimate from FY13 dollars, multiplied over 25 years Estimates show that full rollout of Sunday parking meter operation will likely generate a gross revenue equal to or above the $9.7 million collected in 2013 but will require $2.8 million in additional labor and non-labor expenditures. Evening alignment of all meter hours could generate an additional $25 million in annual revenue, but the SFMTA projects that hours alignment would cost the agency an additional $11.2 million annually in additional labor and materials

Cont. Cost Estimates Assumptions

CR Action ID	Climate Roadmap Action Title	Capital Cost Assumptions	Operating Cost Assumptions
CR-4.2	Gradually Charge the Right Price for Every On-street Space, Lower Range (Note: mutually exclusive to 4.3 for modeling purposes)	2021 Capital Plan: $1,000/meter/year	$1,500 per each of 28,000 meters per year for 24 years
CR-4.3	Gradually Charge the Right Price for Every On-street Space, Upper Range (Note: mutually exclusive to 4.2 for modeling purposes)	2021 Capital Plan: $1,000/meter/year	250,000 new meters, $1,500 per meter per year, 24 years
CR-4.4	Increase Residential Parking Permit Fees, Lower Range	None, operating heavy only	Originally modeled as increase price of existing metered parking by 25%, including sum of FY19 meter and garage revenue, 25% rate increase, 5% decrease in demand for existing paid parking spaces. Later changed to increase Residential Parking Permit fees, Lower Range, as a proxy for original action.
CR-4.5	Increase Residential Parking Permit Fees, Upper Range	None, operating heavy only	Originally modeled as increase price of existing metered parking by 100%, including sum of FY19 meter and garage revenue, 100% rate increase, 20% decrease in demand for existing paid parking spaces. Later changed to increase Residential Parking Permit fees, Upper Range, as a proxy for original action.
CR-5.1	Expand EV Charging Stations	The ICCT EV Charging Costs, 2019: https://theicct.org/publication/estimating-electric-vehicle-charging-infrastructure-costs-across-major-u-s-metropolitan-areas/ Level 2 chargers: $5,700 per charger for 6+ chargers per site or $7,000 per charger for 1 charger per site, for labor and hardware Fast chargers: $31,000 per charger for 50kW, $78,000 per charger for 150kW, $143,000 per charger for 350 kW	20 FTE, average of electrician classes for cost, for 27 years
CR-6.1	Develop and Implement Community Transportation Plans	Capital costs reflected in operating	5 FTE 1312 PIO for 27 years 2 FTE 5290 Transportation Planner IV for 27 years 3 Community Transportation Plans over 27 years at about $4 million each

Cont. Cost Estimates Assumptions

Appendix D: Evaluation Framework and Matrices

Staff developed an evaluation framework to help understand the effectiveness of strategies and actions at reaching transportation-related climate action goals and generating community benefits. Staff developed quantitative and qualitative evaluation metrics that measure the potential effectiveness at full build-out or implementation of each action. The evaluation includes:

Quantitative Evaluation Framework

- Cumulative capital and operating cost (in millions) for full build-out by 2050, measured in millions of 2022 dollars (action-level and package-level evaluation)
- Cumulative greenhouse gas emissions reduction potential at full build-out by 2050 compared to business-as-usual, measured in cumulative $mtCO_2e$ reduced (action-level and package-level evaluation)
- Cumulative cost-effectiveness of greenhouse gas emissions reductions: Cumulative cost-effectiveness of greenhouse gas emissions reductions at full build-out by 2050, measured in millions of dollars for every cumulative $mtCO_2e$ reduced (action-level and package-level evaluation)
- Annual greenhouse gas emissions reductions by 2040 relative to 1990 baseline, measured in annual $mtCO_2e$ reduced (action-level and package-level evaluation)
- Low-carbon mode share by goal year 2030, measured in low-carbon mode share, including transit, walking, bicycling, taxis, paratransit, EVs and HOV 3+ (package-level evaluation)

Qualitative Evaluation Framework

- For each action and each community benefit, we assess the potential benefits (action-level and package-level evaluation)
- "High" – The climate roadmap action significantly increases the community benefit. For example, funding and implementing major transit capital projects significantly increases economic vitality as it connects jobs to support economic vitality.
- "Medium" – The climate roadmap action moderately increases the "community benefit. For example, expanding employer incentives to further reduce auto commutes moderately increases air quality as it has a moderate potential impact on reducing greenhouse gas emissions and pollution.
- "Low" – The climate roadmap action slightly increases the "community benefit. For example, extending paid parking hours to Sundays and evenings may increase the chance a resident finds a parking space and reduce circling for a spot, but only slightly increases safety.

To determine the qualitative impacts of actions on community benefits, staff referenced the community benefit evaluation done for the Climate Action Plan 2021 for each of the corresponding supporting actions, along with the assumed community benefits across each strategy.

Assumptions

Staff made several assumptions about the future of San Francisco which align with the recent long-term planning efforts of ConnectSF and other long-range plans. More detailed assumptions can be found in Appendices B and C. Some of the most notable include:

1. **Population and jobs projections**: We based our analysis on population and jobs projections of the Draft San Francisco Housing Element (at the time of analysis), which uses the Metropolitan Transportation Commission and Association of Bay Area Governments projections from Plan Bay Area 2040.
2. **Other transportation and land use strategies**: The analysis is predicated on the assumptions that the city and region will also implement the "Other Transportation and Land Use Strategies in the Climate Action Plan", including: maintain infrastructure in a state of good repair, implement congestion pricing, implement the housing element which leads to increases in the housing supply, not increase the residential parking supply, build a new transbay tube, implement the Downtown Extension and Caltrain Business Plan and meet state goals of 100% EV sales by 2035. Since they are so impactful, the city will not have a path to reaching the city's goals without those actions.
3. **Assumed start dates**: For each action, we used existing planning documents and educated assumptions on a reasonable start time for when we would both start to see and when we would see the full impact of greenhouse gas emissions reductions if we were to start implementing them in the next five to seven years.
4. **Mode shift to transit, walking, biking and other low-carbon modes**: Mode shift to transit, walking, biking and other low-carbon modes occurs when one mode is more convenient than another mode for a particular trip, including by comfort, availability, time and financial costs. We calculated mode shift based on the more conservative assumptions of San Francisco's transportation model, SF-CHAMP, which assumes a relatively high threshold for switching modes. Further mode shift may require an even higher density of origins and destinations beyond current projections and a cultural change in transportation preferences.
5. **GHG emissions**: The carbon intensity of vehicle travel is anticipated to change over time due to existing trends, such as improved fuel efficiency and EV adoption. We used the baseline annual GHG emissions presented in the Climate Action Plan Transportation Analysis prepared by Cambridge Systematics as a starting point and applied reductions accordingly.
6. **GHG emissions reductions**: GHG emissions reductions reflect changes in tailpipe emissions only as presented here. Lifecycle emissions outside tailpipe emissions, such as emissions from electrical generation to power EVs; the emissions from construction and distribution of new vehicles and vehicle maintenance; and the emissions associated with EV batteries, are not included in the analysis.

Actions Evaluation Matrix: Quantitative

Actions	Quantitative Metrics				
Climate Roadmap Action ID and Title	**Approximate full build-out capital costs and net operating costs by 2050 in millions of 2022 dollars**	**Cumulative greenhouse gas emissions reduction potential at full build-out by 2050 compared to business-as-usual (Measured in cumulative $mtCO_2e$ reduced)**	**Cumulative cost-effectiveness of greenhouse gas emissions reductions: at full build-out by 2050 (Measured in millions of dollars for every cumulative $mtCO_2e$ reduced)**	**Annual GHG Reduction by 2050 Relative to 1990 Baseline (Measured in $mtCO_2e$)**	**Annual GHG Reduction by 2040 Relative to 1990 Baseline (Measured in $mtCO_2e$)**
CR-1.1: Build the Five-minute Network	$9,020	$276,000	$32,681	17,800	0
CR-1.2: Modernize Muni Metro	$700	$137,000	$5,109	8,800	5,800
CR-1.3: Initiate Geary Subway	$20,000	$15,000	$1,333,333	0	15,300
CR-1.4: Initiate Central Subway Extension	$1,680	$22,000	$76,364	2,300	1,500
CR-1.5: Implement Muni Forward Improvements	$2,960	$228,000	$12,982	13,600	8,800
CR-1.6: Improve Transfers	$45	$6,000	$7,500	300	200
CR-2.1: Expand Bicycle Parking	$9	$2,000	$4,500	60	40
CR-2.2: Subsidize E-bikes	$6	$13,000	$462	500	300
CR-2.3: Pilot Mobility Hubs	$6	$400	$15,000	10	10
CR-2.4: Expand the Bicycle Network	$898	$141,000	$6,369	6,700	5,500
CR-3.1: Increase Engagement in Commute Benefits Ordinance Programs	$4	$86,000	$47	3,400	2,200
CR-3.2: Increase Share of Employers Offering Commute Subsidies	$3	$91,000	$33	4,800	3,200
CR-4.1: Expand Paid Parking on Sundays and Evenings	($222)	$55,000	($4,036)	2,200	1,400
CR-4.2: Gradually Charge the Right Price for Every On-street Space, Lower Range (Note: mutually exclusive to 4.3 for modeling purposes)	($980)	$369,000	($2,656)	14,700	9,600
CR-4.3: Gradually Charge the Right Price for Every On-street Space, Upper Range (Note: mutually exclusive to 4.2 for modeling purposes)	($8,750)	$1,761,000	($4,969)	69,900	45,800
CR-4.4: Increase Residential Parking Permit Fees, Lower Range (Note: mutually exclusive to 4.5 for modeling purposes)	($25)	$95,750	($261)	4,800	2,500
CR-4.5: Increase Residential Parking Permit Fees, Upper Range (Note: mutually exclusive to 4.4 for modeling purposes	($80)	$383,000	($209)	15,200	9,900
CR-5.1: Expand EV Charging Stations	$161	$446,000	$361	24,800	24,800
CR-6.1: Develop and Implement Community Transportation Plans	$41	$493,000	$83	19,600	12,800

Actions Evaluation Matrix: Quantitative

Actions Evaluation Matrix: Qualitative

Actions	Community Benefits					
Climate Roadmap Action ID and Title	**Racial Equity**	**Public Health**	**Safety**	**Economic Vitality**	**Travel Experience**	**Air Quality**
CR-1.1: Build the Five-minute Network	High	High	High	High	High	High
CR-1.2: Modernize Muni Metro	High	High	High	High	High	High
CR-1.3: Initiate Geary Subway	High	High	High	High	High	High
CR-1.4: Initiate Central Subway Extension	High	High	High	High	High	High
CR-1.5: Implement Muni Forward Improvements	Medium	Medium	Medium	Medium	High	Medium
CR-1.6: Improve Transfers	Medium	Medium	Medium	Medium	High	Medium
CR-2.1: Expand Bicycle Parking	High	High	Low	Low	Medium	Low
CR-2.2: Subsidize E-bikes	High	High	Low	Medium	Medium	Medium
CR-2.3: Pilot Mobility Hubs	High	High	Medium	Medium	Medium	Medium
CR-2.4: Expand the Bicycle Network	High	High	High	High	High	High
CR-3.1: Increase Engagement in Commute Benefits Ordinance Programs	Low	Medium	Medium	Low	Medium	Medium
CR-3.2: Increase Share of Employers Offering Commute Subsidies	Low	Medium	Medium	Low	Medium	Medium
CR-4.1: Expand Paid Parking on Sundays and Evenings	Low	High	Low	Medium	High	High
CR-4.2: Gradually Charge the Right Price for Every On-street Space, Lower Range (Note: mutually exclusive to 4.3 for modeling purposes)	Low	High	Medium	Medium	High	High
CR-4.3: Gradually Charge the Right Price for Every On-street Space, Upper Range (Note: mutually exclusive to 4.2 for modeling purposes)	Low	High	High	High	High	High
CR-4.4: Increase Residential Parking Permit Fees, Lower Range (Note: mutually exclusive to 4.5 for modeling purposes)	Low	High	Low	Medium	High	High
CR-4.5: Increase Residential Parking Permit Fees, Upper Range (Note: mutually exclusive to 4.4 for modeling purposes	Low	High	Medium	Medium	High	High
CR-5.1: Expand EV Charging Stations	Low	High	Low	Medium	Low	High
CR-6.1: Develop and Implement Community Transportation Plans	High	High	Medium	Medium	Medium	High

Actions Evaluation Matrix: Qualitative

Actions Evaluation: Actions that are Cost-Effective and Can Significantly Reduce Greenhouse Gas Emissions

No single action has a greater impact on reducing greenhouse gas emissions than CR-4.2/4.3, which gradually charges the right price for every on-street space. This Parking action yields the highest annual emissions reductions, the greatest cumulative reductions and is the most cost-effective. In fact, because of low capital and operating costs and its revenue-generating nature, this action has a net-positive financial impact (its revenues more than make up for its costs). Expected to significantly alter behavior through less driving, it yields significant community benefits as well.

Community Transportation Planning, CR-6.1, would not generate revenue, but with a relatively low cost and high annual emissions reduction potential, it would be very cost-effective. By advancing Community-Based Transportation Plans and further resourcing community outreach, this action is a critical way to advance racial equity and promote the shifts to low-carbon modes that other strategies are investing in.

The installation of new EV charging stations on city property, CR-5.1, is also a very cost-effective strategy for bringing down greenhouse gas emissions, with a significant potential for annual reductions. At the same time, an action centered on EVs does not yield many community benefits and would therefore need to be paired with other actions that can help advance racial equity and safety.

The transit improvements that come from Muni Forward, CR-1.5, are exactly the kind that beget important community benefits, which range from air quality to economic activity to travel experience. Such improvements transform the streetscape to improve not only transit but active transportation as well. Though the emissions reduced per dollar spent may not compare with a low-cost programmatic action, the overall benefits of transit actions make it clear these are dollars well spent.

The most substantial action of the Active Transportation strategy, expanding the network with new bikeways and Slow Streets, CR-2.4, is also the most cost-effective. Working with members of the community to plan how and where new infrastructure will go increases the likelihood that more San Franciscans will choose to walk, bike and roll. Importantly, this action is projected to have the highest potential community benefit, advancing racial equity alongside public health and safety.

Packages Evaluation Matrix

Metrics	Package A: Capital-intensive	Package B: Program-intensive	Package C: Do Everything (Packages A + B + more parking reform)
Description	**Includes all the capital-intensive actions (including all transit, all active transportation and some parking actions) if we were to fully implement them by 2050**	**Includes all program-intensive actions (including all TDM, most parking actions, and all community programs actions) if we were to fully implement them by 2050**	**Includes both capital and program-intensivey actions from both Packages A and B, plus more intense parking reform.**
Cumulative capital and operating cost (in millions) for full build-out by 2050	$34,499	($1,173)	$26,481
Cumulative greenhouse gas emissions reduction potential at full build-out by 2050 compared to business-as-usual (cumulative $mtCO_2e$)	1,642,400	1,202,750	4,155,400
Cumulative cost-effectiveness of greenhouse gas emissions reductions: Dollars per metric ton of cumulative greenhouse gas emissions reduction potential at full build-out by 2050	$21,005	($975)	$6,373
Annual GHG emissions reductions compared to baseline by 2040 (annual $mtCO_2e$)	89,070	50,000	189,970
Annual GHG emissions reductions compared to 1990 baseline by 2040 (annual $mtCO_2e$), including all background reductions and non-SFMTA actions	1,542,000	1,527,000	1,597,000
Low Carbon Mode share by 2030	60%	62%	65%
Air Quality	18	11	28
Public Health	22	12	33
Safety	17	4	22
Economic Vitality	16	5	21
Travel Experience	21	10	31
Racial Equity	16	8	24

Packages Evaluation Matrix

Appendix E: Transformative Vision

Though none of the packages are anticipated to allow San Francisco to meet its transportation-related targets to meet its climate goals by 2040, San Francisco can still get to its goals. We can see examples of how global peer cities have handled these transportation challenges and get a lot closer to our transportation-related climate goals if we were to emulate some of those cities: Copenhagen, Singapore and Bogotá.

If San Francisco were to have the current low-carbon mode shares of Copenhagen, Singapore or Bogotá, it would nearly meet or exceed its transportation-related greenhouse gas emissions reduction goals.

Copenhagen

Copenhagen, Denmark, is the capital and most populous city of Denmark with a high bicycle mode share of 28% of all trips. Like San Francisco, it has a similar size and population to San Francisco, a tightly spaced street grid, is economically prosperous and has a strong climate vision.

What did they do?

- Extensive investment in the highest quality bicycle and pedestrian infrastructure
- Rely on rail transit to connect to larger region
- Leverage land use patterns where most goods and services are located within a one-mile radius of home
- Foster a culture where all types of people feel safe bicycling
- Expensive registration taxes for private cars

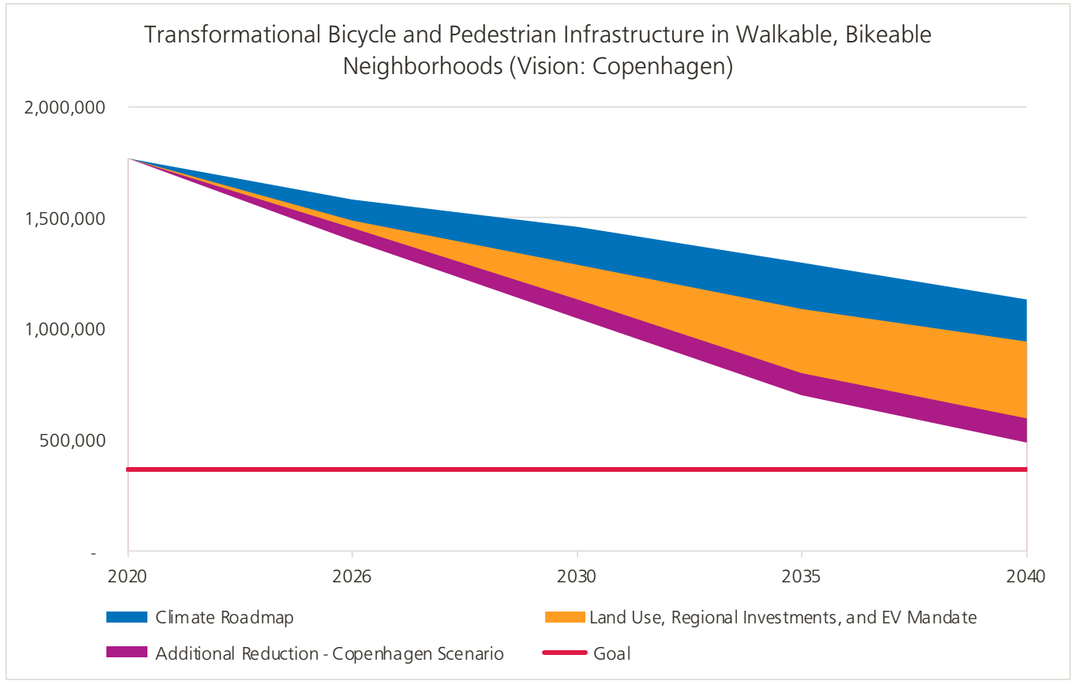
How do they compare?

Mode Share	Copenhagen	San Francisco
Private Car	30%	56%
Public Transport	21%	20%
Walk	21%	20%
Bike	28%	3%

Mode Share of Copenhagen vs. San Francisco

How much GHG could we reduce if we reached a 28% bicycle mode share by 2040?

An additional 109,000 $mtCO_2e$ per year, which would close the gap from a 73% reduction to a 78% reduction in GHG emissions from cars and trucks compared to 1990 levels.



Transformational Bicycle and Pedestrian Infrastructure in Walkable, Bikeable Neighborhoods (Vision: Copenhagen)

Singapore

Singapore is the city-state in Southeast Asia with a high population density and has a high transit mode share of 53% of all trips. Like San Francisco, it has a geography that constrains sprawling development, is a global tech leader and has lots of transit as well as roadway capacity. One of the successes of its high transit mode share can be partly attributed to congestion pricing which helps to price the cost of driving closer to its impact and fund alternatives.

What did they do?

- Implemented congestion pricing around their urban core
- Invested heavily in high quality transit
- Early investor in shared mobility
- Heavy investment in sheltered walkways and bikeways
- Integrated land use planning around 20-minute neighborhood / 45-minute city concept

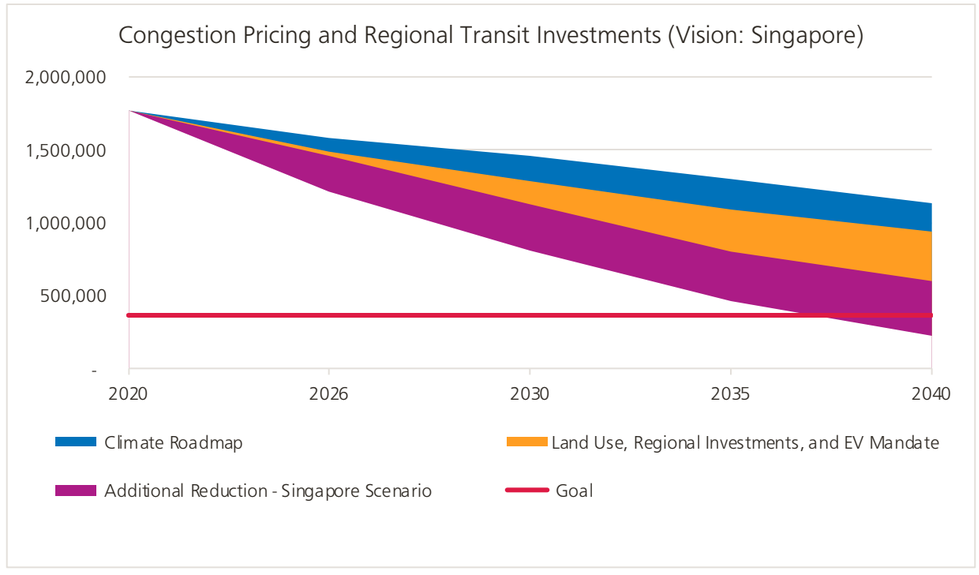
How do they compare?

Mode Share	Singapore	San Francisco
Private Car	33%	56%
Public Transport	53%	20%
Walk	12%	20%
Bike	2%	3%

Mode Share of Singapore vs. San Francisco

How much GHG could we reduce if we reached a 53% transit mode share by 2040?

An additional 370,000 $mtCO_2e$ per year, exceeding our goal moving from a 73% reduction to a 90% reduction in GHG emissions from cars and trucks compared to 1990 levels.



Congestion Pricing and Regional Transit Investments (Vision: Singapore)

Bogotá

Bogotá, Colombia, is the capital and most populous city of Colombia with a high transit mode share of 36% of all trips and a high walk mode share with 46% of all trips. Like San Francisco, it is hilly and geographically constrained, has a reliance on bus transit rather than rail, has a limited roadway network with high levels of congestion and rapid regional growth. Its extensive network of a dozen bus rapid transit lines known as TransMilenio boasts a daily ridership of over a million people.

What did they do?

- Implement extremely high-quality BRT citywide
- Foster a neighborhood-centered culture, where most daily errands are done on foot
- Encourage bicycle culture via ciclovias

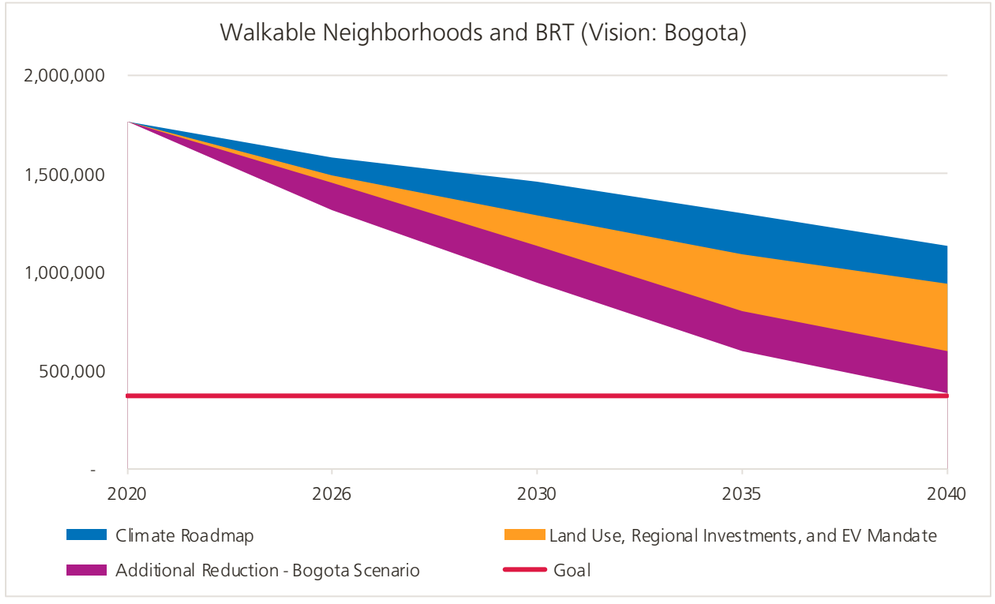
How do they compare?

Mode Share	Bogotá	San Francisco
Private Car	13%	56%
Public Transport	36%	20%
Walk	46%	20%
Bike	4%	3%

Mode Share of Bogota vs. San Francisco

How much GHG could we reduce if we reached a 36% transit mode share and a 46% walk mode share by 2040?

An additional 217,000 $mtCO_2e$ per year, reaching our goal moving from a 73% reduction to an 83% reduction in GHG emissions from cars and trucks compared to 1990 levels.



Walkable Neighborhoods and BRT (Vision: Bogotá)

Endnotes for Appendix

[1] CA OEHHA, CalEnviroScreen 4.0, 2021.

[2] Note: The technical consultant originally modeled GHG emissions for increasing parking pricing in the exiting extent, but staff updated the action to include an increase in Residential Parking Permit fees to better reflect SFMTA plans. Staff independently determined that the GHG emissions reductions from an increase in Residential Parking Permit fees (over a larger area and smaller relative price increase) would be comparable to an increase in parking meter and garage fees (over a smaller area and larger relative price increase).

[3] https://www.caleemod.com/handbook/index.html

[4] Low carbon modes include transit, active transportation, HOV 3+, and EVs. Priority modes are just transit and active transportation.

[5] A 98% electric personal vehicle fleet by 2050 is an assumption based on optimistic estimates of vehicle fleet turnover. See https://www.nytimes.com/interactive/2021/03/10/climate/electric-vehicle-fleet-turnover.html, summarizing work from Alarfaj, A. F., Griffin, W. M., & Samaras, C. (2020). Decarbonizing US passenger vehicle transport under electrification and automation uncertainty has a travel budget. Environmental Research Letters, 15(9), 0940c2.

[6] Assumption based on high-level review of walking speeds, headways, and regional travel patterns.

[7] BART Station Profile Study, 2015. https://www.bart.gov/about/reports/profile, retrieved 11/22/2022

[8] Community Cycling Center (2012). Understanding Barriers to Bicycling Project: Final Report. https://communitycyclingcenter.org/wp-content/uploads/2012/07/Understanding-Barriers-Final-Report.pdf retrieved 11/22/2022

[9] Manaugh, Boisjoly, and El-Geneidy (accepted). Overcoming barriers to active transportation: A mixed methods approach to understanding reasons for not cycling. Transportation. https://tram.mcgill.ca/Research/Publications/over_coming_barriers.pdf retrieved 11/22/2022.

[10] Brand, C., Dons, E., Anaya-Boig, E., Avila-Palencia, I., Clark, A., de Nazelle, A., ... & Panis, L. I. (2021). The climate change mitigation effects of daily active travel in cities. Transportation Research Part D: Transport and Environment, 93, 102764.

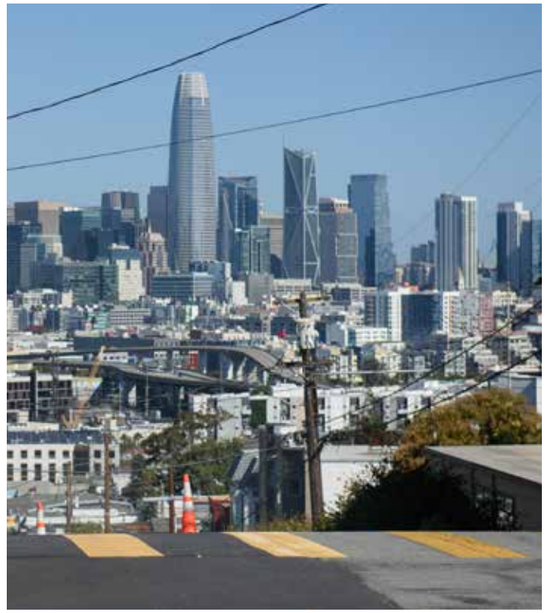
[11] Can Bike Colorado Data Dashboard, https://dashboard.canbikeco.org/ Retrieved 11/22/2022

[12] SF Office of the Environment (2017). San Francisco Commuter Benefits Ordinance Annual Report.

[13] Ibid.

[14] Lehner, S., & Peer, S. (2019). The price elasticity of parking: A meta-analysis. Transportation Research Part A: Policy and Practice, 121, 177-191.

[15] ICF (2018) Electric Vehicle Charging Stations as CEQA Mitigation: Greenhouse Gas Reductions and Cost Effectiveness. https://dtnz.sccgov.org/sites/g/files/exjcpb481/files/Task-3D-EV-Charging-Stations-as-GHG-Mitigation-Mechanism-under-CEQA_White-Paper.pdf Accessed 11/22/2022.



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