DRAFT

Image: Picture of the skyline of San Francisco, the Bay and East Bay looking up Market Street.

2011 Climate Action Strategy
for San Francisco's Transportation System

SFMTA | Municipal Transportation Agency
San Francisco's Mobility Manager

Acknowledgements

The San Francisco Municipal Transportation Agency (SFMTA) 2011 Climate Action Strategy (CAS) is a collaborative planning document developed by the Sustainable Streets Division. The effort was lead by Peter Brown, Project Manager, under the direction of Timothy Papandreou, Deputy Director of Planning and Policy. The San Francisco County Transportation Authority (SFCTA) staff partnership was integral to coordinating and analyzing the greenhouse gas (GHG) emissions data, transportation modeling, and developing the emission reduction strategies. In addition, there were a number of public, academic, business and community-based organizations and individuals that provided guidance and information that was used to create the CAS.

Edwin M. Lee | Mayor

San Francisco Board of Supervisors
John Avalos | District 11
David Campos | District 9
David Chiu | District 3
Carmen Chu | District 4
Malia Cohen | District 10
Sean Elsbernd | District 7
Mark Farrell | District 2
Jane Kim | District 6
Eric Mar | District 1
Ross Mirkarimi | District 5
Scott Wiener | District 8

San Francisco Municipal Transportation Agency Board
Tom Nolan | Chairman
Jerry Lee | Vice-chairman
Leona Bridges| Director
Cheryl Brinkman | Director
Malcolm Heinicke | Director
Bruce Oka | Director

San Francisco Municipal Transportation Agency (SFMTA)
Nathaniel P. Ford Sr. | Executive Director/CEO
Bond Yee | Director Sustainable Streets
Timothy Papandreou | Deputy Director
Darton Ito | Capital Planning Manager
Peter Brown | Project Manager
Anne Fritzler | Transportation Planner

San Francisco Planning Department

Mayor's Office of Climate Protection Initiatives

Port of San Francisco

SF Public Utilities Commission

ICF

Fehr & Peers

The San Francisco County Transportation Authority (SFCTA)
Jose Luis Moscovich, Executive Director
Tilly Chang, Deputy Director for Planning
Zabe Bent, Principal Transportation Planner
Elizabeth Sall, Principal Modeler
Liz Brisson, Planner

San Francisco Department of the Environment
Calla Ostrander, Climate Action Coordinator
Robert Hayden, Clean Air Transportation Manager
Mari Hunter, Electric Vehicles Program Associate

University of California Berkeley
Dr. Mikhail Chester

University of California Los Angeles
Dr. Stephanie Pincetl
Dr. Donald Shoup

Foreword

We are in an historic period here in the San Francisco Bay Area and around the world in terms of climate change action. The San Francisco Municipal Transportation Agency (SFMTA) has grown into a multi-modal transportation agency with a vision of sustainable urban mobility. This vision includes a clear pathway for mitigating the transportation sector's impact on climate change by identifying each of our roles and actions as government, businesses, community groups and individuals. All of these programs, goals, and investment strategies will need broad support to help reduce overall carbon emissions while creating a more livable city. Walking, bicycling and transit trips will become more common than private vehicle trips. Of those trips still made by car, personal and shared vehicles will have the lowest carbon emissions on the market. If the last fifty years of urban transportation and land use development have led to a transportation system responsible for a great deal of the region's greenhouse gas (GHG) emissions, the next fifty years are poised to see a significant reduction. This is an investment in people, policy, technology and infrastructure that will be vastly more cost-effective to make now than to defer into the future. Billions of dollars are spent annually on today's mobility needs in San Francisco. Transitioning into a sustainable transport system will save money and resources, mitigate climate change and build the foundation for a low-carbon future.

The Climate Action Strategy (CAS) is a set of strategic measures that taken together will reduce GHG emissions from the transportation sector. This is a living document that will be updated every two years as more information and analysis becomes available to fine tune the strategies and measure our progress. Every individual contributes to today's emission levels and everyone should become part of the solution. All of our actions, no matter how big or how small, can help create a sustainable San Francisco, region and planet. The SFMTA is ready to provide the leadership needed to pursue that goal.

These climate action strategies are bold and the initiatives will influence public access and mobility choices. Transportation funding is in crisis at a time when our needs are the greatest. One thing we do have is the strength of our people; we are among the most innovative in the world. If any city is poised to lead this effort it is San Francisco. While the challenges in addressing global climate change at times seem insurmountable; the Climate Action Strategy builds upon scientific research, cutting edge public policy, community driven innovations both here and abroad and previous accomplishments that the SFMTA and our myriad of partners have already realized.

The CAS is in many ways the first transportation document of its kind. Through a collaborative effort, substantial reductions in GHG emissions can happen in our lifetimes. Let us show the rest of the nation and the rest of the world how visionary we can all be in creating a sustainable mobility future by implementing these climate action strategies and creating a legacy for future generations.

Sincerely,

Nathaniel P. Ford Sr.
Executive Director/CEO

Image: Picture of Nathaniel P. Ford, Sr.

Box: All of our programs, goals, and investment strategies will need broad support to help reduce overall carbon emissions while creating a more livable city.

Table of Contents

Introduction

In 2007, San Francisco voters passed Proposition A and directed the SFMTA to "develop and implement strategies for substantially reducing" transportation sector carbon emissions. The 2011 CAS meets the 2007 directive by proposing six GHG mitigation strategies that build upon San Francisco and global best practices. The strategies address transportation sector policies and programs needed to meet adopted GHG reduction goals of 80 percent below 1990 levels by 2050.

The CAS is a living document that will be updated every two years as data becomes available from pilot projects and new modeling practices. Quantifying GHG reductions has been challenging due to the availability and quality of data sources. Future updates will include more detailed financial information, cost-benefit analyses, environmental assessments, and life cycle costs. For now, the research of the past two years indicates that these six strategies deserve the region's full attention in meeting the voice of the citizens of San Francisco. The recommendations include new programs and build upon pioneering city policy already adopted. They will need to go through the feasibility and environmental analysis processes, secure funding from existing and new sources and be formally adopted. In addition to the new city policies, a combination of regional, state and federal policies are also recommended in order to realize the greatest carbon emission reduction achievements.

Climate Action Strategy Framework

The 2011 CAS creates the foundation for a financially, environmentally, and socially sustainable transportation system by targeting the most effective GHG reduction strategies and identifying key collective actions, policy changes, and infrastructure investments. It serves as the transportation chapter of the 2011 Communitywide Climate Action Plan being led by San Francisco Environment (SFE) that includes the built environment, energy and water consumption, water transport, waste reduction and recycling sectors.

While vehicle energy efficiency is mostly an industry and regulatory responsibility, travel demand management and supporting infrastructure are within the purview of the SFMTA and its partners. Mitigation is only the first major step in climate action planning; adapting to inevitable changes in storm severity, drought, sea-level rise and transportation system reliability will be developed as part of future document updates. Infrastructure risk assessment and related risk reduction strategies will be recommended at that time to create a resilient transportation system.

San Francisco Surface Transportation System

The SFMTA plans, designs and manages most of the surface transportation system in San Francisco including the San Francisco Municipal Railway transit system (Muni), paratransit, the street network for automobiles, commercial vehicles, bicycles, pedestrians, taxis, as well as parking, traffic signals, signs and traffic enforcement. The SFMTA provides connections to and partners with, six regional transit providers; the Bay Area Rapid Transit District (BART-regional heavy rail), Golden Gate Transit (commuter bus and ferry), Samtrans (commuter bus), Caltrain (commuter rail), Alameda-Contra Costa (AC) Transit (commuter bus) and the Water Emergency Transportation Authority (WETA ferries) to provide regional transit to and from the city.

The California Department of Transportation (Caltrans) operates the state highway system and Amtrak bus service connecting the city to the region. The Golden Gate Bridge, Highway and Transportation District and Bay Area Toll Authority operate the Golden Gate and Bay Bridges, respectively. Additionally, there are a growing number of private local and regional shuttle services providing door-to-door access within San Francisco and employment centers beyond. Lastly, intercity bus services, goods and service delivery companies, vehicle rental companies, limousines, carsharing and bicycle rental operators provide transportation and goods movement services in the city.

The strategies that follow improve access to goods, people and information around San Francisco. The total costs associated with maintaining our hyper-mobile lifestyle will undoubtedly increase in the coming 25 years. The 2011 CAS identifies future investments and quantifies the GHG reductions needed for San Francisco's sustainable transportation future.

Box: The 2011 Climate Action Strategy creates the foundation for a financially, environmentally, and socially sustainable transportation system

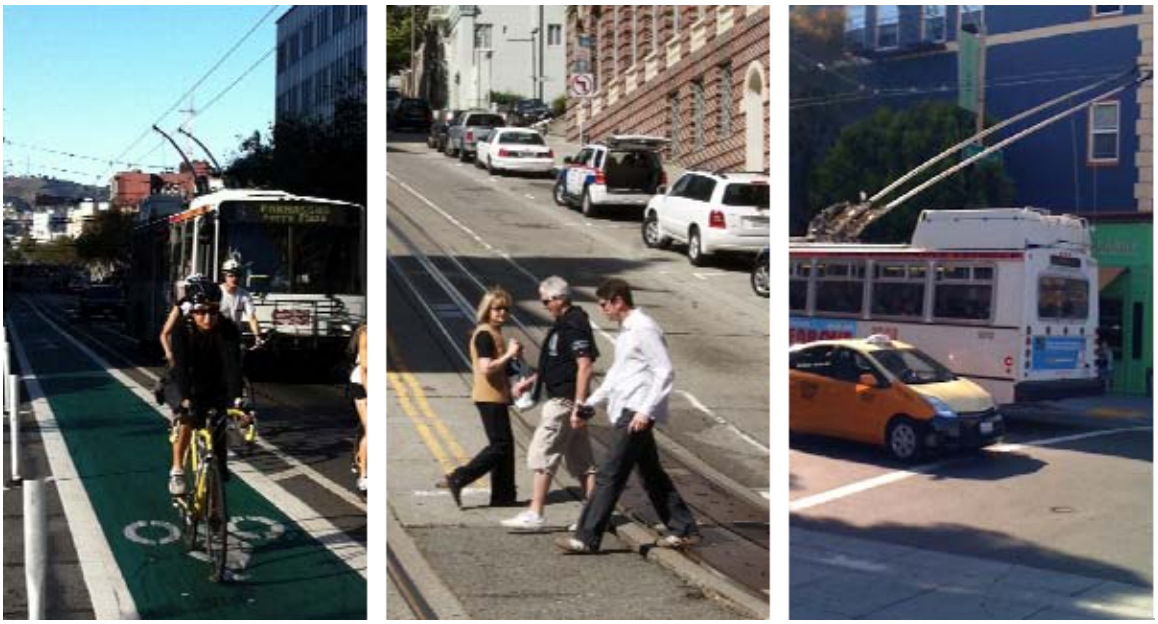


Image: Three street scenes of San Francisco – bicyclists in green bicycle lane on Market Street; pedestrians crossing cable car tracks at California Street; trolley coach and taxi cab on Hayes Street.

The guiding principles of the City and County's Transit First policy, adopted 1973

1. To ensure quality of life and economic health in San Francisco, the primary objective of the transportation system must be the safe and efficient movement of people and goods.
2. Public transit, including taxis and vanpools, is an economically and environmentally sound alternative to transportation by individual automobiles. Within San Francisco, travel by public transit, by bicycle and on foot must be an attractive alternative to travel by private automobile.
3. Decisions regarding the use of limited public street and sidewalk space shall encourage the use of public rights of way by pedestrians, bicyclists, and public transit, and shall strive to reduce traffic and improve public health and safety.
4. Transit priority improvements, such as designated transit lanes and streets and improved signalization, shall be made to expedite the movement of public transit vehicles (including taxis and vanpools) and to improve pedestrian safety.
5. Pedestrian areas shall be enhanced wherever possible to improve the safety and comfort of pedestrians and to encourage travel by foot.
6. Bicycling shall be promoted by encouraging safe streets for riding, convenient access to transit, bicycle lanes, and secure bicycle parking.
7. Parking policies for areas well served by public transit shall be designed to encourage travel by public transit and alternative transportation.
8. New transportation investment should be allocated to meet the demand for public transit generated by new public and private commercial and residential

developments.

9. The ability of the City and County to reduce traffic congestion depends on the adequacy of regional public transportation. The City and County shall promote the use of regional mass transit and the continued development of an integrated, reliable, regional public transportation system.
10. The City and County shall encourage innovative solutions to meet public transportation needs wherever possible and where the provision of such service will not adversely affect the service provided by the Municipal Railway. (Added November 1999)

San Francisco at a Glance

Population Information

Area (Land in square miles)[1] 47.35

Demographics

Resident Population[2]	805,000
Population Density (per square mile)	17,200
No. of Jobs 16 Years of Age or Over[3]	437,000
AM Vehicle Trips into SF[4]	522,000
SF Residents Commuting Out of SF[5]	94,000
Estimated Daytime San Francisco Population	1,200,000
Occupied Housing Units[6]	324,588

Transportation Mode Split in 2010[7]

Total trips within San Francisco:
62% auto / 17% transit / 21% non-motorized

Vehicle Information

Private Vehicles Available By Household[8]

Vehicles Available	*Households*	*Percent*
No Vehicle	98,265	30.3 %
1 Vehicle	132,490	40.8 %
2 Vehicles	68,865	21.2 %
3+ Vehicles	24,968	7.7 %

Total Households	324,588
Total Vehicles Available (estimated):[9]	350,000
Registered Vehicles per Square Mile:[10]	7,392
Average Vehicles Available per Household:[11]	1.07
Registered Vehicles per Capita:[12]	0.43

SFMTA Transit Fleet

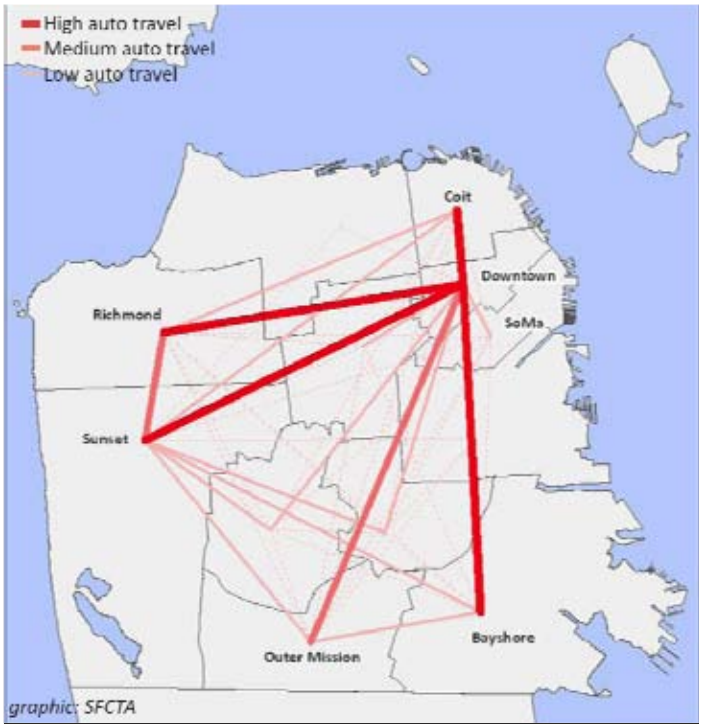
Type	*Number*
Light Rail Vehicles (LRV)	151
Trolley Coaches	313
Diesel Buses	506
Cable Cars	40
Historic Street Cars	40
Total Service Vehicles	1,050

Type	*Number*
Taxis	1,480

San Francisco Transportation Infrastructure

Type	*Miles*
Streets	946
Streets in Parks	65
Bicycle Lanes and Paths	53
Dedicated Transit Lanes	14.8
Light Rail and Streetcar Right-of-Way	71.5
Cable Car Right-of-Way	8.8
Freeways (including ramps and exchanges)	59
BART Right-of-Way in San Francisco	7.2
Caltrain Right-of-Way in San Francisco	6.5

Figure 1: Vehicle Miles Traveled (VMT) between San Francisco Neighborhoods[13]



Map description: Three different colors are used to show the vehicle miles traveled patterns within San Francisco. The most private vehicle travel is from Bayshore to Downtown, Sunset to Downtown, Richmond to Downtown, and Coit to Downtown. The second most private vehicle travel is from the Outer Mission to Downtown. Lesser vehicle miles traveled are from Bayshore to Outer Mission or Sunset, Outer Mission to Sunset, Richmond to Coit, Sunset to Coit, and other internal trips.

Box: In 2010, the majority of private vehicle traffic is between the outer districts of Bayshore, Richmond, and Sunset and the downtown core. The Mission District is well-served by transit, generating fewer car trips.

An Equitable Transportation System

Image: Picture of people walking and bicycling on Sunday Streets, with the street blocked to vehicular traffic.

The transportation system costs billions of dollars annually in public and private funds to operate and correct deficiencies from congestion, injuries and fatalities. In its current form, the land use and transportation system unfortunately contributes to the avoidable loss of life and economic productivity and is a significant source of GHG emissions and air pollution. The public and private expenditures on the transportation system, the societal costs from emissions and injuries and fatalities are disproportionately felt by the most vulnerable San Franciscans. The successful implementation of the CAS not only reduces GHG emissions, it sets the path for a sustainable and equitable transportation system, improving San Francisco's livability.

Box: Those most vulnerable to climate change are the least able to adapt to the impacts. The CAS strategies, if implemented, will create an equitable and sustainable transportation system for current and future generations.

Social Equity – Social Sustainability – Social Cohesion:

- Better transit service for low-income and transit dependent riders
- Improved air quality and public health

- More connected neighborhoods
- Greater access to local and green jobs in San Francisco
- Safer street intersections and quieter neighborhood circulation
- More resilient city to cope with climate disruption
- Market-based pricing to relieve congestion and generate locally-controlled dollars
- Economic and community development through neighborhood agreements and demand pricing
- Better-equipped streets for walking and bicycling
- The development of a more livable city for all
- More affordable transportation options for those who rely on sustainable modes

Image: Three photographs of streetscapes in San Francisco. The first photo is of a pedestrian crossing the street with City Hall in the background. The second is of the parklet installed on Divisadero Street. The third is of a line of people boarding the N-Judah train at Carl and Cole streets.

A City of Short Trips

Image: Picture of pedestrians crossing Third Street on Market Street, in front of cars waiting to cross intersection.

San Francisco is a city of short trips. Its Transit-First Policy, compact development pattern and seven-by-seven mile geography combine to define its success as a transit and walking city. More importantly, however, this success lends itself to the city becoming even more walkable, transit-oriented and bicycle-friendly in the future. The goal of the SFMTA is that by 2030, 40 percent of all city trips will be taken by walking or bicycle.[14]

According to the National Household Travel Survey, the average trip in the US is ten miles long.[15] However, for trips within San Francisco, the average automobile trip is less than three miles, only slightly longer than the average bicycle trip at 2.3 miles.[16]

The transit system has no excess capacity during the peak hours and a majority of those trips are easily within bicycle and walking distance. This short trip pattern creates a strong GHG reduction potential for:

- Existing peak transit and automobile trips that can shift to walking and bicycle trips,
- Car- and bicycle-sharing programs which meet a majority of residents' mobility needs while decreasing auto ownership and parking demand, and
- The passenger vehicle fleet to be electrified as issues of recharging over long distances are not a concern.

With projected growth in population of 150,000 new residents and in employment of

250,000 new jobs,[17] San Francisco's transit system is challenged to meet the 2035 mobility needs. It is critical for the city to have a well-functioning transit system in a state of good repair. Any effort to augment transit capacity through capital and operational enhancements, as well as taxi, bicycle and pedestrian improvements will benefit the entire transportation system while reducing carbon emissions. The region should also see shorter trips as Bay Area jurisdictions increase density and implement the region's Sustainable Communities Strategies.

Table 1: Average Trip Length (in miles) in the City of San Francisco by Mode in 2010[18]

Mode	Average Trip Length
Auto	2.8
Transit	3.4
Bicycle	2.3
Walk	0.9

A recent life cycle cost analysis of average CO_2 per passenger mile by mode shows that bicycling is the most energy efficient mode of transport available and driving alone is the most energy intensive.[19] San Francisco has one of the nation's highest transit occupancy rates per passenger mile, making the bus and rail transit system very energy efficient compared to driving (see *Figure 2*). Transforming how automobiles are powered and shifting trips from automobiles to transit, bicycle, and walking trips will define San Francisco's sustainable, low-carbon transportation future.

Box: The average automobile trip in San Francisco is less than three miles, only slightly longer than the average bicycle trip at 2.3 miles.

Image: Photograph shows adults and children bicycling and walking in the street during a Sunday Streets.

Table 2: Transportation to Work (SF Residents)[20]

Mode	2000	2009	Change
Drive Alone	40.5%	38.9%	-1.6
Carpool	10.8%	7.4%	-3.4
Public Transportation	31.1%	31.8%	+0.7
Taxicab, Motorcycle, other	1.6%	1.8%	+0.2
Bicycle	2.1%	3.0%	+0.9
Walk	9.4%	10.3%	+0.9
Worked at Home	4.6%	6.8%	+2.2

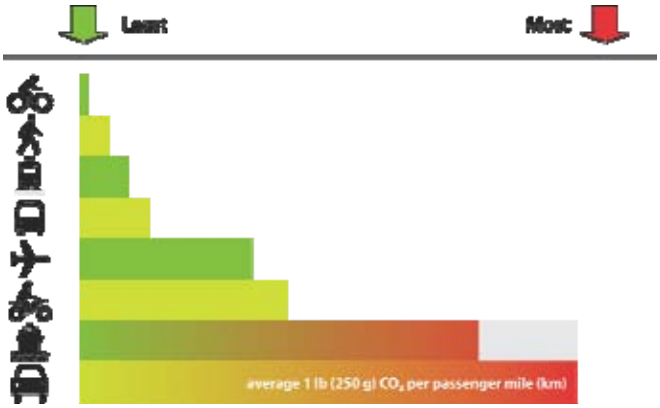
On a typical work day in 2010, the San Francisco transit system contributes just over 2 percent of the city's GHG emissions. Private vehicles are responsible for 33 percent of the total, 14 times more than transit vehicles.[21]

Table 3: Percentage of ALL Trips Taken by Bicycle in 2007[22]

Country	Percentage	City (population)	City percentage
Netherlands	27%	Amsterdam (743,000)	37%
Denmark	18%	Copenhagen (500,000)	20%

Country	Percentage	City (population)	City percentage
Germany	10%	Berlin (3,400,000 metro)	10%
Australia	1%	Sydney (4,500,000 metro)	1%
United States	1%	San Francisco (720,000)	1%

Figure 2: Relative GHG Emissions per Passenger Mile by Transportation Mode in San Francisco[23]
graphic: SFMTA
Description: In a bar graph form shows the relative greenhouse gas emissions per passenger mile. In ascending order of emissions, the ranking of the modes are: bicycle, walking, rail, bus, plane, motorcycle, ship and the highest being the automobile with an average of 1 pound of CO_2 per mile. The amounts associated with each mode i*nclude the supporting infrastructure, energy propulsion and vehicle manufacturing.*



San Francisco Greenhouse Gas Emissions

In 2007, Proposition A required the SFMTA to reduce GHG emissions from its own operations to 20 percent below 1990 levels by 2012 and "to develop and implement strategies for substantially reducing emissions" from the transportation sector. Voter-approved Proposition A also required progress toward the following goals:

1. Zero GHG emissions for SFMTA transit vehicles;
2. Lowering energy consumption in Agency facilities by non-transit vehicles;
3. Maximizing waste reduction in Agency operations;
4. Increasing transit trips and reducing private vehicle trips within the city;
5. Increasing use of bicycling and walking; and
6. Improving regional transit connections to reduce private vehicle use.

The SFMTA will continue to strive for greener transit, however, the real challenge is reducing vehicle miles of travel (VMT) and greening the automobile/truck fleets. In addition to low-carbon vehicles and fuels, shifting trips from auto to transit and non-motorized modes is necessary. This needed shift will impact our transit system's capacity which, at the peak hour, is already overloaded.

The communitywide Climate Action Plan will also be released in 2011 by San Francisco Department of Environment (SFE). This update to the 2004 version will contain a comprehensive list of approaches from all city departments to substantially reduce emissions by 2050 from municipal activities, the built environment and the transportation sector. One critical feature of the plan is that it will go beyond departmental efficiencies and, similar to the SFMTA CAS, seek policy and program improvements that will reduce the carbon impact of all of San Francisco's residents, workers and visitors.

Table 4: Estimated Emissions by Sector in San Francisco, 1990 to 2010[24]

Sector	1990	2010	Change
Municipal Fleet	80,000	88,000	10%
SFMTA (buses & rail)	68,000	53,000	-22%
All Transit	135,000	133,000	12%
Private Vehicles	1,810,000	1,934,000	7%
Transportation Sector	2,020,000	2,155,000	7%
Built Environment	4,080,000	3,760,000	-8%
Total	8,193,000	8,123,000	-1%

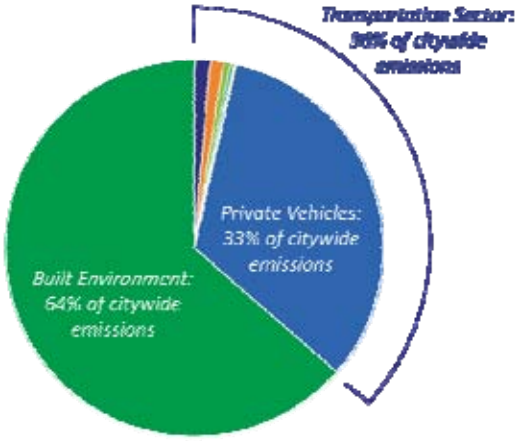
Box: All city departments are required to prepare annual departmental climate action plans which quantify emissions and report on progress made to date. These annual

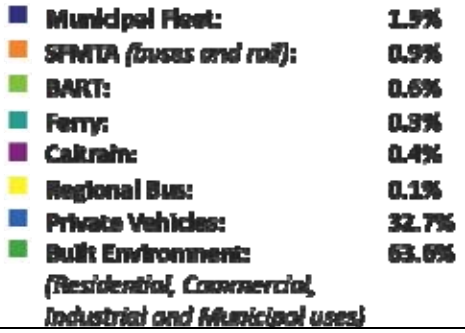
reports are submitted to the Mayor and provide critical information to the communitywide Climate Action Plan.

- SFMTA Departmental Climate Action Plan - Inventory reporting on existing activities
- SFMTA Climate Action Strategy -Transportation sector emission reduction strategies
- San Francisco Climate Action Plan - Communitywide emission reduction strategies

Figure 3: 2010 Citywide GHG Emissions[25]

Figure 3 is a pie chart which shows San Francisco's city wide greenhouse gas emissions by percentage as of 2010. The percentages are: Built Environment 64%, Muni Buses and Rail 0.9%; Municipal Fleet 1.5%; Private Vehicles 33%, BART 0.6%, Ferry 0.3%, Caltrain 0.4% and Regional Bus 0.1%.





Municipal Fleet	1.5%
SFMTA (buses and rail)	0.9%
BART	0.6%
Ferry	0.3%
Caltrain	0.4%
Regional Bus	0.1%
Private Vehicles	32.7%
Built Environment (residential, commercial, industrial and municipal uses)	63.6%

SFMTA Greenhouse Gas Emissions

The SFMTA's buses and rail vehicles account for only 1 percent of citywide GHG emissions. Even with the most radical greening of vehicle fleets or operations, transportation sector reductions cannot be achieved via increased agency efficiency. The SFMTA already operates one of the cleanest multi-modal transportation systems in the world. More than half of its transit vehicles are powered by hydroelectric sources. The Clean Air Plan, released jointly with the San Francisco Department of Environment, includes the SFMTA's fleet replacement blueprint for further reducing bus emissions. Technologies such as hybrid buses and biodiesel fuel are becoming common in fleet vehicles. As low-carbon/electric bus technologies emerge as viable large-fleet replacements, the Agency will continue to lead the nation as a clean air and low-carbon transit provider. The SFMTA's strategy to reduce fleet emissions includes:

1. Maximizing the use of zero- and low-emission buses.
2. Replacing conventional diesel buses with hybrids as a bridge technology to fuel cells.
3. Cleaning up the remaining fleet with the best available retrofit technologies and low-carbon fuels.

Since 1990, the SFMTA has replaced most of its fleet with low-emission vehicles and is planning to install solar power at two of its facilities. Three bin recycling, composting and waste management practices exist at all facilities. The Agency recently joined the American Public Transportation Association (APTA) Sustainability Commitment which sets a series of goals and objectives to reduce the GHG emissions from construction, operations and maintenance practices. The commitment has a five-tier system from entry level to platinum. The SFMTA has applied for recognition at the gold level, one of only a few agencies in the nation. Other responsibilities of the SFMTA include: replacing inefficient traffic signals with state of the art systems, partnering with the taxi providers to achieve a 72 percent clean-air vehicle fleet mix, and partnering with the city real estate department to retrofit several buildings and facilities to meet energy efficiency standards.

Image: Logo stating "Signatory American Public Transportation Association, Sustainability Commitment".

The SFMTA's commitment to green technologies has enabled the Agency to meet the Proposition A departmental efficiency goals and reduce fleet emissions by 25% over the last 20 years. This is a laudable accomplishment for any agency, especially given the current fiscal crisis of the nation's transit industry. The SFMTA now must focus on the greater challenge of reducing GHGs from the transportation sector as a whole.

Box: The SFMTA is proud to note that it will meet the Proposition A goals for the Agency.

Table 5: SFMTA Contribution to Sector and Citywide GHG Emissions[26]

Totals of GHG Emissions	***1990***	***2010***
Transportation Sector GHGs	3.4%	2.5%
San Francisco Total GHGs	1.1%	0.9%

Table 6: SFMTA GHG Emissions Inventory, FY 09/10[27]

Table 6 lists the type of vehicles and the percentage of greenhouse gas emissions by type for SFMTA in 2010: 506 Biodiesel buses and 86 hybrid buses generate 86%; 27 SFMTA facilities generate 5%; Non-revenue vehicle operations generate 4% and 554 LRV and trolley coaches operating on hydro-electric power generate 5% of the total emissions.

Section	***Percentage***
506 Biodiesel (B20, B5, B1) buses, including 86 Hybrid buses:	86 %
27 SFMTA Facilities:	5 %
Non-Revenue Vehicle Operations:	4 %
544 LRV, trolley coaches, cable cars and historic streetcars operating on hydroelectric power:	5 %
TOTAL SFMTA GHGs: 59,000 metric tons* *A 25% reduction from 1990	

Reducing Greenhouse Gas Emissions

Image: Picture of City Hall on the Van Ness Street side with articulated trolley bus in front.

California has led the way in developing climate action policy in the US. Several examples of legislation critical to reducing carbon emissions include:

- California's Low-Carbon Fuel Standard (LCFS) and AB 1493 (Pavley) require cleaner fuels and greater fuel efficiency while encouraging the use of electric vehicles.[28]
- SB 375 (Steinberg) aims to meet the established GHG reduction targets by focusing growth around transit.[29]
- The US Department of Transportation has increased the fuel economy standards to 35 mile per gallon by 2017.[30]

Table 7 below details some related goals set locally, regionally, and nationally. San Francisco has set the most ambitious goals and transportation sector reductions are proving to be the most complex and challenging, and the 2012 goal will fail to be met. Table 8 shows metric tons of CO_2 emitted between 1990 and 2035.

Table 7: GHG Emission Reduction Goals[31]

This is a table demonstrating greenhouse gas emission reduction goals by various entities. For the City and County of San Francisco, in 2005, its GHG emissions are 5% below 1990 emissions. The goal for 2012 is to be 20% below 1990 levels. For 2017, the goal is to be 25% below 1990 levels. For 2024, the goal is to be 40$ below 1990 levels, and for 2050, the goal is to be 80% below 1990 levels. For AB 32, the goal for 2020 is to be 20% below 1990 levels. Executive Order S-3-05 has a goal of being 80% below 1990 levels in 2050. The Metropolitan Transportation Commission has a goal of

15% reduction from 2010 emissions by 2035. The USDOT has a goal in 2017 of 35 miles per gallon CAFÉ. The California Low Carbon Fuel Standard has a 2017 goal of a 10% reduction in fuel carbon intensity.

Agency or Legislation Name	2012	2017	2020	2025	2035	2050
City and County of San Francisco 2007 Prop A	20% below 1990 levels	25% below 1990 levels		40% below 1990 levels		80% below 1990 levels
California's AB 32			20% below 1990 levels			
Schwarzen-egger's Executive Order S-3-05						80% below 1990 levels
Metropolitan Transportation Commission			7% per capita below 2005 levels		15% per capita below 2005 levels	
US Department of Transportation		35 miles per gallon CAFE standards				
California Low Carbon Fuel Standard S-01-07		10% reduction in carbon intensity				

Table 8: Annual Metric Tons of CO2 in the Transportation Sector[32]

This is a table that shows GHG Emissions by type of vehicle. Using these emissions numbers, the redeuction needed to meet target is 1,767,500. The Reductions needed from the CAS is 925,000.

Element of the Transportation Sector	A 1990	B 2010	C 2035 Trend	D 2035 Trend with LCFS	E 2035 Target	Reduction needed to meet target	Reduction needed from the CAS
Private Vehicles	1,810,000	1,934,000	2,430,000	1,575,000	905,000		
Transit & Municipal Fleet	215,000	221,400	350,000	280,000	107,500	C - E =	C - D =
Transportation Sector	2,025,000	2,155,400	2,780,000	1,855,000	1,012,500	1,767,500	925,000

Transportation Greenhouse Gas Emission Reductions

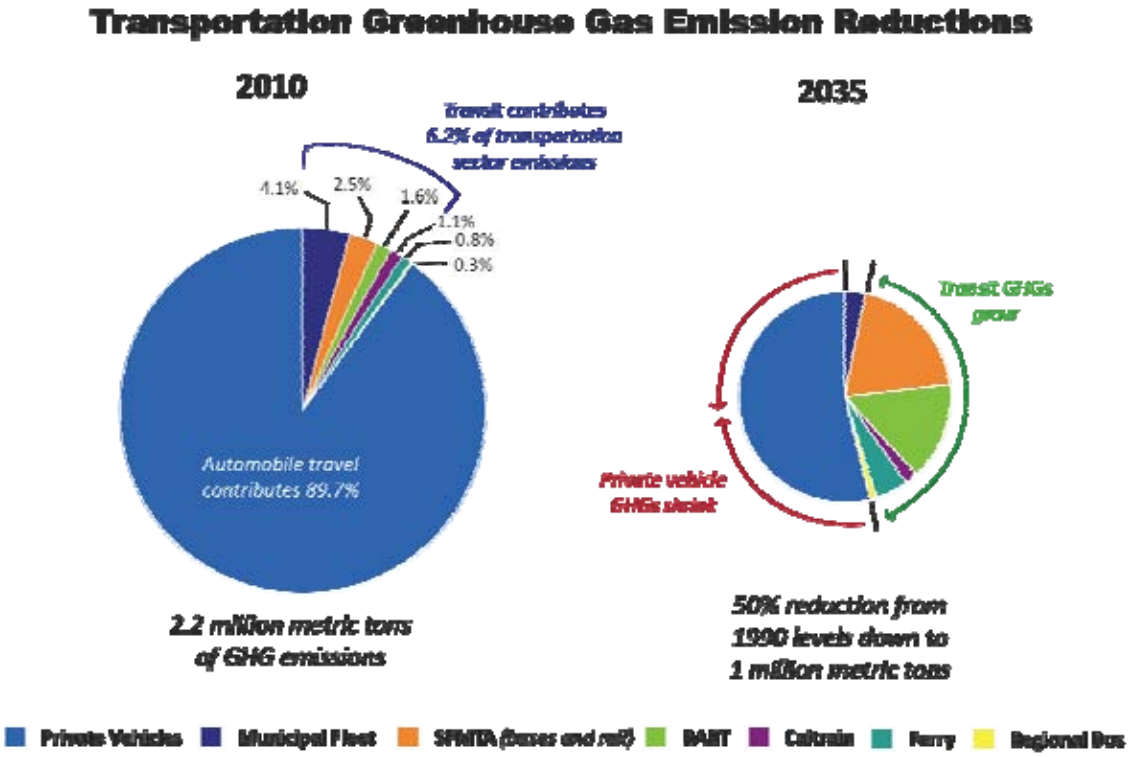


Figure 4: Projected Change in San Francisco Transportation Emissions, 2010 to 2035[33]

Image: There are two graphs showing 2008 greenhouse gas emissions and projected reductions as of 2035. In 2000, there are 8.8 million metric tons of greenhouse gas emissions. 51% come from the city-wide transportation sector. Residential counts for 19% of the emissions; Commercial accounts for 16%; 4% from municipal sources and 10% from industrial sources. Muni buses and rail account for 1%, and the municipal fleet accounts for 1%. San Francisco vehicles on the road account for 24%, while intraregional road vehicles account for 23%. Rail (BART, Caltrain) and Ferry account for 2%. In the 50%greenhouse gas reduction from 1990 levels for 2035, arrows demonstrate that there is no change for residential, commercial, municipal or industrial emissions. However, Muni buses and rail, and rail and ferry need to increase, while road vehicles and intraregional road vehicles need to decrease.

Figure 4 illustrates that increasing transit ridership will increase transit's share of the emissions in the short-term. By 2035, the overall amount of GHGs will be reduced due to decreased auto emissions and the implementation of the Climate Action Strategies. Additionally, as technologies change and transit is able to grow its low-carbon fleet, the emissions attributed to transit as a whole will shrink further, allowing transit operators to expand transit options while continuing to green their fleets.

Transportation is responsible for 37 percent of the GHG emissions citywide (private

autos - 32.5 percent, transit - 3 percent, municipal vehicles - 1.5 percent).[34] The average automobile emits one pound of (CO_2) for every mile traveled, and it takes about 2,200 miles of travel to equal about 1 metric ton of CO_2. In 1990, the city's transportation sector emitted 2 million metric tons of greenhouse gases,[35] and the target is to reduce that by 50 percent by 2035.[36] The challenge will be in reducing emissions from (single occupant) automobile travel through a combination of 1) Energy efficient vehicles, 2) Low-carbon fuels, and 3) Reducing the demand for driving through travel demand management (TDM) programs. The CAS identifies the needed infrastructure to support the anticipated TDM mode shifts. Many San Franciscans have switched from a two-car household to a one-car household: using transit, carshare, walking and bicycling for a majority of trips to both save money and reduce their carbon footprint. Thirty percent of households in the city do not own a car at all.[37]

Box: The average San Francisco driver generates four times more GHG emissions per year than one who relies primarily on transit, walking, and biking.

Developing the 2011 Climate Action Strategy

The Climate Action Strategies were developed based on a combination of available data, travel demand modeling, surveying of transportation best practices in over 30 cities worldwide, and application of the best GHG reduction practices with proven benefits and applicability to San Francisco.

Data

The data used in the analysis is from existing projects, programs and case studies from other cities' transportation experience. Transportation, vehicle miles traveled (VMT) and GHG modeling scenarios from local, regional, and national sources also contributed to the analysis. Industry reports, academic research, surveys, interviews and census data provided information. The SFCTA analyzed VMT and GHG data through the SF-CHAMP travel demand model.[38]

It is important to note that no single strategy can meet our GHG reduction goals alone. As more data is collected, more scenarios can be tested, modeled, and applied. The six strategies presented are interdependent and work best when combined. As strategy performance and new data are assessed, greater accuracy in predicting the GHG emissions reductions of each strategy will be achieved. These include:

- SF*park* data will soon have parking use and benefits information to inform the next CAS,
- Bicycle and walking modeling will become available to quantify how much these trips reduce GHGs,
- Land use modeling and parking occupancy data from recent developments to quantify GHG reductions, and
- A series of travel demand management pilot programs will identify impacts to transit and mode shifts.

Counting the Carbon Footprint

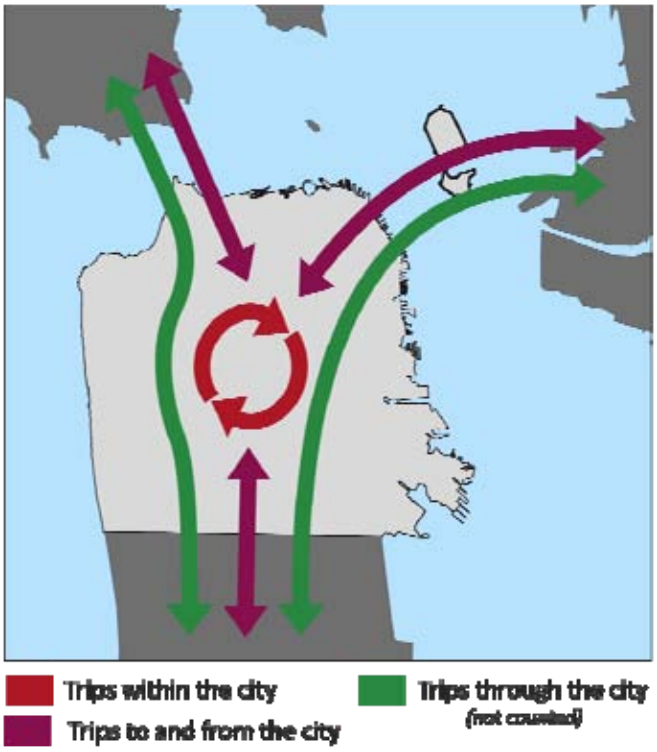
The vehicle miles traveled (VMT) data was developed from the regional travel demand model SF-CHAMP. A strong correlation exists between VMT and transportation sector GHG emissions as VMT accounts for 88 percent of transportation GHGs.[39] Two types of trips were counted: San Francisco intra-city trips and San Francisco regional trips. All trips that originated and ended within San Francisco were included. Of the regional trips that either began or ended in San Francisco, half of the emissions were attributed to the city since the other half will be counted by that origin or destination county. Through trips were not counted as they were not generated from San Francisco nor did they have a destination in the city. While 51 percent of commute trips are locally generated, according to the Transit Effectiveness Report, about 70 percent of all trips begin and end in the city.[40] The future demand on San Francisco's transportation system will continue to be predominantly locally-generated.

Table 9: Private Vehicles Contribute 32.5% to San Francisco's Carbon Footprint[41]

Year	Total Annual Private Vehicle GHGs*
1990	1,810,000
2010	1,934,000
2035 Trend	2,430,000
Trend with LCFS**	1,575,000
2035 Target	905,000

*metric tons of GHGs
**low carbon fuel standards

Figure 5: Types of Trips Assessed when Counting the Carbon Footprint[42]
This figure represents the types of trips counted when calculating the carbon footprint using a group of double-sided arrows. One green arrow running north-south through the city and one green one runs from the East Bay south through San Francisco. These trips were not counted, as the communities in which the trips began and ended will count those trips in their calculations. Three additional double-arrows in magenta show trips originating in Marin County, the East Bay, and the Peninsula and ending in San Francisco. Half of these trips were counted. A circular arrow in red shows all intra-city trips in which were all counted.



Relationship to other Plans
The SFMTA CAS will need to be incorporated into several other key planning

documents and financing plans.

- **SFMTA Strategic Plan 2012-2016** - Develops a 5-year action plan for meeting long-term mobility and livability goals.
- **SFMTA Capital Plan 2012-2016** - Incorporates key capital projects to prioritize for investment.
- **SFCTA San Francisco Transportation Plan 2035** – Identifies goals, needs and investment priorities for all modes.
- **Metropolitan Transportation Commission (MTC) & Association of Bay Area Governments (ABAG) – Sustainable Communities Strategy** – Connects regional land-use and transportation investments to meet the objectives of state legislation to reduce GHG emissions from transportation.
- **MTC – Regional Transportation Plan 2035 -** Develops funding prioritization for the transportation projects in the nine counties of the San Francisco Bay Area.

Methodology

Successful climate and transportation policies from other cities and the successes in the San Francisco region informed these climate action strategies.[43] Evidence-based reductions from selected cities were applied to San Francisco. However, consistent emission data for the six comprehensive strategies proved difficult to quantify. Each reduction strategy is analyzed qualitatively and assessed for relative impacts. Quantification estimates are presented on the Summary of Strategies pages. Further analysis will be performed as data sets become available and each new measure listed in this document will go through the necessary environmental clearance. Future SFMTA Climate Action Strategy updates will contain more detailed cost effectiveness and life cycle analyses.

The best performing individual measures were grouped together into these six strategies. In the Summary of Strategies (pg. 17-18), charts with four categories (GHG Reductions Potential, Public Cost and Private Cost, Impact to Transit or Mode Shift Accommodation, and Overall System Benefit) are ranked low, medium, and high. This gives users of the document an understanding of each strategy's performance, and the ability to compare the interdependent set of six strategies. Using these methods, each strategy is evaluated based on its ability to deliver emission reductions in a cost effective manner. The ranges in Table 10 explain the Strategy Analysis Framework in Figure 6.

Figure 6: Strategy Analysis Framework

This is a bar chart showing the analysis of all the strategies in the CAS. The over all GHG Reduction Potential is medium, Public Costs are medium, Private Costs are high, Impact of Transit System Demand is medium and the Overall Benefit is high.

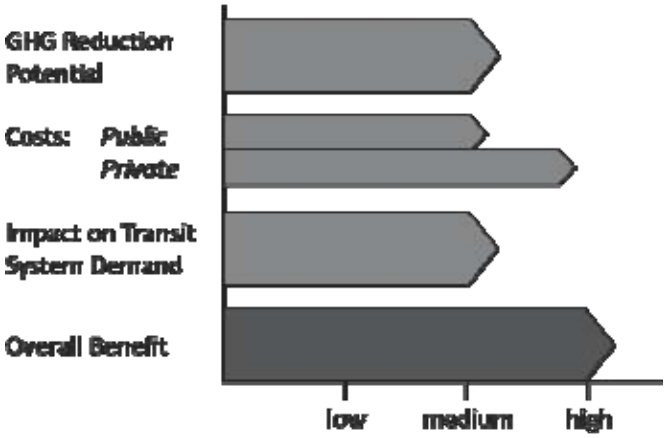


Table 10: Factors Considered in Strategy Effectiveness

Screening Factors	Low	Medium	High
A. GHG Reduction Potential	< 5%	5 – 15%	> 15%
B.1. Public Cost to Implement Over 25 Years	< $100 million	$100 – 500 million	> $500 million
B.2. Private Cost to Implement Over 25 Years	< $100 million	$100 – 500 million	> $500 million
C. Impact on Transit System Demand	< 1% mode shift potential	1 – 5% mode shift potential	> 5% mode shift potential
Potential Effectiveness of Screening Factors *(A. + B. + C.)*	Low Reduction Potential High Costs Little Mode Shift Potential	Medium Reduction Potential Medium Costs Medium Mode Shift Potential Revenue Neutral	High Reduction Potential Medium to Low Costs High Mode Shift Potential Revenue Generator

Six GHG Reduction Strategies

The six Climate Action Strategies fall into two key categories: Travel Demand Management (TDM) and Infrastructure Support. The TDM strategies decrease automobile travel and result in mode shifts toward sustainable transportation. The Infrastructure Support strategies provide the capacity to accommodate the mode shift. In addition, increases in vehicle fuel efficiency and market shifts toward electrification are anticipated to lower emissions. Political will, behavioral change, funding and electric vehicle market penetration will no doubt be some of our most significant challenges. Key points about each strategy include:

- **Travel Choices & Information** can be implemented in the near-term at a relatively low cost while generating net revenue.
- **Demand Pricing** can also happen in the near-term but relies on a great deal of political will and cannot succeed without transit upgrades and expansions.
- **Transit-Oriented Development** (TOD) relies on zoning changes and regional economic growth to continue positive changes to the built environment. It also generates more walking, bicycling and transit trips while reducing per capita VMT.
- **Transit Improvements** have a high initial public cost and are critical to allow the TDM strategies succeed. Maintaining a State of Good Repair is a high priority for the SFMTA.
- **Complete Streets** can be phased and plays a critical role in speeding transit service, allowing safe pedestrian trips and large increases in bicycle travel.
- **Electric Vehicles** have significant CO_2 reduction potential with high private costs and will require significant charging station installations.

Building upon San Francisco's pioneering public policies, the Climate Action Strategy identifies existing and new reduction measures. New policies build upon existing ones or require adoption once feasibility studies and necessary approvals are completed. Sustainable mobility investments and new public policy are recommended. The hidden environmental and economic costs of our current transportation and development patterns have contributed to a system that consumes too much energy and is too dependent on the automobile. The path to the future is clear; zero- and low-emission transport will become the norm, not the exception.

Summary of Strategies

Travel Demand Management

STRATEGY 1: *Travel Choices & Information*

Image: Has a picture of a bicyclist on the street, with private automobiles and a Muni bus.

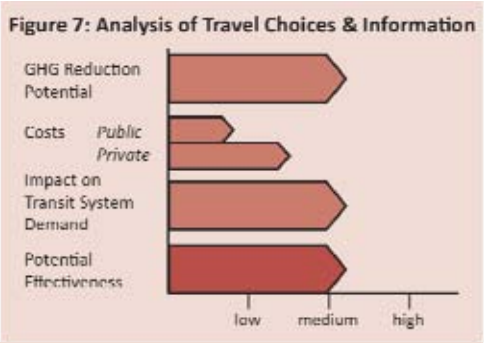
Current Measures:

- Create and enforce a robust parking cash-out program
- Enforce San Francisco's commuter benefits ordinance

New Measures:

- Expand education and support to reduce driving
- Require neighborhood employer-paid TDM programs
- Coordinate private shuttles with the transit system
- Incorporate transit passes with student IDs as part of enrollment
- Integrate all transportation modes, information, and payment systems
- Expand rideshare and commuter carpool options
- Create hotel visitor and tourist transit pass programs

Figure 7: Analysis of Travel Choices and Information
This figure shows an analysis of estimated costs and greenhouse gas reduction in the analysis of travel choice. The greenhouse gas reduction potential is medium, the public cost is low while the private cost is between low and medium and the impact on transit system demand is medium. The overall benefit is medium.



STRATEGY 2: *Demand Pricing*

Image: picture of an automobile entering an area where there is a charge for driving in the area.

Current Measures:

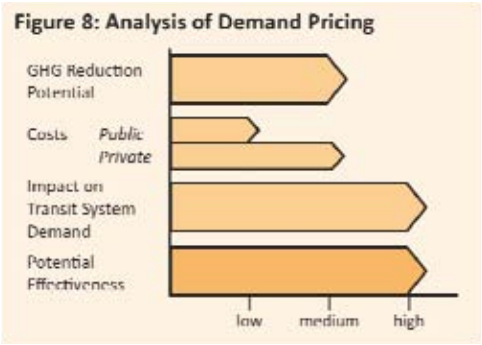
- Expand SF*park* Program and demand-based parking fees citywide
- Expand SF*go* and implement the Intelligent Transportation System and predictable travel routing

New Measures:

- Explore off-street parking policies to encourage transit ridership
- Implement variable rate road pricing on bridges and streets
- Optimize peak hour service delivery schedules

Figure 8: Analysis of Demand Pricing

This figure shows an analysis of estimated costs and greenhouse gas reduction in the analysis of demand pricing. The greenhouse gas reduction potential is medium. The public cost is low and the private cost is shown to be medium. The impact on transit system demand is high, as is the overall benefit.



STRATEGY 3: *Transit-Oriented Development (TOD)*

Image: Shows a picture of high rise buildings near a rail center and transit center.

Current Measure:

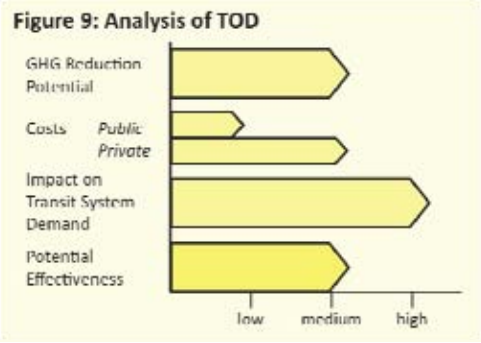
- Focus housing/job growth and infill redevelopment along existing transit lines and within regional Priority Development Areas

New Measures:

- Require all new developments to have smart mobility passes as part of homeowners' association fees and business leases.
- Optimize carshare parking near transit centers and require sufficient parking for carshare and bicycles in new developments
- Remove parking requirements for new developments
- Unbundle parking in new developments

Figure 9: Analysis of TOD

This figure shows an analysis of estimated costs and greenhouse gas reduction in the analysis of transit oriented development (TOD). The greenhouse gas reduction potential is medium, and the public cost is low and the private cost is medium. The impact on transit system demand is seen as high, and the overall benefit is seen as medium.



Infrastructure Support

STRATEGY 4: *Transit Improvements*

Shows a picture of a Muni Metro light rail vehicle in an underground tunnel.

Current Measures:

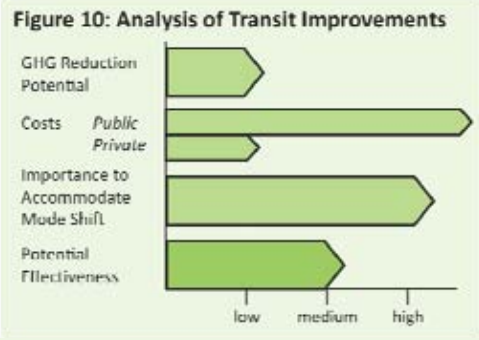
- Improve transit reliability, speed and reduce overcrowding though implementation of the Transit Effectiveness Project
- Fund State of Good Repair and safety improvement

New Measures:

- Expand transit fleet, storage and maintenance to accommodate growth
- Dedicate exclusive right of way for rail and bus networks
- Augment express transit services on key corridors
- Expand regional transit core capacity to serve growth and mode shifts
- Revise regional transit operating practices and policies

Figure 10: Analysis of Transit Improvements

This figure shows an analysis of estimated costs and greenhouse gas reduction in the analysis of transit improvements. The greenhouse gas reduction potential is low, while the public cost is high and private cost is low. The importance to accommodate mode shift is high, while the overall benefits are seen as medium.



STRATEGY 5: *Complete Streets*

Image: Picture of bicyclist on green bike lane.

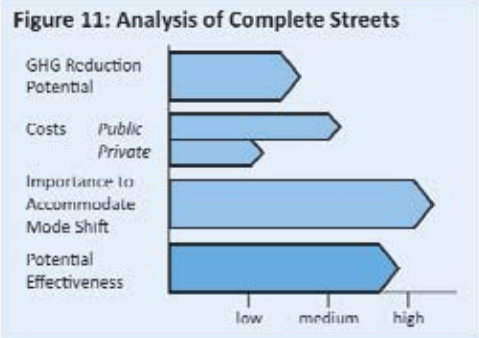
Current Measure:

- Complete the implementation of the SFMTA Bicycle Plan
- Increase bicycle parking capacity citywide
- Develop pedestrian amenities, plazas, and complete the street grid to the waterfront

New Measures:

- Implement complete, green streets and slow zones citywide
- Develop a comprehensive protected "cycle track" network
- Dedicate self-enforcing transit-only lanes especially in the northeast quadrant
- Implement bicycle sharing and create electric bicycle capacity

Figure 11: Analysis of Complete Streets
This figure shows an analysis of estimated costs and greenhouse gas reduction in the analysis of complete streets. The stand alone greenhouse gas reduction is just shy of medium, while the public cost is medium and private cost is low. The importance to accommodate mode shift is high, and the overall benefit doesn't quite reach high.



STRATEGY 6: *Electric Vehicles*

Image: Shows a plug in electrical vehicle being recharged at an outdoor charging station.

Current Measure:

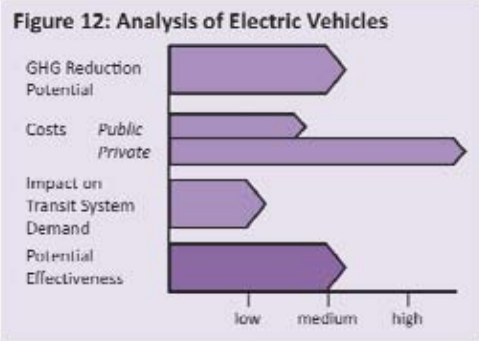
- Convert 100% of taxi fleet to low-carbon vehicles
- Build more publicly accessible and private residential charging stations

New Measures:

- Promote incentives for shared low-carbon and electric vehicles

- Require charging infrastructure for new development, carsharing and electric bicycles
- Require smart-grid networked vehicle charging systems in high demand areas
- Require low-carbon service delivery vehicles in the city

Figure 12: Analysis of Electric Vehicles
This figure shows an analysis of estimated costs and greenhouse gas reduction in the analysis of electric vehicles. The greenhouse reduction potential is greater than medium. The public cost is medium and and private cost is very high, while the impact on transit demand is low. The overall benefit is medium.



Strategy 1: Travel Choices & Information

Image: Picture of cyclists trying to cross Van Ness Avenue at Market with automobiles and a Muni bus.

As a strategy to reduce GHG emissions, Travel Choices & Information creates incentives that help make low-carbon travel possible. Managing the demand for the transportation system is one of the most cost-effective strategies for reducing greenhouse gas emissions, as cities can make significant strides in reducing single-occupant vehicle travel with very low direct costs. There are plenty of reasons why most people choose cars for their trips, not the least of which is convenience. However, by providing increased personal travel choices and reducing roadway demand, San Francisco is heading in the right direction to reduce GHG emissions. The Travel Choices strategy is comprised of:

- Community Transportation Demand Management
- Employment Transportation Demand Management
- School Transportation Demand Management
- Integrated Mobility Management (IMM) and the creation of smart mobility computer applications

By providing real-time, multimodal travel information, the best mode for each trip will become easier to select. Travel Choices is about connecting people to their destinations through real-time information and school-, employee-, and neighborhood-based travel options. Developments in technology and social media allow coordinated trips with friends, family and coworkers; resulting in less carbon-intensive travel behavior and fewer single occupant vehicle trips.

Providing more effective education and outreach to travellers optimizes existing

resources. Student IDs can be integrated with transit passes and/or Clipper Cards. Also, all employers and Home Owners Associations should have programs which provide ridesharing and transit passes. Along with the development of smartphone applications, Travel Choices & Information has the potential to reduce GHGs in the near-term at a low public and private cost. Public agencies should integrate information and data and make it publicly accessible so that the private sector can create premium travel choice applications.

Image: shows a cyclist putting her bicycle in the bike rack on the front of a Muni bus.

Image: Picture of young men using a computer and smart phone to access transit data at 511.org.

Figure 13: Integrated Mobility Management Application
graphic: SFMTA

Shows a smart phone that shows that five choices are available to reach the destination, by transit, bicycle, walking, taxi and car share. Each choice shows how long the trip will take by the mode, and when the transportation choice is available. For transit and car share, the cost is given.

Enhanced modal integration is critical to sustainable transportation. Current and future technologies create better travel information and payment systems that would allow access to all transportation options. As shown in Figure 13: Integrated Mobility Management Application, the development of a free web-based and smart phone app would allow users to quickly and easily link the transit modes, costs, travel time, GHG impact, and payment information in one action. The CO_2 emissions associated with each trip are shown by mode, informing the user how to make it an efficient green trip.

Proposed Measures:

Current:

- Create and enforce a robust parking cash-out program
- Enforce San Francisco's commuter benefits ordinance

New:

- Expand education and support to reduce driving for all trips
- Require neighborhood and employer-paid travel choice programs
- Coordinate private shuttles with the transit system
- Incorporate transit passes with student IDs as part of enrollment
- Integrate all transportation modes, information, and payment systems
- Expand rideshare and commuter carpool options
- Create hotel visitor and tourist transit pass programs

Image: shows the casual carpool and individuals lined up for the ride.

Strategy 2: Demand Pricing

Image: Cars shown entering the Central Zone of London which charges for entry. The signage for entering the Central Zone is also shown.

The subsidies that have gone into creating massive incentives for driving, separation of uses, road building and minimum parking requirements cannot be sustained over the long-term financially or environmentally. To deal with roadway congestion, use existing parking and road capacity more efficiently and most of all to generate greatly needed funds for transit, walking and bicycling, pursuing reforms in parking policy and implementing road pricing are critical GHG reduction tools. When it comes to paying more to drive the private automobile, resistance is expected. However, now is the time to educate those unfamiliar with the benefits of market pricing and create sustainable public policy.

Stockholm, London and Singapore have reduced congestion and carbon emissions while generating revenue for sustainable modes through market pricing. Manhattan, Pasadena, Redwood City and San Francisco have reformed parking policy to charge variable market rates, effectively increasing parking supply without building costly parking infrastructure. San Francisco has pioneered the implementation of these measures with the SF*park* program and by removing parking minimums for some types of new development. These efforts, however, are only a start. The Bay Area should become a leader in both congestion and parking pricing. Travel demand management tools use market-based mechanisms to reduce travel time, decrease vehicle trips and create parking availability. Travel time reliability for both drivers and transit users are significantly improved as well.

Transit Improvements complement Demand Pricing by providing the needed capacity so that drivers have a viable option to use transit in lieu of paying new fees. The SFCTA

has begun the Mobility, Access and Pricing Study to evaluate road pricing in San Francisco and estimate new revenues which would support local and regional transit investments. SF*park* expansion throughout the city would effectively manage the city's parking supply and provide an additional source of new revenue for transit investments. Both market-based tools create greater options for all travelers.

Image: An aerial photograph of the Bay Bridge going into San Francisco fully jammed with traffic.

Image: Picture is of a parking meter which takes various forms of payment and variable pricing.

Image: Photograph shows the direction to three garages and how many spaces are available.

Private vehicles cruising for parking are responsible for approximately 30 percent of city driving. Through a demand-based pricing system, SFpark aims to reduce cruising for parking, road congestion and GHG emissions. Data from sensors located at each parking space is uploaded wirelessly to the SFpark data feed. Information is available to the public on SFpark.org, on street signs and smart phone applications. When fully implemented, SFpark will reduce road congestion and GHG emissions by decreasing the need for drivers to circle neighborhoods looking for parking. Have you ever done that? Would you like there to be at least one space per block just about any time, day or night? Getting the price right for curbside and garage parking will do just that.[44]

Proposed Measures:
Current:

- Expand SF*park* Program and demand-based parking fees citywide
- Expand SF*go* and implement the Intelligent Transportation System and predictable travel routing

New:

- Explore off-street parking policies to encourage transit ridership
- Implement variable rate road pricing on bridges and streets
- Optimize peak hour service delivery schedules

Image: Photograph is of the Golden Gate bridge completely filled with automobiles going in both directions.

Strategy 3: Transit-Oriented Development

Image: This photograph shows high rise buildings built out and under construction next to a transit center.

Although the SFMTA does not have land use authority, the Agency understands the importance of transit-oriented development (TOD). By concentrating new development along existing transit corridors, San Francisco has decreased GHG emissions and growth in vehicle miles traveled. In California, surveys show that residents who live near a transit station take transit to work at a rate five times higher than residents who don't live near stations. Transit improvements should be prioritized and financed though development agreements where new, high-density mixed-use projects are located. Proper analysis of multi-modal trips generated by development projects will help determine fair-share contributions toward transit operations and capital, complete streets and travel demand management options for these new and redeveloped sites.

San Francisco has already begun components of this innovative TOD strategy. Recent project approvals have included the provision of transit passes in new development, lower parking requirements and higher carsharing provisions. Progressive development agreements create GHG reductions, greater livability and allow employees and residents to practice sustainable mobility. They also provide critical revenue to finance the operation and capital investments for the transit system.

In combination with policies such as unbundling the cost of parking, providing sufficient carshare spaces and including mobility passes with residences, the city has another mechanism to achieve its GHG reduction goals. If successful in implementing wide-spread transit-oriented development by 2035, more San Francisco residents will walk, take transit or bicycle for the majority of their trips.

This strategy relies on changing land uses over time and its positive impacts will be experienced in the long-term. Because these changes to the built environment are lasting, so too will be the benefits in decreasing GHG emissions.

Image: Photograph on the page shows a Muni Metro light railon San Jose Boulevard with a Muni bus in the background.

Figure 14: Vehicle Trip Rates of TODs vs. ITE Projections[45]

This figure shows vehicle trip rates of transit oriented developments (TOD) versus Institute of Transportation Engineers (ITE) projections. For 24 hours, it is estimated there are less than 4 vehicle trips per dwelling unit in a TOD versus ITE's projection of slightly less than 8 vehicle trips. For the AM peak, the projection that TOD generates a miniscule amount of vehicle trips, while the ITE projection is greater at a rate a little less than half of one trip. For the PM peak, the TOD projection is greater than for the AM peak, but still doesn't reach the ITE projection of greater than half of one vehicle trip.

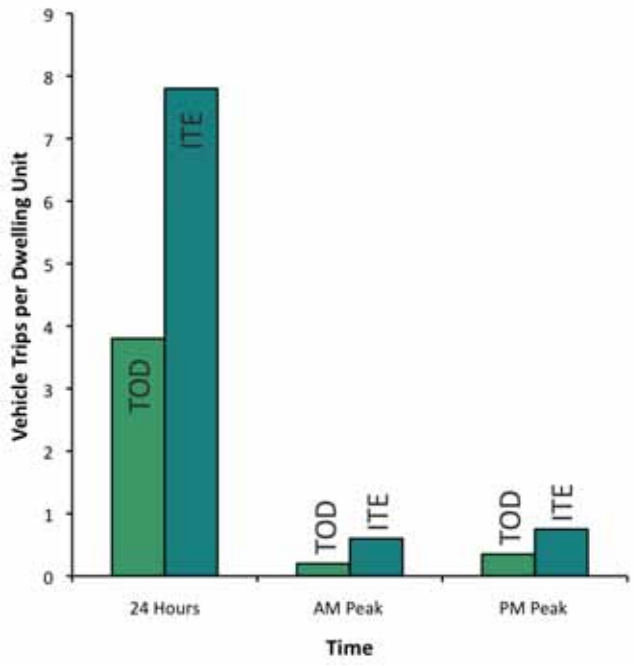



Image: Picture of pedestrians crossing King Street in front of the T-Third line in front of the AT&T Ball Park.

In a study that measured weekday vehicle trip generation rates for 17 TOD projects in five US metropolitan areas (Philadelphia, Northeast New Jersey, Washington, DC, Portland, and the San Francisco Bay Area), TOD housing projects averaged 44% fewer vehicle trips than estimated by the Trip Generation Manual of the Institute of Transportation Engineers (ITE) which is widely used as the reference manual for gauging traffic impacts. As Professor Donald Shoup and others have noted, the predictions of the ITE manual are based largely on observing suburban settings with infrequent transit service. Unsurprisingly, these settings exhibit high levels of car travel. During peak periods, the study showed even higher levels of trip reduction for TODs – nearly 50 percent fewer vehicles trips than ITE predictions.[46]

Proposed Measures:
Current:

- Focus housing/job growth and infill redevelopment along existing transit lines and within regional Priority Development Areas

New:

- Require all new developments to have smart mobility passes as part of homeowners' association fees and business leases.
- Optimize carshare parking near transit centers and require sufficient parking for carshare and bicycles in new developments
- Remove parking requirements for new developments
- Unbundle parking in new developments

Image: Picture of Muni Metro light rail train in the center of the street in a separated right of way.

Strategy 4: Transit Improvements

Image: Photograph is of the Muni Metro light rail train in an underground tunn

The local and regional transit system is at a point of crisis. Funding for operations is at an all-time low, services are being cut and the system needs significant capital investments just to maintain existing infrastructure in a state of good repair (projected at a $12 billion in investment needed through 2030).[47]Opportunities to maximize current transit service must be fully examined, including reallocating scarce funds, dedicating transit lanes to improve reliability and securing new funding sources. At the same time, additional service must be added throughout the region.

San Francisco's transit system is operating beyond its peak-hour capacity. Transit routes on major corridors cannot take on more passengers, let alone meet the latent or projected demand in the coming decades. BART is nearly at capacity in the downtown core and, like Caltrain and Muni, is facing service cuts and revenue shortfalls. Private employer shuttles have begun providing express service to and within San Francisco to compensate for the lack of fast and reliable public transit.

Transit improvements are critical to the success of the CAS so that adequate capacity exists to accommodate mode shifts and growing ridership. Demand is expected to increase significantly by 2035 for the SFMTA and the Bay Area's transit operators.[48] Optimizing and expanding the existing system to create new capacity improvements in the urban core, combine with the TDM and pricing strategies to create a more sustainable transportation system overall.

While initial cost estimates are in the billions of dollars, deferring investments in transit maintenance and expansion is not an option if the city and region are serious about reducing GHGs and sustainable future. The SFMTA and our regional transportation

partners must be prepared to generate the needed revenue to invest in the key corridors, complete regional core-capacity projects, improve the state of good repair, and ensure fast and reliable operations. San Francisco's future as a sustainable city will largely depend on transit upgrades and expansions regionwide.

Image: An artist's rendering of the Transbay Transportation Center.

Image: photograph shows a light rail vehicle loading passengers from a platform that has a glass covered exit for passengers.

Image: Photograph shows an articulated bus rapid transit bus.

The construction of a Bus Rapid Transit system in San Francisco would reduce transit travel time and increase reliability along the most heavily-used corridors. The first proposed route on Van Ness Avenue will combine the following measures: transit-only lanes with limited stops, traffic signal priority for transit vehicles, multi-door boarding capability at sidewalk-level platforms, and real-time information systems. BRT improves the customer experience through faster boarding and alighting from the vehicles, shorter travel times and greater reliability. The transit improvements associated with the Van Ness BRT project have been prioritized for funding; construction is scheduled to start in 2012, with service starting in 2015-2016.

Proposed Measures:
Current:

- Improve transit reliability, speed and reduce overcrowding though implementation of the Transit Effectiveness Project
- Fund State of Good Repair and safety improvements

New:

- Expand transit fleet, storage and maintenance to accommodate growth
- Dedicate exclusive right of way for the rail and bus network to reduce travel time and improve reliability
- Augment express transit services on key corridors
- Expand regional transit core capacity to serve growth and mode shifts
- Revise regional transit operating practices and policies through the MTC Transit Sustainability Project

Image: Photograph shows Muni trolley buses in a storage facility.

Infrastructure Support

Strategy 5: Complete Streets

Image: photograph shows bicyclists in a green separated bicycle lane, with automobiles on both sides and a Muni bus.

As popularity of the automobile grew in the US, transportation engineers primarily designed roadways to allow cars to move quickly and easily. Today, redesigning streets to address the needs of all users is widely accepted. Designing streets that accommodate people's needs, as San Francisco is doing with efforts like the Better Streets Plan, Walk First, the Bicycle Plan and the Transit Effectiveness Project (TEP), creates pleasant urban environments for all users: people in stores, on sidewalks, bicycles, transit and in cars. In lieu of the past focus on wide thoroughfares with abundant parking, the Complete Streets Strategy creates the city's multi-modal connective network. Dedicated transit lanes, cycle tracks, and landscaping facilitate the sustainable mode split goal seen in Table 11. Landscaping sidewalks and medians also develops the urban forest, a recognized carbon sink for the city.

Since it can be phased beginning with paint and signage, Complete Streets is one of the most cost-effective strategies. Upgrades with more permanent facilities can be prioritized and funded to create multiple benefits:

- Improve transit reliability and operational cost savings through dedicated lanes and stop consolidation,
- Improve health of the city through the promotion of walking and bicycling and comfortable streetscapes,
- Reduce noise, air and ground water pollution management through permeable pavements, and

- Reduce transportation-related costs to society (collisions, hospital, legal costs), saving tens of millions annually.

Recent successes with implementing the Bicycle Plan show that developing multimodal infrastructure increases cycling ridership. Along with transit improvements and promoting pedestrian safety, this strategy facilitates future growth and allows achievement of the SFMTA 2030 mode split goal. Like the TOD Strategy, Complete Streets modifies the city's built environment, encouraging changes in travel choices that lead to lasting reductions in GHG emissions.

Table 11: Distribution of Transportation Use by Mode in 2000 Compared to the SFMTA 2030 Goal[49]

Year	Auto	Transit	Bicycle or walk
2000	62%	17%	1% bicycle, 20% walk
2030	30%	30%	40%

Image: photograph shows a street scene with tables and chairs on the sidewalk and individuals having a meal at one of the tables. Text associated with image: People who don't own a car in San Francisco save approx. $9,400 each year.

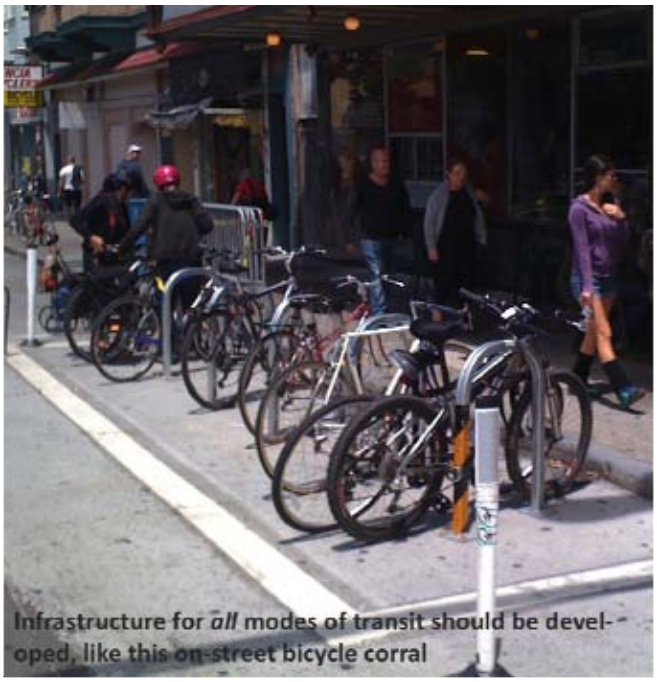
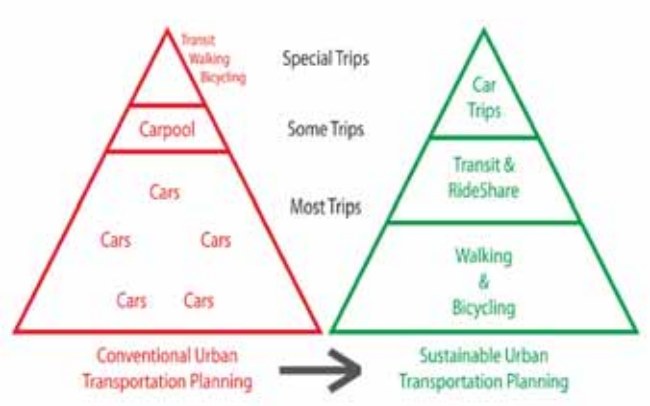


Image: Picture is of a bicycle corral where a parking space has been converted to a multiple bicycle parking area.

Figure 15: Transportation Mode Shift
This figure shows two pyramids showing the transportation mode shift from conventional urban transportation planning to sustainable urban transportation planning. With conventional urban transportation planning, most trips are done by car, while with sustainable urban transportation planning most trips are by walking and bicycling, as well as transit and ride share. For conventional urban transportation planning, some trips are by carpool, while special trips are by transit, walking or bicycling. With sustainable urban transportation planning, the smallest share of modes and for special trips is when the car is used.



Conventional urban planning in the US has provided primarily for the extensive use of private vehicles. The SFMTA aims to reverse this trend so that most trips will be made by walking, biking and transit. Car trips would be limited to special circumstances. By building out the current SFMTA Bike Plan, implementing WalkFirst and the future

pedestrian action plan, developing a cycletrack network, the city will encourage non-motorized transportation and continue the complete street revolution.

Proposed Measures:
Current:

- Complete the implementation of the SFMTA Bicycle Plan
- Increase bicycle parking capacity citywide
- Develop pedestrian amenities, plazas, and complete the street grid to the waterfront

New:

- Implement complete, green streets and slow zones citywide
- Develop a comprehensive protected “cycle track” network
- Dedicate self-enforcing transit-only lanes especially in the northeast quadrant
- Implement bicycle sharing and create electric bicycle capacity

Image: Photograph at the bottom of the page shows a parklet at 17th and Castro with an historic streetcar in the background.

Infrastructure Support

Strategy 6: Electric Vehicles

Image: picture shows a plug in hybrid vehicle plugged in to a charging station on the street.

A logical GHG emissions solution is decreasing the use of carbon-based fuels. San Francisco aims to reduce fuel consumption by having the largest per capita electric vehicle (EV) fleet in the nation by 2035. However, even if all 350,000 vehicles in San Francisco were electric, the result would only be a 44 percent reduction of GHG emissions from the transportation sector,[50] falling short of the 2050 goal of 80 percent below 1990 levels. Federal and state regulations and the utility agencies will need to progress rapidly to accelerate the EV market penetration. In the mean time, consumers needs to be convinced that their next purchase should be an electric or low-carbon vehicle. Taxi rides and carsharing can provide exposure to how well electric cars function. Electric carsharing is also considered a major GHG reduction strategy since carsharing has proven trip reduction benefits.

Rising fuel prices also provide an incentive. If new fuel taxes can be secured, the conversion rate to electric vehicles will increase. Aside from the significant costs associated with purchasing a vehicle, home charging stations need to become ubiquitous in order to support a sustainable EV program. Additionally, a shift away from away fossil fuel energy generation toward solar, wind, tidal and hydroelectric is needed so that carbon emissions are not simply shifted from the tail-pipe to the power plant.

Unlike many Bay Area cities, vehicle owners in San Francisco often do not have garages. To accommodate those without garage access, San Francisco should have an established public charging station network with locations in parking garages, preferred

parking areas, business districts and employment centers. To start the process of electric vehicle integration, the SFMTA is coordinating with its partner agencies to convert its taxi fleet to electric vehicles using battery-switching technology. Over 75% of the city's taxi fleet is already low carbon or hybrid, meaning low fuel consumption for high mileage vehicles.

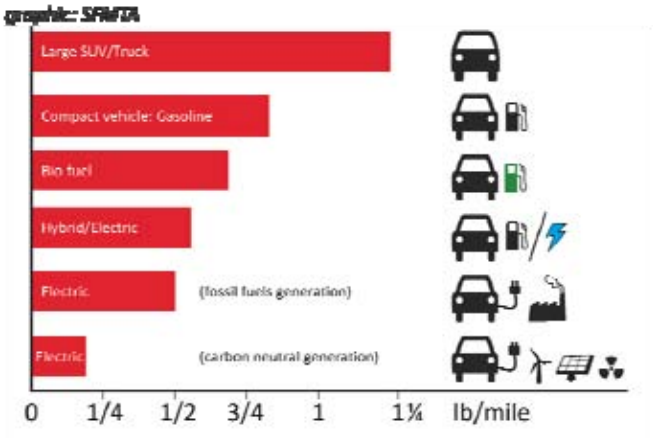
The private costs for electric vehicles today is significant. Currently federal and state subsidies allow for a $12,500 tax rebate per vehicle, indicating a public cost as well. Another source of public expenditure will be incurred as charging infrastructure is developed throughout the region. However, with off-peak energy charging and significant GHG reduction, EV strategy remains promising.

Image: An artists rendering of a solar-powered car charging station.

Image: Picture is of an electric vehicle at the entrance to a station which exchanges electric batteries.

Figure 16: GHG Emissions by Vehicle Type[51]

This figure shows greenhouse gas emissions by vehicle type. Large SUV's and trucks generate approximately 1 ½ lb. per mile. A compact gasoline vehicle generates slightly less than 1 lb. per mile. A biofuel vehicle generates slightly less than ¾ lb. per mile. A hybrid electric vehicle generates more than ½ lb. per mile. An electric vehicle generates ½ lb. of emissions per mile due to fossil fuel generation of electricity. An electric vehicle with carbon neutral electrical generation generates less than ¼ lb. of emissions per mile.



Although the number of taxis in San Francisco is significantly smaller than that of private vehicles, they are responsible for a disproportionate number of vehicle-miles-traveled (VMT) due to their continual use. The electrification of taxis significantly reduces emissions while still providing residents and visitors door-to-door transportation (Figure 16 above). Most electric cars today require hours to charge their batteries through a plug-in device. This delay has been proven to be too costly for the taxi operators and electric cars have not been popular in the taxi industry. However, new swap-out batteries significantly reduce the time it takes to power-up and re-enter the roadway, making it faster than filling up a conventional gas tank. This gives the electric taxis much greater efficiency than a gas-powered vehicle without losses in operating time.

Proposed Measures:

Current:

- Convert 100% of taxi fleet to low-carbon vehicles
- Build more publically accessible and private residential charging stations

New:

- Promote incentives for shared low-carbon and electric vehicles
- Require charging infrastructure for new development, carsharing and electric bicycles
- Require smart-grid networked vehicle charging systems in high demand areas
- Require low-carbon service delivery vehicles in the city

Electric vehicles using renewable energy emit up to 70% less CO_2 than their gasoline-powered equivalents. However, even if all drivers switched to electric, the parking, road infrastructure, battery production and disposal, and vehicle production still results in

GHG emissions before the first mile traveled. Therefore, strategies reducing demand for private vehicle use are critical to the reduction of GHG emissions in the long-term.[52]

Image: Photograph is of a Green Cab picking up passengers in front of the St. Francis Hotel.

Achieving Success Means Driving Less

Achieving success in GHG reductions will depend upon the ability to reduce automobile travel. The majority of San Francisco's private vehicle use comes from the outer neighborhoods of the city. This trend will intensify by 2035. These areas are characterized by single family housing with separated land uses, high levels of commuting by car and roads designed primarily for automobile travel. In contrast, the northeast quadrant of the city is characterized by compact, transit-oriented, mixed-use neighborhoods that encourage walking, bicycling, and transit use. Density is higher and car ownership is substantially lower. Regional densities will also need to increase and auto trips into San Francisco decrease.

Employment center and household VMT maps show the importance of locating jobs in transit-supportive mixed-used neighborhoods. This greatly reduces the likelihood of people commuting by car. Figures 17 and 18 below illustrate that the highest potential for VMT growth is in employment areas outside the established transit corridors in the northeast quadrant. Therefore it will be critical to develop TDM measures for employment areas susceptible to high VMT generation. These include the educational facilities and medical institutions forming a corridor from the Richmond District to Mission Bay, as well as the new employment centers in the southern portions of the city.

Figure 17: Household VMT Generation, 2035[53]

graphic: SFCTA

The figure is a map of San Francisco, showing traffic analysis zones where there are more than 30 workers reside. Most of the vehicle miles traveled for work are clustered in Bayview, the southern part of the City, and the outer reaches of the Sunset and Richmond districts and Treasure Island. The fewest daily vehicle miles generated is clustered in the north east portion of the City, primarily in the Downtown, SOMA and Civic Center areas. This creates ring-type effect of in the city, with the fewest VMTs generated in the north east portion of the City, and the most along the west and south edges.

Area	Typical Range of VMT generated daily
Outer Richmond/Outer Sunset/ Portola/Excelsior/Hunter's Point/Bayview/Silver Terrace	40 to more than 47
Diamond Heights/Laguna Honda/West Portal/Mid-Sunset/Mid-Richmond	32 to 30
Potrero Hill/Mission District/Noe Valley/Western Addition/Inner Sunset/Inner Richmond	24 to 31
North Beach/Marina/Pacific Height/Hayes Valley/ Castro/Mission Bay	16 to 23
Tenerloin/Downtown Core/SOMA	Less than 7 to 15

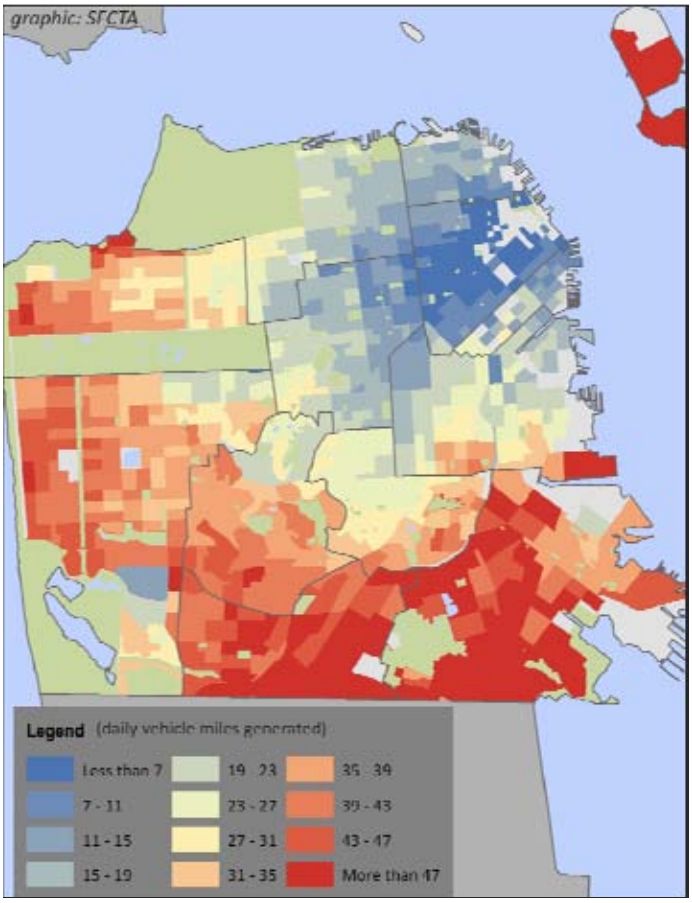


Figure 18: Employment and VMT Generation, 2035[54]
graphic: SFCTA
This map shows traffic analysis zones with greater than 30 workers – it shows that the areas of employment where people will be traveling by vehicle are located in Treasure Island, Bayview and the Central Waterfront, Park Merced, Outer Richmond, Diamond Heights and Ocean Avenue, remote or difficult to reach areas of the City,

Area	Typical Range of VMT generated daily
Treasure Island/Hunter's Point/Outer Richmond/Laguna Honda/Park Merced/Mt. Sutro	15.5 to more than 16.5
Bayview/Central Waterfront/Noe Valley	13.5 to 15.4
Sunset/Richmond/Excelsior/Mission Bay/Pacific Heights/North Beach	10.5 to 13.4
Downtown Core/Tenderloin/Inner Mission/Castro/Western Addition	Less than 7.5 to 10.4

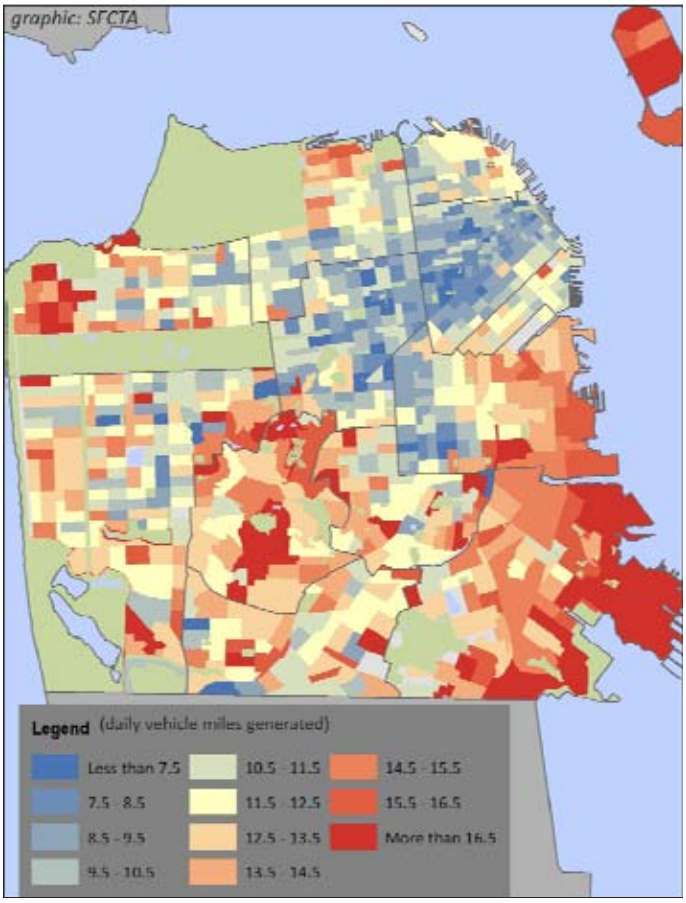


Table 12: San Francisco VMT and GHG Emissions[55]

GHG measurement	1990	2000	2010	2035 (trend)	2035 (LCFS*)	2035 Goal
Annual Vehicle Miles Traveled (millions)	29,291,670	31,161,350	31,437,215	38,388,430	38,388,430	
Greenhouse Gas Emissions (metric tons)	2,047,000	2,120,000	2,198,400	1,855,000	1,855,000	1,023,000

The CAS aims to meet the demands of current and future growth while reducing GHG emissions with the implementation of the six strategies outlined in the report. If successfully implemented, these strategies bring the city nearly halfway to the Proposition A [2007] reduction goals of one million metric tons of GHGs. This process can be categorized into three primary components: policy development, technology advances, and implementation of strategies. If San Francisco is serious about meeting

reduction goals, changing public policy in the needed areas to support each strategy should occur relatively quickly.

For TDM strategies, development of travel choice programs for individuals through their schools, employers and residential associations is a low-cost, high-return endeavor that can occur immediately. While politically tenuous even during periods of economic prosperity, implementing demand pricing creates a critical new funding source amid declining revenues. Infrastructure support strategies, improving and expanding the transit system, redesigning streets for people and building electric charging stations will occur over the 25-year plan horizon. As industry produces electric and low-carbon vehicles, the SFMTA and its partner agencies will achieve greater GHG reductions.

Climate change is a regional issue for transportation. It is not possible to meet these goals without regional, state, and federal policy changes. This includes land uses that support transit-oriented development, optimizing the regional transit system, developing demand management pricing programs, and dedicating new revenue sources for sustainable transportation. The Partnership section (pgs 43-44) highlights ten key actions each stakeholder group needs to make so that overall GHG emissions will decline. In the areas where new legislation needs to be created (to create new pricing and toll authorities, raise fuel taxes, etc.), regional cooperation and advocacy will be needed.

Figure 19: Regional GHG Emissions, Trend vs. Goal *(on-road mobile)*[56]
graphic: SFMTA
The figure shows the show greenhouse gas emissions trend in million metric tons of CO2 annually from 1990 to 2035 with a midpoint measurement at 2010. In 1990, there was just under 25 million metric tons of CO2 measured, and this rose to approximately 27 million metric tons of CO2 in 2010. The trend without any mitigation will rise substantially to approximately 34 million metric tons between 2010 and 2035. The trend with SB375 goal will rise to 30 million metric tons of CO2 in the same time frame. The expected trend with the Pavley standards will lower emission to just over 20 million metric tons, though the expressed goals for our region would have the regional emission measure approximately 18 million metric tons of CO2.

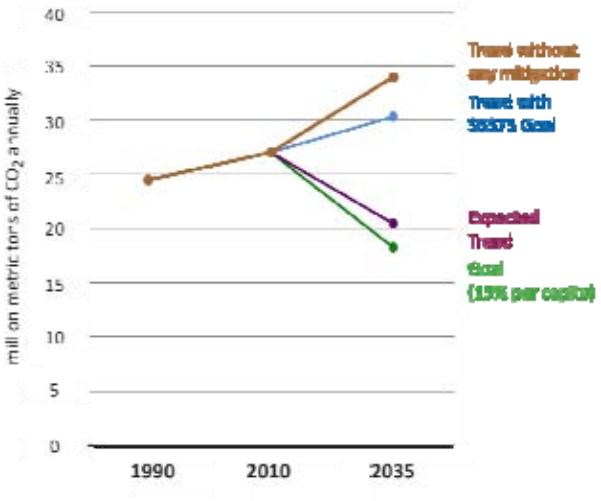
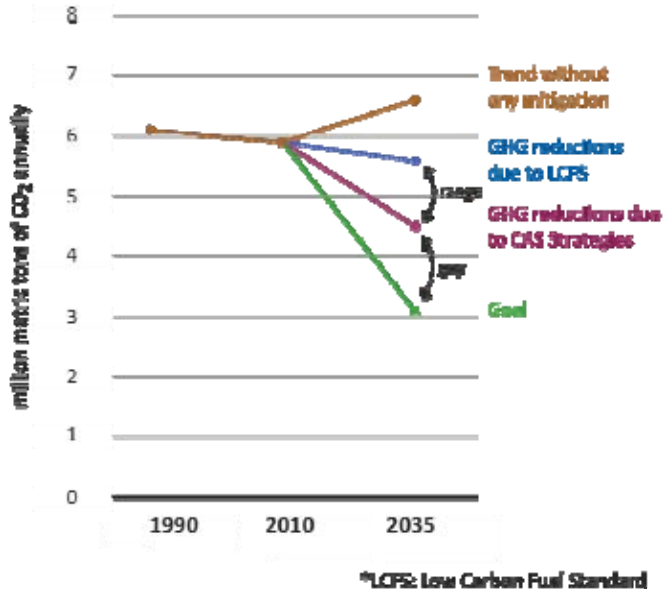


Figure 20: Combined Benefit of Transportation GHG Reduction Measures[57]
graphic: SFMTA
The figure shows the show greenhouse gas emissions trend in million metric tons of CO2 annually from 1990 to 2035 with a midpoint measurement at 2010. In 1990, there was just over 6 million metric tons of CO2 measured, and this lowered to just under 6 million metric tons of CO2 in 2010. The trend without any mitigation will rise to 6.6 million metric tons between 2010 and 2035. The expected trend with the Low-Carbon Fuel Standards will lower emission to 5.6 million metric tons, and the reductions expected from the CAS will reduce City emissions in a range from 6.6 million to approximately 5.3 million metric tons of CO2. This leaves a gap of approximately 1.5 million metric tons to meet the City reduction goals.



Box: All the gains in San Francisco will be irrelevant if the city's regional partners fail to reduce their fair share of GHGs. As the charts above demonstrate, the regional GHG emissions are more than four times San Francisco's.

What Will It Take?

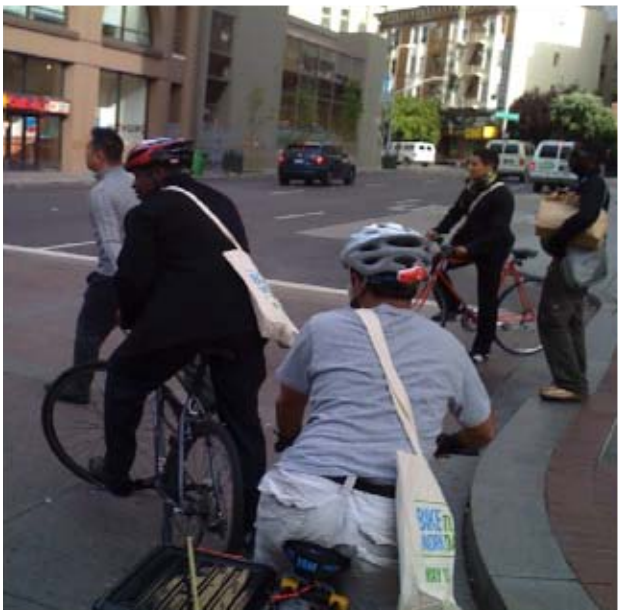


Image: picture of a group of people bicycling on Bike-To-Work Day

Image: Pedestrians crossing the street at a T-Third stop.

Beyond electrification and creating a vastly more fuel efficient vehicle fleet in the Bay Area, mode shifts to sustainable transport are anticipated amid an increasing number of total trips. Using SF-CHAMP regional trip projections, Table 13 shows that total daily trips will increase by almost 20% in the next 25 years, from 4 to 4.7 million. In order to decrease emissions and meet the SFMTA's 30/30/40 mode split goals, a significant shift from the expected trend is needed. If the current mode split is held constant, auto trips would increase to 2.8 million by 2035. "Where we need to go" shows a radical change in mobility for San Franciscans.

For example, transit trips in the city need to double and bicycling needs to increase by 600%. Building the cycletrack and dedicated transit lane network has the greatest potential to quickly grow capacity in a cost effective manner. The Complete Streets, Transit Improvements and Demand Pricing Strategies start a virtuous cycle: new revenue sources help fund capacity increases, added capacity attracts choice riders to transit and bicycling, and a more reliable transportation system develops over time.

Table 13: Needed Mode Shift by 2035[58]

Mode of Transportation	Average trip length in San Francisco	Number of trips in 2010	Number of trips in 2035	Mode Split Goal	Number of trips if mode split goal is met
Timeline	**Where we are today**		**Where we are headed**	**Where we need to go**	
Auto	2.8 miles	2,355,000	2,808,000	30%	1,425,000
Transit	3.4 miles	695,000	886,000	30%	1,425,000
Bicycle	2.3 miles	105,000	134,000	40% for non-motorized transportation	716,000
Walk	0.9 miles	815,000	928,000	40% for non-motorized transportation	1,190,000
Total	2.55 miles	3,970,000	4,756,000	100%	4,756,000

The six strategies are proven measures in decreasing GHG emissions and creating a sustainable transportation system. Both public and private costs are estimated along with a general rating of impact to the transit system. Lastly, reduction benefits in metric tons of CO_2 are shown for each strategy using estimated results achieved by other cities.

The cost estimates and their ranges of effectiveness will depend on the level of implementation. Full implementation of the strategies combined with AB 1493 (Pavley) and the Low Carbon Fuel Standards for California could produce approximately 78 percent of the reductions needed. This leaves a gap to be filled of at least 22 percent if the 2035 target is to be met. This gap could be filled by further electrification of the vehicle fleet and highlights how ambitious San Francisco's adopted reduction targets are. The importance of moving forward with the bold Climate Action Strategies is clear; without their implementation, an additional 54 percent of the needed transportation reductions are unmet.

CAS Costs[59]

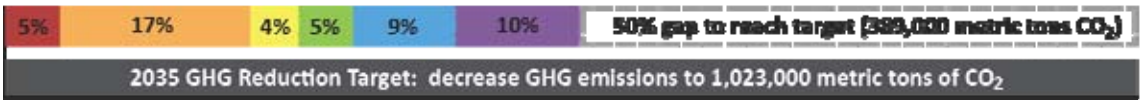
Strategy	Initial Capital	Annual Operating	Annual Net Revenue	Initial Capital	Annual Operating
Source	**Estimated Public Costs** *(millions)*			**Estimated Private Costs** *(millions)*	
Travel Choices & Information	$1.3 - $6	$16.4 – $20	$3 - $8	$2.2 – $5	$96 - $120
Demand	$150 -	$75 – $100	$55 -	$15– $12	$80.2 – $100

Strategy	Initial Capital	Annual Operating	Annual Net Revenue	Initial Capital	Annual Operating
Pricing	$270		$75		
Transit-Oriented Development	$1 - $100	$1 – $10	-	$0.1 – $75	$58 – $100
Transit Improvements	$1,035 - $1,700	$54 – $60	-	$0	$0 – $50
Complete Streets	$410 - $450	$11 – $15	-	$6– $15	$1 – $5
Electric Vehicles	$14 - $20	$0.4 - $5	$20 - $25	$95 – $200	$15 – $30
Total CAS Strategies	**$1,611.3 - $2,546**	**$157.8 - $210**	**$123**	**$118.3 - $307**	**$250.2 - $405**

CAS Benefits[60]

Strategy	Impact on Transit System Demand	Importance to Mode Shift Accommodation	GHG Reduction potential *(metric tons of CO_2)*	% Potential to Achieve 2035 Goal *(after Pavley & LCFS)*
Travel Choices & Information	medium	-	21,000 – 41,000	2% - 5%
Demand Pricing	high	-	83,000 – 140,000	10% - 17%
Transit-Oriented Development	high	-	10,000 – 36,000	1% - 4%
Transit Improvements	-	high	22,000 – 43,000	3% - 5%
Complete Streets	-	high	63,000 – 76,000	8% – 9%
Electric Vehicles	low	-	37,000 – 80,000	4% – 10%
Total CAS Strategies	high	high	236,000 – 416,000	28% - 50%

Figure 21: Combined Benefit of CAS Measures by 2035[61]
This figure is a bar chart showing the potential each strategy has in achieving the 2035 Goal if all measures are implemented: Travel Choices and Information 5%, Demand Pricing 17%, TODs 4%, Transit Improvements 5%, Complete Streets 9% and Electric Vehicles 10%. This leaves a gap of 50% to reach the 2035 reduction target to decrease emissions to 1,023,000 metric tons of CO_2.



Emissions Information:

- ***1990 Emission levels -*** 2 million metric tons of CO2 (1 million needed by 2035)
- ***2035 Emission levels, business as usual -*** 2.7 million metric tons
- ***2035 Emission reductions needed -*** 1.7 million metric tons (920,000 expected from LCFS)
- ***Emissions needed from CAS and other measures*** - 832,000 metric tons

Funding the CAS

Every city in the US has experienced a significant drop in revenue to provide critical services to residents. San Francisco is no different. Creating green jobs, developing and implementing new technology for sustainable transport and becoming a leader in emissions reductions will be a critical component of San Francisco's competitive economic and sustainable transportation future. In order to fund the Climate Action Strategy, several sources must be secured and city policy needs to be revised.

- New fund sources need to be explored in the city and within the region (bonds, fees, or taxes to pay for infrastructure support) to maintain and expand the transit system.
- San Francisco should evaluate a transportation nexus fee (see items 3-5 below) to provide revenue for transit capacity, operating costs and complete streets.

In addition to creating sustainable public policy, the SFMTA and its regional partners will also need to increase internal efficiencies and develop additional sources of revenue. After looking at fourteen potential revenue sources, an SFMTA consultant team focused on five (totaling $93 million to $219 million annually). The SFMTA Board and the Board of Supervisors should consider the first two options in 2012 because these measures amount to transportation user fees and take critical steps toward creating much needed new revenues totaling between $30-$90 million. The public should also be assured that any new funds will only be used for improved service and infrastructure upgrades (salary and benefit expenditures would be illegal uses).

Box: Before June 30, 2012, staff should evaluate and report to the Boards on:

- A mitigation impact fee of $50 to $150 per car, which would raise $24 million to $72 million a year.
- An off-street commercial parking fee of $100 to $300 per stall of free parking, which would raise $6 million to $17 million annually.

If successfully implemented, these two revenue measures would raise between $30 - $90 million annually.

Between 2012 - 2014, the Board of Supervisors should consider:

1. An annual fee based on the idea that transit is similar to a utility, of $60 to $180 per single-family home and other amounts on all residences and businesses, which would raise $26 million to $74 million a year.
2. A parcel tax dedicated to transportation of $100 to $200 per property, which would raise $20 million to $39 million a year.
3. A city transportation sales tax, which would raise $17 million annually for each one-eight of a cent.

Other jurisdictions should consider similar fund raising measures. Each measure may

require a two-thirds majority approval by voters depending on interpretations of 2010's Proposition 26. Some would require the consent of the San Francisco Board of Supervisors. What has become clear is that dwindling funds can no longer support the city's or region's transit and infrastructure needs. Education of the public, along with clear and fair explanations of the pros and cons of generating revenue must take place for both the short- and long-term. Our future as a city is at stake and the choices made today, perhaps more than ever, will dictate San Francisco's leadership as a sustainable city of the future.

Image: Picture of City Hall from Van Ness Avenue.

Implementation

The City and County of San Francisco has adopted goals of emitting 40 percent less greenhouse gas emissions than 1990 levels by 2025, and 80 percent less by 2050. These targets cannot be achieved without a significant new set of public policies and investments. Proposition A (2007) also asks the Board of Supervisors to adopt new goals, beginning in 2012. The board may choose a 50 percent emission reduction goal below 1990 levels by 2035 horizon year of the CAS. These are just the first in a series of local, regional and state targets that have been set yet are impossible to achieve without sweeping public policy, technology and behavioral changes.

The 2011 CAS responds to the Proposition A directive to "develop and implement a set of strategies to substantially reduce carbon emissions." In the *Initiating Implementation* table that follows, near term implementation options for each of the strategies are shown with auxiliary benefits and key actions needed by policy makers and staff.

TDM programs, SF*park*, TOD, Transit Improvements, bicycle lane enhancements and electric vehicle charging have already begun. The CAS recommends strengthening and funding these activities to achieve greater results in reduced congestion and GHG reductions. The SFCTA and the SFMTA are completing planning and engineering phases and securing funding for transit expansion projects such as the Central Subway, and BRT projects on both Van Ness Avenue and Geary Boulevard. This creates the new capacity to accommodate needed mode shifts to transit. However, while capacity expansions are desperately needed to meet existing demand, dwindling transit resources have created a crisis for the transportation sector's GHG reduction efforts. New policies and revenue resources must be created to successfully meet the city's sustainability objectives. Demand pricing is one such program since it reduces traffic congestion, speeds transit service and generates desperately needed transit revenues.

Of all the measures in the strategies, staff prioritized the following recommendations to begin in the next three years. Criteria for selection includes; ongoing programs needing more resources, locally controlled changes such as amendments to the municipal code, and efforts with multiple benefits and low initial and life-cycle costs.

1. Implementing Travel Choices and Information results in reduced vehicle miles traveled and GHG emissions. These measures do not require costly infrastructure and should be expanded quite easily. The SFMTA and our city and community partners should seek public-private partnerships (TDM), propose policy changes and secure new funds for program expansion.
2. Parking pricing (SF*park*) is being implemented and has great promise to reduce congestion and GHG emissions while providing enhanced access to businesses. San Francisco is showing national leadership in the field but will need to enact a suite of complimentary parking management policies. and expand the program citywide. Policy reform creates reduced travel times for both drivers and transit riders.
3. In order to create the cost effective transit and active transportation infrastructure, the current right of way will need to be reconfigured to create

Complete Streets. As existing on-street parking and travel lanes are converted to sidewalks, transit and bike lanes, the city will need to actively defend the Transit First policy and parking reductions to support a sustainable low-carbon mobility lifestyle.

4. Congestion Pricing is undergoing a feasibility study by the SFCTA. Demand pricing the transportation system is inevitable. It is the single most effective way to achieve both GHG and congestion reductions while generating new revenues for sustainable modes. The SFMTA Board and the Board of Supervisors should support a pilot program to test the costs and benefits of pricing the roadways during peak travel demand times.

Image: panoramic view of the San Francisco skyline.

Initiating Implementation for Each Strategy

2011 CAS Strategy	Transportation GHG Reduction Measure	GHG Reduction Potential	Mode shift	Added Benefit of Measure	Program Duration	Responsible Entity	Board, Commission, Staff Action to Consider	Funding and Resource Needs (Capital, Operational, Staffing)
Strategy	Measure	**Benefit Analysis**			**Implementation**		**Key Actions to Implement (State legislation, City Policy change, secure new funding)**	
Travel Choices and Information	1. Work with the largest 100 employers in the city to develop detailed programs and enforce commuter benefits	Medium	High	Saves employee money, increases bicycle demand, promotes green economy	2011-2013	SFMTA, SFE	SFMTA and SFE to generate list of 100 largest employers and continue comprehensive outreach	Partially funded through SFE and SFMTA TDM programs, additional grant funds needed
Travel Choices and Information	2. Expand and enforce San Francisco's Parking Cashout	Medium	Medium	No net expense to employers, decreased work auto trips	2012-2013	SFMTA, SFE	BoS to advocate for the adoption of a penalty for non-compliance of CA Assembly Bill 2109	Employers leasing space and 20+ employees are notified of new regulations

2011 CAS Strategy	Transportation GHG Reduction Measure	GHG Reduction Potential	Mode shift	Added Benefit of Measure	Program Duration	Responsible Entity	Board, Commission, Staff Action to Consider	Funding and Resource Needs (Capital, Operational, Staffing)
Travel Choices and Information	3. Create student ID as transit passes	Medium	Medium	Generates transit revenue, decreases congestion, speeds travel	2012-2013	SFE, SFMTA, School Districts, universities	SFMTA to contact schools and universities to offer program options	Staff outreach to schools, new funding to pay for passes (nominal student university enrollment fee)
Demand Pricing	4. Expand SF*park* citywide	Medium	High	Generates new parking revenue, reduces congestion from cruising	2012 - 2013	SFMTA	SFMTA Converting existing meters to SF*park* and expand the number of metered spaces citywide	Additional grant funds needed to implement citywide.

2011 CAS Strategy	Transportation GHG Reduction Measure	GHG Reduction Potential	Mode shift	Added Benefit of Measure	Program Duration	Responsible Entity	Board, Commission, Staff Action to Consider	Funding and Resource Needs (Capital, Operational, Staffing)
Demand Pricing	5. Support SFCTA North East Cordon Congestion Pricing Study and Pilot Program	High	High	Generates $60-$80m in new annual revenue, decreases congestion, speeds transit and driver travel time	2012-2015	SFMTA, SFCTA	SFMTA and BoS to support congestion pricing pilot program. Needs state legislative action to create new toll authority.	Additional grant funds for pilot project and capital costs (VPP federal program) needed. Bond financing needed to fund transit upgrades prior to implementation

2011 CAS Strategy	Transportation GHG Reduction Measure	GHG Reduction Potential	Mode shift	Added Benefit of Measure	Program Duration	Responsible Entity	Board, Commission, Staff Action to Consider	Funding and Resource Needs (Capital, Operational, Staffing)
Demand Pricing	6. Coordinate with the Bay Area Toll Authority and the Golden Gate Bridge and Highway District to develop peak hour tolls	Medium	Medium	Generates new revenue, decreases congestion on city streets, creates capacity for complete street conversion	2012-2013	BATA, Golden Gate	BoS to advocate by formally requesting BATA/GG to evaluate peak hour tolls	New funds could be dedicated for regional transit service, TDM programs and cities of origin
Transit Oriented Development	7. Eliminate Minimum Parking Requirements for all new development	High	Medium	Reduces housing and development costs, empowers private sector to optimize parking levels	2012	SFMTA, Planning Department	Planning Commission/BoS to amend existing SF Planning Code, Article 1.5	None

2011 CAS Strategy	Transportation GHG Reduction Measure	GHG Reduction Potential	Mode shift	Added Benefit of Measure	Program Duration	Responsible Entity	Board, Commission, Staff Action to Consider	Funding and Resource Needs (Capital, Operational, Staffing)
Transit Oriented Development	8. Require that all multi-family construction provide unbundled parking	High	Low	Reduces housing and development costs, markets to optimize parking levels	2012	SFMTA, Planning Department	Planning Commission/BoS to amend existing SF Planning Code, Article 1.5	None
Transit Oriented Development	9. Require mobility (transit, bikeshare, taxi, etc.) passes as part of new residential and commercial development	High	Medium	Generates new revenue, decreases congestion, speeds transit travel time,	2012-2014	SFMTA, Planning	SFMTA/Planning Commission/BoS to amend existing SF Planning Code, Article 1.5	None for the public sector, minor added costs from development community offset by lower costs to provide parking

2011 CAS Strategy	Transportation GHG Reduction Measure	GHG Reduction Potential	Mode shift	Added Benefit of Measure	Program Duration	Responsible Entity	Board, Commission, Staff Action to Consider	Funding and Resource Needs (Capital, Operational, Staffing)
Transit Improvements	10. Implement the Transit Effectiveness Project (TEP)	Low	Medium	Increases efficiency, reduces expenses and travel time, optimizes capacity	2011-2018	SFMTA	Planning Commission to certify EIR in 2013, SFMTA to dedicate transit funding for TEP implementation	Some new local funding needed, new grants needed, demand pricing revenues would provide critical capital and operating resources
Transit Improvements	11. Expand transit fleet, storage and maintenance to accommodate growth	Low	Medium	Enhances transit service, decreases travel time, promotes green economy	2011-2035	SFMTA	BoS to adopt fees for transit expansion; voter initiative needed to change state funding	Demand pricing revenue, new development contributions and new grant funds needed; significant new staffing needed

2011 CAS Strategy	Transportation GHG Reduction Measure	GHG Reduction Potential	Mode shift	Added Benefit of Measure	Program Duration	Responsible Entity	Board, Commission, Staff Action to Consider	Funding and Resource Needs (Capital, Operational, Staffing)
Transit Improvements	12. Dedicate exclusive right of way for the bus and rail network	Low	Medium	Increases efficiency, reduces operating expenses, promotes green economy	2013-2015	SFMTA to list potential lane dedications	SFMTA to identify key corridors, BoS to adopt a nexus fee and defend Transit First policy	Demand pricing, development contribution revenue and new grant funds needed
Complete Streets	13. Expand transit fleet, storage and maintenance to accommodate growth	Low	Med	Enhances transit service, decreases travel time, promotes green economy	2011-2035	SFMTA	BoS, Planning Commission, SFMTA to adopt new fees; BoS to advocate for federal funds for transit	Demand pricing revenue, new development contributions and new grant funds needed, significant new staffing needed

2011 CAS Strategy	Transportation GHG Reduction Measure	GHG Reduction Potential	Mode shift	Added Benefit of Measure	Program Duration	Responsible Entity	Board, Commission, Staff Action to Consider	Funding and Resource Needs (Capital, Operational, Staffing)
Complete Streets	14. Prioritize investments in bicycle infrastructure, i.e. cycletracks, class II lanes, and bikesharing pods	Medium	Medium	Improves public health and safety, promotes green economy	2012-2016	SFMTA, DPW	SFMTA to adopt cycle track network within two years and uphold Transit First policy	Demand pricing revenue, development contributions and new grant funds needed
Complete Streets	15. Identify locations for pedestrian amenities, plazas and slow zones	Low	Low	Improves public health and safety, promotes green economy	2011-2013	SFMTA, DPW	SFMTA and Planning Commission to adopt the WalkFirst study and Pedestrian Action Plan	Demand pricing, development contributions, new electronic enforcement revenues and staffing needed for pedestrian program

2011 CAS Strategy	Transportation GHG Reduction Measure	GHG Reduction Potential	Mode shift	Added Benefit of Measure	Program Duration	Responsible Entity	Board, Commission, Staff Action to Consider	Funding and Resource Needs (Capital, Operational, Staffing)
Electric Vehicles	16. Allow pilot programs for permeable paving and green streets; revise Level of Service Analysis	Low	Low	Improves public health and safety, promotes green economy	2011-2015	SFMTA, DPW	BoS to streamline green street pilots, revise performance analysis to promote complete streets	Demand pricing, voter initiative revenue and new grant funds needed, dedicated staffing needed
Electric Vehicles	17. Require higher ratios of carshare and bicycle parking, and charging infrastructure in new developments	High	Low	Decreases auto ownership, direct reduction in congestion	2012-2015	Planning, SFE	BoS to amend the SF Planning code, Article 1.5	No new public funds needed, cost savings to private development.

2011 CAS Strategy	Transportation GHG Reduction Measure	GHG Reduction Potential	Mode shift	Added Benefit of Measure	Program Duration	Responsible Entity	Board, Commission, Staff Action to Consider	Funding and Resource Needs (Capital, Operational, Staffing)
Electric Vehicles	18. Promote incentives for expanding carshare with low-carbon/electric vehicles and electric bicycles	High	Low	Decreases auto ownership, direct reduction in GHG and VMT, promotes green economy	2012-2015	SFE, BoS, DMV	SFMTA/BoS to provide incentives; SFMTA and SFE staff to provide EV charging installments for carshare companies	None for public sector, minimal private sector impact as vehicles have high market appeal.

Next Steps

The time for our society to take actions to reduce carbon emissions was yesterday. With continuously rising emissions from the United States and even greater rates of emission increases from developing countries, it is the responsibility of those cities at the forefront of innovation and fiscally prudent governance to actively address global climate change and reverse GHG emission trends. San Francisco's success will rely in large part on the SFMTA and its partners jointly implementing the 2011 Climate Action Strategy.

Immediate Next Steps include:

- Incorporate this document into the Citywide Climate Action Plan.
- Implement Travel Choices, TDM and TOD policies immediately.
- Use the Initiating Implementation for Each Strategy table to begin sustainable policy reform.
- Educate the public and elected official on the benefits of Demand Pricing and implement pilot program by 2015.
- Invest in the transit system for current needs and future capacity to accommodate both mode shifts and future sustainable growth.
- Develop necessary legislation to implement strategies and generate new revenues.
- Create new revenue sources to implement strategies.
- Incorporate key strategies and findings into related plans.
- Develop a Climate Change Adaptation Plan.
- Work with the SFMTA Capital Plan, the SFCTA Transportation Plan and the MTC Regional Transportation Plan to create funding priorities for programs and projects which achieve significant GHG reductions.

Image: Picture of Sunday Streets in the Mission District, with the streets crowded with bicyclists and pedestrians.

Image: Picture of some members of the Board of Supervisors and Nathaniel Ford painting the first bike box in the City.

Image: Picture of bicycling advocates, SFMTA staff, and SFCTA staff with their bicycles and safety gear.

The City and County of San Francisco is already showing leadership in taking actions to mitigate climate change. More can and will be done by its government, residents, business and community groups.

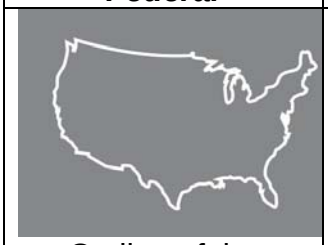
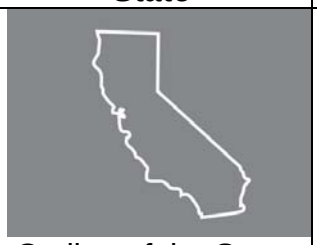
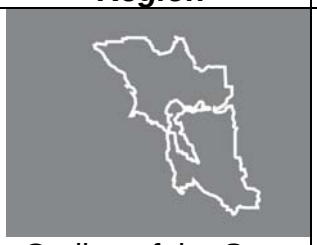
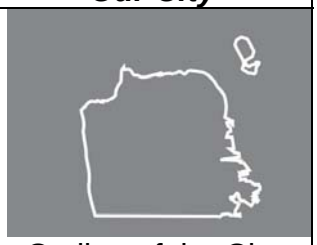
The follow two pages provide ten key steps that our most critical partners can take to begin real improvements in how the transportation sector is operated. Federal and state government departments have work to do in restructuring how transportation in used and financed. The regional and municipal partners in the Bay Area should show leadership and be forward thinking in developing new policies that reduce emissions.

Perhaps most of all, community organizations, business leaders and neighborhood groups have the opportunity to make decisions and take actions that lead to a low-carbon, economically advantageous sustainable transportation future for everyone. Each key partner is given ten actions to take. If any or all of them seem possible or intelligent, now is the time to begin doing your part. If there seems to be an item missing from the list that makes more sense and achieves the same objectives, do that instead.

As Nathanial Ford says, “Every individual contributes to today’s emission levels and everyone should become part of the solution. All of our actions, no matter how big or how small, can help create a sustainable San Francisco, region and planet.”

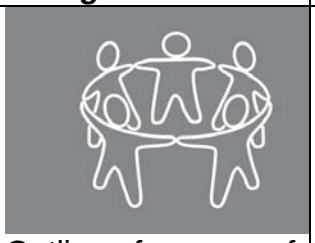
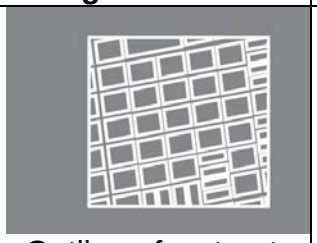
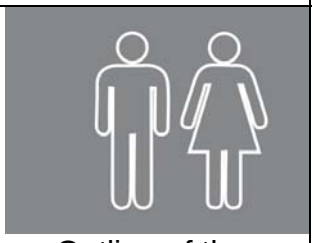
A Partnership - What You Can Do For Climate Action

Government

Federal	***State***	***Region***	***Our City***
			
Outline of the continental U.S.	Outline of the State of California	Outline of the San Francisco Bay Area	Outline of the City and County of San Francisco
Adopt comprehensive climate legislation with dedicated transit funding	**Implement AB 32 and the Western Region's Cap and Trade Program**	**Develop a regional Congestion Pricing Program**	**Fund and implement the 2011 Citywide Climate Action Plan**
Develop Cap and Trade or a carbon tax to fund sustainable transportation	**Raise the fuel tax to fund transit, bicycling and walking**	**Develop a regional VMT fee allocated to sustainable transportation**	**Maintain the multimodal transportation system in a state of good repair**
Raise the Federal Fuel tax and dedicate funding to cities with the highest Transit Ridership	**Give regions the authority to generate local revenues**	**Focus funding on multimodal transportation and reducing GHGs**	**Continue expanding SF*park* and reforming parking policy citywide**
Restructure transportation funding to focus on multimodal infrastructure	Develop a VMT-based fee to generate revenue for transit and infrastructure	Invest in the core transit capacity of the Bay Area	Invest in city transportation and core capacity projects
Require transportation plans to develop GHG reduction strategies.	Incorporate best practice guidelines for complete streets in urban areas	Update transportation models to incorporate non-motorized modes	Fund and implement the Travel Choice Strategy and TDM programs
Dedicate new funding for sustainable mobility (walking, bicycle and transit)	Develop a statewide climate strategy for the transportation system	Fund state of good repair in the updating of regional plans	Support Congestion Pricing in the Central Cordon (northeast quadrant)

Allow cities to adopt their own urban complete street design guidelines	Develop an energy load plan to support focused growth in urbanized areas	Fund projects based on GHG emissions reductions and transit performance	Expand the bicycle sharing program, and build the cycle track network
Raise vehicle efficiency standards to 50 mpg by 2025	Develop a home energy audit and electric vehicle charger rebate program	Create and fund parking policy reform for all jurisdictions	Incorporate Complete Streets and smart mobility passes into TOD agreements
Implement a Low-Carbon Fuel Standard by 2015	Increase low-carbon materials in construction	Fund TDM projects and core transit capital expansions	Complete and adopt the transportation nexus fee for sustainable mobility
Increase commuter tax benefit for all sustainable modes	Analyze TDM data and strategy effectiveness and publish results	Implement the Transit Sustainability Project to create service efficiencies	Complete low-carbon taxi fleet and create Electric Vehicle infrastructure

Community

Businesses	***Organizations***	***Neighborhoods***	***All of Us***
			
Outline of person walking with a briefcase	Outline of a group of people holding hands in a circle	Outline of a street grid	Outline of the international symbols for man and woman
Join the Climate Registry and reduce your carbon footprint by 20%	**Build broad coalitions to support TOD and demand pricing**	**Tell elected officials that you support demand pricing and complete streets**	**Switch 20% of auto trips to walking, bicycling, or transit**
Join the city's green business group and share carbon reduction tools	**Support representatives who complete and green your streets**	**Advocate for transit, bicycles and smart growth in every forum**	**Support raising state and federal fuel taxes for transportation projects**
Educate other businesses on the economic benefits	**Lead by example with green best practices and**	**Support the implementation of the CAS in your**	**Support TOD, demand pricing, and**

of market pricing	broad implementation	neighborhood	complete streets projects
Develop commuter benefits and offer parking cash-out to employees	Post on your website how you are reducing GHGs	Show other neighborhoods how yours is reducing GHGs	Invite your friends to take transit or bike with you to events
Innovate and create public partnerships. We're looking for an App developer!	Educate your elected officials on the benefits of the CAS Strategies	Support transit and bicycle-friendly neighborhood businesses	Combine errands when you use a car - share one with a friend
Request SFMTA bicycle racks and other amenities for your green commuters	Add reducing greenhouse gas emissions to your organization's priorities	Add reducing greenhouse gas emissions to your neighborhood priorities	Create a Facebook event with attendance by bicycle and transit only
Sign up for Bike-to-Work Day and other green transportation events	Produce low-carbon events near transit	Walk and bicycle to farmers' markets and green businesses	Let us know if you've tried or thought of something clever to reduce GHGs
Provide only bicycle and transit directions on your website	Educate and empower your members to support CAS Strategies	Support you neighborhood Safe-Routes-to-School program	Participate in your school's Walk-and-Roll-to-School Day
Develop a workteam plan to reduce driving by 20% in 20 weeks	Help get policies enacted that fund transit and complete streets	Develop a neighborhood plan to reduce driving by 20% in 20 weeks	Explore the city by bicycle,sell your car, and buy a Clipper card
Utilize all the new web teleconferencing tools and promote telecommuting	Engage diverse stakeholders to support the CAS	Tell your electeds you support the 10 items in the "Government" columns	Take a school or family pledge to reduce your carbon footprint by 20%

Endnotes

[1] San Francisco Chronicle, Sept. 11, 1999, “Just how big is S.F?” page A1.

[2] U.S. Census Bureau, 2009 American Community Survey: S081 Commuting Characteristics by Sex. Economic Characteristics. Retrieved Oct. 14, 2010.

[3] U.S. Census Bureau, 2009 American Community Survey: S081 Commuting Characteristics by Sex. Economic Characteristics. Retrieved Oct. 14, 2010.

[4] Metropolitan Transportation Commission. (2007). ACS 2006 San Francisco Bay Area Data Highlights Report.

[5] U.S. Census Bureau, 2009 American Community Survey: S081 Commuting Characteristics by Sex. Economic Characteristics. Retrieved Oct. 14, 2010.; 21.5% of 437,073

[6] U.S. Census Bureau, 2009 American Community Survey: S081 Commuting Characteristics by Sex. Economic Characteristics. Retrieved Oct. 14, 2010.

[7] San Francisco County Transportation Authority. (2010). San Francisco County Transportation Authority SF-CHAMP Model [Software].

[8] U.S. Census Bureau, 2009 American Community Survey: S081 Commuting Characteristics by Sex. Economic Characteristics. Retrieved Oct. 14, 2010.

[9] The number of households with more than 3 vehicles was multiplied by 3.06 based on the proportion of households that reported 4 or 5 vehicles in the 2000 census. (Calculated by adding 132,490, (68,865 by 2) plus (24,968 x 3.06).

[10] Total number of registered vehicles divided by the area of land surface. Oct. 1, 2010.

[11] The number of households with more than 3 vehicles was multiplied by 3.06 based on the proportion of households that reported 4 or 5 vehicles in the 2000 census. (Calculated by adding 132,490, (68,865 by 2) plus (24,968 x 3.06).

[12] Total number of vehicles divided by estimated population. Oct. 1, 2010.

[13] San Francisco County Transportation Authority. (2010). San Francisco County Transportation Authority SF-CHAMP Model [Software].

[14] San Francisco Municipal Transportation Agency. (2010). State of SFMTA Report. Retrieved from: www.sfmta.com

[15] U.S. Department of Transportation, Federal Highway Administration (2000). National Household Travel Survey. Retrieved from: nhts.ornl.gov

[16] San Francisco County Transportation Authority. (2010). San Francisco County Transportation Authority SF-CHAMP Model [Software].

[17] Association of Bay Area Governments. (2009). Building Momentum: Projections and Priorities 2009. Association of Bay Area Governments. http://www.abag.ca.gov/planning/currentfcst/

[18] San Francisco County Transportation Authority. (2010). San Francisco County Transportation Authority SF-CHAMP Model [Software].

[19] Chester M.V., Horvath A., Madanat S. (2010). Comparison of life cycle energy and emissions footprints of passenger transportation in metropolitan regions. Atmospheric Environment, 44 (8), pp. 1071-1079.

[20] 2000 U.S. Census, S0801 and PHC-T-40 Estimated Daytime Population and Employment Residence Rations: 2000. 2009 American Community Survey 1-Year Estimates. http://Factfinder.census.gov. Retrieved Sept. 30, 2010.

[21] San Francisco Municipal Transportation Agency. (2011). Data from: San Francisco County Transportation Authority. (2010). San Francisco County Transportation Authority SF-CHAMP Model [Software].

[22] Pucher, John & Buehler, Ralph. (2007). At the Frontiers of Cycling: Policy Innovations in the Netherlands, Denmark, and Germany. World Transport Policy and Practice, 13 (3), 8-56. Retrieved from: http://www.eco-logica.co.uk/pdf/wtpp13.3.pdf

[23] Chester M.V., Horvath A., Madanat S. (2010). Comparison of life cycle energy and emissions footprints of passenger transportation in metropolitan regions. Atmospheric Environment, 44 (8), pp. 1071-1079.

[24] San Francisco Municipal Transportation Agency. (2011). Data from: San Francisco County Transportation Authority. (2010). San Francisco County Transportation Authority SF-CHAMP Model [Software].

[25] San Francisco Municipal Transportation Agency. (2011). Data from: San Francisco County Transportation Authority. (2010). San Francisco County Transportation Authority SF-CHAMP Model [Software].

[26] San Francisco Municipal Transportation Agency. (2011). Data from: San Francisco County Transportation Authority. (2010). San Francisco County Transportation Authority SF-CHAMP Model [Software].

[27] San Francisco Municipal Transportation Agency. (2010). SFMTA Departmental Climate Action Report, FY09/10.

[28] Executive Order S-01-07: Low-Carbon Fuel Standard (LCFS). Issued January 18, 2007. Retrieved from: http://www.arb.ca.gov/fuels/lcfs/eos0107.pdf; AB 1493 (Pavley). Retrieved from: www.arb.ca.gov/cc/ccms/ccms.htm.

[29] SB 375. Retrieved from: www.arb.ca.gov/cc/sb375/sb375.htm.

[30] Title 49 United States Code, Chapter 329-Autumotive Fuel Economy. Retrieved March 8, 2011: http://www.nhtsa.gov/staticfiles/rulemaking/pdf/cafe/CAFE_2014-18_Trucks_FactSheet-v1.pdf

[31] Climate Action Plan for San Francisco. Retrieved from http://www.sfenvironment.org/downloads/library/climateactionplan.pdf; Assembly Bill 32. (2006). Retrieved from: http://www.arb.ca.gov/cc/ab32/ab32.htm; Executive Order S-3-05. (2005). Retrieved from: http://www.schwarzenegger.com/news.asp?id=2055; Metropolitan Transportation Commission. (2009). Transportation 2035 Plan for the San Francisco Bay Area. Retrieved from: http://www.mtc.ca.gov/planning/2035_plan/, United States Department of Transportation; Executive Order S-01-07: Low-Carbon Fuel Standard (LCFS). Issued January 18, 2007. Retrieved from: http://www.arb.ca.gov/fuels/lcfs/eos0107.pdf

[32] San Francisco Municipal Transportation Agency. (2011). Data from: San Francisco County Transportation Authority. (2010). San Francisco County Transportation Authority SF-CHAMP Model [Software].

[33] San Francisco Municipal Transportation Agency. (2011). Data from: San Francisco County Transportation Authority. (2010). San Francisco County Transportation Authority SF-CHAMP Model [Software].

[34] San Francisco Municipal Transportation Agency. (2011). Data from: San Francisco County Transportation Authority. (2010). San Francisco County Transportation Authority SF-CHAMP Model [Software].

[35] San Francisco Municipal Transportation Agency. (2011). Data from: San Francisco County Transportation Authority. (2010). San Francisco County Transportation Authority SF-CHAMP Model [Software].

[36] Climate Action Plan for San Francisco. Retrieved from http://www.sfenvironment.org/downloads/library/climateactionplan.pdf

[37] 2000 U.S. Census, S0801 and PHC-T-40 Estimated Daytime Population and Employment Residence Rations: 2000. 2009 American Community Survey 1-Year Estimates. http://Factfinder.census.gov. Retrieved Sept. 30, 2010.

[38] San Francisco County Transportation Authority. (2010). San Francisco County Transportation Authority SF-CHAMP Model [Software].

[39] San Francisco County Transportation Authority. (2010). San Francisco County Transportation Authority SF-CHAMP Model [Software].

[40] San Francisco Municipal Transportation Agency (2008). Transit Effectiveness Project. Retrieved: http://www.sfmta.com/cms/mtep/tepover.htm; 2000 - Metropolitan Transportation Commission County to County Commuter Tables and MTC Commute Profile 2003; 2030 - Metropolitan Transportation Commission's Transportation 2030 Plan for the San Francisco Bay Area

[41] San Francisco Municipal Transportation Agency. (2011). Data from: San Francisco County Transportation Authority. (2010). San Francisco County Transportation Authority SF-CHAMP Model [Software].

[42] San Francisco Municipal Transportation Agency. (2011). Data from: San Francisco County Transportation Authority. (2010). San Francisco County Transportation Authority SF-CHAMP Model [Software].

[43] Amsterdam, Copenhagen, Berlin, Sydney, London, Paris, Stockholm, Singapore, Barcelona, Sevilla, Curitiba, Vancouver, Montreal, Capetown, Johannesburg, Munich, Los Angeles, San Diego, Oakland, San Jose, Sacramento, Berkeley, Irvine, Davis, Redwood City, New York City, Chicago, Houston, Seattle, Minneapolis, Washington D.C., Atlanta, Boston, Philadelphia, Denver, Portland, Eugene, Boulder, Albuquerque

[44] San Francisco Municipal Transportation Agency. (2011). SF*park*. Retrieved from: www.sfpark.org

[45] Cervero, Robert. (Fall 2009). TOD and Carsharing: A Natural Marriage. Access, 35, 25-29 - data and graphic

[46] Cervero, Robert. (Fall 2009). TOD and Carsharing: A Natural Marriage. Access, 35, 25-29

[47] San Francisco Municipal Transportation Agency. (2010). State of Good Repair Report. Retrieved from: www.sfmta.com

[48] San Francisco County Transportation Authority. (2010). San Francisco County

Transportation Authority SF-CHAMP Model [Software].

[49] San Francisco County Transportation Authority. (2010). San Francisco County Transportation Authority SF-CHAMP Model [Software].

[50] California Energy Commission. (2011). California Electric Energy Production. Retrieved from: http://ecdms.energy.ca.gov

[51] Papandreou, Timothy. (2004). Moving Toward Sustainable Mobility: Analyzing the Travel Patterns and Demographics of Flexcar Carshare Users in Los Angeles. [Master's Thesis]. University of California, Los Angeles, School of Public Affairs

[52] Papandreou, Timothy. (2004). Moving Toward Sustainable Mobility: Analyzing the Travel Patterns and Demographics of Flexcar Carshare Users in Los Angeles. [Master's Thesis]. University of California, Los Angeles, School of Public Affairs

[53] Traffic Analysis Zones (TAZs) with greater than 30 workers; Source: San Francisco County Transportation Authority. (2010). San Francisco County Transportation Authority SF-CHAMP Model 4.[Software]. draft p2011

[54] Traffic Analysis Zones (TAZs) with greater than 30 workers; Source: San Francisco County Transportation Authority. (2010). San Francisco County Transportation Authority SF-CHAMP Model 4.[Software]. draft p2011

[55] San Francisco Municipal Transportation Agency. (2011). Data from: San Francisco County Transportation Authority. (2010). San Francisco County Transportation Authority SF-CHAMP Model [Software].

[56] San Francisco County Transportation Authority. (2010). Data from: Metropolitan Transportation Commission. (2010). SB375 Regional Transportation goals. Retrieved from: http://www.mtc.ca.gov/

[57] San Francisco Municipal Transportation Agency. (2011). Data from: San Francisco County Transportation Authority. (2010). San Francisco County Transportation Authority SF-CHAMP Model [Software].

[58] San Francisco Municipal Transportation Agency. (2011). Data from: San Francisco County Transportation Authority. (2010). San Francisco County Transportation Authority SF-CHAMP Model [Software].

[59] San Francisco Municipal Transportation Agency. (2011). Data from: San Francisco County Transportation Authority. (2010). San Francisco County Transportation Authority SF-CHAMP Model [Software].

[60] San Francisco Municipal Transportation Agency. (2011). Data from: San Francisco County Transportation Authority. (2010). San Francisco County Transportation Authority SF-CHAMP Model [Software].

[61] San Francisco Municipal Transportation Agency. (2011). Data from: San Francisco County Transportation Authority. (2010). San Francisco County Transportation Authority SF-CHAMP Model [Software].

San Francisco Municipal Transportation Agency (2008). Transit Effectiveness Project. Retrieved: http://www.sfmta.com/cms/mtep/tepover.htm

Additional resources from:

ICF International, www.icfi.com/

Fehr and Peers, www.fehrandpeers.com/

Alice Walker, GOOD Magazine, www.good.is

San Francisco Planning + Urban Research Association (SPUR), www.spur.org

Photo Credits:

Page 19: Strategy 2 - http://congestioncharge.net/; Strategy 3 - San Francisco Redevelopment Agency

Page 23: Congestion pricing (cordon markings) - http://congestioncharge.net/; Bay Bridge - image retrieved from http://www.autoblog.com/2006/04/03/study-san-franciscos-hov-lanes-increase-traffic-congestion/

Page 24: Parking Information - http://sf.streetsblog.org/2009/01/06/sfs-parking-experiment-to-test-shoups-traffic-theories/; Golden Gate Bridge – Henner Zeller, taken 07-08-2004, http://en.wikipedia.org/wiki/San_Francisco_congestion_pricing

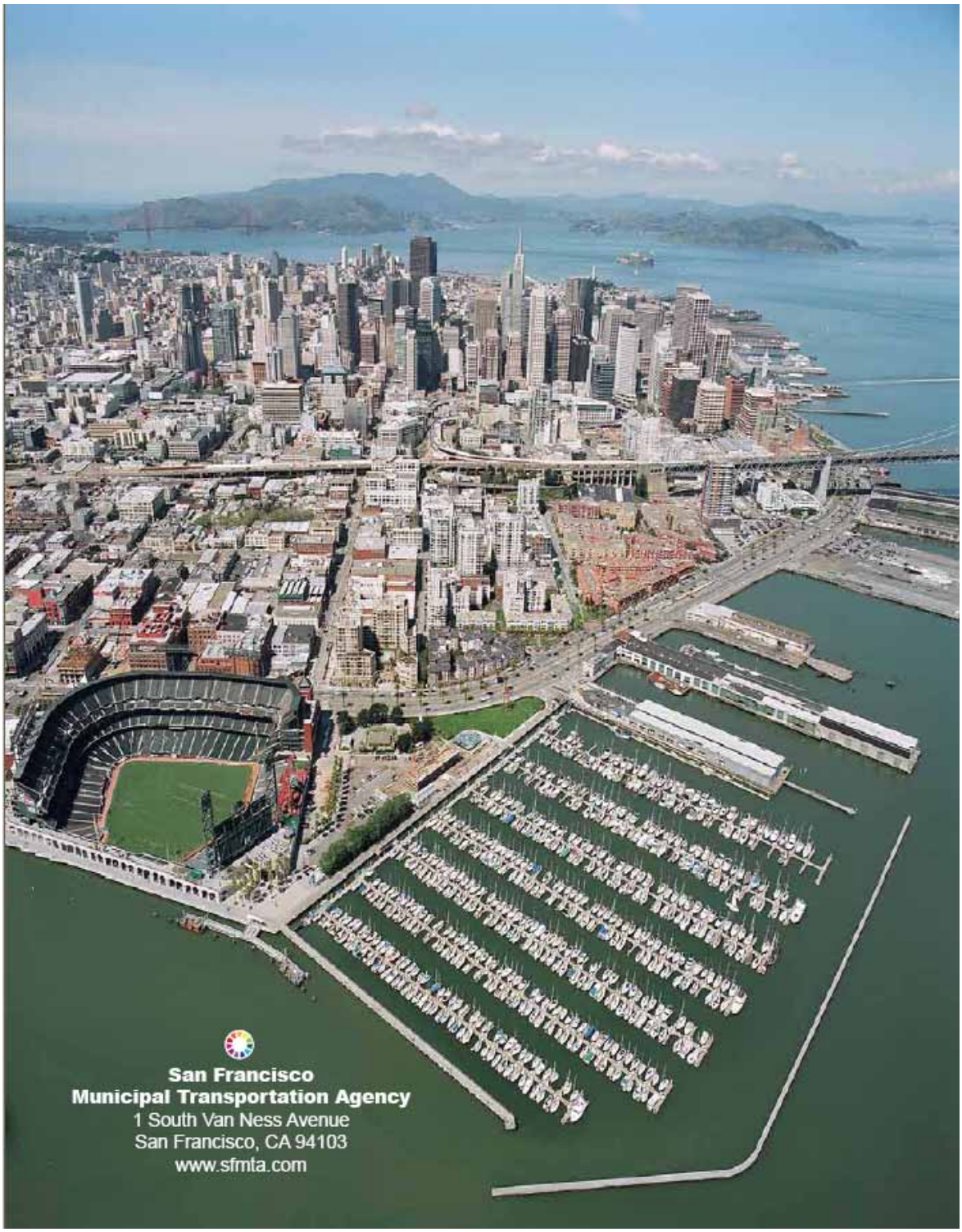
Page 25: city image - San Francisco Redevelopment Agency

Page 31: solar charging station: www.world.honda.com

Page 37: San Francisco panorama: www.city-data.com

Back cover: San Francisco Redevelopment Agency

all other images from SFMTA Photo Archives



Back cover image: Bird's-eye view of San Francisco.

Text: San Francisco Municipal Transportation Agency, 1 South Van Ness Avenue, San Francisco CA 94103, www.sfmta.com