Appendix B: White Paper

TRANSPORTATION NEEDS

KEY TOPICS

- The performance of San Francisco's transportation system, under both current and future (2040) baseline conditions
- Issues that need to be addressed to make progress towards the four major SFTP goal areas: world-class infrastructure; economic competitiveness; livability; and healthy environment
- "What it would take" to achieve San Francisco's ambitious goals in these four areas
- Issues and opportunities related to visitor and student travel and goods movement

1 Introduction

In 2040, San Francisco will host 200,000 new jobs and more than 250,000 additional residents, bringing its population over one million for the first time. Over the next 30 years, the city's transportation system will need to adjust to accommodate the trips made by these new residents and visitors. It will also need to confront the significant challenges it faces today, including years of underinvestment in system upkeep, escalating operating costs, challenges delivering new projects in advance of growth, an overcrowded transit system, and a road network that lacks capacity to absorb the projected growth in driving (even assuming the emerging innovations from the technology sector, including car- and ride-sharing and private commuter shuttles).

We analyzed these trends and their implications for San Francisco's transportation system to inform development of the San Francisco Transportation Plan (SFTP). This report describes the analysis in detail. It is organized in four sections corresponding to the four SFTP goal areas: world-class infrastructure, economic competitiveness, healthy environment, and livability, with a final section analyzing the transportation needs of specific groups of travelers – visitors, students, and companies making deliveries in the city. Specifically:

- **SECTION 2: ECONOMIC COMPETITIVENESS** describes projected housing and employment growth through 2040 and resulting roadway congestion and transit crowding. It shows how system expansion, especially in the downtown core, is needed to ensure new workers, visitors, and residents can be accommodated.

- **SECTION 3: WORLD-CLASS INFRASTRUCTURE** examines what will be required to maintain a state of good repair across our transit and roadway systems. It details the transit system performance impacts of capital asset maintenance deficiencies, identifies key transit systems' capital asset maintenance funding needs, and discusses the condition of the city's roads and bridges. Key needs include a large unfunded backlog of vehicle maintenance needs that will contribute to further declines in transit system reliability if not addressed.

- **SECTION 4: LIVABILITY** analyzes trends in bicycling and walking, especially safety, relative to San Francisco's goals for nonmotorized transportation and describes future investments needed to ensure the city can meet its goals for the share of trips made by bicycling and walking while ensuring safety.

- **SECTION 5: HEALTHY ENVIRONMENT** describes environmental goals for our transportation sector, including those stemming from SB 375 (which set greenhouse gas emission reduction targets for the Bay Area). It describes trends in GHG emissions and vehicle travel under current and future baseline "business as usual" conditions, and explains what it would take to achieve our ambitious environmental goals. The section identifies strategies such as congestion pricing and travel demand management that could help reduce existing vehicle traffic and greenhouse gases.

- **SECTION 6: VISITOR, GOODS MOVEMENT, AND SCHOOL TRANSPORTATION NEEDS** describes the transportation issues faced by these three groups, whose needs do not fit neatly into the sections above. This section discusses strategies to reduce visitors' reliance on private automobile travel to help reduce congestion. It describes the effects of increasing congestion on goods movement and proposes some ways to solve the problems. Then it presents information from a survey of students and their parents about factors that prevent them from taking transit, walking, or riding a bicycle to school.

  In addition to the analysis in these sections, we also assessed the performance of the future transportation system through the lens of geographic and socioeconomic equity (see SFTP Appendix F), and did a focused study of future conditions in the downtown core where transportation congestion and crowding are expected to be most acute (see SFTP Appendix C).

THE FUTURE BASELINE:
THE TRANSPORTATION SYSTEM OF THE FUTURE ASSUMING BUSINESS AS USUAL

Most of the quantitative transportation system performance measures in this document are generated by the SFCTA's travel demand model, SF CHAMP. To identify emerging needs, we compared performance today with performance in a 2040 future baseline scenario. The future baseline includes all projected housing and job growth as well as committed transportation improvements (See SFTP Appendix A for a definition of committed improvements) such as the Central Subway, the Van Ness Bus Rapid Transit, and the Presidio Parkway, among others. The future baseline represents conditions without any new investment beyond what is already committed, and illustrates performance gaps where additional investment is needed.

2 Economic Competitiveness

SECTION SUMMARY:

- San Francisco is planning for jobs and housing to each grow by 30 percent over the plan period.
- Crowding in transit vehicles and at popular transit stations will worsen without investments in new capacity, especially in the highest-growth areas such as the northeast core and southeast waterfront.
- Projected levels of new development will increase street congestion, particularly in the northeast core. Traffic forecasts predict that the city would need to reduce private-vehicle traffic by more than 25 percent to avoid peak-period gridlock in this area.
- Trip-making patterns will evolve with increased density along the eastern waterfront and in the city's southwest, suggesting a need for more investment in these areas.

This section describes the transportation performance indicators most closely related to economic competitiveness, the city's ability to continue drawing jobs and talent. Today, San Francisco is home to 11 percent of Bay Area residents and 17 percent of Bay Area jobs. While the city is projected to grow significantly over the plan period, the ability of San Francisco's transportation system to handle the trips of hundreds of thousands of new residents and workers will determine whether these projections can, in fact, become reality. This section analyzes key aspects of the transportation system and assesses what new investments will be necessary for it to handle forecast growth.

2.1 | Goals and Performance Measures

The SFTP economic competitiveness goal is to ensure the transportation system can accommodate new demands from a growing population and employment, and in doing so, ensure that Bay Area residents, employers, and visitors continue to want to live, work, and play here.

Key metrics associated with this goal are:

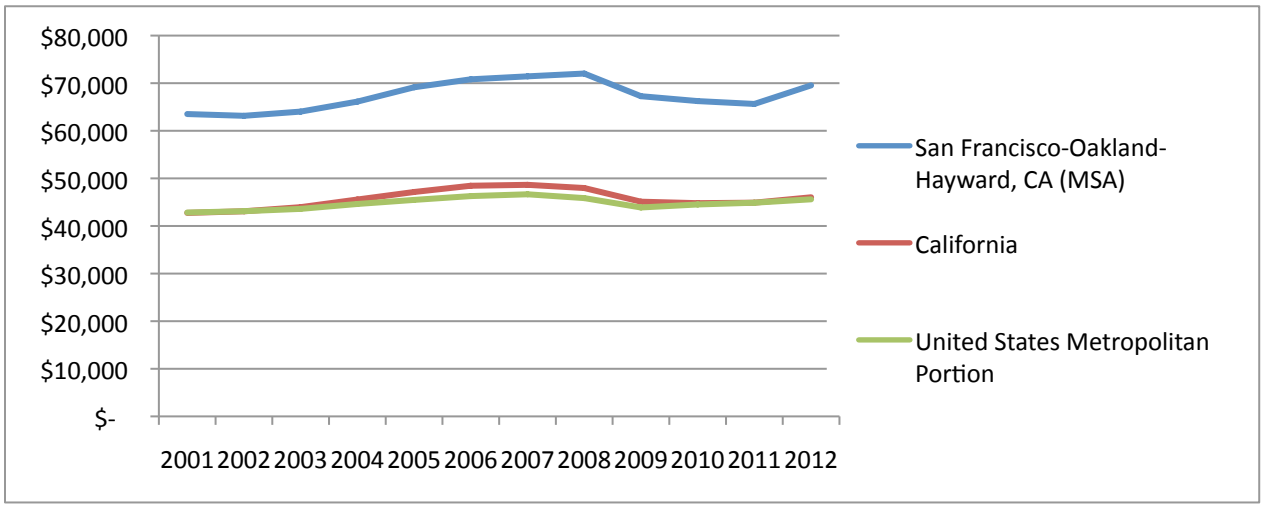
- Major changes in trip making patterns in growing markets
- Commute travel times
- Transit crowding (expressed as person-hours traveled in crowded conditions)
- Street congestion (expressed as percent of roadways experiencing congestion)
- Transit speeds

2.2 | Trends and future conditions

2.2.1 | OVERALL GROWTH TRENDS

San Francisco's economy has seen dramatic growth over the last two decades. As Figure 1 shows, even with the national downturns in 2001 and 2008, the per-capita gross domestic product of the metropolitan area centered on San Francisco outpaced both statewide and national economic productivity over the first decade of the 21st century. This robust economy has led to steady increases in real-estate demand, making San Francisco one of the most expensive places to live in the United States.[10]

Figure 1 Economic Productivity in Per Capita Private-Sector GDP, 2001-2012 (2005 dollars)

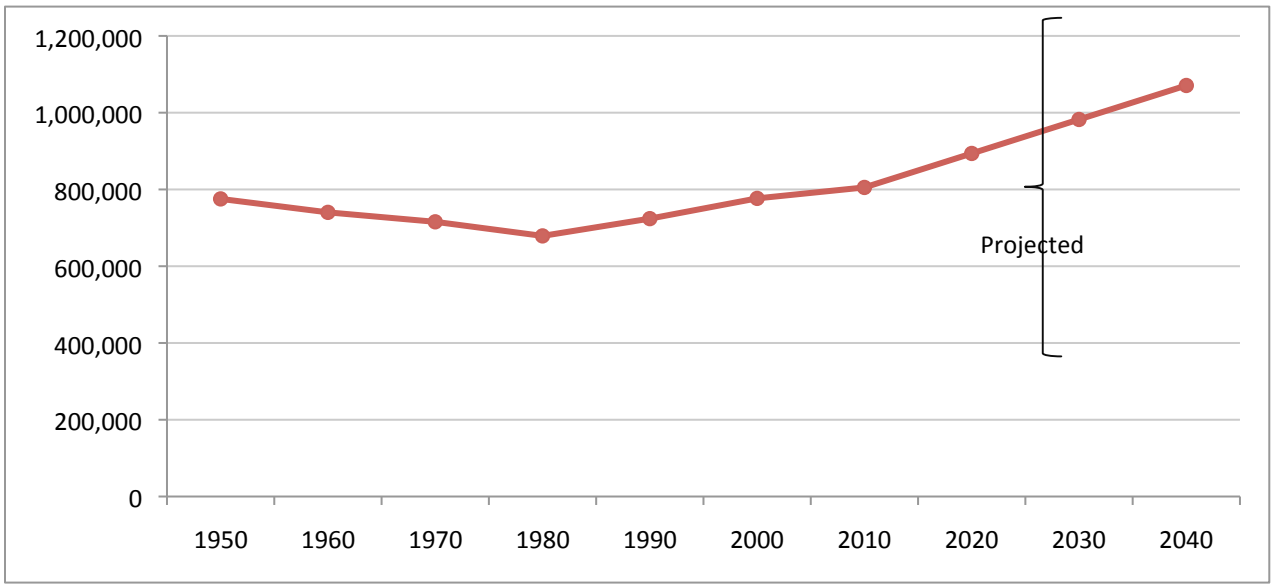


Source: United States Bureau of Economic Analysis. State and Regional Data, Per Capita Real GDP (Chained 2005 Dollars). Retrieved from www.bea.gov on 10/17/13.

Those economic dynamics, combined with state and regional policies aimed at encouraging development in areas that are already urbanized and transit-oriented (see Section 5 for more on these policies), are why the Association of Bay Area Governments has forecast significant job and housing growth in the city. A city of 800,000 residents and 570,000 jobs today is forecast to house nearly 1.1 million residents and more than 750,000 jobs by 2040.[11] This would be the fastest growth in population and jobs since the 1950s (see Figure 2).

[10] Bloomberg.com. "Most Expensive Housing Markets: U.S. Cities." Retrieved from http://www.bloomberg.com/visual-data/best-and-worst/most-expensive-housing-markets-us-cities on 10/7/13.
[11] United States Census Bureau. *American Community Survey*, 2011.

Figure 2 San Francisco: Historic Population Growth, 1850-2013



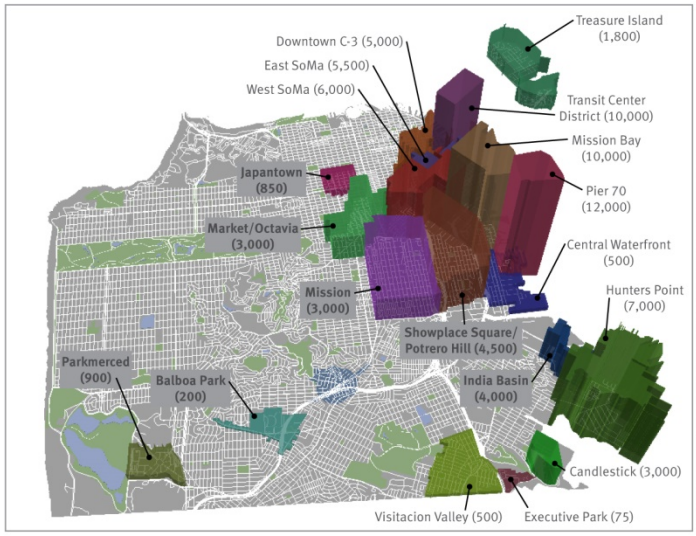
Source, 1950-2010: United States Census Bureau via Bay Area Census. San Francisco City and County Decennial Census Data. Retrieved from http://www.bayareacensus.ca.gov/counties/SanFranciscoCounty40.htm on 10/17/13. 2020-2040 estimated based on projected 2040 from the Association of Bay Area Governments.

The SF Planning Department is planning to accommodate much of the city's projected growth in the northeast core and along the eastern waterfront, both areas the city and region have identified as appropriate for densification given their central locations or access to transit (Figures 3 and 4). Major development projects like those in Mission Bay, Hunters Point/Candlestick Point, Treasure Island, the Schlage Lock site in Visitacion Valley, and Parkmerced will contribute a great deal to this projected growth, but smaller-site projects throughout the eastern third of the city will also house a significant portion of the planned growth.

Much of the new development will also be concentrated in SoMa, which already has significant new transit infrastructure that is already under construction. Two major Planning Department efforts demonstrate this focus. The Central Corridor Plan, for the area around the new Central Subway, includes zoning changes and increases in height limits for a 28-square-block area between Market, Townsend, 2nd, and 6th streets. The Transit Center District Plan, for the area around the new Transbay Terminal, also includes significant increases in zoned density and height limits, among other changes, for the area between Market, Folsom, Steuart, and 3rd streets. The Central Subway and the new Transbay Transit center will help accommodate some of this growth.

Figure 3 Projected Housing Growth by Neighborhood

Figure 4 Projected Job Growth by Neighborhood

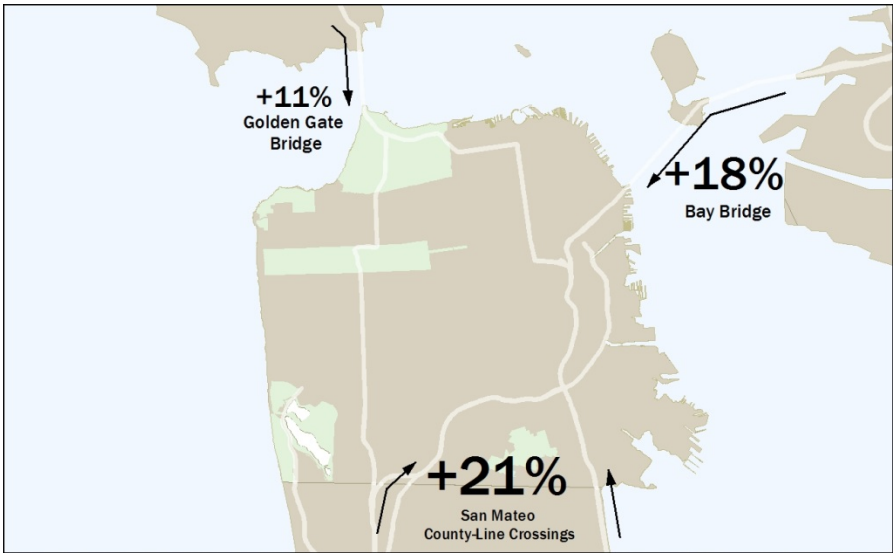


Source: SF Planning Department

The forecast growth in jobs and residents over the plan period is projected to lead to major increases in trip-making across all modes in San Francisco. The city is projected to see 600,000 daily new person-auto trips by 2040.[12] A portion of these new trips are forecast to come from outside the city, and as Figure 5 shows, the bridges and major San Mateo county line crossings are projected to see major increases in daily traffic volumes. However, almost three quarters of all daily auto trips to downtown are forecast to come from elsewhere in San Francisco.

[12] SF-CHAMP 4.3.

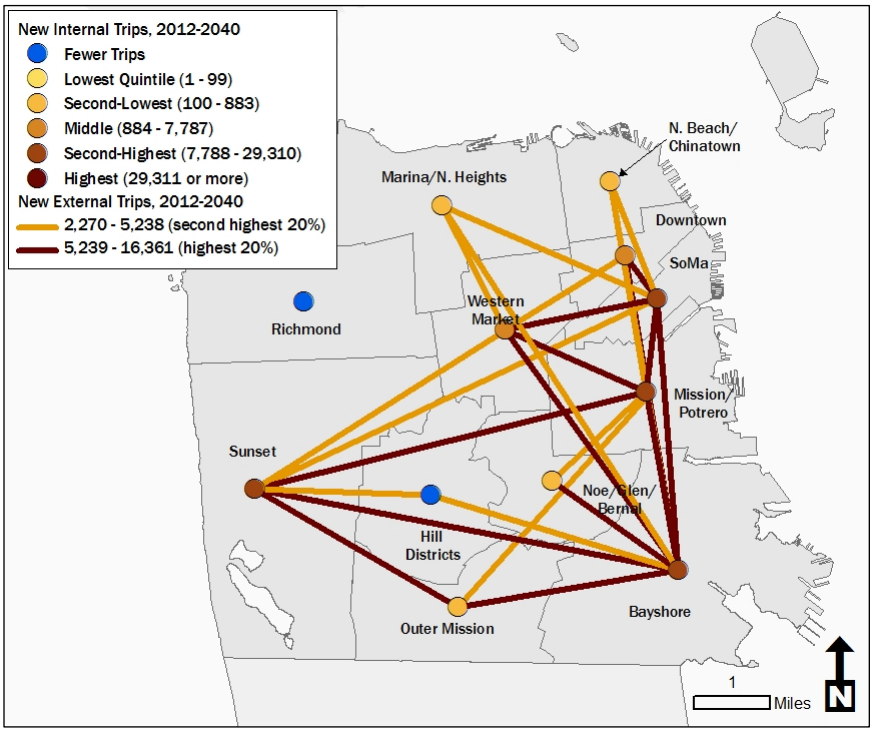
Figure 5 Change in Daily County Line Crossings by Automobile, 2012-2040



Source: SF-CHAMP 4.3.

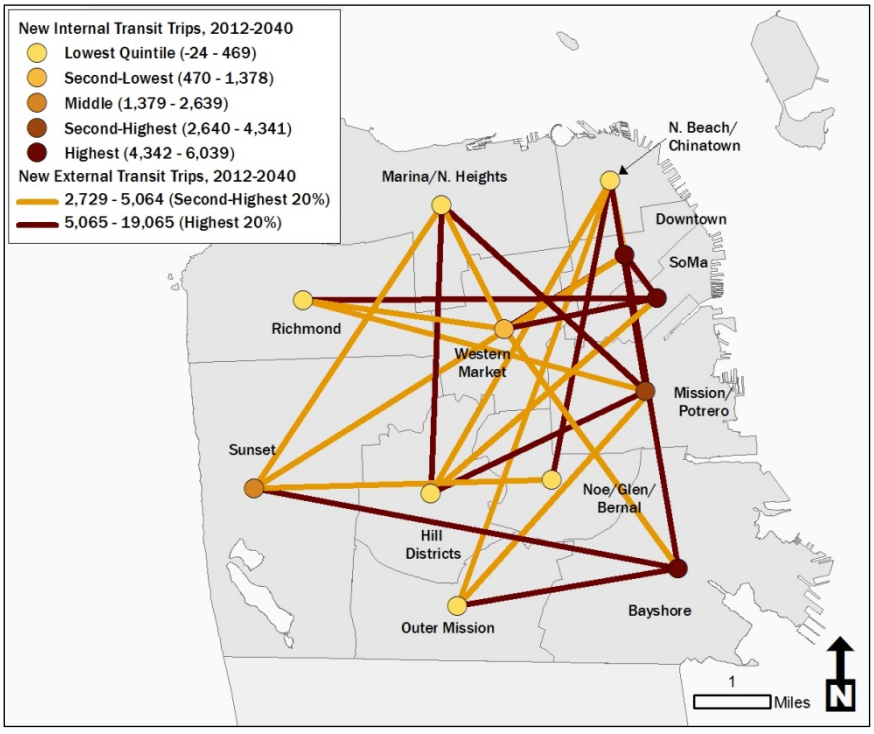
Figure 6 illustrates changes in auto trip-making patterns within the city: darker lines show the neighborhood pairs that will see the highest growth in auto trips between them, and these lines are concentrated along the city's eastern and southern borders. Darker brown circles indicate the neighborhoods that will see the biggest growth in internal auto trips, and again, they concentrate in the east and south. The transit system is also projected to see changes in trip-making patterns (Figure 7). The transit system is centered on the northeast core today, but the biggest increases in transit demand will be for trips across town, to and from the eastern neighborhoods.

Figure 6 Changes in Daily Auto Trip-Making Patterns within San Francisco, 2012-2040



Source: SF-CHAMP 4.3.

Figure 7 Change in Daily Transit Trip-Making Patterns within San Francisco, 2012-2040



Source: SF-CHAMP 4.3.

Economic Competitiveness: What Would it Take?

The SFCTA analyzed what it would take to meet specific quantitative transportation system performance targets for each SFTP goal area. The analysis results for economic competitiveness are presented below.

- **CHALLENGE:** One of the transportation-related factors that affects where employers choose to locate or expand is commute travel times for their employees. Commute travel times are expected to worsen in the future due to new growth.
- **TARGET:** Keep commute travel times (combined for car and transit commuters) to and from downtown San Francisco in 2035 from degrading relative to 2010.
- **IMPROVEMENTS:** This scenario analyzed three levels of investment, as described below.
  - **LOW:** Frequency improvements to local and regional transit service, Caltrain electrification, and lower-cost capital projects such as bus priority measures and more extensive traffic management on key commute corridors.
  - **MEDIUM:** The above plus more extensive programmatic investments in transit, congestion pricing, and higher-cost capital projects such as Caltrain's downtown extension and bus rapid transit on key corridors. A sensitivity test was conducted to determine the effect of a hypothetical regional policy that modestly increases parking prices in other major Bay Area employment centers.
  - **HIGH:** The above plus major capital projects, namely a new cross-bay BART tube and high-speed rail service.

Table 1: Performance of Economic Competitiveness Scenarios

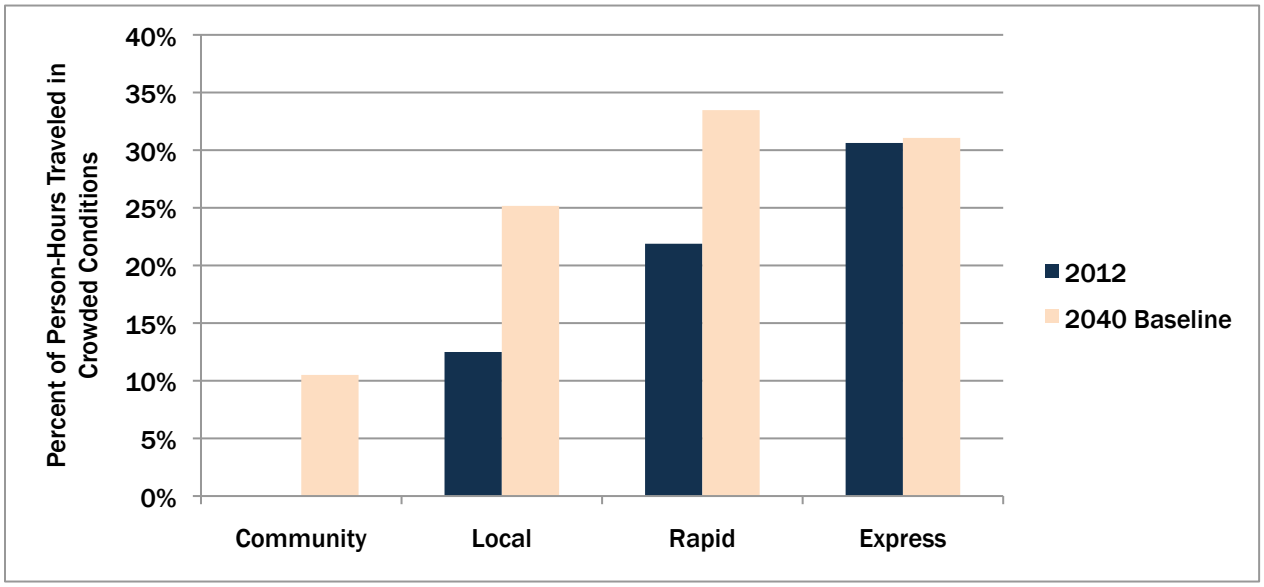
	2010	2035 BASE	2035 LOW	2035 MED	2035 MED + PARKING PRICING	2035 HIGH
Total average commute time to SF including non-motorized (minutes)	40	42	41	40	40	41
Auto	38	39	39	35	35	36
Transit	48	51	49	48	48	49
Cost (millions of $)	–	–	$2,000	$5,000	$5,000	$20,000
Cost Effectiveness	–	–	High	Med	Med	Low

- **COST:** From $2 billion (low level of investment) to $15 billion (high level of investment).
- **RESULTS:** Three of the scenarios (medium, medium with pricing, and high) keep combined car/transit commute travel times from degrading (see table above).
- **CONCLUSIONS:** The target under this scenario appears achievable. Between the low and medium levels, it takes an extra $3 billion in improvements to reduce travel times by one minute. The high level performs worse than the medium level perhaps because major investments such as a new BART tube increase overall travel significantly by improving accessibility. An additional finding was that because so many of San Francisco's commute trips begin or end in other cities, San Francisco's progress is greatly affected by policies implemented elsewhere. SF needs to take an active role in supporting regional policies that support its goals.

2.2.2 | TRANSIT CROWDING

By 2040, the city is forecast to see 300,000 new transit trips per day on a system that already suffers from crowding and reliability issues. Figure 8 shows that a significant percentage of transit passengers experience crowded conditions when traveling during peak hours today and that the issue is projected to get significantly worse under a 2040 baseline scenario. The baseline scenario includes the existing transit system and expansions or enhancements that have already secured significant funding or are already under construction. Crowded conditions are defined as vehicles with loads at 85 percent of capacity or more. As the figure shows, crowding is expected to increase significantly on all Muni service types except the express series.

Figure 8 Daily Person Hours of Travel in Crowded Conditions for Different Muni Service Types



Source: SF-CHAMP 4.3.

Crowding is particularly acute on the ten most crowded lines, with more than 60 percent of person-hours traveled spent in crowded conditions and a slight worsening of conditions on these lines by 2040. The total number of lines with any crowding is projected to grow from 31 to 50 over the plan period.

ADDRESSING CROWDED CONDITIONS

Expected crowding can be addressed, in part, by providing additional transit service during peak periods. However, the need to add peak-hour service should be balanced with consideration of cost-effectiveness (peak service is costly to provide), and equity concerns. Some lower-income shift workers depend on having adequate service during off-peak periods.

Figure 9 shows the current and projected spatial distributions of crowding. While Muni vehicles typically reach their most crowded points near the center of the system today, the extent of crowding moves outward from the core by 2040, in part as a result of significant new development at the end of several key lines and in part because of the increased employment pull of downtown and the eastern waterfront.

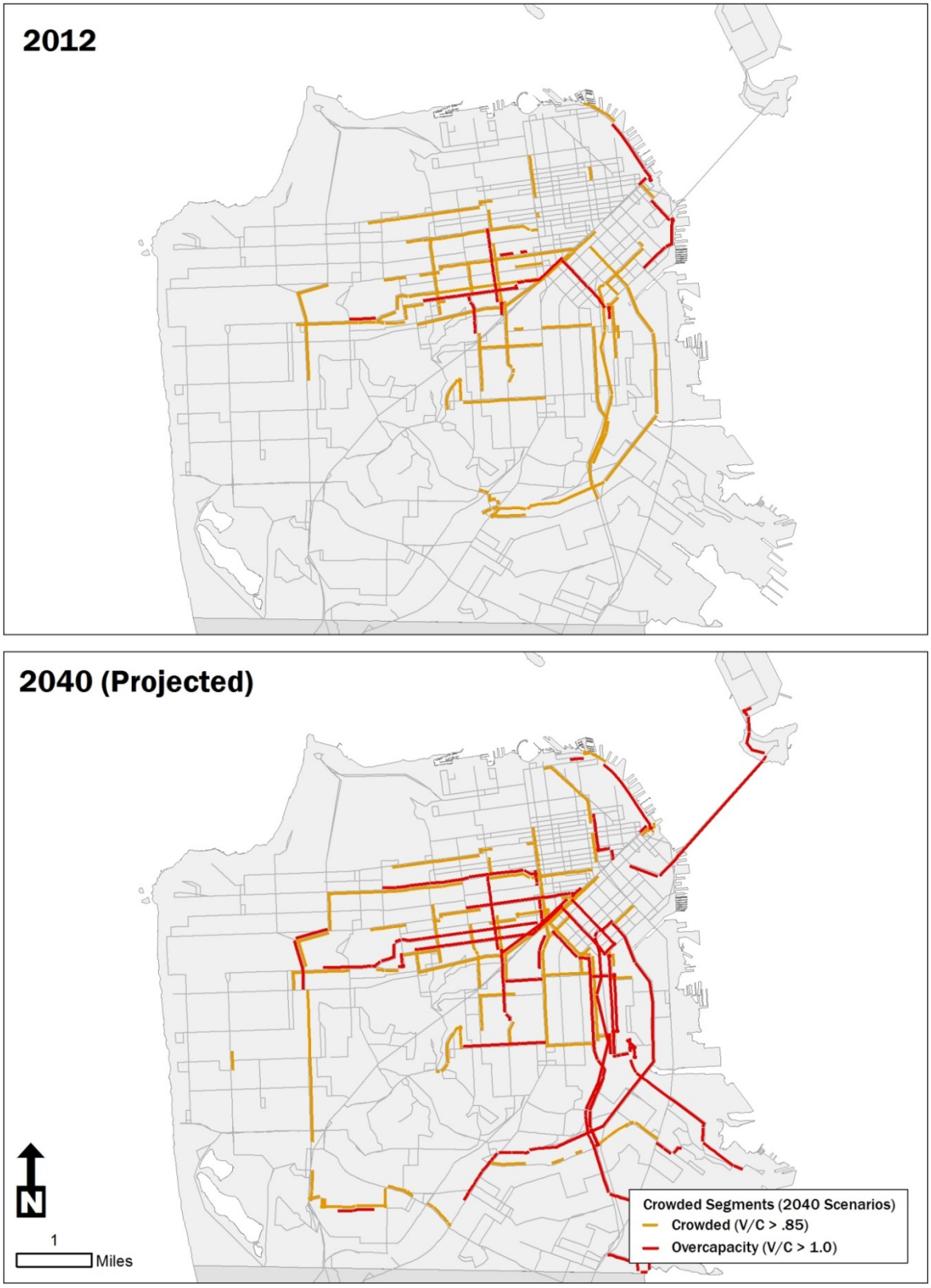
Regional operators will also feel the effects of San Francisco's growth. As Figure 10 shows, bus operators, including SamTrans, Golden Gate Transit, and AC Transit, already face peak-period crowding and would see that increase significantly by 2040. Caltrain and BART are both currently below 85 percent full during peak periods but would see some lines go over the threshold during the SFTP plan period.

For regional operators, crowding will have noticeable effects outside of transit vehicles as well. Projected ridership growth will make it more difficult to access stations and could make stations themselves crowded at key points in the system. BART ridership to, from, and within San Francisco is projected to grow by 37 percent, and as such, the system's two most crowded stations, Embarcadero and Montgomery, are forecast to hit limits in their capacity.[13] According to a BART study, delayed peak-hour conditions could lead to significant backups at escalators and crowding-related safety issues on platforms. Demand for travel to the system's core will also create station access issues outside San Francisco. Even with new transit-oriented developments around stations, BART will likely see issues like full parking lots and crowded feeder-bus routes throughout the system.

The agency has started to work solutions to all of these problems, exploring ways to redesign Embarcadero and Montgomery stations and improve parking management and bike and bus access,[14] but the agency and partner municipalities, including San Francisco, will need to identify funding for such changes once plans are in place. Caltrain could see similar problems up and down its corridor with projected ridership growth.

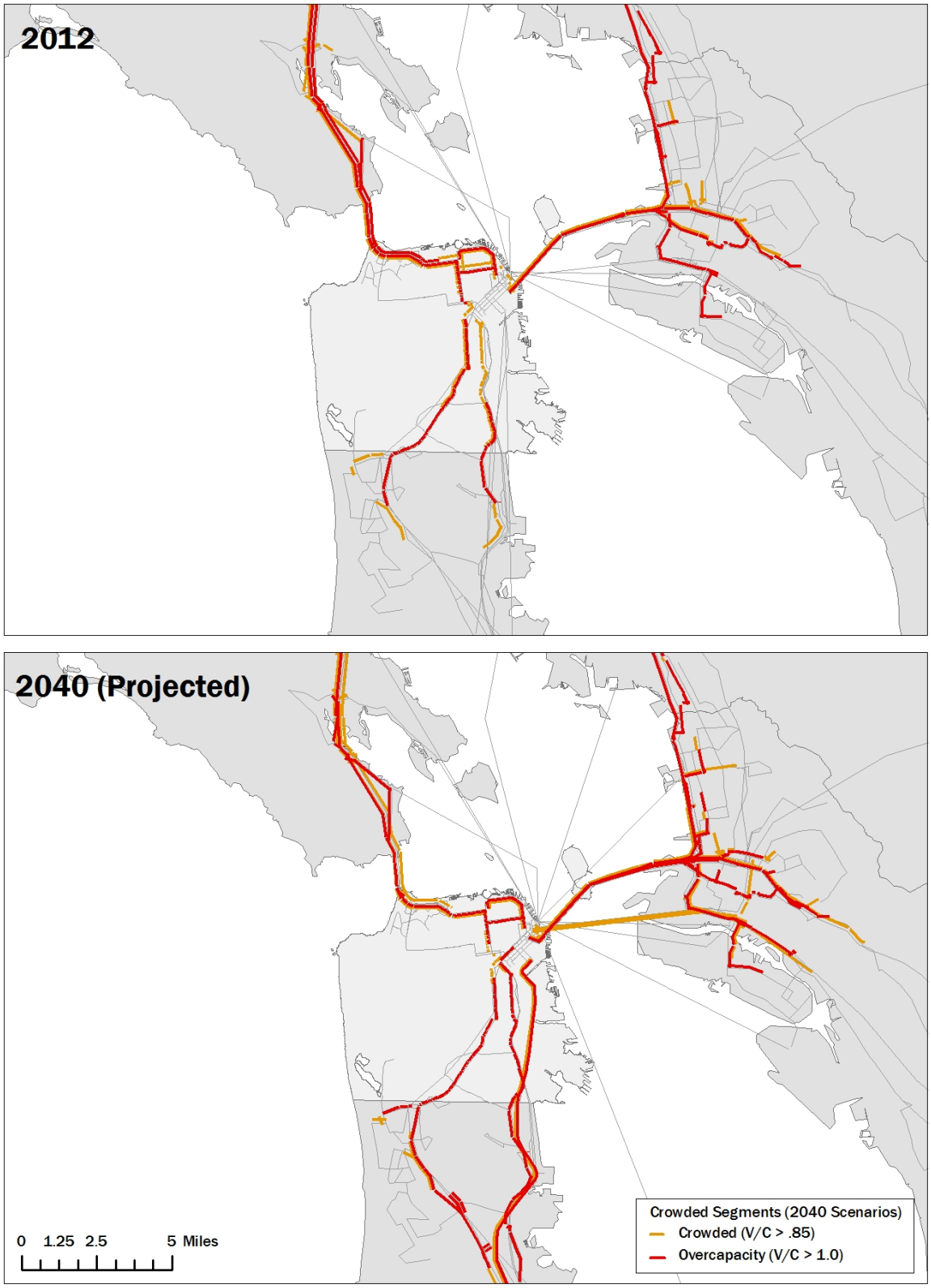
[13] Capacity Planning: Board Workshop, January 2013 (http://www.bart.gov/docs/capacity.pdf)
14 Capacity Planning: Board Workshop, January 2013 (http://www.bart.gov/docs/capacity.pdf), page 6.

Figure 9 Crowding on Muni, 2012 and 2040



Source: SF-CHAMP 4.3. O:\Active Studies\CWTP Update\Data\Zonal Maps\Crowding for map; Q:\Model Projects\sftp\ch430.JHC.2040.SFTP.NoProject\Outputs - SFTP Transit AM mdb 4040 and 2012

Figure 10 Regional Transit Crowding, 2012 and 2040.



Source: SF-CHAMP 4.3.

2.2.3 | STREET CONGESTION

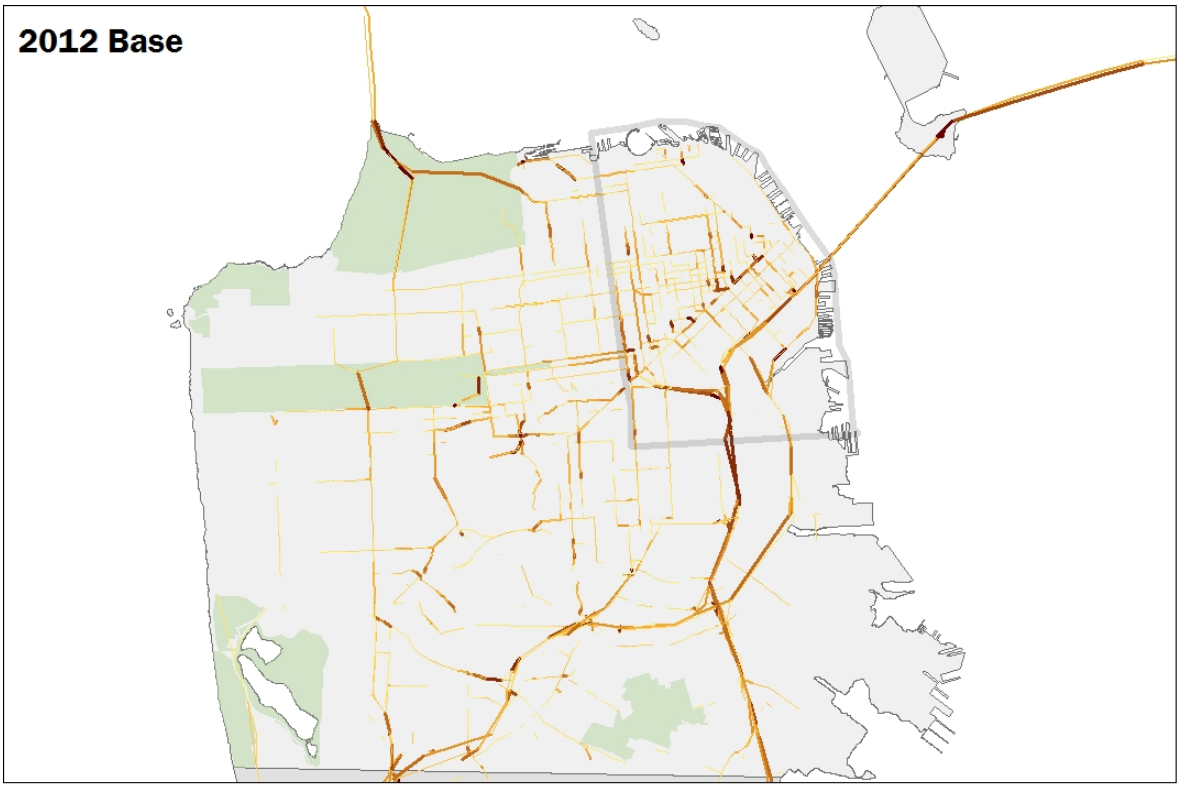
New population and employment will result in about 30 percent more automobile trips on the network compared to today, or an increase of about 600,000. Figure 11 illustrates the effects of this increase on the street network, and shows that many streets will reach or exceed levels considered congested or overcapacity.[15]

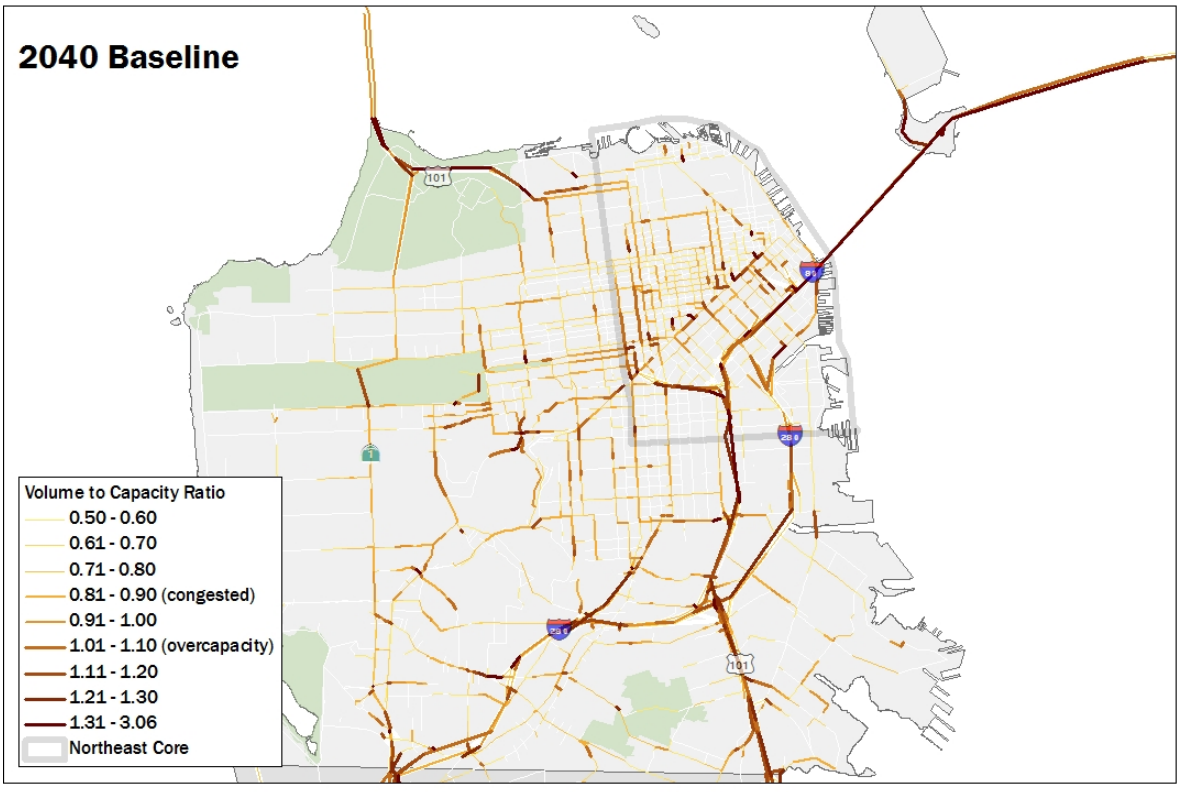
2.2.4 | TRANSIT SPEEDS

Overall modeled daily average speeds on the Muni network are around 11 miles per hour today. Projections for the 2040 baseline scenario show those speeds remaining the same in the future although street congestion worsens due to population growth. This is in part because several major transportation improvements included in the future baseline (such as the Van Ness Bus Rapid Transit Project, the Central Subway, and others) improve conditions for transit and offset the negative effects of congestion.

[15] Congestion is defined as a ratio between a road's volume and its capacity of between .8 and 1.0. "Congested" means vehicle volumes are between 80% and 100% of the volumes the road was designed to handle. "Overcapacity" is defined as a ratio of more than 1.0, in which a road carries volumes that are greater than the levels for which it was designed.

Figure 11 Congestion, 2012 and 2040





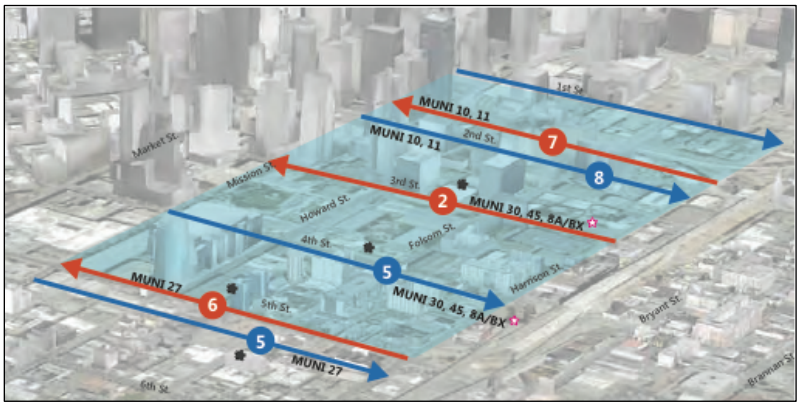
Source: SF-CHAMP 4.3.

2.2.5 | CONGESTION IN THE NORTHEAST CORE

The effects of increased congestion will be most acute in SoMa, given the area's significant projected job and housing growth and its location between Interstate 80 and the city's dense job core. The forecast increase in auto traffic is projected to lead to gridlock during peak periods, with queues at traffic lights spilling into downstream intersections and bringing multi-block areas to a standstill. Avoiding these cascading effects in this critical part of the system would require a 27 percent reduction in private-vehicle traffic in SoMa.[16]

Gridlocked conditions in SoMa would slow transit vehicles as well as cars. As Figure 12 shows, some of the bus lines that run through the neighborhood would slow to the low single digits during the evening peak hour. Such slow speeds would have a ripple effect across Muni's bus system, tying up drivers and vehicles and exacerbating reliability issues throughout the city.

Figure 12 Projected 2035 SoMa Bus Speeds (miles per hour), Evening Peak Hour



Source: SF-CHAMP 4.3 volumes for "Baseline Prime," Fehr + Peers SimTraffic Analysis, 2012

2.3 | Summary of needs

San Francisco needs to improve its transportation system, especially in the downtown core, to accommodate new growth. The following strategies could help address transit and roadway crowding caused by development growth:

- **ENHANCED TRANSIT CAPACITY IN GROWING AREAS (E.G. CORE, SOUTHWEST, SOUTHEAST), ESPECIALLY ON REGIONAL TRANSIT.** BART has already started to explore increasing its capacity in the most heavily used parts of its system through the BART Metro concept, which could increase service levels, platform capacity, and/or the number of stops between the Mission in San Francisco and downtown Oakland. Caltrain is also working to increase the number of trains it can run every hour through electrification (see Section 2) and new communications equipment that would allow the system to safely run trains closer together during peak times. Implementing these ideas could help reduce auto traffic on downtown streets.

- **IMPROVED DIRECT REGIONAL TRANSIT SERVICES FOR AREAS OF THE CITY LESS WELL SERVED BY TRANSIT.** Much of the west side of San Francisco is at least a bus ride away from the Bay Area's regional transit system. A regional express-bus system providing direct connections from San

[16] Brisson, Liz, Kyle Gebhart, and John Urgo. "Core Network Circulation Study – Evaluation Framework and Baseline Analysis Findings." 9/14/2012.

Francisco's west side to regional transit and regional employment centers could help address the growing numbers of trips expected between the west and east sides of the city.

- **IMPLEMENTATION OF INVESTMENTS CRITICAL TO MEET NEW DEMAND GENERATED BY DEVELOPMENT.** The city and developers have already agreed to a set of transit enhancements to serve the major developments that will come online between now and 2040. Timely implementation of these investments – including enhanced bus and ferry service to and from Treasure Island, light-rail enhancements serving San Francisco State University and Parkmerced, express-bus service to Candlestick and Hunters points, and the other enhancements already underway as part of the Southeast Waterfront Transportation Plan –will be critical to accommodating new growth in these areas.

- **MORE EFFICIENT USE OF FREEWAY CAPACITY TO SERVE TRAVELERS, ESPECIALLY IN THE SOUTH BAY MARKET.** High occupancy vehicle lanes on the city's freeway system and other performance enhancements could encourage carpooling and ensure that commuters are making efficient use of ever more crowded infrastructure.

- **DIRECT CONGESTION MANAGEMENT AND PARTNERSHIPS WITH PRIVATE OPERATORS.** The city will also need to provide financial disincentives to driving alone into the congested core through congestion pricing and transportation demand management partnerships with private companies. See Section 5 for more detail.

3 World-Class Infrastructure

SECTION SUMMARY:

- After years of underinvestment, Muni and regional transit agencies that serve San Francisco have significant unfunded capital needs.
- Poor vehicle condition is already responsible for many transit service delays and the situation will worsen without increased investment.
- Operating costs are growing rapidly and will crowd out critical capital investments if transit agencies do not take steps to control growth in costs.
- Pavements will require significant new investment to maintain adequate conditions.

San Francisco's transportation system relies on aging infrastructure that will need significant repair or replacement over the course of the plan period. This section discusses investments needed to achieve the goal of world-class infrastructure and maintain a state of good repair.

It includes the following sections:

- **TRANSIT OPERATING NEEDS** discusses what it will take to keep the existing system running given rising transit operating costs. It does not discuss the additional service expansion necessary to accommodate San Francisco's growing population and employment, which were covered in the prior section on Economic Competiveness.
- **TRANSIT MAINTENANCE NEEDS** discusses what it will take to repair and replace vehicles and fixed infrastructure at the appropriate times in their lifecycles over the course of the plan period and the performance consequences of not investing sufficiently in capital asset maintenance.
- **ROADS, BRIDGES, AND STRUCTURES** discusses investments needed to meet city pavement-condition goals and keep bridges and other structures in safe operating conditions for all users.

3.1 | Goals and Performance Measures

The SFTP world class infrastructure goal is to improve the condition of San Francisco's infrastructure so that it is reliable and can be maintained cost-effectively. Key goals and performance measures for this section include:

- Stabilize transit operating costs
- Improve transit system reliability through adequate maintenance
- Achieve a pavement condition index of 70 [Proposition B streets bond goal]
- Maintain road and bridge structural sufficiency

3.2 | Trends and future conditions

3.2.1 | TRANSIT OPERATING NEEDS

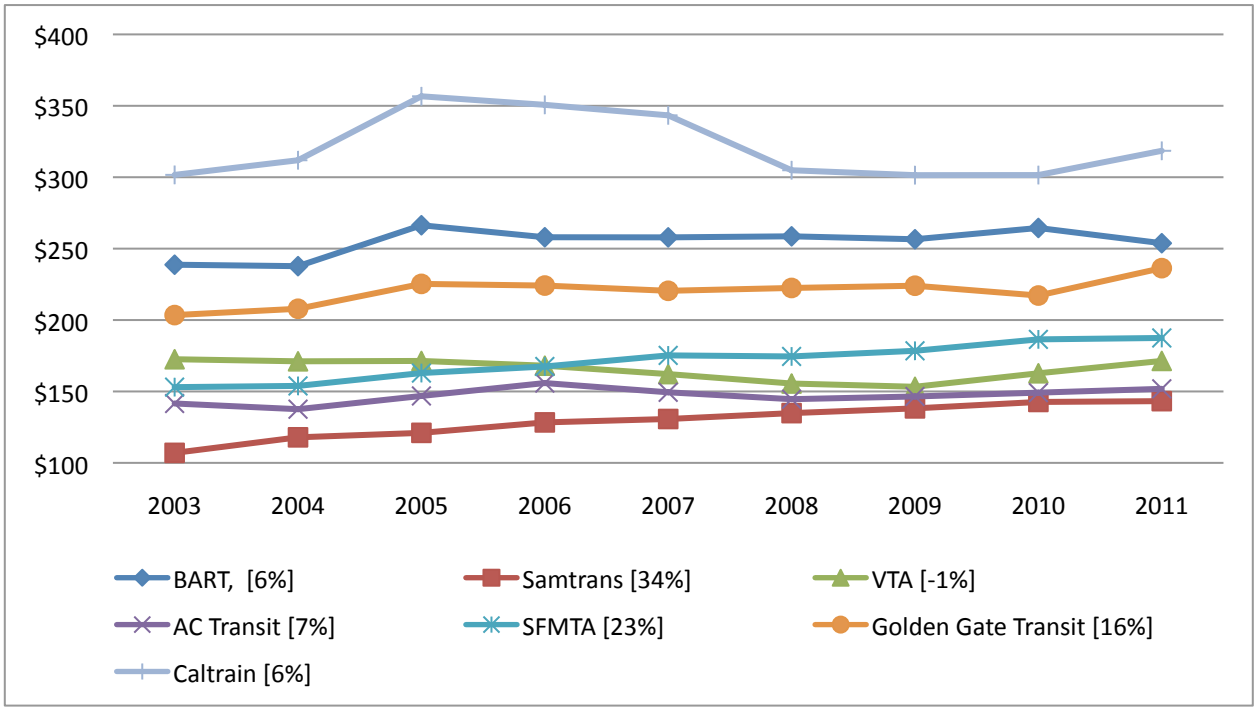
Transit operating expenses include the cost of wages for vehicle drivers, maintenance and customer-service staff, system administrators, and others. They also include the cost of fuel or energy to power transit

vehicles and parts or other materials for regular maintenance tasks. Transit operating needs alone will take up nearly 60 percent of available revenues. If current trends continue, funding needs could be even higher and could crowd out system-efficiency projects and those aimed at serving new trip patterns. Among these trends:

- **RISING COSTS:** The real cost of providing transit service has been rising over the last several decades (Figure 13). According to the Metropolitan Transportation Commission's Transit Sustainability Project, rising fringe benefit costs are a major contributor to cost growth. The cost of fringe benefits like health care and pensions nearly doubled between 1997 and 2008 (Figure 14).

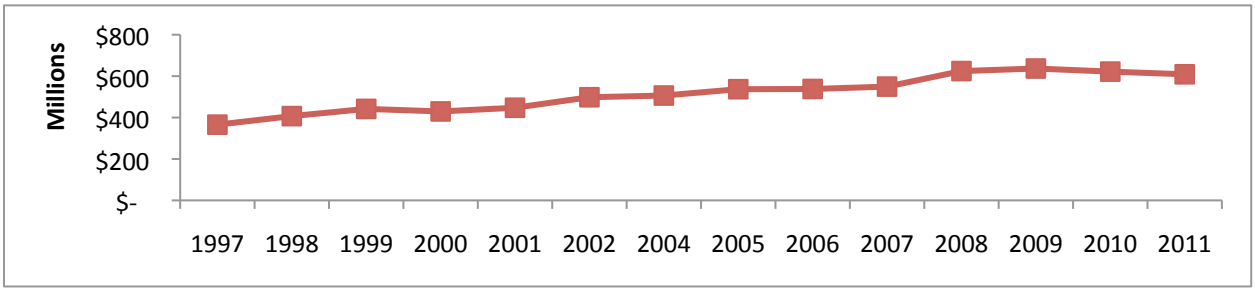
- **SLOWER SPEEDS AND LOWER RELIABILITY FOR SFMTA AND REGIONAL BUS OPERATORS:** A less direct but still important operating-cost driver, speeds slowed significantly on SFMTA's bus and light-rail systems between 1997 and 2008 (see Figure 15). Slower speeds mean a driver and vehicle can complete fewer route runs in a day, leading to less service for the same price.

Figure 13 Cost per Hour of Service, 2003-2011 (Inflation-Adjusted)



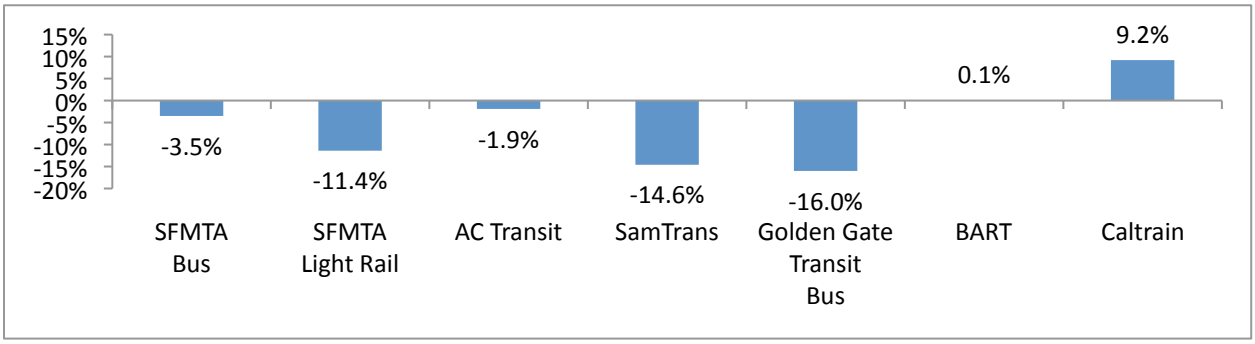
SOURCE: NATIONAL TRANSIT DATABASE TS2.2 - SERVICE DATA AND OPERATING EXPENSES TIME-SERIES BY SYSTEM, AND THE CALIFORNIA DEPARMENT OF FINANCE (FOR BAY AREA INFLATION DATA).

Figure 14 Growth in General and Fringe Benefit Costs for Agencies Serving San Francisco, 1997-2011 (Inflation-Adjusted)



Agencies included: SFMTA, BART, AC Transit, Golden Gate Transit, and SamTrans. Caltrain contracts for operations and maintenance, so fringe benefit data only covers administration and was not included.

Figure 15 Change in Average Speed, 1997-2008



Source: Metropolitan Transportation Commission. Transit Sustainability Project: Background and Findings. September 2011, page 8.

Agencies are already taking steps to make their operations more efficient. The MTC's Transit Sustainability Project created an incentive program that is aimed at reducing agencies' operating costs[17] by 5 percent by the middle of this decade. Implementation of additional cost-control recommendations from the TSP, such as capping agency contributions to health insurance costs, could also be explored.

Strategies to improve transit vehicle speeds and reliability can also help address crowding, since faster-moving vehicles are less expensive to operate. SFMTA is moving forward with its Transit Effectiveness Project, which aims to improve speeds and make operations across the system more efficient through route changes, stop consolidation, and small-scale investments like curb bulb-outs and painted transit-only lanes at key bottlenecks. Caltrain is moving forward with a plan to power its trains by overhead wires rather than diesel locomotives, which is projected to save fuel costs and trim travel times up and down the corridor due to faster acceleration and deceleration rates. BART is also studying expanded service in the system's core, between downtown Oakland and the Mission in San Francisco, allowing it to more efficiently meet demand in the highest ridership portion of the system. Many of these projects support both the world class infrastructure and economic competitiveness goals.

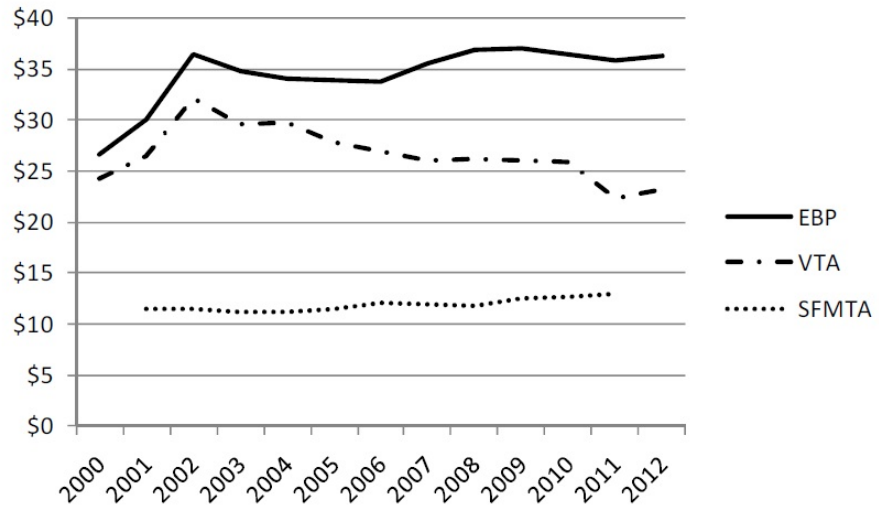
3.2.2 | PARATRANSIT

Growth in San Francisco's senior population and accompanying demand for paratransit services may also put additional growth pressure on operating costs, though SFMTA and other large paratransit operators in

[17] The MTC Transit Sustainability Project's final recommendations say these reductions can be per service hour, per passenger, or per passenger mile.

the Bay Area have effectively controlled the cost of such services on a per-trip basis in recent years (see Figure 16).[18] As of 2011, paratransit services made up just over 5 percent of transit operating costs region-wide.

Figure 16 Paratransit Operating Cost per Eligible Passenger Trip, Large Bay Area Operators



Source: Metropolitan Transportation Commission. "Transit Sustainability Project: Draft Paratransit Final Report." August 29, 2011. Page 3-10. Note: Dollars adjusted for inflation. VTA is Valley Transportation Agency, EBP is East Bay Paratransit.

San Francisco's senior population is projected to grow by 68 percent over the plan period, which should increase demand and thus the total cost of paratransit over time. However, several recent research reports on the strength of the relationship between the size of a city's elderly population and the level of paratransit demand have reached conflicting conclusions. While data shows that paratransit demand increased by 37% nationally between 2000 and 2009, and the American Public Transportation Association forecasts a 32% increase in paratransit demand by seniors between 2010 and 2020, a 2007 report concluded that demand is more closely related to an area's total population than to its senior population.[19] Further study is needed to quantify precisely how costs will increase as the elderly population grows.

[18] Metropolitan Transportation Commission. "Transit Sustainability Project: Draft Paratranist Final Report." San Francisco: August 29, 2011, page 3-10.
[19] *Ibid*, 3-18.

3.2.3 | TRANSIT CAPITAL NEEDS

Bay area transit operators face significant transit capital shortfalls totaling approximately $5 billion over the SFTP plan period. These capital needs include new vehicles and mid-life overhauls and for repairing or rebuilding existing infrastructure. Table 1 shows the total need, San Francisco share, and projected funding shortfall for Muni and the regional operators that serve San Francisco.

Table 1 Transit Capital Revenue and Need, 2012-2040 (In Billions, Year-of-Expenditure Dollars)

Operator	Total Need[1]	Revenue Vehicle and Score 16[3] Need	Revenue Vehicle and 70% of Score 16 Need	Expected Transit Capital Revenue	Total Shortfall
SFMTA	$12.7	$9.1	$7.6	$8.4	$4.3
Caltrain (SF Share)	$1.1	$0.7	$0.5	$0.4	$0.8
BART (SF Share)[2]	$2.1	$2.1	$2.1	$2.1	N/A
GGBHTD (SF Share)[2]	$0.3	$0.3	$0.3	$0.3	N/A
Grand Total	$16.16	$12.13	$10.48	$11.10	$5.07

[1] Need to meet target of 0% of assets past useful life.
[2] For the purpose of this assessment we are not expecting SF to have a discretionary share of the BART and GGBHTD capital need. BART and GGBHTD needs will be addressed at the regional/partner level.
[3] Score 16 vehicles are those the regional government has identified as top priority for replacement.

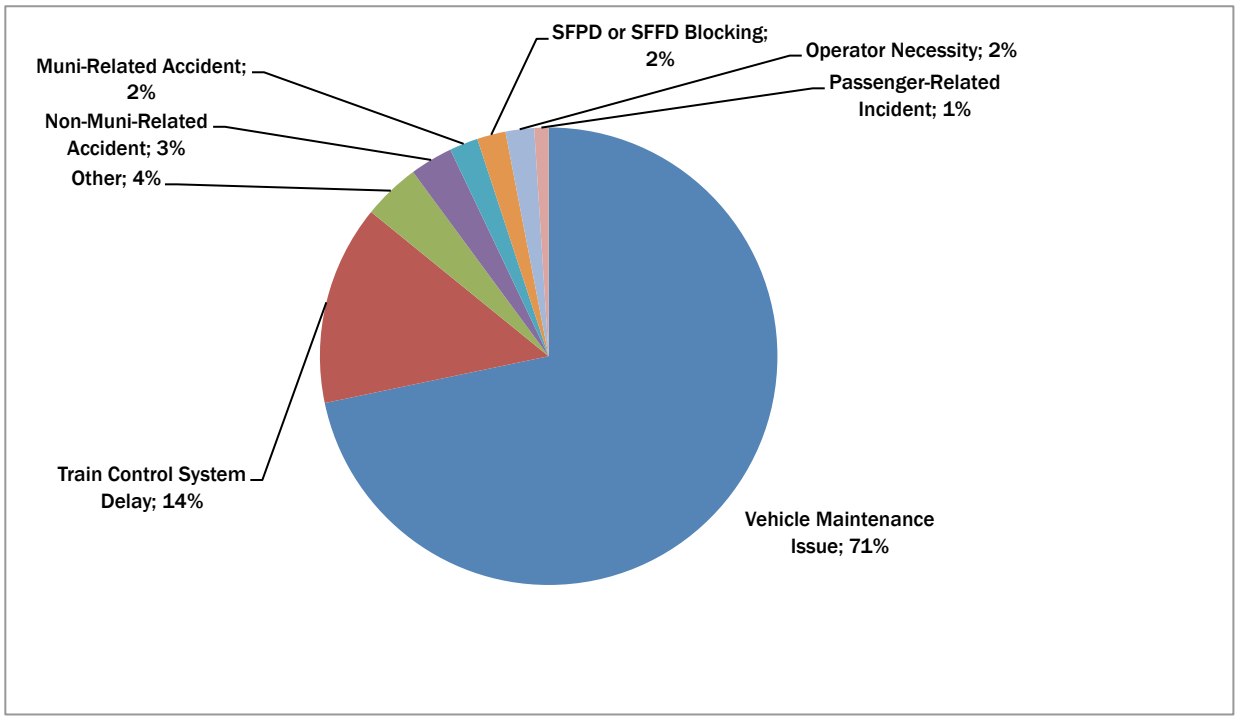
Shortfalls in state-of-good-repair investments can lead to significant reliability, safety, and customer-satisfaction issues. Specifically, they can, over time, cause:

- **VEHICLE BREAKDOWNS.** Failing to perform routine service on buses and rail cars can increase maintenance issues later in vehicles' lives. Poor transit vehicle maintenance has significant reliability impacts, resulting in service breakdowns, unscheduled turnbacks, and delays in tunnels. Illustrating this point, Muni's aging light-rail fleet had on-time performance of 50 percent in May 2013, and vehicle mechanical issues were responsible for 71 percent of the delays (see Figure 17).

- **INFRASTRUCTURE PROBLEMS.** Failing to invest appropriate amounts in fixed infrastructure can lead to cracked or worn-down rails, electricity issues, and communications problems along whole segments of the system, causing more frequent service suspensions for emergency repairs. It can also require initiation of "go slow" zones, further reducing speeds. As shown in Figure 17, train-control system delays were the second-largest cause of light-rail delay in May 2013. These maintenance-related delays are experienced on top of the routine delays associated with street congestion, traffic signals, and so forth.

- **DEGRADATION IN PASSENGER SAFETY AND COMFORT.** All of these issues have an impact on passenger safety and comfort, as they lead to lower adherence to service schedules and more frequent inconveniences like vehicle turn-backs and pass-ups. Additionally, they can lead to unevenness in passenger loads, with significant crowding on delayed vehicles.

Figure 17 Muni Light Rail Reasons for Delay, May 2013



Source: SFMTA 2013.

Table 1 shows that transit capital needs are very large and that much of the need is unfunded. This is because of the age of the region's transit systems, many of which are among the oldest in the state. The region as a whole, and San Francisco in particular, relies heavily on rail systems, which require higher ongoing maintenance investments than other modes because of the significant amount of fixed infrastructure they require.[20] Budget pressure over the last several years, which resulted in some deferred maintenance in addition to service cuts, also contributed to the large amount of need going forward. The following sections describe operator capital needs in more detail.

MUNI

Based on the direction set in its 2010 Fleet Plan, the agency aims to steadily lower the average age of its fleet through smaller vehicle procurements every few years instead of large procurements every five or 10 years, as it has done in the past.[21] As of 2010, the average Muni vehicle age was 7.5 years, but the agency projects that it can reduce that to 4 to 6 years by 2030. This approach would help keep enough operational vehicles available for peak service and reduce stress on the agency's maintenance department by spreading out lifecycle maintenance demands.

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[20] Metropolitan Transportation Commission. *Plan Bay Area*. Draft, March 2013. Page 67.
[21] San Francisco Municipal Transportation Agency. *2010 SFMTA Transit Fleet Management Plan*. Revised April 2011. Retrieved from http://beta.sfmta.com/cms/rhome/documents/2010FleetPlan_MainText-FinalAccessible.pdf on 9/16/13.

Beyond vehicles, Muni has several other areas of need related to maintaining a state of good repair. The agency estimates that, given the need for more vehicles of all types due to increased peak-hour demand, it will need more than 17 additional acres for maintenance facilities through 2030.[22] A portion of the total need also includes repairing or replacing rails, wires, and systems for train control and communication.[23]

REGIONAL TRANSIT OPERATORS

Caltrain will be transitioning from its current diesel-powered trains to new electric-powered trains by 2019. As such, the system's needs are related to both existing vehicles' ages and the need to buy train cars that are compatible with the new technology. Many of Caltrain's locomotives are more than 25 years old, near the end of their useful lives, and their age is already resulting in increased delays and maintenance issues.[24]

BART's vehicle fleet is one of the oldest and most heavily used in the industry, with an annual average of 95,000 miles of use per car.[25] As such, the agency's vehicle-replacement and maintenance needs make up a significant proportion of its total capital needs over the plan period. The agency also expects that it will need 30 percent more rail cars by 2030 to serve a growing number of riders. Given all of these factors, the agency's total capital shortfall is the largest of any Bay Area operator.[26]

Golden Gate Transit's capital needs are all related to replacing its more than 200 buses and 5 ferries at the end of their useful lives and growing its fleet as needed to meet passenger demand.[27]

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[22] SFMTA (2011), page 38.
[23] SFMTA. *2011 20-Year Capital Plan*. Page 9. Retrieved from https://www.sfmta.com/sites/default/files/FInalCapitalPlanMTAB_accessibleplan.pdf on 9/16/13.
[24] Emslie, Alex. "Aging Caltrain fleet leading to longer delays." San Francisco Examiner. September 18, 2013. Retrieved from http://www.sfexaminer.com/sanfrancisco/aging-caltrain-fleet-leading-to-longer-delays/Content?oid=2580990.
[25] Bay Area Rapid Transit. "New Rail Vehicle Program: Board Workshop." January 2013, Slide 11. Retrieved from http://www.bart.gov/docs/NewVehicleProgram.pdf on 9/16/13.
[26] MTC. *Plan Bay Area: Transit Operating and Capital Needs and Revenue Assessment.* Draft March 2013. Retrieved from http://onebayarea.org/pdf/Draft_Plan_Bay_Area/Draft_PBA_Transit_Operating_and_Capital_Needs_and_Revenue_Assessment.pdf on 9/16/13.
[27] Golden Gate Bridge, Highway, and Transportation District. *Short-Range Transit Plan, Fiscal Years 2008-2017*. Page 3-2. Retrieved from http://goldengatetransit.org/services/documents/SRTP-Chapter3.pdf on 10/2/13.

World Class Infrastructure: What Would it Take?

- **CHALLENGE:** San Francisco has an extensive and aging transportation infrastructure. Funding is not sufficient to adequately maintain the system in a state of good repair.
- **TARGET:** Raise the city's transportation system to a state of good repair, defined as:
    - Transit: fully fund transit vehicle replacement and mid-life overhauls and replace all capital assets at the end of their useful life; maintain today's levels of transit operations.
    - Roads: achieve a pavement quality index of 70 and maintain today's levels of street operation.
- **IMPROVEMENTS:** This scenario estimated the funding needed to achieve the state of good repair performance measures listed above. It does not include any needs associated with meeting additional demand due to population and employment growth.
- **CONCLUSIONS:** An additional $5 billion in year-of-expenditure dollars through 2040 would be needed to fully fund all transit capital maintenance needs. An additional $1.5 billion is necessary to reach and maintain a pavement condition index of 70. Existing revenues are sufficient to maintain today's levels of street and transit operation.

3.2.4 | STREETS AND BRIDGES

Maintaining San Francisco's road and bridge infrastructure is another key element of achieving the goal of world-class infrastructure. Smooth and well maintained streets increase safety and reduce wear and tear on both private cars and transit vehicles and make conditions safer for bikers and pedestrians.

As of 2011, the average pavement condition on local streets was "fair," with a pavement condition index rating of 64 out of 100, although TRIP: A National Transportation Research Group recently ranked the San Francisco-Oakland metropolitan area's roads the second worst in the country, with 60 percent of roadways in poor condition.[28]

In developing the Proposition B streets bond in 2011, the Department of Public Works and the San Francisco Capital Planning Committee set a goal of achieving an average citywide PCI score of 70, which is considered "good" condition, by 2021. Proposition B increased San Francisco's annual street resurfacing budget from $26 million in 2011 to $65.5 million in 2012 and provided funds for this increased investment level for four additional years. Achieving and maintaining a PCI score of 70 over the long term will require a total investment of $3.83 billion over the life of the plan, $1.53 billion more than is already committed to street resurfacing. Without a sustained, long-term increase in street resurfacing funding, San Francisco's PCI score will fall below 60 and into "poor" condition by 2030.

Streets and roads also require an investment of $2.84 billion in street operations like street cleaning, pothole filling, and signal maintenance; this funding is available through existing sources.

[28] TRIP: A National Transportation Research Group. "Bumpy Roads Ahead: America's Roughest Rides and Strategies to Make our Roads Smoother." Washington, DC: October 3, 2013. Retrieved from http://www.tripnet.org/docs/Urban_Roads_Report_Oct_2013.pdf on 10/11/13.

Bridges and other structures, including the state-owned freeways that run through San Francisco, will require additional investments over the coming decades. According to a recent study by Transportation for America, most of San Francisco's bridges are in good condition, but segments of U.S. 101 and a few non-freeway bridges will be in need of attention in the next 20 years.[29] In many cases, bridge decks (the concrete road beds on which surface asphalt rests) are the element that needs the most urgent attention, rather than deeper structural elements.

Caltrans owns and maintains state and US highways and interstates and will be responsible for funding the upkeep and replacement of highway bridges and structures. San Francisco government agencies can play an important role in advocating for timely investment in these structures. The Department of Public Works maintains a number of additional local-road bridges, retaining walls, and stairways that will need to be repaired or rebuilt over the life of the plan. The department prioritizes and funds maintenance needs through a citywide 10-year capital planning process.

[29] Transportation for America. "The Fix We're In For: The State of Our Bridges." Retrieved from http://t4america.org/resources/bridges/#?latlng=37.77583200000001,-122.4180973&bridge_id=%0A340034 on 9/16/13.

4 Livability

SECTION SUMMARY:

- Infill development near transit within San Francisco is expected to slightly increase the share of trips made by bicycling and walking by 2040, but this will be insufficient to achieve the city's aggressive goals. Additional investment will be needed.
- Investments in safety for walkers and bicyclists is a critical step necessary to allow growth in walking and bicycling.
- The SFMTA's Bicycle Strategy provides a vision for a safe, interconnected network of protected bicycle-ways, but funding is not sufficient to complete the network.
- The SFMTA's Pedestrian Strategy provides a vision for reducing collisions on the 44 miles of the most dangerous roadways. Funding is not sufficient to implement the strategy.

The concept of livability has become a key focus in recent years. Former U.S. Secretary of Transportation Ray LaHood described livability as "being able to take your kids to school, go to work, see a doctor, drop by the grocery or post office, go out to dinner and a movie, and play with your kids in a park, all without having to get in your car.[30]" The SFCTA also recently held a twitter contest to define livability and received numerous creative responses (Figure 18).

Figure 18 Responses to SFCTA Twitter Contest on Defining Livability

This section reviews recent trends and future needs with respect to improving the quality of alternatives to the automobile, with a particular emphasis on bicycling and walking.[31] It includes discussion of the current

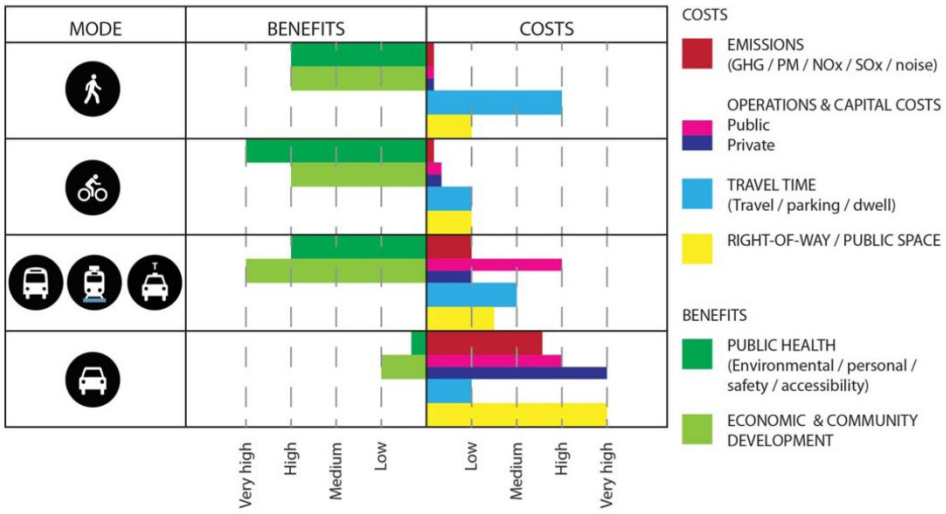
[30] See the U.S. DOT's livability web page: http://www.dot.gov/livability

[31] Mass transit is covered in the World Class Infrastructure and Economic Competitiveness sections.

condition of bicycling and walking infrastructure, recent planning efforts in the area of bicycling and walking, and a summary of future investments needed to make bicycling and walking as safe and attractive as possible.

Bicycling and walking are the focus of efforts to improve livability because they are environmentally sustainable, pollution-free, and healthful modes of travel, and are inexpensive relative to other modes of travel, as illustrated in Figure 19. Additionally, if bicycling and walking investments shift even a small number of trips out of crowded transit vehicles, significant savings can be realized since peak-period demand is a key driver of the cost of providing transit service.

Figure 19 Cost Effectiveness of Bicycling, Walking, Transit, and Automobile Use



Source: SFMTA Bicycle Strategy.

4.1 | Goals and performance measures

The SFTP livability goal is to improve the quality and safety of the bicycle, pedestrian, and transit networks so that San Franciscans can have multiple attractive options for getting where they need to go. Performance measures for this area include:

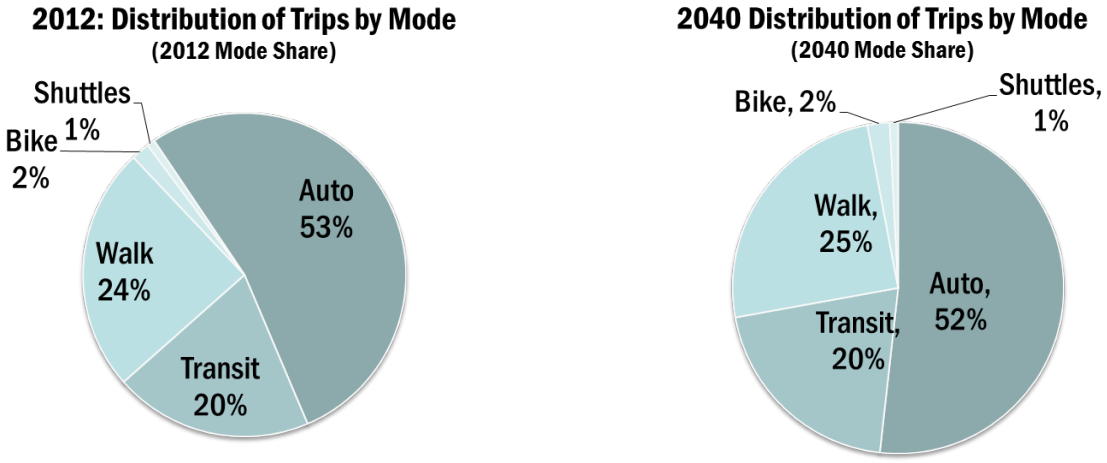
- **THE SHARE OF TRIPS MADE BY BICYCLING, WALKING, AND TRANSIT.** SFMTA has set a goal of greater than 50 percent of trips by these non-automobile modes. The Board of Supervisors set a goal of a 20 percent bicycle mode share by 2020.
- **BICYCLE AND PEDESTRIAN SAFETY.** The Mayor's Pedestrian Safety Task Force set a goal of reducing severe and fatal pedestrian collisions by 50 percent by 2021.
- **TRIP LENGTHS** (shorter trips are more easily made with non-motorized modes).

4.2 | Trends and future conditions

The outlook for increased rates of bicycling and walking is good. As San Francisco adds population and employment to areas already convenient for bicycling and walking (see the Economic Competitiveness section for a discussion of land use projections), the share of trips made by bicycling and walking is expected to grow slightly (by about a percentage point) without any additional infrastructure investment (Figure 20).

Nevertheless, as the following discussions demonstrate, additional investment will be needed for the city to meet its aggressive goals for increasing the share of trips made by bicycling and walking.

Figure 20 Distribution of All Trips To, From, and Within San Francisco by Mode, 2012 and 2040 Baseline

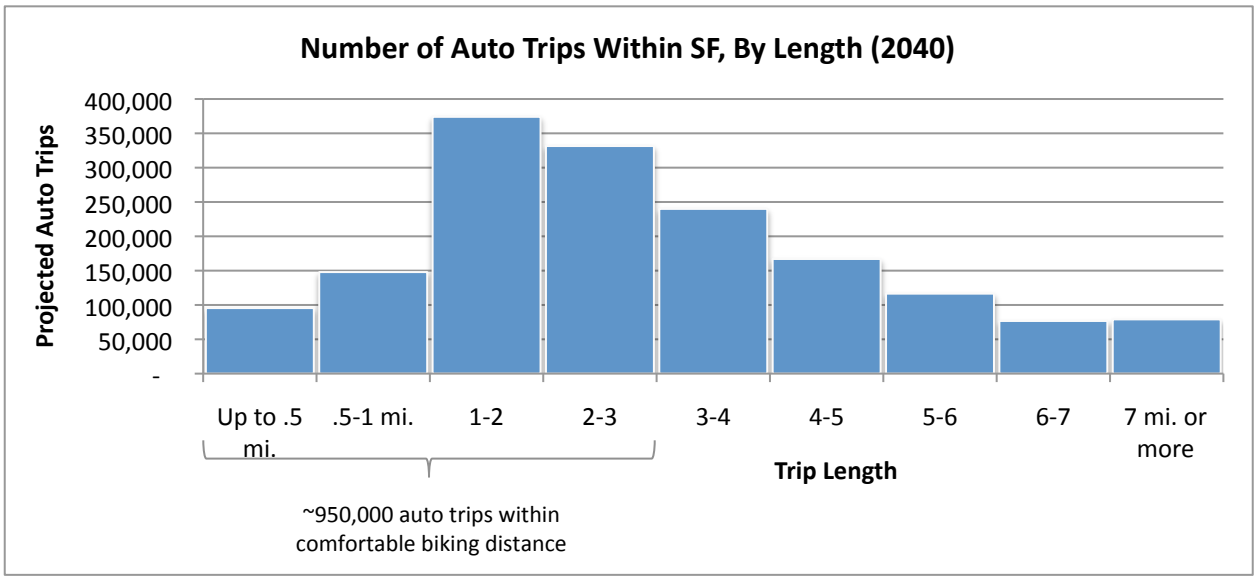


Source: SF-CHAMP 4.3 with manual adjustments to include private shuttle sector.

4.2.1 | BICYCLING

Bicycling is on the rise in San Francisco. The SFMTA's State of Cycling Report indicates that bicycle trip volumes are approaching 75,000 bicycle trips per day; nearly a third of San Francisco residents report bicycling at least occasionally. Rates of commuting by bicycle are also growing, and San Francisco now ranks third in the nation behind Portland, Oregon and Seattle, Washington in bicycle commuting rates among major US cities. The potential for further increasing rates of bicycling is high – as Figure 21 shows, nearly 60 percent of all local automobile trips will be less than three miles in length by 2040, a convenient distance for bicycling.

Figure 21 Projected Auto Trip Lengths, 2040



The SFMTA and its partners are making rapid progress towards improving infrastructure. Since completion of the city's Bicycle Plan in 2009, 50 bicycle projects and nearly 30 miles of bicycle lanes have been added, along with more than four thousand shared lane markings (sharrows), hundreds of new bicycle racks, numerous innovative pilot projects such as the Green Wave on Market Street, and initiation of a regional bicycle sharing system in San Francisco.

These improvements are helping support the trend towards more and more bicycling, but are not sufficient to allow achievement of the aggressive goal – set by the San Francisco Board of Supervisors in 2010 – of achieving a 20 percent bicycle mode share by 2020. To grow bicycling further, San Francisco must do more to address cyclist safety. Surveys conducted for the SFMTA's 2012 State of Cycling Report indicated that almost half of those who do not currently bicycle say they are uncomfortable bicycling in mixed-flow traffic with cars, and only 13 percent said they feel safe from traffic when bicycling. At the same time, 94 percent of respondents say they would feel comfortable riding in bicycle lanes. Network fragmentation is also a challenge to improving cyclists' sense of safety. Many of the existing bicycle facilities are disconnected from one another (Figure 22), and cyclists may find it impossible to complete their whole trip on protected bicycle ways or bicycle lanes.

Figure 22 Bicycle Network Fragmentation

The SFMTA's recent Bicycle Strategy (2013) envisions a world-class bicycle facility network for San Francisco – one on which cyclists of all ages and abilities would be safe and comfortable. Full network build-out would include the following actions:

- Complete the bicycle plan (10 miles)
- Upgrade 200 miles of the existing bicycle network to premium bicycle facilities
- Construct 35 miles of new bicycle facilities
- Upgrade 200 intersections to accommodate bicycles
- Install 50,000 bicycle parking spaces
- Deploy and maintain a 3000+ bicycle / 300+ station bicycle sharing system. Support electric bicycles. This system was recently launched with the implementation of the Bay Area Bike Share Program in 2013, which includes an initial 700 bicycles and 70 stations throughout the Bay Area (including San Francisco).
- Provide supportive programs ($10m/yr).

CHALLENGES IN IMPROVING BICYCLING AND WALKING INFRASTRUCTURE

Many of the "easy fixes" to improve bicycling and walking infrastructure have already been completed or are underway. These include pedestrian crosswalk restriping, countdown signals, curb cuts, and striping of new bicycle lanes and sharrows.

Improvements that more significantly benefit bicyclists and pedestrians by physically separating them from vehicular traffic or by reducing vehicle traffic and speeds are frequently more challenging to implement, as they may require re-allocation of roadway space. These include road diets, widened sidewalks, and separated bike-ways, or signal timing changes such as more crossing time for pedestrians. Implementing these improvements requires political and community acceptance of parking or lane removal, or signal delays for vehicles.

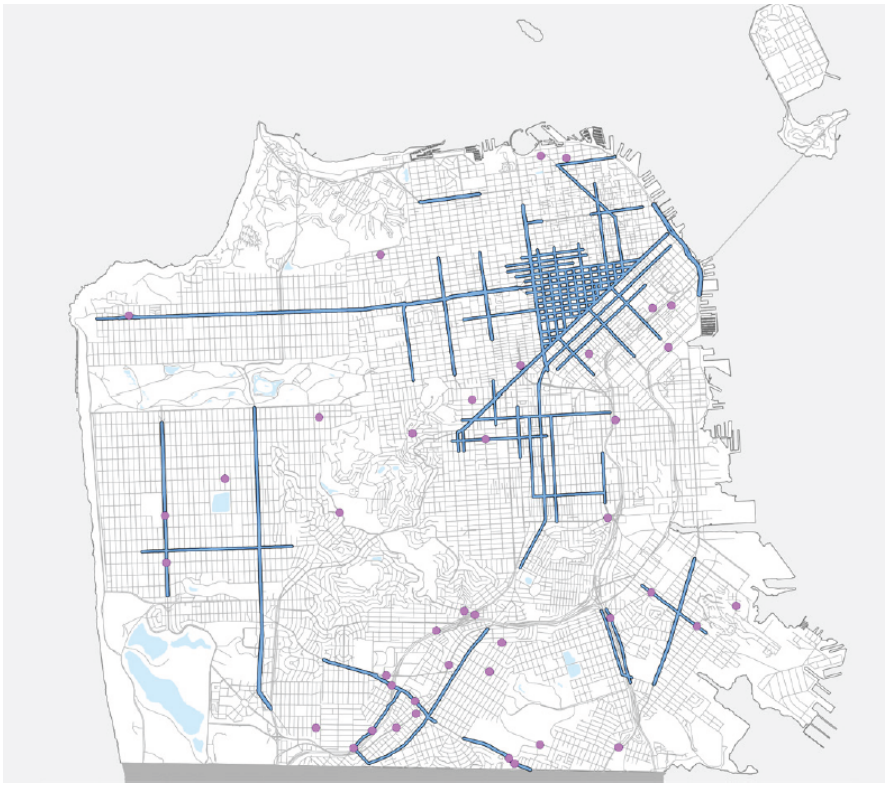
The SFMTA's Strategy estimates the total cost of this strategy to be approximately $600 million in year-of-expenditure dollars through 2040; most of this is unfunded.

4.2.2 | WALKING

San Francisco is a walking city, with nearly 20 percent of trips made by walking. The condition of the city's streets – whether noisy or calm, crowded or spacious, clean or dirty, safe or scary – greatly impacts how San Franciscans and visitors experience the city as they walk around, and is a major determinant of livability.

Although many of San Francisco's streets are inviting and pleasant, many are not, and some are inhospitable to pedestrians. This is evidenced by the fact that on average, 20 pedestrians are killed and 800 injured in collisions with motor vehicles every year.[32] In 2008, Gavin Newson initiated the Mayor's pedestrian safety task force and set a goal of reducing serious and fatal pedestrian injuries by 25% by 2016 and by 50% by 2021. The Task Force's report identified key sources of pedestrian danger, including speeding, failure to yield, and conflicts involving drivers making left turns, and identified 70 miles of the highest-injury corridors for pedestrians. These miles account for 60 percent of all pedestrian collisions in the city, and include most of the city's busiest arterial roadways (Figure 23).

Figure 23 High-Injury Corridors and Pedestrian-Injury Collisions



Source: SFMTA 2013.

Achieving the Mayor's goals will be a major challenge and will require high levels of investment in pedestrian infrastructure. The challenge is compounded by growing population and employment, which will bring an increase in walking trips, automobile trips, and pedestrian-automobile collisions unless aggressive action is taken.

[32] SFMTA Pedestrian Strategy, page 5

Aging of the population is another major challenge for pedestrian safety. San Francisco is projected to experience a 68 percent growth in the number of people 65 and older by 2040, making this group 20 percent of the population (compared to 16 percent today[33]). Older pedestrians are more likely to be killed when struck by an automobile.

Another notable recent effort to improve pedestrian safety and livability is the Better Streets Plan, which creates a unified set of standards, guidelines, and implementation strategies to govern how the city designs, builds, and maintains its pedestrian environment. The Plan seeks to balance the needs of all street users, with a particular focus on the pedestrian environment and how streets can be used as public space.

The Mayor's Pedestrian Safety Task Force report presented a vision for improving pedestrian safety and walkability in San Francisco. Key strategies referenced in the plan include:

- Upgrading the 44 miles of high-injury corridors to provide pedestrian safety features throughout
- Providing extra pedestrian crossing time at 800 intersections citywide
- Re-engineering streets around at least five schools and in 2 areas with high numbers of senior injuries annually
- Updating or creating at least nine plazas
- Re-opening 20 closed crosswalks
- Planning a city-wide network of 140 miles of green streets to help people walk safely to parks and the waterfront
- Upgrading 13,000 curb ramps
- Installing pedestrian countdown signals at 184 intersections by 2021
- Targeting enforcement of high-risk behaviors such as speeding and red-light running on high-injury corridors and intersections, and reporting quarterly on injury collisions and enforcement
- Pursuing state legislation for prioritizing sustainable transportation and targeted enforcement, such as speed cameras, congestion pricing, and vulnerable user laws

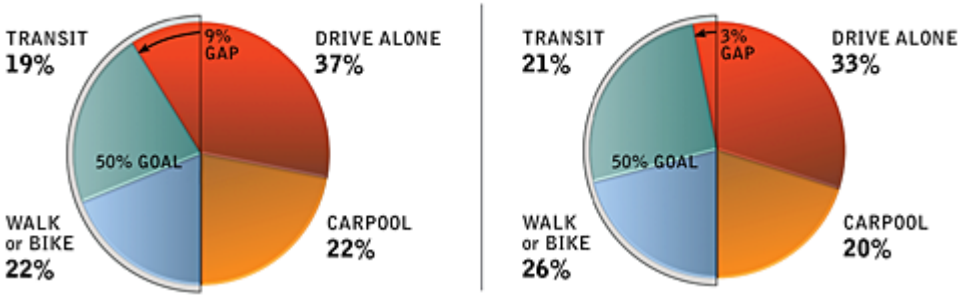
Full funding of the SFMTA Pedestrian Strategy would require approximately $600 million over the life of the SFTP; most of this is unfunded.

[33] Association of Bay Area Governments population projections

Livability: What Would it Take?

- **CHALLENGE:** San Francisco has a "Transit First" policy, yet under the Baseline almost 60% of trips in the city will be made by car (this includes carpooling). Such high levels of car use will have significant negative impacts on traffic safety, neighborhood cohesion, noise levels and other important aspects of urban livability.
- **TARGET:** Less than 50% of trips to, from and within San Francisco are made by car. Reaching this target means shifting approximately 430,000 trips daily in 2035 from cars to "Transit First" modes (transit, walking and biking).
- **IMPROVEMENTS:**
  - Transit projects that improve frequency or reliability or that reduce travel times, transfers or crowding; includes big-ticket items such as new rail lines and a second cross-bay tube for BART
  - Projects to promote walking, such as traffic calming, road diets, street closures and streetscaping
  - Projects to encourage bicycling, such as a network of cycletracks, more secure bike parking (including bike stations at major transit hubs) and bike sharing
  - In order to make it sufficiently different from other scenarios, this scenario did not incorporate congestion pricing
- **COST:** $15 billion.
- **RESULTS:** This scenario results in a shift in mode share from cars to "Transit First" modes of 6 percentage points compared to the Baseline scenario: the percentage of trips made by car decreases from 59% of all trips to 53% while the percentage of trips made by transit, walking and bicycling increases from 41% to 47% (see figure below).

Figure 1. Performance of Livability Scenario: 2035 Baseline (LEFT), Livability Scenario (RIGHT)



- **CONCLUSIONS:** The scenario makes significant progress toward its target but does not reach it. To achieve the target, an additional shift in mode share of 3 percentage points is necessary. That shift could be accomplished through congestion pricing: based on other analyses, congestion pricing would yield an additional shift in mode share from cars to "Transit First" modes of 3–5 percentage points.

5 Healthy Environment

SECTION SUMMARY:

- San Francisco has set aggressive goals for reducing greenhouse gas emissions from transportation; the goals would require 80 percent reduction in greenhouse gas below 1990 levels, which is five times more aggressive than regional greenhouse gas reduction goals.
- More stringent state vehicle emissions regulations will cause greenhouse gas emissions to fall by about 30 percent by 2040, but this is insufficient to achieve the goal.
- Some of the most promising strategies to achieve additional progress include congestion management, employer outreach, and partnerships with the private sector.

Transportation has significant environmental impacts. For example, emissions from cars and trucks account for one third of San Francisco's greenhouse gas emissions.[34] Addressing these impacts, particularly greenhouse gas emissions, is a key focus of the SFTP. This section reviews trends in greenhouse gas emissions, and discusses possible additional strategies that could help San Francisco achieve its goals, especially congestion management, employer outreach, and private sector partnerships.

5.1 | Goals and performance measures

The SFTP healthy environment goal focuses on minimizing the negative environmental effects of motorized transportation. Key performance measures include:

- Vehicle miles of travel
- Greenhouse gases associated with vehicle travel

5.2 | Trends and future conditions

Technology will do much to reduce climate change impacts from private vehicles. Tough state laws (Pavley I and II) regulating vehicle emissions are expected to reduce greenhouse gases by more than 40% compared to a business-as-usual scenario. However, this is not sufficient to allow San Francisco to achieve its goal of an 80% reduction below 1990 levels by 2050,[35] especially given the large amount of population and employment growth San Francisco expects to absorb. Additional, aggressive strategies will be needed to meet these goals.

[34] Brisson, Elizabeth, Elizabeth Sall, and Jeffrey Ang-Olson. "Achieving Goals of San Francisco, California, for Greenhouse Gas Reductions in Transportation Sector: What Would it Take?" Transportation Research Record: Journal of the Transportation Research Board. No. 2287, 2012, p89.

[35] From local ordinance 81-08. This is the amount climate scientists say is needed to stabilize the climate and prevent major sea level rise, extreme heat events, and other impacts.

Miles driven by private vehicles, or "VMT" (vehicle miles of travel) is the main source of greenhouse gases and air pollutants from the transportation sector. Growing population and employment in San Francisco and regionally is expected to result in a VMT increase of approximately 30% by 2040 under a business-as-usual scenario.[36] As shown in Figures 24 and 25, much of this VMT will come from the downtown core (for workplace VMT), and outlying southwest and southeast neighborhoods (for household VMT). The maps illustrate that major institutions such as medical centers and universities generate significant vehicle miles of travel.

PLAN BAY AREA: REGIONAL GREENHOUSE GAS REDUCTION GOALS

Plan Bay Area is the regional transportation plan developed by the Bay Area's regional transportation planning agency (the Metropolitan Transportation Commission). Approved in 2013, it sets a goal of reducing greenhouse gas emissions by 15% between 2005 and 2035, a statutory requirement of the California Air Resources Board.

Plan Bay Area shows how this reduction will be met by concentrating new growth in already built-up transit-accessible areas and through regional transportation investments and policies. Notably, San Francisco is expected to take on more new jobs than any other city, and more new housing than all other cities except San Jose. Concentrating jobs and housing in San Francisco supports efficient travel patterns and greenhouse gas reduction, but could also result in severe congestion and transit system crowding in downtown San Francisco unless major new system investments are made. See the Economic Competitiveness section for more detail.

[36] O:\Active Studies\CWTP Update\Data\Scenarios\Data\GraphicsSheets-E.xlsx Economic competitiveness. Includes VMT within SF only.

Figure 24 Household Vehicle Miles of Travel, 2040

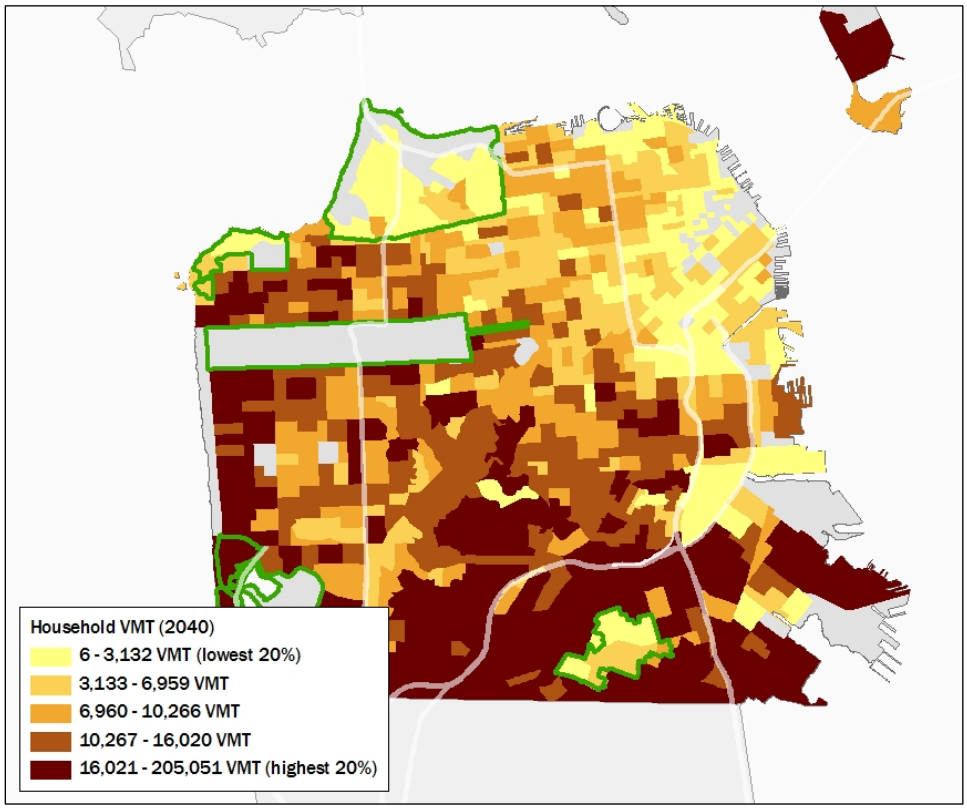
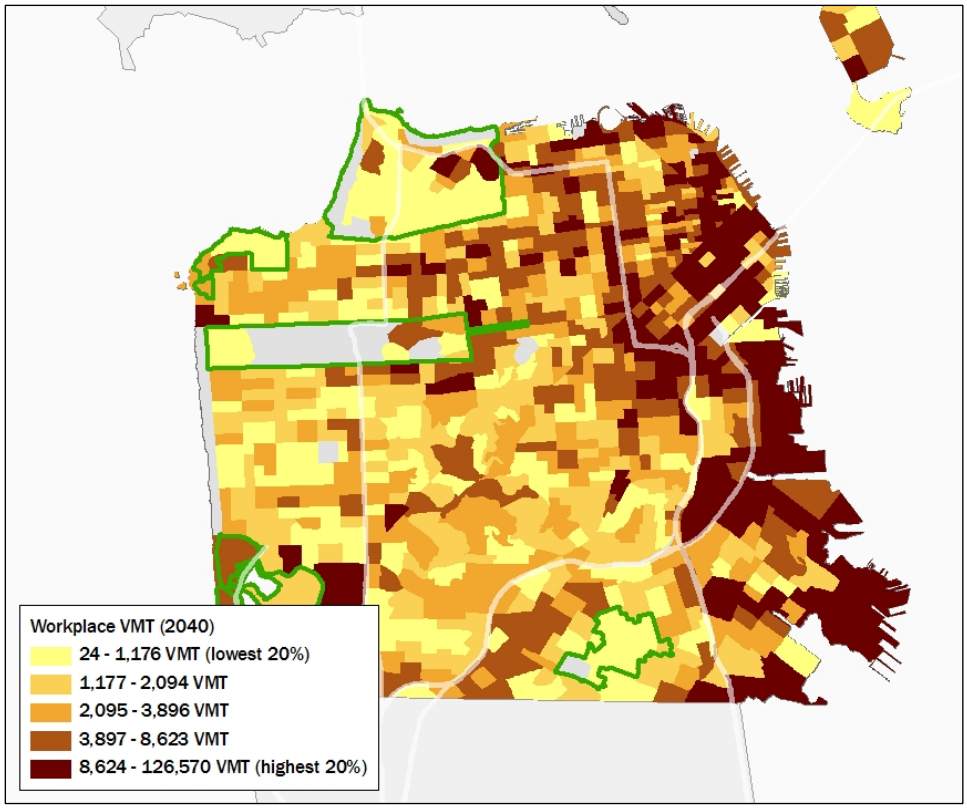
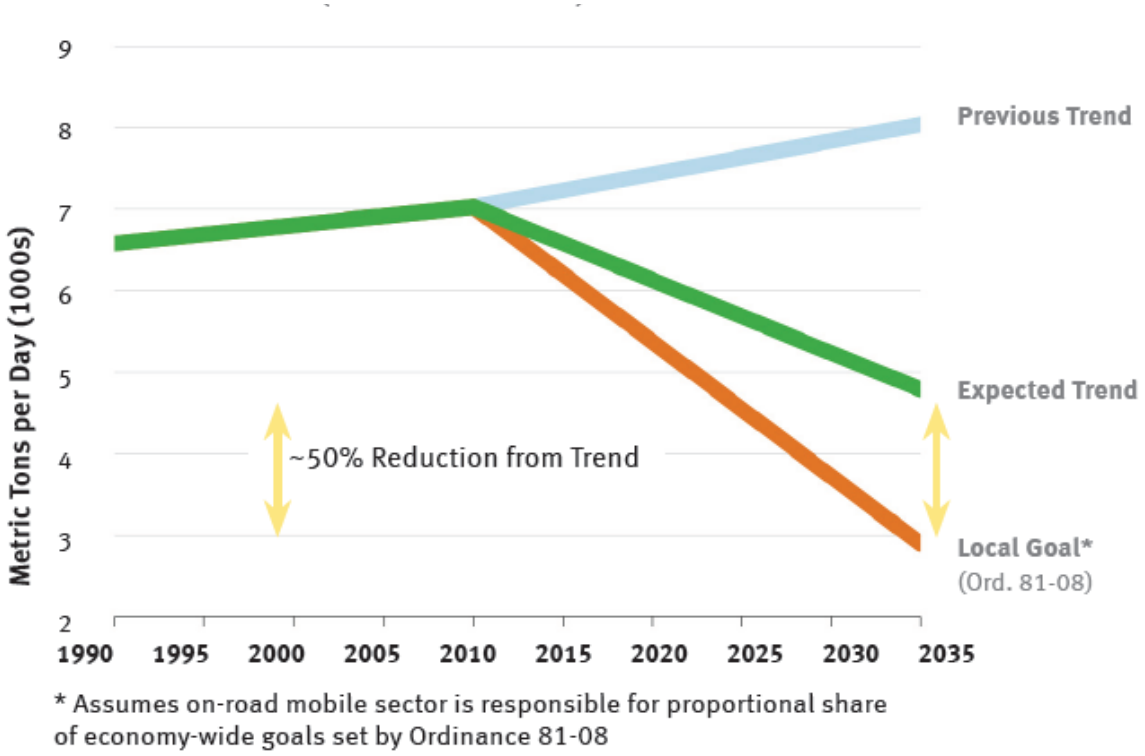


Figure 25 Vehicle Miles of Travel to Workplaces, 2040



Despite this VMT growth, greenhouse gases are expected to fall by about 30 percent between 2012 and 2040 due to the state emissions regulations described above. As shown in Figure 26, this will be insufficient to achieve the levels of GHG necessary to meet San Francisco's goals expressed in the city's Climate Action Strategy, which sets a very aggressive goal of reducing GHGs by 80 percent below 1990 levels by 2050, the reduction scientists consider necessary to stabilize the climate.[37] This goal is five times more aggressive than regional GHG reduction goals outlined in the One Bay Area Plan.

Figure 26 San Francisco Greenhouse Gas Reduction Goal Compared to Expected Trend



As described in the sidebar box above, the SFCTA conducted scenario testing to determine what it would take to achieve this goal. Multiple strategies were tested, focusing on road pricing, transit investments, and travel demand management activities. While even the most aggressive scenarios were insufficient to achieve San Francisco's goals, they allowed up to an 85 percent reduction relative to the expected trend.

The analysis also revealed which are the most cost-effective strategies for reducing greenhouse gases, namely congestion pricing, subsidized transit passes, and travel demand outreach programs. Investments in new mass transit services and electric vehicles were less cost-effective methods. The section below describes how the most cost-effective programs could be expanded and advanced in the future.

5.3 Approaches to achieving GHG reduction goals

This section describes three cost-effective approaches to reducing greenhouse gases in San Francisco: congestion management programs, outreach/incentive programs, and leveraging of private sector

[37] From ordinance 81-08.

investments. Ideas in this section are drawn from the city's Climate Action Plan and the Core Circulation Study (Appendix C).

5.3.1 | CONGESTION MANAGEMENT

Managing congestion through roadway pricing or similar means is one of the most effective tools available for reducing greenhouse gas emissions from transportation. One form of pricing already implemented in San Francisco is the SF*park* Program, which uses variable pricing on parking spots to reduce congestion (and associated greenhouse gases) associated with drivers searching for parking.

Another form of pricing has also been considered for downtown San Francisco. In 2010, the Transportation Authority published the Mobility, Access and Pricing study, which examined the feasibility of implementing a congestion charge for vehicles entering or leaving the northeast quadrant of San Francisco. The study found the following potential benefits of the program:

- 12 percent fewer peak-period vehicle trips
- 21 percent reduction in vehicle hours of delay
- 5 percent reduction in greenhouse gases citywide
- Increase in transit speeds of 20-25 percent
- Reduction in pedestrian incidents of 12%
- Generation of $60-$80 million in annual net revenue for mobility improvements

On December 14, 2010, the Transportation Authority Board unanimously approved the MAPS Final Report and voted 8–3 in favor of pursuing additional study of the concept.

Vehicle travel can also be limited through regulation. For example, a 1998 ordinance implemented in Cambridge, Massachusetts, requires any employer who expands available parking by more than five spaces to develop a plan for limiting vehicle trips to the worksite through employee incentives, parking pricing, technology, or other means. Implementation of the plan is enforced by the city and employers must demonstrate through surveys and driveway vehicle counts that they are not exceeding their vehicle trip allowance. The program has reduced vehicle miles of travel by 24 percent between 2000 and 2010, and has successfully allayed community concerns regarding traffic impacts from new development.

5.3.2 | INCENTIVE PROGRAMS AND OUTREACH

Incentive and outreach programs can also be a cost-effective method of reducing private vehicle travel and associated environmental impacts. Programs that involve personal interaction, monetary incentives, and tailored information are particularly effective in supporting behavioral change. One example is King County, Seattle's "In Motion" program, which involves provision of targeted marketing materials to encourage alternatives to driving paired with free transit passes to neighborhoods in King County on a rolling basis. Since 2004, about 13,000 residents have participated, and follow-up surveys indicate that vehicle miles of travel have been reduced by 2.4 million miles. Crowding on San Francisco's transit vehicles (covered in Section 3) and budget shortfalls make widespread provision of free transit passes impractical, but other types of incentives can be explored.

TRAVEL DEMAND PARTNERSHIP PROGRAM

The San Francisco Travel Demand Partnership Program is an innovative inter-agency effort to pilot test several innovative approaches to managing greenhouse gas emissions from transportation. Pilot projects include employer ridesharing and shuttle programs, a sustainability marketing campaign, and a flexible employee benefits program designed to reduce solo commuting. These pilot programs will inform development of the next generation of travel demand management strategies in San Francisco. The program is being funded through the Metropolitan Transportation Commission's Climate Initiatives Program.

5.3.3 | PRIVATE SECTOR TRANSPORTATION SERVICES AND TECHNOLOGY

Another approach to cost-effectively reducing greenhouse gases is to leverage private sector investment. In recent years, the private sector, and the technology sector in particular, have become more active in the transportation sector, both by providing direct transportation services to their employees in San Francisco, and by creating new services and technologies to serve the general public. Many of these innovations have significant potential to reduce single occupancy vehicle trips and greenhouse gases. Examples include:

- **CAR-SHARING AND SCOOTER-SHARING -** Private car-sharing companies have expanded rapidly, with multiple companies such as Zipcar, CityCarshare, Getaround, and the scooter-sharing company Scoot now offering services in many neighborhoods. Some companies, like Getaround and Relayrides, allow private vehicle owners to share their personal vehicles with others. Studies have indicated that access to car-sharing vehicles can allow residents to reduce the number of vehicles owned[38], which can support reductions in driving and associated greenhouse gas emissions. When car-sharing is offered at the worksite, it can also support employees who want to avoid driving to work but need access to a car during working hours.
- **RIDE-MATCHING -** Technological advances are allowing people to share rides more easily. Many private vendors are now offering customizable software programs that employers can offer to their employees to help them identify co-workers with similar travel needs – examples include Zimride, ride Amigos, rideShark, Greenride, TwoGo, and many others. Another set of companies, including Lyft, Uber, and Sidecar, have developed smartphone applications that allow drivers to find potential riders in exchange for a donation.
- **PRIVATE EMPLOYER SHUTTLES -** Many of the larger technology sector employers, such as Google and Genentech, are now offering private shuttles for their employees' commutes. Surveys have indicated that shuttles are serving about 35,000 commute trips per day, or about 1 percent of all trips to, from, and within San Francisco. About half of riders indicate they would drive alone if the shuttle were not provided.

[38] Martin, E., Shaheen, S., Lidicker, J. Carsharing's Impact on Household Vehicle Holdings: Results from a North American Shared Used Vehicle Survey. 2010 Transportation Research Record, March 15, 2010.

The public sector can play a key role in supporting growth of these services while minimizing any negative impacts on the transportation system. Some examples of possible roles the public sector can play include:

- **ADOPTING REGULATORY POLICY THAT SUPPORTS GROWTH IN PRIVATE SECTOR TRANSPORTATION SERVICES.** One such effort is the Shuttle Partners Program, a pilot program within the TDM Partners Project described previously. The program would allow private employer shuttles access to select MUNI stops in exchange for a fee. Successful implementation of this program will clear a path toward expansion of the private shuttle sector while addressing community concerns around shuttle impacts. Another example is the city planning department's policy of allowing developers to purchase residential car-share accounts to justify exceptions to maximum parking allowances.
- **ALLOWING PRIVATE SERVICES ACCESS TO STREET SPACE.** In July 2013 the SFMTA adopted a formal policy to guide the agency's facilitation of car-sharing in its off-street parking lots and garages, as well as approving a two-year pilot to test the use of on-street parking spaces as car-share spaces ("pods"). This pilot builds on lessons learned from a small-scale pilot of on-street car-share pods carried out in 2011 and 2012, and will make as many as 900 on-street parking spaces available across all districts of the city for use by qualified car-share organizations over the two years of the pilot.
- **SUPPORTING MARKETING OF PRIVATE SERVICES.** City staff can aid in the marketing of private sector services that support sustainability goals by incorporating information on these services into marketing materials provided to employees, and on city web sites.

Healthy Environment: What Would it Take?

- **CHALLENGE:** The city has an ambitious official policy to reduce emissions of greenhouse gases to 80% below 1990 levels by 2050. However, the large number of new residents and workers anticipated for San Francisco in coming decades will greatly blunt the impact of even such effective measures as the state's "Pavley Law," which tightens fuel-economy standards for cars and light trucks.
- **TARGET:** To reduce the city's transportation-related emissions of greenhouse gases by 2035 to 2,900 metric tons daily below the post-Pavley trend (this translates the city's official policy to the SFTP's horizon year and to the percentage contributed by transportation sources to total emissions).
- **IMPROVEMENTS:** This scenario included the projects, programs, and policies identified below. An additional, more aggressive sensitivity analysis was also conducted incorporating a regional road-pricing strategy that doubles the operating cost for a car and estimates a penetration rate for electric vehicles of 25%.
  - Increased penetration of electric vehicles into San Francisco's private-vehicle fleet to 9–16%
  - A $6 congestion-pricing toll in downtown San Francisco during peak periods
  - New designated transit lanes and rail extensions
  - Employer-subsidized transit passes and additional employer-based TDM measures
  - Mandatory transit passes for new housing units and other residential TDM measures, including personalized outreach on commute alternatives and increased car-sharing
  - Bicycle improvements, including a network of cycle tracks
  - School-based TDM measures, including Safe Routes to School-type investments, and outreach and other tools to facilitate carpools and school-pools, at both primary and secondary schools
- **COST:** $10 billion ($4 billion excluding second cross-bay BART tube and high-speed rail service).
- **RESULTS:** The basic scenario reduces post-Pavley emissions by 1,600–1,800 metric tons daily (see chart below). With the aggressive sensitivity analysis, the reduction is 2,200–2,600 metric tons daily.
- **CONCLUSIONS:** The basic scenario falls well short of its target even with the most aggressive measures. It is worth noting that each improvement analyzed presents trade-offs in terms of performance, cost-effectiveness, political acceptability, and co-benefits. Electric vehicles, for example, reduce emissions very cost-effectively but lack the co-benefits of strategies aimed at reducing car travel, such as reducing congestion or improving traffic safety. These tradeoffs were considered in the evaluation of improvements for inclusion in the preferred and vision alternatives.

6 Visitor, Goods Movement, and School Transportation Needs

SECTION SUMMARY:

- Of the thousands of people who visit San Francisco every day, more than 25 percent are from the Bay Area, and many of these visitors drive. Reducing this group's reliance on automobile travel could have a significant impact on congestion in the northeast core, where many visitor trips end.
- Increasing congestion could have an impact on goods movement, delaying delivery vehicles and causing inconveniences and economic hardships for delivery recipients. A combination of citywide congestion-mitigation programs and neighborhood-level parking-management strategies will be required to solve this problem.
- Reliability, safety, and other factors prevent students from taking transit to school instead of getting a ride from a parent.

The prior sections discussed the transportation investments necessary to make progress towards the SFTP goals of world-class infrastructure, economic competitiveness, a healthy environment, and livability,. This section discusses the transportation needs of three important constituencies whose needs do not fit neatly within the SFTP goal areas: visitors, companies moving goods through the city, and students.

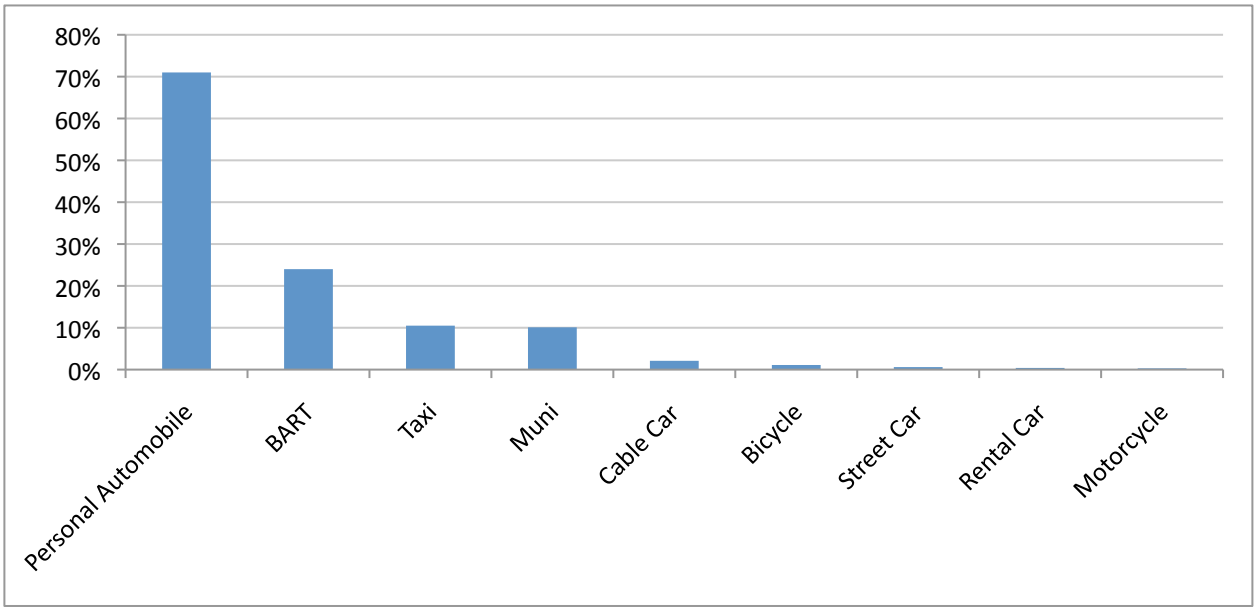
6.1 | Visitors

The San Francisco Convention and Visitors Bureau estimates that approximately 131,000 people visit San Francisco every day,[39] generating an estimated 500,000 miles of daily vehicle travel[40]. While this is far less vehicle travel than generated by daily commutes, it can still contribute to intense congestion as it clusters in specific times and places, such as around popular tourist sites, for major sports events, and during Sunday afternoons.

Visitor travel is concentrated in the city's congested northeast core, and as Figure 27 shows, many visitors from the Bay Area, who make up nearly a quarter of all visitors, come to the city by car.[41] Shifting them to other modes will be critical in reaching the San Francisco Transportation Plan's goals.

[39] San Francisco Convention and Visitors Bureau. "San Francisco Visitor Industry Statistics." Retrieved from http://www.sanfrancisco.travel/research/ on 10/7/13.
[40] Estimate assumes each visitor makes 4 trips per day; about 30 percent of trips are by automobile; and trips are three miles in length.
[41] San Francisco Convention and Visitors Bureau. "Visitor Profile Research." Presentation, January-September 2010. Slide 14.

Figure 27 Bay Area Residents' Mode of Travel to San Francisco for Day Trips



Source: San Francisco Convention and Visitors Bureau, 2010.

While visitors from further away have more varied travel patterns, they still center on the automobile. Seventy-six percent of international visitors and 61 percent of domestic visitors travel by taxi or rental car.

Some potential strategies for addressing congestion associated with visitor demand include:

- Distributing transportation information and, potentially, Clipper cards, to hotels. The SFMTA has already begun outreach to hotels and convention centers.
- Working with major event venues to manage demand, such as through advertising alternatives and facilitating shared rides or taxis to events.
- More clearly identifying designated areas for tour bus loading and unloading.
- Providing additional transit services in areas with the highest tourist demand, where appropriate.
- Piloting direct bus services from Bay Area locations to major San Francisco attractions not readily accessible by transit to serve high demand from Bay area visitors.
- Working to deploy bicycle sharing at the most visited locations.

6.2 | Goods Movement

Goods movement is critical to San Francisco's economic competitiveness and livability, two of the San Francisco Transportation Plan's four goal areas. Problems with goods movement in today's transportation

system center on delivery vehicles' competition with private automobiles for space on city roads and at the curbside.

In Spring 2011, the SFTP team conducted eight interviews with a variety of goods movement stakeholders, including merchants, delivery companies, and drivers, the United Parcel Service, and the San Francisco Municipal Transportation Agency. The conversations revealed a number of related issues that impede efficient deliveries:

- **INSUFFICIENT SPACE FOR LOADING AND UNLOADING.** Though yellow curb zones reserve some space for deliveries, delivery vehicles often must compete with cars, large employer shuttles, and other vehicles to drop off goods at local businesses. When there is no curbside space available, drivers double park or must take additional time to cart deliveries from more distant parking spots.
- **POOR MANAGEMENT OF AVAILABLE LOADING AND UNLOADING SPACE.** Stakeholders noted that loading and unloading zones are often too short, poorly placed, have inadequate hours, and are poorly enforced.
- **CONGESTION DURING PEAK TRAVEL PERIODS.** Many delivery-vehicle destinations are in the densest parts of the city, where traffic congestion is the biggest problem. For such vehicles, slower deliveries mean less productivity and, ultimately, lost money.

Shorter-term strategies to remedy these issues include continually refining and rationalizing the hours of yellow zones and determining locations through a community process. Delivery spaces should also be an additional consideration in crafting neighborhood plans.

In the longer term, congestion management strategies can support more efficient goods movement. As described in the Environment section, forecasts show that pricing will significantly reduce congestion in the city's dense northeast core, the destination of many deliveries and the area of the city in which competition between drivers and delivery vehicles is most intense

6.3 | School Transportation

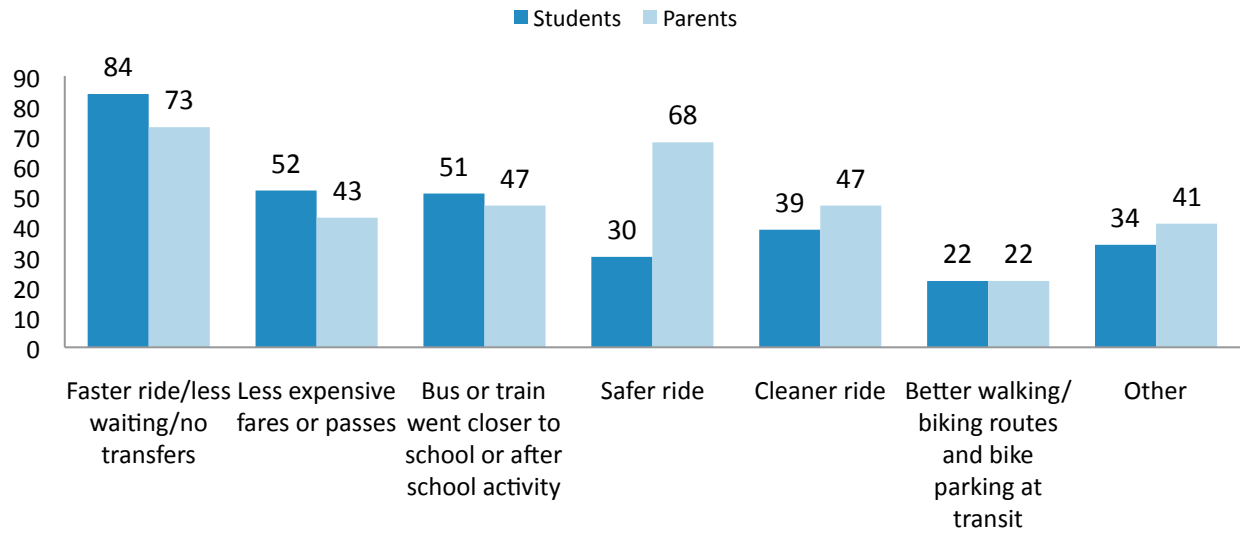
Outreach for the SFTP (described fully in the SFTP Appendix E: Outreach Summary) included a survey of students and parents to gauge their transportation needs. The survey asked participants about factors that hold them back from taking transit, biking, or walking to school (or, in the case of parents, allowing their students to take those modes). More than 1,000 responses were received, and results revealed that the frequency and reliability of transit service is the top priority of students and parents. For students, reduced-price transit passes and transit stops closer to school were also important but significantly less so. For parents, transportation safety was another key area of importance (Figure 28).

The survey findings reveal that the top school transportation needs can be met through projects and programs designed to improve transit service quality, especially those that would serve major educational institutions. Sections 2 and 3 discuss current efforts and possible future strategies to improve transit service.

In addition, other efforts are already underway to support non-auto school transportation. In late 2012, the Board of Supervisors funded a short-term youth-pass pilot to provide students with free Muni passes, more

than 18,000 students signed up for the program in the months before it officially began, in March 2013.[42] The pilot will continue for 16 months. The program was developed in response to cuts in San Francisco Unified School District's yellow school bus service and recent increases in the cost of Muni youth passes.[43]

Figure 28 Priority School Transportation Concerns of San Francisco Students and Parents



Source: SFCTA School Transportation Survey. Numbers indicate number of respondents who marked the issue as being of importance.

[42] Cabanatuan, Michael and Neal J. Riley. "18,000 youth sign up for free Muni pass." *San Francisco Chronicle*, February 7, 2013. Retrieved from http://www.sfgate.com/bayarea/article/18-000-youth-sign-up-for-free-Muni-pass-4261349.php on 10/15/13.

[43] Ciria-Cruz, Rene. "Youth Score Win for Free MUNI Passes." Retrieved from http://urbanhabitat.org/19-2/ciria-cruz-TJ on 10/15/13.