SAN FRANCISCO
MODAL EQUITY STUDY

Prepared by:

TRANSPORTATION CHOICES
for sustainable communities
RESEARCH AND POLICY INSTITUTE
OCTOBER 2014
SAN FRANCISCO MODAL EQUITY STUDY

http://transportchoice.org

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1. INTRODUCTION

This report presents an analysis of the roadways in the City and County of San Francisco. It focuses on two main areas: 1) upkeep requirements of roadway infrastructure and how maintenance and repairs of roadways are funded; and 2) the allocation of public roadway space in San Francisco compared to the mode split between automobiles, transit and bicyclists. In addition it presents a literature review of work by others that documents the external costs that dependence on the automobile causes to society.

Our analysis is not intended as a critique of San Francisco’s policies but rather as an objective look at the allocation of one of the City’s most important and scarce resources - public roadway space. Indeed some San Francisco policies - e.g., the Transit First Policy – are commendable and ahead of their time in that they directly deal with the allocation of roadways by mode.

In essence, this report is a snapshot of San Francisco transportation, based on the most current data available from the San Francisco Municipal Transportation Agency, (SFMTA), the San Francisco County Transportation Authority (SFCTA), the San Francisco Planning Department, and the San Francisco Department of Public Works (SFDPW).

Community values evolve over time and San Francisco policies have valiantly aimed to keep up. The Gold Rush city’s predominant modes were pedestrians and horses. The City has since incorporated many modes of public transportation from the 1870s on, and throughout the 20th century policies evolved to accommodate increasing numbers of automobiles. Through all of its history, San Francisco has always been a compact, mixed-use and multi-modal city.

San Francisco’s land use and transportation setting will continue to evolve since transportation challenges and related environmental concerns are unlikely to be fully resolved in the foreseeable future. There is a perennial need to seek out and deploy novel, viable and sustainable transportation options. Understanding the current state of the transportation system is a vital first step toward developing better options and a better future. We hope this report contributes to such understanding.
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To facilitate duplex printing.
2. MODAL SHARES AND ROADWAY SPACE

The purpose of this section is to compare and contrast the allocation of public roadway space to the current modal shares. First, this chapter documents the existing travel of San Francisco residents by driving, transit, walking and biking. Then this chapter documents how San Francisco’s roadway space is allocated to several primary uses: moving auto traffic, on-street parking, public transit and bicycling. Since virtually all roadways in San Francisco have defined sidewalks outside of the roadway, this report does not address allocation of public space to pedestrians.

TRAVEL MODES SHARES IN SAN FRANCISCO

Information about modal shares in San Francisco in this report is derived from the San Francisco Municipal Transportation Agency and the American Community Survey of the US Bureau of the Census, and the San Francisco County Transportation Authority. As is typical with data sources, the methodologies used vary as do the years which the data represent. These data reveal that public transit, walking, and bicycling are popular alternatives to car use in San Francisco.

In June 2011, MTA conducted a telephone survey of a representative cross-section of 520 San Francisco residents on the mode of transportation that they normally take for work and non-work purposes. A majority (52.2%) reported using transit, walking, or bicycling as their normal mode of transportation. Furthermore, majorities of respondents reported using these non-auto alternative modes of travel for both work (55.5%) and non-work (50.3%) purposes. More residents chose transit (41%) than driving alone (32.5%) as their most frequent work commute mode. More respondents also relied on public transit (34.3%) instead of driving alone (26.3%) for non-work purposes. Table 2.1, as well as Figures 2.1, 2.2, and 2.3, show these findings.

<table>
<thead>
<tr>
<th></th>
<th>Public Transit</th>
<th>Drive Alone</th>
<th>Walk</th>
<th>Carpool/Vanpool</th>
<th>Bike</th>
<th>Taxi</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Trips</td>
<td>36.8%</td>
<td>28.6%</td>
<td>11.8%</td>
<td>13.6%</td>
<td>3.6%</td>
<td>3.6%</td>
<td>1.8%</td>
</tr>
<tr>
<td>Non-Work Trips</td>
<td>34.3%</td>
<td>26.3%</td>
<td>13.1%</td>
<td>16.8%</td>
<td>2.9%</td>
<td>5.1%</td>
<td>1.5%</td>
</tr>
<tr>
<td>Work Trips</td>
<td>41.0%</td>
<td>32.5%</td>
<td>9.6%</td>
<td>8.4%</td>
<td>4.8%</td>
<td>1.2%</td>
<td>2.4%</td>
</tr>
</tbody>
</table>

Note: Excludes Survey respondents not working or working from home.
Figure 2.1

San Franciscans Mode Choice: 2011

Source: Adapted from San Francisco Municipal Transportation Agency, Mode Share Survey 2011 Summary Report. Note: Excludes Survey respondents not working or working from home.

Figure 2.2

How San Franciscans Commuted to Work: 2011

Source: Adapted from San Francisco Municipal Transportation Agency, Mode Share Survey 2011 Summary Report. Note: Excludes Survey respondents not working or working from home.
Results for work commute mode choice by San Franciscans reported in the 2013 American Community Survey (ACS) broadly confirm the preference of City residents for alternatives to solo occupant commuting\textsuperscript{ii}. A majority of respondents (60.9\%) indicated they typically used alternatives to driving alone to work (39.1\%). The most popular alternatives reported were public transit (35.0\%), walking (11.7\%), and carpooling/vanpooling (7.3\%). ACS data is represented on Table 2.2 and Figure 2.4. ACS does not report non-work travel data.

### Table 2.2

<table>
<thead>
<tr>
<th></th>
<th>Public Transit</th>
<th>Drive Alone</th>
<th>Walk</th>
<th>Carpool/Vanpool</th>
<th>Bike</th>
<th>Taxi</th>
<th>All Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work Trips</td>
<td>35.0%</td>
<td>39.1%</td>
<td>11.7%</td>
<td>7.3%</td>
<td>4.1%</td>
<td>0.5%</td>
<td>2.3</td>
</tr>
</tbody>
</table>


Notes: Data is from a one-year sample (2013). ACS only surveys work commute mode.

“All Other” modes include motorcycle, motor scooter, etc...
Summary
San Franciscans value alternatives to travel by car. The most recent representative cross-section survey of travel for all trip purposes by San Franciscans shows that public transportation maintains a nearly 37% mode share in the City, compared to a less than 29% share for solo-occupant driving. Overall, non-automobile modes, including transit, walking and bicycling hold a 10% mode share advantage, 52% to 42% over the combined auto modes of solo-occupant driving and ridesharing.

ROADWAY SPACE
This section describes how the roadway space in San Francisco is allocated among several uses: auto traffic; on-street parking; public transit; and bicycling. We used several measures in this report in order to give a more complete picture: centerline miles; lane miles; and square footage of paved roadway area. These are defined in more detail in the respective section below. In addition, where possible, we also characterize roadways using the existing categories of Street Types described in the Transportation Element of the San Francisco General Plan – freeways, arterials and city streets.
Centerline Miles

Centerline miles represent the linear length of a roadway regardless of whether it is a one-way or two-way street, or whether it is a divided or undivided roadway. iii

As shown in Table 2.3, there are 1,088 centerline miles of roadway in San Francisco. Of these, 59 miles are freeways and associated ramps, 18 are either private or military, and 1011 are public surface (i.e. not freeway) streets.

About two percent of these roadways, 22 miles, have a dedicated transit lane: 12 miles of roadway have bus only lane(s) and 10.5 miles have an LRT lane(s). With respect to cycling, seven percent of roadways have a bike lane. Thus, while motor vehicles have access to 1086 miles of streets, fewer than 100 miles of roadway provide dedicated space for bicyclists and transit vehicles.

<table>
<thead>
<tr>
<th>Street Type</th>
<th>Total Centerline Miles (1)</th>
<th>With BUS HOV Lane (2)</th>
<th>With Bike Lane</th>
<th>With LRT Exclusive Lane (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freeway, ramps &amp; connectors</td>
<td>59</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Surface Streets</td>
<td>1011</td>
<td>12</td>
<td>74</td>
<td>10.5</td>
</tr>
<tr>
<td>Private/Military</td>
<td>18</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>1088</td>
<td>12</td>
<td>74 (1)</td>
<td>10.5</td>
</tr>
</tbody>
</table>

Source:
1) 2013 San Francisco Transportation Fact Sheet; San Francisco MTA.
2) Jeffrey Flynn, SF MTA

The General Plan categorizes the streets of San Francisco in many ways. Map 6 of the Transportation Element depicts the functional classifications of streets as arterials, transit conflict streets, park/recreational streets and others; this map is presented in Appendix A.

The General Plan also describes some roadways in terms of modal preference: e.g. transit preferential streets, arterials for freight and bicycle priority streets. Each of these are described below. Linear miles for each of these categories are shown below in Table 2.4:
Table 2.4
Priority Streets for Various Modes - Centerline Miles of Roadway

<table>
<thead>
<tr>
<th>Street Type</th>
<th>Total Length</th>
<th>Transit Priority Streets (1)</th>
<th>Recommended Arterials for Freight (1)</th>
<th>Green Wave Timing for Bicyclists (3) (4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freeways, Ramps and Expressways (2)</td>
<td>74</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Surface Streets (1)</td>
<td>995</td>
<td>112</td>
<td>135</td>
<td>3.9 - 7.8</td>
</tr>
<tr>
<td>Private/Military (1)</td>
<td>17</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>1086</td>
<td>112</td>
<td>135</td>
<td>3.9 - 7.8</td>
</tr>
</tbody>
</table>

Note: Mileage lengths vary slightly from Table 2.3 due to different sources.
Source:
1) Mike Webster, San Francisco Planning Department
2) Dan Tischler, SF CTA model (includes Expressway category which is not in the Transportation Element)
3) Charles Ream, SF MTA, Bicycle Network Tracking Database. The Bicycle Program database is by directional miles; so the centerline miles is between 3.9 and 7.8 depending on how many of these streets are 1-way vs. 2-way.
4) Green wave streets are used as a proxy for Bicycle Priority Street.

The San Francisco Transportation Element describes three types of transit preferential streets. While this designation does not give transit vehicle exclusive right of way or an exclusive lane, it does give transit vehicles special operating preferences as described in Table 4 of the Transportation Element, presented in Appendix B. Given their key role in San Francisco’s Transit First policy, it was felt that these roads and roadway miles should be recognized in this report. There are 112 miles of streets designated as Transit Preferential Streets. Since buses on these roadways must mix with traffic and are thus correspondingly slowed, the remainder of this report concentrates on bus-only and LRT-only lanes and not transit preferential streets.

San Francisco does not have designated truck routes, as many California cities do. The Transportation Element identifies certain roadways as Arterials Recommended for Freight. These constitute 135 miles of roadway.

A third category of streets is the Green Wave streets where the signal timing has been programmed for bicycle speeds. This is used as a proxy for bicycle priority streets, as there is no official designation of any street as a bicycle priority street. There are approximately 4 to 8 miles of green wave streets. It is acknowledged that there are many more miles of “Bike Routes” and also that cyclists are legally entitled to use all roads except freeways. However, in practice many roads are not conducive to cycling due to extreme traffic volumes and narrow lanes. Furthermore many people do not feel comfortable riding in shared traffic lanes even on roadways with moderate volumes. The significant increase in bicyclist volumes on Valencia Street after it was striped with bike lanes illustrates this point. Thus this report concentrates on designated bike lanes and does not discuss Bike Routes or roadways with “sharrows.”
Lastly, while there is no official designation of an auto-priority street, one could argue that freeways, freeway ramps and roads leading to freeways such as Doyle Drive are exclusively for automobiles. There are 74 centerline miles of such streets. We have included this for comparison purposes. When considering lane miles, the number is much higher: 211 lane miles.

**Lane Miles**

The second measure analyzed in this report is lane miles\(^7\). As of 2014, one-way lane miles is the measure used by SFMTA to track bikeways, and it is also the standard measure for bus-only lanes and rail transit track miles. Most arterials and some other roadways have more than two lanes and lane miles reflect these multilane streets. According to the SFCTA, there are almost 2600 lane miles of vehicle-travel lanes. Of these, 15 miles are bus-only lanes, and 21 miles are LRT-only lanes. Given that most freeway mainline sections are 8 lanes, it is not surprising that the 74 centerline miles contain 211 lane-miles. The remaining 2375 lane miles are general purpose - auto-dominated lanes. This information is presented in Table 2.5

From the parking census, we can calculate that the on-street parking constitutes 902 lane-miles of parking. Lastly, there are 143 miles of bike lanes.

<table>
<thead>
<tr>
<th>Street Type</th>
<th>Roadway Peak Hour Travel Lanes</th>
<th>BUS HOV Lane (2)</th>
<th>LRT Exclusive Lane (3)</th>
<th>Bike Exclusive Lane (3)</th>
<th>Parking Lane (4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freeway, ramps and expressways (1)</td>
<td>211</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Surface Streets</td>
<td>2375</td>
<td>15</td>
<td>21</td>
<td>143</td>
<td>NA</td>
</tr>
<tr>
<td>Total</td>
<td>2586 (1)(5)</td>
<td>15</td>
<td>21</td>
<td>143</td>
<td>902</td>
</tr>
</tbody>
</table>

Source:
1) Dan Tischler, San Francisco CTA
2) Jeffrey Flynn, SF MTA. A list of streets with Bus-only and LRT-only lanes is presented in Appendix C.
3) Charles Ream, SF MTA; Bikeway Database.
4) See Table 4.1 of this report.
(5) Total includes only travel lanes, it does not include bike lanes or parking lanes.

As illustrated in Figure 2.5, the amount of lane-miles allocated to the movement of private motor vehicles is much higher than that allocated to either transit or bicyclists. Parking lanes are the second highest mileage, 902 miles, after general purpose lanes. This over 6 times the length of all the bike lanes. The third highest mileage dedicated to a single mode are auto-only lanes, defined as those on freeways and ramps, with 211 lane-miles. There are 143 lane miles of bike lanes. Transit has the fewest number of dedicated lane miles, at 36 lane-miles; the total miles of freeway lanes is almost 6 times as long as transit-only lanes.
Another key point is that while San Francisco has had public transit for over a century\textsuperscript{vi} and a Transit-First policy since 1973, its attention to bicycle transportation is less than 20 years old. Thus San Francisco has been playing catch-up in the last two decades to provide adequate infrastructure for bicyclists. As shown in Figure 2.6, there were very few bike lanes prior to 1990. The vast majority of bike lanes has been built since the adoption of the city’s first Bicycle Plan in 1996.
Paved Roadway Area

The third measure of analyzing roadway space was by paved area. Given the constrained geography in San Francisco, this can be considered the most pertinent. According to the 2013 San Francisco Transportation Fact sheet, there are 195,000,000 square feet of paved roads in San Francisco. The amount of square footage of roadway space dedicated to specific modes is presented in Table 2.6 and illustrated in Figure 2.7.

As might be expected, by far the largest amount of paved area is allocated to travel lanes. On-street parking takes up the next largest amount of space, taking up 17% of the paved roadway area. Next comes auto only lanes take up 8%, bike lanes occupy 1.5%, followed by bus-only and LRT-only lanes each with less than 1% of roadway space.

<table>
<thead>
<tr>
<th>Table 2.6</th>
<th>Paved Roadway Area by Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Roadway Area (sq. ft.)</td>
</tr>
<tr>
<td>On-street Parking (1)</td>
<td>33,340,300</td>
</tr>
<tr>
<td>Bus-Only Lane (2)</td>
<td>950,400</td>
</tr>
<tr>
<td>LRT-Only Lane (2)</td>
<td>1,330,560</td>
</tr>
<tr>
<td>Bike Lanes (3)</td>
<td>3,020,160</td>
</tr>
<tr>
<td>General Purpose SF DPW Maintained Roads</td>
<td>157,000,000 (4)</td>
</tr>
<tr>
<td>State Highways</td>
<td>5,280,000</td>
</tr>
<tr>
<td>Auto-only (Freeways etc.) (5)</td>
<td>18,450,000</td>
</tr>
<tr>
<td>Total Paved Area (6)</td>
<td>218,000,000</td>
</tr>
</tbody>
</table>

Note: Based on the one-way lane-miles presented in Table 2.5 and the following:
1) See Table 4.1 for parking lane assumptions.
2) Assumes 12-foot wide lanes.
3) Assumes average of 4 feet for asphalt portion of bike lane, acknowledging that the bike lane width is composed of both gutter pan and asphalt pavement.
4) This was calculating by subtracting all of the above from the total paved area maintained by SF DPW of 195,000,000 s.f.
5) Assumes 12-foot wide lane, plus extra width for shoulders next to some freeway lanes.
6) Based on 195 million sq. ft. from SF Transportation Fact Sheet 2013, plus freeway sand state highway; assumes 195 million sq. ft. only includes streets maintained by San Francisco DPW.
Figure 2.7

Paved Roadway Area by Mode

- On-street parking
- Bus-only lanes
- LRT-only lanes
- Bike lanes
- Auto-only (freeways)
- General purpose-auto dominated lanes

73.5%
ANALYSIS

Figure 2.8 presents the existing mode splits compared to the existing allocation of roadway space. While bicyclists currently comprise 4% of the mode split, bicycle lanes have been allocated 1.5% of the roadway space. Transit users fare less well, while they constitute 37% of the mode split and 41% of the work trip mode split, only 2.0% of the lane mileage and only 1.2% of the roadway space has been dedicated to public transit.

Figure 2.8

Percent Mode Splits Compared to Roadway Space by Mode
3. MAINTENANCE COSTS AND REVENUE SOURCES

ROADWAY MAINTENANCE AND REPAIR COSTS

The Dimensions of Roadway Maintenance

The Department of Public Works reports is responsible for maintaining approximately 865 miles of streets and roadways comprising of 12,855 street segments. Based on this, the average block length in San Francisco is 355 feet. Given that there are 195 million square feet city maintained streets (per the Transportation Fact Sheet, 2013) this implies an average paved street width of 43 feet.

Unit Costs by Roadway Condition

Like many street and highway agencies, the SF DPW uses the Pavement Condition Index (PCI) a numerical index between 0 and 100 to indicate the general condition of a pavement and for prioritizing roadway maintenance. Developed originally by the U.S. Army Corps of Engineers, PCI surveying processes and calculation methods have been standardized by American Society for Testing and Materials (ASTM). Qualitatively, scores of 85 and above are considered “excellent”, scores between 64 and 84 are considered “good”, scores from 50 to 63 are rated fair, while scores below 50 are classed as “poor”. In 2011 the average street segment PCI in San Francisco was 64, while the statewide average PCI was 66. Both values are just above the boundary between “good” and “fair” condition.

Table 3.1 below summarizes the distribution of City-maintained streets by PCI Score. It also shows the required pavement treatment and the average repair cost for the associated PCI range.

<table>
<thead>
<tr>
<th>% of SF Streets</th>
<th>PCI Score</th>
<th>Treatment</th>
<th>Avg. Cost per Block</th>
</tr>
</thead>
<tbody>
<tr>
<td>19</td>
<td>85-100 “excellent”</td>
<td>No improvement needed</td>
<td>$0</td>
</tr>
<tr>
<td>30</td>
<td>64-84 “good”</td>
<td>Pavement Preservation - slurry sealing or crack sealing to extend life of street</td>
<td>$9,000</td>
</tr>
<tr>
<td>28</td>
<td>50-63 “fair”</td>
<td>Repave - grind off and replace the top two inches of asphalt</td>
<td>$97,800</td>
</tr>
<tr>
<td>33</td>
<td>0-49 “poor”</td>
<td>Reconstruction – reconstruct the street including concrete base and top layer of asphalt Resurface with Base Repair - grind off and replace the top two inches of asphalt and complete localized repairs to the concrete base</td>
<td>$436,400 $140,000</td>
</tr>
</tbody>
</table>

SOURCE: 2011 Road Repaving and Street Safety Bond Report, p. 9
The lower the PCI score, the more expensive it is to repair a street. As shown in Table 3.1 above, when conditions degrade, costs of maintenance and repair increase. When they fall to “poor” condition, repair costs skyrocket. Depending upon the degree of damage to the concrete base underlying the surface pavement, the cost of rehabilitating a roadway segment in poor condition is 15 to nearly 50 times as costly as reconditioning a road that is in good condition. Moreover, street reconstruction is far more disruptive to travelers and to residents and businesses compared to pavement preservation treatments such as crack sealing.

By reducing the frequency of asset replacement, research cited by DPW indicates that preservation treatments can increase the life-cycle of roadways and reduce maintenance costs by from 75 to 90 percent.\textsuperscript{xiii} Deferring maintenance significantly increases the cost of repair in the future. Clearly the most cost-effective pavement management strategy is to preserve streets in good condition.

The DPW has estimated that to maintain San Francisco’s streets at the current level (i.e., an average PCI score of 64) requires an investment of $50 million per year (2011 dollars). To increase the average PCI score to 70 after ten years, the City would need to appropriate $65.5 million annually (increasing 5% per year for construction). In the five years prior to 2011, the budget for street repair averaged $42 million annually, resulting in a growing backlog of repair needs.\textsuperscript{9} Revenue from a 2011 general obligation bond money and a 2014 discretionary allocation of general fund revenue has begun to reduce the backlog of deferred maintenance. These recent augmentations of maintenance funding are discussed in the next section.

**Sources and Determinants of the Need for Roadway Repair**

New pavements generally remain in good-to-excellent condition for several years, even with little or no upkeep. However the rate of deterioration increases rapidly after 7-20 years, depending on the type and usage of the street. The DPW reports that in San Francisco, streets and roads have an average useful life of 14 to 21 years\textsuperscript{x}

All street pavements deteriorate over time, in part due to weathering and other natural forces such as earth subsidence and tree roots. The DPW notes two major factors besides deferred maintenance that accelerate deterioration:

1. **Motor Traffic**, especially by Heavy Vehicles – A Street’s lifecycle depends on how heavily that street is used, particularly by heavy buses and trucks. Per the DPW, a street with heavy traffic can deteriorate seven years sooner than a street that carries lighter traffic.

2. **Excavation** – Underlying many streets are underground utility lines: pipes and cables carrying water, sewage, natural gas, electricity and communications. When these underground lines need repair or replacement, utility companies must cut a trench in the pavement, leaving a vulnerable spot in the street. Over time these “utility scars” can reduce the life span of the street.

The first factor represents “wear and tear” on the system, while the second represents the need to cut into pavement for non-traffic reasons. Virtually all wear and tear deterioration is due to motor vehicles, especially heavy vehicles. A search of the comprehensive TRID database\textsuperscript{xii} revealed no credible research indicating that bicycles or pedestrians make a significant contribution to pavement deterioration. While any user creates friction with the road surface, and hence some wear, the damage from bicycles and pedestrians is minor compared to the effects of natural elements.
Allocation of Responsibility for Maintenance Costs by Mode

The SFDPW does not separate out the cost of maintaining city streets by mode. A simplistic way of allocating maintenance costs among modes is to base it on the allocation of roadway space. As indicated above in Table 2.6 “Paved Roadway Area by Mode”, San Francisco’s 143 miles of bicycle lanes represents 1.4% of the City’s roadway space. Another 1.0 % of roadway space is dedicated to public transit. The remainder of the City’s roadway space -- 97.6% -- is dedicated completely or primarily to motor vehicles, moving and parked (although bicycles and transit may also use most of this roadway space, even shared streets are paved, striped and signed primarily for motorists).

Based on the needed road repair budget of $50 million (the amount needed to maintain the current PCI of 64) a modal allocation of annual maintenance costs based solely on roadway space allocation would be as follows:

- $48,800,000 due to motor vehicles including trucks and buses in mixed traffic
- $700,000 due to bicycles
- $500,000 due to transit buses on dedicated lanes.

However this calculation ignores the fact that motor vehicles have a greater impact on roadways than do bicycles. Any attempt to determine the maintenance cost allocation by mode should ideally be adjusted to reflect the greater impact on roads by heavy vehicles, including both buses and trucks. Detailed vehicular mode split data for trucks and buses was not available, but as a surrogate, the following analysis is offered.

As noted above in the experience of the DPW, San Francisco streets have an average useful life of 14 to 21 years, but high levels of heavy vehicles can reduce the life-cycle of a street by 7 years -- i.e., to as little as 7 years before major repair is needed. Based on this, we may hypothesize the following relation between traffic level, pavement life span and maintenance costs, shown in Table 3.2:

<table>
<thead>
<tr>
<th>Street Traffic</th>
<th>Street Life Expectancy</th>
<th>Adjustment Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Truck/Bus traffic</td>
<td>7 years</td>
<td>2.0</td>
</tr>
<tr>
<td>Moderate to High Auto Traffic</td>
<td>14 years</td>
<td>1.0</td>
</tr>
<tr>
<td>Light Auto Traffic</td>
<td>21 years</td>
<td>0.67</td>
</tr>
</tbody>
</table>

Focusing on bicycle facilities, it would be difficult to empirically derive the costs of bicycle lane maintenance from San Francisco data, since the City’s street are generally paved to a uniform standard designed to accommodate motor vehicles, i.e., bike lanes are not paved to only accommodate bicycles (the pavement thickness to accommodate only bicycles is typically less than half the thickness of a roadway carrying moderate motor traffic). Moreover, cars and trucks can and do use the City's bicycle lanes for turning and parking movements.

Recent cost studies suggest that in the US the cost (per linear mile) of constructing a facility to accommodate only bicycles is under five percent of the cost per mile of a road which must
accommodate motor vehicles\textsuperscript{xi}. Similarly, the costs of maintaining the pavement of a bike facility will be less than that of a roadway, due to both its structural section and the fact that loads produced by cyclists have less impact on pavement than damage due to weather, adjacent landscaping and how well the pavement was initially constructed (e.g., proper compaction of the soil below the pavement, proper drainage, and quality of materials used.\textsuperscript{xiii} In contrast to roadways for cars, buses and trucks, the costs of maintaining the pavement of a bike facility is mainly related to factors that are independent of the actual use.

Evidence from the Rails to Trails Conservancy and others \textsuperscript{xiv}suggests that the useful life of bicycle-only facility is up to 30 to 40 years (about twice the life-cycle of a San Francisco street without heavy vehicle traffic). Based on this, we conservatively estimate that pavement preservation treatment to maintain a bike facility at a given PCI score would be needed at less than half the frequency as for a roadway carrying mainly auto traffic. Similarly, repaving or major pavement rehabilitation would generally be needed at less than half the frequency compared to facilities for cars and trucks.
SOURCES OF ROAD MAINTENANCE FUNDING

The Department of Public Works provided a summary analysis of the percentage of its transportation budget that has come from user fees vs. general revenues in recent years. The sources for each of these is shown in Table 3.3 below.

<table>
<thead>
<tr>
<th>Fiscal Years 2008/09 – 2011/12</th>
<th>Fiscal Years 2011/12 – 2013/14</th>
<th>Fiscal Year 2014/2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>48%/52%</td>
<td>25%/75%</td>
<td>26%/74%</td>
</tr>
</tbody>
</table>

User Fee sources for this period included state sources (Proposition 1B, Proposition 42, and the Highway User Tax Account (HUTA), and Federal (FHWA) grants

General Tax sources included Federal ARRA, local sales tax, and San Francisco Certificates of Participation

User Fee sources for this period included HUTA and Prop AA (local vehicle registration fee)

General Tax sources included local sales tax and 2011 General Obligation Bond

User Fee sources for this year includes HUTA and FHWA grants and Prop AA General Tax includes local sales tax and discretionary general fund allocations.

Source: Ananda D. Hirsch Transportation Finance Analyst, SF DPW, email 9/23/14

Examining Table 3.3 it is evident that in the three years prior to 2011, road maintenance costs were funded with a nearly equal mix of general tax revenue and roadway user fees. Since 2011 about three-quarters of roadway funding comes from general revenue sources. Only one-quarter currently comes from user fees paid by motorists.

With respect to the current FY 14/15 figure, the largest component of the general tax source is a transfer from the City’s general fund. This is a discretionary funding source, subject to the City’s budget process and Board of Supervisor’s approval each year. Thus the ratio will likely fluctuate somewhat in the future. Without the general fund transfer in the current fiscal year, DPW’s transportation budget would be about 65% from user fees. However, the total budget for street repair and maintenance would also be reduced by 60%, and such a level of funding would lead to a growing backlog of street repairs and general deterioration of the street system.

Federal funding is generally considered a motorist user fee source since the federal Highway Trust Fund was sustained almost exclusively by fuel and other motorist excise taxes from 1956 until the early 2000s. However in the past 10 years, outlays from the Highway Trust Fund have exceeded revenues by more than $52 billion. Since 2008, Congress has addressed ongoing Trust Fund shortfalls by transferring $54 billion mostly from the general fund. The Congressional Budget Office (CBO) estimates that obligations will exceed revenues by an estimated $167 billion over the
2015–2024, or about $17 billion per year in the decade ahead. The CBO estimate assumes that allocations continue at the 2014 rate (with adjustments for future inflation) and that taxes on fuels and heavy vehicles set to expire are extended at their current rates.

Given that the federal government currently spends more than $50 billion per year on surface transportation programs, the anticipated shortfall of approximately $17 billion per year means that at present, only two-thirds of the revenue to the Highway Trust fund comes from user fees.¹⁵

This is mainly due to the fact that the federal gas tax of 18.3 cents per gallon has not been increased since 1993. Since it is a flat tax and not percentage, the tax does not increase as the price of gas increases, and it has lost up to 80% of its purchasing power due to inflation. As shown in Figure 3.1, in adjusted dollars, Americans are paying the least amount of gas taxes since 1983, when notably, the gas tax was increased 5 cents per gallon during the Reagan administration. It was increased another 4 cents per gallon during the George H.W. Bush administration, and the last increase was 4.3 cents per gallon in 1993, during the Clinton administration. To keep up with both inflation and fuel efficiency, the Institute on Taxation and Economic Policy (ITEP) calculated that the gas tax in 2013 should be 29 cents per gallon, an increase of 10.6 cents per gallon. ITEP estimates that this would cost the average driver less than $5 per month. According to USA Today, “Taking the federal gasoline tax to 30 cents per gallon would not even be an increase, as that is where it was in 1993 in inflation-adjusted dollars. More is needed to keep up with today’s traffic. One approach would be to raise the tax by a penny a month for as long as two years, which would either go unnoticed amid normal price swings or promote sales of fuel-efficient vehicles.”²⁶

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**Figure 3.1**

Federal Gas Tax Rates Since 1933

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The Incidence of Maintenance Costs vs. Sources of the Need for Maintenance

Based on the information presented in the preceding sections, the costs of maintaining and repairing are not proportional to the contributions from different modes of transportation. Motorist user fees have provided at most a quarter of San Francisco roadway maintenance budget, while general tax revenues (sales taxes, property taxes, and general obligation bond revenue) provide three-quarters of the budget. Thus 75% of the roadway maintenance budget is paid for by all San Franciscans regardless of whether they drive or not while the vast majority of roadway maintenance costs are due to motor vehicles.
4. AUTO PARKING AND LAND VALUE

PARKING SPACE CENSUS

The SFMTA recently completed a six-year effort to document all the on-street and off-street parking spaces in the City of San Francisco. These findings are available at the following website: http://sfpark.org/resources-overview/ and http://sfpark.org/resources/off-street-parking-census-gis-data/.

A summary of the parking census is presented below along with a rough estimate of the current real estate value of the land area occupied by street parking and surface lot parking spaces.

On-street Parking

According to the MTA parking census, there are 26,750 metered spaces and 248,700 unmetered spaces on public streets. This is roughly equivalent to almost 900 miles of parking lanes on city roadways xx. These on-street spaces take up roughly 33 million square feet of roadway space; see Table 4.1. This almost 50 times the size of Mission Dolores Park. xxi

<table>
<thead>
<tr>
<th>Table 4.1</th>
<th>On-Street Parking Census</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td># Spaces (1)</td>
</tr>
<tr>
<td>Metered (2)(3)</td>
<td>26,750</td>
</tr>
<tr>
<td>Unmetered (4)</td>
<td>248,700</td>
</tr>
<tr>
<td>TOTAL</td>
<td>275,450</td>
</tr>
</tbody>
</table>

Source: SF MTA Parking Census, April 2014
1) On-street spaces include green, white and yellow curb.
2) The city’s 2,270 motorcycle spaces are counted as 450 metered automobile parking spaces as each motorcycle space uses about 1/5 of a regular metered car space.
3) This total includes Port of San Francisco meters.
4) A standard unmetered parking space is measured as 17 feet long for parallel spaces, 8.5 feet if perpendicular.
5) See endnote no. xx for assumptions.
Off-street Parking in Surface lots

The MTA parking census revealed that there are 166,500 publicly available parking spaces in San Francisco. There are 85,743 spaces in surface lots and 77,073 spaces in garages and another 3,684 that was either in a garage or lot, as shown in Table 4.2. The parking spaces in the surface lots take up over 20 million square feet of land.

<table>
<thead>
<tr>
<th># Spaces (1)</th>
<th>Area (sq. ft.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface</td>
<td>85,743</td>
</tr>
<tr>
<td>Garage</td>
<td>77,073</td>
</tr>
<tr>
<td>Garage or Lot</td>
<td>3,684</td>
</tr>
<tr>
<td>TOTAL</td>
<td>166,500</td>
</tr>
</tbody>
</table>

Source: SF MTA Parking Census, April 2014
1) Publicly available i.e. both City-owned lots and private business parking lots open to the public, (e.g. grocery stores).
2) Database field was either blank or was "Garage and Lot
3) Estimate assumes an average space including aisles takes up an area of 12 feet by 20 feet.

LAND VALUE

The land area currently devoted to parking is very valuable real estate. Admittedly it is not practical to convert roadway space to developable real estate whereas it is more feasible to imagine converting surface parking lots to commercial or residential use. Nevertheless for completeness and consistency we provide an estimate below of the land value of both off-street and on-street parking.

The land value varies depending on its zoning, in which neighborhood it is located, how usable the size of the lot is, whether or not it is contaminated and many other factors. It is impossible to derive an exact value for the land without the use of professional assessor and evaluating each block and each parcel individually. In order to come up with an order of magnitude estimate, a brief survey of recently sold lots in San Francisco was performed using the website http://www.loopnet.com/. This survey revealed that price per acre varied from $2 million to $200 million per acre. (See Appendix D).

Thus a conservative average for the land value of current parking spaces in San Francisco is $10 to $45 million per acre or $230 to $1000 per square foot.
If the existing off-street surface parking lots were converted to developable real estate, it would have a value of between $5 and $20 billion. Using half this rate for the on-street parking area, the land occupied by on-street parking spaces has a value of between $4 and $16 billion. This is presented in Table 4.3.

<table>
<thead>
<tr>
<th>Land Value- Land Dedicated to Public Parking</th>
</tr>
</thead>
<tbody>
<tr>
<td># Spaces (1)</td>
</tr>
<tr>
<td>Surface Lot</td>
</tr>
<tr>
<td>Street Parking (2)</td>
</tr>
<tr>
<td>TOTAL</td>
</tr>
</tbody>
</table>

Source:
1) SF MTA Parking Census, April 2014; It should be noted that some of the street parking converts to peak hour travel lanes.
2) See Table 4.1 of this report
3) Based on a land value range of $2,000,000 to $200,000,000 per acre of recently sold lots in San Francisco, see Appendix D. A value range of approximately $10,000,000 - $43,000,000 per acre or $230 to $1000 per square foot was chosen to be a conservative average. Half this value was used for street parking spaces.
5. EXTERNAL COSTS OF MOTOR VEHICLE USE

EXTERNAL COSTS OF TRANSPORT MODES

The overall cost of transportation modes including cars and trucks, transit vehicles, bicycling, and walking can be considerably higher than what the vehicle driver, transit rider, bicyclist, or pedestrian actually pays. The costs beyond what the user directly pays are known as “external costs”. These external costs include the cost of car collisions, air pollution, water pollution, solid waste disposal, loss of permeable land area, and the cost to public health from a sedentary lifestyle which is facilitated by dependence on automobiles.

This report focusses on the external costs of vehicle collisions and vehicle air pollution in San Francisco, and addresses to a lesser extent other environmental damage from vehicles. The findings are based on extensive literature review. Information on the external costs of other transportation modes in San Francisco, including transit, biking, and walking are not forthcoming in the literature review. However, based on detailed findings by Chester and Horvath in a comprehensive life cycle cost assessment of transportation modes, the external costs of transit, bicycling, and walking in San Francisco are minor compared to private motor vehicles.xxii

EXTERNAL COSTS OF VEHICLE COLLISIONS

A study conducted by the San Francisco Planning and Urban Research (SPUR) organization in 2005 estimated that the externalities from traffic collisions in San Francisco causes insurance premiums for drivers not involved in the collisions to go up by $400 to $900 in aggregate. This external cost of the collisions translates into $0.04 to $0.09 per vehicle-mile or $0.80 to $1.80 per gallon of gasoline, as shown in Table 5.1. This is a very conservative estimate because it only includes the cost of the health expenses covered by insurance – it does not include the cost of the pain and suffering endured by the crash victims or the cost of productivity losses, legal and court costs, administrative costs, workplace costs, or property damage. When all of the external costs of vehicle collisions are included, SPUR estimates that the costs could be as high as $0.15 to $0.33 per vehicle-mile or $2.80 to $6.30 per gallon of gasoline in San Francisco.xxiii

<table>
<thead>
<tr>
<th>Table 5.1</th>
<th>Range of Estimates of Collision Costs of Motor Vehicle Collisions in San Francisco</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Per Vehicle-mile</td>
</tr>
<tr>
<td>External Costs Covered By Insurance</td>
<td>$0.04 to $0.09</td>
</tr>
<tr>
<td>Total External Costs of Collisions</td>
<td>$0.15 to $0.33</td>
</tr>
</tbody>
</table>

Source: San Francisco Planning and Urban Research (SPUR), Estimating the External Costs of Driving in San Francisco, September 2005
Table 5.2 presents the findings of a study prepared for the American Automobile Association (AAA) by Cambridge Systematics in November 2011 which estimated the external costs of vehicle crashes in metropolitan areas throughout the United States including the San Francisco - Oakland metropolitan area. This study estimated the cost of traffic fatalities in the San Francisco – Oakland area in 2009 to be $1.3 billion, the cost of traffic injuries to be $2.0 billion, and the total external cost of the vehicle crashes to be $3.3 billion. This translates into a total cost of $796 per person in the San Francisco – Oakland metropolitan area in 2009. Overall, this Cambridge Systematics study for AAA estimated that the external cost of vehicle crashes ranges from $0.25 per vehicle-mile to $0.41 per vehicle-mile xxiv.

<table>
<thead>
<tr>
<th>Table 5.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated Cost of Traffic Collisions, San Francisco - Oakland Metropolitan Area, 2009</td>
</tr>
<tr>
<td>-----------------------------------------</td>
</tr>
<tr>
<td>External Costs of Traffic Fatalities</td>
</tr>
<tr>
<td>External Costs of Traffic Injuries</td>
</tr>
<tr>
<td>Total External Costs of Vehicle Crashes</td>
</tr>
<tr>
<td>Total Cost per Person</td>
</tr>
<tr>
<td>Total Cost per Vehicle-mile</td>
</tr>
<tr>
<td>Source: American Automobile Association, Crashes vs. Congestion – What is the Cost to Society?, November 2011</td>
</tr>
</tbody>
</table>

Todd Littman in his report Transportation Cost and Benefit Analysis II – Safety and Health Costs estimated the external costs of pedestrian and cyclist deaths at $0.56 per vehicle-mile and those of pedestrian and cyclist injuries at $0.21 per vehicle-mile.xxv

EXTERNAL COSTS OF AIR POLLUTION FROM MOTOR VEHICLES

Air pollution produced by motor vehicles has many external costs that are borne by society at large and by individuals, and not by those who produce the air pollution. The primary quantifiable cost is the detrimental effect on human health, but also includes the costs to clean up the air pollution, damage to agricultural production and other external costs. The literature review found that most urban air pollution cost studies primarily reflect human mortality, but some also include morbidity (illnesses). Furthermore, older cost studies only considered criteria pollutants (lead, CO, SOx, NOx and VOCs) but more recent research indicates that fine particulates are very harmful, and some studies include greenhouse gasses (CO2 and CO), which tends to increase cost estimates. ( . found the most on the public health impacts of air pollution as described below.

A study conducted by the San Francisco Planning and Urban Research (SPUR) organization in 2005 estimated that the external costs of air pollution caused by motor vehicles is responsible for 50 to 90 deaths per year in San Francisco. According to the SPUR study, these deaths have an economic value of $280 million to $550 million per year. This translates into an average cost of $0.07 to $0.13 per vehicle-mile or $1.30 to $2.50 per gallon of gasoline. This is a conservative estimate because it only accounts for the deaths due to particulate matter emissions from motor vehicles and does not include the illnesses or deaths resulting from other pollutants coming from the vehicles.xxvi
The San Francisco Department of Public Health has developed estimates for the impact of air pollution on the cancer risk of San Francisco residents. Overall, 1.2% of the population of San Francisco is living in neighborhoods with a risk of cancer from air pollution greater than 100 cases per million.

The neighborhoods in the City where the risk of cancer from air pollution is most pronounced include the Financial District, Civic Center, South of Market, Bayview, Bernal Heights, Mission, Mission Bay, Excelsior, Potrero Hill, Visitacion Valley, and the Western Addition.\textsuperscript{xxvii}

A study conducted by the Transportation Research Board (TRB) developed estimates for the external costs of air pollution emissions from motor vehicles in 86 metropolitan areas in the United States including the San Francisco – Oakland metropolitan area. This TRB study estimated that the external cost of the air pollution from vehicles in the San Francisco Oakland metropolitan region amounts to $4.3 million per day. This translates into a cost of $1.00 per person per day and $0.056 per vehicle-mile.\textsuperscript{xxvii}

### Table 5.3

<table>
<thead>
<tr>
<th>Rate</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Per Day</td>
<td>$4.3 Million</td>
</tr>
<tr>
<td>Per Person/Day</td>
<td>$1.00</td>
</tr>
<tr>
<td>Per Vehicle-Mile</td>
<td>$0.056</td>
</tr>
</tbody>
</table>

Source: Transportation Research Board, \textit{Cost of Automobile Air Emissions in the US Metropolitan Area}.

Todd Litman in his report “Transportation Costs and Benefit Analysis II – Safety and Health Costs” describes the wide range of estimates for the external cost of air pollution from vehicles in urban areas, depending on which specific air pollutants are considered and which impact models are used\textsuperscript{xxix}. He prepared an amalgamation of the diverse estimates prepared by others, and determined the external costs in terms of a rate per vehicle-mile, which is summarized in Table 5.4. He concluded that the external cost of air pollution is approximately $0.05 per vehicle-mile during peak hours and $0.04 per during off peak times. Mr. Litman also estimates the external cost of greenhouse gas emissions from automobiles to be $0.024 per vehicle-mile.

### Table 5.4

<table>
<thead>
<tr>
<th>Cost category</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Pollution Cost per Vehicle-Mile, Peak Hours</td>
<td>$0.05</td>
</tr>
<tr>
<td>Air Pollution Cost per Vehicle-Mile, Off-Peak Hours</td>
<td>$0.04</td>
</tr>
<tr>
<td>Greenhouse Gas Costs per Vehicle-Mile</td>
<td>$0.024</td>
</tr>
</tbody>
</table>


OTHER EXTERNAL ENVIRONMENTAL COSTS

Apart from air pollution, there are a number of other external environmental impacts caused by motor vehicles, including noise, water pollution, and storm water runoff, damage to wetlands and agricultural lands, and solid waste disposal. Based on the literature review, we offer the following findings:

- The external cost of noise from vehicles was estimated by Ketcham and Komonoff to be $21.1 billion nationwide in 1992.xxx
- A study by Hilary Nixon and Jean-Daniel Sophores of the University of California at Irvine in 2007 estimated that the cost of cleaning up toxic pollution due to storm water runoff from highways could be as high as $249 billion on principal arterials roads and $375 billion for all arterial roads in the United States.xxxi
- The Nixon-Sophores study also estimated that the cost of cleaning up leaking gasoline from underground storage tanks in the United States could be as high as $19.6 billion.xxxii
- The construction of roads and highways throughout the country has caused the loss of wetlands, watershed regions, aquifer recharge areas, parklands, scenic areas, and historic and cultural areas. More than 60,000 square miles of the US is paved over, which equates to approximately 10% of all the arable land in the country.xxxiii
- Other external costs including agricultural and aesthetic impacts of air pollution are harder to quantify but have been addressed in several reports.xxxiv

CONCLUSION

The external costs of vehicle collisions and public health impacts due to air pollution from motor vehicles in San Francisco highlighted in this report cumulatively account for between $0.20 to $0.52 per vehicle-mile. The external costs of these and other negative environmental impacts are not being paid by vehicle drivers in San Francisco, (nor anywhere in the United States). Rather than being paid by gas taxes or vehicle fees, these costs are being born by residents, workers, and visitors in the City as a whole.
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To facilitate duplex printing.
6. CONCLUSION

In San Francisco, bicyclists, pedestrians and transit constitute over 50% of the modal split for all trip purposes and 55% of the modal split for work trips, yet only 2% of all roadway paved area is allocated for the preferential use of bicyclists and transit vehicles. It is noteworthy that in the 21st century, San Francisco has made significant progress on improving bicycling facilities; bike lanes have increased from 0.35% of roadway space in 1999 (36 one-way miles of bike lanes) to 0.9% by 2009 (90 one-way miles of bike lanes) to 1.4% of roadway space today (143 one-way miles of bike lanes).

General taxes not vehicle-user fees pay for most of the maintenance of these roadways. The SF DPW budget for maintaining roadways receives 75% its revenue from the general fund, sales taxes and other sources paid for by all citizens, and only 25% of its budget from vehicle-user fees. This is partly due to the fact that the federal gas tax of 18.3 cents per gallon has not been increased in 21 years, and in real dollars it is at the lowest point since 1983, (when during the Reagan Administration, the gas tax was more than doubled from 4 cents to 9 cents per gallon). Consequently, counties including San Francisco have implemented sales taxes, paid by all citizens, to help fill the shortfall in the transportation budgets that used to be filled by user fees like gas taxes.

The recently concluded parking census conducted by SF MTA found that San Francisco streets have over 275,000 parking spaces. This is equivalent to 902 miles of parking lanes. In addition there are over 166,000 spaces available in surface lots and garages for public parking. Considering only the 85,743 spaces in the surface lots, this is equivalent to a real estate value of between $5 and $20 billion. It is estimated that the on-street spaces have a land value of between $4 and $15 billion.

The external costs of vehicle collisions is estimated at between $0.15 and $0.41 per vehicle-mile. The costs to public health from motor vehicle air pollution is estimated to be between $0.056 to $0.11 per vehicle-mile. This adds up to between $0.20 to $0.52 per vehicle-mile. The external costs of these and other negative environmental impacts are not being paid by vehicle drivers in San Francisco, (nor anywhere in the United States). Rather than being paid by gas taxes or vehicle fees, these costs are being born by residents, workers, and visitors in the City as a whole.

RECOMMENDATIONS FOR FURTHER RESEARCH

This report, while answering some questions, also reveals the need for additional research. These include:

- Analysis of the economic impacts of automobile use by neighborhood;
- Economic activity in San Francisco of non-auto-owning households compared to auto-owning households;
- The economic disparity between the payers of the various taxes that fund our roadways including sales taxes and general funds;
- The declining contributions of the federal and state gas taxes to funding transportation;
- Further analysis of the external costs of automobile use in the San Francisco Bay Area;
- Comparison of traffic safety funds expenditures by victims of traffic collisions;
• An updated San Francisco Bay Area version of the 1994 Roelofs & Komanoff report\textsuperscript{xxiv} that demonstrated that in New York State the use of automobiles is being subsidized by taxpayers rather than being paid for by auto user fees;

• Actual costs of bicycle facility maintenance (especially bike lanes);

• How to best maintain and update on a regular basis a consistent database covering:
  
  o Transportation system use by mode of transport;
  
  o Transportation system maintenance and expansion cost by mode of transport;
  
  o Transportation system revenues by source;

• The impact of electric vehicles on the future viability of gas taxes as a revenue source.
ABOUT TRANSPORTATION CHOICES FOR SUSTAINABLE COMMUNITIES
RESEARCH AND POLICY INSTITUTE

Transportation Choices For Sustainable Communities Research and Policy Institute is a 501(c)3 nonprofit organization founded in 2012. Our mission is:

> to advance understanding and support for sustainable transportation as an essential component of livable communities and cities. The Institute studies and evaluates the ways and means of creating more life-affirming transportation systems and disseminates this information to both the public and decision makers. The Institute also partners and collaborates with academics and advocates as well as city planners, engineers, architects, public health planners, and allied professions. The aim of this endeavor is to illuminate the central role that sustainable transportation plays in the vibrancy of communities. In pursuing these aims, the Institute researches and informs on a variety of policies and programs, including non-motorized transport, public transportation, traffic calming, street design, transit-oriented development, travel safety, public health, environmental quality, urban design and smart growth.

Please visit us at our website at: [http://transportchoice.org](http://transportchoice.org)
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To facilitate duplex printing.
END NOTES AND REFERENCES

1 San Francisco Municipal Transportation Agency, Mode Share Survey 2011 Summary Report. Note that to reflect travel mode choice for work commuting by San Franciscans, survey findings have been adjusted to remove those respondents who either did not work or worked at home.  

2 http://www.census.gov/acs/www/

iii For example, one mile of a two-way street and one mile of a one-way street are both recorded as 1.0 mile of roadway. If a bike lane is on either of these streets, it is recorded as 1.0 mile of bike lane. One mile of a two-way road with a raised center median is also recorded as 1.0 mile. This important because the CTA database will often distinguish between roadways that are “divided” i.e. have a raised median separating the two directions of traffic, and those that are undivided. Other data from other departments sometimes present “directional miles”, whereby 1.0 mile of a two-way road will be presented as 2.0 miles of directional roadway, or a bike lane on both sides of a two-way road will be recorded as 2.0 miles of bike lane.

iv Policy 27.2 of the Transportation Plan calls for the development of a system of bicycle priority streets: “Develop a rational classification system of bicycle preferential streets. The bicycle preferential streets system should consider the multi-modal functions of the street, the topography, and the existing and potential volume of bicycle traffic on the street. Streets and pathways in the bike route system that are relatively level, do not have conflicts with high volumes of pedestrian traffic, and do not have the primary functions of freight routes, major arterials and primary transit streets should be designed and treated to prioritize the movement of bicycles. Other streets and paths on the bike route system should be designed and treated to balance the other modes of transportation with the movement of bicycles. As with transit preferential streets, general traffic should be routed away from the bicycle preferential streets system wherever possible, except when they are arterial streets. Note that some bicycle preferential streets may have to be primary or secondary arterials or transit preferential streets, if feasible alternatives do not exist. In general, bicycle preferential streets should include design treatments that encourage all segments of the population to bicycle, not only experienced cyclists.”

v For example, one mile of a one-way street with two travel lanes and one bike lane will appear as 2.0 lane miles of roadway and 1.0 lane miles of Bike Lane. One mile of a two-way street with one lane in each direction and one bike lane in each direction is recorded as 2.0 lane miles of roadway and 2.0 bike lane miles. One mile of a four-lane roadway is recorded as 4.0 lane miles.

vi San Francisco established its publicly-owned streetcar system in 1912, and privately operated public transit dates to the 1840s. See http://www.streetcar.org/streetcars/1/

vii San Francisco Department of Public Works, 2011 Road Repaving and Street Safety Bond Report, p. 7


ix Ibid, p. 12

x Ibid, p. 8.

xi TRID is maintained by the Transportation Research Board and the Joint Transport Research Centre of the Organisation for Economic Co-operation and Development and the International Transport Forum have launched the Transport Research International Documentation (TRID) database. TRID offers access to more than 900,000 records of published or on-going research.

xii Bushell, Max; Poole, Bryan; Rodriguez, Daniel; Zegeer, Charles, (July, 2013), Costs for Pedestrian and Bicyclist Infrastructure Improvements: A Resource for Researchers, Engineers, Planners and the General Public, www.walkinginfo.org/download/PedBikeCosts.pdf. Bushell et al report average cost of $133,000 per mile for dedicated bicycle lanes based on six cases. By comparison, the Florida DOT estimates the cost for new construction of a 2-Lane Urban Arterial Roadway) with 5’ sidewalks, and curb & gutter to be $9,518,000 per centerline mile, or $4,759,000 per direction. http://www.dot.state.fl.us/planning/policy/costs/costs-D7.pdf, costs updated June 2014. If we subtract the per-mile costs found by Bushell et al for curb and gutter ($111,000) and sidewalks ($169,000) from the Florida DOT directional cost, we arrive at a construction cost per urban arterial traffic lane of $4,479,000 or more than 30 times the cost of bicycle lane.

Bondurant, Julie and Laura Thompson et al. Trail Planning for California Communities, Table 8-10 and sidebar pp 353, Solano Press Books, September 2009.


http://taxfoundation.org/blog/federal-gas-tax-hikes-proposed-senator-carper


Editorial Board, USA Today June 17, 2014.

This is based on 20 linear feet per metered space and 17 linear feet per unmetered space, as described in the SF MTA Parking Census; the exact number of linear feet is less since some parking spaces are perpendicular rather than parallel thus take up less curb space.

This is based on Mission Dolores Park’s size of 15.94 acres (694,000 sq. ft.). Source: http://sfrecpark.org/destination/mission-dolores-park/.


Todd Litman. Transportation Costs and Benefit Analysis II – Safety and Health Costs. Victoria Transport Policy Institute, August 2013, especially Table 5.10.3-1.


Ibid, p. 12


Mark Delucchi (1996), James Murphy, Jin Kim, and Donald McCubbin, Cost of Crop Damage Caused by Ozone Air Pollution From Motor Vehicles, UC Davis, ITS (www.its.ucdavis.edu); at www.its.ucdavis.edu/people/faculty/delucchi/index.php; and Mark Delucchi, et al. (1996), Cost of Reduced Visibility Due to Particulate Air Pollution From Motor Vehicles, UC Davis, ITS (www.its.ucdavis.edu); at www.its.ucdavis.edu/people/faculty/delucchi/index.php

Roelofs, Carla and Charles Komanoff, Subsidies for Traffic: How Taxpayers Dollars Underwrite Driving in New York State, Tri-State Transportation Campaign, March 1994