FEHR PEERS

2013 - 2017 Travel Decision Survey Data Analysis and Comparison Report

Prepared for SFMTA

July 2017

EXECUTIVE SUMMARY

The SFMTA 2013-2018 Strategic Plan sets a goal to make transit, walking, bicycling, taxi, ridesharing, and carsharing the preferred means of travel in San Francisco. To monitor progress toward this strategic goal, SFMTA conducts travel decision surveys on an annual basis. This report analyzes data provided by Corey, Canapary & Galanis Research to examine overall travel trends in San Francisco from 2013 to 2017,[1] identify key demographics or trip purposes where the share of trips made by automobile exceeds the current goal, and compare findings to additional data sources documenting or forecasting travel behavior in San Francisco.

Based on 804 responses for 2017 and a total of 2,324 responses from 2013 to 2017, Fehr & Peers identified the following key findings:

San Francisco Drives Less than Half the Time

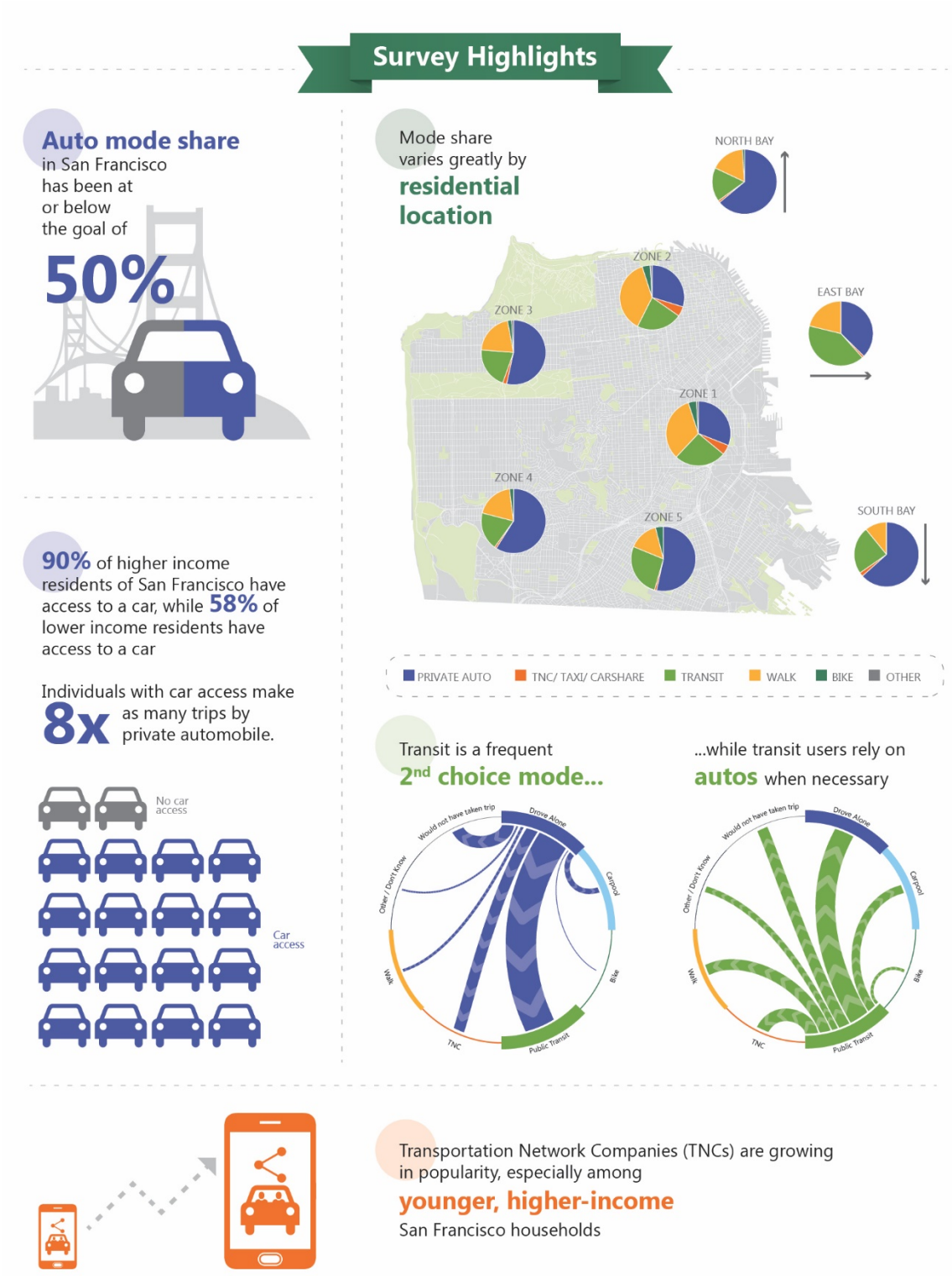
- The City has met its goal of having fewer than 50 percent of trips be made by private auto in every year since 2013, and total private vehicle mode share has decreased from 48 percent of trips to 43 percent of trips since 2013.
- Transit mode share has remained flat over time, with a slight increase in transit use among non-San Francisco residents in the past year.
- Walk and bike trips show a similar pattern to transit use, with minor fluctuations but no significant change since 2013. The bicycle mode share data suffers from a small sample size; however, other data sources indicate that bicycling has remained steady from 2013 to 2017, and has increased substantially from 2006 levels.
- Share of travel by private automobile also varies based on trip purpose; school and shopping trips in particular are more likely to be made by private vehicle than other types of trips.

San Francisco Walks

- Over the past five years, around one quarter of all trips in San Francisco has been made on foot.
- Patterns in other data sources such as the California Household Travel Survey and intercept surveys conducted for the San Francisco Planning Department indicate that walking rates may be even higher than indicated in the survey responses.
- If walking rates are higher, they likely correspond to a slight decrease in rates of taking transit and potentially rates of driving alone.

[1] Survey years are presented by fiscal year (i.e., the first survey conducted in FY12-13 is reported as 2013), while prior reports have been by calendar year.

Figure E-1: Summary of Survey Findings



Travel Decisions Vary by Geography, Income, and Auto Access

- Share of travel by private automobile varies widely based on residential location, with residents of outer San Francisco neighborhoods and the North and South Bay areas making more than half of their San Francisco trips by private automobile. This pattern has been consistent from 2013 to 2017.
- Higher income households in San Francisco make more trips by automobile. Much of this difference is associated with variations in auto access by income, with only 10 percent of households with incomes over $75,000 reporting no access to a vehicle, compared to 40 percent of households with incomes under $75,000.
- The difference in auto mode share between lower income households and higher income households is highest in the densest neighborhoods, even though these neighborhoods also have the lowest total private auto use.
- However, the strongest indicator of private auto mode share greater than 50 percent is place of residence, rather than income, with residents of the North and South Bay areas and outer neighborhoods more likely to make vehicle trips at all incomes.

San Francisco has a Diverse Set of Transportation Options

- Among individuals not using transit, transit was by far the most popular "second choice" of mode (i.e., individuals indicated that if they had been unable to drive / carpool / walk for a trip, they would have taken transit instead).
- Transportation network companies ("TNCs," such as Lyft and Uber) and taxis serve an important service as a "second choice" mode among transit users and drivers alike.
- Generally, only 15 to 20 percent of respondents across all modes indicated they would not have made a trip if their preferred mode was unavailable. The highest level of 'no trip' responses was for carpool trips. This indicates that most respondents felt they had multiple travel options available to them.
- Even so, driving is still perceived as being more convenient and faster than all other transportation options, based on responses from drivers.

Transportation Network Companies are Increasing in Popularity

- Use of TNCs has increased significantly over the past two years, with TNC trips now comprising approximately four percent of all trips made in San Francisco (+/- 1%).[2]
- Around a fifth of San Franciscans use a TNC at least once a week, with 40 percent using a TNC at least once a month.

[2] If TNCs were considered to be private automobiles for purposes of goal monitoring, the City would still be meeting its overall goals for 2017; however, total auto mode share would increase from a total of 43 percent to 47 percent.

- Frequent TNC users are more likely to be young (under age 35), high income, and live in dense, inner neighborhoods of San Francisco.
- Evidence from outside studies indicates that some of the increase in TNC mode share may be resulting in shifts away from transit use, walking, and bicycling.

Looking Forward

- Demographic and social trends such as labor force participation, household formation, economic growth, and the rise in on-demand and delivery services will all affect future levels of vehicle traffic on San Francisco's roadways.
- Technological innovations such as continued TNC operations and the introduction of autonomous vehicles may also have direct effects on travel in San Francisco, including increases in vehicle trips on City roadways, but these effects are difficult to project definitively.
- Ultimately, land use patterns and neighborhood characteristics, such as demography, neighborhood density, and income, tend to be the strongest indicators of mode share among individuals.

Implications for future surveys and the setting of future performance metrics largely revolve around measurements of total vehicle use. The Travel Decision Survey characterizes trips by modes such as taxi, TNC, or carshare as "non-private auto," rather than labeling such trips as "private automobile use." The goal set in the Strategic Plan specifically lists ridesharing and carsharing as modes to encourage, and the data regarding "second choice" modes indicates that they are a key component in creating a dense web of potential travel options. But while these modes were used infrequently in 2012, TNC use in particular has grown quite strongly, and preliminary evidence suggests that TNCs may be adding additional vehicle trips to the roadway by inducing vehicle trips and capturing mode shift from transit in particular.[3,4,5,6] Additionally, there is generally a distinction made between TNC or "ridehailing" type travel and "ridesharing," with ridesharing referring to traditional means of carpooling mechanisms and their evolutions, such as casual carpools or services such as Scoop. In comparison, most TNC activity is more comparable to taxi use.

The increase in TNC use over a period of five years also has some implications for handling future technological innovations. While autonomous vehicles (AVs) are currently under active development, and

[3] Anderson, D. 2014. "'Not Just a Taxi'? For-Profit Ridesharing, Driver Strategies, and VMT" *Transportation*. Volume 41, Issue 5, pp. 1099-1117.
[4] Henao, Alejandro. 2017. Impacts of Ridesourcing – Lyft and Uber – on Transportation including VMT, Mode Replacement, Parking, and Travel Behavior. University of Colorado Denver
[5] Rayle, Shaheen, Chan, et al. 2014. App-Based On-Demand Ride Services: Comparing Taxi and Ridsourcing Trips and User Characteristics in San Francisco. University of California Transportation Center.
[6] Schaller Consulting. 2014. *Unsustainable? The Growth of App-Based Ride Services and Traffic, Travel and the Future of New York City.*

may be consumer ready between 2020 and 2030, there is limited real world data for assessing their effects. Travel demand models modified to reflect key AV features (such as decreased parking costs, increased vehicle density during congested periods, etc.) generally show an increase in vehicle miles traveled (VMT) as more vehicles on the road are autonomous.[7]

Overall, however, survey results show that San Francisco has a diverse set of attractive travel options. Walking and transit together comprise more than half of trips in some areas of the City, and travelers from the East Bay in particular use transit at high rates. Further encouragement to take transit, walk, and bicycle can occur through continued investment in each of those networks, through implementation of Muni Forward and other transit enhancements, improvements to walking and bicycling facilities, and careful coordination with other agencies in the City family.

[7] Transportation Research Board. 2017. *NCHRP Report 845: Strategies to Advance Automated and Connected Vehicles: A Primer for State and Local Decision Makers.*

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1 INTRODUCTION

The SFMTA's 2013-2018 Strategic Plan establishes a goal that less than half of all trips to, from, or within the City are made by private automobile. The SFMTA conducts travel decision surveys by telephone once a year to monitor progress toward the City's goal. The SFMTA 50 percent goal target includes only trips made by driving alone or driving with others (i.e., carpool). Trips made by transit, walking, and bicycling, as well as trips made using Transportation Network Companies (TNCs, such as Uber and Lyft) and taxis have been categorized as "non-private auto" modes. Within this report, Fehr & Peers has introduced an additional designation, "auto modes," to include trips made by private vehicles as well as trips made by TNCs and taxis, due to their continued growth as a travel choice.

This report identifies trends in travel decision survey results from 2013-2017, as well as discusses potential demographics or geographic areas with potential for further reductions to private vehicle mode share. This report also introduces data from several additional sources when it serves to provide context, support, or additional information on the trends observed in the survey result data set. These data sources include monitoring reports from other SFMTA programs, data from projects undertaken for the San Francisco Planning Department, academic research on travel choices, and data from the California Household Travel Survey, last conducted in 2012.

Special focus is also given to particular modes of transportation and trends that may affect future travel decisions in unknown ways. This includes TNCs, as well as potential future shifts in demographics, social trends, or the introduction of autonomous vehicles (AVs) into the vehicle fleet. These trends, along with patterns identified through examination of the Travel Decision Survey data, may inform future policy decisions by SFMTA or other City agencies. Potential effects on future policy decisions are discussed further in this report as appropriate.

2 SUMMARY OF DATA SETS

Fehr & Peers used a database of survey responses collected by professional surveying and data collection firm Corey, Canapary & Galanis Research over a five year period. All surveys were conducted on the phone, and the most recent set of data was collected in Spring 2017. The initial findings report prepared by Corey, Canapary & Galanis Research includes further details on precise question wording and survey methodology. To prepare the database for additional analysis, Fehr & Peers added several calculated fields, as well as identified methods to reconcile slight variations in questions and response categories over the five year dataset.

2.1 DATA COLLECTION METHODOLOGY

Each year the TDS collects responses from approximately 750 Bay Area residents. In 2017, telephone surveying collected responses from 804 Bay Area residents aged 18 and older, representing a total of 11,899 trips made to, from, or within San Francisco. The margin of error at the 95 percent confidence level for 2017 data is +/-3.4 percent in the total sample (n = 804). For other sample sizes, the margin of error is as follows:

- n = 400. Margin of error = +/- 4.85%
- n = 100. Margin of error = +/- 9.80%
- n = 50. Margin of error = +/- 13.9%

Due to large margins of error, we have chosen not to include in this report certain data backed by fewer than 50 individual respondents for purposes of examining mode share by sub-groups. Notes throughout the text of this document indicate where data are not reported due to small sample size or other concerns with the sample.

In addition to providing analysis of data collected in the 2017 survey, this memorandum incorporates data collected from 2013 to 2016 to examine year-over-year trends, as well as provides five year averages for data points with small numbers of respondents in a single year. This method was primarily employed in examining mode share by trip purpose and mode share by place of residence.

2.2 DATA CONSISTENCY

For a subset of demographic questions, the surveys from 2013 to 2017 did not provide consistent response options when compared year to year. This section discusses how responses were adjusted to provide consistent categories for year to year comparisons.

2.2.1 Income

The 2016 and 2017 surveys provided eight response options for income, while the 2013, 2014, and 2015 surveys provided five response options. The 2016 and 2017 options were identical, and the 2013-2014 options were identical. The income range cutoffs for 2015 did not match those for the 2013-2014 surveys. To combine the five datasets, the 2016 and 2017 options were consolidated to more closely resemble the 2015 response options. The response options are listed in **Table 1**.

The consolidation of data categories for income does introduce some variation in the categories. For instance, the reported category of $76,000 - $100,000 in income includes individuals in 2013 and 2014 who responded with a household income between $71,000 and $75,000. Similarly, the category of $36,000 to $75,000 includes some responses from individuals earning between $31,000 and $36,000. Because prior data sets tabulate income by category rather than exact response, we have accepted that these categories are not fully in alignment, and believe that the recategorization is sufficient for comparison purposes.

Table 1: Survey Response Options for Income by Year

2017 & 2016	2015	2013 & 2014
$15,000 or less	**$35,000 or less**	$30,000 or less
$15,001 - $25,000		
$25,001 - $35,000		
$35,001 - $75,000	**$36,000 - $75,000**	$31,000 - $70,000
$75,001-$100,000	**$76,000 - $100,000**	$71,000 - $100,000
$100,001 - $200,000	**Over $100,000**	Over $100,000
Over $200,000		
Refused	**Refused**	Refused

2015 response options were selected for use in this report, as indicated in **bold**.

2.2.2 Age

The 2015, 2016, and 2017 surveys provided options for the respondent's age where the upper bound of the range's ones digit was a four (e.g. 24), while the 2013 and 2014 surveys provided options where the ones digit was a five. In addition, while the 2013, 2014, and 2016 surveys highest age bracket was either 55 years or 56 years and older, the 2017 survey included an additional response option, resulting in a category for those 65 years old and older. To combine the datasets, the 2016 survey was used as the standard. The 2017 "55-64" and "65+" options were combined.

Table 2: Survey Response Options for Age by Year

2017	2013-2016
18 – 24	**18 - 24**
25 - 34	**25 - 34**
35 - 44	**35 - 44**
45 - 54	**45 - 54**
55 - 64	**55 and older**
65 and older	
Refused	**Refused**

2013-2016 response options were selected for use in this report, as indicated in **bold**.

2.2.3 Mode

The 2015, 2016, and 2017 surveys included 12 consistent mode response options: drive alone, drive with others, carshare, TNC, taxi, transit, shuttle, bicycle, walk, scooter, other, and don't know. The 2014 survey included an additional option for carpool passengers. When the datasets were combined, this mode was aggregated with the "drive with others" category, which is reported as 'carpool' within this report. The 2013 survey included just eight modes, excluding carshare, TNC, shuttle, and scooter. In the tables below, no data is reported for these modes when 2013 information is presented.

Table 3: Survey Response Options for Mode by Year

2015-2017 Option	2014 Option	2013 Option
Drive Alone	Drive Alone	Drive Alone
Drive with Others	Carpool Driver Carpool Passenger	Drive with Others
Carshare	Carshare	N/A
TNC	TNC	N/A
Taxi	Taxi	Taxi
Transit	Transit	Transit
Shuttle	Shuttle	N/A
Bicycle	Bicycle	Bicycle
Walk	Walk	Walk
Scooter	Scooter	N/A
Other	Other	Other
Don't Know	Don't Know	Don't Know

2015-2017 response options were selected for use in this report, as indicated in **bold**.

2.3 DATA WEIGHTING

To ensure the survey responses were representative of the Bay Area population, the responses were weighted based on age. The proportion of survey respondents in each age bracket was adjusted to match the distribution of those age brackets within the region, based on the American Community Survey five-year data for the year of each survey. This weight was separate for the age distribution within San Francisco and the age distribution for the eight other Bay Area counties included in the survey.

For the 2014, 2015, 2016, and 2017 surveys, the weights were calculated by Corey, Canapary & Galanis Research. Fehr & Peers calculated and applied the response weights for the 2013 survey.

3 TRENDS IN TRAVEL BEHAVIOR

This review of travel trends focuses on assessing progress toward the goal of 50 percent of trips or less made by private vehicle, with a secondary goal of identifying key trip types or populations for which the existing private auto mode share is significantly higher than the goal of 50 percent. As such, we have presented travel trends for trips made only by San Francisco residents, for trips made only by individuals living outside of San Francisco, and for all trips.

3.1 OVERALL TRAVEL TRENDS

Overall, there have been minimal shifts in the percentage of individuals using each travel mode over the past five years. The largest apparent shift has been away from driving alone, potentially to either transit trips or to TNC trips. However, these fluctuations on a year-over-year basis largely fall within a typical margin of error, and are not considered statistically significant.

3.1.1 Automobile Travel

In 2017, fewer than half of trips taken in San Francisco were taken by private automobile (43 percent); this finding holds even when considering non-private automobile trips that nonetheless involve travel in an automobile, such as taxi, carshare, and TNC trips (47 percent). San Francisco residents have an overall lower private auto mode share than non-residents, although they are also more likely to use other forms of automobile travel such as carshare, TNC, and taxi services (see **Table 4, Table 5**, and **Table 6**).

Among trips made to, from, or within San Francisco by non-San Francisco residents, private vehicle mode share has decreased slightly from a peak in 2014 and 2015, from 56 percent to 48 percent, although this decrease is still within a margin of error of the two proportions.

To reach an average citywide mode share that includes both trips made by residents and non-residents, the data are weighted to reflect the total number of trips made by each group. Based on the SFCTA travel demand model, the San Francisco Chained Activity Modeling Process (SF-CHAMP), only 24 percent of trips within the city were made by individuals who live outside of San Francisco;[8]

[8] Results from SF-CHAMP model runs were used to estimate the share of trips within San Francisco made by residents as opposed to non-residents. Details are included in **Attachment A**.

as a result, the mode shift is muted when examining the overall private auto mode share as shown in **Table 6**. SF-CHAMP model results are discussed in more detail in Section 4.1.

Table 4: Auto Mode Share over Time by San Francisco Residents

Mode	2013	2014	2015	2016	2017
Drive Alone	26%	28%	25%	29%	27%
Carpool	22%	14%	20%	15%	15%
Total (Private Vehicles)	**48%**	**42%**	**45%**	**44%**	**41%**
Carshare	-	<1%	<1%	<1%	<1%
TNC	-	2%	2%	2%	4%
Taxi	2%	<1%	<1%	<1%	<1%
Total (All Vehicles)	**49%**	**45%**	**47%**	**47%**	**46%**

Source: Corey, Canapary & Galanis Research, 2017; Fehr & Peers, 2017

Inset Figure 1: Auto Mode Share by SF Residents Over Time

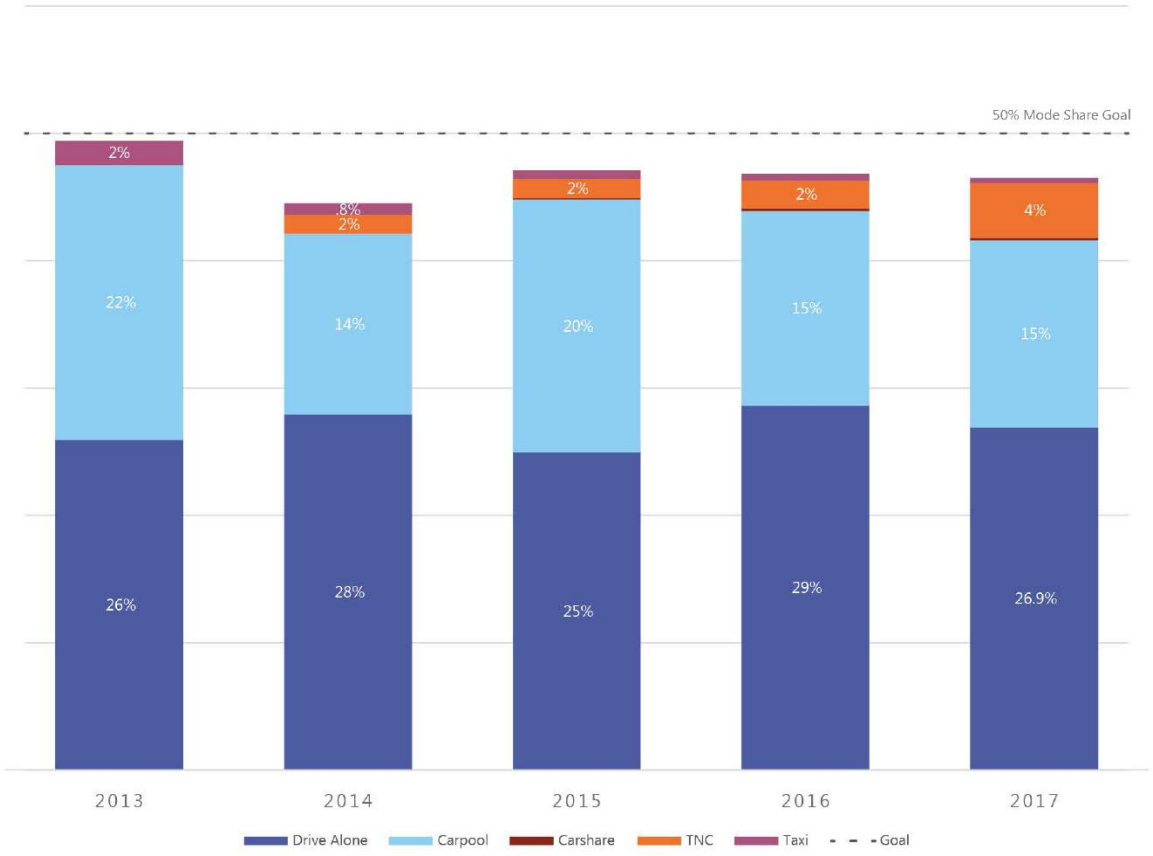


Table 5: Auto Mode Share over Time by Non-San Francisco Residents

Mode	2013	2014	2015	2016	2017
Drive Alone	27%	36%	34%	31%	31%
Carpool	24%	20%	23%	18%	17%
Total (Private Vehicles)	**51%**	**56%**	**57%**	**49%**	**48%**
Carshare	-	<1%	<1%	<1%	<1%
TNC	-	<1%	<1%	2%	2%
Taxi	<1%	<1%	<1%	<1%	<1%
Total (All Vehicles)	**52%**	**57%**	**58%**	**51%**	**50%**

Source: Corey, Canapary & Galanis Research, 2017; Fehr & Peers, 2017

Inset Figure 2: Auto Mode Share by Non-SF Residents over Time

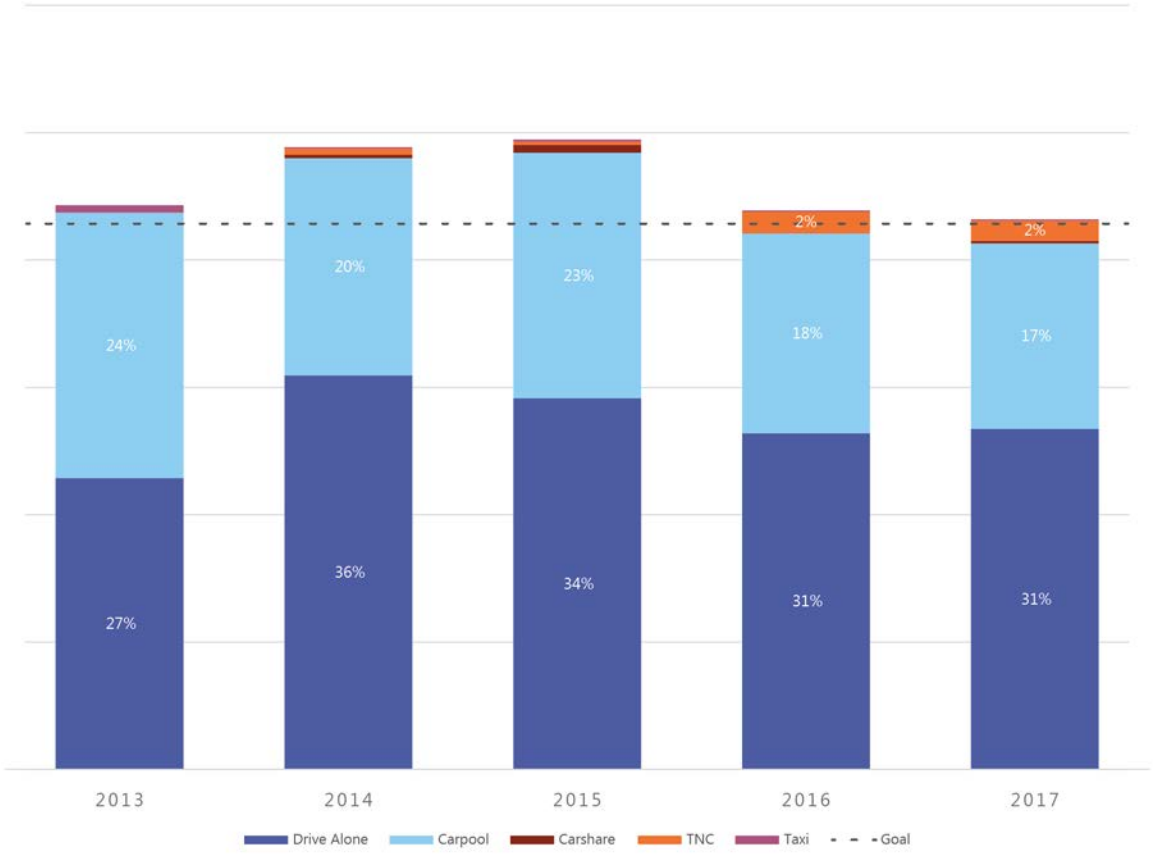
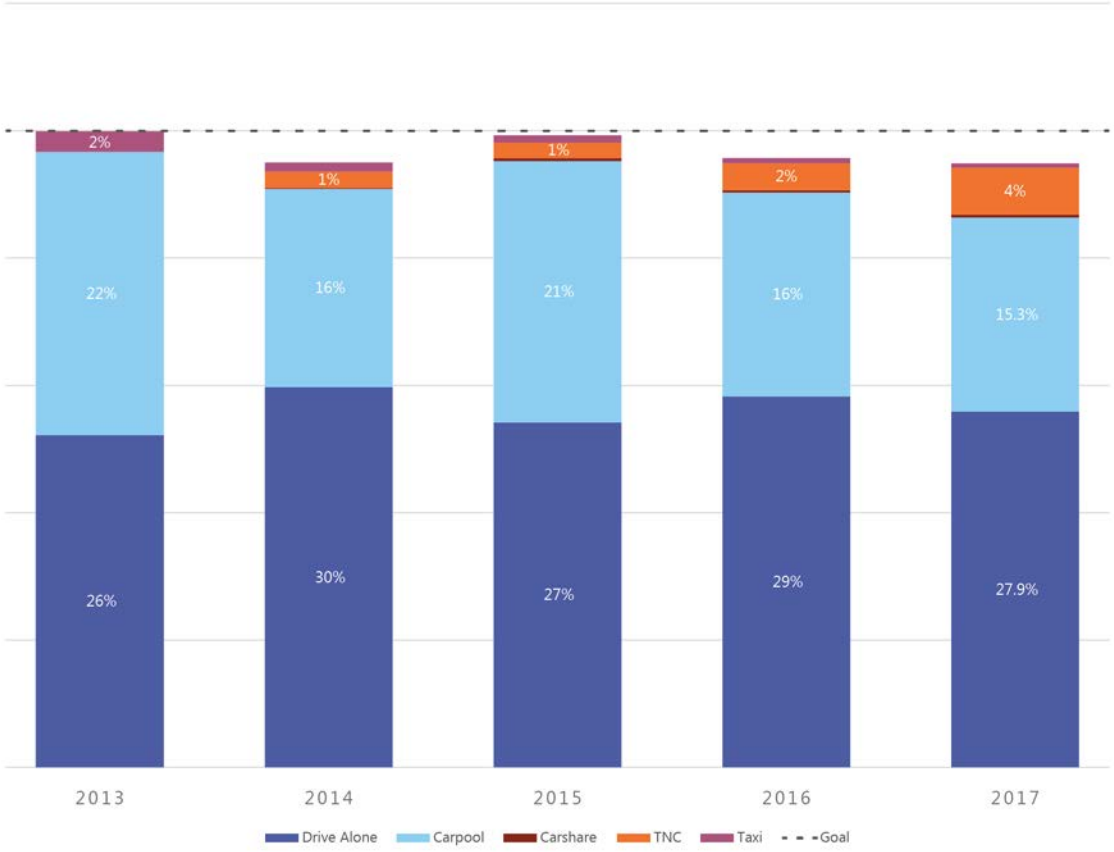


Table 6: Overall Auto Mode Share over Time

Mode	2013	2014	2015	2016	2017
Drive Alone	26%	30%	27%	29%	28%
Carpool	22%	16%	21%	16%	15%
Total (Private Vehicles)	**48%**	**45%**	**48%**	**45%**	**43%**
Carshare	<1%	<1%	<1%	<1%	<1%
TNC	<1%	1%	1%	2%	4%
Taxi	2%	1%	1%	<1%	<1%
Total (All Vehicles)	**50%**	**48%**	**50%**	**48%**	**47%**

Source: Corey, Canapary & Galanis Research, 2017; Fehr & Peers, 2017

Inset Figure 3: Total Auto Mode Share over Time (All Respondents)



While auto mode share has remained reasonably flat from 2013 to 2017, the 2015 Congestion Monitoring Program (CMP) Report indicates that average vehicle speeds on both arterials and freeway segments within San Francisco has decreased. On arterial roadways in the PM peak hour, vehicle speeds decreased 21 percent, from 16.0 miles per hour to 12.7 miles per hour, while on

freeway segments vehicle speeds decreased 11 percent from 29.5 miles per hour to 26.3 miles per hour.[9] These decreases reflect an increase in peak hour demand for space on the roadways in the CMP network. The likely explanation for the decrease in speeds on major arterials and freeway segments while total auto mode share remains constant is that the increase in regional population and economic activity led to more total trips being made on San Francisco roadways, and a corresponding increase in traffic density during the peak periods; even with mode share fairly static, an increase in number of trips represents a corresponding increase in vehicle trips on local roadways.

3.1.2 Transit and Shuttle Travel

For this analysis, transit modes include local and regional transit providers, such as Muni, Bay Area Rapid Transit (BART), Alameda-Contra Costa Transit (AC Transit), Santa Clara Valley Transportation Authority, Amtrak, and paratransit services. Shuttle modes include corporate shuttle, campus shuttle or similar (including University of California - San Francisco, California Pacific Medical Center, Art Institute, Chariot, Leap, and RidePal). In the Initial Findings Report,[10] shuttles and transit are aggregated into a single transit category. Year-over-year changes in use of both transit and shuttles are relatively small, and fluctuations fall within a margin of error of other years (see **Table 7** for more detail).

[9] *2015 Congestion Management Program*, San Francisco County Transportation Authority, 2015.
[10] *Travel Decision Survey Initial Findings Report*, prepared by Corey, Canapary & Galanis Research, 2017.

Table 7: Change in Transit Use over Time

Mode	2013	2014	2015	2016	2017
San Francisco Residents					
Transit	22%	24%	24%	22%	23%
Shuttles	-	<1%	<1%	<1%	<1%
Total	**22%**	**24%**	**24%**	**22%**	**24%**
Margin of Error	+/- 3%	+/- 4%	+/- 4%	+/- 4%	+/- 4%
Living Outside of San Francisco					
Transit	28%	31%	27%	28%	32%
Shuttles	-	<1%	<1%	<1%	1%
Total	**28%**	**31%**	**28%**	**29%**	**33%**
Margin of Error	+/- 4%	+/- 5%	+/- 4%	+/- 5%	+/- 5%
All Trips					
Transit	24%	25%	25%	23%	25%
Shuttles	-	<1%	<1%	<1%	1%
Total	**24%**	**26%**	**25%**	**24%**	**26%**
Margin of Error	+/- 3%	+/- 3%	+/- 3%	+/- 3%	+/- 3%

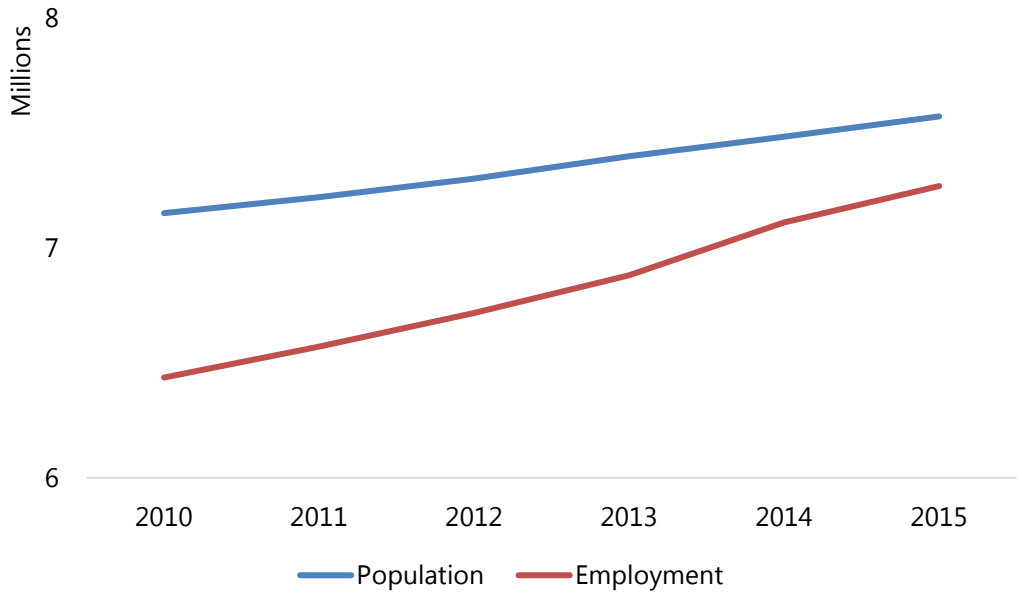
Source: Corey, Canapary & Galanis Research, 2017; Fehr & Peers, 2017

Inset Figure 4 shows previous travel decision survey results for 2013 through 2016 compared to total unlinked passenger trips (i.e., boardings) using all Muni services, as taken from the National Transit Database. Transit mode share for 2012 is taken from CHTS data due to a lack of available data for that year from the travel decision survey process. Both sets of data show an increase in ridership / transit use from 2013 to 14, and a subsequent decrease in following years.

Inset Figure 4: Comparison of Muni Ridership and Surveyed Transit Mode Share over Time

However, mode share and passenger boardings do not correlate precisely with each other due to economic growth and population changes occurring over the same period of time. With a growth in total person trips, the same level of transit mode share will result in an increase in passenger boardings on transit vehicles. A growth in total person trips can occur with a growth in regional population, or with increased economic activity that leads to additional travel. **Inset Figure 5** shows an overall increase in both Bay Area population and employment from 2010 to 2015. With this pattern of economic and population growth, we would expect to see total transit boardings increase, as was the case from 2012 to 2014. However, this still does not explain the reduction in boardings from 2014 to 2015, indicating that economic growth may have led to higher rates of driving, or that growth in ridership in that year primarily occurred outside of the Muni system (for instance, on BART or Caltrain).

Inset Figure 5: Bay Area Population and Employment, 2010 - 2015



Source: MTC Vital Signs, 2017.

3.1.3 Bicycle and Pedestrian Travel

As with transit and shuttle travel, survey responses show little change in bicycle and pedestrian behavior over time; fluctuations in mode share are within a margin of error year over year.

Variations in bicycle mode share may seem dramatic, with an apparent decrease in bicycle mode share among San Francisco residents from 2013 to 2017; however, this decrease largely reflects variation in the portion of the sample reporting a bicycle trip. In 2013, 17 respondents living in San Francisco reported a bicycle trip, with the average bicycle user reporting 9.8 trips over a three day period. In contrast, in 2016, only 12 respondents living in San Francisco were bicycle users, with an average of 4.6 trips each over a three day period. These small samples are the root of the apparent decrease in bicycle trip-making; the variation year over year falls within a margin of error based on this sample size and is not considered a significant shift.

In comparison, SFMTA's manual bicycle counts indicate that bicycle ridership at key intersections has remained largely flat since 2013, with between 10,500 bicyclists and 11,500 bicyclists observed in total at the 19 monitoring locations, and a total increase in bicycles observed of six percent between 2013 and 2016.

Table 8: Change in Bike/Walk Use over Time

Mode	2013	2014	2015	2016	2017
San Francisco Residents					
Bicycle	6%	3%	3%	2%	2%
Walk	22%	28%	25%	27%	27%
Total	**28%**	**30%[1]**	**28%**	**29%**	**30%[1]**
Margin of Error	+/- 5%	+/- 5%	+/- 5%	+/- 5%	+/- 4%
Living Outside of San Francisco					
Bicycle	<1%	<1%	<1%	<1%	<1%
Walk	20%	12%	14%	19%	17%
Total	**20%**	**12%**	**15%**	**20%**	**17%**
Margin of Error	+/- 4%	+/- 3%	+/- 3%	+/- 4%	+/- 4%
All Trips					
Bicycle	5%	2%	2%	2%	2%
Walk	22%	24%	23%	25%	25%
Total	**26%[1]**	**26%**	**25%**	**27%**	**26%[1]**
Margin of Error	+/- 3%	+/- 3%	+/- 3%	+/- 3%	+/- 3%

1. Individual modes do not sum to total due to rounding
Source: Corey, Canapary & Galanis Research, 2017; Fehr & Peers, 2017

3.1.4 Mode Trends from Other Data Sources

Additional data sources examining travel decisions within San Francisco include Census journey to work data (for commute trips), California Household Travel Survey data, and recent intercept surveys at various locations in San Francisco. Overall, Census data seem to confirm the travel trends noted in this report, particularly that travel decisions have not shifted strongly since 2013. However, both CHTS data and intercept survey data indicate that there may be some systemic under-reporting of walking trips in the travel decision surveys, and that San Francisco residents and visitors make a higher share of their trips by walking than is indicated in the Travel Decision Survey results.

3.1.4.1 Census Data

In addition to the sources referred to inline above, mode share data for commute trips only is presented by the American Community Survey, a project of the U.S. Census Bureau. These data, shown in **Table 9,** indicate that mode share has been largely stable for San Francisco residents on their way to work. The figures presented are five year averages, and may mute year-to-year differences, but do show a slight decrease in private auto mode share similar to the trend indicated by survey data.

Table 9: Mode Share Data from Additional Sources

Mode	2011[1]	2012[2]	2013[3]	2014[4]	2015[5]	2012	2013
	American Community Survey – Journey to Work (Age 16+)					California Household Travel Survey[6]	Travel Decision Survey Mode Share
Drive Alone	38%	37%	37%	36%	36%	18%	26%
Carpool	8%	8%	8%	8%	7%	24%	22%
Transit	33%	32%	33%	33%	33%	15%	24%
Walk	10%	10%	10%	10%	10%	38%	22%
Bicycle	3%	3%	4%	4%	4%	3%	5%
Work at Home	7%	7%	7%	7%	7%	-	-
Other	2%	2%	2%	2%	2%	1%	1%

1. American Community Survey 5-year, 2007-2011, Table S0801, San Francisco residents
2. American Community Survey 5-year, 2008-2012, Table S0801, San Francisco residents
3. American Community Survey 5-year, 2009-2013, Table S0801, San Francisco residents
4. American Community Survey 5-year, 2010-2014, Table S0801, San Francisco residents
5. American Community Survey 5-year, 2011-2015, Table S0801, San Francisco residents
6. California Household Travel Survey 2012, trips starting and ending in San Francisco

3.1.4.2 California Household Travel Survey Data

Also shown in **Table 9** are static data from the CHTS, last collected in 2012. The CHTS is a large scale survey asking residents to keep a detailed travel diary of all their trip-making activity over the survey period. It indicates that in 2012, 42 percent of trips starting or ending in San Francisco were made in a private automobile; this rate is largely similar to the mode share of survey respondents.

However, there are several key differences in the mode share data from the 2012 CHTS and the 2013 TDS. First, CHTS data show carpool rates substantially higher than drive alone rates, while survey results indicate a higher drive alone rate. This may reflect the shorter sample period of the TDS effort, or it may reflect that CHTS captures a larger number of recreational trips, trips made with children, or non-work trips, all of which are more likely to involve multiple occupants per vehicle. Second, CHTS data show substantially more walking trips and fewer transit trips than TDS data. This may indicate that the travel decision surveys exhibit a common reporting bias among

such surveys, where short walking trips are under-reported,[11] a hypothesis further validated by recent intercept surveys in San Francisco.

3.1.4.3 Intercept Surveys

The San Francisco Planning Department conducted intercept travel surveys at retail and residential land uses throughout San Francisco in Summer 2014, Summer 2015, and Fall 2016. This data collection effort, intended to help inform an update of the City's travel demand management guidelines for use in its development review process, resulted in site-specific mode share data for dozens of sites throughout the City. These intercept surveys differ in methodology in a few key ways from the telephone surveys conducted for the Travel Decision Survey:

- Surveys were focused on residential and retail sites only.
- Sites were selected to be representative of future development, and as such tended to be newer construction.
- Surveyors interviewed people who were entering / exiting the building, leading to an increased percentage of walking trips, which may be easily forgotten during a telephone travel diary interview.
- Surveys were conducted during the AM and PM peak periods only (7:00AM – 10:00AM and 3:30PM – 7:00PM).
- Information was only collected about the trip to the location being surveyed, and no data regarding trip chaining or a travel tour was collected (i.e., if an individual stopped at a site on their way elsewhere, the trip was still counted as a single person trip).

Table 10 compares the findings from the Travel Decision Survey to the results from intercept surveys at 15 residential sites and 22 retail sites throughout San Francisco. Retail sites were predominantly drugstores and grocery stores, while residential sites were a mix of rental and condominium properties built between 2000 and 2014. The primary differences in the results for the two surveys occur with carpool trips, walking trips, and transit trips. The intercept surveys tend to have a much higher share of walking trips than the telephone surveys, which may be due to several factors. First, the retail sites selected for intercept surveys tended to have a high volume of foot traffic, and may have a higher share of trips occurring as part of a trip chain. Second, sites in inner San Francisco neighborhoods are over-represented in the intercept survey sample, indicating that we would expect travel patterns to reflect the dominant mode choices in those zones, which

[11] McGuckin, N. (2012). Walking and Biking in California: Analysis of the CA-NHTS (No. UCD-ITS-RR-12-13).

have a lower rate of private auto use. In the case of the residential sites, the number of recreational walk trips (i.e., jogging or walking for health or enjoyment, or walking with a dog) may also have inflated the total share of walk trips as well.

However, as discussed above, the telephone surveys used in the Travel Decision Survey may tend to neglect short walk trips made within the neighborhood, while the intercept methodology tallies such trips as they occur. Given the similarity in walking mode share between the intercept surveys and the 2012 CHTS survey data, there may be an inherent bias in the Travel Decision Survey data causing walking trips to be underreported. If so, CHTS data and intercept survey data indicate that there may also be a corresponding decrease in transit trip mode share and, potentially, private auto mode share.

Table 10: Comparison of Intercept Survey and Travel Decision Survey Results

	Intercept Survey Mode Share	Telephone Survey Mode Share	Intercept Survey Mode Share	Telephone Survey Mode Share
Mode	**Residential Land Use[1]**		**Retail Land Use[2]**	
Drive Alone	20%	28%	27%	27%
Drive with Others	16%	18%	11%	21%
Walk	40%	21%	37%	28%
Taxi/TNC	4%	4%	<1%	2%
Bike	4%	3%	4%	1%
Transit	16%	25%	18%	20%
Bus	*4%*	-	*9%*	-
Light Rail	*7%*	-	*3%*	-
BART	*3%*	-	*5%*	-
Private Shuttle	*5%*	-	*0%*	-

1. Telephone survey mode share for residential land use is taken from trips with "Trip Purpose = Home"
2. Telephone survey mode share for retail land use is taken from trips with "Trip Purpose = Shopping/Errands"

Individual modes do not sum to total due to rounding.

Source: Corey, Canapary & Galanis Research, 2017; Fehr & Peers, 2017

3.2 MODE BY GEOGRAPHY

Travel patterns differ widely based on the types of neighborhoods in which individuals live, work, and visit. **Inset Figure 6** shows the residential zones, based on zip codes, used for analysis of trends by home location. Zones were developed to group neighborhoods with similar travel patterns;

however, each zone differs in terms of total population and number of households, with Zone 2 having the most households and the largest population.

In addition to these zones, we have also categorized trips by non-San Francisco residents as being associated with the North Bay (Marin, Sonoma, Solano, and Napa Counties), East Bay (Alameda and Contra Costa Counties) and the South Bay (Santa Clara and San Mateo Counties).

Table 11 and **Inset Figure 6** show a summary of the average mode share for each residential zone / region over the past five years (2013 – 2017). When examining mode share by location, five-year averages achieve a much lower margin of error than data from a single year.

Individuals living in San Francisco Zones 1 and 2, corresponding to the densest areas with the highest levels of transit service, have the lowest levels of private auto use. However, they also show the highest levels of use of TNCs, carshare, and taxi services. Individuals coming from the East Bay are less likely to travel in personal vehicles than even individuals in some San Francisco neighborhoods (Zones 3, 4, and 5); this likely reflects the presence of high-frequency transit service from the East Bay to key San Francisco locations.

Inset Figure 6: Map of San Francisco Residential Zones

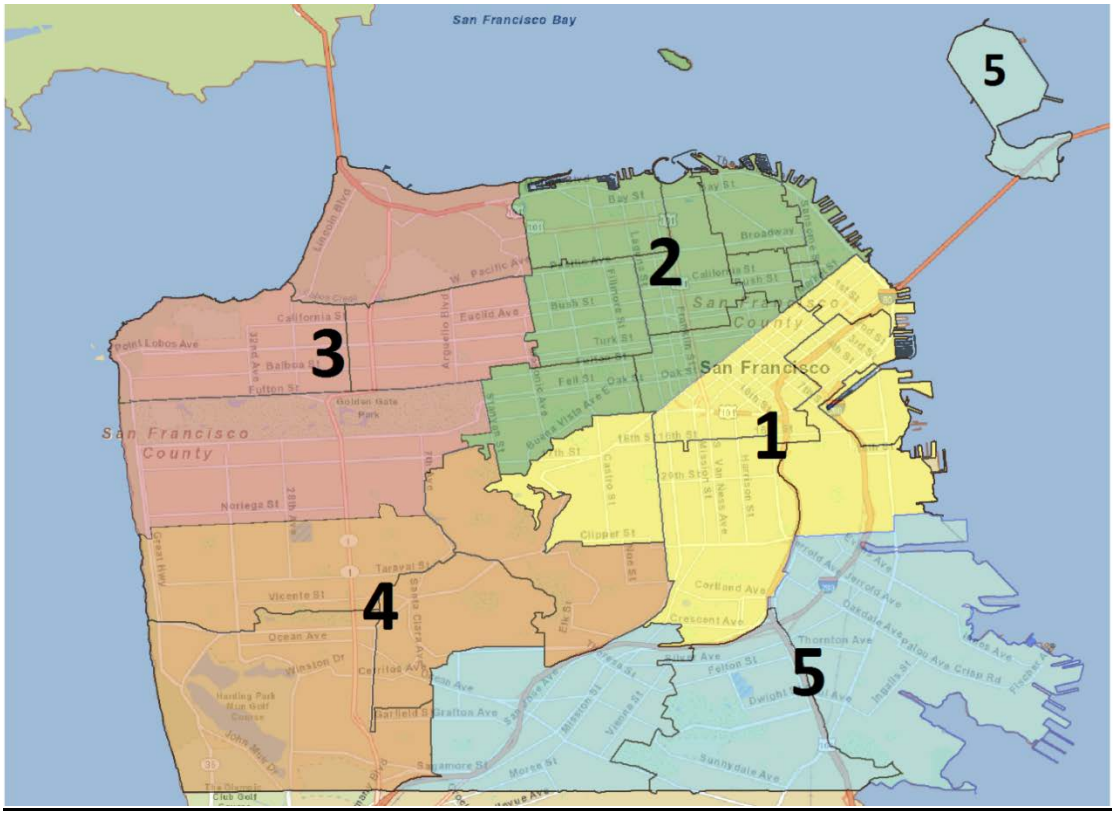


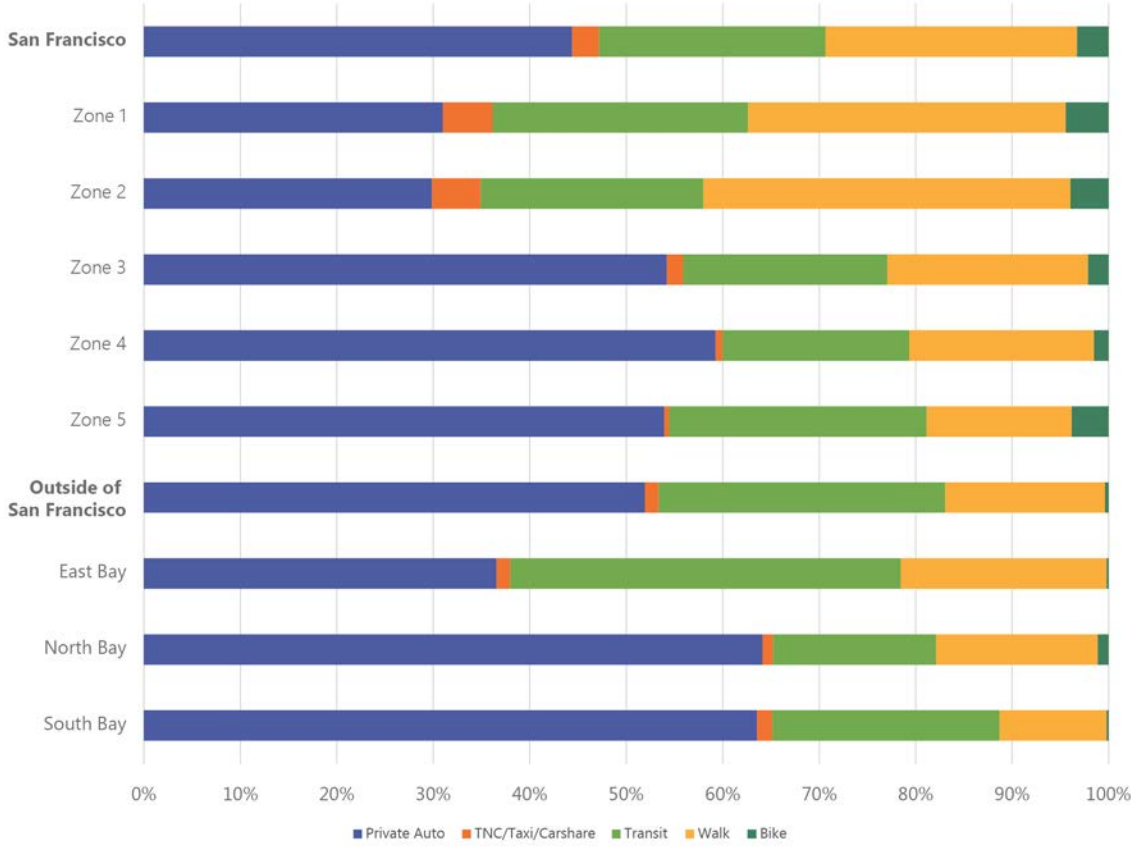
Table 11: Mode Share by Residential Location, Five Year Averages (2013 - 2017)

Place of Residence	Private Auto	TNC/ Taxi/ Carshare	Transit	Walk	Bike	Other
San Francisco	**44%**	**3%**	**23%**	**26%**	**3%**	**1%**
Zone 1	31%	5%	26%	33%	4%	1%
Zone 2	30%	5%	23%	38%	4%	1%
Zone 3	54%	2%	21%	21%	2%	1%
Zone 4	59%	1%	19%	19%	2%	<1%
Zone 5	54%	1%	27%	15%	4%	<1%
Outside of San Francisco	**52%**	**1%**	**30%**	**17%**	**<1%**	**<1%**
East Bay	37%	1%	40%	21%	<1%	<1%
North Bay	64%	1%	17%	17%	1%	<1%
South Bay	64%	2%	24%	11%	<1%	<1%

Shaded cells indicate mode share above 50% goal
Source: Corey, Canapary & Galanis Research, 2017; Fehr & Peers, 2017

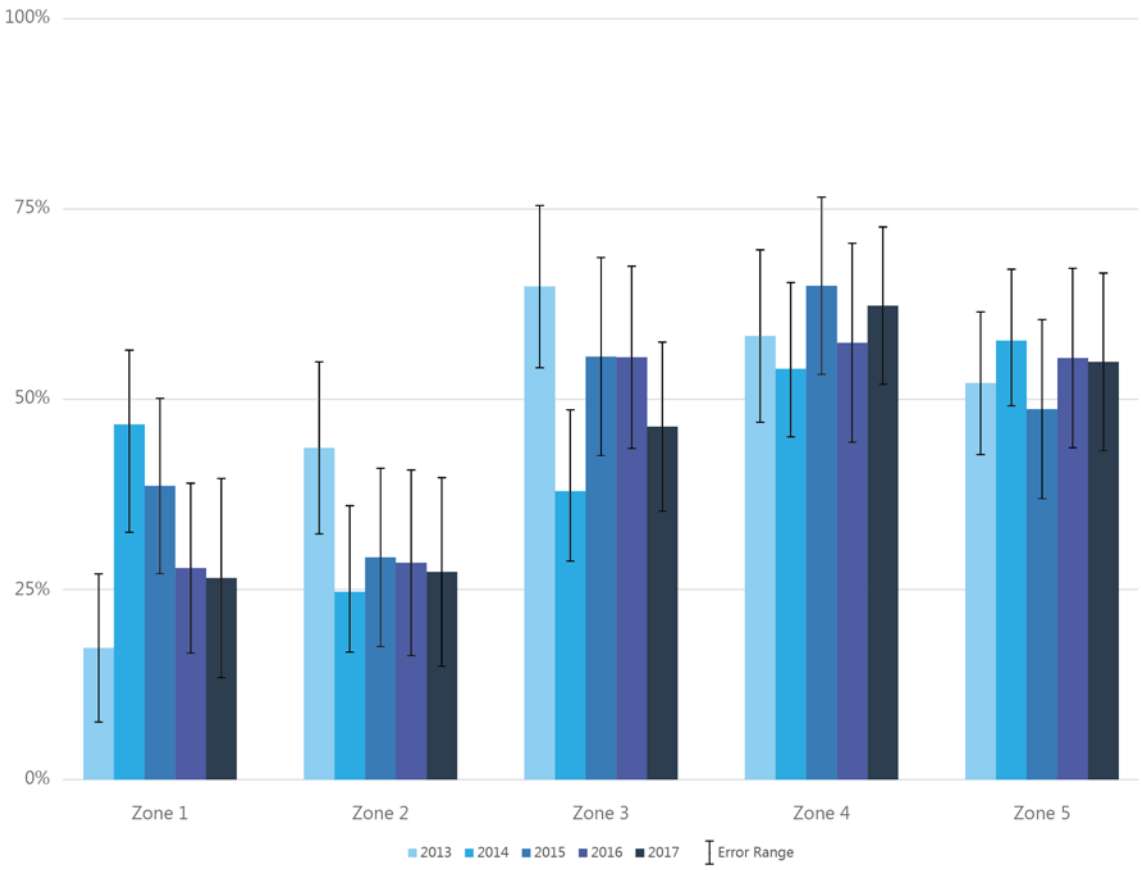
San Francisco Zones 3, 4, and 5 are all slightly above the target level for private vehicle mode share. They also tend to have significantly fewer walking trips than other neighborhoods in San Francisco, possibly due to several factors, including less dense development patterns, the balance of jobs and housing, and the mix of nearby land uses. The highest levels of private auto use for trips within San Francisco occur among North Bay and South Bay residents, with nearly two thirds of their trips to, from, and within San Francisco occurring in private vehicles.

Inset Figure 7: Mode Share by Residential Location, 2013 - 2017 Average



Tracking change over time among different residential locations presents some difficulty due to the small sample sizes, which tend to result in wide margins of error. A look at year-over-year trends by residential location reveals that most shifts have been within a margin of error, as shown in **Inset Figure 8**. The grey markers on each bar represent the margin of error for each year, with a confidence level of 95 percent; while levels of private vehicle use may seem to shift substantially, most of these shifts are in fact within a margin of error for each place type.

Inset Figure 8: Private Vehicle Mode Share of San Francisco Residents by Zone over Time



3.3 TRAVEL MODE BY INCOME AND AUTO ACCESS

Individuals living in lower income households tend to make fewer trips by private auto due to multiple factors. **Inset Figure 9** shows that among San Francisco residents, lower income households have consistently had a lower rate of private auto use than higher income households, with households making incomes over $76,000 having a significantly higher private auto mode share than households making $35,000 or less. This trend does not hold true for non-San Francisco residents, however. **Table 12** shows information in tabular format by year, as well as the average rate and rates for non-San Francisco residents.

Inset Figure 9: Private Auto Mode Share by Income, San Francisco Residents, 2013 – 2017 Average

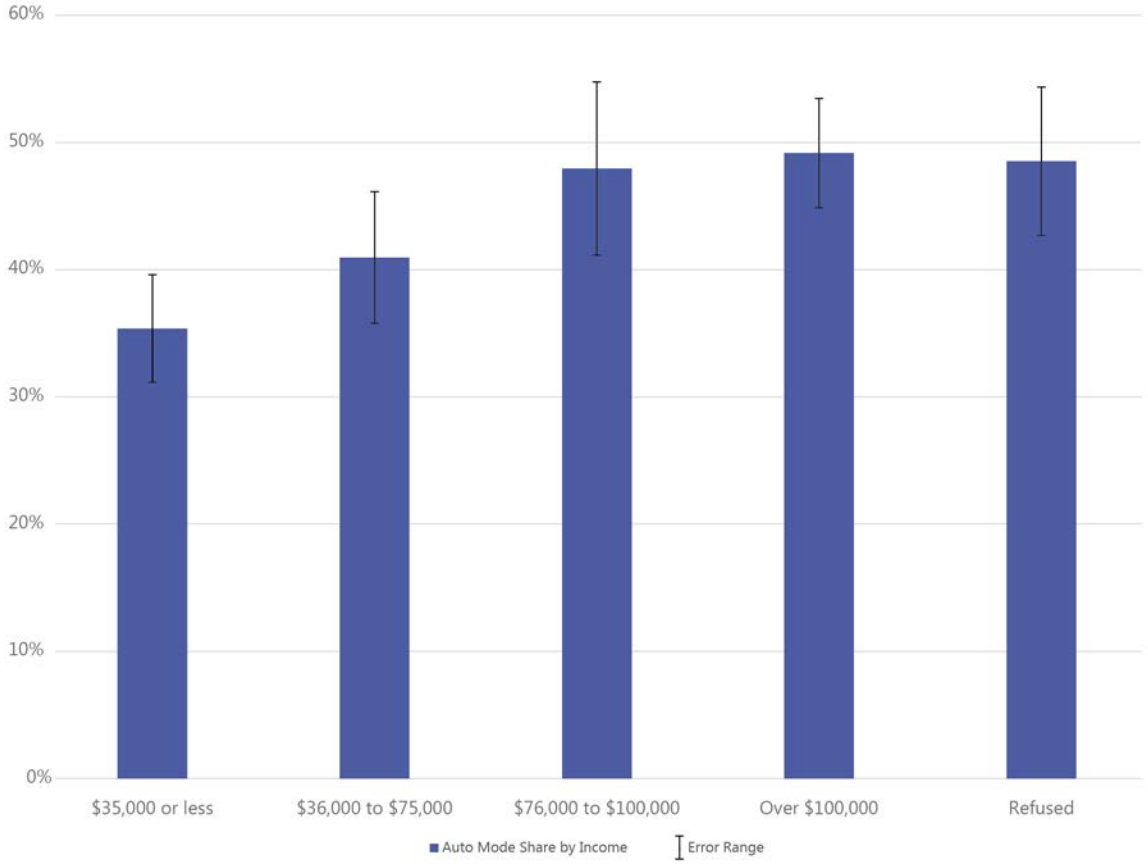


Table 12: Private Auto Mode Share by Income

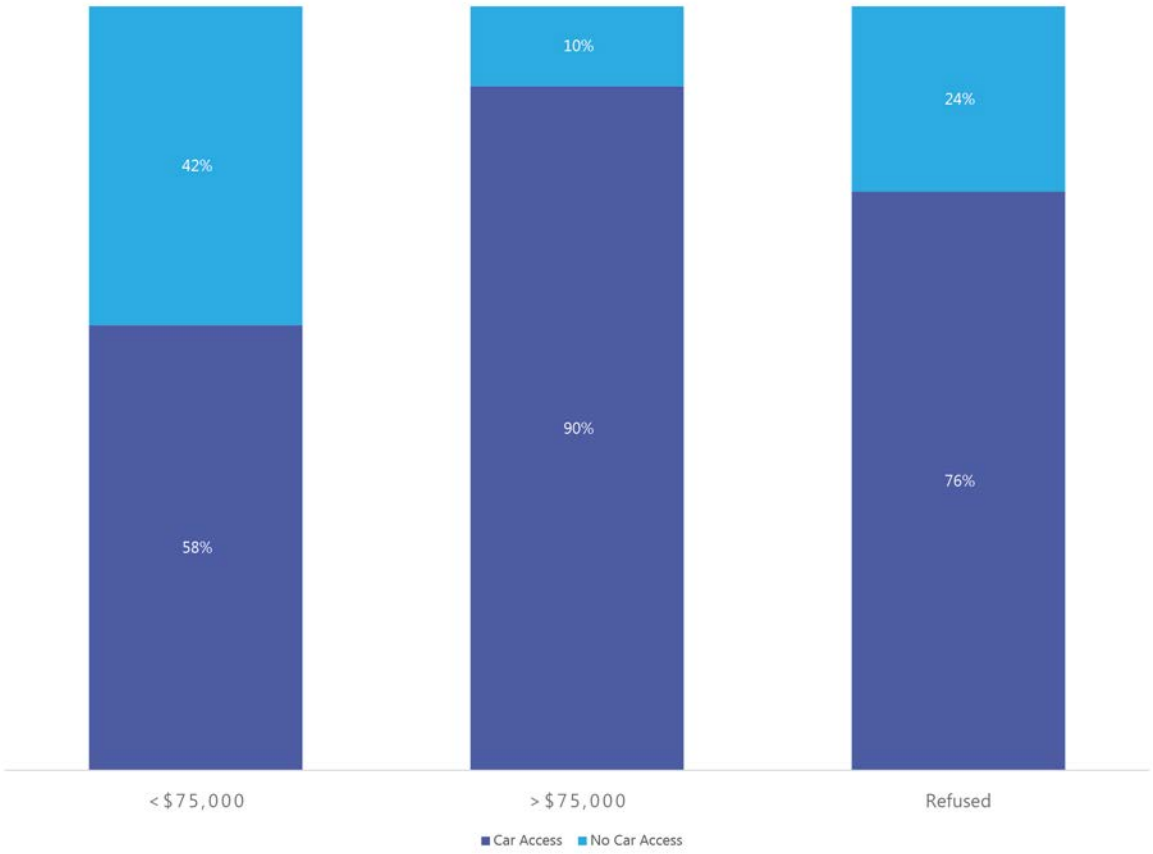
Income	Average	2013	2014	2015	2016	2017
San Francisco Residents						
$75,000 or Less	38%	42%	36%	40%	37%	32%
More than $75,000	49%	55%	44%	49%	48%	48%
Total	**44%**	**48%**	**42%**	**45%**	**44%**	**41%**
Living Outside of San Francisco						
$75,000 or Less	53%	53%	61%	50%	55%	45%
More than $75,000	52%	48%	57%	61%	45%	49%
Total	**52%**	**51%**	**56%**	**57%**	**49%**	**48%**
All Trips						
$75,000 or Less	42%	45%	42%	42%	41%	35%
More than $75,000	49%	54%	47%	52%	47%	48%
Total	**46%**	**48%**	**45%**	**48%**	**45%**	**43%**

Shaded cells indicate populations with private auto mode share above the 50% goal.
Source: Corey, Canapary & Galanis Research, 2017; Fehr & Peers, 2017

One of the factors contributing to lower auto mode share among lower income individuals is auto access: in general, lower income households are less likely to own a car, or may have fewer cars than a household of similar size with higher income.[12] **Inset Figure 10** shows that San Francisco households with less than $75,000 in household income are four times as likely as higher income households to have no vehicle available.[13] Furthermore, as shown in **Table 13**, respondents with vehicle access made more than half of trips by private automobile, while respondents without vehicle access, a much smaller share of the sample, made only six percent of trips by private automobile.

[12] This survey collected vehicle availability using the following question: Do you own a car or have regular access to a car through family or friends? As such, this is not a direct representation of vehicle ownership rates.
[13] Median household income in San Francisco in 2015 (the most recent available data) was $92,094 (American Community Survey Table S1903, 1-Year Estimates), with approximately 43 percent of households earning less than $75,000 (American Community Survey Table S1901, 1-Year Estimates).

Inset Figure 10: Car Access by Household Income, San Francisco Residents, 2017



As shown in **Table 13**, individuals without car access (who represent around 26 percent of the survey sample in San Francisco, and only around 5 percent of the survey sample among non-San Francisco residents) make substantially different travel decisions from those with car access. Most notably, they are around three times likelier to make a trip by transit than individuals who have car access, and among San Francisco residents, they are around twice as likely to make a trip by TNC, taxi, or carshare. Car access also has a higher relationship to private auto mode share in outlying neighborhoods of San Francisco, such as Zones 3, 4, and 5, as well as for residents of the North Bay and South Bay. This may reflect the more auto-oriented built environment in those areas, as well as the level of available transit service.

Table 13: Mode Share by Vehicle Availability (2015-2017)

Residence	n	Private Auto	TNC/ Taxi/ Carshare	Transit	Walk	Bike	Other
Access to a Car							
Living in San Francisco	**792**	**54%**	**3%**	**16%**	**24%**	**2%**	**1%**
Zone 1	149	42%	3%	20%	30%	3%	2%
Zone 2	184	41%	5%	16%	34%	2%	1%
Zone 3	148	59%	3%	13%	20%	2%	2%
Zone 4	145	68%	1%	12%	17%	2%	0%
Zone 5	166	65%	1%	17%	16%	0%	1%
Living Outside San Francisco	**1086**	**54%**	**2%**	**25%**	**17%**	**0%**	**1%**
East Bay	445	39%	2%	37%	21%	0%	1%
North Bay	229	64%	1%	14%	18%	1%	1%
South Bay	412	66%	2%	18%	13%	0%	1%
Total	**1878**	**54%**	**2%**	**22%**	**20%**	**1%**	**1%**
No Access to a Car							
Living in San Francisco	**283**	**7%**	**6%**	**46%**	**35%**	**3%**	**2%**
Zone 1	62	5%	9%	41%	37%	6%	2%
Zone 2	99	2%	7%	37%	46%	4%	4%
Zone 3	39	16%	4%	48%	27%	4%	2%
Zone 4	25	19%	0%	54%	27%	0%	0%
Zone 5	58	11%	1%	68%	21%	0%	0%
Living Outside San Francisco	**64**	**9%**	**1%**	**79%**	**9%**	**0%**	**1%**
East Bay	34	6%	0%	74%	13%	0%	7%
North Bay	7	54%	0%	31%	9%	6%	0%
South Bay	23	8%	5%	86%	1%	0%	0%
Total	**347**	**8%**	**5%**	**55%**	**28%**	**3%**	**2%**

Source: Corey, Canapary & Galanis Research, 2017; Fehr & Peers, 2017

3.4 INTERACTIONS BETWEEN MODES SHARE, INCOME, AND RESIDENTIAL LOCATION

As discussed above, multiple individual factors contribute to varying levels of auto use across the City. Geographically, individuals living in outlying neighborhoods (in Zones 3, 4, and 5) tended to

make more auto trips. Economically, individuals in households making less than $35,000 a year made a lower share of trips by car. In addition, households making less than $75,000 in income are less likely to have access to a car than households making more than that amount across the city. These demographic and geographic traits interact in complicated ways; with varying distributions of household types and travel patterns across San Francisco. For instance, as shown in **Table 14** and **Table 15**, the areas of San Francisco with the lowest total private auto mode share and the lowest rates of car ownership also have above average shares of higher income households. Similarly, Zone 5 has a rate of car access similar to more central neighborhoods, but still has a private auto mode share above the City's average.

Table 16 summarizes the five year average for private auto mode share by income and residential location. As a whole, San Francisco's private auto mode share is below the 50 percent goal. However, several locations and income groups exceed this threshold. All income groups in Zone 1 and Zone 2 complete less than half their trips by private automobile, while almost every income group within Zones 3, 4, and 5 does not meet the private auto mode share goal (with the exception of those with a household income of less than $35,000 in Zones 4 and 5 and income from $36,000 to $75,000 in Zone 3).

For non-San Francisco residents, the private auto mode share is 53 percent. However, mode share is not consistent across the East, North, and South Bays. The East Bay private auto mode share is less than the 50 percent goal for all income groups, while the North and South Bay exceed 50 percent for all income groups. Again, this imbalance likely results from the presence of high-frequency transit service from the East Bay to key San Francisco locations.

Generally, **Table 16** suggests that residential location may matter more than income in determining a household's level of private auto use. Many factors contribute to the increased auto use of households living in some zones or Bay Area counties; these may include land use characteristics such as walkability or transit access, as well as demographic characteristics such as family size. Notably, the largest difference in travel behavior between lower income and higher income households is in the areas with the lowest private vehicle use; in Zone 1 and Zone 2 of San Francisco, the highest income households are twice as likely to make trips by private automobile compared to the lowest income households. This may reflect the increased cost of owning and parking a vehicle in these areas, which may lead only higher income households to own a private automobile. Conversely, in outlying neighborhoods, lower income groups still rely on private auto use, even though their average auto mode share is below that of higher income individuals in similar

neighborhoods. In these areas, access to a car may be seen as more of a necessity for mobility, even if the cost of maintaining a vehicle represents a more substantial economic burden.

Table 14: Income by Residential Location (2013-2017)

Residential Location	< $35,000	$36,000 - $75,000	$76,000 - $100,000	>$100,000	Refused
San Francisco Total	**27%**	**19%**	**11%**	**29%**	**14%**
SF Zone 1	26%	16%	11%	33%	13%
SF Zone 2	24%	19%	9%	34%	15%
SF Zone 3	25%	19%	13%	28%	15%
SF Zone 4	23%	16%	14%	33%	14%
SF Zone 5	37%	26%	10%	13%	14%
Outside of San Francisco	**13%**	**18%**	**14%**	**37%**	**18%**
East Bay	15%	21%	13%	35%	17%
North Bay	12%	19%	14%	40%	15%
South Bay	11%	15%	16%	38%	20%

'Refused' indicates refusal to answer income question.
Source: Corey, Canapary & Galanis Research, 2017; Fehr & Peers, 2017

Table 15: Car Access by Place of Residence, 2015 - 2017

Residential Location	Car Access	No Car Access
Living in San Francisco	**74%**	**26%**
Zone 1	71%	29%
Zone 2	65%	35%
Zone 3	79%	21%
Zone 4	85%	15%
Zone 5	74%	26%
Living Outside San Francisco	**94%**	**6%**
East Bay	93%	7%
North Bay	97%	3%
South Bay	95%	5%
Total	**80%**	**20%**

Source: Corey, Canapary & Galanis Research, 2017; Fehr & Peers, 2017

Table 16: Five Year Average for Private Auto Mode Share, by Income and Residential Location (2013-2017)

Residential Location	$35,000 or less	$36,000 - $75,000	$76,000 - $100,000	Over $100,000	Total
San Francisco	**35%**	**41%**	**48%**	**49%**	**47%**
Zone 1	19%	33%	34%	38%	**31%**
Zone 2	15%	18%	30%	40%	**30%**
Zone 3	52%	40%	58%	60%	**54%**
Zone 4	46%	53%	62%	65%	**59%**
Zone 5	47%	58%	59%	54%	**54%**
Outside of San Francisco	**55%**	**52%**	**55%**	**51%**	**52%**
East Bay	35%	44%	40%	33%	**37%**
North Bay	77%	69%	79%	56%	**64%**
South Bay	68%	56%	61%	69%	**64%**

Shaded cells indicate populations with private auto mode share above the 50% goal.
Source: Corey, Canapary & Galanis Research, 2017; Fehr & Peers, 2017

Ultimately, income, geography, and land use decisions influence travel in complicated ways that cannot be fully accounted for through a telephone survey. However, all else being equal, the following findings remain:

- Lower income households are less likely to own vehicles, and less likely to use private vehicles to travel.
- Individuals living in central San Francisco neighborhoods with high quality transit and walkable destinations nearby are less likely to own vehicles, and less likely to use private vehicles to travel.
- Higher income residents of dense, central neighborhoods are still substantially more likely to use private vehicles than their lower income neighbors, while lower income residents of outlying neighborhoods are more likely to use private vehicles than individuals with similar incomes living in denser areas.
- Private auto mode share seems to vary more between residential locations than between income groups.
- Access to a vehicle (either through car ownership or through friends and family) is the strongest indicator of auto mode share in general, although the choice to own a vehicle is also tied to residential location and other travel options.

3.5 SECOND MODE CHOICE

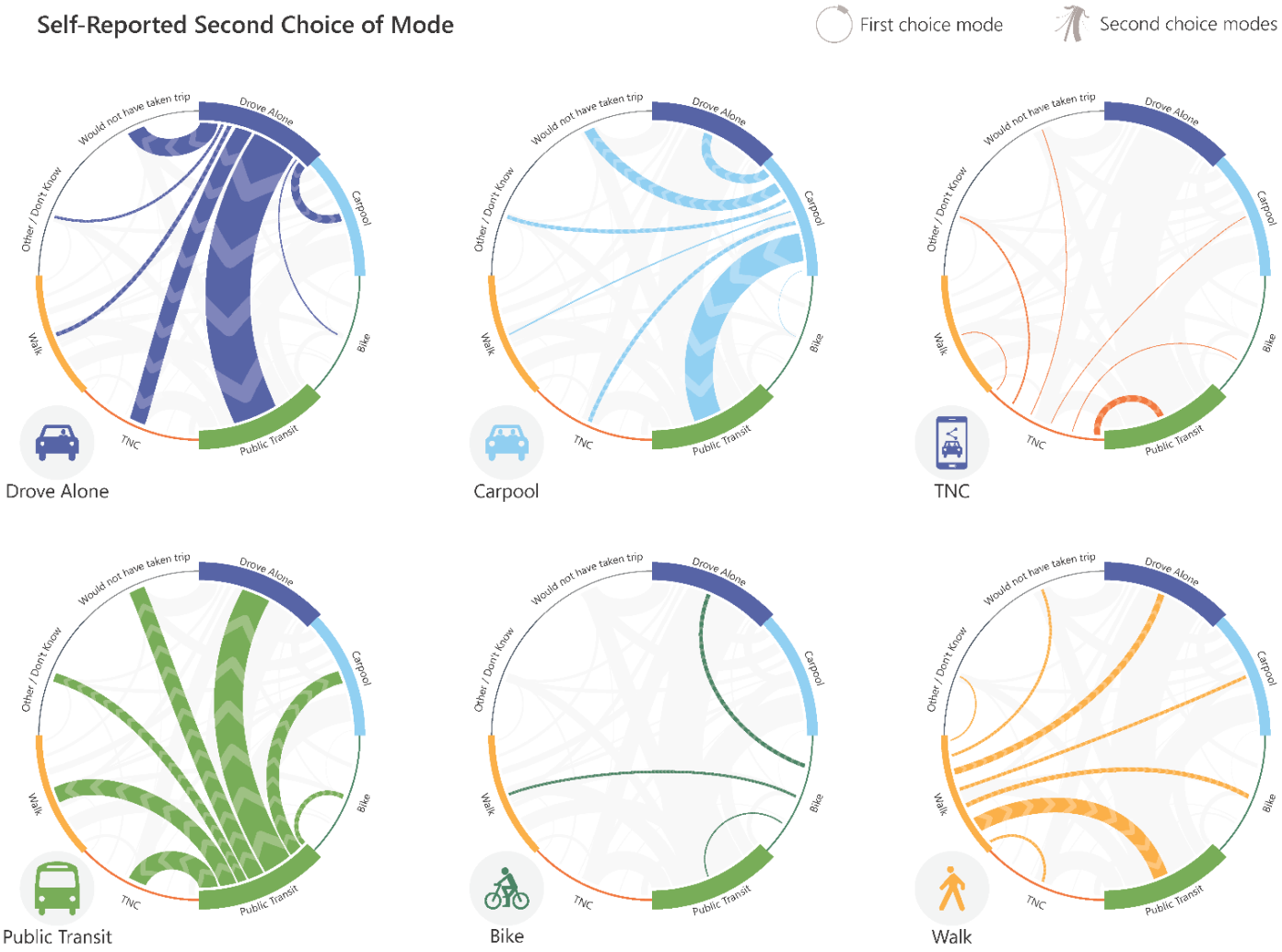
Survey respondents were asked what transportation mode they would have taken had their primary mode for the first trip of their day been unavailable. **Table 17** shows a summary of second mode choice by private auto / non-private auto modes, and generally indicates that around 43 percent of non-private auto trips would be made by private auto if the primary mode were unavailable.

Table 18 provides further detail for modes with adequate numbers of responses, for San Francisco residents only from 2014 to 2017; **Figure 1** illustrates these findings graphically. **Table 19** and **Table 20** provide information about second choice mode for respondents residing outside San Francisco and an aggregated dataset including both San Francisco and other Bay Area respondents from 2014 to 2017. Each table includes first choice modes of drive alone, transit, walk, and other modes, with the exception of **Table 19**, where walking is excluded. This question referred specifically to respondent's first trip. For those living outside of San Francisco, this trip is travel into the city, which cannot currently be made by walking from the East Bay or North Bay.

For both San Francisco residents and non-San Francisco residents, the most common second choice for all non-transit trips in San Francisco is to make the trip by transit. Transit comprised 30 percent of second choice modes for San Francisco residents and 36 percent of second choice modes for those living elsewhere in the Bay Area. When respondents' first choice mode is transit, respondents living outside of San Francisco are more likely to switch to driving than those within San Francisco (42 percent and 20 percent, respectively).

Over the past four years, for San Francisco residents, 11 percent of drivers and 11 percent of transit users view TNC service as a key transportation option, should their primary option not be available. These numbers have shifted over time; in 2017, 20 percent of drivers and 21 percent of transit users identified TNCs as their second choice mode. This may reflect a growing perception of TNC service as a valid complement to transit service (i.e., by providing a faster but costlier option for certain trips, or providing connections to transit) or a potential substitute for use of a private vehicle (thereby supporting households in choosing to own fewer cars, or by eliminating a need to find parking).

Figure 1: Second Choice of Mode by First Choice of Mode



These findings indicate that there is a fairly strong array of transportation options in San Francisco, with about 15 to 25 percent of individuals stating they would not have made the trip if their mode of choice were unavailable. Those living outside of San Francisco were more likely to not make a trip if their first choice mode was unavailable than San Francisco residents. In addition, people who make carpool trips are more likely to indicate that the trip would not have happened if their auto mode had been unavailable, while people who walk or bicycle for their preferred mode generally have other transportation options available. This may reflect that carpool trips are more likely to be made by families, who may be less willing to use public transit for a variety of reasons, that individuals receiving rides from others are less likely to accept other transportation options, or that carpool trips are more likely to be non-essential trips (such as those for recreation, shopping, or eating out, as discussed in Section 3.7).

Table 17: Second Choice Mode by Primary Mode (2017) - All Trips

Initial Mode	Second Choice: Private Auto	Second Choice: Non-Private Auto	Second Choice: Would not have taken trip	Second Choice: Don't know/ Don't remember
Private Auto	12%	67%	19%	2%
Non Private Auto	43%	42%	14%	1%

Shaded cells indicate most popular second choice of mode
Source: Corey, Canapary & Galanis Research, 2017; Fehr & Peers, 2017

Table 18: Second Choice Mode by Primary Mode (2014-2017) – San Francisco Residents

Year	N	Drove Alone	Carpool	TNC	Taxi	Transit	Shuttle	Bicycle	Walk	Other	No Trip
Drive Alone											
2017	114	-	7%	20%	2%	44%	-	2%	5%	2%	18%
2016	114	-	8%	14%	2%	44%	2%	-	8%	5%	18%
2015	99	2%	18%	5%	4%	46%	-	3%	10%	3%	9%
2014	97	4%	15%	2%	3%	47%	2%	2%	7%	3%	15%
Total	**424**	**1%**	**12%**	**11%**	**3%**	**45%**	**1%**	**2%**	**7%**	**3%**	**15%**
Carpool											
2017	51	14%	-	6%	6%	46%	2%	-	4%	2%	20%
2016	60	20%	-	12%	4%	41%	-	-	4%	2%	18%
2015	78	12%	1%	5%	6%	32%	1%	4%	10%	4%	24%
2014	41	6%	6%	6%	9%	35%	-	6%	3%	-	29%
Total	**230**	**13%**	**1%**	**7%**	**6%**	**38%**	**1%**	**2%**	**6%**	**2%**	**23%**
Transit											
2017	134	23%	7%	21%	9%	-	-	6%	20%	1%	14%
2016	109	16%	18%	10%	5%	1%	2%	7%	26%	1%	14%
2015	118	16%	19%	8%	5%	3%	-	3%	23%	3%	19%
2014	107	26%	15%	1%	19%	4%	2%	6%	14%	3%	11%
Total	**468**	**20%**	**15%**	**11%**	**9%**	**2%**	**1%**	**5%**	**21%**	**2%**	**15%**

Table 18, Continued: Second Choice Mode by Primary Mode (2014-2017) – San Francisco Residents

Year	N	Drove Alone	Carpool	TNC	Taxi	Transit	Shuttle	Bicycle	Walk	Other	No Trip
Walk											
2017	63	16%	9%	7%	2%	43%	-	13%	-	4%	7%
2016	75	15%	12%	3%	3%	39%	-	4%	-	3%	21%
2015	51	13%	2%	12%	2%	48%	-	8%	-	2%	13%
2014	66	11%	6%	-	3%	42%	-	8%	6%	3%	-
Total	**255**	**14%**	**8%**	**5%**	**3%**	**43%**	**0%**	**8%**	**2%**	**3%**	**11%**
Total											
2017	362	13%	6%	15%	5%	30%	-	5%	10%	2%	14%
2016	358	12%	10%	9%	5%	29%	1%	3%	12%	3%	16%
2015	346	10%	12%	7%	4%	30%	1%	4%	13%	3%	15%
2014	311	13%	12%	-	9%	30%	-	5%	9%	-	17%
Total	**1377**	**12%**	**10%**	**8%**	**6%**	**30%**	**0%**	**4%**	**11%**	**2%**	**15%**

Shaded cells indicate most popular second choice of mode. Only modes with more than 50 responses for second mode choice are included.

Source: Corey, Canapary & Galanis Research, 2017; Fehr & Peers, 2017

Table 19: Second Choice Mode by Primary Mode (2014-2017) – Non-San Francisco Residents

Year	N	Drove Alone	Carpool	TNC	Taxi	Transit	Shuttle	Bicycle	Walk	Other	No Trip
Drive Alone											
2017	136	-	10%	10%	-	53%	-	-	1%	4%	21%
2016	111	1%	14%	3%	1%	67%	-	-	-	1%	14%
2015	116	1%	12%	3%	-	62%	-	-	1%	1%	21%
2014	120	4%	18%	1%	2%	45%	-	1%	-	2%	29%
Total	**483**	**1%**	**13%**	**4%**	**1%**	**56%**	**0%**	**0%**	**0%**	**2%**	**22%**
Carpool											
2017	126	18%	-	8%	-	55%	1%	1%	-	2%	16%
2016	138	16%	-	1%	-	65%	-	1%	-	2%	14%
2015	144	6%	-	2%	1%	69%	-	1%	-	-	21%
2014	110	11%	7%	-	4%	51%	1%	-	-	3%	23%
Total	**518**	**12%**	**2%**	**3%**	**1%**	**61%**	**0%**	**1%**	**0%**	**2%**	**19%**
Transit											
2017	127	43%	27%	5%	1%	-	1%	-	1%	3%	19%
2016	122	45%	32%	2%	1%	-	-	1%	2%	4%	12%
2015	116	43%	31%	-	3%	-	2%	-	1%	-	21%
2014	119	39%	35%	-	1%	3%	-	-	2%	2%	18%
Total	**484**	**42%**	**31%**	**2%**	**1%**	**1%**	**1%**	**0%**	**1%**	**2%**	**18%**
Total											
2017	389	20%	13%	7%	-	36%	1%	-	-	3%	19%
2016	371	17%	13%	3%	1%	37%	1%	2%	3%	7%	13%
2015	376	13%	11%	2%	2%	38%	2%	2%	2%	3%	22%
2014	349	18%	20%	-	2%	33%	1%	1%	1%	2%	24%
Total	**1485**	**17%**	**14%**	**3%**	**1%**	**36%**	**1%**	**1%**	**1%**	**4%**	**19%**

Shaded cells indicate most popular second choice of mode. Only modes with more than 50 responses for second mode choice are included. Due to aggregating of modes, some rows may have responses listing second choice as same as first choice.

Source: Corey, Canapary & Galanis Research, 2017; Fehr & Peers, 2017

Table 20: Second Choice Mode by Primary Mode (2014-2017) – Total

Year	N	Drove Alone	Carpool	TNC	Taxi	Transit	Shuttle	Bicycle	Walk	Other	No Trip
Drive Alone											
2017	250	-	8%	18%	1%	47%	-	1%	4%	2%	19%
2016	225	-	10%	11%	2%	49%	1%	-	6%	4%	17%
2015	215	2%	17%	4%	3%	50%	-	2%	8%	3%	11%
2014	217	4%	16%	2%	3%	46%	2%	2%	5%	3%	18%
Total	**907**	**1%**	**12%**	**9%**	**2%**	**48%**	**1%**	**1%**	**6%**	**3%**	**16%**
Carpool											
2017	177	15%	-	6%	5%	48%	2%	-	3%	2%	19%
2016	198	19%	-	9%	3%	47%	-	-	3%	2%	17%
2015	222	10%	1%	4%	5%	41%	1%	3%	8%	3%	23%
2014	151	7%	6%	4%	8%	39%	-	4%	2%	1%	28%
Total	**748**	**13%**	**2%**	**6%**	**5%**	**44%**	**1%**	**2%**	**4%**	**2%**	**22%**
Transit											
2017	261	28%	12%	17%	7%	-	-	4%	15%	1%	15%
2016	231	23%	21%	8%	4%	1%	1%	6%	20%	2%	13%
2015	234	22%	22%	6%	4%	2%	-	3%	17%	3%	19%
2014	226	29%	20%	1%	14%	4%	1%	5%	11%	2%	13%
Total	**952**	**26%**	**19%**	**8%**	**7%**	**2%**	**1%**	**4%**	**16%**	**2%**	**15%**

Table 20, continued: Second Choice Mode by Primary Mode (2014-2017) – Total

Year	N	Drove Alone	Carpool	TNC	Taxi	Transit	Shuttle	Bicycle	Walk	Other	No Trip
Walk											
2017	63	16%	9%	7%	2%	43%	-	13%	-	4%	7%
2016	75	15%	12%	3%	3%	39%	-	4%	-	3%	21%
2015	52	10%	25%	9%	1%	37%	-	6%	-	1%	10%
2014	67	8%	5%	-	2%	56%	-	6%	5%	2%	15%
Total	**257**	**13%**	**12%**	**4%**	**2%**	**44%**	**0%**	**7%**	**1%**	**3%**	**14%**
Total											
2017	751	15%	8%	13%	4%	31%	-	3%	8%	3%	15%
2016	729	14%	11%	9%	3%	32%	1%	2%	9%	3%	16%
2015	723	11%	12%	6%	4%	32%	1%	4%	10%	4%	16%
2014	661	15%	14%	1%	8%	29%	1%	4%	8%	2%	17%
Total	**2864**	**14%**	**11%**	**8%**	**5%**	**31%**	**1%**	**3%**	**9%**	**3%**	**16%**

Shaded cells indicate most popular second choice of mode. Only modes with more than 50 responses for second mode choice are included.

Source: Corey, Canapary & Galanis Research, 2017; Fehr & Peers, 2017

3.6 REASONS FOR DRIVING

The 2014, 2016, and 2017 surveys included a question asking respondents' reasons for driving, if they reported a drive alone or carpool trip. **Table 21** includes 2014 responses by residential location. The response options in this survey highlight some of the limitations of other modes: "Transit is not convenient," "Biking and walking take too long or are not possible," etc. In contrast, the 2016 and 2017 survey response options focus more specifically on what benefits respondents feel they receive by choosing to drive, such as faster travel times, increased flexibility, etc. (**Table 22**). In all surveys asking respondents' reason for driving, respondents could report multiple response. The average number of selected options per respondent were four options (4.4 in 2014, 3.5 in 2016, and 3.7 in 2017).

Reasons for driving were similar for both San Francisco and other Bay Area residents. In both 2014 and 2016-2017, drivers overwhelmingly mention that driving provides them with additional convenience or time savings (i.e., it was the fastest/cheapest option); they also indicated that availability of parking near their destination was a key factor in their decision to drive. Free parking was also noted as an incentive for driving for all survey years. In 2016 and 2017, nearly 70 percent of respondents chose to drive because parking was close to their destination, and over 50 percent drove because parking at the destination was either free or "cheap." Parking is implicit in the first option of the 2014 survey, where almost 100 percent cite convenience as the reason for driving.

While on average most respondents provided multiple reasons for driving, 11 percent of respondents only provided one reason for driving in aggregated 2016 and 2017. From this sample, 52 percent of respondents reported deciding to drive because "Driving and parking is faster than other modes of travel." In 2014, two percent of respondents provided only one reason for driving (10 surveys). Of these surveys, seven (70 percent) indicated that "Driving is most convenient."

Table 23 provides reasons for driving by location, using survey responses from 2016 and 2017. While responses are generally consistent across different neighborhoods in San Francisco and regions in the Bay Area, Zone 5 is an outlier, with a higher proportion of respondents stating that that driving is safer than other modes (50 percent in Zone 5 compared to 37 percent for the entire region) and a high proportion of respondents stating that they "need to make multiple stops" (51 percent in Zone 5 compared to 42 percent for the entire region).

Table 21. Reasons for Driving (2014)

Reason	SF Residents	Live Outside San Francisco	Total
Driving is most convenient (parking is free/cheap /close, it is the fastest, need to make multiple stops, travel with others)	99%	97%	99%
Transit is inconvenient (i.e. does not come often enough, does not operate when I need it, too far from home/destination, takes too long)	76%	79%	77%
Biking and walking take too long or are not possible	82%	84%	83%
Need access to a car (Need access to car for work, my schedule is unpredictable or requires flexibility, need to transport something)	72%	76%	73%
Cost (already paying for car, need to cover cost of multiple travelers)	29%	26%	28%
Safety/Personal security (I don't feel safe walking, biking, or taking transit)	29%	31%	30%
Comfort (I don't feel comfortable walking, biking, or taking transit; personal preference)	65%	62%	64%
Don't know how to bike or take transit	16%	14%	15%

Table 22. Reasons for Driving (2016 & 2017)

Reason	SF Residents		Live Outside San Francisco		Total	
	2017	2016	2017	2016	2017	2016
Parking at my destination was free	49%	50%	44%	34%	47%	45%
Parking at my destination was cheap	8%	6%	7%	6%	8%	6%
Parking was available close to my destination	70%	68%	65%	69%	69%	68%
Driving and parking is faster than other modes of travel	72%	76%	66%	78%	70%	77%
Driving and parking is safer than other modes of travel	36%	38%	34%	43%	36%	39%
I needed to make multiple stops before returning home	41%	39%	49%	36%	43%	38%
I was traveling with children	20%	23%	26%	20%	21%	22%
I need to carry something	54%	49%	47%	40%	52%	46%

Table 23. Reasons for Driving by Location (2016 & 2017)

Reason	SF	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Outside SF	East Bay	North Bay	South Bay	Total
Parking at my destination was free	**50%**	40%	54%	52%	43%	56%	**39%**	38%	40%	39%	46%
Parking at my destination was cheap	**7%**	8%	8%	6%	6%	9%	**7%**	6%	6%	8%	7%
Parking was available close to my destination	**70%**	62%	63%	71%	72%	78%	**67%**	64%	69%	69%	69%
Driving and parking is faster than other modes of travel	**74%**	69%	72%	75%	72%	81%	**72%**	67%	73%	75%	74%
Driving and parking is safer than other modes of travel	**36%**	28%	33%	35%	31%	50%	**38%**	39%	36%	40%	37%
I needed to make multiple stops before returning home	**41%**	37%	42%	40%	34%	51%	**43%**	38%	42%	47%	42%
I was traveling with children	**22%**	23%	12%	24%	23%	25%	**23%**	22%	23%	24%	22%
I need to carry something	**52%**	52%	49%	55%	50%	54%	**44%**	43%	44%	43%	50%

3.7 TRIP PURPOSE

This section reviews mode share by trip purpose. For each trip taken, respondents were given the option to report that they were traveling to work, to school, for shopping and errands, for dining and recreation, back to their residence, or to other destinations. **Inset Figure 10** summarizes trip purpose for 2015 to 2017. Three trip purposes comprise the majority of trips: work (21 percent), shopping (19 percent), and dining (21 percent). About one third of trips are respondents returning to their residences.

Inset Figure 11: Trip Purpose (2015-2017)

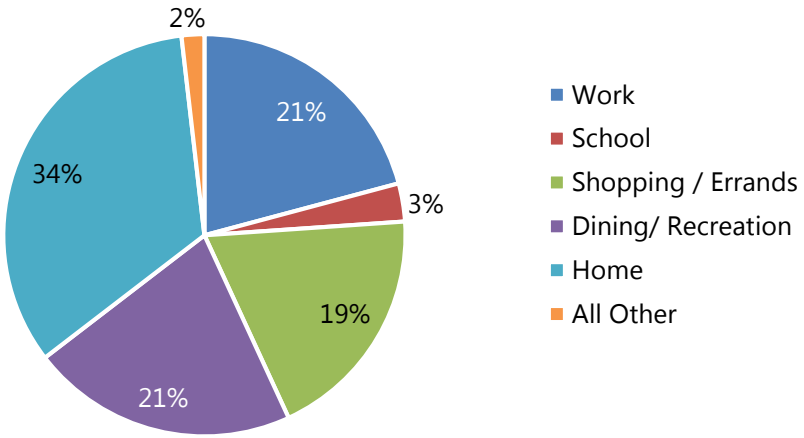


Table 24 summarizes the three year average for private auto mode share by trip purpose. Drive alone was consistently the highest portion of the private auto mode share, with exceptions for school and dining trips, where carpool exceeded drive alone. This is unsurprising, as school trips typically involve a driver and at least one student, and dining or recreation trips often involve multiple people in the same household traveling together.

Inset Figure 12 shows mode share by trip purpose for additional modes, and includes non-auto modes, averaged across a three year period (2015-2017). The trip purposes with the highest number of transit trips are work and school; trip purposes that generate the highest proportion of walking trips are shopping, errands, and recreation/eating out. This may reflect a tendency for people to run errands and seek out entertainment and dining in neighborhoods near their place of residence, or near another place they are visiting. Commute trips and school trips tend to occur during the

most congested periods of the day, when transit service is most frequent, which may account for the higher share of those types of trips by transit.

Inset Figure 12: Three Year Average Mode Split by Trip Purpose (2015-2017)

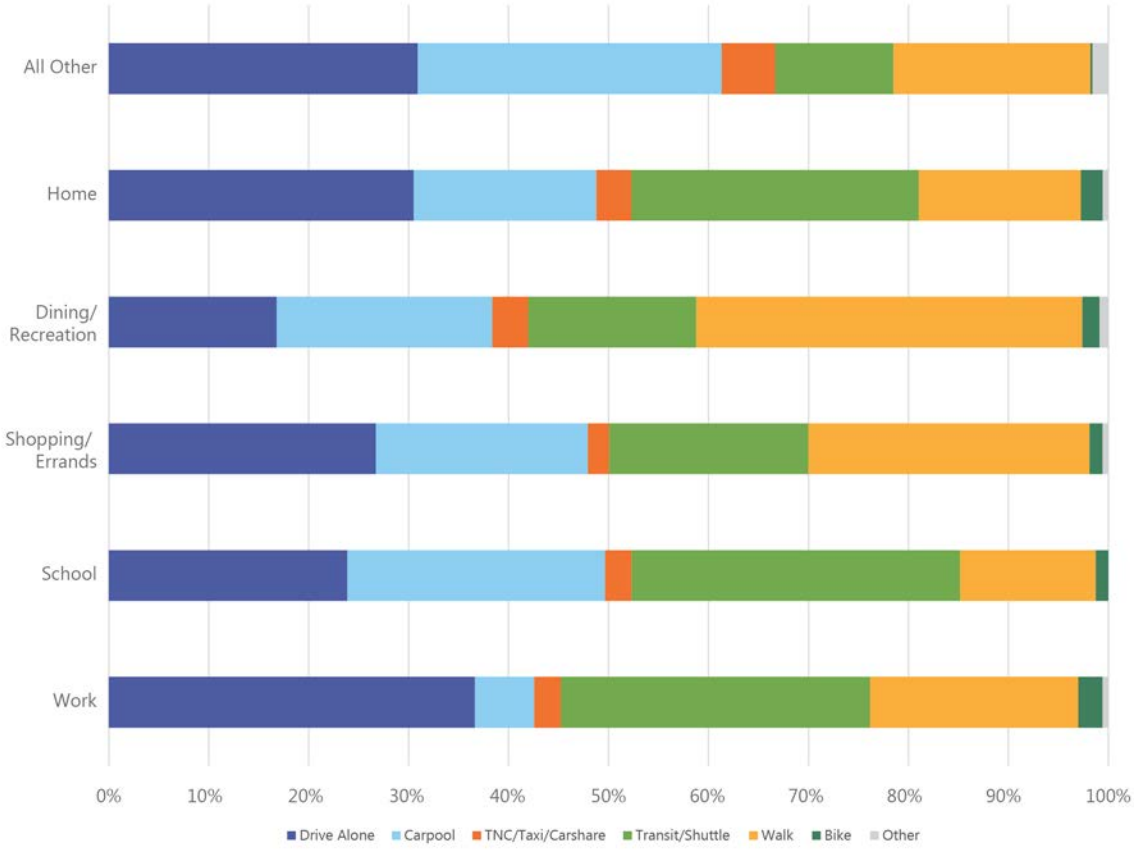


Table 24: Three Year Average for Auto Mode Share, by Trip Purpose (2015 – 2017)

Purpose	% of Trips	Drive Alone	Carpool	Private Auto Total	Carshare	TNC	Taxi	Auto Total
San Francisco Residents								
Work	18%	35%	5%	**40%**	0%	3%	<1%	**44%**
School	4%	23%	24%	**48%**	0%	3%	0%	**51%**
Shopping/Errands	21%	28%	19%	**47%**	<1%	1%	<1%	**49%**
Dining/ Recreation	21%	16%	20%	**37%**	<1%	3%	<1%	**40%**
Home[1]	34%	28%	18%	**46%**	<1%	3%	<1%	**50%**
All Other[2]	1%	27%	23%	**49%**	0%	4%	1%	**55%**
Non-San Francisco Residents								
Work	29%	40%	9%	**49%**	<1%	<1%	<1%	**50%**
School	2%	25%	30%	**56%**	0%	2%	0%	**58%**
Shopping/Errands	13%	23%	27%	**49%**	<1%	2%	<1%	**52%**
Dining/Recreation	22%	19%	25%	**44%**	<1%	3%	<1%	**47%**
Home[1]	32%	38%	20%	**58%**	<1%	1%	<1%	**60%**
All Other[2]	3%	18%	29%	**47%**	0%	1%	0%	**46%**
All Trips								
Work	21%	37%	6%	**43%**	<1%	2%	0%	**45%**
School	3%	24%	26%	**50%**	0%	3%	0%	**52%**
Shopping / errands	19%	27%	21%	**48%**	<1%	1%	0%	**50%**
Dining/Recreation	21%	17%	22%	**38%**	<1%	3%	0%	**42%**
Home[1]	34%	30%	18%	**49%**	<1%	3%	1%	**52%**
All Other[2]	2%	25%	24%	**49%**	<1%	3%	1%	**52%**

1. Home indicates the last segment of a trip, from a respondent's final non-home destination to home.
2. All Other includes refused to answer, religious/volunteer, medical appointments, etc.

Shaded cells indicate trip purposes with private vehicle mode share above the 50 percent goal.

Source: Corey, Canapary & Galanis Research, 2017; Fehr & Peers, 2017

4 TRAVEL TRENDS AND FORECASTS

One use of the data from the Travel Decision Survey effort is in forecasting and examining the potential effects of mode split trends on total vehicle travel in San Francisco. The measure of Vehicle Miles Traveled (VMT) is used to estimate the effects of travel decisions on roadway capacity and on greenhouse gas emissions.

4.1 SF-CHAMP FORECASTS

The SF-CHAMP model, developed and maintained by the SFCTA, represents existing and future transportation conditions in San Francisco. The model predicts all person travel for a typical weekday based on population and employment locations. Using outputs from the SF-CHAMP 5.0 2012 base year run for total number of person trips in San Francisco, Corey, Canapary & Galanis Research prepared the following projections of the total number of expected daily vehicle trips in San Francisco:

Table 25: Daily Trip Projections based on Total Daily Trips and Mode Share Survey, 2017

Mode	Estimated Weekday Trips
Private Auto	1,798,748
Non-Private Auto	2,361,238
Don't Know*	7,083

Source: Corey, Canapary & Galanis Research, 2017
*"Don't Know" represents individuals who could not remember / did not know how they took a reported trip when responding to the survey.

These projections indicate that in 2017, the model forecasts around 1.8 million daily person trips by private auto, and 2.4 million daily person trips by non-private auto. These estimates have been used to extrapolate the average daily person trips by mode, as well as to estimate vehicle trips by passenger vehicles (**Table 26**).

Table 26: Estimated Total Daily Trips by Mode

Mode	Percent of Trips	Estimated Number of Daily Trips[1]	Average Vehicle Occupancy[2]	Estimated Vehicle Trips
Drive Alone	28.0%	1,164,000	1.0	1,164,000
Carpool	15.0%	636,000	2.5	254,400
Carshare	0.2%	8,000	1.0	8,000
TNC	4.0%	155,000	1.0	155,000
Taxi	0.3%	14,000	1.0	14,000
Transit	25.0%	1,045,000	-	-
Shuttles	0.8%	35,000	-	-
Bicycle	1.6%	69,000	-	-
Walk	24.8%	1,034,000	-	-
Other / Don't Know	0.2%	7,000	-	-
Total	**100%**	**4,167,000**	**-**	**1,595,400**

1. Totals rounded to nearest 1,000 trips, and are based on non-rounded trip percentages.
2. Average vehicle occupancy reflects assumptions that all non-carpool trips are taken alone, and that carpool trips average between 2-3 occupants.
Source: Corey, Canapary & Galanis Research, 2017; Fehr & Peers, 2017

Overall, using conservative assumptions for passengers per trip for carshare, TNC, and taxi trips, projections show a total of 1,595,400 passenger vehicle trips (not including buses, freight and delivery vehicles, or shuttles). These assumptions are based entirely on total person trips as generated by SF-CHAMP. The resulting ratio of vehicle trips to person trips is 0.38, indicating that for every 100 person trips generated, we expect 38 vehicle trips, and a total auto mode share (including both private vehicles and TNC/taxi/carshare) of 47.5 percent. This analysis reinforces that the number of person trips involving a vehicle is not equal to the number of vehicle trips. As a result of carpooling, there are fewer vehicle trips than person trips involving a vehicle.

4.2 DEMOGRAPHIC TRENDS AND TRAVEL PATTERNS

Existing travel demand models may not fully account for anticipated changes to transportation. Disruptive forces include new technologies and shifts in demographics.[14, 15, 16] Fehr & Peers has consolidated available travel demand research on key factors into TrendLab+, a sketch planning tool that helps planners forecast total VMT in 2040 under a number of different scenarios. TrendLab+ is the result of research into how demographics, economic factors, and transportation innovations shape the rate of vehicle travel. While

[14] Fulton, L.; Mason, J., Meroux, D. 2016. *Three Revolutions in Urban Transportation: How to achieve the full potential of vehicle electrification, automation and shared mobility in urban transportation systems around the world by 2050.*
[15] McKinsey & Company and Bloomberg. 2016. *An Integrated Perspective on the Future of Mobility*.
[16] Arbib, J. and Seba, T. 2017. *Rethinking Transportation 2020-2030: The Disruption of Transportation and the Collapse of the Internal-Combustion Vehicle and Oil Industries.*

calibrated to national VMT levels, findings can generally be applied to San Francisco by examining the trend of future VMT per capita. As a sketch planning tool, TrendLab+ is valuable in examining how variations in trends may affect future VMT and, potentially, future auto mode share. In the four scenarios presented below, inputs reflect a variety of sources, from regional projections, to commonly discussed social shifts and policy changes, as well as trends revealed through examination of past travel decision surveys. More information on each of the variables can be found in **Appendix B**.

Scenario A: MTC Projections

This scenario assumes changes projected by MTC in *Projections: 2013***.** This includes an increase in the total share of the population of driving age, continued increases in traffic congestion, implementation of transit programs and first/last mile strategies, continued growth in area GDP, increased rates of growth in Alameda and Santa Clara counties compared to San Francisco, and increased rates of household formation.

Scenario B: Social Shifts

This scenario assumes that many widely theorized social shifts continue and accelerate. This includes a decrease in auto ownership, a continued increase in congestion, as well as increases in services such as home delivery, telecommuting, social networking, TNC activity, and the introduction of autonomous vehicles.[17]

Scenario C: Policy Changes

Scenario C examines a future with key policy changes at the local or state level, including stricter licensing requirements, and a potential gas tax or license fee that increases the cost of vehicle operation. It also assumes implementation of first/last mile strategies such as bicycle facilities between transit and common destinations, promotion of shuttle services, and pedestrian enhancements.

Scenario D: Travel Decision Survey Trends Continue

Scenario D selects a few key trends from responses to the travel decision survey. First, it assumes vehicle ownership will increase, based on a higher number of survey respondents indicating they obtained a new vehicle compared to those indicating they reduced the number of vehicles in their household. It assumes

[17] Circella, G. et al., 2016. "What Affects U.S. Passenger Travel? Current Trends and Future Perspectives" *National Center for Sustainable Transportation. https://ncst.ucdavis.edu/wp-content/uploads/2014/08/06-15-2016-NCST_White_Paper_US_Passenger_Travel_Final_February_2016_Caltrans3.pdf*

increased household income / GDP growth based on increases in average reported household income over the past five years, and also reflects an increase in TNC usage based on the increase in reported TNC trips.

Table 27: Summary of TrendLab+ Scenarios and Results

Variable	Scenario A MTC Projections	Scenario B Social Shifts	Scenario C Policy Changes	Scenario D TDS Trends Continue
Labor Force Participation	No Change	No Change	No Change	No Change
Driving Age Population	**Increase**	No Change	No Change	No Change
Vehicle Ownership	No Change	**Decrease**	No Change	**Increase**
Licensing Regulations	No Change	No Change	**Increase**	No Change
Auto Operating Costs	No Change	No Change	**Increase**	No Change
Congestion and Time Use	**Increase**	**Increase**	No Change	No Change
First/Last Mile Strategies	**Increase**	No Change	**Increase**	No Change
GDP/ Real Income Growth	**Increase**	No Change	No Change	**Increase**
Suburban Migration	**Increase**	No Change	No Change	No Change
Household Formation	**Increase**	No Change	No Change	No Change
Goods & Service Delivery	No Change	**Increase**	No Change	No Change
Telecommuting	No Change	**Increase**	No Change	No Change
Social Networking	No Change	**Increase**	No Change	No Change
Shared Mobility Services / TNCs	No Change	**Increase**	No Change	**Increase**
Autonomous Vehicles	No Change	**Increase**	No Change	No Change
VMT per Capita Estimate	**Increase 10%**	**Increase 4%**	**Decrease 4%**	**Increase 13%**

As shown in **Figure 2** and **Table 27**, these scenarios result in differing levels of change in VMT per capita. The reported VMT is based on national levels; however, the trend and percent change are more relevant to this discussion. In Scenario A, which focuses on demographic projections and policy trends prepared by MTC for use in regional forecasting, there is potential for a 10 percent increase in VMT per capita over the status quo. This change is driven largely by demographic changes and continued growth in the Bay Area economy at large, and shows the effect of both economic growth as well as population growth on VMT.

In Scenario B, which focuses on social changes, there is a more modest projection of a four percent increase in VMT. This increase is driven mostly by changes in service delivery and private sector trends, such as a continued increase in home delivery, telecommuting, and TNC use. The introduction of autonomous vehicles may also lead to increases in VMT based on preliminary models.

Scenario C focuses on policy changes, which could occur at either the state or local level – these policies are assumed to make vehicle ownership more onerous by increasing costs, potentially through taxes or fees, while also investing in first/last mile connections to facilitate use of transit. These changes could result in a four percent decrease in VMT.

Finally, Scenario D selects a few trends from the 2013 – 2017 travel decision surveys and examines their potential effect on VMT. Economic growth is likely tied to increased vehicle ownership, as well as the increase in use of TNCs; taken together, and with growth of these trends continuing in the future, there could very well be a resultant increase in VMT per capita in San Francisco, potentially up to 13 percent. This level of VMT increase would likely correspond to additional traffic on both local and regional roadways, and may reflect an overall increase in private auto mode share.

Additional information on TrendLab+ and its supporting white paper is included as **Attachment A.**

4.3 TECHNOLOGY AND MOBILITY ON DEMAND

The transportation landscape in San Francisco has changed significantly since the current Strategic Plan metrics were adopted in 2012, largely due to the introduction and growth of several new transportation options. Private shuttles such as tech buses and Chariot have become more common, with SFMTA launching a pilot program for managing their use of curb space, while TNC services such as Lyft and Uber have been used at least once by over 70 percent of survey respondents. Autonomous vehicles are being tested in locations nationwide, including San Francisco. While TNC use has been a growing and evolving piece of the transportation sector in San Francisco for several years, autonomous vehicles have yet to reach public markets. While AVs have fueled much speculation regarding their potential effects on overall travel behavior, the results of their introduction to the vehicle fleet remain to be seen.

4.3.1 TNC

While the current goal does not consider TNC trips to be private vehicle trips, they often result in adding additional vehicles to the roadway, to a degree similar to if not greater than private automobile trips. TNC services rely on having vehicles available on demand, which typically requires drivers to spend a portion of their time driving while anticipating a ride request. In addition, there is evidence from studies in San Francisco, New York City and Denver that TNC services induce trips that would not otherwise be taken, or that would otherwise use non-auto modes, such as transit[18] (**Table 28**). While the total share of trips by TNC remains relatively small, at around four percent in the latest Travel Decision Survey, TNCs currently represent a larger share of trips than carshare, bicycling, or private shuttle, despite having no presence in the transportation landscape prior to 2012.

[18] Henao, Alejandro. 2017. Impacts of Ridesourcing – Lyft and Uber – on Transportation including VMT, Mode Replacement, Parking, and Travel Behavior. University of Colorado Denver; Rayle, Shaheen, Chan, et al. 2014. App-Based On-Demand Ride Services: Comparing Taxi and Ridsourcing Trips and User Characteristics in San Francisco. University of California Transportation Center.; Schaller Consulting. 2014. *Unsustainable? The Growth of App-Based Ride Services and Traffic, Travel and the Future of New York City*.

Table 28: Summary of Findings from TNC Studies on Mode Shift

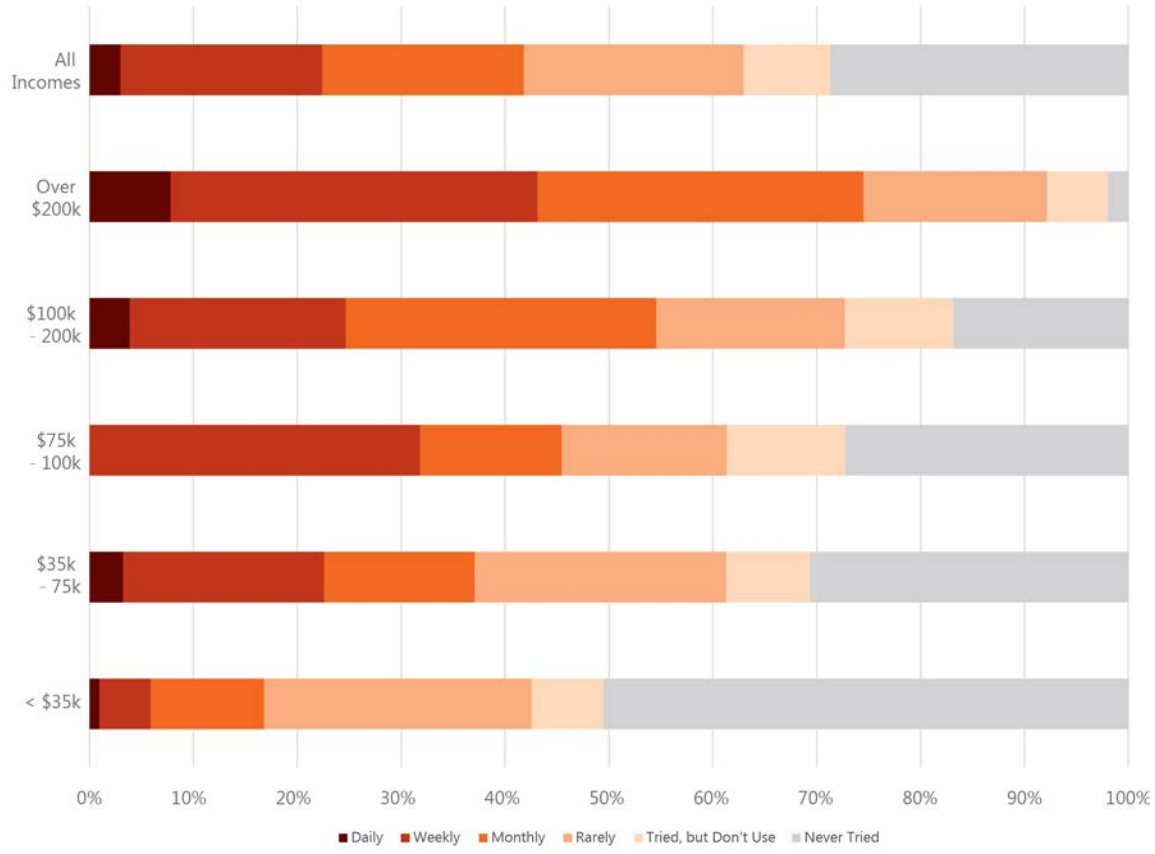
	San Francisco (Rayle, Shaheen, Chan, et al.)	Denver (Henao, 2017)	New York (Schaller, 2017)
Mode Shifts from:			
Taxi	36%	10%	81m annually
Transit	30%	22%	Not studied
Walk	7%	12%	Not studied
Bike	2%	Included in 'Walk'	Not studied
Private Vehicle	7%	31%	Not studied
Induced Trips (Trips otherwise not taken)	8%	12%	Not studied
Added Vehicle Trips (Shifts from Transit, Walk, Bike, plus induced trips)	47% of TNC trips	46% of TNC trips	Overall 7% increase in all vehicle trips
Added VMT per PMT (Includes shifted trips, trips otherwise not taken and deadhead)	Not studied	.75	Not studied

Sources: Henao, 2017; Rayle, Shaheen, Chan, et al., 2014; Schaller Consulting, 2017.

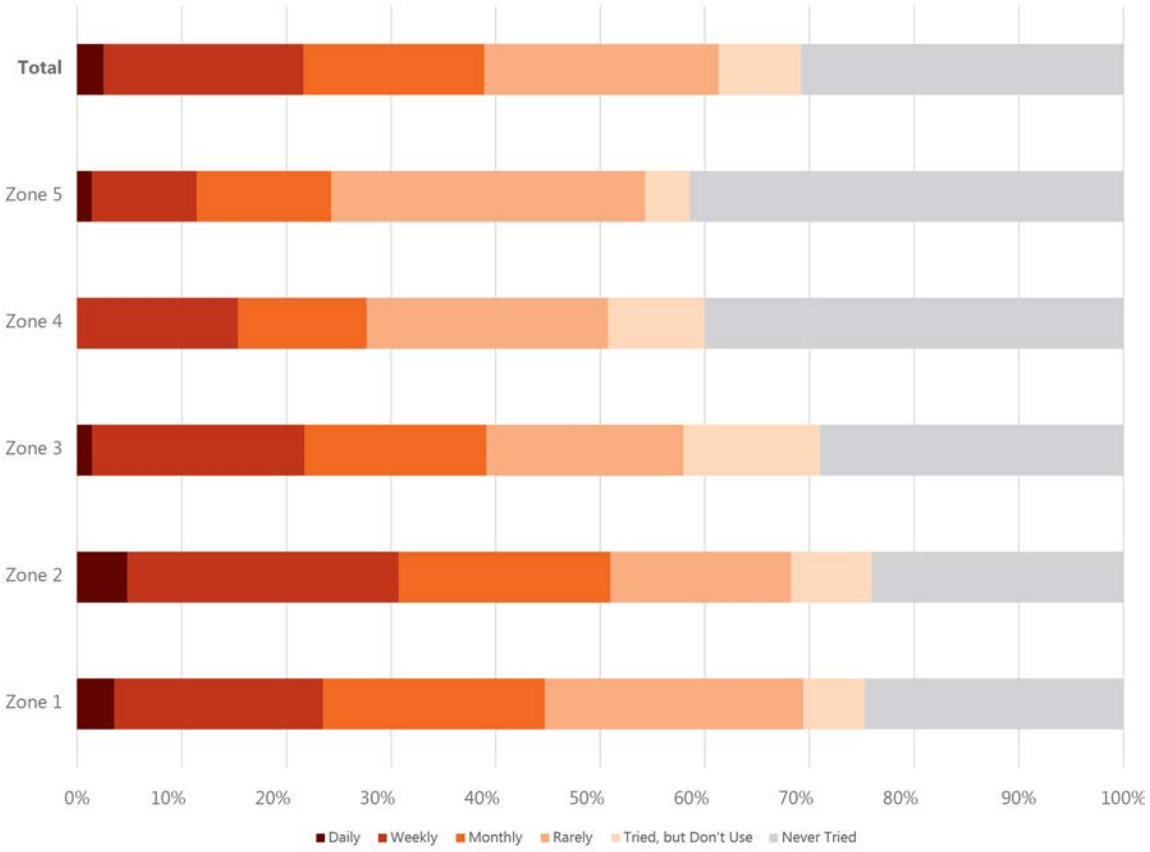
Additionally, use of TNCs varies substantially by income**. Inset Figure 13** shows responses to the survey question asking individuals how frequently they used TNC services. Overall, around 40 percent of survey respondents used TNC services at least once a month, with around 20 percent using them at least weekly. However, among the highest income earners (household income over $200,000), nearly three quarters use TNC services at least monthly.

TNC use also varies by place of residence, as shown for San Francisco residents of each zone in **Inset Figure 14**. Residents of Zone 1 and Zone 2 are most likely to use TNC services, with 45 to 50 percent of respondents using those services at least once a month. This contrasts sharply to responses from residents of Zone 4 and Zone 5, where 35-40 percent of respondents had never tried a TNC service. Zones with lower TNC usage coincide with the zones with the highest private auto mode share. In inverse, zones with high TNC use coincide with zones with the highest transit, walking, and bicycling mode share. This may reflect that TNC availability helps to enhance the overall network of transportation options, particularly in denser neighborhoods where car ownership is lower than the city average, and parking is less available, more expensive, or both.

Inset Figure 13: Self-Reported Frequency of TNC Use by Income (2017)



Inset Figure 14: Self-Reported TNC Use by Place of Residence (San Francisco Residents, 2017)



Age shows a similar pattern, with younger respondents (under age 35) much more likely to use TNCs on a regular basis than respondents over age 35. As shown in **Inset Figure 15**, nearly 30 percent of individuals under age 35 used a TNC service at least once a week, with half of them using a service at least once per month. In contrast, 40 percent of individuals over age 35 had never tried a TNC service. Survey responses also show a marked increase in TNC use among younger adults compared to older adults, as shown in **Table 29**.

Inset Figure 15: Self-Reported TNC Usage by Age

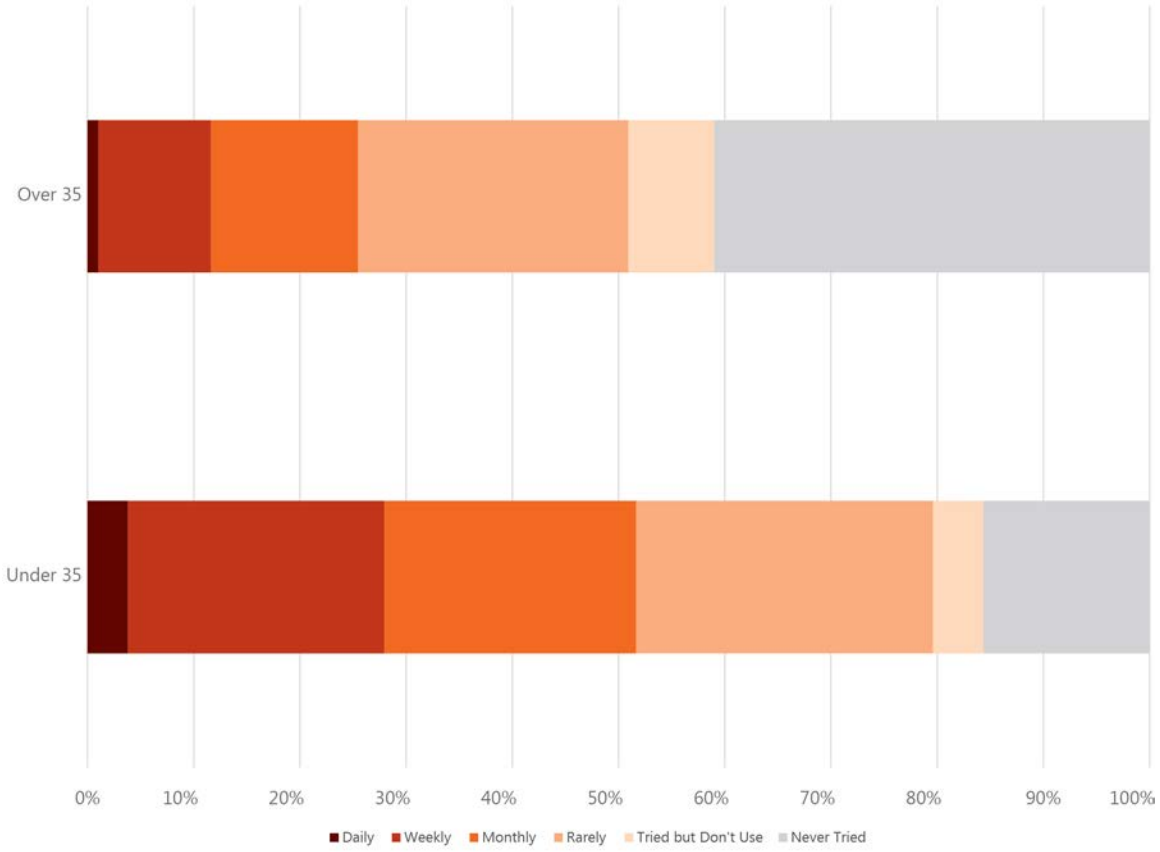


Table 29: TNC Mode Share by Age, All Trips

Age	TNC Mode Share
Under 35	7% (*+/-3.4%)*
35+	2% (*+/- 1.2%)*

Source: Corey, Canapary & Galanis Research 2017; Fehr & Peers, 2017

Finally, survey respondents were asked for their second choice of travel mode if their initial mode was unavailable for the first leg of their trip. Because only a small share of respondents reported a TNC trip, there is a large margin of error for these data, and they should be used with caution. Of the 14 TNC trips for which the second choice of mode question was asked, nine respondents reported that if they had not taken a TNC, they would have used transit. This, along with the results of prior studies as shown in **Table 28**, suggests that TNC trips may be substituting for transit trips at a fairly high rate; however, more study is needed to draw a conclusion regarding motivations for TNC use.

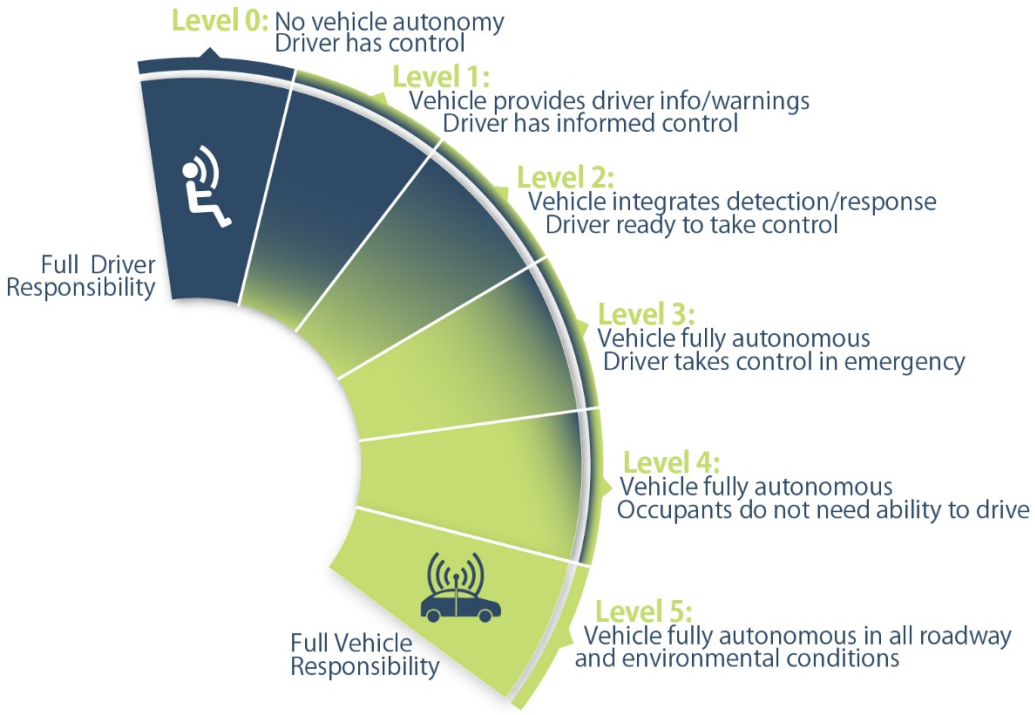
While TNCs may be providing a substitute for transit use among some users, for others they may simply represent an additional mobility option, particularly in cases where a trip made by transit would be

substantially longer than one made by TNC. Recent data on peak periods of TNC use indicate that TNC companies provide the highest volume of rides on weekends and in evenings, particularly in the late evening on Fridays and Saturdays.[19] These trips, likely reflecting recreational purposes such as socializing or eating out, occur during times when traditional transit service is less time-competitive due to decreased frequency of service.

4.3.2 Autonomous Vehicles

While not yet prevalent in the transportation market, AVs are being researched and tested on roadways nationwide. Vehicle autonomy is typically classified into five levels, illustrated in **Inset Figure 16**. Many new vehicles incorporate autonomy at Level 1, with features such as lane departure warnings or blind spot warnings. AVs at levels 3, 4, and 5 are currently being tested in road conditions by several technology and transportation companies; car makers expect AVs at this level of autonomy to be available between 2020 and 2030.

Inset Figure 16: Levels of Vehicle Autonomy



[19] "TNCs Today," San Francisco County Transportation Authority; June 2017.

AVs have the potential to also reduce or completely eliminate collisions. Ninety-four percent of vehicular collisions are related to driver behavior such as speeding or inattentive driving.[20] The combined package of sensors and collision avoidance systems may address these behaviors.[21]

AV adoption and the introduction of an AV fleet has aroused much discussion and controversy among transportation planners. Potential theorized effects of AV fleets include effects as varied as potential decreases in freeway congestion (due to reduced following distances), induced travel demand (due to reducing the stress of driving and allowing drivers the option to use travel time productively), increased surface street congestion (due to induced demand), increased auto availability due to concurrent innovations in mobility on demand, or the ability for individuals who cannot currently drive to use an AV for travel.

Further speculation includes discussion of how the initial entry of AV into the fleet may shape future patterns: for instance, if TNC companies are early adopters of the technology (which would substantially reduce their labor costs), AVs may become means to foster mobility on demand, in which individual auto ownership becomes less important due to the ubiquitous and cost-competitive AV TNC service. If AVs enter the market primarily as replacements for personal automobiles (i.e., continue to be individually owned), there may be relatively little disruption in travel choices in the medium term.

Initial looks at how various AV features and implementation scenarios affect vehicle travel have produced mixed results, based on how they incorporate the speculative effects discussed above. Existing travel models are capable of estimating the effects of AVs based on manipulating key inputs; initial tests of these models indicate that high levels of AV penetration may generate from around 3 percent to 25 percent more vehicle trips if there is no increase in ridesharing, and a slight reduction (-5 percent) to a slight increase (+5 percent) in vehicle trips if high levels of ridesharing are incorporated (a scenario that would likely involve regulation, and accelerated adoption by current TNC operators).[22] A summary of model results from seven regional travel demand models is provided as **Appendix B**; generally, this shows a high level of uncertainty regarding the effects of AVs, but a trend toward an increase in VMT with increased AV penetration.

[20] National Highway Traffic Safety Administration. *Critical Reasons for Crashes Investigated in the National Motor Vehicle Crash Causation Survey*. February 2015.
https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/812115
[21] McKinsey & Company and Bloomberg. *An Integrated Perspective on the Future of Mobility*. October 2016.
[22] Fehr & Peers Internal Research, 2017. See Appendix B or http://www.fehrandpeers.com/automated-vehicle-research/.

5 POTENTIAL POLICY IMPLICATIONS

Overall, the City is meeting its goals for private auto mode share. Fewer than half of trips made to, from, or within San Francisco are made by private car. However, realizing further reductions in auto mode share, if desired, may require additional planning and investment. Trends over the past five years largely show that the variation in private auto use falls within a margin of error on a year-over-year basis, and that the primary indicator of a household's auto mode share is its residential location. Additionally, the emergence of new modes such as TNCs or the introduction of autonomous vehicles may affect future travel patterns; from 2016 to 2017, the share of trips made by TNC doubled among San Francisco residents. Finally, shifts between the various automobile modes may have differing effects on total VMT, based on factors such as average vehicle occupancy.

5.1 THE IMPORTANCE OF RESIDENTIAL LOCATION

Private vehicle mode share varies based primarily on household location and trip purpose, with individuals living in areas with high quality transit access showing the lowest total auto mode share (such as in San Francisco zones 1 and 2, and in the East Bay, where BART provides high-frequency, time-competitive access to San Francisco).

To further reduce private vehicle mode share, the City will need to review reasons for variations in auto mode share. As discussed above, the convenience and frequency of transit service is one key element; however, the number of walking trips made in Zones 1 and 2 also surpasses those made by residents of other locations. Development patterns emphasizing walkable neighborhoods and providing key shopping, school, and entertainment options within walking distance may help further reduce the share of trips made by private vehicles.[23] Alternatively, if future growth in residential development is expected to occur largely in areas that already have lower private auto mode share, private auto mode share may decline over time as a larger share of the population lives in a low-auto-use area.

But while housing options for new residents, density, and land use mix play a key role in individual travel decisions, the process of planning for these land use elements involves coordination between multiple agencies and stakeholders. Transportation-focused interventions shown to increase the use of non-auto modes include increased frequency, reliability, and coverage of transit service[24] as well as providing new or

[23] Ewing, R. and Cervero, R. 2010. "Travel and the Built Environment: A Meta-Analysis" *Journal of the American Planning Association*. Volume 76, Issue. 3 (pages 265-294).
[24] Taylor, B. D., Miller, D., Iseki, H., & Fink, C. (2009). Nature and/or nurture? Analyzing the determinants of transit ridership across US urbanized areas. *Transportation Research Part A: Policy and Practice*, *43*(1), 60-77.

enhanced bicycle facilities including Class I and Class II bicycle lanes, secure parking, and other improvements.[25, 26]

In general, given that the most frequent reason for driving is that driving is faster and more convenient, strategies to reduce auto mode share will generally work by enhancing the perceived speed, convenience, and flexibility of other options such as walking, bicycling, and transit. Many of these changes include those listed above; for instance, increasing transit frequency decreases the total average travel time once waiting time is included. However, other factors than total time spent traveling may also contribute to the perceived cost and convenience of different modes. For instance, time spent on a transit vehicle may be less private or comfortable than time spent driving, but may also allow for other activities such as reading. As such, providing a more comfortable experience on transit may help to reduce its total perceived time cost even if travel times remain the same.

5.2 TNC EFFECTS ON THE TRANSPORTATION NETWORK

TNC usage as a share of trips taken in San Francisco has doubled in the last year. Survey questions asking about frequency of TNC use reflect that most San Francisco residents and Bay Area residents who visit San Francisco have used these services, and that many use them on at least a monthly basis. Recent research in San Francisco indicates that on Fridays and Saturdays, there may be more than 220,000 TNC trips made in San Francisco, with between 130,000 and 188,000 daily trips on weekdays. This represents around 20 percent of local VMT (i.e., trips within San Francisco only) and 6.5 percent of total VMT (including regional trips).[27] If, as suggested by recent studies, around 45 percent of TNC trips represent a shift from another mode,[28] the emergence of TNC services would account for a two to three percent net increase in weekday VMT in San Francisco. This increase in vehicle trips on local roadways may contribute to congestion, which may in turn create delay for transit vehicles, and increase the City's greenhouse gas emissions from transportation sources.

Several policy proposals have entered the public sphere based on the rise in popularity of TNC services, including potential operation, pick-up/drop-off, or curbside usage fees. Beyond the potential addition of vehicle trips to roadways, this trend may signal an increased demand for curbside passenger loading, and conversely a potential decrease in on-site parking demand at some destination types.

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[25] Hunt, J. D., & Abraham, J. E. (2007). Influences on bicycle use. *Transportation*, *34*(4), 453.
[26] Pucher, J., Buehler, R., & Seinen, M. (2011). Bicycling renaissance in North America? An update and re-appraisal of cycling trends and policies. *Transportation research part A: policy and practice*, *45*(6), 451-475.
[27] "TNCs Today," San Francisco County Transportation Authority, June 2017
[28] Rayle, L., Shaheen, S., Chan, N., Dai, D., & Cervero, R. (2014). *App-based, on-demand ride services: Comparing taxi and ridesourcing trips and user characteristics in San Francisco*. UCTC-FR-2014-08.

However, the effects of TNCs may be more complicated. Both Lyft and Uber offer some services that include a ridesharing component, allowing users to share rides for a portion of their trip based on a matching algorithm, with a corresponding lower fare. Similarly, peak demand for TNC services tends to occur outside of the weekday peak hours, with the highest volume of trips on Friday and Saturday nights between 6pm and midnight[27]. Trips taken during these hours, which may include trips for which a transit alternative would be substantially longer, begin in a location without high levels of taxi availability, or where the individual may have been consuming alcohol, may represent a general increase in mobility due to the presence of TNCs. Ultimately, policy decisions regarding TNC operations in San Francisco will involve careful weighing of individual mobility, equity considerations, and the City's transportation goals.

5.3 INTRODUCTION OF AUTONOMOUS VEHICLES

As discussed previously, AV technology is still under development, and much of the discussion surrounding its future effects on travel behavior and transportation facilities are speculative. However, as the technology emerges, regulatory frameworks, public projects and infrastructure may have some influence on the manner in which AV technology or other connected transportation technology is integrated into the fleet.

SFMTA has previously prepared proposals for several major projects integrating advanced transportation technology as a grant application for Advanced Transportation and Congestion Management Technologies Deployment Initiative grant funding. These include:

- Connected Carpool Lanes, integrating app-based carpooling with expansions of carpool lanes on the local and regional transportation network
- Smart Traffic Signals in Vision Zero Corridors, using dedicated short range communication technology to enhance signal coordination with high truck volumes and reduce pedestrian collisions
- Treasure Island Autonomous Shuttle, designed to provide fast, frequent service between Treasure Island and downtown San Francisco
- Treasure Island Congestion Toll infrastructure, designed to implement a variable toll structure for vehicle trips to and from Treasure Island

While not all of the projects under discussion are traditional AV projects, they all incorporate key aspects of technology associated with AVs and with coordinated or smart transportation systems. They also illustrate that as new technologies emerge, opportunities for grant funding and pilot programs will likely follow. A pipeline of innovative policies and strategies for approaching the different potential directions of AV implementation may help position the SFMTA favorably for these opportunities.

5.4 FUTURE METRICS FOR MODE SHARE

SFMTA currently sets its benchmark based on the proportion of person trips made by private automobile, which includes driving alone as well as driving with others/carpooling. It does not define trips made by taxi, TNC, or carshare as private auto trips. Because the number of people transported by each of these options differs, there are many configurations of total auto mode share that could meet the current goal while generating a wide range in the number of total daily vehicle trips. As an illustrative example, **Table 30** presents three hypothetical mode share scenarios and evaluates them using the existing mode share goal.

Scenario A represents the status quo, and assumes an average occupancy of 2.5 trips for carpool/drive with others, and an average occupancy of 1.0 for all other vehicle modes (not including a TNC driver). Scenario B includes an increase in private drive alone trips, as well as a shift from carpooling to TNC, with a slight increase in average occupancy for TNC trips. Scenario C shows a dramatic increase in carpooling, as well as an increase in average occupancy for TNC trips.

As shown in the table, Scenario A and Scenario B both meet the current mode share goal, despite Scenario B generating around 300,000 more daily vehicle trips than Scenario A. Scenario C, however, would result in a decrease in daily vehicle trips compared to Scenario A, yet would not meet the auto mode share goal as currently stated.

The past five years of monitoring have not shown shifts as dramatic as those in **Table 30**, which is intended as an illustration only. Overall, private vehicle mode share has been a reliable method of measuring the total share of vehicle trips in the city; it is only in the previous two years that increases in TNC usage have affected that metric. Including carpool/drive with others trips in auto mode share is also appropriate for trip purposes in which a driver is escorting a passenger, such as a guardian taking a child to school or a family member dropping another family member off at work. These trips likely comprise a large number of carpool/drive with other type trips. However, as TNCs and other technologies continue to grow in market share, it may be worth considering introduction of additional vehicle trip types into the monitoring goal.

Ultimately, the metrics used to assess progress toward the goals in the Strategic Plan should reflect the primary purpose of each goal, while also being feasibly measurable. In the case of the current goal, "Make transit, walking, bicycling, taxi, ridesharing, and carsharing the preferred means of travel," the division between private auto trips and all other trips is clear, and the current metric is sensible.

Table 30: Illustrations of Private Auto Goals and Vehicle Trips

Mode	Mode Share	Average Occupancy
Scenario A – Status Quo		
Drive Alone	28%	1.0
Carpool	15%	2.5
Carshare	1%	1.0
TNC	4%	1.0
Taxi	1%	1.0
Non-Auto	51%	-
Scenario B – Drive Alone and TNC Increase		
Drive Alone	35%	1.0
Carpool	10%	2.5
Carshare	1%	1.0
TNC	8%	1.2
Taxi	1%	1.0
Non-Auto	45%	-
Scenario C – Carpooling Increase		
Drive Alone	25%	1.0
Carpool	25%	2.5
Carshare	1%	1.0
TNC	4%	1.5
Taxi	1%	1.0
Non-Auto	44%	-

Table 31: Summary of Change in Vehicle Trips under Scenarios in Table 30

	Scenario A	Scenario B	Scenario C
Total Vehicle Trips	1,667,000	1,986,000	1,653,000
Meets Goal?	Yes	Yes	No

Vehicle trips are derived from mode share, average occupancy, and total daily person trips, as shown in **Table 26** above.
Source: Fehr & Peers, 2017

6 CONCLUSION

Fewer than half of Bay Area resident trips in San Francisco are made by private automobile, indicating that the SFMTA continues to meet its mode share goals under the current Strategic Plan. While rates of private and non-private vehicle use vary based on place of residence, income, age, car ownership, and other demographic factors, more trips are made to, from, and within San Francisco without a car than with one. Specifically, transit and walking accounted for nearly half of trips made by San Francisco residents in 2017, and those two modes account for up to 60 percent of trips in the densest neighborhoods in the city. These areas, which tend to have dense development patterns as well as frequent and high quality transit service, may serve as examples for reducing total auto mode share in other areas of the city through both transportation policy and urban planning.

Many of the factors influencing individual travel choices fall outside the traditional realm of transportation facilities. Land use planning, development, and personal choice play significant roles in travel decisions. Additionally, fluctuations in societal variables (such as labor force participation, household size, economic growth, and population demographics) and emerging technologies (such as AVs) can have a large effect on transportation trends, while also being difficult to forecast accurately. While Fehr & Peers has presented several feasible scenarios for some of these demographic and technology changes using TrendLab+, each of these factors is itself somewhat unpredictable. Ongoing monitoring of auto mode share, travel trends, and demographic relationships to those trends will be necessary to assess current goals and set future ones.

In particular, regional population and employment fluctuations will highly influence future transportation patterns. While mode share within San Francisco may very well remain stable, if additional trips are made due to growing population, patterns of housing development, or job creation, the total number of vehicles on local roadways will still increase. However, the patterns of this growth can also influence mode share in turn, particularly the locations of new housing and new employment centers within the region. The dense network of transportation choices currently present in San Francisco will likely shift naturally as individuals travel to and from the places they frequent most often: home, work, school, shops, and restaurants.

Transportation agencies like the SFMTA still have critical roles to play in influencing trip modes. Quality and frequency of transit service, cycling infrastructure, pedestrian safety, and public parking prices all affect travel decisions by individuals. As the SFMTA moves forward with pedestrian improvements on high injury corridors, enhanced bicycling services, bike share expansion, and continued implementation of transit service improvements, the attractiveness of walking, bicycling, or taking transit will likely increase and provide incentives for residents and visitors alike to choose a mode other than a private vehicle.

APPENDIX A: TRENDLAB+ DOCUMENTATION

APPENDIX B: AUTONOMOUS VEHICLE MODELING RESULTS