Plan/Bay Area: Technical Summary of Predicted Traveler Responses to Second Round Scenarios

Technical Report

Metropolitan Transportation Commission

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1 Introduction

This report presents selected technical results from the second round of scenario analyses undertaken in support of the Metropolitan Transportation Commission's (MTC's) 2013 Plan/Bay Area. To provide context, the results are preceded by a brief overview of the technical methods used in the analysis.

For detailed information regarding the broader Plan/Bay Area effort, please see OneBayArea.org.

2 Analytical Tools

To first describe the reaction of travelers to transport projects and policies and to then quantify the impact of cumulative individual decisions on the Bay Area's transport networks and environment, MTC maintains an analytical tool, i.e. a collection of computer programs that implement statistical models, known to transportation planners as a "travel model" (or "travel demand model", "travel forecasting model"). The travel model is described here, along with two supporting tools, namely the population synthesizer and vehicle emissions model.

2.1 Population Synthesizer

MTC's travel model is an "agent-based simulation"; the "agents", in this case, are individual households, further described by the persons which form each household. The computer programs that apply the series of statistical models attempt to predict the behavior of individual households and persons. In order to use such a tool, a population in which households and persons are described in a fair amount of detail is needed – and such information is needed for both the historical and prospective points in time at which the travel model is asked to describe traveler behavior.

Tools that perform the above-described task are known as "population synthesizers" because they create what are generally referred to as "synthetic"[1] populations. These synthetic populations are detailed descriptions of households (and the persons in those households, the details of which are drawn from the Census) that are constructed in such a way that the aggregation of characteristics across households along a variety of dimensions (specifics in the next paragraph), and combinations of dimensions, match the aggregate characteristics of the Bay Area's population we either know to be true (from Census data, when attempting to describe historical populations) or we are willing to guess will be true in the future (when attempting to forecast populations). MTC's partner agency, the Association of Bay Area Governments (ABAG), predicts aggregate population characteristics 30 years hence.

MTC's population synthesizer attempts to "control" (i.e. make sure the synthetic population matches) along the following dimensions:

- Household "type", individual household unit or group quarters (e.g. college dorm);
- Household income category;
- Householder age;
- Number of persons in the household;
- Number of children under age 17 in the household;
- Number of employees in the household;

[1] Merriam-Webster defines *synthetic* as follows: "devised, arranged, or fabricated for special situations to imitate or replace usual realities" (definition 4b).

- Number of units in the household's physical location (one or more than one, as in an apartment building).

The population synthesizer attempts to locate actual households described in the 2000 Decennial Census Public Use Micro-sample (PUMS) data (i.e. those who responded to the old "long forms" used by the Census Bureau to collect more detailed household information) in such a way that when looking at the population along these dimensions spatially (at a level of detail below which the PUMS data is reported), the aggregate totals more or less match those predicted by other Census summary tables (in the base year) or ABAG's land use projections (in the forecast years). For example, if ABAG projects that 60 households containing 100 workers and 45 children will live in spatial unit X in the year 2035, the population synthesizer will attempt to locate 60 PUMS households in spatial unit X such that the number of workers in those households is close to 100 and the number of children is close to 45.

2.2 Travel Model

Travel models are frequently updated and modified. As such, a bit of detail as to which version of a given travel model is used for a given analysis is required. The current analysis uses MTC's *Travel Model One (version 0.1)*, completed Winter 2010/2011, calibrated to a 2000 base year, and validated to both year 2000 and year 2005 observed conditions.

Travel Model One is of the so-called "activity-based" archetype[2]. A more useful description of the travel model is given above: it is a partial agent-based simulation in which the agents being simulated are the households and persons that either engage or consider engaging in daily travel in the Bay Area. The simulation is partial because it stops short of simulating the *individual* behavior of passenger and transit vehicles on roadways and transit facilities (the model system does simulate the behavior of *aggregations* of vehicles and transit passengers).

The model operates on a synthetic population that includes representative households and persons for each actual household and person in the nine-county Bay Area – both in the base year and forecast years. Travelers move through a space segmented into "travel analysis zones"[3]. A series of travel-related choices are simulated for each household and person within each household; these choices are simulated in the following sequence:

- Usual workplace and school location – Each worker, student, and working student in the synthetic population selects a travel analysis zone in which to work or attend school (or one zone to work and another to attend school);
- Household automobile ownership – Each household, given the household location and demographics as well as each members' work and/or school locations, decides how many vehicles to own;

[2] The term "activity-based" is not the most descriptive label for the travel model, but it has been adopted into transportation planning jargon as a label for the family of travel models of which *Travel Model One* belongs.

[3] An interactive map of MTC's travel analysis zones is available here: http://geocommons.com/maps/58264

- Daily activity pattern – Each household determines, together, the daily activity pattern of each household member, the choices being mandatory (go to work or school), non-mandatory (leave the house, but not for work or school), or stay at home;
- Work/school tour frequency and scheduling – Each worker, student, and working student decides how many round-trips they will make to work and/or school, and then schedules a time to leave home for work and/or school as well as a time to return home;
- Joint non-mandatory tour frequency, party size, participation, destination, and scheduling – Each household determines the number and type (e.g., to eat, to visit friends, etc.) of "joint" (i.e. two or more members of the same household traveling together) non-mandatory (i.e. not work or school) round trips in which to engage, then determines which members of the household will participate, where and at what time the tour (i.e. the time leaving home and the time returning home) will occur;
- Non-mandatory tour frequency, destination, and scheduling – Each person determines the number and type of non-mandatory (e.g., to eat, to visit friends, to shop, etc.) round trips to engage in during the model day, where to engage in them, and at what time to leave and return home;
- Tour travel mode – The tour-level travel mode choice (e.g., drive alone, walk, take transit, etc.) decision is simulated separately for each tour and represents the best[4] mode of travel for the round trip (a "tour" is a round trip from either home or the workplace);
- Stop frequency and location – Each traveler or group of travelers decide whether to make a stop on an outbound (from home) or inbound (to home) leg of a travel tour, and if a stop is to be made, where the stop is made, all given the round trip tour mode choice decision;
- Trip travel mode – A trip is a portion of a tour, either from the tour origin to a stop, a stop to another stop, or a stop to a tour destination, and a separate mode choice decision is made for each trip, doing so with awareness of the prior tour mode choice decision;
- Assignment – Vehicle trips for each synthetic traveler are aggregated to build time-of-day-specific matrices (i.e. tables of trips segmented by origin and destination) that are assigned via the standard static user-equilibrium procedures to the highway network (i.e. each vehicle is assigned to his or her shortest cost – both monetary and non-monetary – path between the origin and destination); transit trips are assigned to time-of-day-specific transit networks.

The *Travel Model One* system inherits without significant modification the representation of interregional and commercial vehicle travel from MTC's previous travel model (referred to as *BAYCAST-90*). Specifically, commercial vehicle demand is represented using methods developed for Caltrans and Alameda County as part of the *Interstate 880 Intermodal Corridor Study* conducted in 1982, and the *Quick Response Freight Manual* developed by the United States Department of Transportation in 1996. In combination, these methods estimate four classes of commercial travel, specifically: "very small" trucks, two-axle four-tire commercial

[4] The choice of travel mode, as well as all other choices represented in the model, is simulated within a random utility theory framework – additional information is available here: http://en.wikipedia.org/wiki/Choice_modelling.

vehicles; “small” trucks, two-axle six-tire vehicles; “medium” trucks, three-axle vehicles; and, “combination” trucks, four-or-more axle vehicles.

Reconciling travel demand with available transport supply is particularly difficult near the boundaries of planning regions, as models must attempt to predict travel demand with limited knowledge of what land use – the primary driver of demand – or transport supply exists beyond the boundary. The typical approach to representing such interregional travel is to first estimate demand at each location where a major transport facility interacts with the boundary and to then distribute this demand to locations either within the planning region (so-called “internal/external” travel) or to other boundary locations (so-called “external/external” travel). MTC uses this typical approach and informs the process with Census 2000 journey-to-work flows, which are allocated via a simple method to represent flows to and from MTC’s 1,454 travel analysis zones and 21 boundary locations (as well as flows between boundary locations).

2.3 Vehicle Emissions Model

Travel Model One generates spatially- and temporally-specific estimates of roadway usage and speed. This information is then input into an emissions model to estimate emitted criteria pollutants as well as carbon dioxide (used as a proxy for all greenhouse gases). MTC used the EMFAC 2007 version of the California Air Resources Board emissions factor software in the current analysis.

3 Scenarios

In total, eleven scenarios are presented and discussed in the remainder of this document. One scenario is presented for year 2005; for years 2020 and 2035, the following five scenarios are presented: Initial Vision, Core Concentration, Focused Growth, Constrained Core Concentration, and Outward Growth.

The above scenarios differ across four dimensions, namely: land use, roadway supply, transit supply, and prices. By land use we mean the location of different kinds of households and jobs. Roadway supply refers to the network upon which automobiles, trucks, transit vehicles, bicycles, and pedestrians travel. Transit supply refers to the facilities upon which transit vehicles travel (the roadway, along with rail lines and other dedicated – to transit – infrastructure), as well as the stop locations, route, and frequency of service on each facility. Prices include the monetary fee users are charged to board transit vehicles, cross bridges, park private vehicles, use high-occupancy toll lanes, etc.

In the following paragraphs, each scenario is described along these four dimensions.

3.1 Baseline Scenario

Travel models must first demonstrate an ability to replicate historical conditions prior to being used to predict future conditions. This process of "ground-truthing" is known as "model validation". After making improvements to our analytical tools, MTC validated the model for two points in time, year 2000 and year 2005[5].

Even with a rigorous model validation effort, no travel model can accurately reflect all aspects of travel behavior in the base year. To ameliorate the inability of the model to inform every absolute truth, models are used to inform relative truths by comparing future year results to base year results. The year 2005 scenario facilitates such comparisons.

The year 2005 (as opposed to other past years, i.e. 2006, 2007, 2008, etc.) is selected as the "baseline" scenario against which the following scenarios are compared because (a) the Air Resources Board established 2005 as the base year to which forecast year greenhouse gas emissions are compared; and, (b) 2005 is the most recent year for which MTC has validated *Travel Model One.*

3.1.1 Land use inputs

The year 2005 travel model generates travel based on land use patterns estimated by ABAG in the *Projections 2009*[6] data series. Prior to executing the travel model, the land use patterns estimated by ABAG are run through the population synthesizer described above. In doing so, minor inconsistencies between ABAG's estimates and the travel model inputs emerge. These inconsistencies emerge for two reasons: (1) expediency limits the time provided to the software to find the optimal solution, i.e. the synthetic population that best matches the control totals; (2) the control totals, as provided by ABAG, and base year data, as provided by the Census, are not

[5] Detailed documentation of this effort is available here: http://mtcgis.mtc.ca.gov/foswiki/Main/Development.

[6] More details are available here: http://www.abag.ca.gov/planning/currentfcst/.

perfectly consistent, meaning there is no synthetic population that could satisfy each of the control totals. These inconsistencies are quantified and presented in Table 1 below. Note that the inconsistencies only exist with the population estimates, not the employment estimates.

One key function of the population synthesizer is to identify each member of the imaginary populous with one of eight "person type" labels. As shown in Figure 1 (for year 2020) and Figure 2 (for year 2035), each person in the population is identified as a full-time worker, part-time worker, college student, non-working adult, retired, driving-age student, non-driving-age student, or child too young for school. The travel model relies on these person type classifications to predict behavior. Two notable results apparent in Figure 1 and Figure 2 are as follows:

- The retired share of the population increases substantially from 2005 through 2020 to 2035 in each of the five forecast scenarios; and,
- The share of full-time (and, to a lesser-extent, part-time) workers is higher in the Initial Vision and Core Concentration scenarios than in the other forecast scenarios (this effect is more pronounced in 2035 than 2020).

Table 1: Basic Demographic Statistics

Scenario	Households				Population			Total Employment
	Land use Projections							
	Households	Group Quarters Population	Synthetic Population	Percent difference†	Land Use Projections	Synthetic Population	Percent difference	
Year 2005 (version 0.1)	2,583,077	144,597	2,720,722	-0.3%	7,096,469	7,007,634	-1.3%	3,449,640
Year 2020, Initial Vision (v 0.1)	3,018,097	160,979	3,166,616	-0.4%	8,161,864	8,079,368	-1.0%	3,716,964
Year 2020, Core Concentration (v 0.1)	2,941,167	145,798	3,068,784	-0.6%	7,937,696	7,856,760	-1.0%	3,716,340
Year 2020, Focused Growth (v 0.1)	2,854,000	151,129	2,986,256	-0.6%	7,831,480	7,733,078	-1.3%	3,567,250
Year 2020, Constrained Core Con. (v 0.1)	2,852,312	151,154	2,984,466	-0.6%	7,831,483	7,732,766	-1.3%	3,603,519
Year 2020, Outward Growth (v 0.1)	2,851,833	151,139	2,984,256	-0.6%	7,831,470	7,734,448	-1.2%	3,603,382
Year 2035, Initial Vision (v 0.1)	3,570,081	168,225	3,724,558	-0.4%	9,429,971	9,399,522	-0.3%	4,494,489
Year 2035, Core Concentration (v 0.1)	3,470,592	151,979	3,604,402	-0.5%	9,183,302	9,143,566	-0.4%	4,493,933
Year 2035, Focused Growth (v 0.1)	3,277,238	157,302	3,414,414	-0.6%	8,984,267	8,880,802	-1.2%	4,096,306
Year 2035, Constrained Core Con. (v 0.1)	3,272,322	157,275	3,408,700	-0.6%	8,984,255	8,877,506	-1.2%	4,101,096
Year 2035, Outward Growth (v 0.1)	3,276,405	157,273	3,414,998	-0.5%	8,984,246	8,877,966	-1.2%	4,100,890

† – individuals living in group quarters are considered individual households in the synthetic population and, subsequently, the travel model

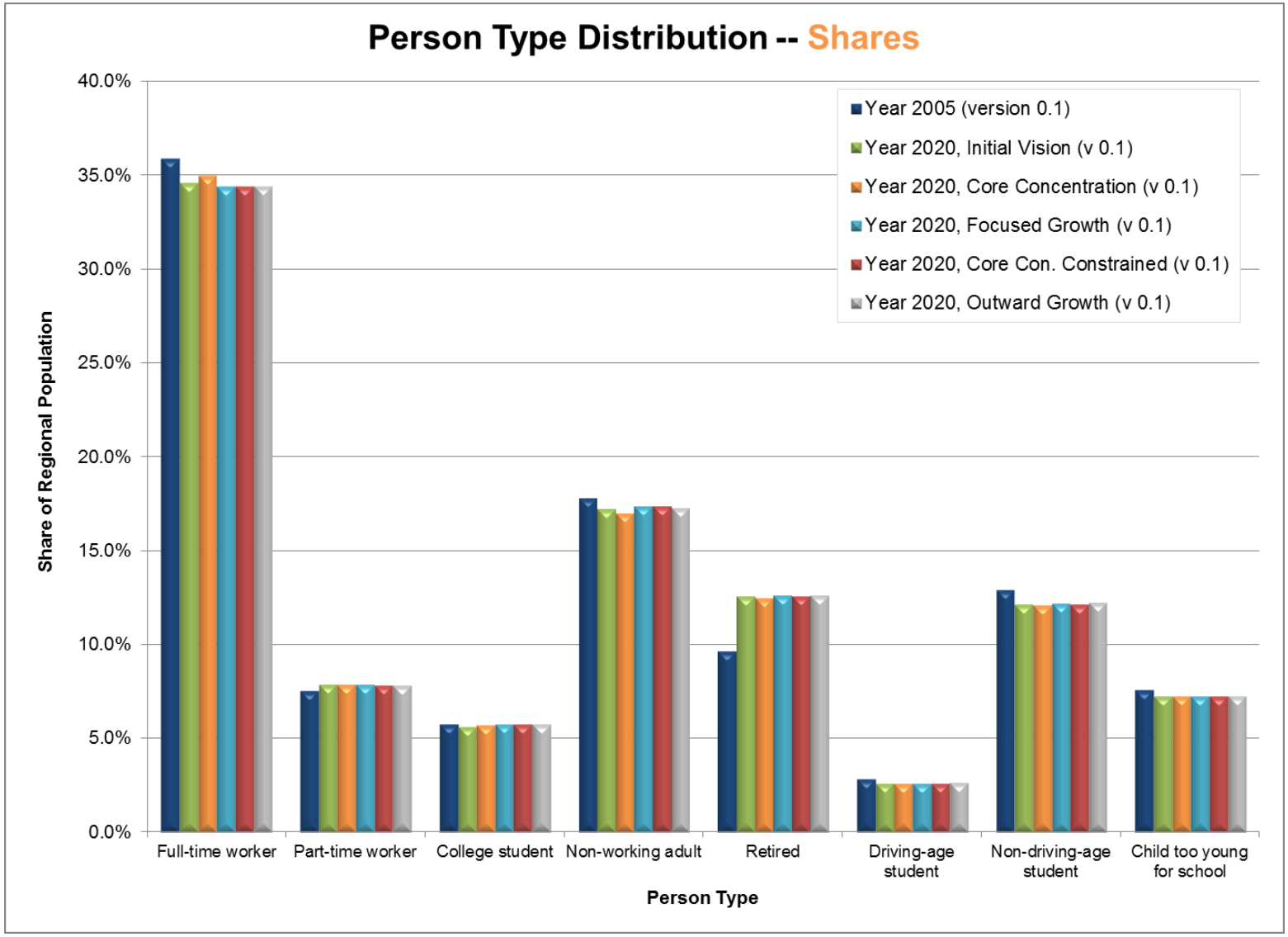

Figure 1: Year 2020, Synthetic Population Person Type Distribution

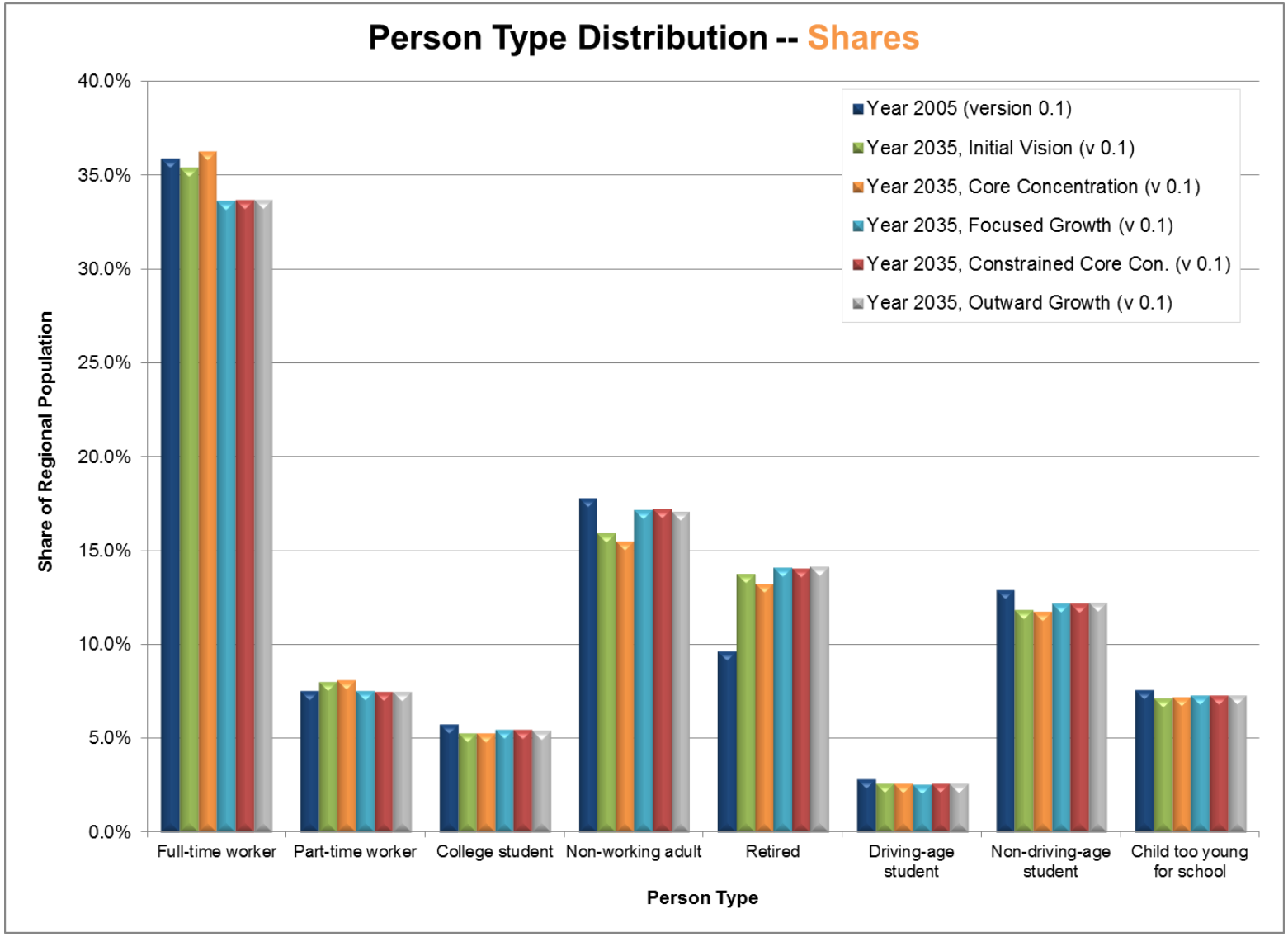

Figure 2: Year 2035, Synthetic Population Person Type Distribution

3.1.2 Roadway supply

An abstract representation of the roadway network as it was in 2005 is used in the baseline scenario.

3.1.3 Transit supply

An abstract representation of the transit network as it was in 2005 is used in the baseline scenario.

3.1.4 Prices

Travel Model One includes statistical models in which travelers determine the best travel "mode" (e.g., automobile, transit, bicycle, etc.) for each of their daily trips. One determinant of this choice is the trade-off between saving time and saving money. For example, a traveler may have two realistic options for traveling to work: (a) driving, which would take 40 minutes roundtrip and cost $10 in parking fees; or, (b) taking transit, which would take 90 minutes roundtrip and cost $4 in bus fare ($2 each way). The mode choice model structure, as estimated in the early 2000s, includes coefficients that dictate how different travelers in different contexts make decisions between saving time and saving money. These model coefficients value time in units consistent with year 2000 dollars, i.e. the model itself – not an exogenous input to the model – values time relative to costs in year 2000 dollars. Because re-estimating model coefficients is an "expensive" (in terms of staff time and/or consultant resources) process, it is done infrequently, which, in effect, "locks in" the dollar year in which prices are input to the travel model. In order to use the current model's coefficients properly, all prices must be input in year 2000 dollars. In the remainder of this document, prices are presented both in more current year dollars, to give the reader an intuitive sense as to the scale of the input prices, as well as year 2000 dollars, which are the units demanded by the model coefficients.

Five different types of prices are explicitly represented in the travel model, as follows: (i) bridge tolls; (ii) high-occupancy-lane tolls; (iii) transit fares; (iv) perceived automobile operating cost; and, (v) parking charges. Following a brief discussion on how the travel model determines each travelers value of time, each of these five price categories is described below.

Value of Travel Time

The model coefficients which link the value of time with other components of decision utilities remain constant between the baseline and forecast years, with the one exception of the coefficients on travel cost. These coefficients are a function of each individual's value of time, a number drawn, in both the base year and forecast years, from one of four log-normal distributions (see Figure 3) – the means of which are a function of each traveler's household income. The value of time for children in a household is equal to two-thirds that of an adult (the latter quantity is drawn from the distributions show in Figure 3). The means and shapes of the distributions are held constant between the base and forecast years.

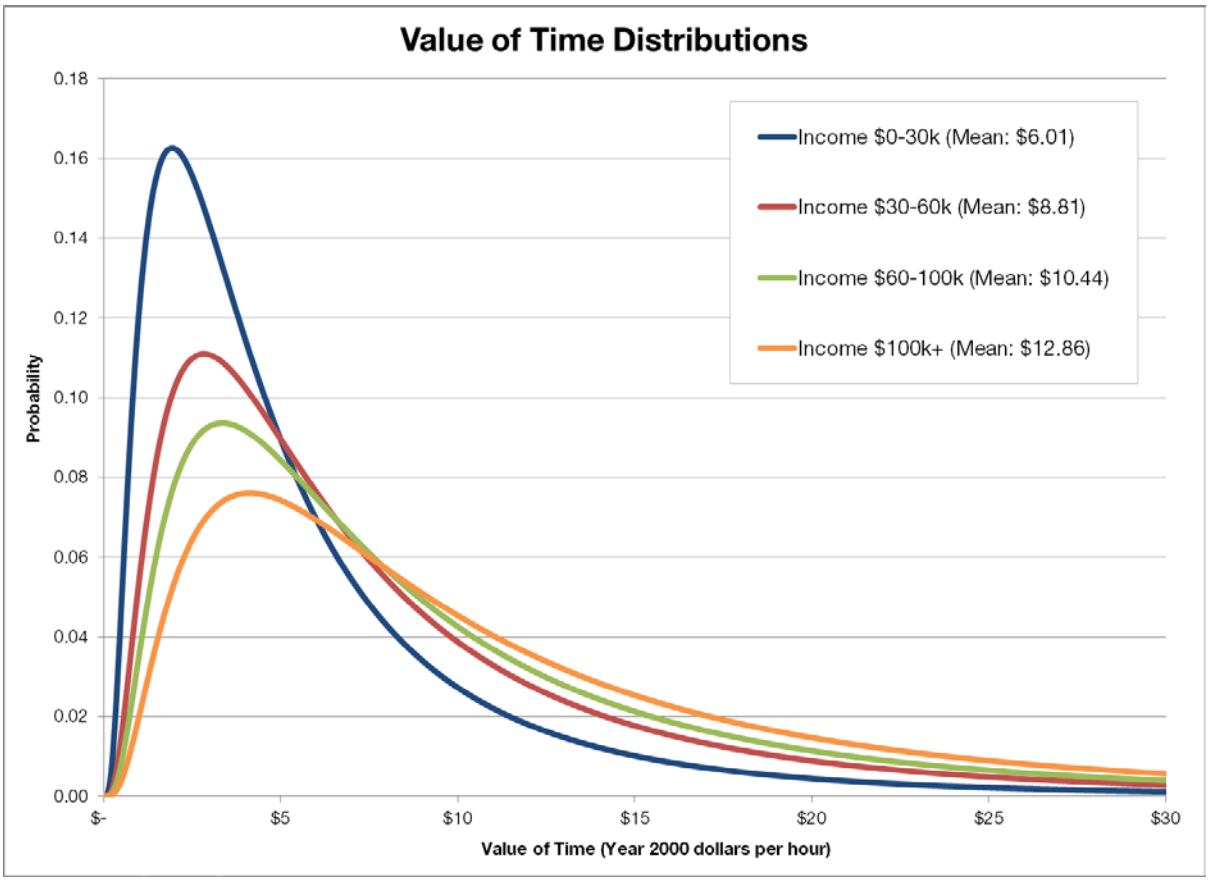

Figure 3: Value of Time Distribution by Household Income (Year 2000 dollars)

Bridge Tolls

The bridge tolls assumed in the year 2005 baseline scenario are shown below in Table 2. Please note that Table 2 includes the price of tolls in year 2005 expressed in both year 2000 and year 2005 dollars.

Table 2: Common Peak Period Bridge Tolls in Year 2005 Baseline Scenario†

Bridge	2-axle, Single-occupant Vehicle Toll ($2000)	2-axle, Single-occupant Vehicle Toll ($2005)	2-axle, Carpool * Vehicle Toll ($2000)	2-axle, Carpool Vehicle Toll ($2005)
San Francisco/Oakland Bay Bridge	$2.67	$3.00	$0.00	$0.00
Antioch Bridge	$2.67	$3.00	$0.00	$0.00
Benicia-Martinez Bridge	$2.67	$3.00	$0.00	$0.00
Carquinez Bridge	$2.67	$3.00	$0.00	$0.00
Dumbarton Bridge	$2.67	$3.00	$0.00	$0.00
Richmond-San Rafael Bridge	$2.67	$3.00	$0.00	$0.00
San Mateo Bridge	$2.67	$3.00	$0.00	$0.00
Golden Gate Bridge	$3.56	$4.00	$0.00	$0.00

† The full toll schedule includes tolls for 3- or more axle vehicles; * Carpools are defined as either two-or-more- or three-or-more-occupant private vehicles, depending on the bridge, and only receive a discount during the morning and evening peak periods (Source: bata.mtc.ca.gov; goldengatebridge.org)

High-occupancy Toll (HOT) Lane Prices

No high occupancy toll facilities were in operation in the Bay Area in 2005.

Transit Fares

The transit fares assumed in the year 2005 baseline scenario are shown below in Table 3. Please note that Table 3 includes the price of fares in year 2005 expressed in both year 2000 and year 2005 dollars (i.e. the table does not include information about the cost of taking transit in year 2000).

Table 3: Common Transit Fares in Year 2005 Baseline Scenario†

Operator	Base Fare ($2000)	Base Fare ($2005)
San Francisco Municipal Transportation Agency (Muni)	$1.33	$1.50
Alameda Contra Costa Transit (AC Transit)	$1.56	$1.75
Santa Clara Valley Transportation Authority (VTA) – Local buses	$1.56	$1.75
Santa Clara Valley Transportation Authority (VTA) – Express buses	$3.11	$3.50
San Mateo County Transit (SamTrans) – Local buses	$1.33	$1.50
Golden Gate Transit – Marin County to San Francisco service	$1.78	$2.00
County Connection (CCCTA)	$1.33	$1.50
Vallejo Transit	$1.33	$1.50
Tri-Delta Transit	$1.11	$1.25
Livermore Amador Valley Transit Authority (WHEELS)	$1.11	$1.25

† This is a sample, rather than an exhaustive list, of Bay Area transit providers and fares.

Perceived Automobile Operating Cost

When deciding between traveling to work in a private automobile or on a transit vehicle (or by walking, bicycling, etc.), MTC assumes travelers consider the cost of operating and maintaining, but not owning and insuring, their automobiles. The following three inputs are used in determining this perceived automobile operating cost: average fuel price, average fleet-wide fuel economy, and non-fuel-related operating and maintenance costs.

In an effort to improve consistency among travel models across the state, the Regional Targets Advisory Committee (formed in response to Senate Bill 375) recommended that California's metropolitan planning organizations (MPOs) use consistent assumptions for fuel price and for the computation of automobile operating cost in long range planning. Using forecasts generated by the United States Department of Energy (DOE) in the Summer of 2010, MPOs agreed to use the fuel prices and non-fuel-related prices presented in Table 4, which represents a weighted average of DOE's low-end estimate (25 percent weight) and DOE's high-end estimate (75 percent weight), plus a 25 cents surcharge to account for fuel generally being more expensive in California. The average fleet-wide fuel economy implied by the EMFAC 2007 software – also presented in Table 4 – is used to represent the average fleet-wide fuel economy.

Table 4: Inputs to MTC's Perceived Automobile Operating Cost Calculations

Measure	Analysis Year		
	2005	**2020**	**2035**
Average fuel price ($2000 per gallon)	$2.24	$3.81	$4.21
Average fuel price ($2009 per gallon)	$2.79	$4.74	$5.24
EMFAC implied fuel economy (miles per gallon)	19.76	24.10	30.88
Non-fuel-related operating cost ($2000 per mile)	$0.05	$0.07	$0.09
Non-fuel-related operating cost ($2009 per mile)	$0.06	$0.08	$0.11
Perceived automobile operating cost ($2000 per mile) †	*$0.166*	*$0.223*	*$0.222*
Perceived automobile operating cost ($2009 per mile) †	*$0.206*	*$0.278*	*$0.277*

† Sum of the fuel-related operating cost (average fuel price divided by average fuel economy) and non-fuel-related operating cost

Parking Costs

As noted in *2.2 Travel Model*, MTC's travel model segments space into travel analysis zones (TAZs). Travelers move between TAZs and, in so doing, burden the transport network. Parking costs are applied at the TAZ-level: travelers going to zone X in an automobile must pay the parking cost assumed for zone X.

MTC's travel model uses hourly parking rates for daily (long-term, those going to work or school) and hourly (short-term) parkers. The long-term hourly rate for daily parkers represents the advertised monthly parking rate, averaged for all lots in a given TAZ, scaled by 22 days per month, and then scaled by 8 hours per day; the short-term hourly rate is the advertised hourly rate – generally higher than the rate daily parkers pay – averaged for all lots in a given TAZ.

To give the reader a sense of the spatial distribution and scale of parking charges in the Bay Area, Figure 4 presents a zoomed-in map of the hourly parking rates for daily parkers assumed for the 2005 model year in San Francisco, Oakland, and Berkeley; note that a handful of zones (in downtown San Jose and Palo Alto specifically) outside these areas are also priced, but not shown in Figure 4.

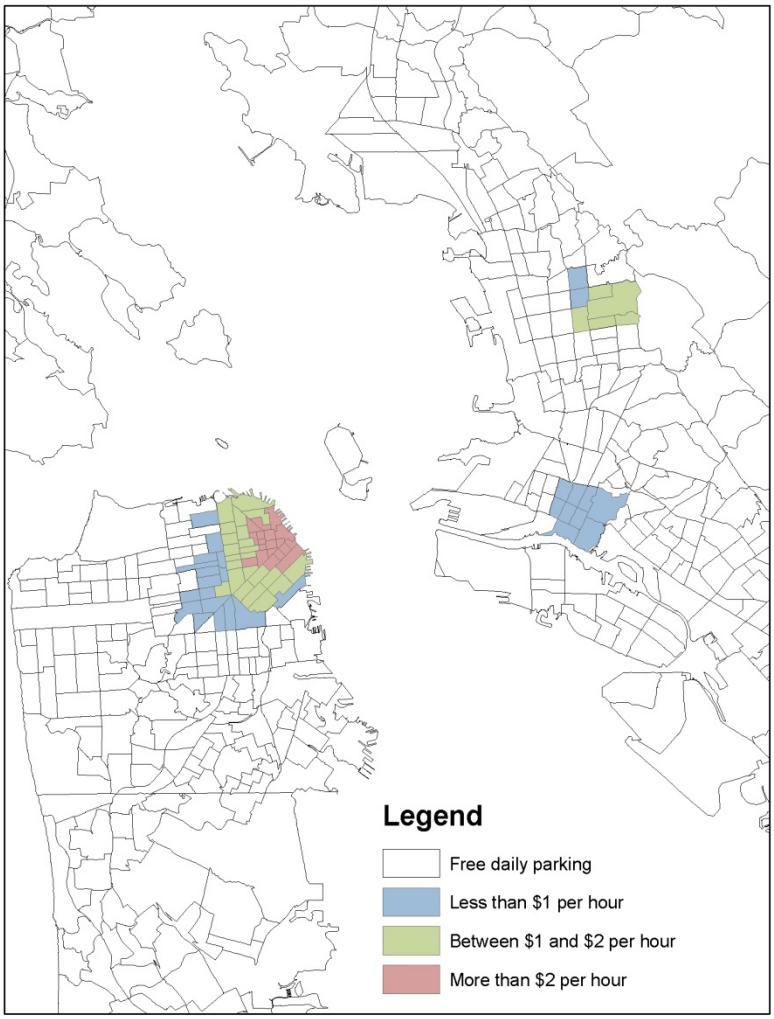

Figure 4: Year 2005 Hourly Parking Charge for Daily Parkers in Year 2010 Dollars by Travel Analysis Zone

3.2 Initial Vision Scenarios

The first of the five forecast year scenarios is named "Initial Vision". The first round of scenario analysis done in support of Plan/Bay Area[7] also included a so-called Initial Vision scenario. The scenario described here differs in the following important ways from the version considered in the first round of analysis: (i) *Travel Model One* version 0.1 is used rather than version 0.0; (ii) changes have been made to the land development pattern, including the addition of 100,000 more employed residents in year 2035; and, (iii) the transport networks differ.

3.2.1 Land use inputs

Historically, ABAG has produced bi-annual *Projections* data series in which formal land use forecasts are developed and distributed to interested stakeholders. With Senate Bill (SB) 375,

[7] A companion to the current document which describes the response of travelers to the first round of scenarios is available here: http://mtcgis.mtc.ca.gov/foswiki/Main/PlanBayArea.

ABAG now develops a draft set of land use forecasts which are used by MTC and others at the beginning of the development of the sustainable communities strategy. These forecasts are not formally adopted by ABAG's board. The region will formally adopt a land development pattern as part of the adoption of Plan/Bay Area.

Table 1, Figure 1, and Figure 2 above provide a broad overview of the land use characteristics contained in this scenario as well as the resulting synthetic population. More detailed documentation of this and each of the other scenarios is available from ABAG on the OneBayArea.org website[8].

3.2.2 Roadway supply

Each of the five forecast scenarios is paired with one of two transportation networks. The so-called "Transportation 2035" network, which allocates available funds in a manner similar to the approach taken in MTC's last Regional Transportation Plan[9] in 2009, is included in the Initial Vision scenario. Details of the projects included in the roadway network are available on the OneBayArea.org website[10].

On key feature of the Transportation 2035 roadway network is the proposed system of high-occupancy toll (HOT) lanes. MTC is currently seeking approval from the California Transportation Commission to pursue the network presented in Figure 5 below. The build out of this system, assumed to be complete by year 2035, includes 540 miles of HOT lanes, 340 of which are created by converting existing high-occupancy vehicle (HOV) lanes. The limits of the HOT network expected to be in place by 2020 are summarized in Table 6.

Figure 6 and Figure 7 below show the growth in roadway miles relative to a 2005 base year for the year 2020 and year 2035, respectively, versions of the Initial Vision scenario (as well as the other four scenarios, which are described in subsequent sections of this document).

3.2.3 Transit supply

The Transportation 2035 network also includes transit projects, details of which are available in the previously-cited references. Figure 8 and Figure 9 below show the growth in transit seat miles relative to a 2005 base year for the year 2020 and year 2035, respectively, versions of the Initial Vision and other forecast scenarios. Importantly, the transit network uses the year 2010 networks as the "background" network – meaning, the networks were created by starting with a 2010 representation of transit service and then adding/deleting/modifying projects as necessary to represent the service described in each included project.

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[8] The best available information at the time of writing is: http://onebayarea.org/pdf/alternative/SCS_Alternative_Scenarios_Aug_2011.pdf.

[9] Full details are available here: http://www.mtc.ca.gov/planning/2035_plan/index.htm

[10] The best available information at the time of writing is available here: http://onebayarea.org/plan_bay_area/land_use.htm.

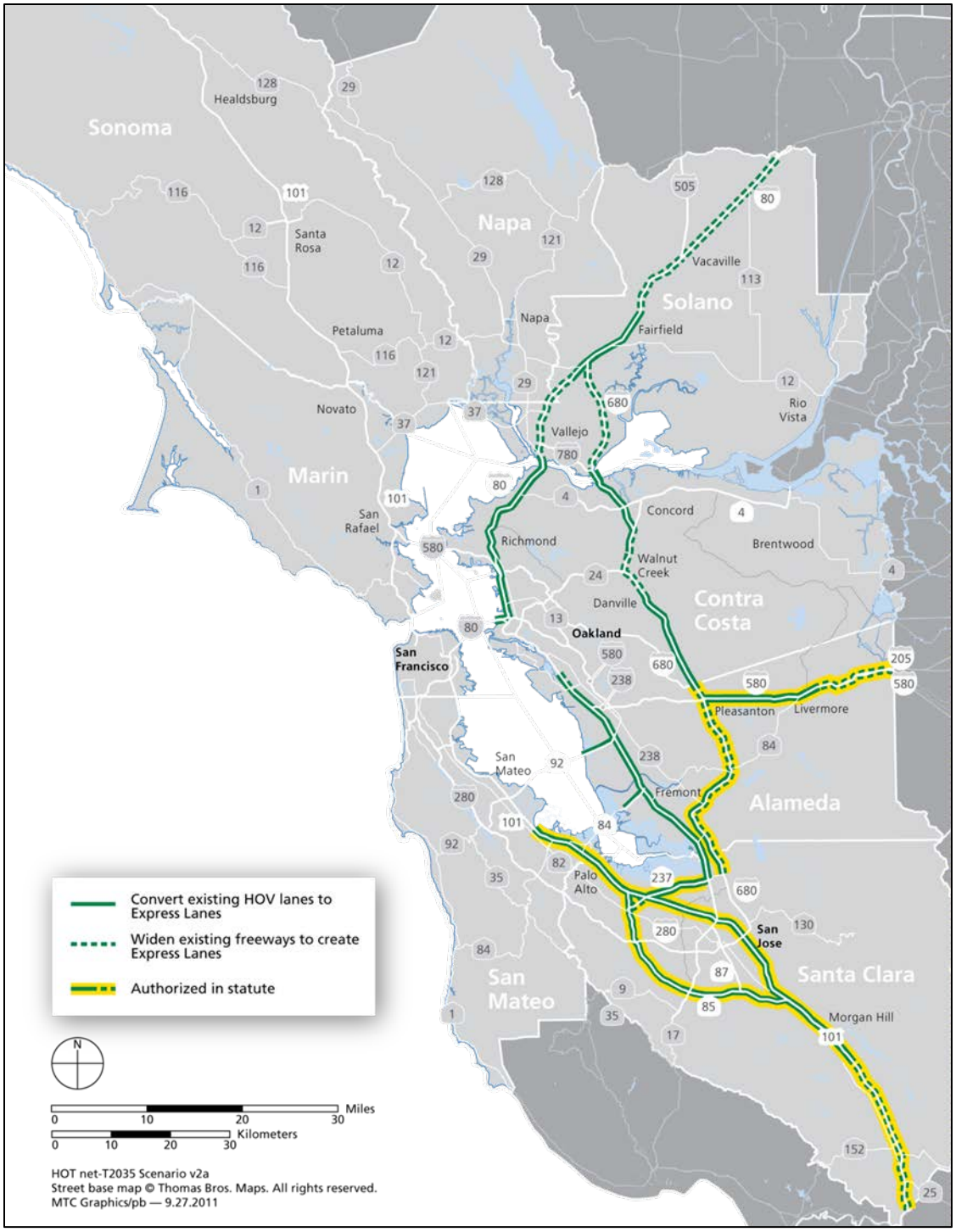

Figure 5: Year 2035, Transportation 2035 High Occupancy Toll Network

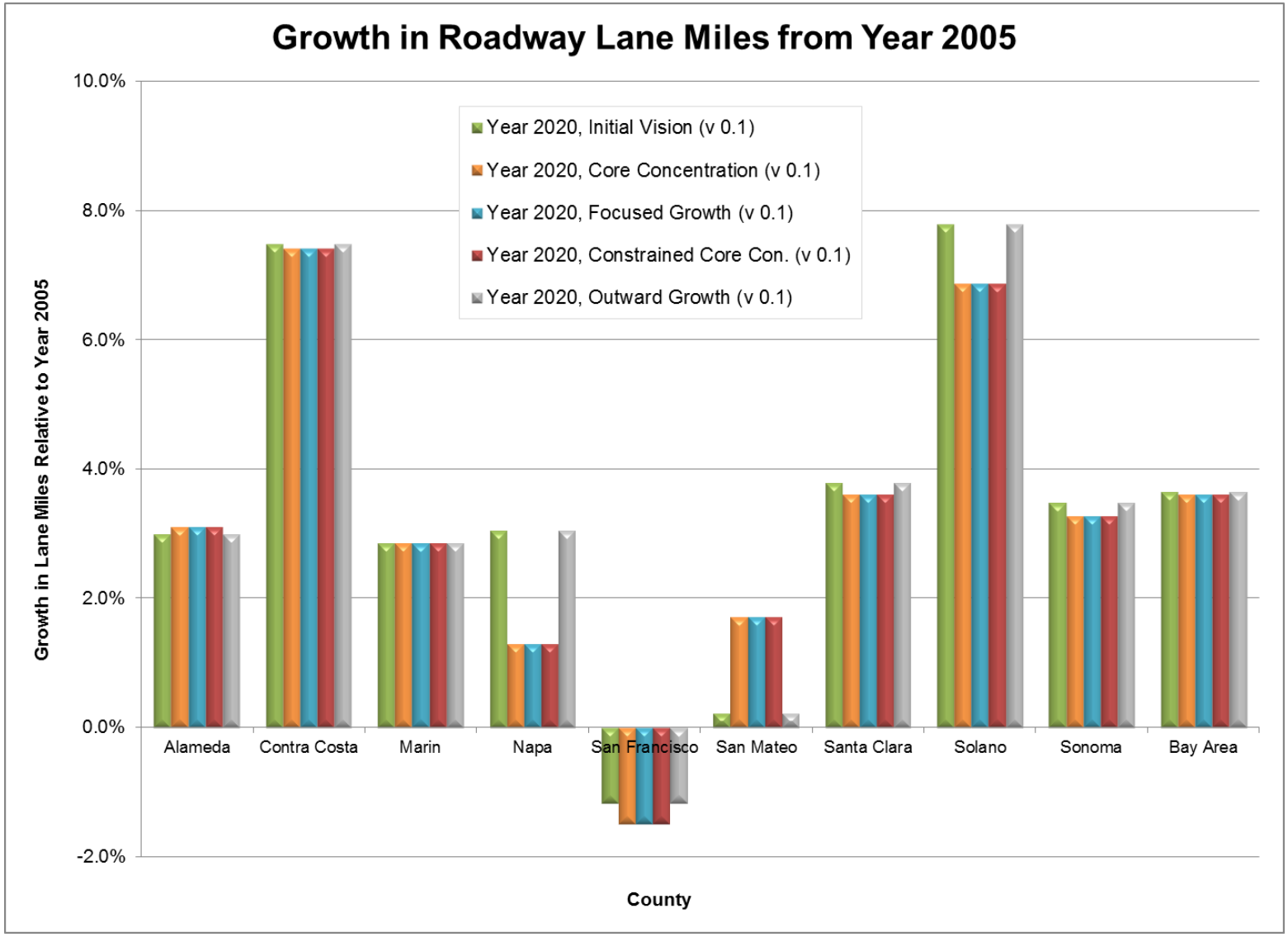

Figure 6: Growth in Roadway Lane Miles from Year 2005 to Year 2020

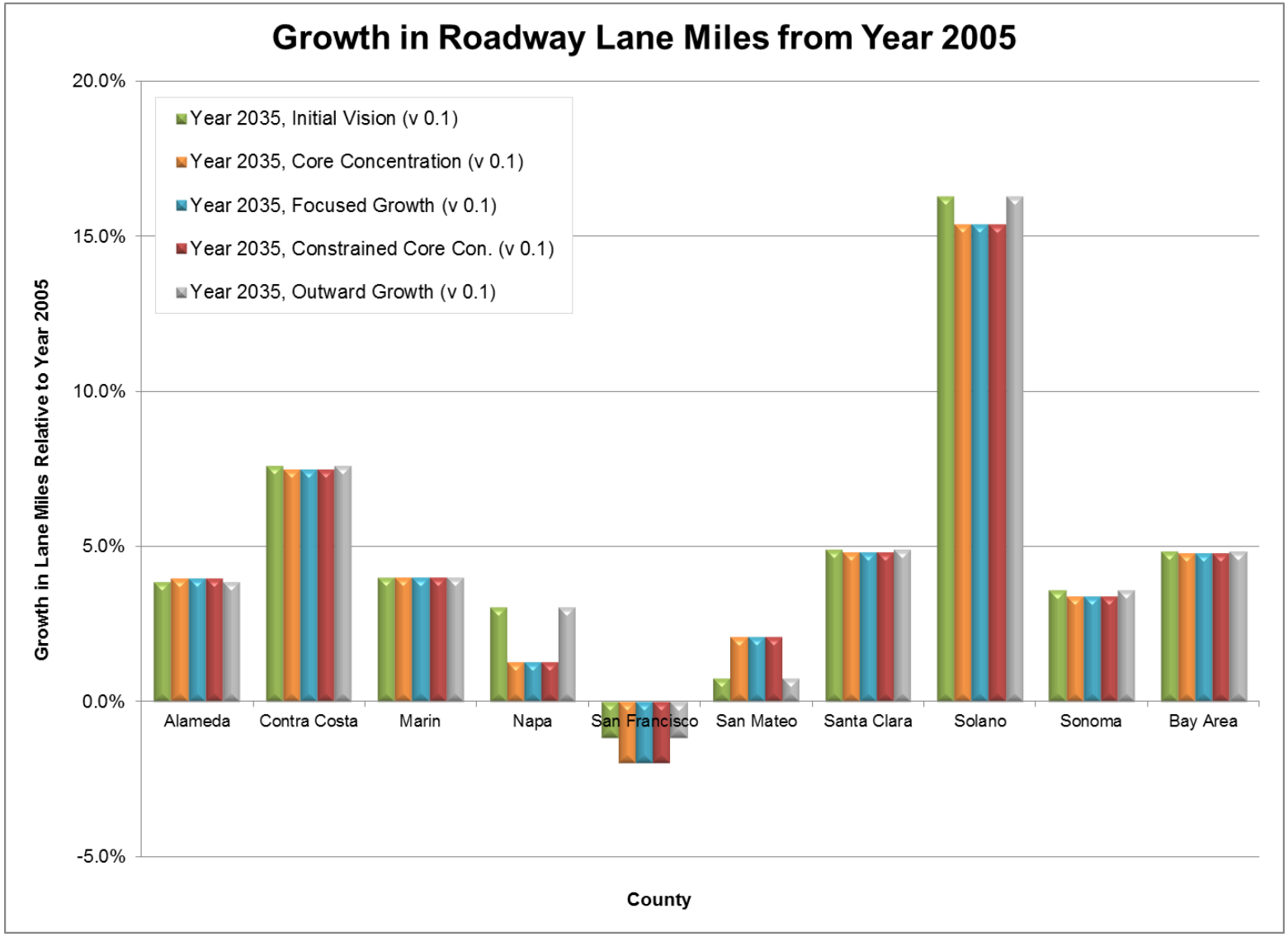

Figure 7: Growth in Roadway Lane Miles from Year 2005 to Year 2035

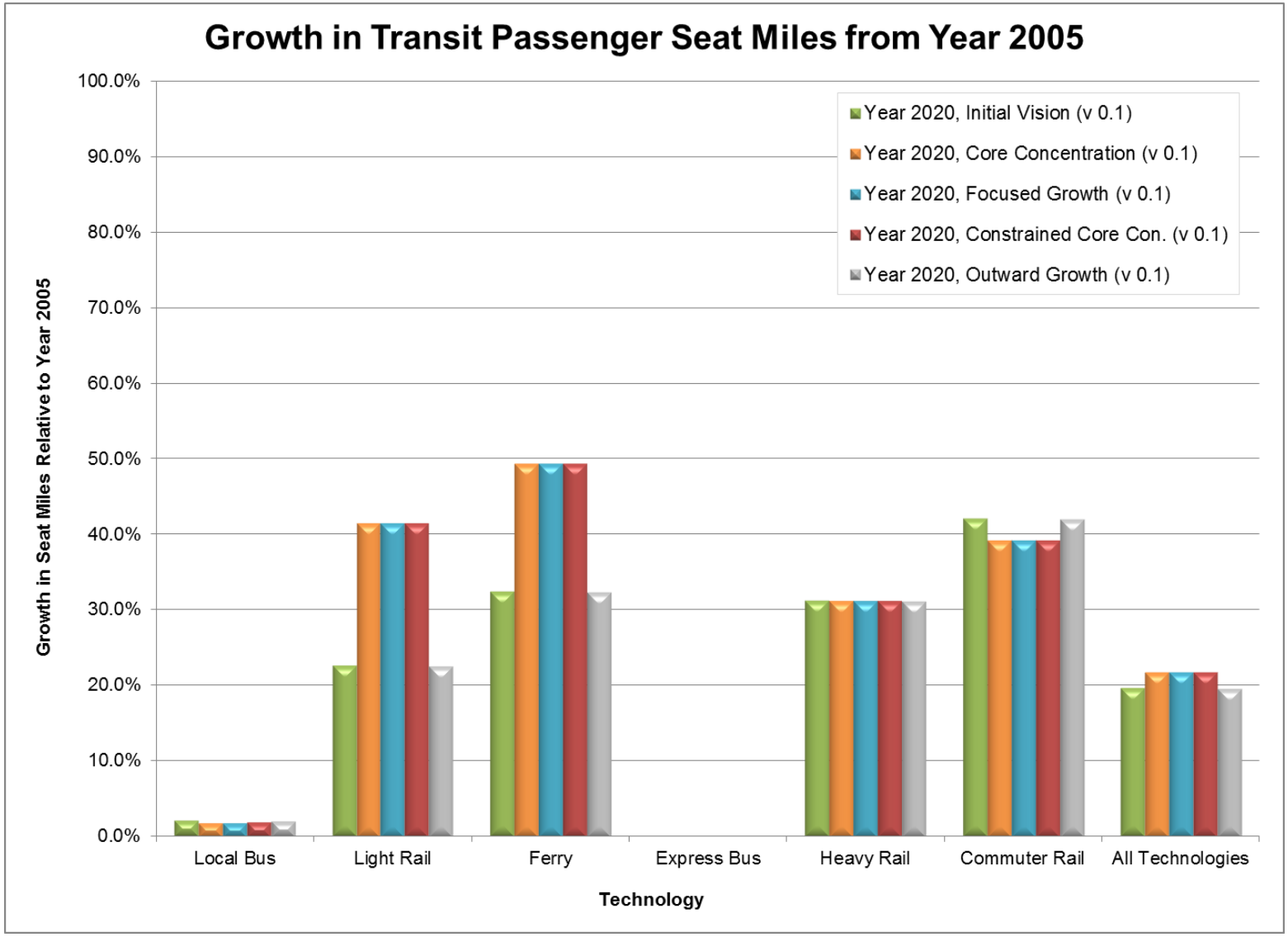

Figure 8: Growth in Transit Passenger Seat Miles from Year 2005 to Year 2020

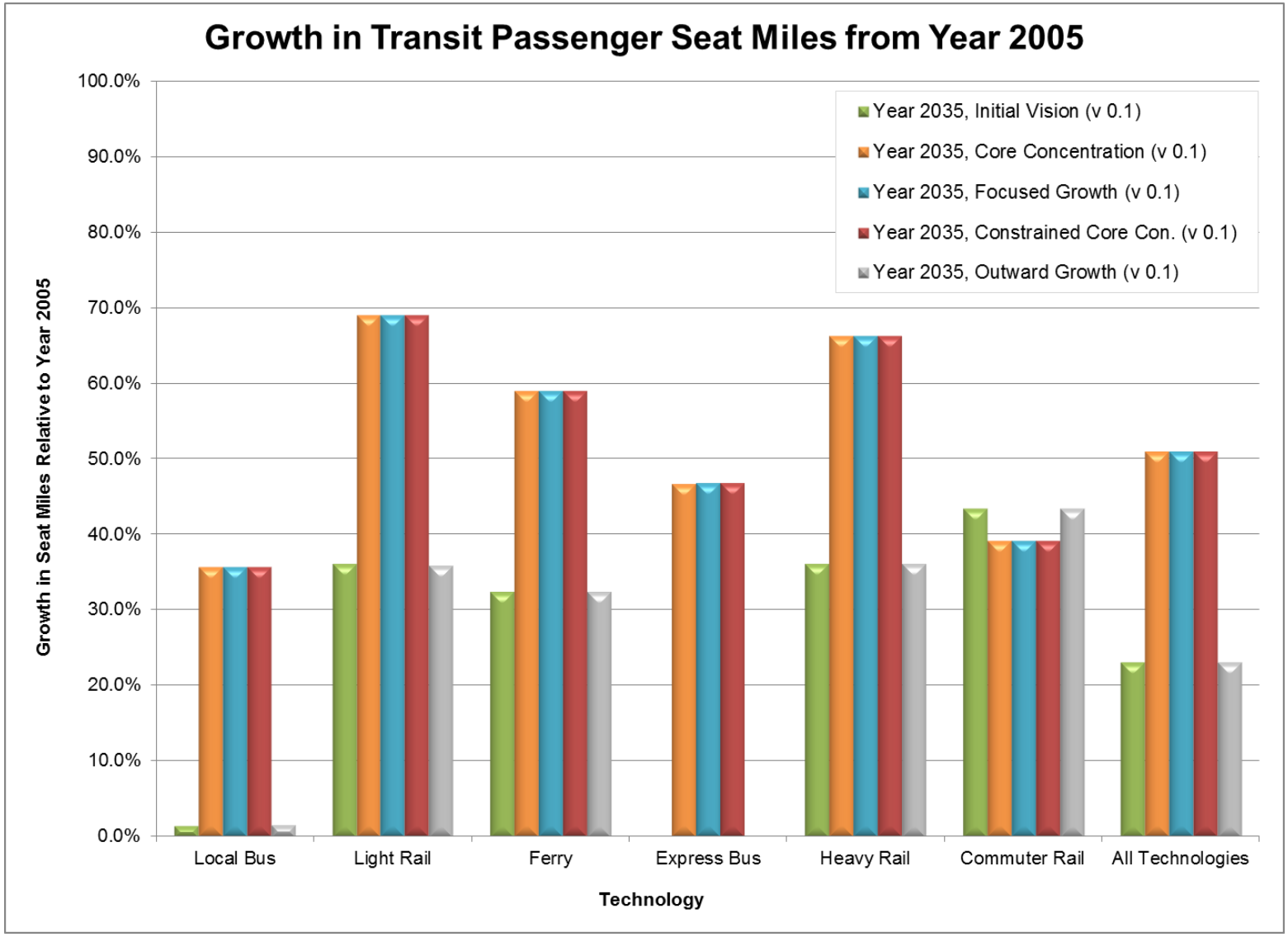

Figure 9: Growth in Transit Passenger Seat Miles from Year 2005 to Year 2035

3.2.4 Prices

As with the baseline scenario, five different types of prices are included in the Initial Vision scenario, as follows: (i) bridge tolls; (ii) high-occupancy-lane tolls; (iii) transit fares; (iv) perceived automobile operating cost; and, (v) parking charges. A note on value of time precedes the discussion of each of these prices.

Value of Travel Time

In each of the forecast scenarios, ABAG assumes a slight increase in real incomes, i.e. the average Bay Area household's income will increase at a rate that exceeds inflation. Because the model's prediction of each traveler's value of time is a function of household income (see *3.1.4 Prices*), the average traveler will have a higher value of time in the forecast years than the base year.

Bridge Tolls

The bridge tolls assumed in each of the forecast scenarios are shown below in Table 5; these toll values are expected to be in place as of July 1, 2012[11]. Table 5 includes the price of tolls in years 2020 and 2035 expressed in both year 2000 and year 2010 dollars. The bridge tolls, as expressed in year 2000 dollars, do not change in the forecast years; the implication of this assumption is that MTC expects bridge fares to be as "expensive" relative to parking fees, travel time, and transit fares in the forecast years as they are today.

Table 5: Common Peak Period Bridge Tolls in Year 2020 and Year 2035 Scenarios†

Bridge	2-axle, Single-occupant Vehicle Toll ($2000)	2-axle, Single-occupant Vehicle Toll ($2010)	2-axle, Carpool * Vehicle Toll ($2000)	2-axle, Carpool Vehicle Toll ($2010)
San Francisco/Oakland Bay Bridge	$4.82	$6.00	$2.01	$2.50
Antioch Bridge	$4.02	$5.00	$2.01	$2.50
Benicia-Martinez Bridge	$4.02	$5.00	$2.01	$2.50
Carquinez Bridge	$4.02	$5.00	$2.01	$2.50
Dumbarton Bridge	$4.02	$5.00	$2.01	$2.50
Richmond-San Rafael Bridge	$4.02	$5.00	$2.01	$2.50
San Mateo Bridge	$4.02	$5.00	$2.01	$2.50
Golden Gate Bridge	$4.82	$6.00	$2.41	$3.00

† The full toll schedule includes off-peak tolls and tolls for 3- or more axle vehicles; * Carpools are defined as either two-or-more- or three-or-more-occupant private vehicles, depending on the bridge, and only receive a discount during the morning and evening peak periods (Source: bata.mtc.ca.gov; goldengatebridge.org)

[11] Complete details are available here: http://bata.mtc.ca.gov/tolls/schedule.htm.

High-occupancy Toll (HOT) Lane Prices

MTC's *Travel Model One* explicitly represents the choice of travelers to pay a toll to use a high-occupancy toll lane in exchange for the travel time savings offered by that facility. To exploit this functionality, the analyst must explicitly assign a travel price by time of day and vehicle class on each HOT link in the network. To increase the efficiency and transparency of this effort, MTC segmented the Transportation 2035 HOT network, which is part of the Initial Vision scenario, into about fifty corridors, with each corridor receiving a time-of-day-specific per mile price.

Table 6 presents the limits of each of HOT corridors, as well as the number of lanes and occupancy rules for each corridor, for the year 2020 Transportation 2035 network. In corridors with "2+" occupancy rules, carpools with two or more persons may use the lanes for free; in corridors with "3+" occupancy rules, carpools with three or more persons may use the lanes for free. The prices included in Table 6 are the peak period, peak direction price for each corridor.

Table 7 presents the same information for the year 2035 Transportation 2035 network.

Table 6: Year 2020, Transportation 2035 Network Peak Period, Peak Direction HOT Lane Prices

Roadway		From	To	Lanes	Occu-pancy Rules	Cents per mile ($2000)	Cents per mile ($2010)
I-80	WB	Vallejo	Bay Bridge	1	3+	6.0	7.5
I-80	WB	I-680	Route 12	1	3+	6.0	7.5
I-80	EB	Bay Bridge	Vallejo	1	3+	2.0	2.5
I-80	EB	Route 12	I-680	1	3+	2.0	2.5
I-80	WB	Fairfield	I-680	1	3+	0.0	0.0
I-80	EB	I-680	Fairfield	1	3+	0.0	0.0
I-880	NB	CA 237	Oakland International	1	2+	10.0	12.5
I-880	SB	Oakland International	CA 237	1	2+	18.0	22.4
US 101	NB	I-880	Santa Clara Cnty line	2	2+	4.0	5.0
US 101	NB	Santa Clara Cnty line	Whipple Rd	1	2+	6.0	7.5
US 101	SB	Whipple Rd	Santa Clara Cnty line	1	2+	4.0	5.0
US 101	SB	Santa Clara Cnty line	I-880	2	2+	2.0	2.5
US 101	NB	Cochrane Rd	I-880	2	2+	0.2	0.2
US 101	SB	I-880	Cochrane Rd	2	2+	0.2	0.2
CA 85	NB	US 101	I-280	1	2+	0.3	0.4
CA 85	NB	I-280	SR 87	2	2+	0.1	0.1
CA 85	NB	SR 87	US 101	1	2+	0.3	0.4
CA 85	SB	US 101	SR 87	1	3+	0.2	0.2
CA 85	SB	SR 87	I-280	2	2+	0.0	0.0
CA 85	SB	I-280	US 101	1	3+	0.2	0.2
I-680	SB	I-580	Calaveras Rd	1	2+	35.0	43.6
I-680	NB	Calaveras Rd	I-580	1	2+	8.0	10.0
I-680	SB	Walnut Creek	I-580	1	2+	10.0	12.5
I-680	NB	I-580	Walnut Creek	1	2+	3.0	3.7
I-580	WB	Vasco Road	I-680	1	2+	10.0	12.5
I-580	EB	I-680	Tassajara Rd	1	2+	4.0	5.0
I-580	EB	Tassajara Rd	Vasco Rd	2	2+	2.0	2.5
I-580	EB	Vasco Rd	Greenville Rd	1	2+	4.0	5.0
CA 237	WB	I-880	CA 85	1	2+	20.0	24.9
CA 237	EB	CA 85	I-880	1	2+	10.0	12.5

† This is a sample, rather than an exhaustive list, as separate tolls are coded for each of five time periods, as follows: early AM (3 am to 6 am), AM peak (6 am to 10 am), midday (10 am to 3 pm), PM peak (3 pm to 7 pm), and evening (7 pm to 3 am the next day). The above tolls are for the peak period for each corridor, which is either the AM peak or the PM peak, depending on the directionality of travel.

Table 7: Year 2035, Transportation 2035 Network Peak Period, Peak Direction HOT Lane Prices

Roadway		From	To	Lanes	Occu-pancy Rules	Cents per mile ($2000)	Cents per mile ($2010)
I-80	WB	I-680	Bay Bridge	1	3+	9.0	11.2
I-80	EB	Bay Bridge	I-680	1	3+	3.0	3.7
I-80	WB	Yolo County line	I-680	1	3+	0.0	0.0
I-80	EB	I-680	Yolo County line	1	3+	0.0	0.0
I-880	NB	CA 237	Oakland International	1	3+	9.5	11.8
I-880	SB	Oakland International	CA 237	1	3+	16.0	19.9
US 101	NB	I-880	Santa Clara Cnty line	2	2+	5.0	6.2
US 101	NB	Santa Clara Cnty line	Whipple Rd	1	3+	5.0	6.2
US 101	SB	Whipple Rd	Santa Clara Cnty line	1	3+	3.0	3.7
US 101	SB	Santa Clara Cnty line	I-880	2	2+	3.0	3.7
US 101	NB	San Benito Cnty line	Cochrane Rd	1	3+	0.3	0.4
US 101	NB	Cochrane Rd	I-880	2	2+	0.3	0.4
US 101	SB	I-880	Cochrane Rd	2	2+	0.3	0.4
US 101	SB	Cochrane Rd	San Benito Cnty line	1	3+	0.3	0.4
CA 85	NB	US 101	I-280	1	3+	0.2	0.2
CA 85	NB	I-280	SR 87	2	2+	0.2	0.2
CA 85	NB	SR 87	US 101	1	3+	0.2	0.2
CA 85	SB	US 101	SR 87	1	3+	0.1	0.1
CA 85	SB	SR 87	I-280	2	2+	0.1	0.1
CA 85	SB	I-280	US 101	1	3+	0.1	0.1
I-680	SB	I-580	Calaveras Rd	1	3+	28.0	34.9
I-680	NB	Calaveras Rd	I-580	1	3+	6.0	7.5
I-680	SB	I-80	I-580	1	3+	6.0	7.5
I-680	NB	I-580	I-80	1	3+	2.5	3.1
I-580	WB	San Joaquin Cnty line	I-680	1	3+	7.0	8.7
I-580	EB	I-680	Tassajara Rd	1	3+	3.0	3.7
I-580	EB	Tassajara Rd	Vasco Rd	2	2+	3.0	3.7
I-580	EB	Vasco Rd	San Joaquin Cnty line	1	3+	3.0	3.7
CA 237	WB	I-880	CA 85	1	3+	17.0	21.2
CA 237	EB	CA 85	I-880	1	3+	8.0	10.0

† This is a sample, rather than an exhaustive list, as separate tolls are coded for each of five time periods, as follows: early AM (3 am to 6 am), AM peak (6 am to 10 am), midday (10 am to 3 pm), PM peak (3 pm to 7 pm), and evening (7 pm to 3 am the next day). The above tolls are for the peak period for each corridor, which is either the AM peak or the PM peak, depending on the directionality of travel.

The prices presented in Table 6 and Table 7 are not optimal; meaning, MTC did not analyze each corridor iteratively to find the price that maximized a pre-defined operational goal. Rather, the prices were adjusted a couple of times in an attempt to keep congestion low and utilization high. Please keep in mind that these prices are held constant over four-hour morning/evening peak period assignments. Meaning, MTC's model structure assumes congestion to be uniform over the morning and evening peak periods. We know this is not true, but make this assumption as a simplification; the peak one-hour within the peak four-hours would require a higher toll than those listed in the tables above.

Transit Fares

As noted above, the transit networks used in this scenario are built from the year 2010 transit networks. As such, the transit fares in place in 2010 remain in place through the year 2020 and year 2035 scenarios. By keeping these values constant in year 2000 dollars, MTC is explicitly assuming that transit fares will keep pace with inflation in the forecast years. Please note that Table 8 includes the price of fares in year 2010 expressed in both year 2000 and year 2010 dollars (i.e., the table does not include information about the cost of taking transit in year 2000).

Table 8: Common Transit Fares in Forecast Year Scenarios[†]

Operator	Base Fare ($2000)	Base Fare ($2010)
San Francisco Municipal Transportation Agency (Muni)	$1.58	$2.00
Alameda Contra Costa Transit (AC Transit)	$1.58	$2.00
Santa Clara Valley Transportation Authority (VTA) – Local buses	$1.58	$2.00
Santa Clara Valley Transportation Authority (VTA) – Express buses	$3.17	$4.00
San Mateo County Transit (SamTrans) – Local buses	$1.58	$2.00
Golden Gate Transit – Marin County to San Francisco service	$3.37	$4.25
County Connection (CCCTA)	$1.58	$2.00
Vallejo Transit	$1.39	$1.75
Tri-Delta Transit	$1.39	$1.75
Livermore Amador Valley Transit Authority (WHEELS)	$1.58	$2.00

[†] This is a sample, rather than an exhaustive list, of Bay Area transit providers and fares.

Perceived Automobile Operating Cost

For the Initial Vision scenarios, the perceived automobile operating cost is assumed to be 22.3 cents per mile ($2000) in 2020 and 22.2 cents per mile ($2000) in 2035 (in $2010, the prices are 28.1 and 28.0 cents per mile, respectively); see Table 4 for details. By increasing the perceived cost of operating an automobile in the forecast years, MTC is explicitly assuming that operating a car will be more expensive in 2020 and 2035 than it was in 2005 relative to transit fares, travel time, bridge tolls, and parking fees.

Parking Costs

MTC assumes that parking prices will change over time per a simple model: parking cost is assumed to increase linearly with employment density. In the current analysis, future year density estimates are based on the land use data provided by ABAG.

3.3 Core Concentration Scenarios

The second of the five forecast scenarios is named Core Concentration and pairs a more focused and dense land use pattern with a transit-centric transportation network. Details are described below.

3.3.1 Land use inputs

A broad overview of the Core Concentration land use pattern is presented in Table 1, Figure 1, and Figure 2. The OneBayArea.org website contains more complete information about the different land use scenarios[12].

3.3.2 Roadway supply

As noted previously, each of the five forecast scenarios is paired with one of two transportation networks. The Initial Vision scenario is paired with the Transportation 2035 Network. The Core Concentration scenario is paired with the "Core Capacity Transit" network, which allocates less funds on roadway expansion and more funds to transit service relative to the Transportation 2035 Network. Details of the projects included in the roadway network are available on the OneBayArea.org website[13].

The Core Capacity Transit network includes a more robust HOT high-occupancy toll (HOT) lane network than the Transportation 2035 Network. The build out of this system, assumed to be complete by year 2035, includes 700 miles of HOT lanes, 390 of which are created by converting existing high-occupancy vehicle (HOV) lanes and 90 miles of which are created by converting an existing general purpose and/or auxiliary lane. The limits of the HOT network expected to be in place by 2020 are summarized in Table 9.

Figure 6 and Figure 7 above show the growth in roadway miles relative to a 2005 base year for the year 2020 and year 2035, respectively, versions of the Core Concentration scenario.

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[12] At the time of writing, the best available information is located here: http://onebayarea.org/plan_bay_area/land_use.htm.

[13] At the time of writing, the best available information is located here: http://onebayarea.org/plan_bay_area/land_use.htm.

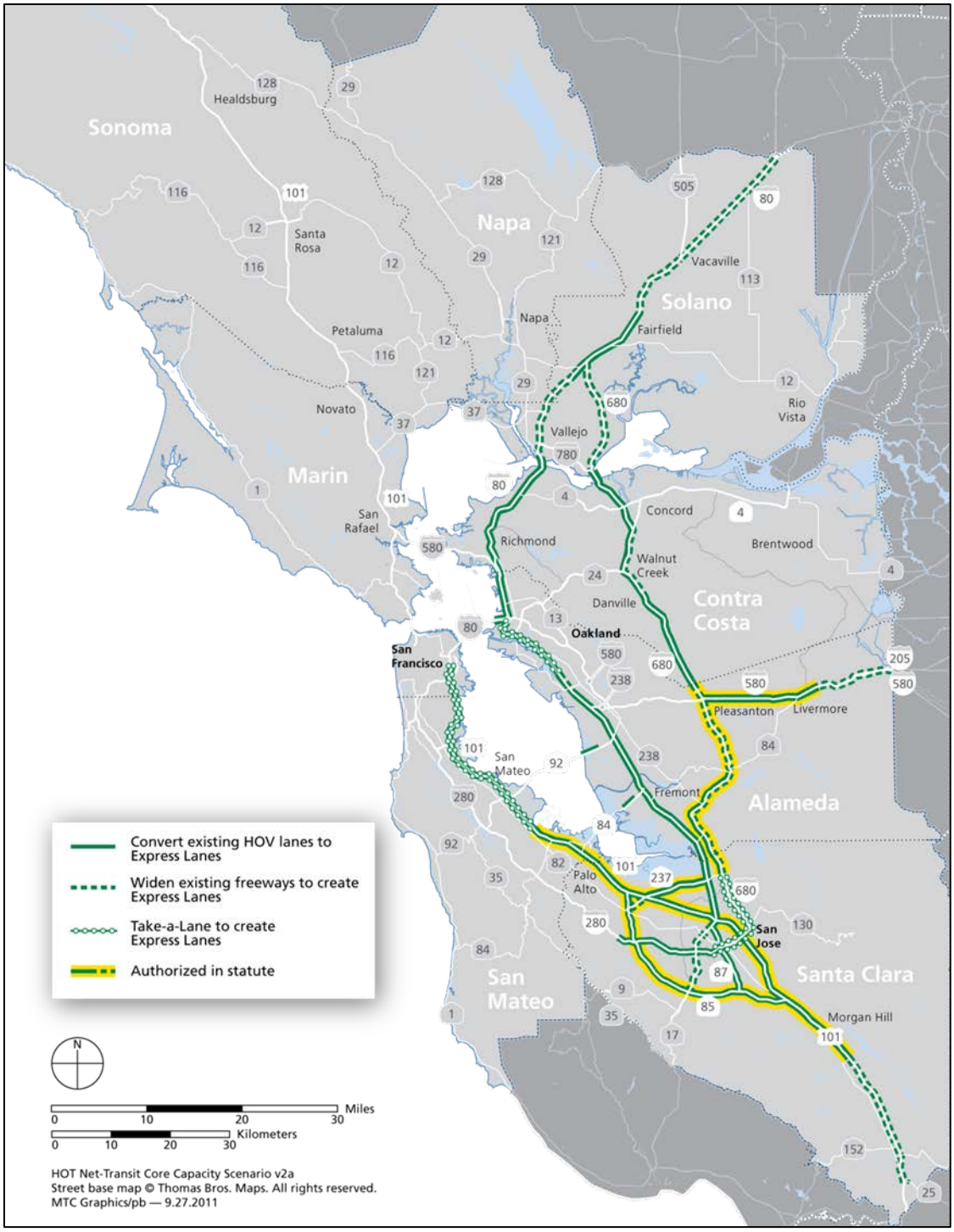

Figure 10: Year 2035, Core Capacity Transit High Occupancy Toll Network

3.3.3 Transit supply

The Core Capacity Transit network also includes transit projects, details of which are available in the previously-cited references. Figure 8 and Figure 9 above show the growth in transit seat miles relative to a 2005 base year for the year 2020 and year 2035, respectively, versions of the Core Concentration scenarios. Importantly, the transit network uses the year 2010 networks as the "background" network – meaning, the networks were created by starting with a 2010 representation of transit service and then adding/deleting/modifying projects as necessary to represent the service described in each included project. The Core Capacity Transit network also includes service improvements that were not submitted as projects through MTC. MTC wanted to improve service in corridors that were expected to experience significant growth between year 2010 and 2035, but were not served by the projects submitted by the project sponsors. A list of the routes on which MTC improved headways, as well as a rough cost estimate for these increases, is included in *Appendix B: Core Capacity Transit Network Non-Project Service Improvements*; a map of the routes MTC improved is also available[14].

3.3.4 Prices

A brief note about value of time is followed by descriptions of the following six types of prices assumed in the Core Concentration scenario: (i) bridge tolls; (ii) high-occupancy toll (HOT) lane prices; (iii) transit fares; (iv) perceived automobile operating cost; (v) parking fees; and, (vi) cordon tolls. The Transportation 2035 network, which was part of the Initial Vision scenario, did not include cordon tolls; the Core Capacity Transit network, which is part of the Core Concentration scenario, does.

Value of Travel Time

Time is valued in the Core Concentration (as well as all other forecast) scenarios in a manner identical to the Initial Vision scenarios.

Bridge Tolls

The bridge tolls assumed in the Core Concentration scenario are shown in Table 5 and are identical to those assumed in each of the forecast scenarios; these toll values were in place as of July 1, 2012 and are assumed to increase with inflation.

High-occupancy Toll (HOT) Lane Prices

Table 9 presents the limits of each of HOT corridors, as well as the number of lanes and occupancy rules for each corridor, for the year 2020 Core Capacity Transit network. In corridors with "2+" occupancy rules, carpools with two or more persons may use the lanes for free; in corridors with "3+" occupancy rules, carpools with three or more persons may use the lanes for free. The prices included in Table 9 are the peak period, peak direction price for each corridor. Table 10 presents the same information for the year 2035 Core Capacity Transit network.

[14] Here: http://geocommons.com/maps/121505

Table 9: Year 2020, Core Capacity Transit Network Peak Period, Peak Direction High Occupancy Toll Lane Prices

Roadway		From	To	Lanes	Occu-pancy Rules	Cents per mile ($2000)	Cents per mile ($2010)
I-80	WB	Vallejo	Bay Bridge	1	3+	10.0	12.5
I-80	WB	I-680	Route 12	1	3+	10.0	12.5
I-80	EB	Bay Bridge	Vallejo	1	3+	3.0	3.7
I-80	EB	Route 12	I-680	1	3+	3.0	3.7
I-80	WB	Fairfield	I-680	1	3+	0.0	0.0
I-80	EB	I-680	Fairfield	1	3+	0.0	0.0
I-880	NB	US 101	Bay Bridge	1	2+	14.0	17.4
I-880	SB	Bay Bridge	US 101	1	2+	30.0	37.4
US 101	NB	I-880	Santa Clara Cnty line	2	2+	4.0	5.0
US 101	NB	Santa Clara Cnty line	Cesar Chavez (SF)	1	2+	7.5	9.3
US 101	SB	Cesar Chavez	Santa Clara Cnty line	1	2+	5.0	6.2
US 101	SB	Santa Clara Cnty line	I-880	2	2+	2.0	2.5
US 101	NB	Cochrane Rd	I-880	2	2+	0.2	0.2
US 101	SB	I-880	Cochrane Rd	2	2+	0.2	0.2
CA 85	NB	US 101	I-280	1	2+	0.3	0.4
CA 85	NB	I-280	SR 87	2	2+	0.1	0.1
CA 85	NB	SR 87	US 101	1	2+	0.3	0.4
CA 85	SB	US 101	SR 87	1	3+	0.2	0.2
CA 85	SB	SR 87	I-280	2	2+	0.0	0.0
CA 85	SB	I-280	US 101	1	3+	0.2	0.2
I-680	SB	I-580	US 101	1	2+	20.0	24.9
I-680	NB	US 101	I-580	1	2+	7.0	10.0
I-680	SB	Walnut Creek	I-580	1	2+	10.0	12.5
I-680	NB	I-580	Walnut Creek	1	2+	5.0	6.2
I-580	WB	San Joaquin Cnty line	I-680	1	2+	7.0	8.7
I-580	EB	I-680	Tassajara Rd	1	2+	3.0	3.7
I-580	EB	Tassajara Rd	Vasco Rd	2	2+	2.0	2.5
I-580	EB	Vasco Rd	Greenville Rd	1	2+	3.0	3.7
CA 237	WB	I-880	CA 85	1	2+	20.0	24.9
CA 237	EB	CA 85	I-880	1	2+	8.0	10.0
CA 87	NB	CA 85	US 101	1	2+	6.0	7.5
CA 87	SB	US 101	CA 85	1	2+	4.0	5.0
I-280	WB	US 101	Pass CA 85 interchange	1	2+	4.0	5.0
I-280	EB	Pass CA 85 interchange	US 101	1	2+	3.0	3.7

† This is a sample, rather than an exhaustive list, as separate tolls are coded for each of five time periods, as follows: early AM (3 am to 6 am), AM peak (6 am to 10 am), midday (10 am to 3 pm), PM peak (3 pm to 7 pm), and evening (7 pm to 3 am the next day). The above tolls are for the peak period for each corridor, which is either the AM peak or the PM peak, depending on the directionality of travel.

Table 10: Year 2035, Core Capacity Transit Network Peak Period, Peak Direction High Occupancy Toll Lane Prices

Roadway		From	To	Lanes	Occu-pancy Rules	Cents per mile ($2000)	Cents per mile ($2010)
I-80	WB	I-680	Bay Bridge	1	3+	9.0	11.2
I-80	EB	Bay Bridge	I-680	1	3+	3.0	3.7
I-80	WB	Yolo County line	I-680	1	3+	0.0	0.0
I-80	EB	I-680	Yolo County line	1	3+	0.0	0.0
I-880	NB	US 101	Bay Bridge	1	3+	6.5	8.1
I-880	SB	Bay Bridge	US 101	1	3+	10.0	12.5
I-880/CA 17	NB	CA 85	US 101	1	3+	1.5	1.9
I-880/CA 17	SB	US 101	CA 85	1	3+	2.0	2.5
US 101	NB	I-880	Santa Clara Cnty line	2	2+	5.0	6.2
US 101	NB	Santa Clara Cnty line	Cesar Chavez (SF)	1	3+	5.0	6.2
US 101	SB	Cesar Chavez (SF)	Santa Clara Cnty line	1	3+	3.0	3.7
US 101	SB	Santa Clara Cnty line	I-880	2	2+	3.0	3.7
US 101	NB	San Benito Cnty line	Cochrane Rd	1	3+	0.3	0.4
US 101	NB	Cochrane Rd	I-880	2	2+	0.3	0.4
US 101	SB	I-880	Cochrane Rd	2	2+	0.3	0.4
US 101	SB	Cochrane Rd	San Benito Cnty line	1	3+	0.3	0.4
CA 85	NB	US 101	I-280	1	3+	0.2	0.2
CA 85	NB	I-280	SR 87	2	2+	0.2	0.2
CA 85	NB	SR 87	US 101	1	3+	0.2	0.2
CA 85	SB	US 101	SR 87	1	3+	0.1	0.1
CA 85	SB	SR 87	I-280	2	2+	0.1	0.1
CA 85	SB	I-280	US 101	1	3+	0.1	0.1
I-680	SB	I-580	US 101	1	3+	9.0	11.2
I-680	NB	US 101	I-580	1	3+	3.5	4.4
I-680	SB	I-80	I-580	1	3+	3.0	3.7
I-680	NB	I-580	I-80	1	3+	0.8	1.0
I-580	WB	San Joaquin Cnty line	I-680	1	3+	3.0	3.7
I-580	EB	I-680	Tassajara Rd	1	3+	3.0	3.7
I-580	EB	Tassajara Rd	Vasco Rd	2	2+	3.0	3.7
I-580	EB	Vasco Rd	San Joaquin Cnty line	1	3+	3.0	3.7
CA 237	WB	I-880	CA 85	1	3+	15.0	18.7
CA 237	EB	CA 85	I-880	1	3+	5.0	6.2
CA 87	NB	CA 85	US 101	1	3+	3.0	3.7
CA 87	SB	US 101	CA 85	1	3+	4.0	5.0
I-280	WB	US 101	Pass CA 85 interchange	1	3+	3.0	3.7
I-280	EB	Pass CA 85 interchange	US 101	1	3+	2.0	2.5

† This is a sample, rather than an exhaustive list, as separate tolls are coded for each of five time periods, as follows: early AM (3 am to 6 am), AM peak (6 am to 10 am), midday (10 am to 3 pm), PM peak (3 pm to 7 pm), and evening (7 pm to 3 am the next day). The above tolls are for the peak period for each corridor, which is either the AM peak or the PM peak, depending on the directionality of travel.

Transit Fares

The transit networks used in this scenario are built from the year 2010 transit networks. As such, the transit fares in place in 2010 remain in place through the year 2020 and year 2035. The fares are the same in each of the forecast year scenarios, including the Core Concentration scenarios – see Table 8 for details.

Perceived Automobile Operating Cost

The perceived automobile operating cost is the same in each of the forecast year scenarios, including the Core Concentration scenarios; see Table 4 for details.

Parking Costs

As noted in the Initial Vision scenario section, MTC assumes that parking prices increase linearly with employment density. In the current analysis, future year density estimates are based on the Core Concentration land use data.

Cordon Tolls

The Core Capacity transit etwork, which is part of the Core Concentration scenarios, includes two new pricing schemes. The first is a $3.00 ($2010; $2.40 in year 2000 dollars) fee charged to all vehicles to enter the greater downtown San Francisco area during the morning and evening peak periods. The cordoned area is bounded by Laguna Street to the West, 18th Street to the South, and the San Francisco Bay to the North and East[15]. The second fee is charged to personal vehicles entering and exiting Treasure Island during the morning and evening periods; the fee is $5.00 ($2010; $4.02 in year 2000 dollars). Both of these fees are in place in both 2020 and 2035.

3.4 Focused Growth Scenarios

The third scenario is referred to as "Focused Growth".

3.4.1 Land use inputs

A broad overview of the Focused Growth land use pattern is presented in Table 1, Figure 1, and Figure 2. The OneBayArea.org website contains more complete information about the different land use scenarios[16].

3.4.2 Roadway supply

The Focused Growth scenario uses the Core Capacity Transit roadway network, which is described in *3.3.2 Roadway supply* (the description of the Core Concentration scenario roadway network).

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[15] Additional details are available from San Francisco County here: http://www.sfcta.org/content/view/468/288/.

[16] At the time of writing, the best available information is located here: http://onebayarea.org/plan_bay_area/land_use.htm.

3.4.3 Transit supply

The Focused Growth scenario uses the Core Capacity Transit transit network, which is described in *3.3.3 Transit supply* (the description of the Core Concentration scenario transit network).

3.4.4 Prices

The Focused Growth scenario uses the same price assumptions as the Core Concentration scenario, as described in *3.3.4 Prices*. With the one exception of the parking prices, the absolute prices in the Focused Growth scenario are also identical to those assumed in the Core Concentration scenario.

3.5 Constrained Core Concentration Scenarios

The fourth scenario is referred to as "Constrained Core Concentration".

3.5.1 Land use inputs

A broad overview of the Constrained Core Concentration land use pattern is presented in Table 1, Figure 1, and Figure 2. The OneBayArea.org website contains more complete information about the different land use scenarios[17].

3.5.2 Roadway supply

The Constrained Core Concentration scenario uses the Core Capacity Transit roadway network, which is described in *3.3.2 Roadway supply* (the description of the Core Concentration scenario roadway network).

3.5.3 Transit supply

The Constrained Core Concentration scenario uses the Core Capacity Transit transit network, which is described in *3.3.3 Transit supply* (the description of the Core Concentration scenario transit network).

3.5.4 Prices

The Constrained Core Concentration scenario uses the same price assumptions as the Core Concentration scenario, as described in *3.3.4 Prices*. With the one exception of the parking prices, the absolute prices in the Constrained Core Concentration scenario are also identical to those assumed in the Core Concentration scenario.

3.6 Outward Growth Scenarios

The fifth scenario is referred to as "Outward Growth".

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[17] At the time of writing, the best available information is located here: http://onebayarea.org/plan_bay_area/land_use.htm.

3.6.1 Land use inputs

A broad overview of the Outward Growth land use pattern is presented in Table 1, Figure 1, and Figure 2. The OneBayArea.org website contains more complete information about the different land use scenarios.

3.6.2 Roadway supply

The Outward Growth scenario uses the Transportation 2035 roadway network, which is described in *3.2.2 Roadway supply* (the description of the Initial Vision scenario roadway network).

3.6.3 Transit supply

The Outward Growth scenario uses the Transportation 2035 transit network, which is described in *3.2.3 Transit supply* (the description of the Initial Vision scenario transit network).

3.6.4 Prices

The Outward Growth scenario uses the same price assumptions as the Initial Vision scenario, as described in *3.3.4 Prices*. With the one exception of the parking prices, the absolute prices in the Outward Growth scenario are identical to those assumed in the Initial Vision scenario.

4 Key Results

In this section, key travel model results for the base year and the five forecast scenarios are summarized across numerous dimensions of individual travel behavior and transport system performance.

4.1 Performance Targets and Equity Analysis

The purpose of this document is to describe the response of travelers to the projects and policies implemented in the five scenarios described in the previous section. The travel model also informs agency-adopted performance targets, the purpose of which is to illuminate the relative effectiveness of various alternatives in meeting the agency's long range goals. A separate summary of the performance targets methodology and results is forthcoming.

The travel model also informs an analysis of how different populations are impacted by the investments included in each scenario. A separate summary of the equity analysis methodology and results is forthcoming.

4.2 Automobile Ownership Levels

The automobile ownership decision is made in the travel model at the household level and considers, among other factors, household characteristics (e.g., number of workers, licensed drivers, and children), competiveness of transit for the work travel of household members, and accessibility of the home location to retail services.

Figure 11 presents the distribution of households by automobile ownership category for each of the five scenarios for year 2020; Figure 12 presents the year 2035 results. Important findings include:

- Across each of the scenarios, we see a small increase in the share of zero automobile households in the region from 2005 to 2020 and on through 2035; and,
- The two most compact scenarios, Scenario 2 Core Concentration and Scenario 4 Constrained Core Concentration, allow for the largest share of households to avoid owning a vehicle.

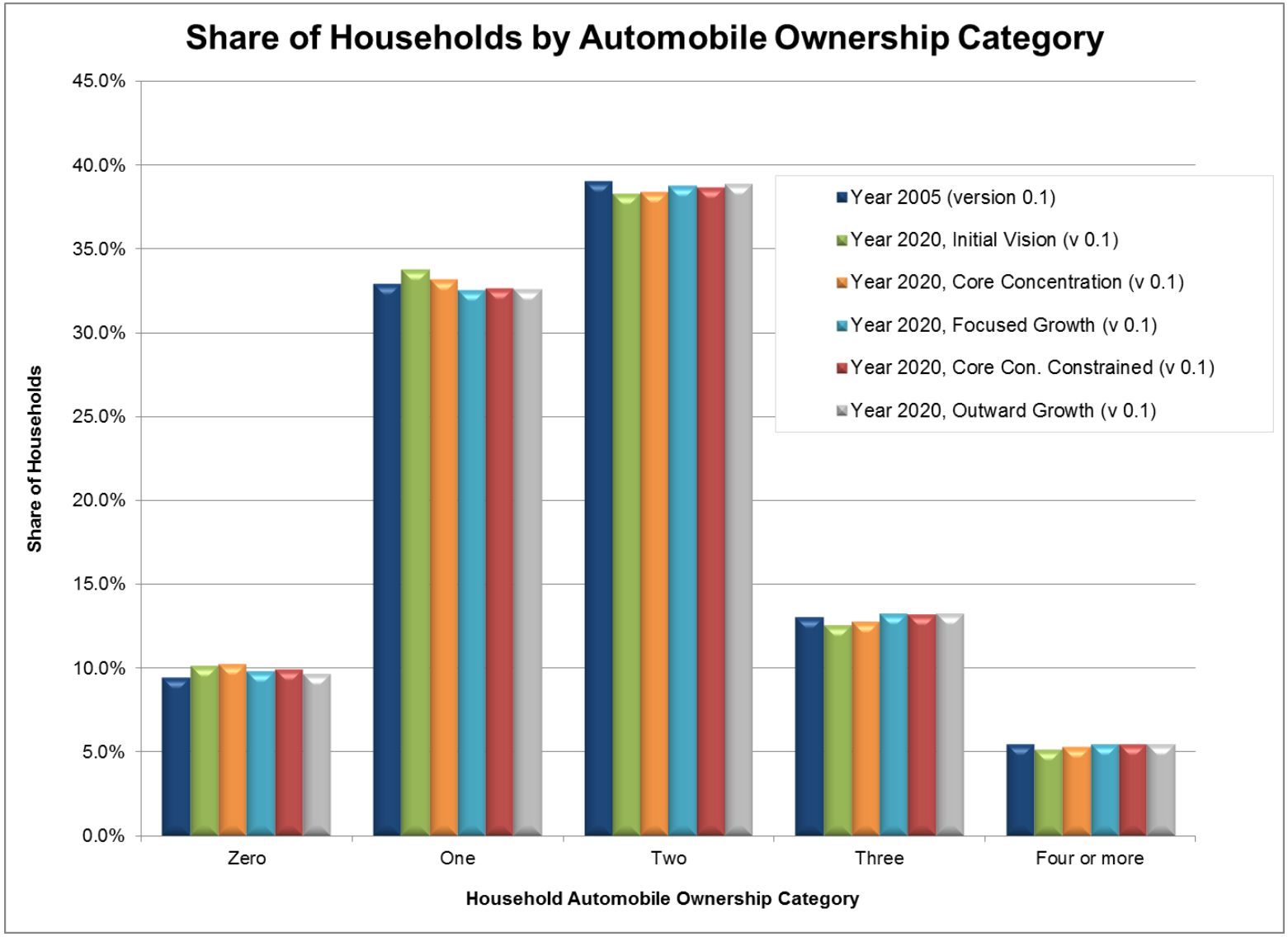

Figure 11: Year 2020, Share of Households by Automobile Ownership Category

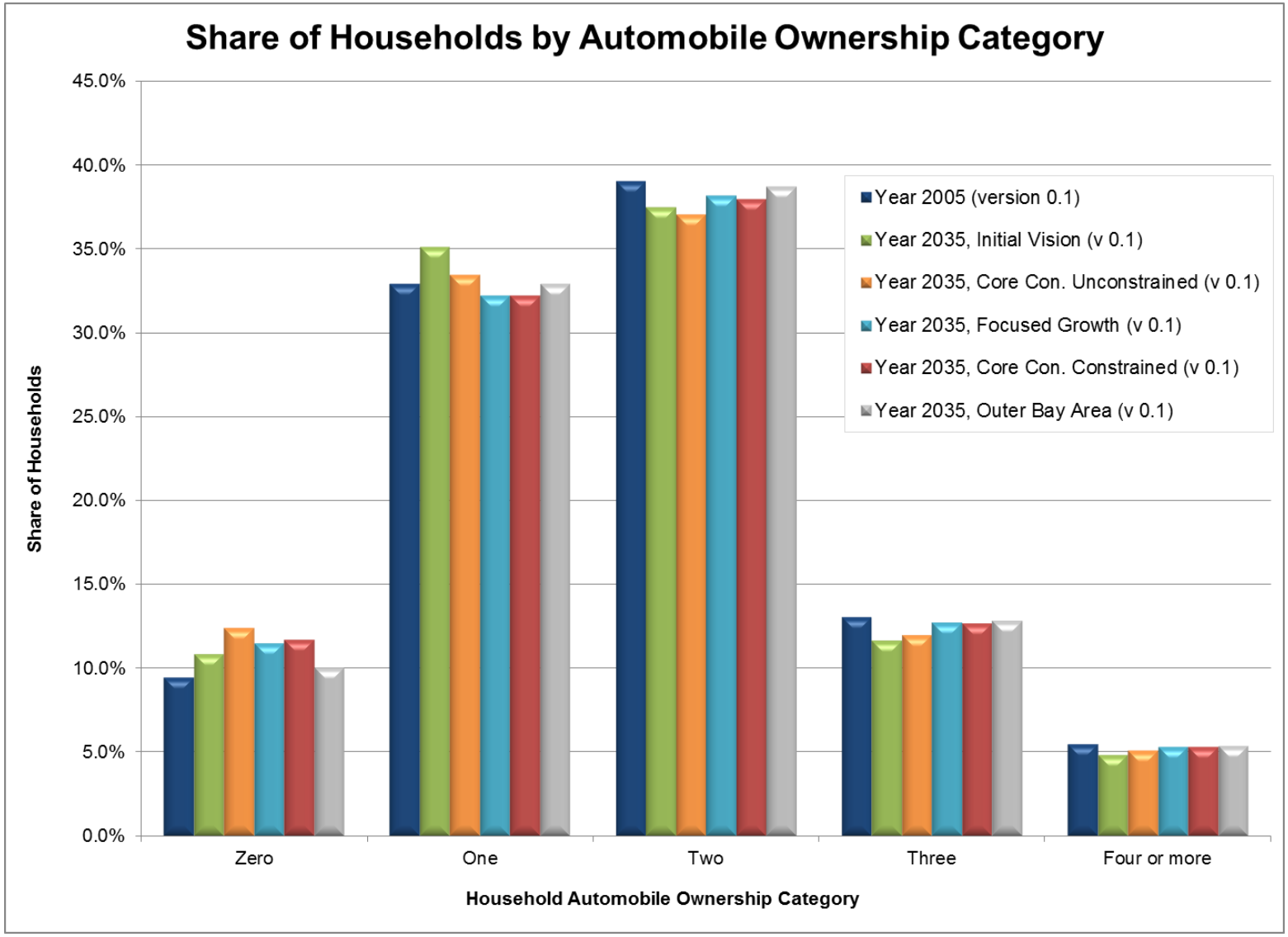

Figure 12: Year 2035, Share of Households by Automobile Ownership Category

4.3 Activity Location Decisions

The travel model explicitly identifies the location in which travelers participate in all manner of activities, including working, going to school, and visiting friends. These decisions are an important factor in determining the manner in which travel is made. Figure 13, Figure 14, Figure 15, and Figure 16 below provide a broad summary of both the volume of activity participation as well as the spatial separation of activity locations. Figure 13 and Figure 15 show the increase in trip making, by tour purpose[18], for forecast years 2020 and 2035, respectively. Figure 14 and Figure 16 summarize average trip distance, by travel mode, for all travel. Important findings from these charts include the following:

- The number of trips increases in the forecast years due to the increase in population. Scenario 1 Initial Vision and Scenario 2 Core Concentration have higher populations than the other three scenarios and, as such, a larger number of trips.
- There is a decrease in travel distance across all modes (in both year 2020 and year 2035), which suggests that the forecasted land use patterns provide for a more efficient spatial mix of households, jobs, and other activity locations.
- The general increase in transit travel distance is expected, as travelers who switch to transit are likely to be traveling longer distances than those currently taking transit (as congestion increases, transit becomes more attractive to automobile users).
- The average travel distance on so-called "non-motorized" modes, namely walking and bicycling, does not change across scenarios. This finding reflects a general tendency of travelers within the model to choose these modes when travel distances are short, as well as the general inability of the model to provide useful information as to the micro-impact (i.e. at geographies smaller than travel analysis zones) of land use patterns.

[18] Tours are round-trips that begin and end at either a traveler's residence (all tours except "at work" tours) or workplace ("at work" tours). Travelers can make stops on these tours, for example at a coffee shop on the way to work – all travel on the way to and from work is considered trips on work tours.

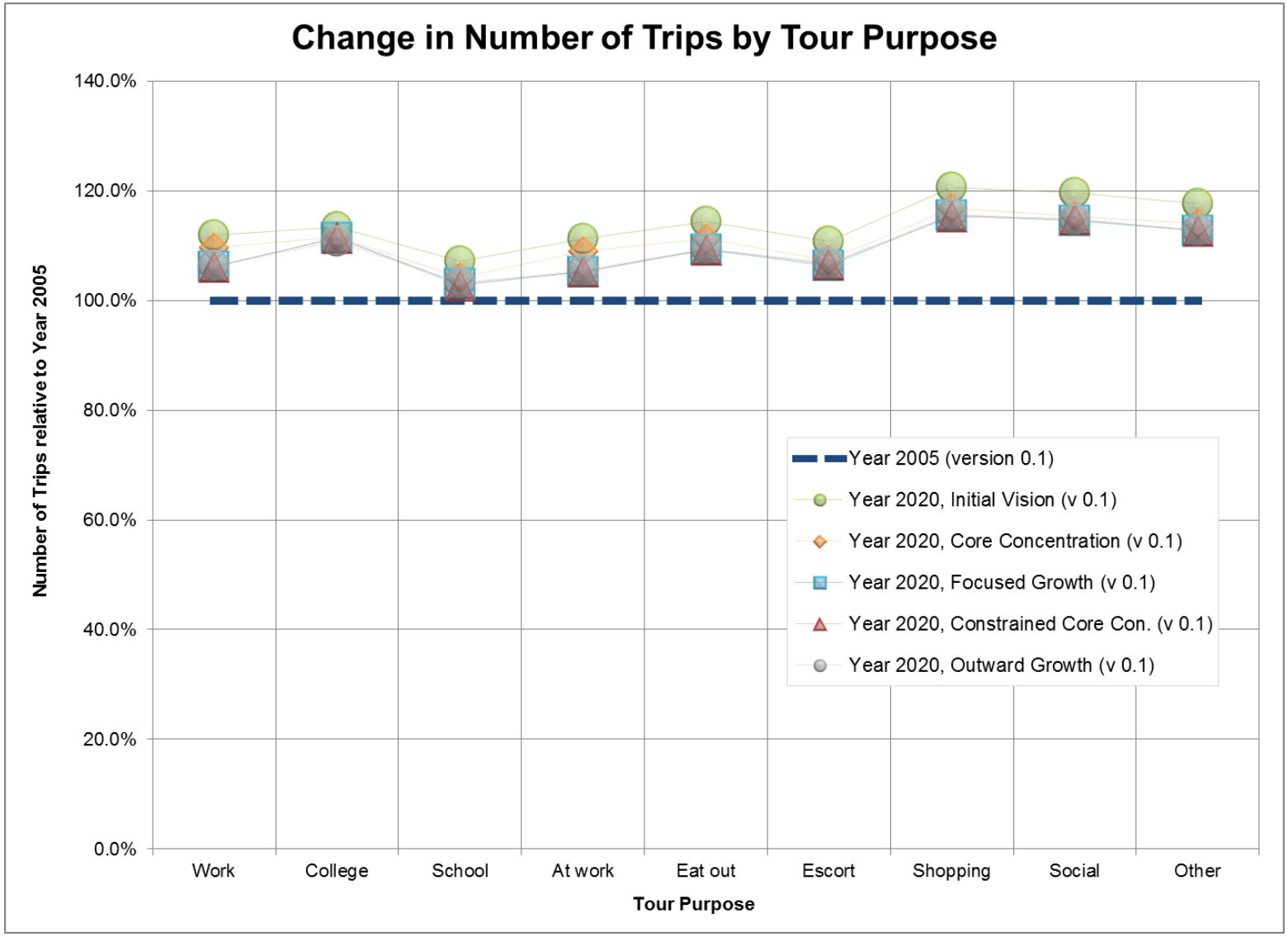

Figure 13: Year 2020, Change in Number of Trips by Tour Purpose

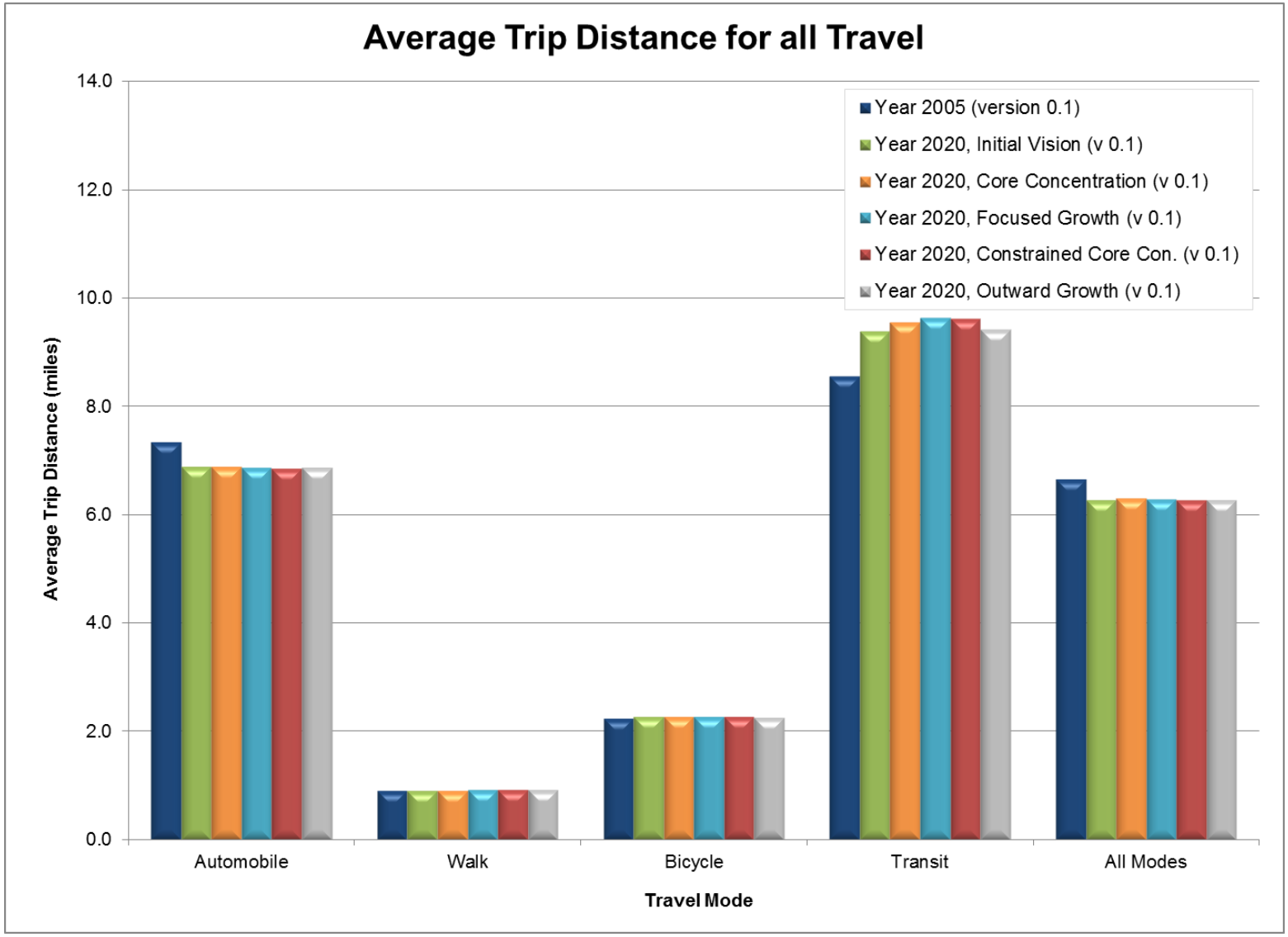

Figure 14: Year 2020, Average Trip Distance for all Travel

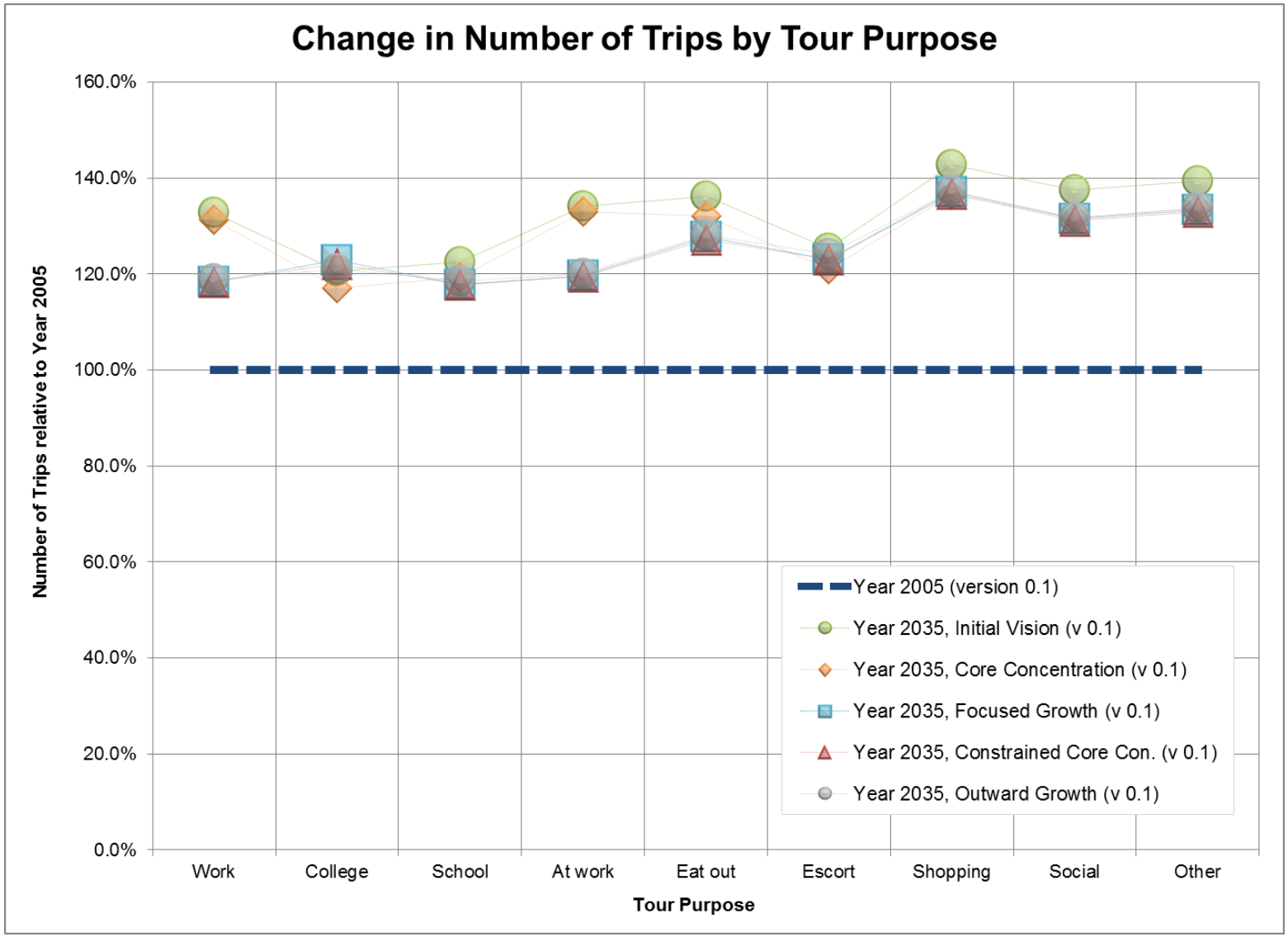

Figure 15: Year 2035, Change in Number of Trips by Tour Purpose

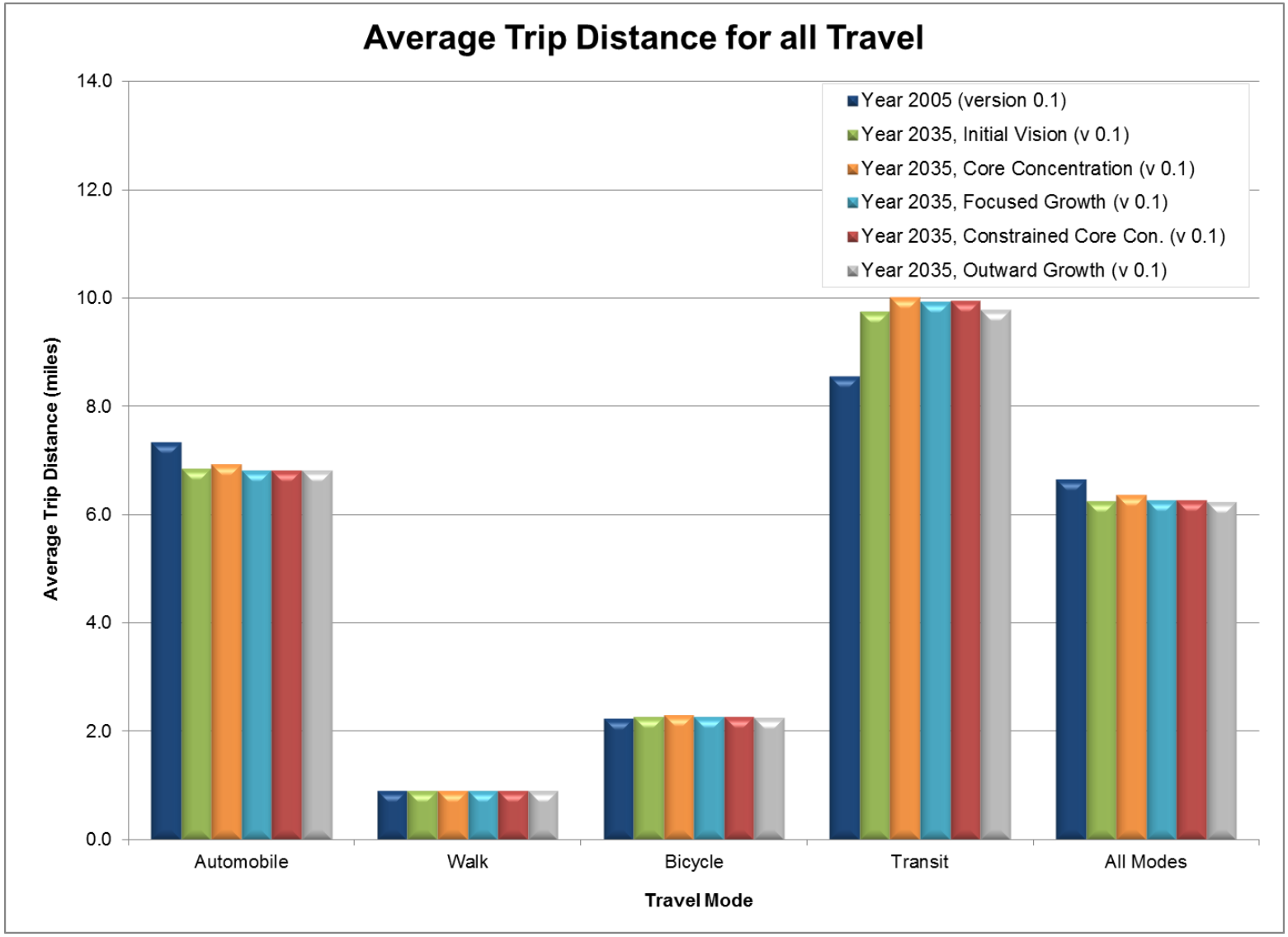

Figure 16: Year 2035, Average Trip Distance for all Travel

4.4 Travel Mode Choice Decisions

The means by which a traveler gets from point A to point B is referred to as the travel mode. Within MTC's representation of travel behavior, five automobile-based modal options are considered, specifically:

- traveling alone in a private automobile and opting *not* to pay to use a high-occupancy toll facility ("single occupant, no HOT"), an option only available to those in households who own at least one automobile;
- traveling alone in a private automobile and opting to pay to use a high-occupancy toll facility ("single occupant, pay to use HOT"), an option only available to those who both own a car and whose journey would logically benefit from using an HOT facility (e.g., this option is not available to those driving through a residential neighborhood to drop a child at school);
- traveling with one other occupant in a private automobile and opting *not* to pay to use a high-occupancy toll facility ("two occupants, no HOT"), an option available to those in households with and without automobiles;
- traveling with one other occupant in a private automobile and opting to pay to use a high-occupancy toll facility ("two occupants, pay to use HOT"), an option available to those in households with and without automobiles but only to those who would logically benefit from using an HOT facility (if the facility allows vehicles with two occupants to travel for free, than these travelers are categorized as "two occupants, no HOT" trip makers); and,
- traveling with two other occupants in a private automobile – these vehicles are allowed to travel for free on HOT facilities.

The share of all trips by the above automobile modes is presented in Figure 17 for year 2020 and Figure 18 for year 2035. Figure 17 and Figure 18 show the overall share of travel by all automobile modes decreases in the forecast years; this result is expected, as the combination of increased densities, congestion, and improved transit service lessens the attractiveness of automobile travel. As HOT lanes come on line in 2020 and 2035, a small share of regional travelers choose to use them. Scenario 2 Core Concentration results in the lowest share of automobile travel among the five scenarios.

The travel model explicitly considers numerous non-automobile options, which are collapsed to the following four options shown in Figure 19 and Figure 20:

- walk;
- bicycle;
- transit, getting to and from by foot ("walk to transit"); and,
- transit, getting to or from in an automobile ("drive to transit").

Figure 20 shows a general increase in the mode share of each of these modes, with larger transit share increases occurring in Scenario 2 Core Concentration – an expected result, given the dense land development pattern and the dramatic increase in transit supply included in this scenario.

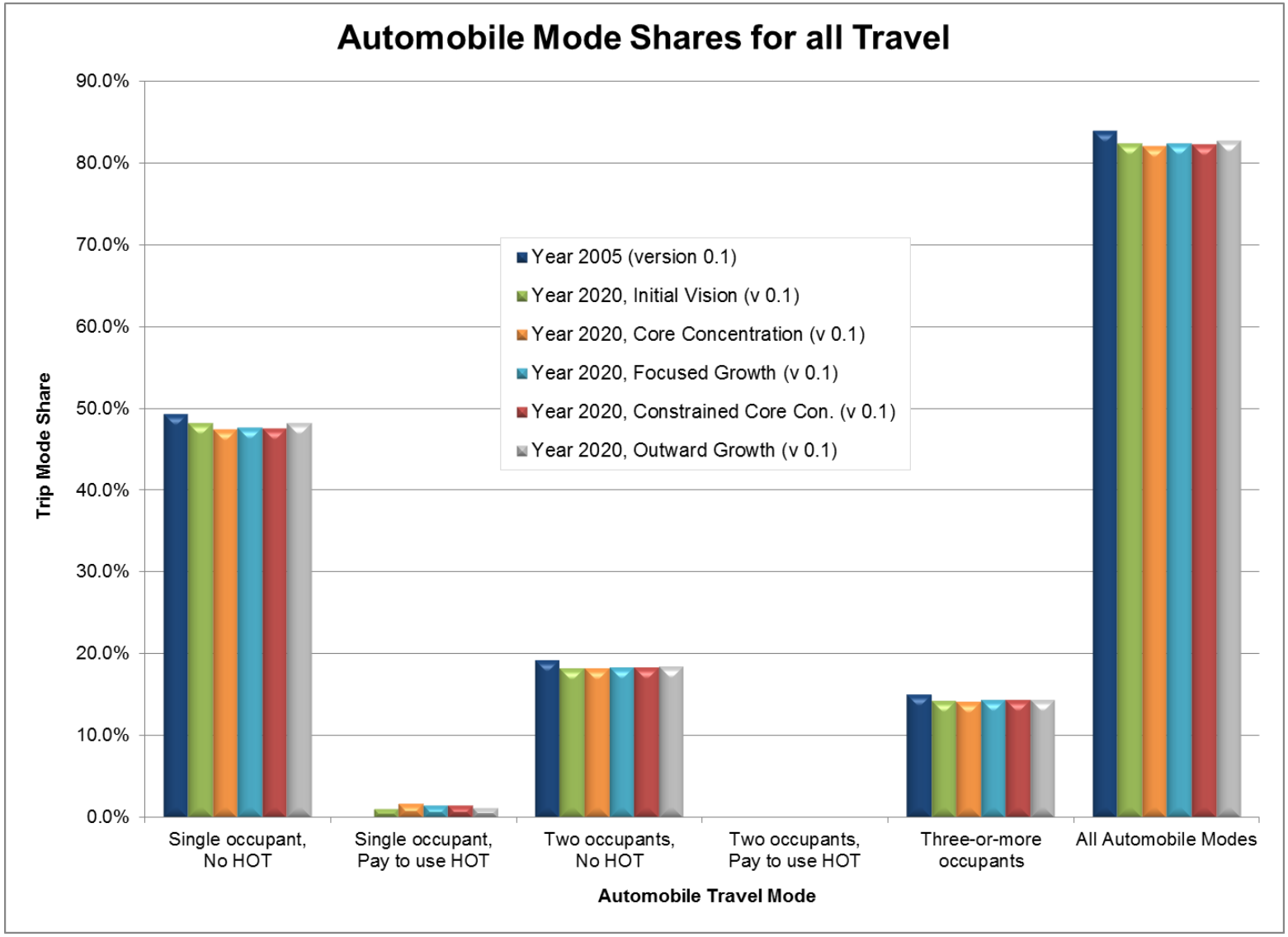

Figure 17: Year 2020, Automobile Mode Shares for all Travel

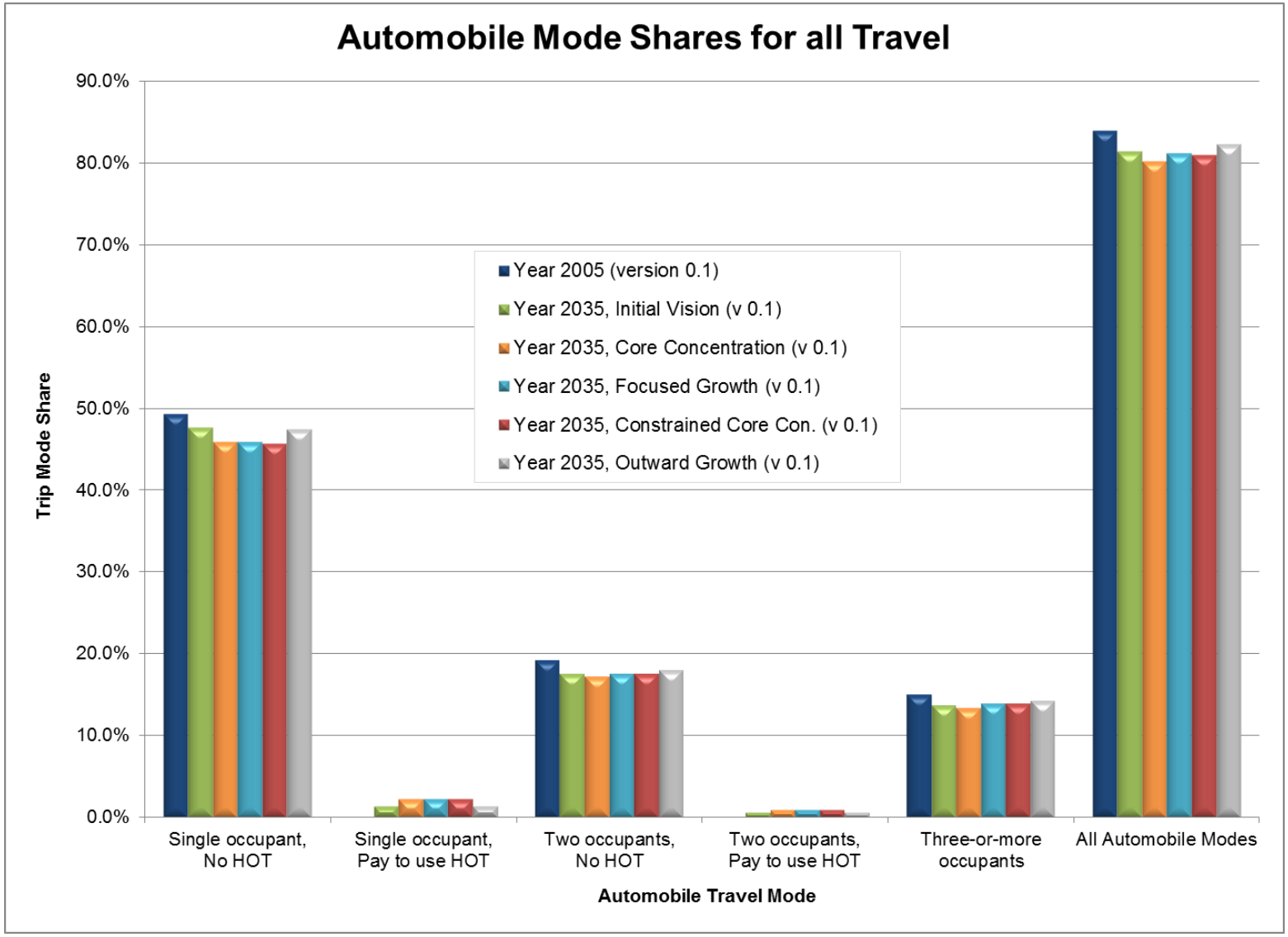

Figure 18: Year 2035, Automobile Mode Shares for all Travel

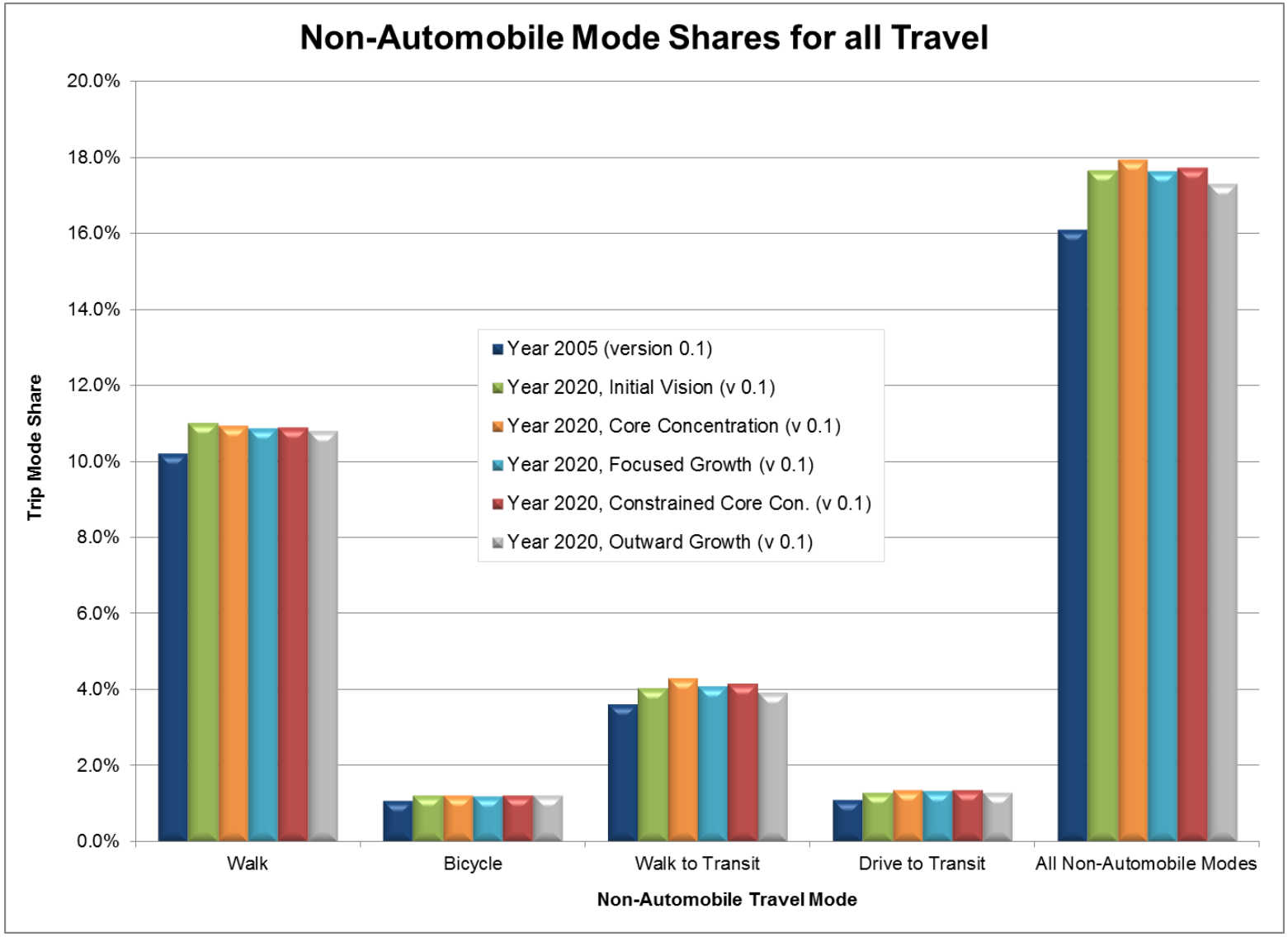

Figure 19: Year 2020, Non-Automobile Mode Shares for all Travel

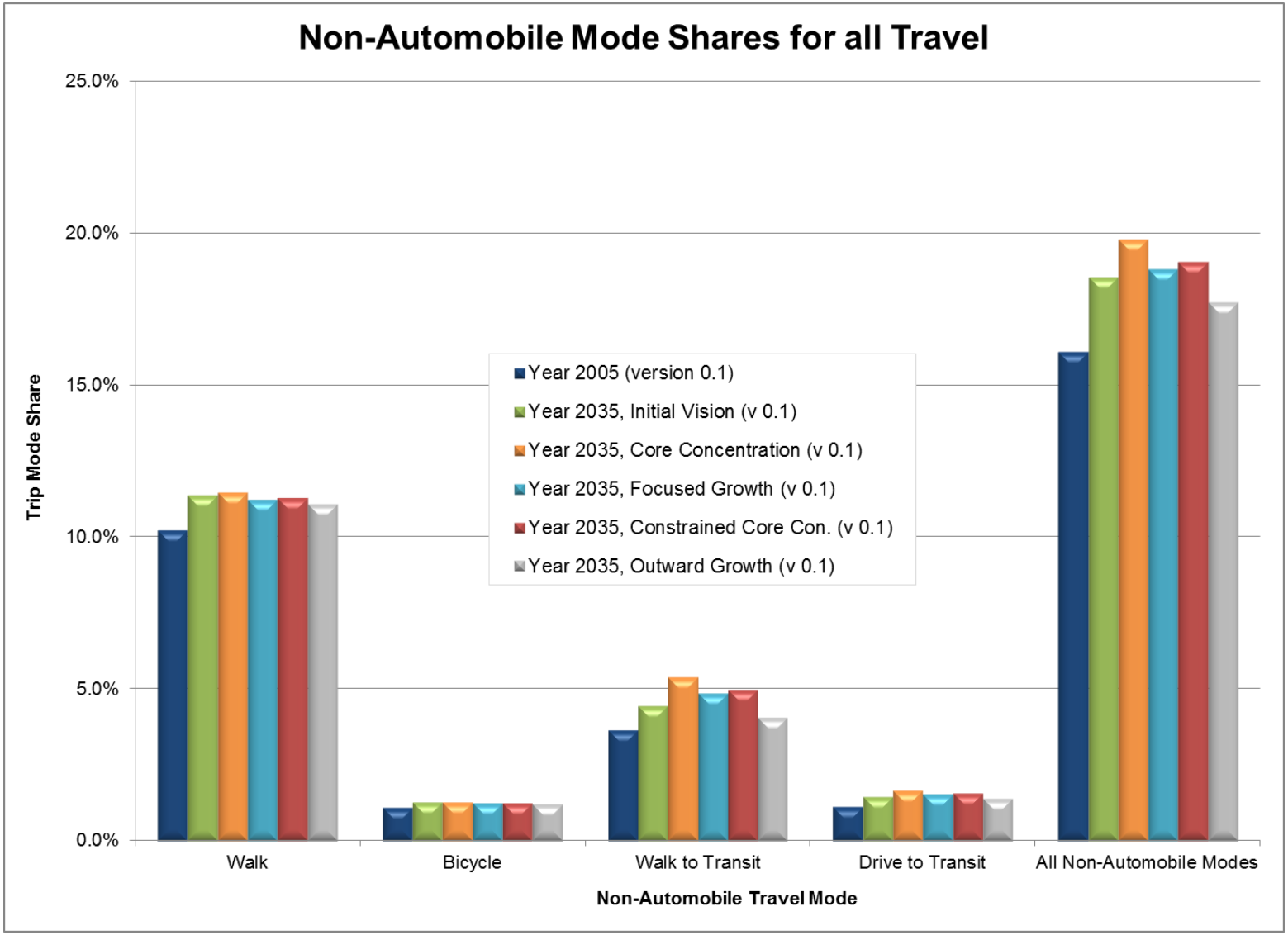

Figure 20: Year 2035, Non-Automobile Mode Shares for all Travel

4.5 Aggregate Transit Demand Estimates

Travelers choosing to travel by transit are explicitly assigned to a specific transit line. As a simplification, MTC groups transit lines by the following technology categories: local bus, express bus, light rail, ferry, heavy rail, and commuter rail. Local bus transit service represents standard, fixed-route bus service, of the kind a traveler may take to and from a neighborhood grocery store, as well as bus rapid transit service. Express bus service represents longer-distance service typically provided in over-the-road coach technology; Golden Gate Transit, for example, provides this service between Marin County and downtown San Francisco. Light rail service is represented in the Bay Area by San Francisco's Muni Metro and F-Market streetcar services, as well as Santa Clara Valley Transportation Authority's light rail service. Heavy rail service is provided in the Bay Area by the Bay Area Rapid Transit (BART) district; BART is the only provider of heavy rail in each of these forecasts. Finally, commuter rail captures longer distance rail service typically on grade-separated railroads; Caltrain, for example, offers this service along the Peninsula (other Bay Area providers of commuter rail service are Altamont Commuter Express and Amtrak).

Figure 21 presents transit boarding estimates for the typical weekday simulated by the travel model by technology and by scenario for year 2020; Figure 22 provides a companion chart for the year 2035 results. Important findings include:

- Transit boardings increase to well over 3.2 million boardings in 2035 in Scenario 2 Core Concentration, up from about 1.5 million in year 2005.
- The impact of the transit network on the scenarios is shown by comparing Scenario 3 Focused Growth to Scenario 5 Outward Growth. While these land development patterns are similar, the difference in transit ridership is substantial (600,000 more boardings in year 2035 in Scenario 3 Focused Growth).

Transit crowding[19] is a concern for both BART and the San Francisco Municipal Transit Agency (SFMTA). Figure 23 shows the demand in the Transbay Tube, which passes under the San Francisco Bay between Oakland and Downtown San Francisco, in each of the year 2035 scenarios. In Scenarios 2 Core Concentration, 3 Focused Growth, and 4 Constrained Core Concentration, capital projects increase the capacity of the BART system and reduce the demand when expressed as a percent of the capacity. Figure 24 shows similar results for two crowded downtown stations, Embarcadero and Montgomery Street. Figure 25 shows the demand at two key locations on the SFMTA Muni Metro system. Scenarios 2 Core Concentration, 3 Focused Growth, and 4 Constrained Core Concentration include a cordon toll around downtown San Francisco which increases the attractiveness as well as crowding at these locations.

[19] Per the representation of transit in *Travel Model One*, transit service does not degrade as transit patronage increases. As such, transit demand can exceed supply.

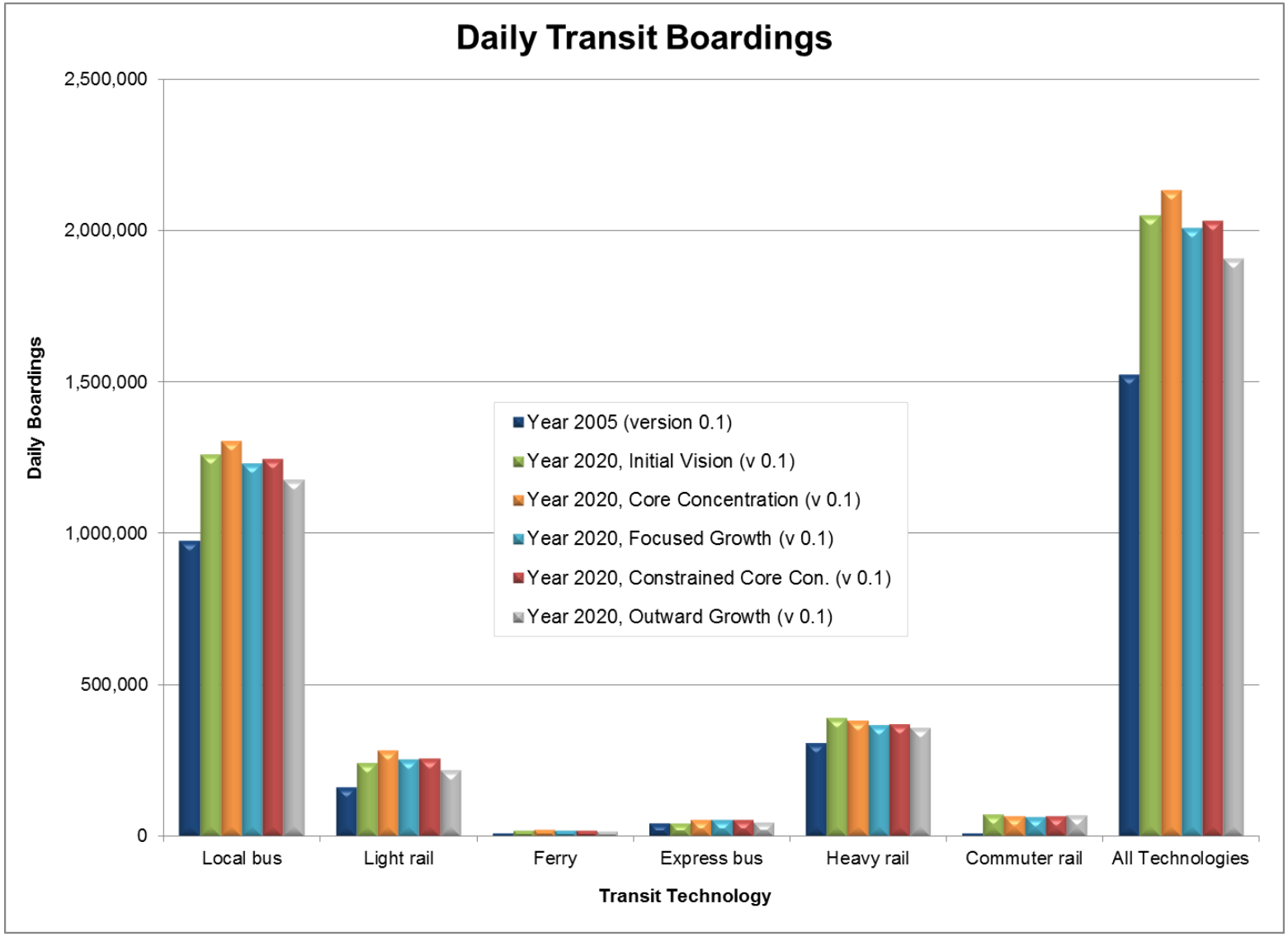

Figure 21: Year 2020, Daily Transit Boardings

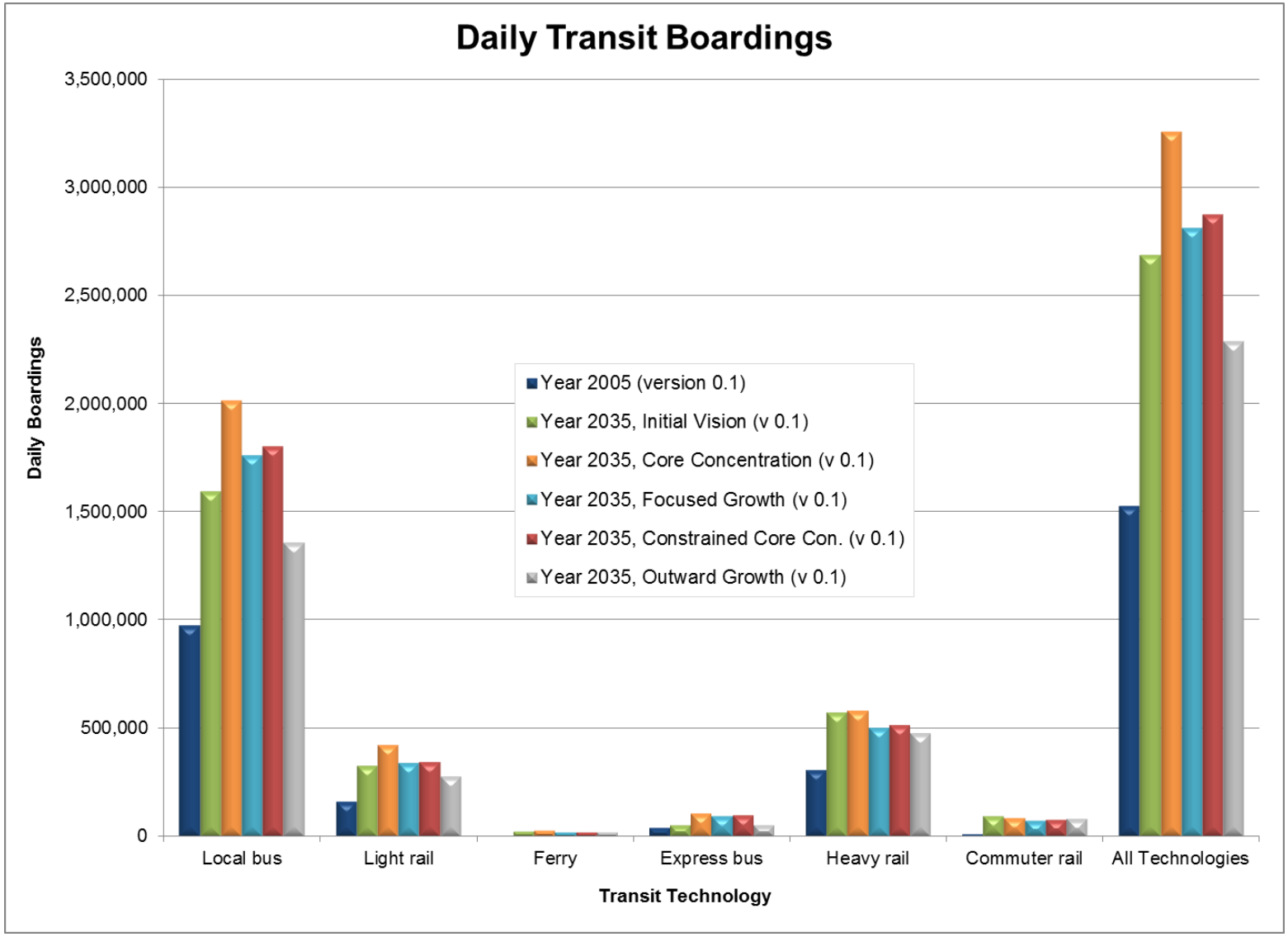

Figure 22: Year 2035, Daily Transit Boardings

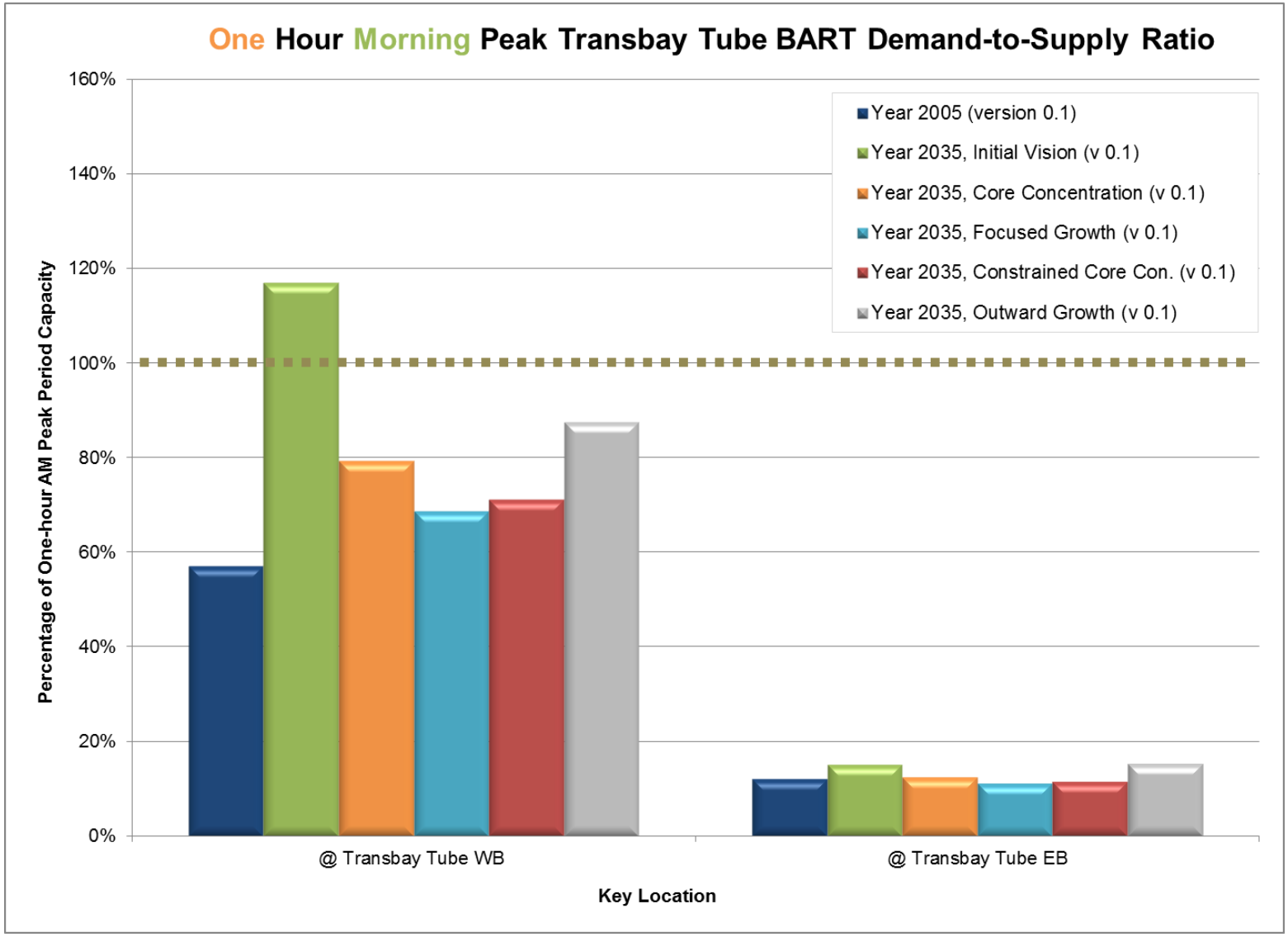

Figure 23: Year 2035, One Hour Morning Peak Transbay Tube BART Demand-to-Supply Ratio

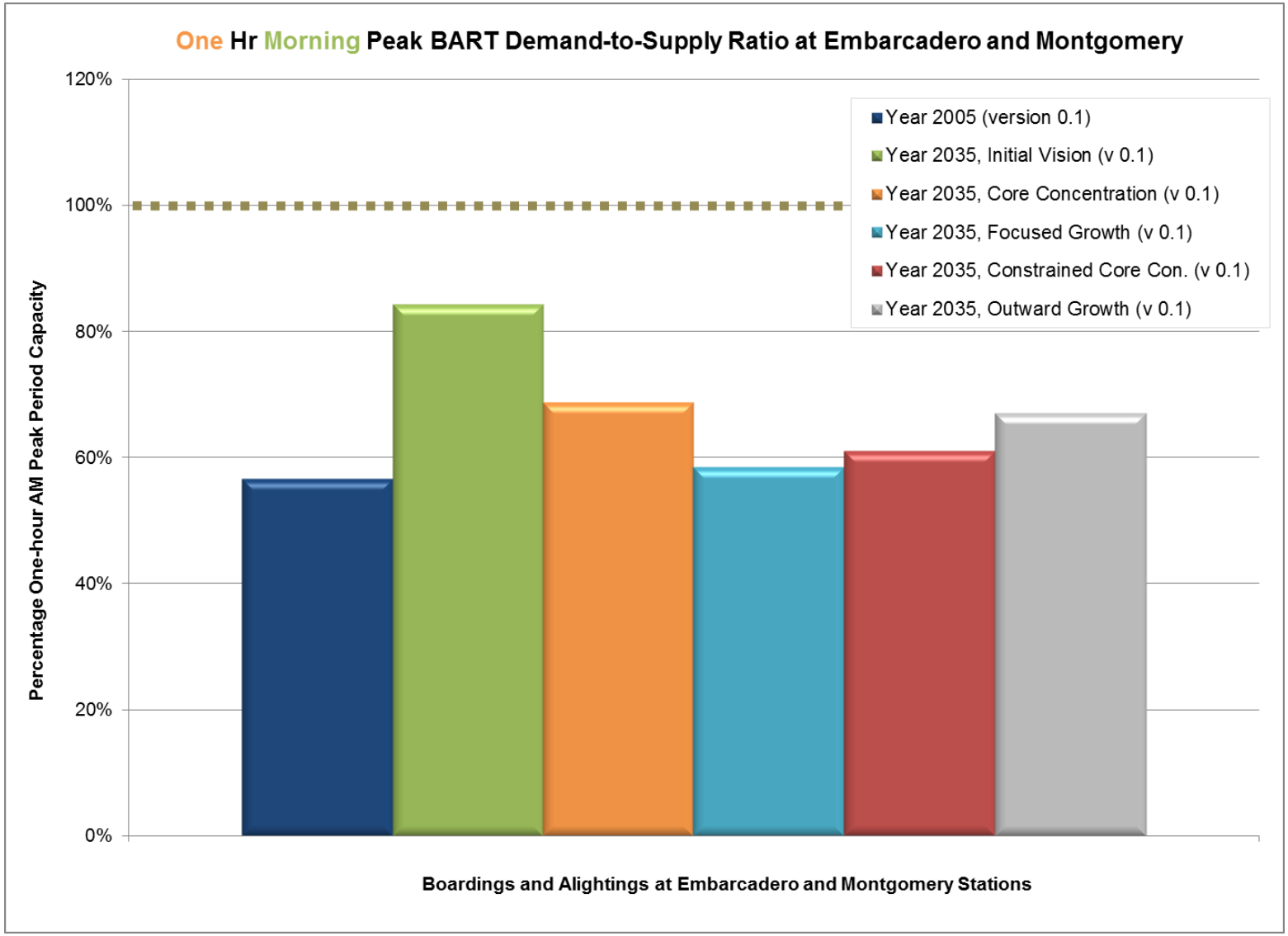

Figure 24: Year 2035, One Hour Morning Peak Embarcadero and Montgomery BART Demand-to-Supply Ratio

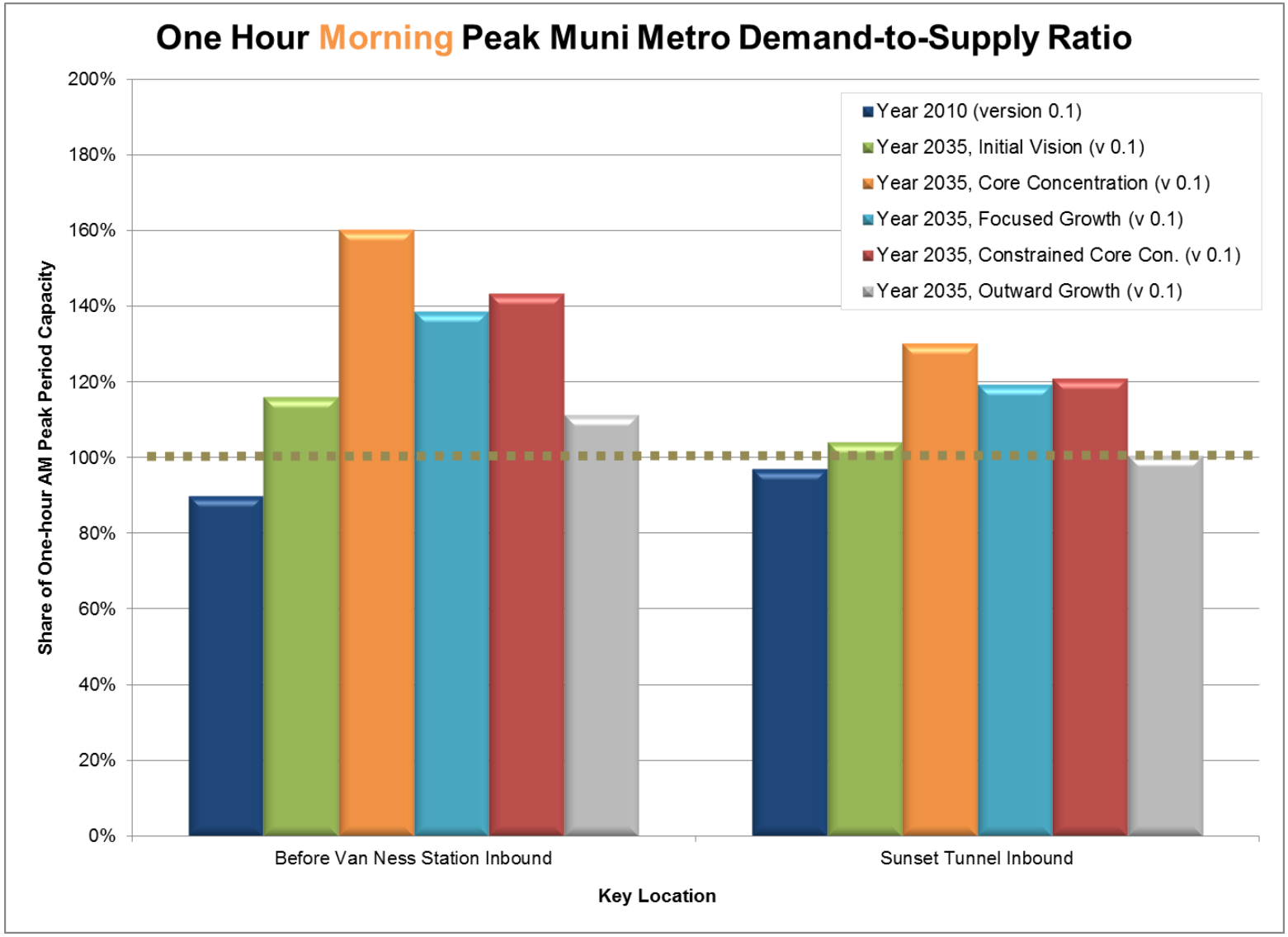

Figure 25: Year 2035, One hour Morning Peak Muni Metro Demand-to-Supply Ratio

4.6 Congestion Estimates

Trips made by automobile are first aggregated into matrices identifying each trip's origin and destination and then "assigned" to a representation of the Bay Area's roadway network. The assignment process iteratively determines the shortest path between each origin-destination pair, shifting some number of trips to each iteration's shortest path, until the network reaches a certain level of equilibrium – defined as a state in which travelers cannot change to a lower "cost" route (where cost is expressed in monetary and non-monetary (e.g. time) units). The assignment process inherently computes numerous quantities of interest, such as vehicle miles traveled, delay, and average travel speed.

Please note that MTC maintains three separate estimates of the quantity vehicle miles traveled (VMT), specifically: (1) the quantity assigned directly to the highway network; (2) the quantity assigned to the highway network plus so-called intra-zonal VMT, which is computed off-line; (3) the quantity (2) adjusted to match the amount of VMT the Air Resources Board (CARB) believes takes place in the Bay Area (a number slightly higher than MTC's estimate). In this document, the VMT identified as quantity (1) in the above list is presented.

Figure 26 and Figure 27 below present vehicle miles traveled by time period for simulation years 2020 and 2035, respectively; interesting aspects of these results include:

- VMT is scaled by the number of hours in each time period to give the reader a feel for the rate of travel that takes place in each interval (e.g., a greater intensity of traffic occurs during the morning and evening commute).
- Vehicular travel increases as population increases, even with the improvements in transit service included in Scenario 2 Core Concentration.
- Across Scenarios 3 Focused Growth, 4 Constrained Core Concentration, and 5 Outward Growth, each of which has the same population, Scenario 5 Outward Growth has the highest amount of vehicular travel.

Figure 28 and Figure 29 summarize the change in average freeway travel speed for simulation years 2020 and 2035, respectively. Important findings along this analytical arc include:

- The roadway expansion projects included in the 2020 and 2035 representations of each of the scenarios keeps congestion at bay through 2020 but not to 2035, when freeway speeds begin to degrade below 2005 levels.
- The location of households in the existing inner urban areas in Scenario 1 Initial Vision and Scenario 2 Core Concentration causes an increase in roadway congestion.

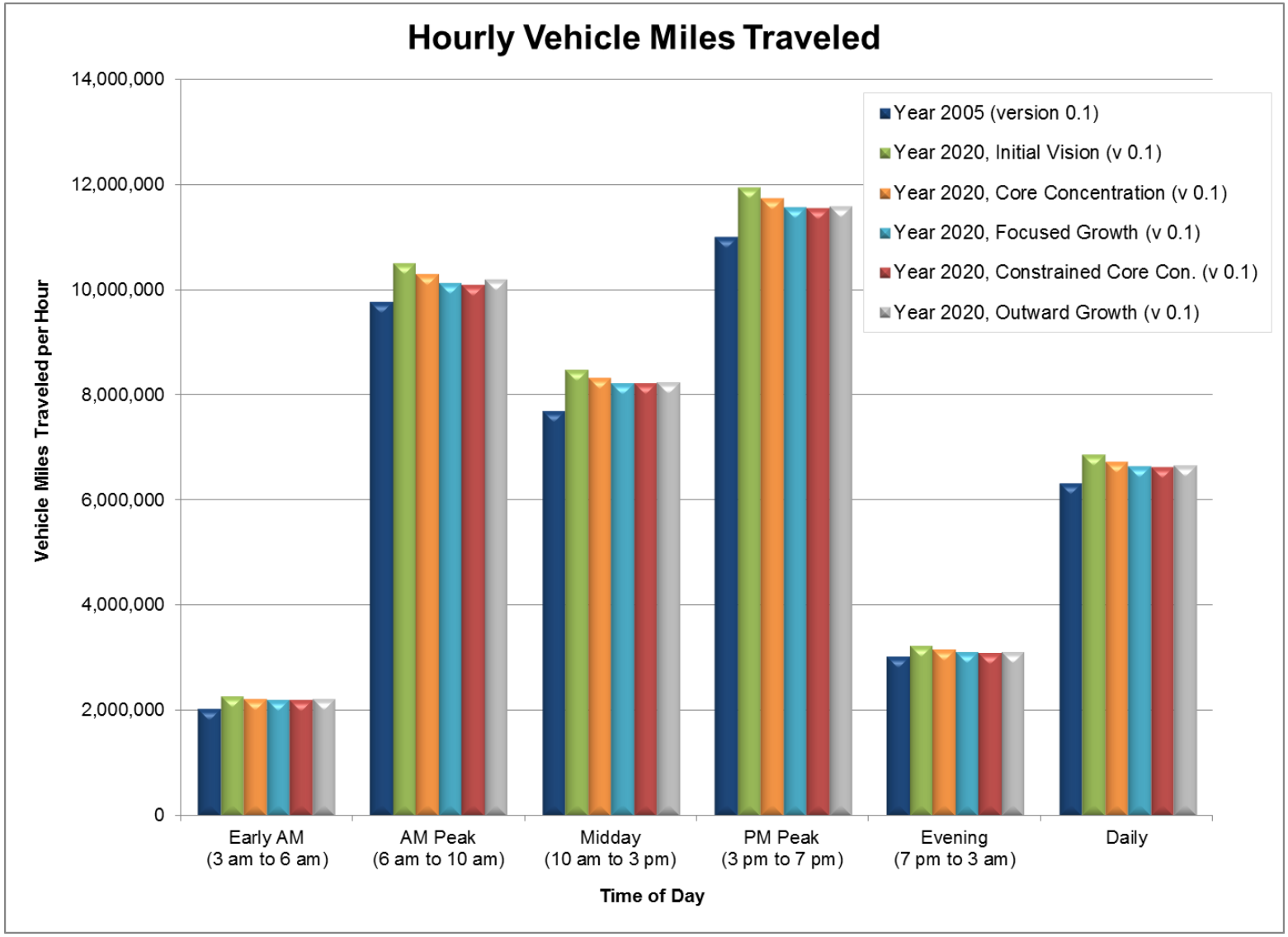

Figure 26: Year 2020, Hourly Vehicle Miles Traveled

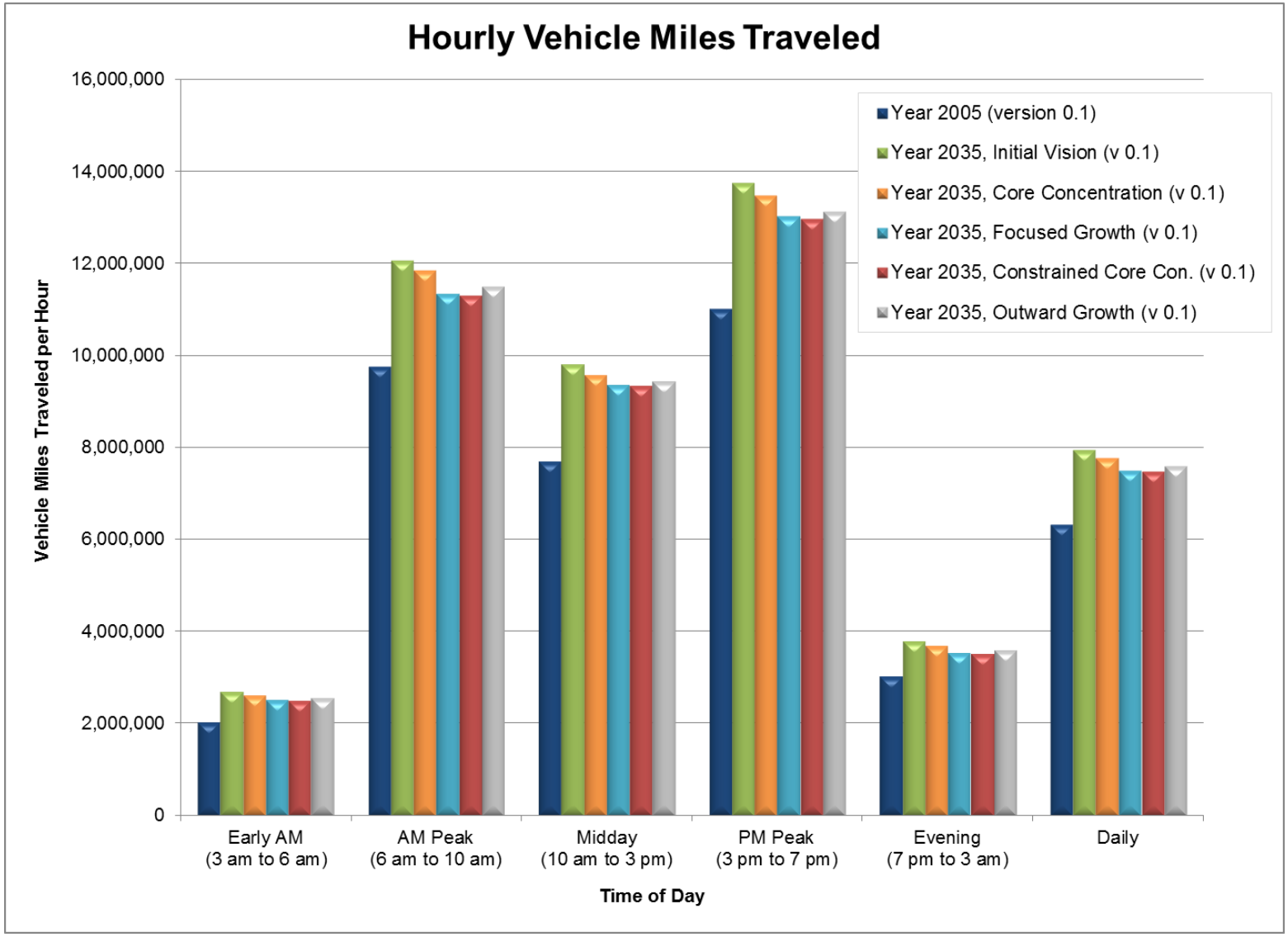

Figure 27: Year 2035, Hourly Vehicle Miles Traveled

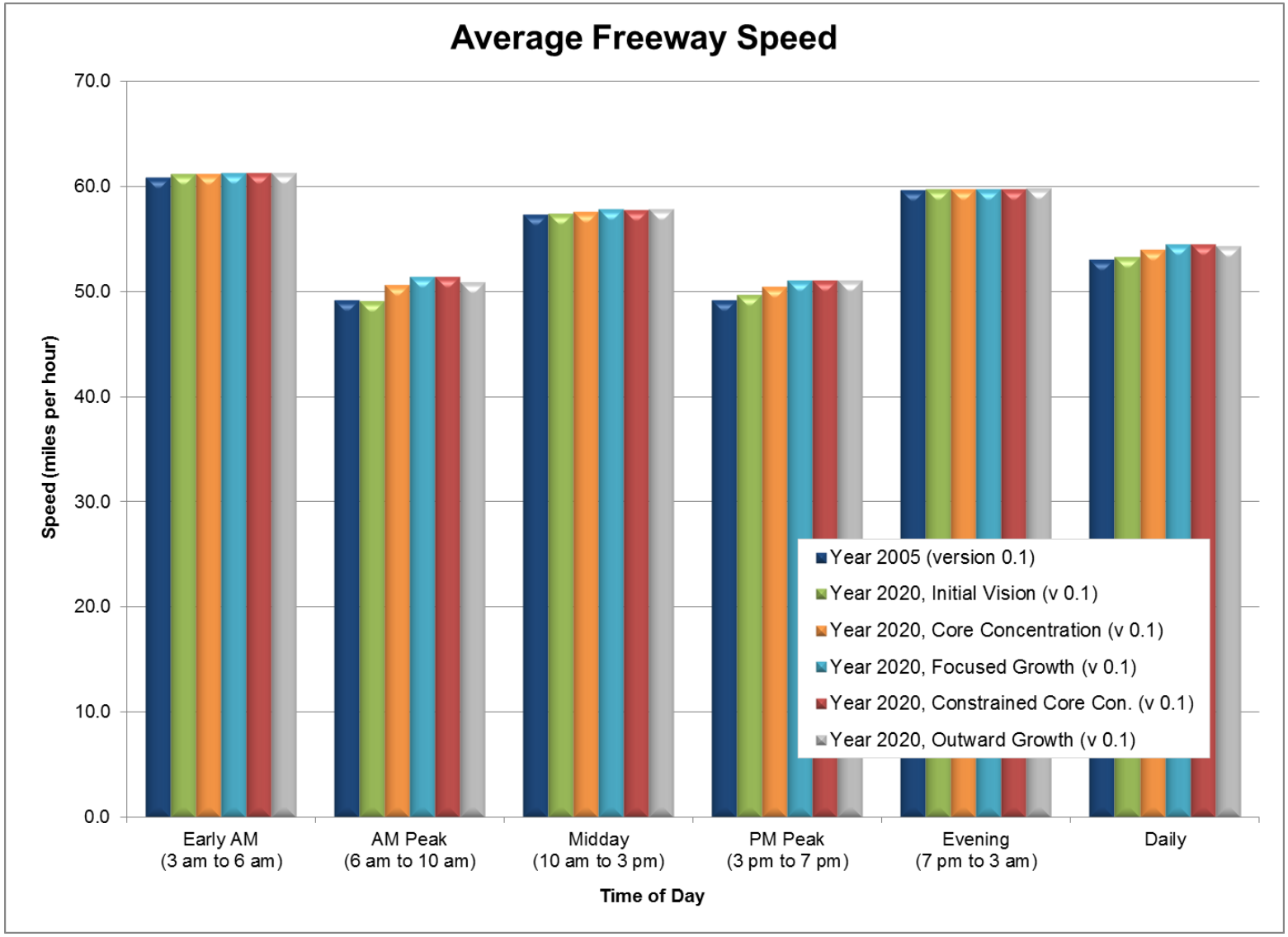

Figure 28: Year 2020, Average Freeway Speed

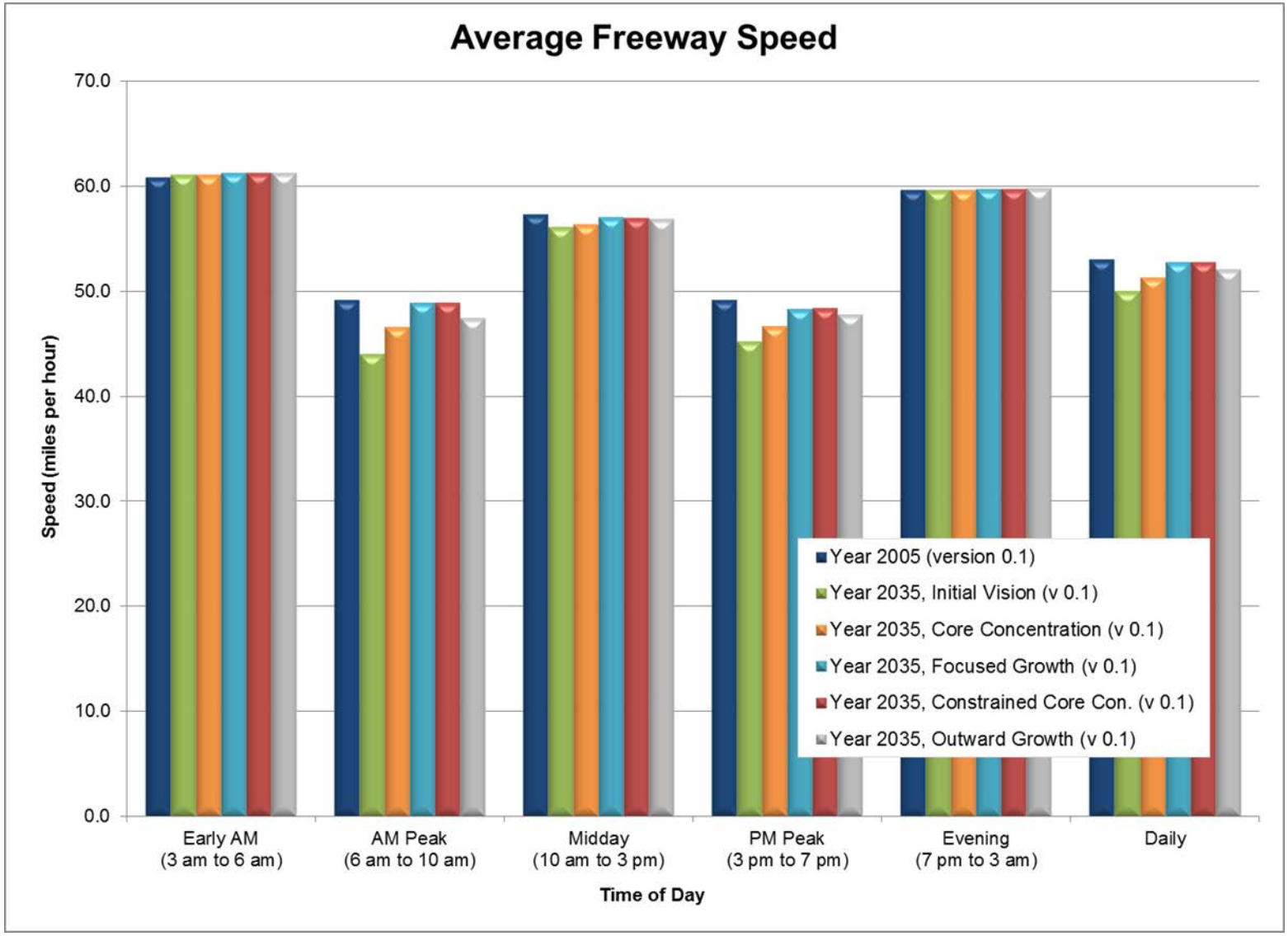

Figure 29: Year 2035, Average Freeway Speed

4.7 Air Quality Implications

Table 11 and Table 12 below summarize various on-road mobile source emission estimates for simulation years 2020 and 2035, respectively. A few key notes on these tables are as follows:

- Carbon dioxide, which serves as a proxy for all greenhouse gases, is reported for the entire nine county Bay Area;
- All other emissions are reported for the MTC air basin, which includes a portion of Solano County;
- Carbon dioxide is reported two ways: the first ignores vehicle and fuel regulations (specifically the so-called Pavley[20] and low-carbon fuel standard) and the second considers the impact of vehicle and fuel regulations; and,
- Pollutants subject to vehicle control regulations decrease, in some cases dramatically, when moving from the base year through the forecast years.

[20] Additional information is available here: http://www.arb.ca.gov/cc/ccms/ccms.htm

Table 11: Year 2020, On-road Mobile Source Emission Estimates for the MTC Air Basin

Scenario	Pollutant (tons per typical weekday from all vehicles)							
	Carbon Dioxide (CO_2) *	CO_2* Pounds per Capita	Carbon Dioxide (CO_2) **	Small Particulate Matter ($PM_{2.5}$)†	Particulate Matter (PM_{10}) †	Wintertime Nitrous Oxides (NO_x)	Reactive Organic Gases	Carbon Monoxide (CO)
Year 2005 (version 0.1)	69,790	19.9	69,790	6.46	9.26	238.2	133.8	1,271.0
Year 2020, Initial Vision (v 0.1)	73,940	18.3	54,880	5.03	7.88	76.08	51.14	388.8
Year 2020, Core Concentration (v 0.1)	71,520	18.4	53,710	4.92	7.71	74.76	50.04	380.0
Year 2020, Focused Growth (v 0.1)	71,340	18.5	52,920	4.83	7.59	73.44	49.33	374.4
Year 2020, Constrained Core Concentration (v 0.1)	71,220	18.4	52,840	4.84	7.56	73.33	49.26	373.9
Year 2020, Outward Growth (v 0.1)	71,520	18.5	53,060	4.86	7.59	73.72	49.49	375.6

* – Emissions for the entire nine-county Bay Area, from passenger vehicles only and does not include – per SB 375 – expected reductions from fuel and vehicle regulations; ** – Emissions for the entire nine-county Bay Area, from passenger vehicles only and does include reductions expected from Pavley I and Low Carbon Fuel Standard regulations; † – Does not include road dust emissions

Table 12: Year 2035, On-road Mobile Source Emission Estimates for the MTC Air Basin

Scenario	Pollutant (tons per typical weekday from all vehicles)							
	Carbon Dioxide (CO_2) *	CO_2* Pounds per Capita	Carbon Dioxide (CO_2) **	Small Particulate Matter ($PM_{2.5}$)†	Particulate Matter (PM_{10}) †	Wintertime Nitrous Oxides (NO_x)	Reactive Organic Gases	Carbon Monoxide (CO)
Year 2005 (version 0.1)	69,790	19.9	69,790	6.46	9.26	238.2	133.8	1,271.0
Year 2035, Initial Vision (v 0.1)	85,930	18.3	55,080	5.44	8.70	42.18	33.02	238.6
Year 2035, Core Concentration (v 0.1)	83,550	18.3	52,170	5.28	8.44	41.12	32.22	232.5
Year 2035, Focused Growth (v 0.1)	80,410	18.1	51,570	5.06	8.10	39.59	31.09	223.8
Year 2035, Constrained Core Concentration (v 0.1)	80,130	18.1	51,370	5.04	8.08	39.47	30.97	222.9
Year 2035, Outward Growth (v 0.1)	81,450	18.3	52,210	5.12	8.20	40.13	31.43	226.6

* – Emissions for the entire nine-county Bay Area, from passenger vehicles only and does not include – per SB 375 – expected reductions from fuel and vehicle regulations; ** – Emissions for the entire nine-county Bay Area, from passenger vehicles only and does include reductions expected from Pavley I and Low Carbon Fuel Standard regulations; † – Does not include road dust emissions

Appendix A: Chart Data

Table 13: Year 2020, Synthetic Population Person Type Distribution (Data for Figure 1)

Scenario	Person Type								
	Full-time worker	Part-time worker	College student	Non-working adult	Retired	Driving-age student	Non-driving-age student	Child too young for school	All Persons
Year 2005 (version 0.1)	35.9%	7.6%	5.8%	17.8%	9.7%	2.8%	12.9%	7.6%	100.0%
Year 2020, Initial Vision (v 0.1)	34.6%	7.9%	5.6%	17.2%	12.6%	2.6%	12.2%	7.3%	100.0%
Year 2020, Core Concentration (v 0.1)	35.0%	7.9%	5.7%	17.0%	12.5%	2.6%	12.1%	7.2%	100.0%
Year 2020, Focused Growth (v 0.1)	34.4%	7.9%	5.8%	17.3%	12.6%	2.6%	12.2%	7.2%	100.0%
Year 2020, Constrained Core Con. (v 0.1)	34.4%	7.8%	5.8%	17.4%	12.6%	2.6%	12.2%	7.2%	100.0%
Year 2020, Outward Growth (v 0.1)	34.4%	7.8%	5.8%	17.3%	12.6%	2.6%	12.2%	7.3%	100.0%

Table 14: Year 2035, Synthetic Population Person Type Distribution (Data for Figure 2)

Scenario	Person Type								
	Full-time worker	Part-time worker	College student	Non-working adult	Retired	Driving-age student	Non-driving-age student	Child too young for school	All Persons
Year 2005 (version 0.1)	35.9%	7.6%	5.8%	17.8%	9.7%	2.8%	12.9%	7.6%	100.0%
Year 2035, Initial Vision (v 0.1)	35.4%	8.0%	5.3%	16.0%	13.8%	2.6%	11.9%	7.1%	100.0%
Year 2035, Core Concentration (v 0.1)	36.3%	8.1%	5.3%	15.5%	13.2%	2.6%	11.8%	7.2%	100.0%
Year 2035, Focused Growth (v 0.1)	33.6%	7.5%	5.5%	17.2%	14.1%	2.6%	12.2%	7.3%	100.0%
Year 2035, Constrained Core Con. (v 0.1)	33.7%	7.5%	5.5%	17.2%	14.1%	2.6%	12.2%	7.3%	100.0%
Year 2035, Outward Growth (v 0.1)	33.7%	7.5%	5.4%	17.1%	14.1%	2.6%	12.2%	7.3%	100.0%

Table 15: Year 2020, Growth in Roadway Lane Miles from Year 2005 (Data for Figure 6)

Scenario	County									
	Alameda	Contra Costa	Marin	Napa	San Fran.	San Mateo	Santa Clara	Solano	Sonoma	Bay Area
Year 2005 (version 0.1)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Year 2020, Initial Vision (v 0.1)	3.0%	7.5%	2.9%	3.1%	-1.2%	0.2%	3.8%	7.8%	3.5%	3.6%
Year 2020, Core Concentration (v 0.1)	3.1%	7.4%	2.9%	1.3%	-1.5%	1.7%	3.6%	6.9%	3.3%	3.6%
Year 2020, Focused Growth (v 0.1)	3.1%	7.4%	2.9%	1.3%	-1.5%	1.7%	3.6%	6.9%	3.3%	3.6%
Year 2020, Constrained Core Con. (v 0.1)	3.1%	7.4%	2.9%	1.3%	-1.5%	1.7%	3.6%	6.9%	3.3%	3.6%
Year 2020, Outward Growth (v 0.1)	3.0%	7.5%	2.9%	3.1%	-1.2%	0.2%	3.8%	7.8%	3.5%	3.6%

Table 16: Year 2035, Growth in Roadway Lane Miles from Year 2005 (Data for Figure 7)

Scenario	County									
	Alameda	Contra Costa	Marin	Napa	San Fran.	San Mateo	Santa Clara	Solano	Sonoma	Bay Area
Year 2005 (version 0.1)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Year 2035, Initial Vision (v 0.1)	3.9%	7.6%	4.0%	3.1%	-1.2%	0.8%	4.9%	16.3%	3.6%	4.9%
Year 2035, Core Concentration (v 0.1)	4.0%	7.5%	4.0%	1.3%	-2.0%	2.1%	4.8%	15.4%	3.4%	4.8%
Year 2035, Focused Growth (v 0.1)	4.0%	7.5%	4.0%	1.3%	-2.0%	2.1%	4.8%	15.4%	3.4%	4.8%
Year 2035, Constrained Core Con. (v 0.1)	4.0%	7.5%	4.0%	1.3%	-2.0%	2.1%	4.8%	15.4%	3.4%	4.8%
Year 2035, Outward Growth (v 0.1)	3.9%	7.6%	4.0%	3.1%	-1.2%	0.8%	4.9%	16.3%	3.6%	4.9%

Table 17: Year 2020, Growth in Transit Passenger Seat Miles from Year 2005 (Data for Figure 8)

Scenario	Technology						
	Local Bus	Light Rail	Ferry	Express Bus	Heavy Rail	Commuter Rail	All Technologies
Year 2005 (version 0.1)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Year 2020, Initial Vision (v 0.1)	2.1%	22.6%	32.4%	-12.6%	31.2%	42.1%	19.6%
Year 2020, Core Concentration (v 0.1)	1.9%	41.4%	49.4%	-4.1%	31.2%	39.1%	21.7%
Year 2020, Focused Growth (v 0.1)	1.9%	41.4%	49.4%	-3.7%	31.2%	39.1%	21.8%
Year 2020, Constrained Core Con. (v 0.1)	1.9%	41.4%	49.4%	-3.7%	31.2%	39.1%	21.8%
Year 2020, Outward Growth (v 0.1)	2.1%	22.6%	32.4%	-12.5%	31.2%	42.1%	19.6%

Table 18: Year 2035, Growth in Transit Passenger Seat Miles from Year 2005 (Data for Figure 9)

Scenario	Technology						
	Local Bus	Light Rail	Ferry	Express Bus	Heavy Rail	Commuter Rail	All Technologies
Year 2005 (version 0.1)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Year 2035, Initial Vision (v 0.1)	1.5%	36.0%	32.4%	-1.4%	36.1%	43.3%	23.1%
Year 2035, Core Concentration (v 0.1)	35.7%	69.0%	59.0%	46.7%	66.2%	39.1%	51.0%
Year 2035, Focused Growth (v 0.1)	35.7%	69.0%	59.0%	46.8%	66.2%	39.1%	51.0%
Year 2035, Constrained Core Con. (v 0.1)	35.7%	69.0%	59.0%	46.8%	66.2%	39.1%	51.0%
Year 2035, Outward Growth (v 0.1)	1.6%	35.8%	32.4%	-1.0%	36.1%	43.3%	23.1%

Table 19: Year 2020, Share of Households by Automobile Ownership Category (Data for Figure 11)

Scenario	Automobile Ownership Category					All Households
	Zero	One	Two	Three	Four or more	
Year 2005 (version 0.1)	9.5%	32.9%	39.0%	13.1%	5.5%	100.0%
Year 2020, Initial Vision (v 0.1)	10.2%	33.8%	38.3%	12.6%	5.2%	100.0%
Year 2020, Core Concentration (v 0.1)	10.3%	33.2%	38.4%	12.8%	5.3%	100.0%
Year 2020, Focused Growth (v 0.1)	9.9%	32.6%	38.8%	13.3%	5.5%	100.0%
Year 2020, Constrained Core Con. (v 0.1)	10.0%	32.6%	38.7%	13.2%	5.5%	100.0%
Year 2020, Outward Growth (v 0.1)	9.7%	32.6%	38.9%	13.3%	5.5%	100.0%

Table 20: Year 2035, Share of Households by Automobile Ownership Category (Data for Figure 12)

Scenario	Automobile Ownership Category					All Households
	Zero	One	Two	Three	Four or more	
Year 2005 (version 0.1)	9.5%	32.9%	39.0%	13.1%	5.5%	100.0%
Year 2035, Initial Vision (v 0.1)	10.9%	35.1%	37.5%	11.7%	4.9%	100.0%
Year 2035, Core Concentration (v 0.1)	12.4%	33.4%	37.0%	12.0%	5.1%	100.0%
Year 2035, Focused Growth (v 0.1)	11.5%	32.2%	38.2%	12.7%	5.3%	100.0%
Year 2035, Constrained Core Con. (v 0.1)	11.7%	32.2%	38.0%	12.7%	5.3%	100.0%
Year 2035, Outward Growth (v 0.1)	10.1%	32.9%	38.7%	12.9%	5.4%	100.0%

Table 21: Year 2020, Change in Number of Trips by Tour Purpose (Data for Figure 13)

Scenario	Tour Purpose									
	Work	College	School	At work	Eat out	Escort	Shopping	Social	Other	All Trips
Year 2005 (version 0.1)	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Year 2020, Initial Vision (v 0.1)	111.9%	113.4%	107.2%	111.3%	114.5%	110.8%	120.6%	119.7%	117.7%	113.8%
Year 2020, Core Concentration (v 0.1)	109.6%	111.6%	104.3%	109.0%	111.3%	107.3%	116.8%	115.4%	114.1%	110.8%
Year 2020, Focused Growth (v 0.1)	106.2%	111.5%	103.0%	105.2%	109.3%	106.3%	115.5%	114.6%	112.8%	108.7%
Year 2020, Constrained Core Con. (v 0.1)	106.2%	111.5%	102.8%	105.3%	109.3%	106.6%	115.3%	114.9%	112.8%	108.8%
Year 2020, Outward Growth (v 0.1)	106.4%	110.8%	103.3%	105.6%	109.5%	107.0%	115.8%	114.8%	112.7%	109.0%

Table 22: Year 2020, Average Trip Distance for All Travel (Data for Figure 14)

Scenario	Travel Mode				All Travel Modes
	Automobile	Walk	Bicycle	Transit	
Year 2005 (version 0.1)	7.3	0.9	2.3	8.6	6.7
Year 2020, Initial Vision (v 0.1)	6.9	0.9	2.3	9.4	6.3
Year 2020, Core Concentration (v 0.1)	6.9	0.9	2.3	9.6	6.3
Year 2020, Focused Growth (v 0.1)	6.9	0.9	2.3	9.6	6.3
Year 2020, Constrained Core Con. (v 0.1)	6.9	0.9	2.3	9.6	6.3
Year 2020, Outward Growth (v 0.1)	6.9	0.9	2.3	9.4	6.3

Table 23: Year 2035, Change in Number of Trips by Tour Purpose (Data for Figure 15)

Scenario	Tour Purpose									
	Work	College	School	At work	Eat out	Escort	Shopping	Social	Other	All Trips
Year 2005 (version 0.1)	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Year 2035, Initial Vision (v 0.1)	132.8%	120.7%	122.5%	134.2%	136.1%	125.4%	142.7%	137.6%	139.4%	133.5%
Year 2035, Core Concentration (v 0.1)	131.4%	117.1%	119.4%	133.0%	132.1%	121.0%	136.6%	131.7%	133.7%	129.9%
Year 2035, Focused Growth (v 0.1)	118.3%	122.9%	117.9%	119.7%	127.7%	123.0%	137.1%	131.4%	133.3%	125.0%
Year 2035, Constrained Core Con. (v 0.1)	118.3%	122.1%	117.8%	119.5%	127.3%	123.0%	136.8%	131.1%	133.1%	124.8%
Year 2035, Outward Growth (v 0.1)	118.9%	121.1%	118.7%	120.0%	128.1%	124.2%	137.4%	131.8%	133.8%	125.5%

Table 24: Year 2035, Average Trip Distance for All Travel (Data for Figure 16)

Scenario	Travel Mode				All Travel Modes
	Automobile	Walk	Bicycle	Transit	
Year 2005 (version 0.1)	7.3	0.9	2.3	8.6	6.7
Year 2035, Initial Vision (v 0.1)	6.9	0.9	2.3	9.7	6.3
Year 2035, Core Concentration (v 0.1)	6.9	0.9	2.3	10.0	6.4
Year 2035, Focused Growth (v 0.1)	6.8	0.9	2.3	9.9	6.3
Year 2035, Constrained Core Con. (v 0.1)	6.8	0.9	2.3	9.9	6.3
Year 2035, Outward Growth (v 0.1)	6.8	0.9	2.3	9.8	6.2

Table 25: Year 2020, Automobile Mode Shares for all Travel (Data for Figure 17)

Scenario	Automobile Travel Mode					All Automobile Modes
	Single occupant, No HOT	Single occupant, Pay to use HOT	Two occupants, No HOT	Two occupants, Pay to use HOT	Three-or-more occupants	
Year 2005 (version 0.1)	49.4%	0.0%	19.3%	0.0%	15.2%	83.9%
Year 2020, Initial Vision (v 0.1)	48.3%	1.2%	18.4%	0.1%	14.4%	82.4%
Year 2020, Core Concentration (v 0.1)	47.6%	1.8%	18.3%	0.1%	14.3%	82.1%
Year 2020, Focused Growth (v 0.1)	47.7%	1.6%	18.4%	0.1%	14.5%	82.4%
Year 2020, Constrained Core Con. (v 0.1)	47.7%	1.7%	18.4%	0.1%	14.5%	82.3%
Year 2020, Outward Growth (v 0.1)	48.3%	1.3%	18.5%	0.1%	14.5%	82.7%

Table 26: Year 2035, Automobile Mode Shares for all Travel (Data for Figure 18)

Scenario	Automobile Travel Mode					All Automobile Modes
	Single occupant, No HOT	Single occupant, Pay to use HOT	Two occupants, No HOT	Two occupants, Pay to use HOT	Three-or-more occupants	
Year 2005 (version 0.1)	49.4%	0.0%	19.3%	0.0%	15.2%	83.9%
Year 2035, Initial Vision (v 0.1)	47.7%	1.5%	17.7%	0.7%	13.8%	81.5%
Year 2035, Core Concentration (v 0.1)	46.0%	2.4%	17.3%	1.0%	13.5%	80.2%
Year 2035, Focused Growth (v 0.1)	46.0%	2.3%	17.7%	1.0%	14.1%	81.2%
Year 2035, Constrained Core Con. (v 0.1)	45.8%	2.4%	17.7%	1.0%	14.0%	80.9%
Year 2035, Outward Growth (v 0.1)	47.5%	1.5%	18.1%	0.7%	14.4%	82.3%

Table 27: Year 2020, Non-Automobile Mode Shares for all Travel (Data for Figure 19)

Scenario	Travel Mode				
	Walk	Bicycle	Walk to Transit	Drive to Transit	All Non-Automobile Modes
Year 2005 (version 0.1)	10.2%	1.1%	3.6%	1.1%	16.1%
Year 2020, Initial Vision (v 0.1)	11.0%	1.3%	4.1%	1.3%	17.6%
Year 2020, Core Concentration (v 0.1)	11.0%	1.3%	4.3%	1.4%	17.9%
Year 2020, Focused Growth (v 0.1)	10.9%	1.2%	4.1%	1.4%	17.6%
Year 2020, Constrained Core Con. (v 0.1)	10.9%	1.3%	4.2%	1.4%	17.7%
Year 2020, Outward Growth (v 0.1)	10.8%	1.2%	3.9%	1.3%	17.3%

Table 28: Year 2035, Non-Automobile Mode Shares for all Travel (Data for Figure 20)

Scenario	Travel Mode				
	Walk	Bicycle	Walk to Transit	Drive to Transit	All Non-Automobile Modes
Year 2005 (version 0.1)	10.2%	1.1%	3.6%	1.1%	16.1%
Year 2035, Initial Vision (v 0.1)	11.4%	1.3%	4.5%	1.4%	18.5%
Year 2035, Core Concentration (v 0.1)	11.5%	1.3%	5.4%	1.7%	19.8%
Year 2035, Focused Growth (v 0.1)	11.2%	1.2%	4.8%	1.5%	18.8%
Year 2035, Constrained Core Con. (v 0.1)	11.3%	1.2%	5.0%	1.6%	19.1%
Year 2035, Outward Growth (v 0.1)	11.1%	1.2%	4.0%	1.4%	17.7%

Table 29: Year 2020, Daily Transit Boardings (Data for Figure 21)

Scenario	Technology						
	Local Bus	Light Rail	Ferry	Express Bus	Heavy Rail	Commuter Rail	All Technologies
Year 2005 (version 0.1)	976,833	164,407	12,247	45,316	311,783	14,174	1,524,760
Year 2020, Initial Vision (v 0.1)	1,262,849	245,224	23,706	47,791	395,112	75,782	2,050,464
Year 2020, Core Concentration (v 0.1)	1,308,685	285,885	24,407	58,924	386,026	70,329	2,134,256
Year 2020, Focused Growth (v 0.1)	1,232,905	257,723	22,947	58,119	370,460	67,638	2,009,792
Year 2020, Constrained Core Con. (v 0.1)	1,249,214	261,538	23,583	58,630	372,530	68,736	2,034,231
Year 2020, Outward Growth (v 0.1)	1,179,443	222,462	20,899	50,401	361,461	72,279	1,906,945

Table 30: Year 2035, Daily Transit Boardings (Data for Figure 22)

Scenario	Technology						
	Local Bus	Light Rail	Ferry	Express Bus	Heavy Rail	Commuter Rail	All Technologies
Year 2005 (version 0.1)	976,833	164,407	12,247	45,316	311,783	14,174	1,524,760
Year 2035, Initial Vision (v 0.1)	1,597,462	332,663	27,809	57,048	576,195	98,167	2,689,344
Year 2035, Core Concentration (v 0.1)	2,017,883	425,914	31,542	110,241	585,949	88,275	3,259,804
Year 2035, Focused Growth (v 0.1)	1,762,887	342,605	24,464	99,001	507,967	77,055	2,813,979
Year 2035, Constrained Core Con. (v 0.1)	1,803,979	347,620	25,059	101,648	517,638	80,545	2,876,489
Year 2035, Outward Growth (v 0.1)	1,361,670	280,088	22,629	56,231	481,648	84,936	2,287,202

Table 31: Year 2035, One Hour Morning Peak Transbay Tube and Embarcadero and Montgomery BART Demand-to-Supply Ratios (Data for Figure 23 and Figure 24)

Scenario	One Hour AM Peak Period Demand and supply using Fixed Peak Hour Factor					
	@ Transbay Tube WB	Share of WB Tube Capacity	@ Transbay Tube EB	Share of EB Tube Capacity	Montgomery and Embarc. Boardings and Alightings	Share of Montgomery and Embarc. Capacity
Year 2005 (version 0.1)	14,376	57.0%	3,098	12.3%	15,441	56.7%
Year 2035, Initial Vision (v 0.1)	29,493	117.0%	3,887	15.4%	22,991	84.4%
Year 2035, Core Concentration (v 0.1)	25,824	79.3%	4,105	12.6%	20,615	68.7%
Year 2035, Focused Growth (v 0.1)	22,316	68.6%	3,712	11.4%	17,527	58.4%
Year 2035, Constrained Core Con. (v 0.1)	23,117	71.0%	3,811	11.7%	18,313	61.0%
Year 2035, Outward Growth (v 0.1)	22,024	87.4%	3,899	15.5%	18,264	67.0%

Table 32: Year 2035, One Hour Morning Peak Muni Metro Demand-to-Supply Ratios (Data for Figure 25)

Scenario	One Hour AM Peak Period Demand and supply using Fixed Peak Hour Factor			
	Before Van Ness Station Inboud	Share of Inbound Capacity	Sunset Tunnel Inbound	Share of Inbound Capacity
Year 2010 (version 0.1)	7,000	89.7%	1,980	97.1%
Year 2035, Initial Vision (v 0.1)	9,056	116.1%	2,125	104.2%
Year 2035, Core Concentration (v 0.1)	12,500	160.3%	2,657	130.3%
Year 2035, Focused Growth (v 0.1)	10,818	138.7%	2,433	119.3%
Year 2035, Constrained Core Con. (v 0.1)	11,177	143.3%	2,469	121.0%
Year 2035, Outward Growth (v 0.1)	8,676	111.2%	2,050	100.5%

Table 33: Year 2020, Hourly Vehicle Miles Traveled (Data for Figure 26)

Scenario	Time of Day					Daily
	Early AM (3 to 6 am)	AM Peak (6 to 10 am)	Midday (10 am to 3 pm)	PM Peak (3 to 7 pm)	Evening (7 pm to 3 am)	
Year 2005 (version 0.1)	2,047,692	9,763,230	7,695,205	11,007,397	3,039,463	6,334,055
Year 2020, Initial Vision (v 0.1)	2,296,331	10,504,621	8,481,446	11,947,293	3,251,734	6,879,906
Year 2020, Core Concentration (v 0.1)	2,238,250	10,306,441	8,324,010	11,744,286	3,174,165	6,747,126
Year 2020, Focused Growth (v 0.1)	2,225,989	10,125,541	8,233,363	11,569,503	3,125,428	6,651,183
Year 2020, Constrained Core Con. (v 0.1)	2,214,192	10,102,805	8,233,567	11,550,387	3,114,743	6,639,213
Year 2020, Outward Growth (v 0.1)	2,231,499	10,197,445	8,244,400	11,593,820	3,130,873	6,672,023

Table 34: Year 2035, Hourly Vehicle Miles Traveled (Data for Figure 27)

Scenario	Time of Day					Daily
	Early AM (3 to 6 am)	AM Peak (6 to 10 am)	Midday (10 am to 3 pm)	PM Peak (3 to 7 pm)	Evening (7 pm to 3 am)	
Year 2005 (version 0.1)	2,047,692	9,763,230	7,695,205	11,007,397	3,039,463	6,334,055
Year 2035, Initial Vision (v 0.1)	2,722,343	12,070,028	9,825,665	13,752,442	3,812,541	7,961,898
Year 2035, Core Concentration (v 0.1)	2,635,958	11,846,497	9,580,145	13,479,201	3,716,483	7,785,136
Year 2035, Focused Growth (v 0.1)	2,530,221	11,333,674	9,370,732	13,022,822	3,557,161	7,513,650
Year 2035, Constrained Core Con. (v 0.1)	2,512,456	11,296,053	9,340,468	12,971,438	3,535,664	7,483,125
Year 2035, Outward Growth (v 0.1)	2,583,323	11,501,040	9,445,700	13,131,572	3,607,707	7,598,774

Table 35: Year 2020, Average Freeway Speed (Data for Figure 28)

Scenario	Time of Day					Daily
	Early AM (3 to 6 am)	AM Peak (6 to 10 am)	Midday (10 am to 3 pm)	PM Peak (3 to 7 pm)	Evening (7 pm to 3 am)	
Year 2005 (version 0.1)	60.8	49.2	57.3	49.2	59.6	53.1
Year 2020, Initial Vision (v 0.1)	61.2	49.1	57.4	49.7	59.7	53.3
Year 2020, Core Concentration (v 0.1)	61.2	50.7	57.6	50.5	59.7	54.0
Year 2020, Focused Growth (v 0.1)	61.3	51.4	57.8	51.1	59.7	54.5
Year 2020, Constrained Core Con. (v 0.1)	61.3	51.4	57.8	51.1	59.7	54.5
Year 2020, Outward Growth (v 0.1)	61.3	50.9	57.8	51.1	59.8	54.3

Table 36: Year 2035, Average Freeway Speed (Data for Figure 29)

Scenario	Time of Day					Daily
	Early AM (3 to 6 am)	AM Peak (6 to 10 am)	Midday (10 am to 3 pm)	PM Peak (3 to 7 pm)	Evening (7 pm to 3 am)	
Year 2005 (version 0.1)	60.8	49.2	57.3	49.2	59.6	53.1
Year 2035, Initial Vision (v 0.1)	61.1	44.0	56.1	45.3	59.6	50.0
Year 2035, Core Concentration (v 0.1)	61.1	46.6	56.4	46.7	59.6	51.4
Year 2035, Focused Growth (v 0.1)	61.3	48.9	57.0	48.4	59.7	52.8
Year 2035, Constrained Core Con. (v 0.1)	61.3	49.0	57.0	48.4	59.7	52.8
Year 2035, Outward Growth (v 0.1)	61.3	47.5	56.9	47.8	59.8	52.1

Appendix B: Core Capacity Transit Network Non-Project Service Improvements

Summary of Changes in Transit Supply -- Year 2035 Core Capacity Frequency Improvements -- Rough Service Increase Estimate

Technology	Operator	Weighted hourly passenger seat miles					
		2010	**2035 Core Capacity *without* Frequency Improvements**	**Difference from 2010**	**2035 Core Capacity *with* Frequency Improvements**	**Difference from 2010**	**Difference from 2035 Core Capacity without Frequency Improvements**
Local Bus	All	1,432,943	1,938,664	35%	2,049,572	43%	6%
	SF Muni	293,317	382,220	30%	388,749	33%	2%
	SC VTA	235,900	253,893	8%	304,657	29%	20%
	AC Transit	280,956	674,601	140%	692,464	146%	3%
	SamTrans	110,245	127,028	15%	149,041	35%	17%
Light Rail		338,081	463,429	37%	528,718	56%	14%
Ferry		192,178	310,857	62%	310,857	62%	0%
Express		313,181	484,918	55%	521,257	66%	7%
Heavy Rail		1,838,927	2,753,097	50%	2,753,097	50%	0%
Commuter Rail		602,634	921,546	53%	921,546	53%	0%
Total		*4,717,944*	*6,872,512*	*46%*	*7,085,048*	*50%*	*3%*

Summary of Changes in Transit Supply -- Year 2035 Core Capacity Frequency Improvements -- Rough Annual Capital Cost Estimate

Scenario	Compared to …	Item	Transit technology					
			Bus and paratransit	Light rail	Ferry	Heavy rail	Commuter rail	System total
Current system data	---	Number of vehicles	3,799	387	22	669	181	5,058
		Average vehicle cost ($2011)	$ 489,191	$ 2,124,724	$ 27,624,832	$ 3,205,578	$ 2,803,579	$ 1,962,771
		Approximate useful vehicle life (years)	14	27	30	27	27	---
		Revenue vehicle hours	9,561,141	602,470	28,542	1,940,000	225,000	12,357,154
		Annual hours per revenue vehicle	2,517	1,557	1,297	2,900	1,243	2,443
		Cost of maintenance facilities ($2011)	$ 2,365,533,834	$ 723,349,826	$ 61,462,928	$ 533,032,132	$ 179,556,444	$ 3,862,935,164
		Maintenance facility cost per vehicle ($2011)	$ 622,673	$ 1,869,121	$ 2,793,769	$ 796,760	$ 992,025	$ 763,728
Year 2035 Core Capacity Capital Projects	Current system	Service change from current system	38.8%	37.1%	61.8%	49.7%	52.9%	45.7%
		Estimated revenue vehicle hours	13,270,657	825,844	46,168	2,904,417	344,069	18,000,358
		Additional vehicles needed	1,474	143	14	333	96	2,310
		Cost of additional vehicles ($2011)	$ 721,033,087	$ 304,867,127	$ 375,311,174	$ 1,066,093,480	$ 268,539,461	$ 2,736,000,000
		Cost of additional maintenance faclities ($2011)	$ 917,775,974	$ 268,191,761	$ 37,956,172	$ 264,981,909	$ 95,020,599	$ 1,584,000,000
Year 2035 Core Capacity Capital Projects plus Additional Service	Current system	Service change from current system	47.2%	56.4%	61.8%	49.7%	52.9%	50.2%
		Estimated revenue vehicle hours	14,076,930	942,190	46,168	2,904,417	344,069	18,557,029
		Additional vehicles needed	1,794	218	14	333	96	2,538
		Cost of additional vehicles ($2011)	$ 877,751,410	$ 463,660,114	$ 375,311,174	$ 1,066,093,480	$ 268,539,461	$ 3,051,000,000
		Cost of additional maintenance faclities ($2011)	$ 1,117,256,851	$ 407,882,029	$ 37,956,172	$ 264,981,909	$ 95,020,599	$ 1,923,000,000
Year 2035 First iteration of additional service	Year 2035 Core Capacity Capital Projects	Service change from current system	6.1%	14.1%	0.0%	0.0%	0.0%	3.1%
		Estimated revenue vehicle hours	14,076,930	942,190	46,168	2,904,417	344,069	18,557,029
		Additional vehicles needed	320	75	0	0	0	2,538
		Cost of additional vehicles ($2011)	$ 156,718,324	$ 158,792,987	$ -	$ -	$ -	$ 316,000,000
		Cost of additional maintenance faclities ($2011)	$ 199,480,877	$ 139,690,268	$ -	$ -	$ -	$ 339,000,000

Summary of Changes in Transit Supply -- Year 2035 Core Capacity Frequency Improvements -- Rough Annual Operating Cost Estimate

Scenario	Compared to …	Item	Transit technology					
			Bus and paratransit	**Light rail**	**Ferry**	**Heavy rail**	**Commuter rail**	**System total**
Current system data	---	Annual cost of existing service	$ 1,332,647,906	$ 202,059,422	$ 41,345,169	$ 484,824,142	$ 98,771,000	$ 2,159,647,639
		Revenue vehicle hours	9,561,141	602,470	28,542	1,940,000	225,000	12,357,154
		Cost per revenue vehicle hour	$ 139	$ 335	$ 1,449	$ 250	$ 439	$ 175
Year 2035 Core Capacity Capital Projects	Current system	Service change from current system	38.8%	37.1%	61.8%	49.7%	52.9%	45.7%
		Revenue vehicle hours	13,270,657	825,844	46,168	2,904,417	344,069	18,000,358
		Additional revenue vehicle hours	3,709,516	223,374	17,626	964,417	119,069	5,643,205
		Cost of additional service	$ 517,038,569.62	$ 74,916,272	$ 25,532,535	$ 241,016,664	$ 52,269,244	***$ 911,000,000***
Year 2035 Core Capacity Capital Projects plus Additional Service	Current system	Service change from current system	47.2%	56.4%	61.8%	49.7%	52.9%	50.2%
		Revenue vehicle hours	14,076,930	942,190	46,168	2,904,417	344,069	18,557,029
		Additional revenue vehicle hours	4,515,789	339,720	17,626	964,417	119,069	6,199,875
		Cost of additional service	$ 629,418,180.79	$ 113,937,135	$ 25,532,535	$ 241,016,664	$ 52,269,244	***$ 1,062,000,000***
Year 2035 Core Capacity Capital Projects plus Additional Service	Year 2035 Core Capacity Capital Projects	Service change from current system	6.1%	14.1%	0.0%	0.0%	0.0%	3.1%
		Additional revenue vehicle hours	806,272	116,346	-	-	-	556,671
		Cost of additional service	$ 112,379,611	$ 39,020,864	$ -	$ -	$ -	***$ 151,000,000***

Note: Base year cost and service data was taken from the 2008 Statistical Summary

Year 2035 Core Capacity Network Frequency Improvements -- Rough Plan Cost Estimate

Assumed annual inflation rate = 2.2%

Year	Annual operating cost increase		Annual capital cost increase - vehicles		Annual capital cost increase - maint facilities		Cumulative cost increase	
	Year 2008 dollars	YOE dollars	Year 2008 dollars	YOE dollars	Year 2008 dollars	YOE dollars	Year 2008 dollars	YOE dollars
2013	$151,000,000	$168,357,096	$17,075,388	$19,038,164	$6,780,000	$7,559,345	$174,855,388	$194,954,605
2014	$151,000,000	$172,060,952	$17,075,388	$19,457,003	$6,780,000	$7,725,651	$349,710,775	$394,198,211
2015	$151,000,000	$175,846,293	$17,075,388	$19,885,057	$6,780,000	$7,895,615	$524,566,163	$597,825,176
2016	$151,000,000	$179,714,912	$17,075,388	$20,322,528	$6,780,000	$8,069,319	$699,421,551	$805,931,935
2017	$151,000,000	$183,668,640	$17,075,388	$20,769,624	$6,780,000	$8,246,844	$874,276,939	$1,018,617,042
2018	$151,000,000	$187,709,350	$17,075,388	$21,226,556	$6,780,000	$8,428,274	$1,049,132,326	$1,235,981,222
2019	$151,000,000	$191,838,955	$17,075,388	$21,693,540	$6,780,000	$8,613,696	$1,223,987,714	$1,458,127,413
2020	$151,000,000	$196,059,412	$17,075,388	$22,170,798	$6,780,000	$8,803,197	$1,398,843,102	$1,685,160,821
2021	$151,000,000	$200,372,720	$17,075,388	$22,658,555	$6,780,000	$8,996,868	$1,573,698,489	$1,917,188,964
2022	$151,000,000	$204,780,919	$17,075,388	$23,157,044	$6,780,000	$9,194,799	$1,748,553,877	$2,154,321,726
2023	$151,000,000	$209,286,100	$17,075,388	$23,666,499	$6,780,000	$9,397,084	$1,923,409,265	$2,396,671,409
2024	$151,000,000	$213,890,394	$17,075,388	$24,187,162	$6,780,000	$9,603,820	$2,098,264,653	$2,644,352,785
2025	$151,000,000	$218,595,982	$17,075,388	$24,719,279	$6,780,000	$9,815,104	$2,273,120,040	$2,897,483,151
2026	$151,000,000	$223,405,094	$17,075,388	$25,263,103	$6,780,000	$10,031,037	$2,447,975,428	$3,156,182,385
2027	$151,000,000	$228,320,006	$17,075,388	$25,818,892	$6,780,000	$10,251,719	$2,622,830,816	$3,420,573,002
2028	$151,000,000	$233,343,046	$17,075,388	$26,386,907	$6,780,000	$10,477,257	$2,797,686,203	$3,690,780,213
2029	$151,000,000	$238,476,593	$17,075,388	$26,967,419	$6,780,000	$10,707,757	$2,972,541,591	$3,966,931,982
2030	$151,000,000	$243,723,078	$17,075,388	$27,560,702	$6,780,000	$10,943,328	$3,147,396,979	$4,249,159,090
2031	$151,000,000	$249,084,986	$17,075,388	$28,167,038	$6,780,000	$11,184,081	$3,322,252,367	$4,537,595,195
2032	$151,000,000	$254,564,856	$17,075,388	$28,786,713	$6,780,000	$11,430,131	$3,497,107,754	$4,832,376,894
2033	$151,000,000	$260,165,283	$17,075,388	$29,420,020	$6,780,000	$11,681,593	$3,671,963,142	$5,133,643,791
2034	$151,000,000	$265,888,919	$17,075,388	$30,067,261	$6,780,000	$11,938,589	$3,846,818,530	$5,441,538,559
2035	$151,000,000	$271,738,475	$17,075,388	$30,728,741	$6,780,000	$12,201,237	$4,021,673,917	$5,756,207,012
2036	$151,000,000	$277,716,721	$17,075,388	$31,404,773	$6,780,000	$12,469,665	$4,196,529,305	$6,077,798,171
2037	$151,000,000	$283,826,489	$17,075,388	$32,095,678	$6,780,000	$12,743,997	$4,371,384,693	$6,406,464,335
2038	$151,000,000	$290,070,672	$17,075,388	$32,801,783	$6,780,000	$13,024,365	$4,546,240,081	$6,742,361,155
2039	$151,000,000	$296,452,227	$17,075,388	$33,523,422	$6,780,000	$13,310,901	$4,721,095,468	$7,085,647,706
2040	$151,000,000	$302,974,176	$17,075,388	$34,260,937	$6,780,000	$13,603,741	$4,895,950,856	$7,436,486,560

Year 2035 Core Capacity Transit Frequency Improvements

Operator	Service	Route	Core Capacity Capital Projects Network Headways					Core Capacity Capital + Additional Service Headways				
			Early AM	AM Peak	Midday	PM Peak	Evening	Early AM	AM Peak	Midday	PM Peak	Evening
AC Transit	Express bus	LA Richmond Parkway TC to Transbay Terminal EB	---	12	12	12	22.5	30	5	5	5	12
AC Transit	Express bus	LA Richmond Parkway TC to Transbay Terminal WB	---	12	12	12	22.5	30	5	5	5	12
AC Transit	Express bus	NL Eastmont to Transbay Terminal EB	---	7.5	7.5	7.5	15	30	5	5	5	15
AC Transit	Express bus	NL Eastmont to Transbay Terminal WB	---	7.5	7.5	7.5	15	30	5	5	5	15
AC Transit	Local Bus	1 Berkeley to Bay Fair EB	---	3	5	3	9	9	3	3	3	9
AC Transit	Local Bus	1 Berkeley to Bay Fair WB	---	3	5	3	9	9	3	3	3	9
AC Transit	Local Bus	Treasure Island to Downtown Oakland EB	---	10	30	10	30	10	5	10	5	15
AC Transit	Local Bus	Treasure Island to Downtown Oakland WB	---	10	30	10	30	10	5	10	5	15
SamTrans	Local Bus	292 Hillsdale to Downtown SF NB	60	15	30	15	20	30	10	15	10	15
SamTrans	Local Bus	292 Hillsdale to Downtown SF SB	90	15	30	15	20	30	10	15	10	15
SamTrans	Local Bus	390 Palo Alto to Daly City NB	---	10	15	10	15	30	5	10	5	15
SamTrans	Local Bus	390 Palo Alto to Daly City SB	---	10	15	10	15	30	5	10	5	15
SC VTA	Light Rail	900 Almaden to Mountain View	15	15	15	15	15	15	10	10	10	15
SC VTA	Light Rail	900 Mountain View to Almaden	15	15	15	15	15	15	10	10	10	15
SC VTA	Light Rail	901 Eastridge to Santa Teresa	15	15	15	15	15	15	10	10	10	15
SC VTA	Light Rail	901 Santa Teresa to Eastridge	15	15	15	15	15	15	10	10	10	15
SC VTA	Light Rail	902 Vasona Junction to Winchester	15	15	15	15	15	15	10	10	10	15
SC VTA	Light Rail	902 Winchester to Vasona Junction	15	15	15	15	15	15	10	10	10	15
SC VTA	Light Rail	903 Eastridge to Mountain View	---	15	---	15	---	---	10	---	10	---
SC VTA	Light Rail	903 Mountain View to Eastridge	---	15	---	15	---	---	10	---	10	---
SC VTA	Local Bus	22 Palo Alto to East Ridge EB	30	15	15	15	20	15	8	8	8	15
SC VTA	Local Bus	22 Palo Alto to East Ridge WB	30	15	15	15	20	15	8	8	8	15
SC VTA	Local Bus	23 De Anza to Alum Rock EB	90	15	15	15	30	30	10	10	10	15
SC VTA	Local Bus	23 De Anza to Alum Rock WB	90	15	15	15	30	30	10	10	10	15
SC VTA	Local Bus	523 Express EB	90	10	10	10	30	15	10	10	10	15
SC VTA	Local Bus	523 Express WB	90	10	10	10	30	15	10	10	10	15
SC VTA	Local Bus	57 West Valley to Great America NB	---	30	30	30	60	30	15	15	15	30
SC VTA	Local Bus	57 West Valley to Great America SB	---	30	30	30	60	30	15	15	15	30
SC VTA	Local Bus	60 Winchester to Great America NB	99.99	30	30	30	60	60	15	15	15	30

Operator	Service	Route	Core Capacity Capital Projects Network Headways					Core Capacity Capital + Additional Service Headways				
			Early AM	AM Peak	Midday	PM Peak	Evening	Early AM	AM Peak	Midday	PM Peak	Evening
SC VTA	Local Bus	60 Winchester to Great America SB	---	30	30	30	60	60	15	15	15	30
SC VTA	Local Bus	61 Good Sam to Sierra & Piedmont via Bascom NB	---	30	30	30	120	30	15	15	15	30
SC VTA	Local Bus	61 Good Sam to Sierra & Piedmont via Bascom SB	---	30	30	30	120	30	15	15	15	30
SC VTA	Local Bus	62 Good Sam to Sierra & Piedmont via Union NB	---	30	30	30	60	30	15	15	15	30
SC VTA	Local Bus	62 Good Sam to Sierra & Piedmont via Union SB	---	30	30	30	60	30	15	15	15	30
SC VTA	Local Bus	64 Almaden LRT to McKee NB	99.99	30	30	30	60	30	15	15	15	30
SC VTA	Local Bus	64 Almaden LRT to McKee SB	99.99	30	30	30	60	30	15	15	15	30
SC VTA	Local Bus	66 Kaiser to Milipitas NB	99.99	15	20	15	60	30	10	15	10	30
SC VTA	Local Bus	66 Kaiser to Milipitas SB	99.99	15	20	15	60	30	10	15	10	30
SC VTA	Local Bus	68 Gilroy to Diridon NB	30	15	20	15	60	30	10	15	10	30
SC VTA	Local Bus	68 Gilroy to Diridon SB	60	15	20	15	60	30	10	15	10	30
SF Muni	Light Rail	J Church IN	60	9	10	9	15	15	9	10	9	15
SF Muni	Light Rail	J Church OUT	60	9	10	9	15	15	9	10	9	15
SF Muni	Light Rail	K Ingleside IN	60	9	10	9	15	15	9	10	9	15
SF Muni	Light Rail	K Ingleside OUT	60	9	10	9	15	15	9	10	9	15
SF Muni	Light Rail	L Taraval IN	30	5	10	5	12	15	5	10	5	12
SF Muni	Light Rail	L Taraval OUT	30	5	10	5	12	15	5	10	5	12
SF Muni	Light Rail	M Ocean IN	60	7.5	10	7.5	12	15	7.5	10	7.5	12
SF Muni	Light Rail	M Ocean OUT	60	7.5	10	7.5	12	15	7.5	10	7.5	12
SF Muni	Light Rail	N Judah IN	30	5	10	5	12	15	5	10	5	12
SF Muni	Light Rail	N Judah OUT	30	5	10	5	12	15	5	10	5	12
SF Muni	Light Rail	T Third Street IN	30	3	5	3	12	15	3	5	3	12
SF Muni	Light Rail	T Third Street OUT	30	3	5	3	12	15	3	5	3	12
SF Muni	Local Bus	1 California IN	45	6	5	7	15	10	6	5	7	10
SF Muni	Local Bus	1 California OUT	90	6	5	7	15	10	6	5	7	10
SF Muni	Local Bus	108 Treasure Island EB	40	6	10	5	20	10	6	6	5	10
SF Muni	Local Bus	108 Treasure Island WB	40	6	10	5	20	10	6	6	5	10
SF Muni	Local Bus	14 Mission IN	15	7	7.5	7	10	10	7	7.5	7	7
SF Muni	Local Bus	14 Mission OUT	30	7	7.5	7	10	10	7	7.5	7	7
SF Muni	Local Bus	22 Fillmore NB	30	6	7	6	15	15	6	7	6	15
SF Muni	Local Bus	22 Fillmore SB	30	6	7	6	15	15	6	7	6	15

Operator	Service	Route	Core Capacity Capital Projects Network Headways					Core Capacity Capital + Additional Service Headways				
			Early AM	AM Peak	Midday	PM Peak	Evening	Early AM	AM Peak	Midday	PM Peak	Evening
SF Muni	Local Bus	49 Van Ness NB	60	7	9	7	12	**12**	7	**7**	7	12
SF Muni	Local Bus	49 Van Ness SB	90	7	9	7	15	**12**	7	**7**	7	**12**