CalShuttle - The Future of Bay Area Transit

A summary of a 64-page study at www.knowledgewise.com

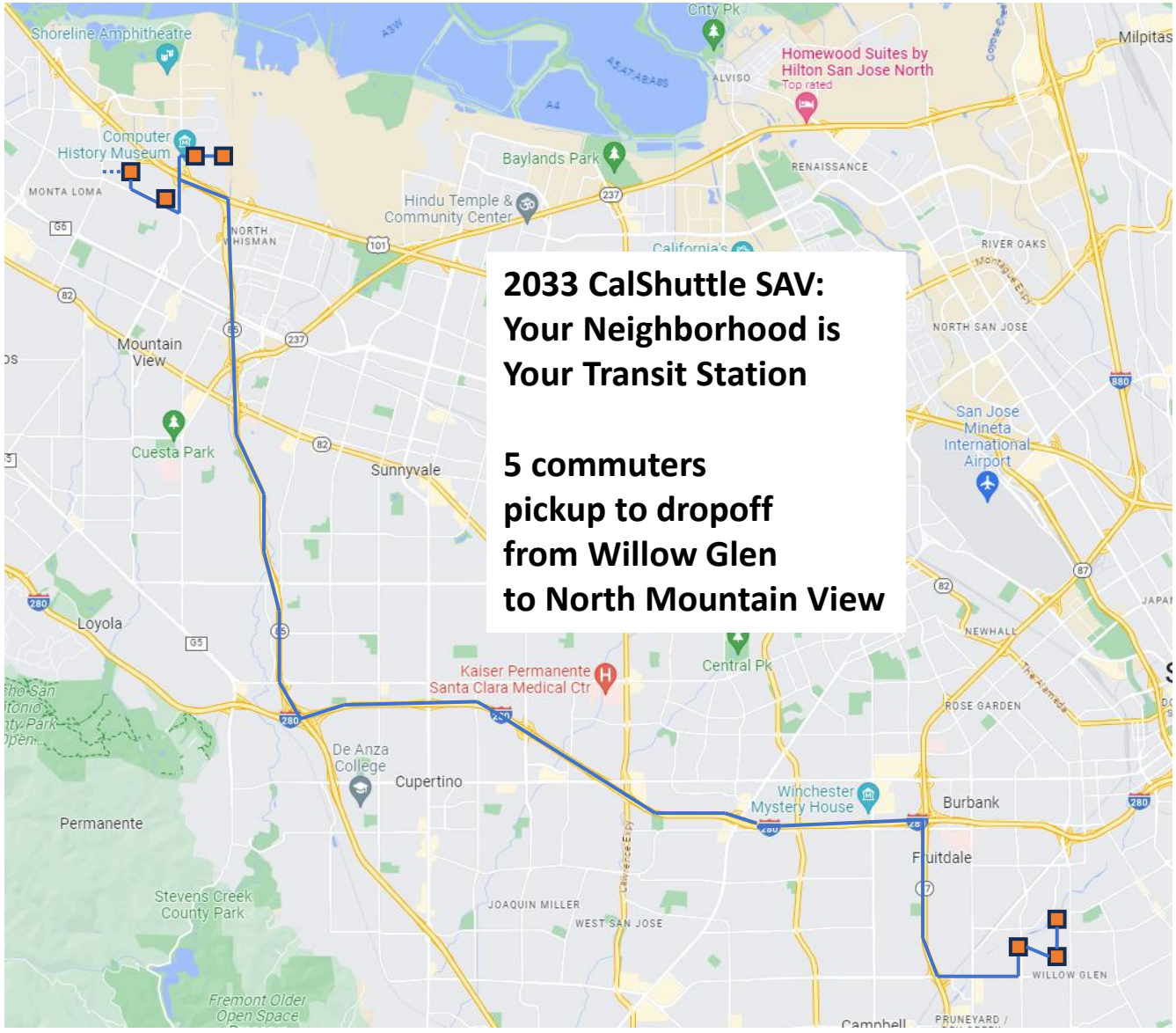
Shared Autonomous Vehicles (SAVs)

Waymo 6th-generation robotaxi –
based on a body by China-based Geely/Zeekr
(Image courtesy of Waymo –
https://waymo.com/blog/2021/12/expanding-our-waymo-one-fleet-with)

Amazon-owned Zoox Robotaxi.
(Image courtesy of Zoox –
https://zoox.com/vehicle/)

Presto driverless shuttle at Bishop Ranch spring 2023.
(Image courtesy of Contra Costa Transit Authority -
(https://patch.com/california/sanramon/bay-areas-first-autonomous-shuttles-debut-bishop-ranch)

1. 2033: Your Neighborhood is your Transit Station



[Google Maps]

2. CalShuttle: On-demand, point-to-point, fast, 24-hour shuttle rapid transit

2.1 On-demand. Algorithms gather riders with similar routes.

2.2 Point-to-point or pickup-to-dropoff locations within 2 blocks of start and destination.

2.3 Fast. SAVs reduce vehicles and congestion. Connected SAVs minimize acceleration reaction lag.

2.4 24-Hour Availability. Without human drivers, service will be available 24/7.

2.5 Safe travel. Waymo study reports 82 to 92 percent safer operation than human drivers.

2.6 Resilient. SAVs will automatically route around accidents or roadways damaged in disasters.

2.7 Robustly Redundant. When a Shuttle breaks down, a replacement Shuttle will quickly arrive.

2.8 Scalable Down and Up. As demand varies, service availability will automatically scale.

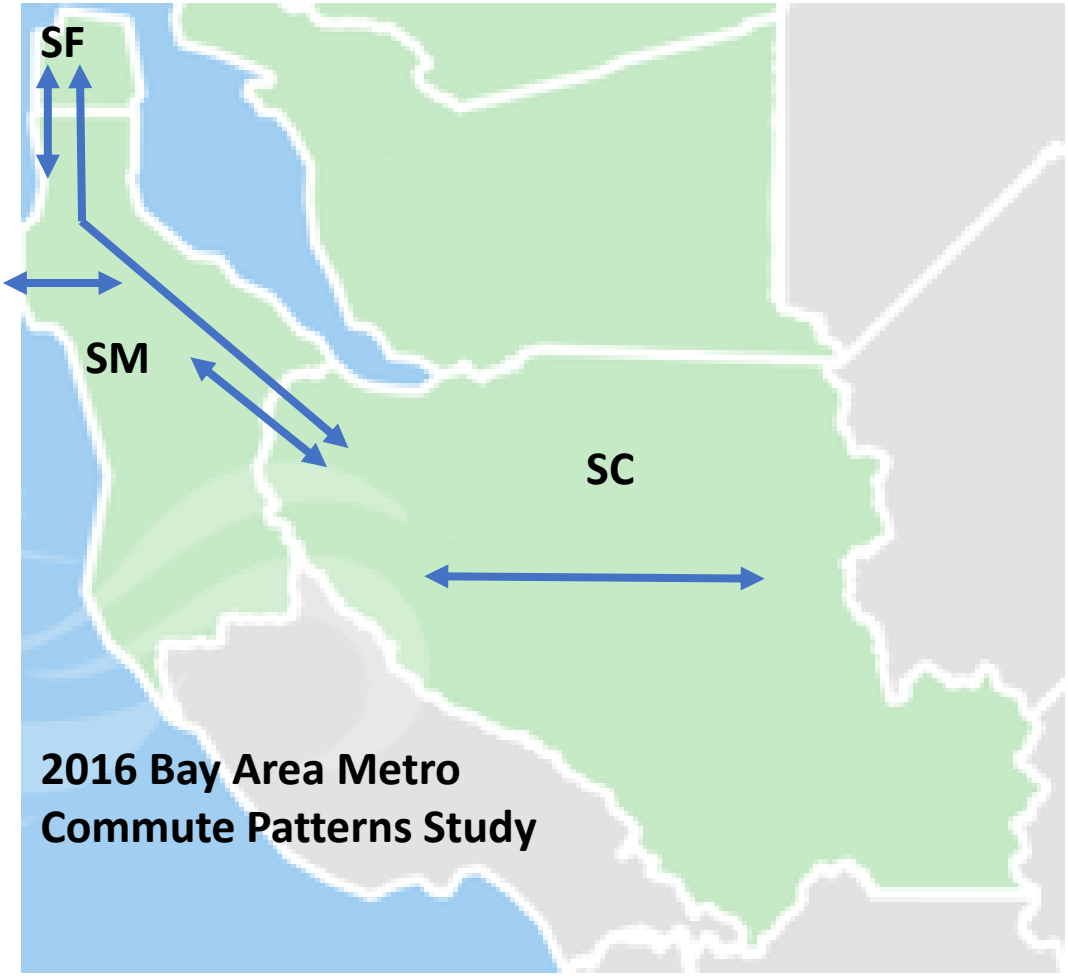
3. CalShuttle Impacts

The travel scope of this analysis includes these Counties:

- San Francisco to and from San Mateo
- San Francisco to and from Santa Clara
- San Mateo to and from Santa Clara
- Within San Mateo
- Within Santa Clara

Travel within densely-populated San Francisco is excluded. The assumption is that travel entirely within San Francisco will continue to be serviced by San Francisco Muni buses and light rail / trolleys, taxis, and other existing means of transportation.

Based on the 2016 Bay Area Metro Study: Vital Signs: Commute Patterns - Bay Area https://data.bayareametro.gov/dataset/Vital-Signs-Commute-Patterns-Bay-Area/c33n-96bi



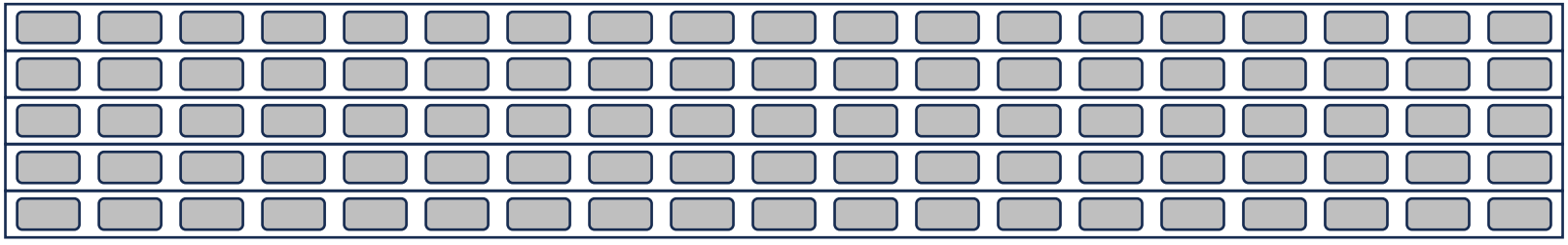
Base Map Courtesy of
San Francisco Bay Area Hispanic Chamber of Commerce
https://www.sfbayhcc.com/

3. CalShuttle Impacts

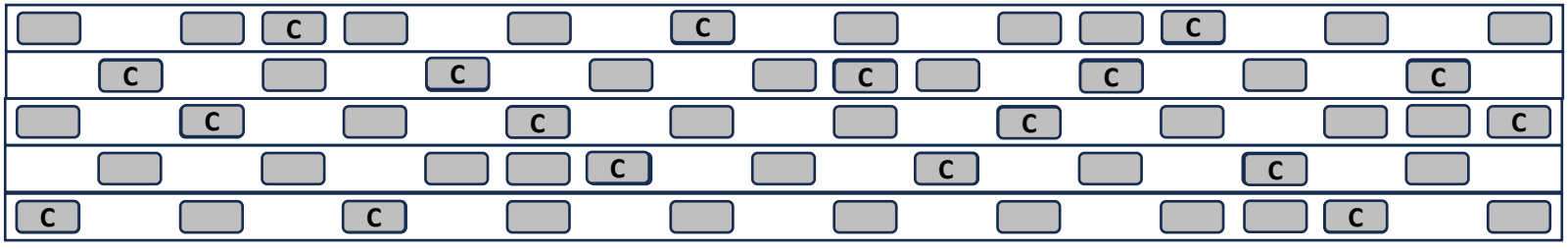
3.1 Reduces vehicle traffic counts, traffic congestion, and energy usage.

31,354 Shuttles will reduce commute periods vehicles on the road by 46% or 468,000 vehicles, thereby reducing traffic congestion.

2016 Rush Period Traffic: 100 commuter vehicles



2033 Rush Period Traffic: 54 commuter vehicles
Including 18 CalShuttle SAVs



3.2 Minimizes infrastructure costs through reuse of existing street network.

Our Bay Area streets, expressways, and highways will become our transit network –
like subways just not underground, without having to change trains,
and departing and arriving close to any destination.

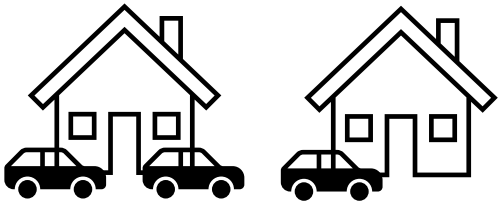
3.3 Eliminates the need for more highway or bridge construction.

For example, a new Southern Crossing bridge from Highways 380 to 238 would not longer be needed.

3. CalShuttle Impacts

3.4 Reduces or eliminates family car ownership cost.
Families' private automobile ownership cost savings:
$4.75 billion per year

Many families will downsize to 1 or no cars that they own



3.5 Reduces passenger and pedestrian injuries and death.
Reduces the 90% of accidents caused by human error.

3.6 Improves mobility for our older and disabled residents.
Point-to-point, 24/7, affordable service.

3.7 Enables converting street parking spaces, parking lots and garages to other uses.
Wider sidewalks, bike lanes, housing, and others.

[Google Maps]

3.8 Eliminates the need, cost for corporate shuttle buses.

3.9 Enables productive activities or resting while shuttling.

4. CalShuttle Agency and Private Vendor Shuttles

Private vendors purchase, own, operate, and maintain the SAVs. Likely companies:

- On-demand rideshare companies like Uber, Lyft;
- Traditional rental-car companies like Hertz, Avis, National, Alamo, Budget;
- Automobile companies such as Ford, GM, and Tesla.

CalShuttle will be a three-county agency arranging and providing services.

- Akin to an airport like SFO does for airlines but with different and fewer services.
- SF MTA, San Mateo SamTrans, and Santa Clara County VTA will jointly operate this agency.

CalShuttle duties will include:

- Construct, maintain electric, hydrogen charging stations throughout the three counties.
- Manage interoperability among shuttle operation companies [Chan2012a].
- Monitor the shuttle vendors so that their algorithms achieve the rush period passenger load.
- Monitor the shuttle fleets to assure sufficient accessible support for disabled passengers.
- Manage fare subsidies for : low-income, disabled, seniors, students.

Charging stations will be automated with one or more technologies, so no human will need to be involved. For each Shuttle:

- A retractable arm connecting to a charging port at a standard location on the side.
- A retractable post connecting to a charging port at a standard location on the bottom.
- Wireless charging through coils mounted in the ground below the charging lane.

5. Cost-Effective Implementation and Operation

Capital Costs – fully paid for by private shuttle operators

SAV shuttles:	$2.5B
Chargers and stations:	$0.4B Initially paid for by CalShuttle, but reimbursed over time by operators.
Total:	**$2.9B**

Operational Costs and Fares

- Eliminates the driver labor costs that comprise 80% of per-mile cost [Shetty202a].
- Spreads operational costs across multiple passengers and trips.
- As with any EV, Shuttles reduce energy costs. [VanderWerp2021a]

100 per cent fare recovery is possible with the following parameters:

- 31,354 CalShuttle-administered, private vendor-operated Shuttles.
- 505 million annual passenger trips.
- 155 million annual Shuttle trips.
- 3.3 average Shuttle passenger load per trip: 4 during commute periods, fewer other times
- 20.3 mile average Shuttle trip distance.
- $6.39 cost per 20.3 mile Shuttle commuter trip = $0.31 per Shuttle mile
- **$1.96 fare** per Shuttle passenger = $0.097 per passenger mile for a 20.3 mile trip.

Vendor-operated Shuttles cover all costs for:

- SAV Shuttle operations.
- CalShuttle charging stations and office operations.
- CalShuttle capital equipment costs, paid back over time.

No ongoing government subsidy is required, except possibly for special classes of passengers such as: low-income; students; seniors; and special assistance shuttles with ramps.

6. CalShuttle - The Future of Bay Area Transit

6.1 Shared Autonomous Vehicles for transit should happen.

- Improved service.
- Financial and other beneficial impacts.
- Reduced government capital and operational costs.

6.2 Shared Autonomous Vehicles for transit will happen.

- On-demand, point-to-point model is already popular.
- Many commuters already "share" transit: carpool, bus, light rail, CalTrain, Capitol Corridor, etc.

6.3 The beginnings of a Bay Area-wide network.

- CalShuttle services will grow organically beyond the 3-county confines of this study.
- First expansions would likely be across the San Mateo and Dumbarton bridges.

6.4 Even longer distances.

- CalShuttle would expand to distant destinations: Sacramento, Monterey, Sierras, Bakersfield.
- Businesspeople and families could make effective use of time for such 2-to-4-hour trips.

6.5 Timeframe: Early 2030s.

- Predictions for AV maturity range from now (2023) to many decades hence.
- Waymo's driverless robotaxis have already captured 27 percent of ridesharing in San Francisco.
- This study arrived at: 2030 for Level 5 operation plus 3 years for 65 percent acceptance.

6.6 Parallels the automobile revolution in the early 1900s.

- At first, autos were unreliable, useless in many conditions, and unsafe with inexperience drivers.
- But advantages won: speed, availability vs. a horse, power, less pollution and odor than manure.

7. Changes in Government Approaches: Cost Savings

- **Cost avoidance savings:**

	Potential Cost Avoidance Savings	Taxpayer
		$Billion
Entity	Item	Savings
Caltrain	**Grade Separations**	**$10.2B**
Caltrain	**DTX**	**$6.7B**
Caltrain	**Dumbarton**	**$2.4B**
VTA	**BART Extension**	**$12.2B**
	Savings	**$31.5B**

- **Caltrain grade separations might no longer be necessary …**
  - If Caltrain Corridor traffic reduces to just CA HSR, Caltrain event trains, and freight traffic.
- **Caltrain DTX might no longer be necessary …**
  - If most commuters and travelers use CalShuttle SAVs.
- **Caltrain Dumbarton Extension would no longer be cost-effective …**
  - When most commuters use CalShuttle SAVs across the Dumbarton Bridge.
- **VTA BART Extension would no longer be cost-effective …**
  - If most commuters and travelers use CalShuttle SAVs.

- **Operational cost savings …**
  - On reduced Caltrain, SamTrans, and VTA commuter service.

7. Changes in Government Approaches: Questions

- **Should we suspend planning and arranging funding** for … ?
  - **Caltrain** grade separations, DTX, and the Dumbarton Corridor projects?

- **Should we suspend planning and arranging funding** for … ?
  - the **BART Santa Clara extension**?

- **Should we refocus city and county government attention** on other issues?
  - **Housing**
  - **Police and fire department** services
  - Water and power **infrastructure**
  - Supporting **neighborhood retail businesses**

8. The Analysis and Your Questions

- **The Full Report**
  - 19 pages of narrative, summarized in this presentation.
  - 10 pages of arithmetic analysis tables (from the spreadsheet analysis), with the analysis parameters and algorithms plus a separate VTA BART Extension analysis.
  - 34 pages of references.
  - 1 page version history.

  - Available for review at https://www.knowlegewise.com

- **Your Questions?**