In Case You Missed It!: Horizon Perspective Paper #1 (Autonomous Vehicles)

Plan Bay Area 2050 Summer Webinar Series
Adam Noelting, MTC/ABAG
August 14, 2019
Today’s Webinar

- Quick Introduction to Plan Bay Area 2050
- Autonomous Vehicles 101
- Implications and Strategies
- The Integration of AVs into Futures
- Q&A + Future Webinars
What is Plan Bay Area?

• The regional plan is a blueprint for growth and infrastructure for the next 30 years.

• The regional plan is updated every four years, with this major update due in 2021.

• The regional plan is a reflection of the shared priorities of the diverse nine-county San Francisco Bay Area.

• The regional plan is fiscally-constrained, even as it aspires to tackle the Bay Area’s big challenges with specific strategies.

• The regional plan is not an expenditure plan; it is focused on setting priorities and over the long term and looking holistically across “silos”.

Overview
High-performing strategies and projects from *Horizon* - those that are resilient to uncertainties - will be recommended for inclusion in the Preferred Plan Bay Area 2050 (RTP/SCS).
What Topic Areas Do These Efforts Tackle?

Horizon and Plan Bay Area 2050 are addressing four core topic areas, as we work to create a long-range integrated regional vision for the next 30 years.

- Transportation
- Housing
- Economy
- Environment
Plan Bay Area 2050: Summertime Webinar Series

Growth Framework Update
- June 26, July 1 & July 10
  - New Criteria and Submitting Letters of Interest/Letters of Confirmation

Preparing for Plan Bay Area 2050
- July 9
  - Public Engagement Process Overview
- August 6
  - Bay Area Spatial Information System (BASIS)
- September 5
  - Looking Ahead: The Vision for Plan Bay Area 2050
- September 10
  - Exploring Policy Questions with Models
- September (date TBD)
  - Horizon Perspective Paper 5: Bay Crossings

Target audience:
Cities, counties, and CTAs

In Case You Missed It! (ICYMI)
- July 30
  - ICYMI: Horizon Futures Round 1 Analysis
- August 14
  - ICYMI: Horizon Perspective Paper 1 - Autonomous Vehicles

Target audience:
Stakeholders & interested public

Target audience:
New stakeholders/public

More information available at:
In Case You Missed...
the AV Perspective Paper!

Finalized in June 2018, the paper is available on the MTC website at:

https://mtc.ca.gov/our-work/plans-projects/horizon/perspective-papers
Autonomous Vehicles 101
“Automated” versus “Connected”

**AUTOMATED** The increasing ability to drive without human assistance.

**CONNECTED** The increasing ability to share mobility or safety information among other vehicles, infrastructure, systems, etc.

None of the automation technologies require a vehicle to be connected.
Autonomous Vehicles Components

- **LIDAR**: Light pulse-based radar that sees surroundings in all lighting conditions.
- **CENTRAL COMPUTER**: Interprets input from all sensors and manages driving decisions.
- **MAPPING DATA**: Input for navigation (routes, loading locations, etc.).
- **RADAR**: Radio wave-based sensor that identifies barriers.
- **CAMERAS**: Identify and distinguish volumes (people, vehicles, etc.) and read the rules of the road (signals, signs, etc.).
- **GPS**: Provides geographic positioning of vehicle for navigation.
- **ULTRASONIC SENSORS**: Measure objects at short distances, such as curbs.
## Levels of Automation

<table>
<thead>
<tr>
<th>Level 0</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
<th>Level 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO AUTOMATION</td>
<td>ASSISTED DRIVING</td>
<td>PARTIAL AUTOMATION</td>
<td>CONDITIONAL AUTOMATION</td>
<td>HIGH AUTOMATION</td>
<td>FULL AUTOMATION</td>
</tr>
</tbody>
</table>

**Driver controls:**
- **Level 0:** all functions, all times, all locations
- **Level 1:** all functions, all times, all locations
- **Level 2:** all times, all locations
- **Level 3:** all times, all locations
- **Level 4:** ready to take control, optional
- **Level 5:** all functions, all times, all locations

**Vehicle controls:**
- **Level 0:** multiple functions
- **Level 1:** all functions
- **Level 2:** certain times or locations
- **Level 3:** all functions
- **Level 4:** all functions
- **Level 5:** all functions

**Vehicle assists:**
- **Level 0:** multiple functions
- **Level 1:** all functions
- **Level 2:** certain times or locations
- **Level 3:** all functions
- **Level 4:** all functions
- **Level 5:** all functions
When might AVs become commonplace?

Fully Autonomous Vehicle (L4/5) uptake predictions based on high disruption scenarios, indicates possible percentage of new car sales 2016 to 2050.

**Revolutionary**
- Technology breakthroughs
- Regulatory resolutions
- Shared model, at much lower cost than ownership
- Rapid adoption

**Evolutionary**
- Slower technology development and rollout
- Owned AV model with cost premium
- Slower adoption
The future is highly uncertain

- **TIMING**: 3 to 13 years until L5 AVs available for purchase
- **SAFETY**: +40% to +90% increase in safety
- **CAPACITY**: 0% to +45% increase in roadway capacity
- **DEMAND**: +5% to +40% increase in VMT
- **ENERGY/EMISSIONS**: -50% to +100% change in GHGs
Bay Area Pilot Programs and Companies

Guiding Principles for Emerging Mobility, San Francisco

Lead Agency: SFCTA
Policy framework to evaluate new mobility services for all SFMTA and SFCTA decisions, including:

- Safety
- Transit
- Equitable Access
- Disabled Access
- Sustainability
- Congestion
- Accountability
- Labor
- Financial Impact
- Collaboration

GoMentum Station, Concord

Lead Agency: CCTA
- Robust testing facility with city-like road networks, tunnels, over- and under-passes, and railroad crossings that simulate real world conditions.
- Testing partners include EasyMile (low-speed electric shuttles), Honda (passenger AVs), Toyota (passenger AVs), Otto (long-haul automated trucks), and Sumitomo Electric (supplier of electronics).

Companies licensed to test AVs on California public roads

- Almotive
- Apex.AI
- Apple
- Aurora Innovation
- AutoX Technologies Inc
- Baidu
- Bauer’s Intelligent Transportation
- BMW
- Bosch
- Continental Automotive Systems
- CYNGN
- Delphi Automotive
- Drive.ai
- Ford
- GM Cruise
- Jingchi CorpLyft
- Mercedes Benz
- NIO
- Nissan
- Nullmax
- Nuro
- NVIDIA
- Phantom AI
- PlusAI
- Pony.AI
- Qualcomm Technologies
- Renovo.auto
- Roadstar.AI
- SAIC Innovation Center
- Samsung Electronics
- SF Motors Inc.
- Subaru
- Telenav
- Tesla Motors
- Toyota Research Institute
- Uber
- Udacity
- Valeo North America
- Volkswagen
- Voyage
- Waymo
- Zoox

Shared Autonomous Vehicle Demonstration

Lead Agency: LAVTA
- First/Last mile to Dublin-Pleasanton BART station
- Low speed autonomous shuttle on public streets
- Complements fixed route buses
- Funded with BAAQMD Grant
- Partnership with County Connection, GoMentum Station, City of Dublin

AV Pilot Program, San José

Lead Agency: City of San José
- RFI for how AVs could help advance broader goals for the city.
- Six specific project areas for AV deployment, but allowed respondents to propose their own project areas.
- Two main pilot programs: small-area or corridor-specific transit service and technology to support broader AV operations in the future.
Implications and Strategies
The San Francisco Bay Area Aspires To Be:

**AFFORDABLE**
All Bay Area residents and workers have sufficient housing options they can afford - households are economically secure.

**CONNECTED**
An expanded, well-functioning transportation system connects the Bay Area - fast, frequent and efficient intercity trips are complemented by a suite of local transportation options, connecting communities and creating a cohesive region.

**DIVERSE**
The Bay Area is an inclusive region where people from all backgrounds, abilities, and ages can remain in place - with access to the region’s assets and resources.

**HEALTHY**
The region’s natural resources, open space, clean water and clean air are conserved - the region actively reduces its environmental footprint and protects residents from environmental impacts.

**VIBRANT**
The Bay Area region is an innovation leader, creating quality job opportunities for all and ample fiscal resources for communities.
Horizon Guiding Principle - All Bay Area residents and workers have sufficient housing options they can afford - households are economically secure.

As parking demand drops, new housing opportunity sites could emerge.

However, AVs could facilitate sprawl, increasing travel costs as people live farther from jobs.
Housing Opportunity Sites in an Autonomous Future

- Decreasing parking demand with AV services
- Reduce parking requirements
- Obsolete parking could be replaced with infill development

Priority Strategies

- Repurpose off-street parking for infill development
- Institute parking maximums for both on- and off-street parking supply
- Retain or strengthen urban growth boundaries to control greenfield development
Horizon Guiding Principle - An expanded, well-functioning transportation system connects the Bay Area - fast, frequent and efficient intercity trips are complemented by a suite of local transportation options, connecting communities and creating a cohesive region.

Shared AV services could introduce a transit renaissance with improved on-demand services.

AVs could worsen congestion with more induced travel and empty vehicle circulation.
Regional Autonomous Demand-Responsive Transit

- High frequency regional trunk lines + on demand local service
- Autonomous BRT network
- On-demand, door-to-door and first/last-mile service
- Mobility as a Service models

Priority Strategies

- Double down on high-capacity bus and rail corridors
- Innovate suburban transit with autonomous, demand-responsive microtransit
- Develop a mobility as a service platform to provide a unified and equitable gateway to services and information
Dynamic Pricing Opportunities in an AV Future

- New data and platform capabilities with AVs
- Dynamic pricing to manage limited capacity

Priority Strategies

- Price mobility fairly through dynamic road pricing
- Design smart streets with dynamic allocation of street and curb space
- Develop industry-wide data sharing protocols to provide real-time information to connected AVs
Horizon Guiding Principle - The Bay Area is an inclusive region where people from all backgrounds, abilities, and ages can remain in place - with access to the region’s assets and resources.

**Mobility options** could proliferate with new business models, benefitting people from all backgrounds, abilities and ages.

**AVs could widen the equity gap with declining public transit, service disparities, job loss, digital divide.**
Equitable AV Services

Priority Strategies

- Mandate equitable provision of mobility services with transparent reporting
- Subsidize public transit innovations, replacing fixed route transit in Communities of Concern
- Prioritize AV mobility services or programs that serve Communities of Concern

• Require accountability: targets, metrics, monitoring, improvement
• Target strategies for specific equitable outcomes.
• Focus all strategies on inclusive prosperity.
Horizon Guiding Principle - The region’s natural resources, open space, clean water and clean air are conserved - the region actively reduces its environmental footprint and protects residents from environmental impacts.

Significant reduction in human driving error could save lives. AVs that are EVs could improve air quality.

Hacking and cybersecurity could introduce new safety risks. AVs that are not EVs could worsen air quality.
Vision Zero 2.0

- Eliminate traffic-related deaths
- Nullify cybersecurity vulnerabilities
- Improve air quality
- Reduce transportation-related public health issues

Priority Strategies

- Cap speed limits in downtowns and neighborhoods
- Mandate that all AVs are EVs and invest in the necessary infrastructure
- Develop “bounty program” to reduce hacking vulnerability
Horizon Guiding Principle - The Bay Area region is an innovation leader, creating quality job opportunities for all and ample fiscal resources for communities.

AVs have the potential to reduce transportation and logistics operating costs.

AVs could cause rapid job loss or a shift to other occupations.
“New Deal” for Mobility

Priority Strategies

- **Comprehensive program to maximize local economic benefits** of the AV industry
- **Workforce advancement programs**
- Related **new industries** (manufacturing, data, services, goods, repair, etc.)

**Strengthen the capacity of training programs** to expand opportunities for workers in the AV industry

**Target job clusters on industrially-zoned land** for production, distribution, and repair

**Pilot innovative AV applications** that could spur new job opportunities
Perspective Paper #1: Autonomous Vehicles Priority Strategies

- Affordable Housing Opportunity Sites
- Connected Fair Pricing Autonomous Transit
- Diverse Equitable Outcomes
- Healthy Vision Zero 2.0
- Vibrant New Deal for Mobility
Changing Expectations - Gartner Hype Cycle

https://www.gartner.com/smarterwithgartner/
Traffic Impacts - TNCs as a Proxy for AVs?

Average Weekday VMT

<table>
<thead>
<tr>
<th>Year</th>
<th>TNC</th>
<th>All Other</th>
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<tbody>
<tr>
<td>2016</td>
<td>6.5%</td>
<td>93.5%</td>
</tr>
<tr>
<td>2018</td>
<td>13.4%</td>
<td>86.6%</td>
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TNC Driver Time

- 2018:
  - With a Passenger: 35%
  - Driving to a Passenger: 55%
  - Waiting for Fare: 10%

2. Fehr & Peers, Estimated TNC Share of VMT in Six US Metropolitan Regions (Revision 1), [https://drive.google.com/file/d/1FIUskVkj9IsAnWJQ6kLhAhNoVLjFdx3/view](https://drive.google.com/file/d/1FIUskVkj9IsAnWJQ6kLhAhNoVLjFdx3/view)
Futures - “What If?” Scenarios

**A - Clean and Green**
What if... new technologies and a national carbon tax enabled greater telecommuting and distributed job centers?

**B - Rising Tides, Falling Fortunes**
What if... the federal government cuts spending and reduces regulations, leaving more policy decisions to states and regions?

**C - Back to the Future**
What if... an economic boom and new transportation options spur a new wave of development?
Potential Market Shares - AVs & EVs in 2050

Rising Tides, Falling Fortunes
- 10%

Clean and Green
- 95%

Back to the Future
- 75%
Assumptions for Analysis

For HIRE

TNCs would likely be early adopters of AV technology in order to reduce labor costs

ZERO

For every 1 mile driven with a passenger, a TNC will drive just under a mile without a passenger

If the AV fleet penetration is high enough, AVs can drive slightly closer together on freeways

< 75%

>= 75%

The in-vehicle time “feels” slightly less negative than in non-AVs

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>= 75%
Potential Impacts of AVs

Futures Interim Report: Opportunities and Challenges (March 2019)

Rising Tides, Falling Fortunes
Cost to drive one mile - $0.20
Autonomous vehicle share - 10%

Vehicle Miles Traveled (VMT) per day
- 2015 VMT
- 2050 VMT change in auto travel with passengers
- 2050 VMT change in auto travel without passengers

Per-Capita VMT (2050 - 21 miles)
- 19 miles (2015 baseline)

Total VMT (2050 - 175 million miles)
- 125 million miles (2015 baseline)

Clean and Green
Cost to drive one mile - $0.40
Autonomous vehicle share - 95%

Vehicle Miles Traveled (VMT) per day
- 2015 VMT
- 2050 VMT change in auto travel with passengers
- 2050 VMT change in auto travel without passengers

Per-Capita VMT (2050 - 21 miles)
- 19 miles (2015 baseline)

Total VMT (2050 - 225 million miles)
- 135 million miles (2015 baseline)

Back to the Future
Cost to drive one mile - $0.10
Autonomous vehicle share - 75%

Vehicle Miles Traveled (VMT) per day
- 2015 VMT
- 2050 VMT change in auto travel with passengers
- 2050 VMT change in auto travel without passengers

Per-Capita VMT (2050 - 28 miles)
- 19 miles (2015 baseline)

Total VMT (2050 - 375 million miles)
- 135 million miles (2015 baseline)

Highway Conditions
- major highways
- 2050, congestion (less than 35mph)
- 2050, closure from hazards

https://mtc.ca.gov/our-work/plans-projects/horizon/futures-planning
Futures Round 1
Opportunities and Challenges

Transit demand increases in all Futures, but commute times are worse.

Pricing is an appropriate strategy to mitigate some of the adverse impacts of autonomous vehicles.

Traffic congestion could reach new extremes, in part due to the high level of individual ownership for autonomous vehicles.
Futures Round 2 - Transportation Strategies

**Improve Access, Speed, and Reliability of Transportation**

- **PBA-6** Operate and Maintain the Existing System
- **PBA-5** Build Carpool Lanes & Address Interchange Bottlenecks
- **PBA-4** Make Strategic Transit Modernization/Expansion Investments
- **C-4** Build a Next-Generation Bus Rapid Transit Network
- **C-10** Increase Capacity/Frequency by Modernizing Existing Rail
- **C-9** Extend the Regional Rail Network
- **C-7** Build a New Transbay Rail Crossing

**Make active modes safer and more accessible.**

- **D-4** Invest in Free Short-Trip Service
- **NEW!** Implement Vision Zero Speed Reduction Measures
- **C-3** Build a Complete Micromobility Network

**Price freeways to drive different mode choices and advance equitable outcomes.**

- **C-1** Develop a Single Platform to Access & Pay for all Mobility
- **C-6** Apply Time-of-Day Tolls on All Freeways
- **A-3** Provide Free Transit to Lower-Income Riders

* = modifications have been made to Plan Bay Area 2040 strategy
** = included only in two higher-growth, higher-resource Futures

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*Build a next-generation transit network for the 21st century.*

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Price freeways to drive different mode choices and advance equitable outcomes.
Thanks for attending today’s webinar!

Contact Adam Noelting with questions at: anoelting@bayareametro.gov
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