Toward an Autonomous Future in San Mateo County

November 17, 2021

SAN MATEO COUNTY
Transportation Authority

samTrans

Workshop Protocols

Participants are encouraged to participate!

- During the panels, please put your questions in the chat. We will select questions to ask the panelists.

- Later in the workshop, participants will be split into smaller groups to discuss the application of AVs in San Mateo County.

- Finally, there will be a live poll to report back on what was said during the breakout session.

Today's Agenda

1. Welcome
2. Keynote
3. Panel #1
4. Panel #2
5. Breakout Group
6. Report back/Live poll
7. Summary and wrap up

Welcome

Emily Beach

Charles Stone

Keynote

Dr. Billy Riggs

Toward an Autonomous Future

William Riggs, PhD, AICP, LEED AP
wriggs@usfca.edu | @billyriggs

How can plan for & integrate automated vehicles into our mobility systems?

New Platforms *New Behaviors*

New Policies *New Opportunities*

William Riggs, PhD

2019 7

New Platforms

New Platforms: offer a revolution of the curb that's not just about the car

Automation Level	Description	Status
Level 0	no driving automation vehicle control: human operation monitoring: human fallback for error: human situation / time limitation of system: N/A	on the market (any standard vehicle, esp. w/out advanced control system)
Level 1	driver assistance vehicle control: human and system operation monitoring: human fallback for error: human situation / time limitation of system: yes	on the market (e.g. adaptive cruise control <u>or</u> lane centering)
Level 2	partial driving automation vehicle control: system operation monitoring: human fallback for error: human situation / time limitation of system: yes	on the market (e.g. adaptive cruise control <u>and</u> lane centering)
Level 3	**conditional driving automation** **vehicle control: system** **operation monitoring: system** **fallback for error: human** **situation / time limitation of system: yes**	**current frontier** **(e.g. introduced in very limited situations such as parking, stop-and-go)**
Level 4	high driving automation vehicle control: system operation monitoring: system fallback for error: system situation / time limitation of system: yes	pilot testing (e.g. tests of ride-hailing services / autonomous vehicle companies)
Level 5	full driving automation vehicle control: system operation monitoring: system fallback for error: system situation / time limitation of system: no	no prediction (unlimited operation characteristic makes forecasts impossible today)

Projections for autonomous vehicle[1] new sales share as published by different analysts

Percent — U.S. — Global

today

30
25
20
15
10
5
0

NEXT 5 YEARS

TRANSIT PILOTS / FLEET DEPLOYMENTS

2026-2030
INCREASING PROLIFERATION & POTENTIAL FOR MORE PRIVATE AVS

[PLANNING WILL FRAME]

2015   2020   2025   2030
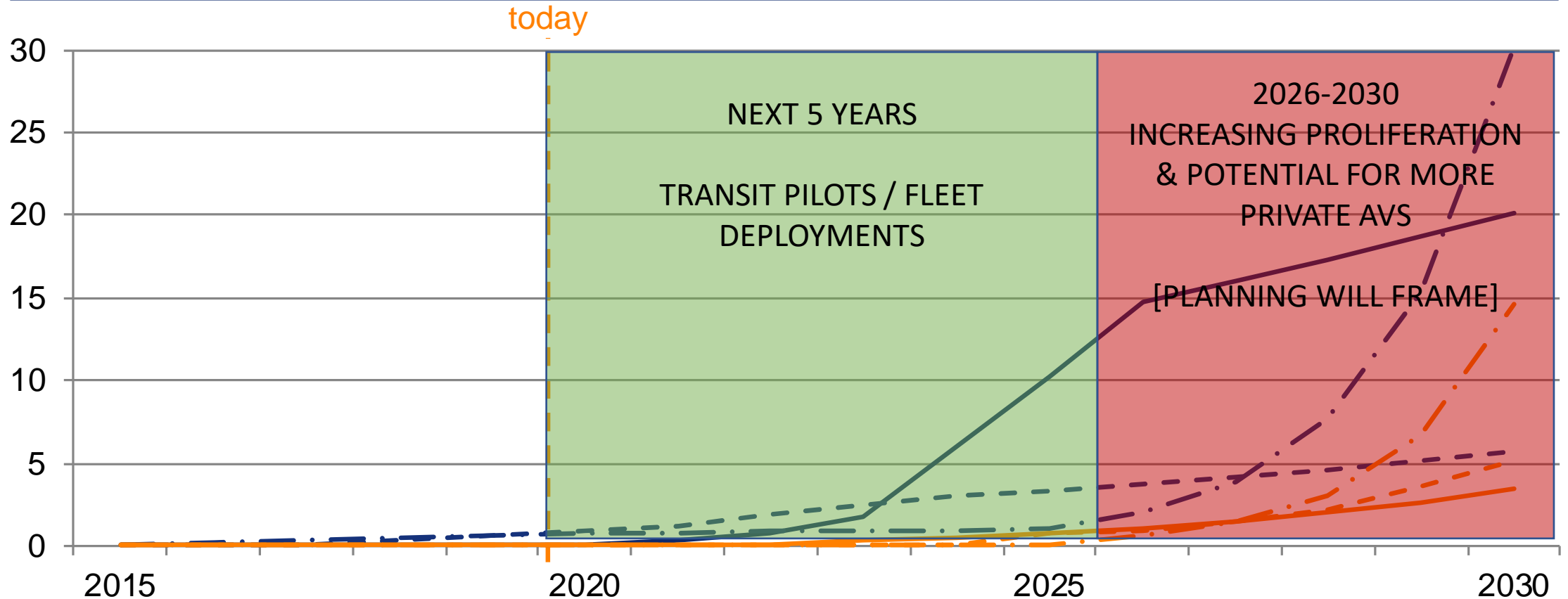
1 autonomous (SAE L4-5)

New Behaviors

Modeling research shows the safety and reliability improvements from AVs could double or triple roadway capacity (+300%).

New behaviors: if travel via car and not transit becomes easier...

- Induced demand because of lost friction of time, cost, convenience, etc.
  - More frequent travel
  - Farther travel
  - Less travel via walking, biking or transit

- More travel for low car households, young, and disabled
  - But with this comes increase in total VMT and ultimately shifts in destinations.

Rideshare applications change the game

- Rideshare applications provided innovation & convenience – confluence of technology and consumer demand

- Coincided with shift toward complex and multimodal trips

- Competitors (including public transit agencies werenot positioned to respond to changing preferences and demographic / generational trends

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Rideshareing was Lesson for Transit: Meeting Consumer Demand; Replacing Transit and Driving

- **Austin Case Study**

  - Revealed what people did when TNCs unavailable

  - Driving or other ridesourcing products replaced UberX

    - 45% switched to a personal vehicle

    - 41% switched to another ridesourcing service

    - 3% transit

Do You Use TNCs?

Hey Austin—

Do you use Transportation Networking Companies?

Transportation Networking Companies (TNCs) Uber and Lyft suspended service in Austin in May of this yea Other, local companies like Fare and RideAustin have since stepped in to provide similar services.

Texas A&M Transportation Institute and the University of Michigan are conducting research to learn how the departure of Uber and Lyft has impacted travel behavior in the Austin region. You can help out by participati in this survey.
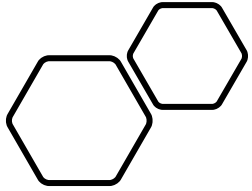
Ridesourcing is Not a Substitute For Taxi: Complex and Multimodal Travel Behavior

- More choices, dynamic environment, and movement between transportation modes
  - Large multi-city analysis: Absent TNCs, 22% trips would not have been made at all

- Higher adoption rate for Millennials than Gen X: variety seeking, pro-environment & technology embracing behaviors (Alemi et al, 2018; Circella & Alemni, 2018)
  - Not that price sensitive

TNC Trip Alternatives (Boston, Chicago, Los Angeles, New York, San Francisco/ Bay Area, Seattle, and Washington, D.C.)
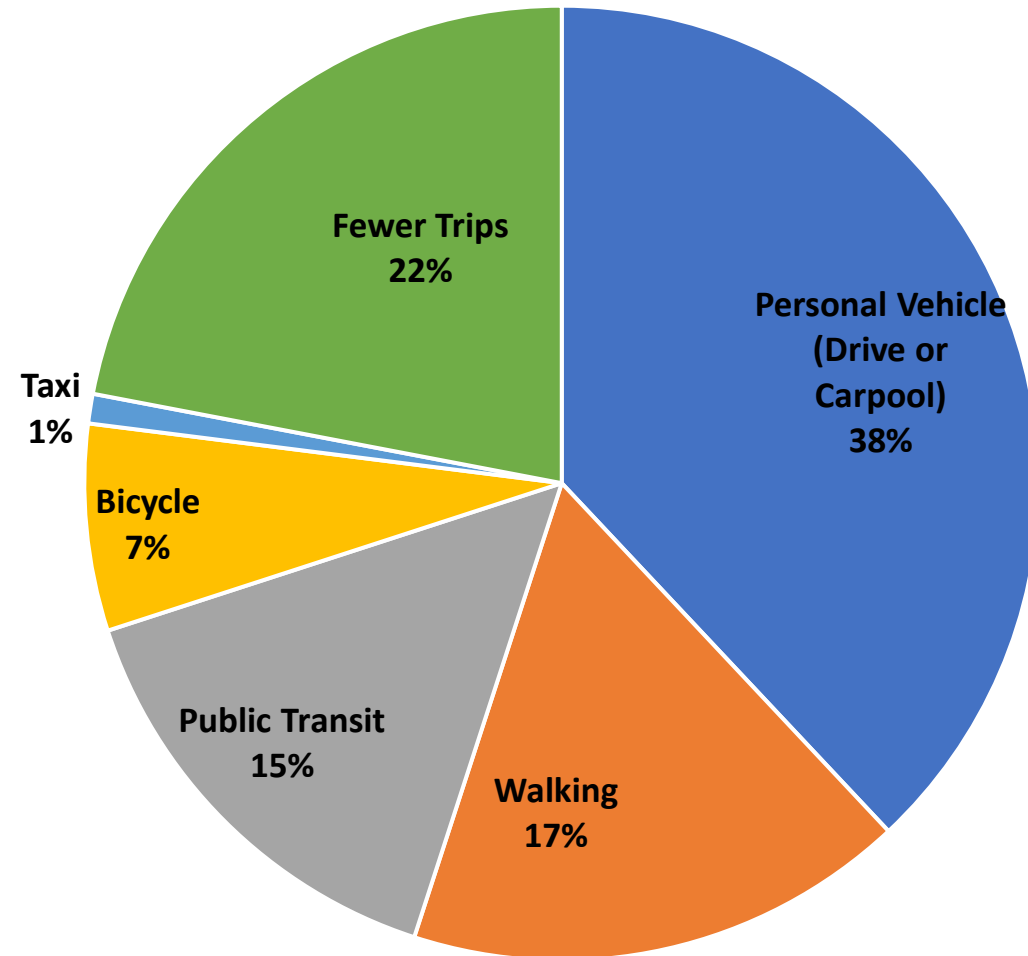
Source: Clewlow and Mishra, 2017

Consumers are Demanding More Reliable & Convenient Service

- **San Francisco Case Study**

  - Ridesourced / TNC trips more likely to be slightly shorter (more trips, less miles traveled)

  - Include another form of transportation (for example starting or ending at the end of a transit line)

  - 59% replacing a trip other than via taxi (e.g. transit, walking, biking

Percentage of Respondents

Reason	Percentage
Ease of payment	35%
Short wait time	30%
Fastest way to get there	30%
Easy to call car	21%
Didn't want to drive after drinking	21%
Don't need to park	18%
Reliable	16%
Comfort/safety	12%
Cost (cheaper than alternatives)	10%
No public transit option	6%
Could not get taxi	2%
Other	5%
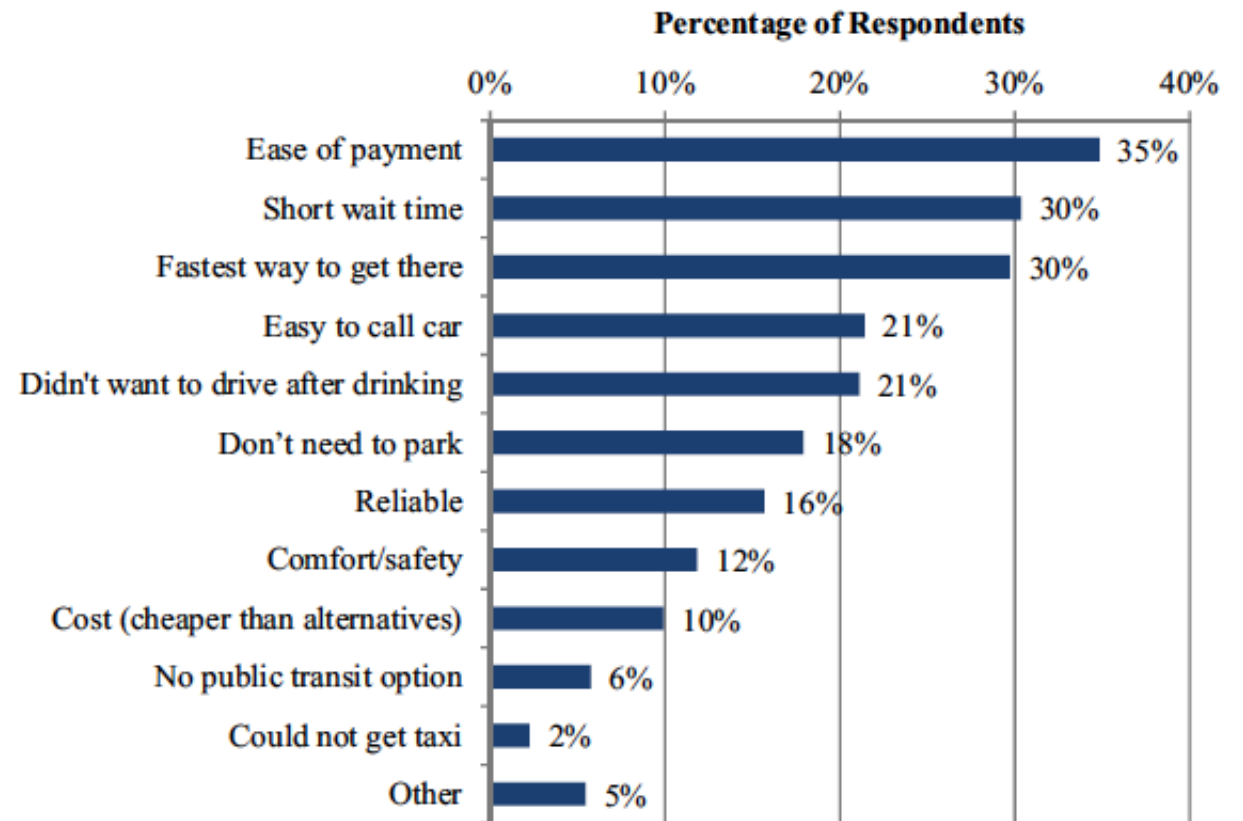
Fig. 2. Responses to "what are the top two reasons you used uberX/Lyft/Sidecar for this trip?" ($n=313$). "Other" included, for example, need to carry stuff, friendly driver, car being repaired, and company pays for it.

Many Trips Compliment Transit

- Most TNC trips off-peak
- Safe and reliable late-night service
- Shorter trips serving last mile beyond a walking distance
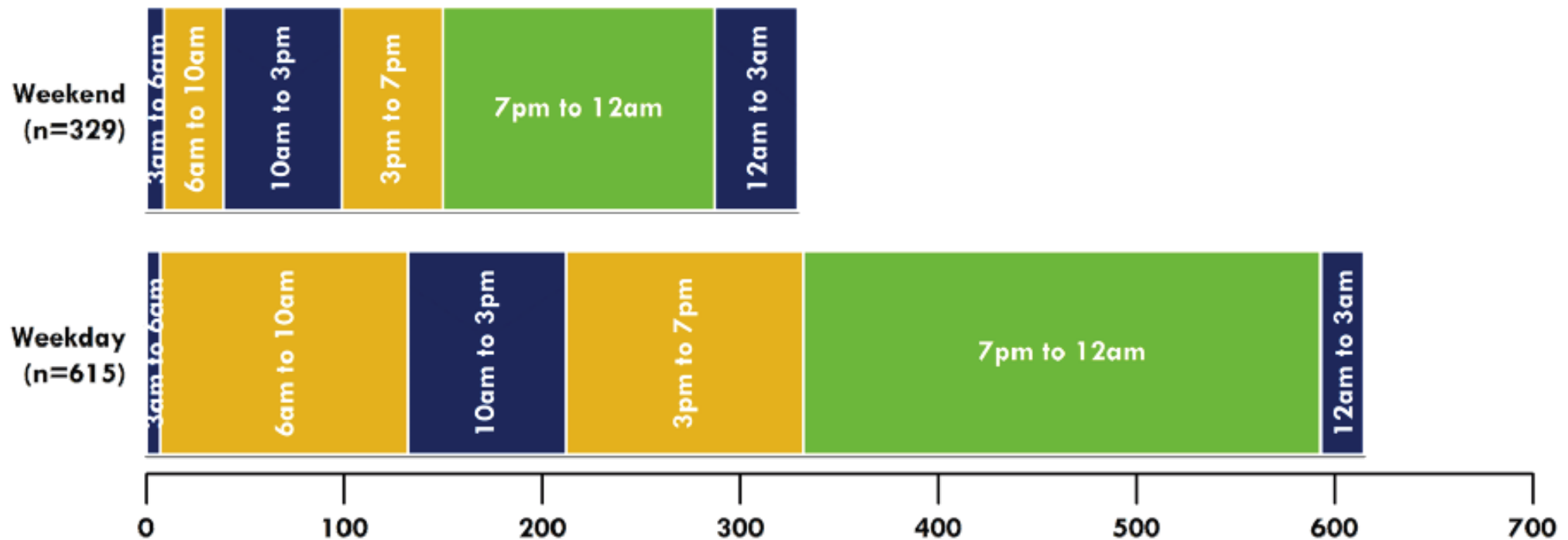
Weekend (n=329)
- 3am to 6am
- 6am to 10am
- 10am to 3pm
- 3pm to 7pm
- 7pm to 12am
- 12am to 3am

Weekday (n=615)
- 3am to 6am
- 6am to 10am
- 10am to 3pm
- 3pm to 7pm
- 7pm to 12am
- 12am to 3am

0   100   200   300   400   500   600   700
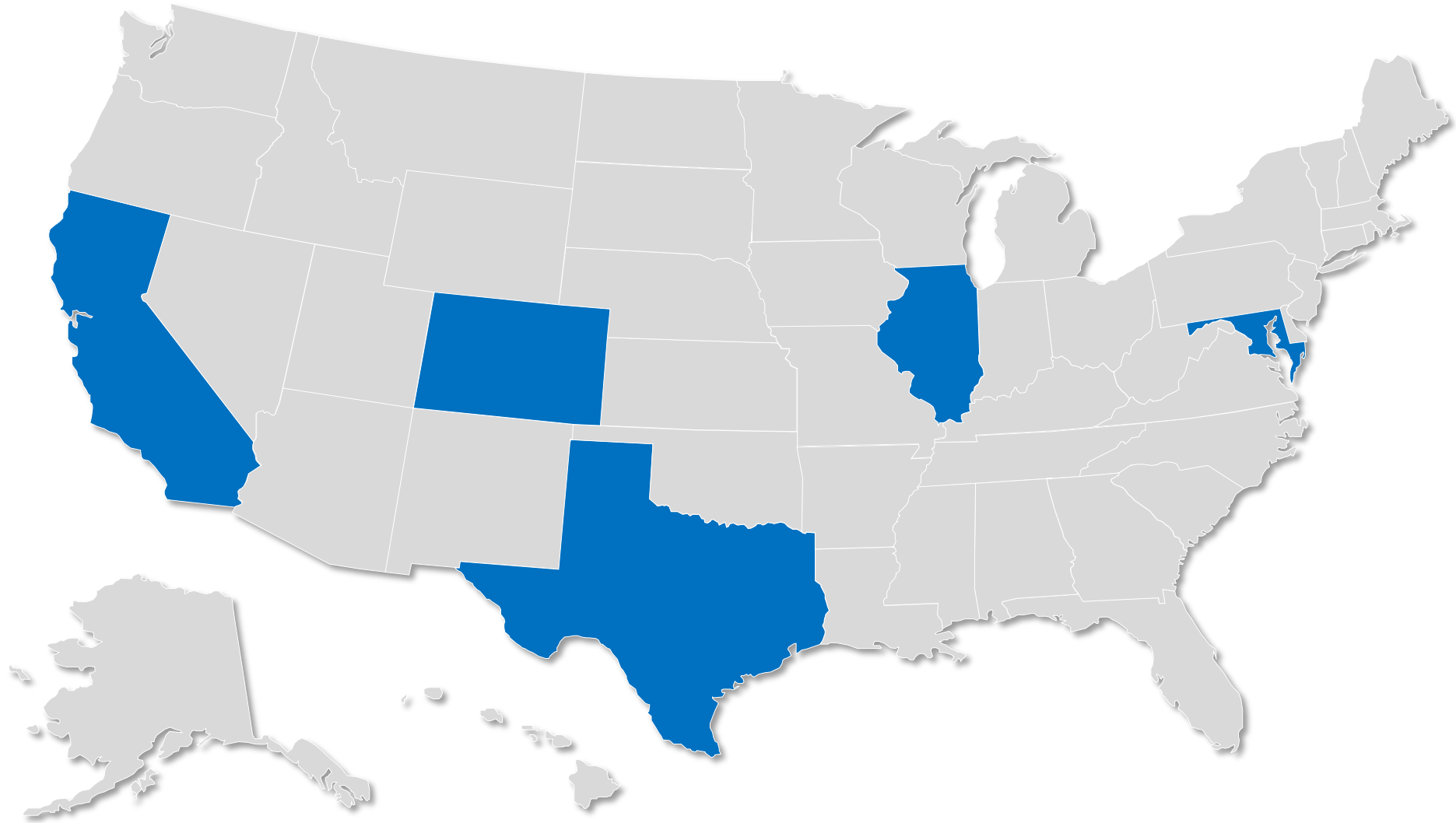
New Policies
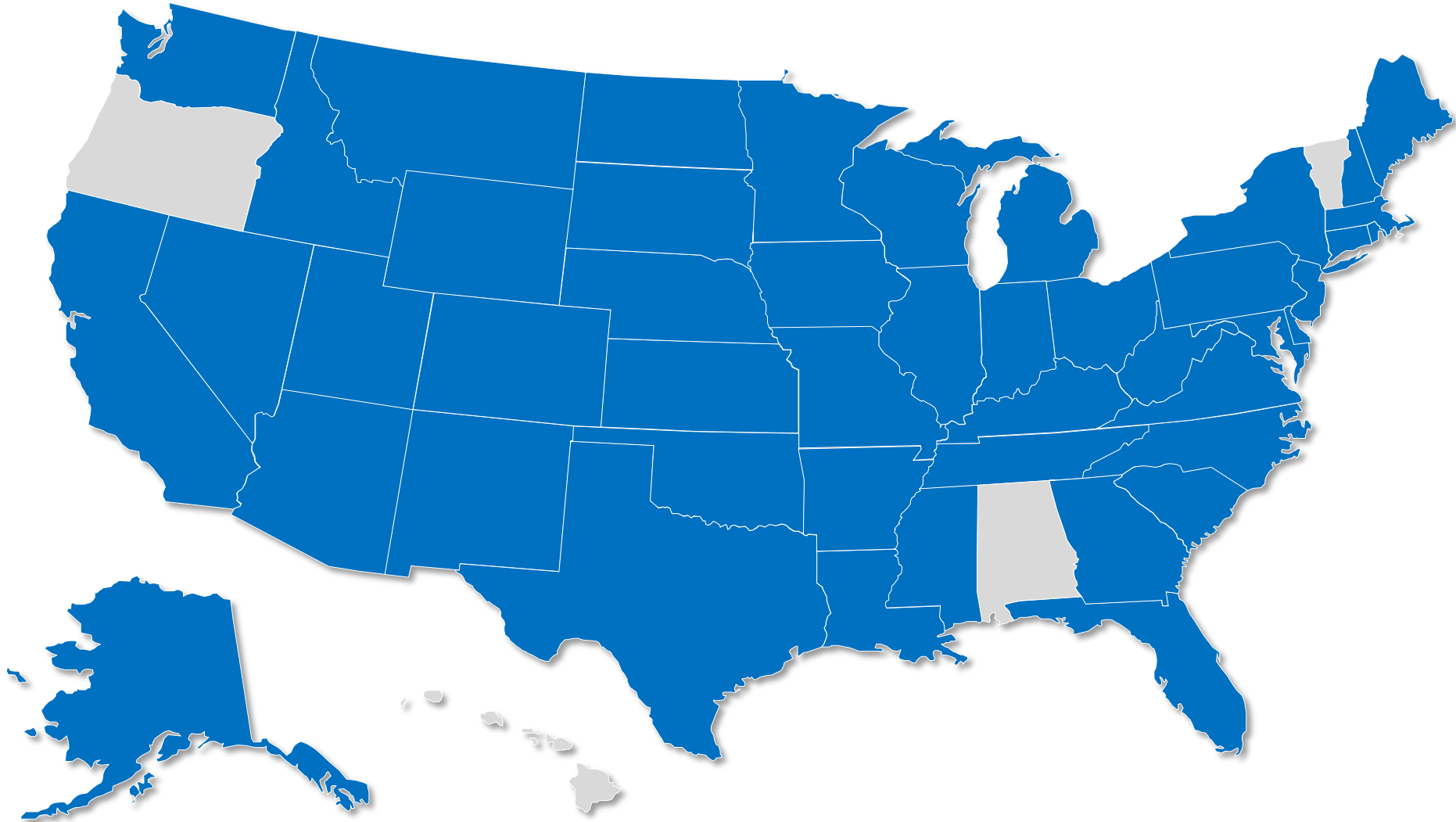
Passenger Service in CA Regulated by Public Utilities Commission (PUC)

Existing Regulatory Framework

- Policy Patchwork; Federal Guidance on **Operational Design Domain (ODD)**

- Operational Permit from CA Department of Motor Vehicles (DMV): Autonomous Vehicle Tester Program Manufacturer's Testing Permit

- Passenger Service Regulated by CA Public Utilities Commission (PUC)
  - **Drivered AV Passenger Service** pilot program - passenger service in test AVs with a driver in the vehicle
  - **Driverless AV Passenger Service** pilot program - passenger service in test AVs without a driver in the vehicle.

CA PUC - Autonomous Vehicle Program Permits Issued – Nov 10, 2021

TCP Number	Carrier Name	dba Name	Permit Type	Exemption Request	Exemption Renewal
TCP 39523	Argo AI	Argo AI	Drivered Pilot	Yes	N/A
TCP 39036	Aurora Innovation, Inc.(REVOKED)	Aurora Innovation	Drivered Pilot	N/A	N/A
TCP 38539	Autox Technologies, Inc.	AutoX	Drivered Pilot	N/A	N/A
TCP 39080	Cruise LLC	Cruise	Drivered Pilot	Yes	Yes
TCP 39080	Cruise LLC	Cruise	Driverless Pilot	Yes	N/A
TCP 39434	DeepRoute.ai	DeepRoute.ai	Drivered Pilot	N/A	N/A
TCP 38723	Pony.ai, Inc.	Pony.ai	Drivered Pilot	Yes	Yes
TCP 39235	Voyage Auto, Inc.	Voyage	Drivered Pilot	N/A	N/A
TCP 38723	Waymo LLC	Waymo	Drivered Pilot	Yes	Yes
TCP 38380	Zoox, Inc.	Zoox	Drivered Pilot	Yes	Yes

cruise

November 5, 2021

Advice Letter - 0001
(Cruise LLC PSG 00390807)

PUBLIC UTILITIES COMMISSION OF THE STATE OF CALIFORNIA
Consumer Protection and Enforcement Division
500 Van Ness Avenue
San Francisco, CA 94102-3214
douglas.ito@cpuc.ca.gov
AVPrograms@cpuc.ca.gov

SUBJECT: **Cruise Application for Driverless Deployment Permit - Tier 3
Advice Letter**

New
Opportunities

Harness New Behaviors

FOR RIDERS   **FOR DRIVERS**

Improved service to areas outside the central city

- Peer-to-peer network / Network Connectivity
- Integrated payment / ease of payment
- Two-way rating & identification system
- Dynamic mapping & routing / ability to drop a pin

Improved flexibility & transparency
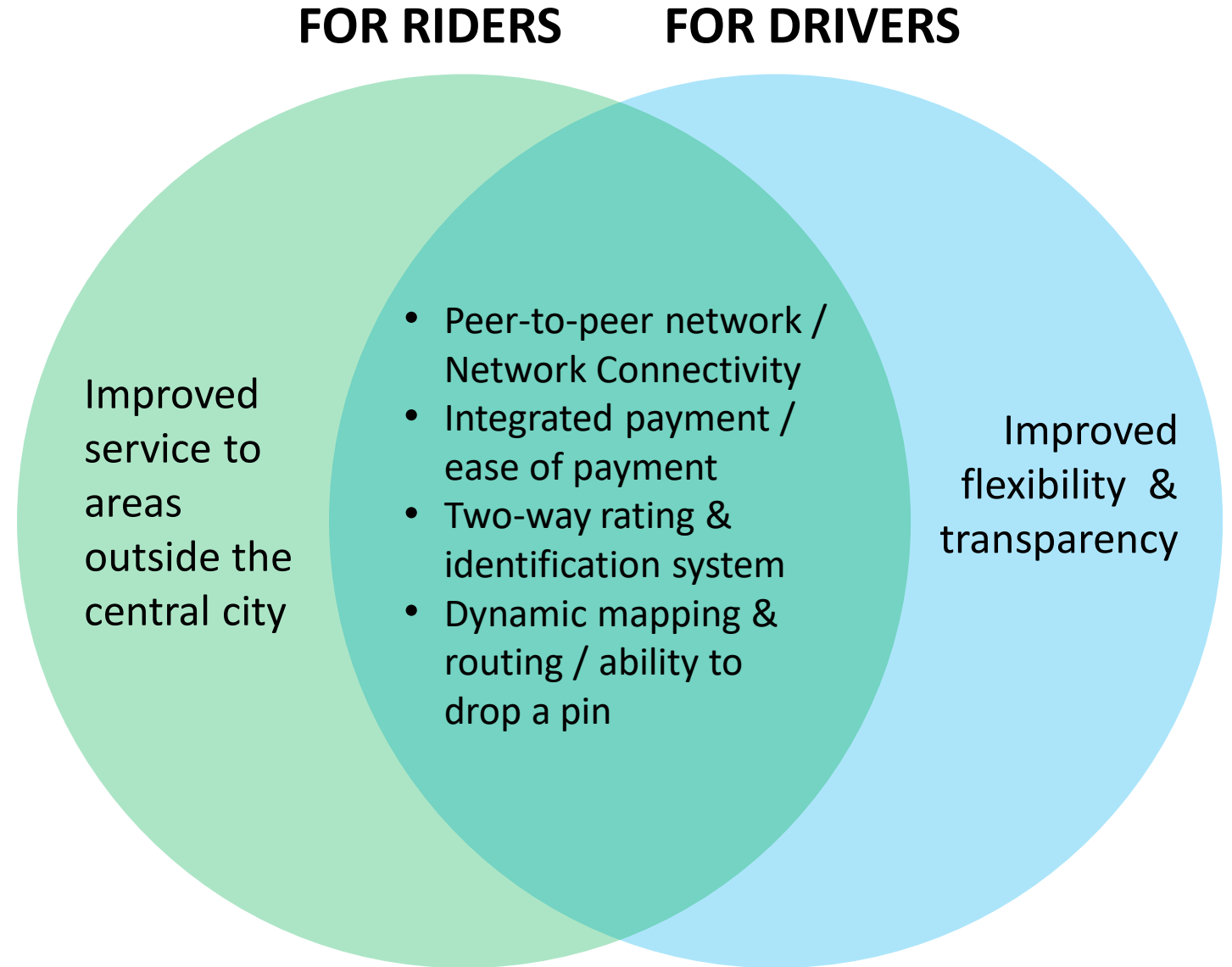
km Kidder Mathews COMMERCIAL REAL ESTATE **LA BASIN MARKET TRE**

News

Los Angeles | Neighborhood

This Lyft Partnership Program May Change City Transportation

July 9, 2018 | Joseph Pimentel, Bisnow Los Angeles ✉

*Want to get a jump-start on upcoming deals? Meet the major Los Angeles players at **one of our upcoming events**!*

Maricela Hernandez has only been driving for Lyft for about a month but has already observed some key differences with ridership in certain markets.

Downtown Los Angeles has more competition. There are plenty of riders but longer drives and more traffic, she said. In Pasadena, there are more tourists. Most of the rides are shuttling people to and from their hotels.

News

Lyft in Monrovia is Almost Too Successful

By **Susan Motander** - August 9, 2018

< | Share   f   🐦   📌

$5.00
CLASSIC RIDE
Travel anywhere within the service area!

Private ride or for groups up to 4 passengers

No stops before reaching final destination

$3.00
SHARED RIDE
Select a shared ride and receive an even greater discount when traveling in the service area!

Up to two (2) passengers

Possible stops before reaching final destination

$1.00
SHARED RIDE
Those traveling to and from Old Town Monrovia, the Metro Gold Line Station, or any hospitals within the service area will pay just $1.00!

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William Riggs, PhD

2019

Thinking About Networks / Systems Planning

William Riggs, PhD

Demand Planning

- Evaluating service demand then determining typology

- Classify what is BACKBONE vs. DOOR to DOOR

- Ask: What can be "crowd-sourced?"

- Preservation and prioritization of existing high-capacity service

- Consider LOS / Free Flow

SB 50 IMPACTS
Silcon Valley

■ 1/4 mile of major transit stop

■ 1/2 mile of major transit stop

■ High quality transit corridor

■ Jobs-rich areas

▦ Sensitive communities

Courtesy: Urban Footprint
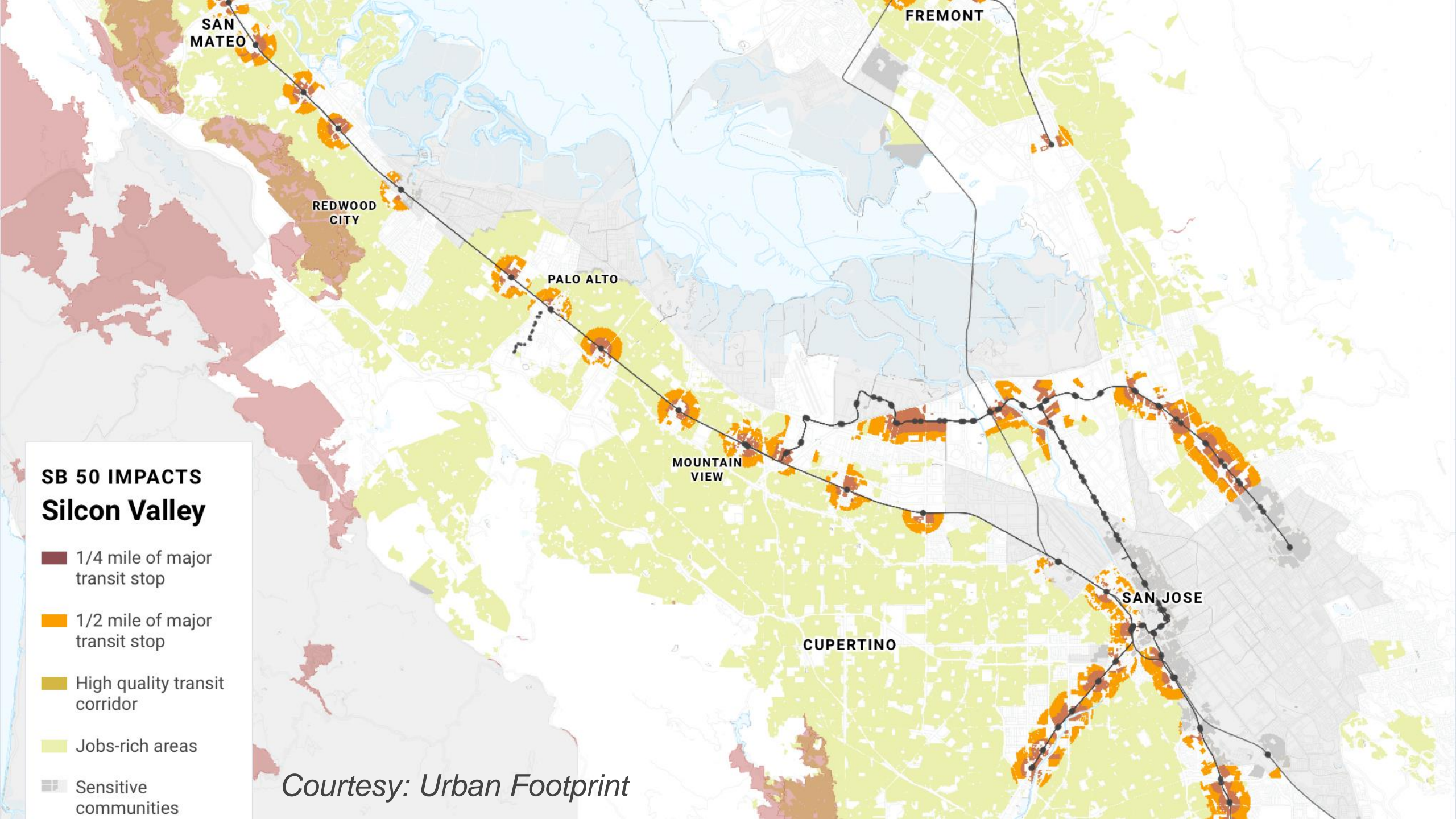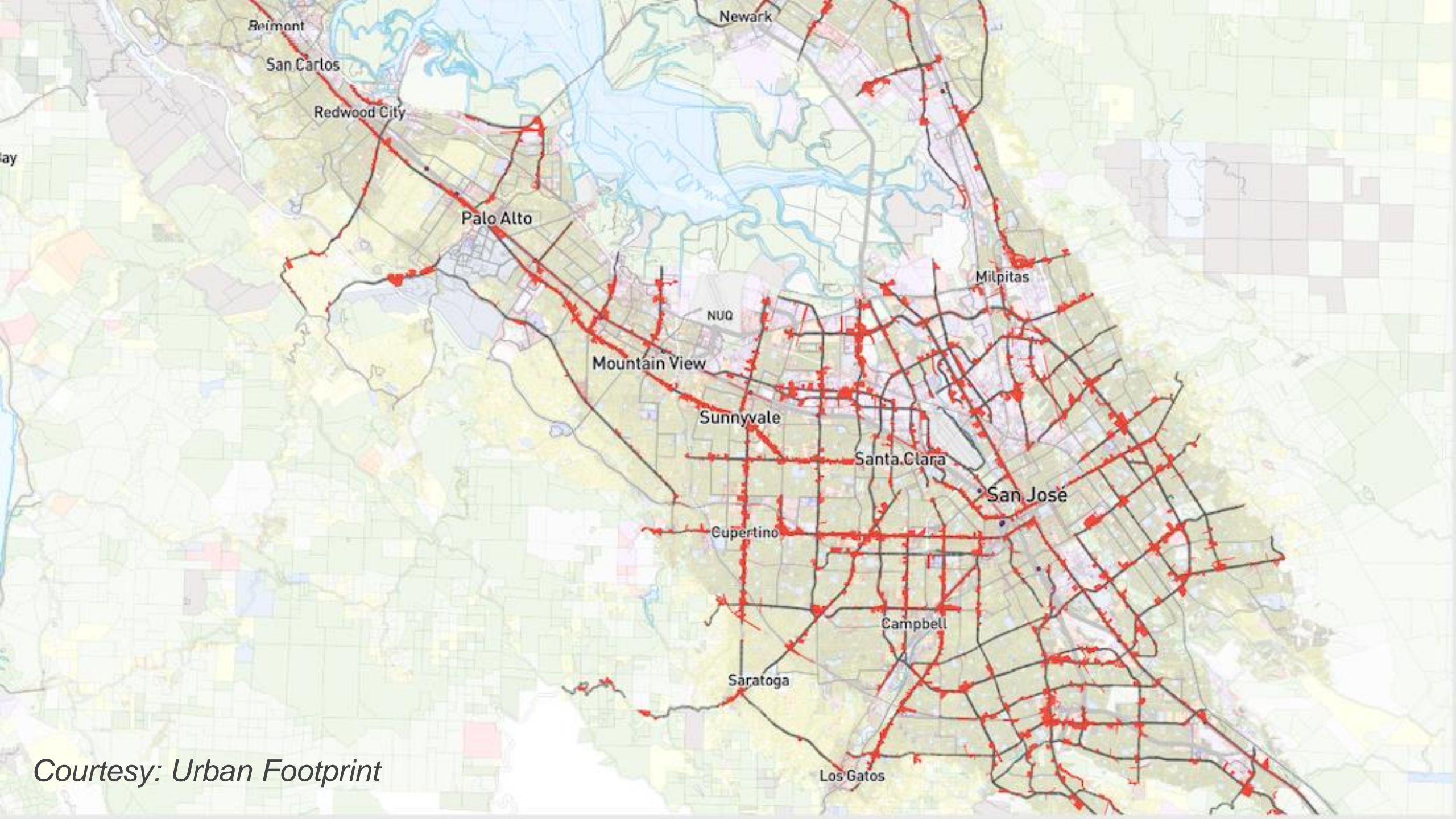
Courtesy: Urban Footprint

Accessibility on Demand Mobility Pilots

- INFRASTRUCTURE PLANNNING:
  - **Coordination to on enhance and build appropriate infrastructure (curb ramps, bus stops, etc.)**
  - **Prioritization curb availability for accessible services and collaboratively managing pick up and drop off locations between multimodal users**
- DATA PLANNING:
  - **Digitization of transit trip data to encourage multimodal integration of future service with existing transportation infrastructure**

Project 2106 | August 2021

SJSU SAN JOSÉ STATE UNIVERSITY

MTI MINETA TRANSPORTATION INSTITUTE

Gaps and Opportunities in Accessibility Policy for Autonomous Vehicles

William Riggs, PhD
Anurag Pande, PhD

https://transweb.sjsu.edu/research/2106-Accessibility-Policy-Autonomous-Vehicles

Opportunities for...

- Lane / road / signal prioritization (**create operational efficiency**)

- Fleet partnership for extended service accessibility (time/space)

- Adoption for policy / fire / first responders

- Curbside allocation and maximization

- Investment in signs, lines and potholes

- Transitioning former private-auto-serving land uses

Opportunities rethink pricing, incentive programs

Can we rethink the traditional way we do encourage travel and do transportation demand management?
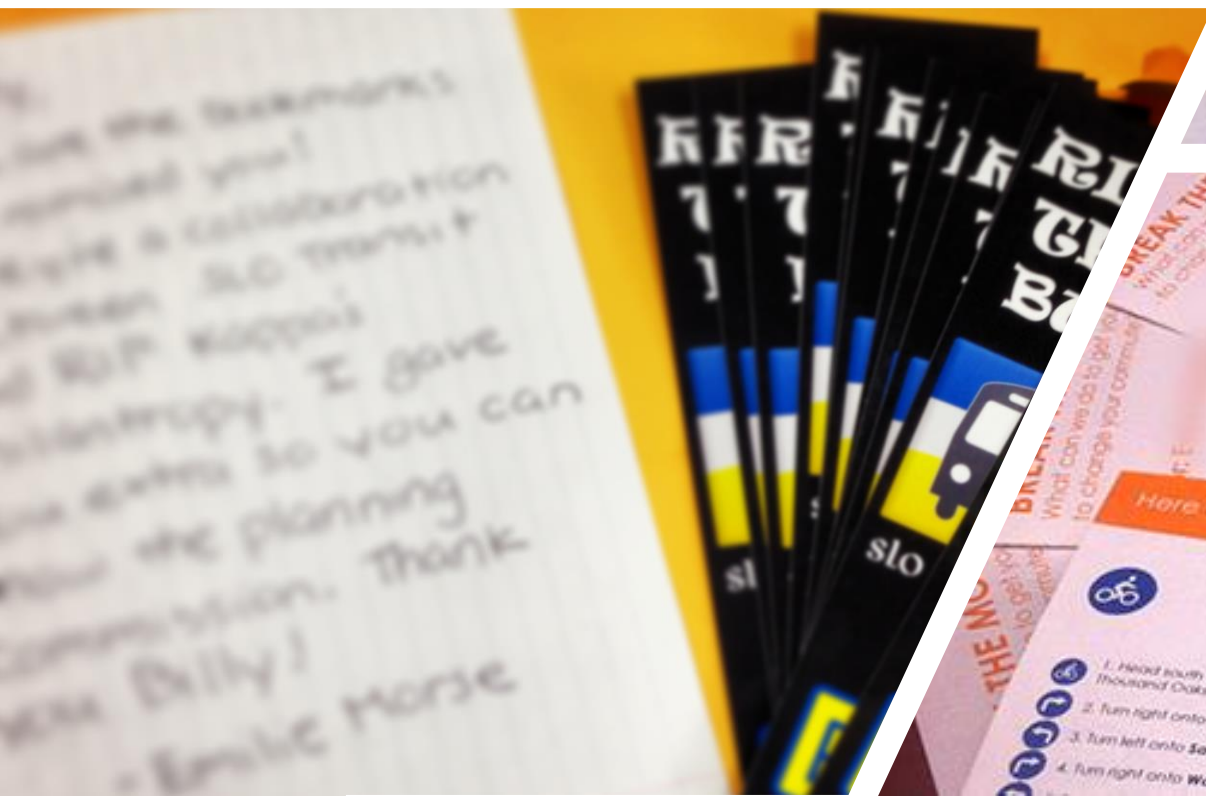
Behavior Change Tactics

- **Engage in Transportation Demand Management and use social / financial incentives**
- **Partner rail agencies and local govs on public service announcements that drive multimodal travel decisions (Train/Walk/Bike)**
- **Social media messaging**
- **Engage influencers**
- **Early educational programming to highlight benefits**
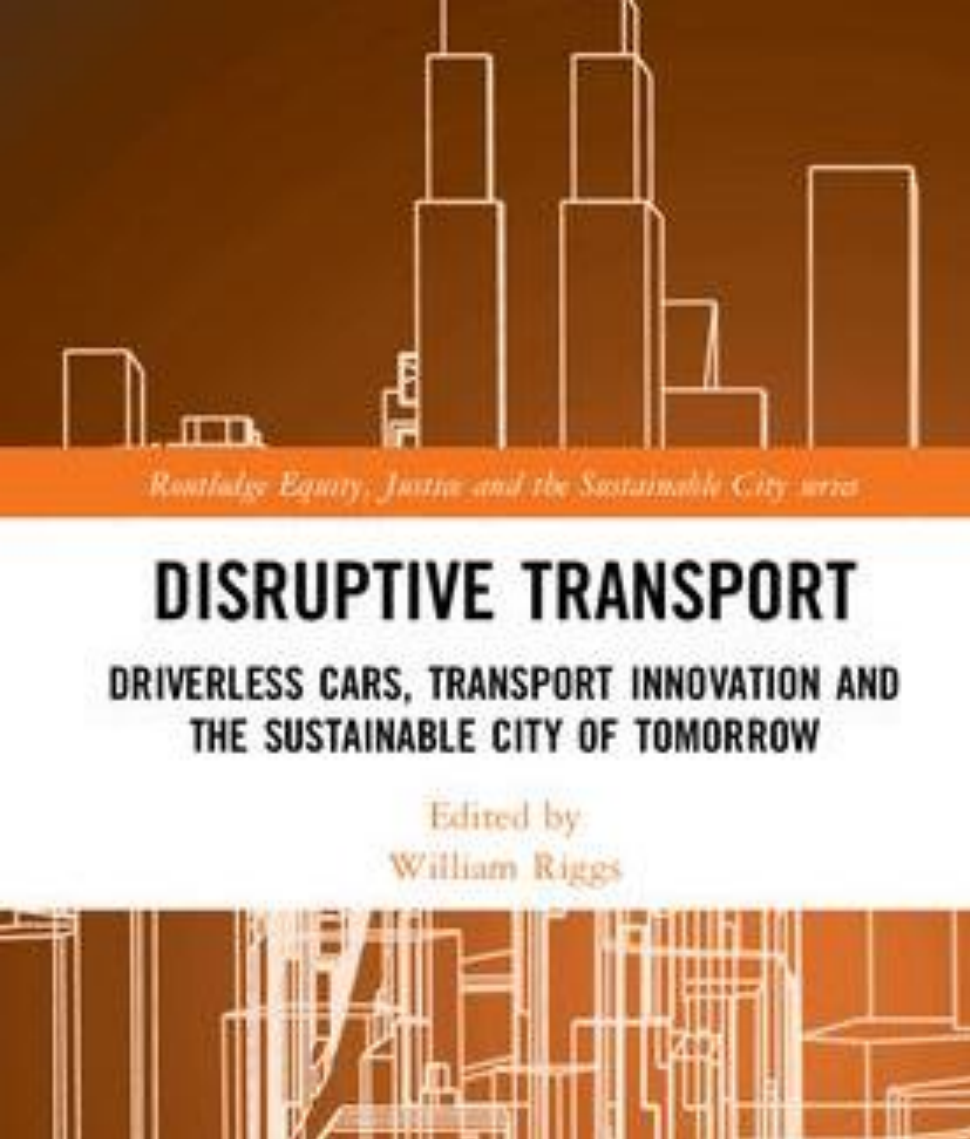
William Riggs, PhD, AICP, LEED AP

University of San Francisco

wriggs@usfca.edu | @billyriggs
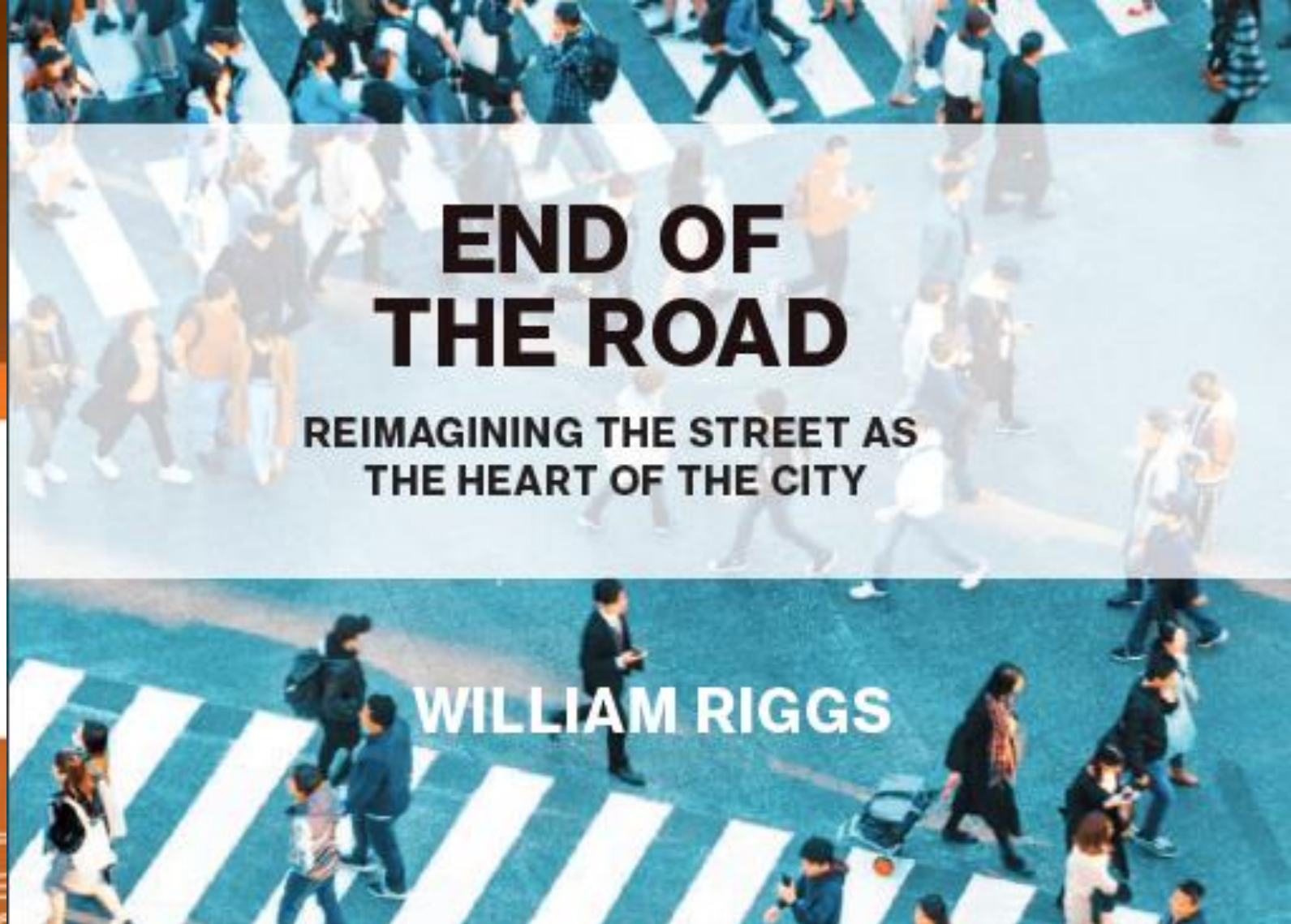
End of the Road: Reimagining the Street as the Heart of the City.
Available for preorder now:
https://bristoluniversitypress.co.uk/end-of-the-road

Disruptive Transport: Driverless Cars, Transport Innovation and the Sustainable City of Tomorrow
Available from Routledge:
http://bit.ly/disruptivetransport

Panel #1: AV Technology and Deployment

Virginia Lingham, Moderator

Panelists

Imran Ali

Partner Success Principal, Via

Jose Alvarado

Manager of Government Affairs, Cruise

Dan Mitchell

City and Community Engagement, Nuro

Mark Rosekind

Chief Safety Innovation Officer, Zoox

Via Transportation

Imran Ali

Imran is a Partner Success Principal at Via, a TransitTech company powering public mobility systems. In this role, Imran provides strategic guidance on operational and product opportunities to public and private transportation agencies, including multiple autonomous vehicle deployments.

Prior to joining Via, Imran was on the Safety and Policy team at Zoox and worked in the Obama White House.

Via provides the digital infrastructure connecting everything that moves across a community.
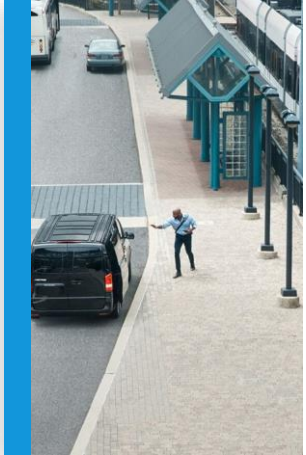
On-demand public transit

- First-and-last-mile
- Transit deserts
- Replace underperforming bus routes

Fixed-route public transit

- Scheduling
- Capacity management

Paratransit / NEMT

- Accessible transport
- Health care

Advanced technologies

- EV/AV fleet management

Corporate and university shuttles

- Campus
- Employee
- Airport
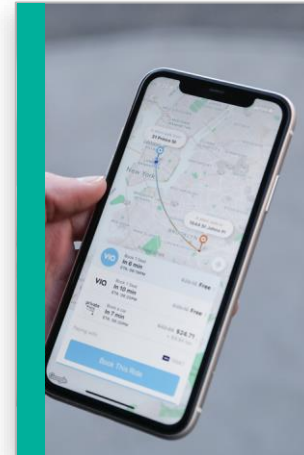
Integrated mobility

- Multi-modal & multi-leg trip planning
- Payments/ticketing

We partner with innovative organizations to deploy autonomous vehicles around the world.

Public & Private Transit Partners

Autonomous Vehicle Partners

Autonomous Vehicle Forms

Via enables AVs to provide useful, efficient transit services today.

Useful
When designed properly (i.e., accounting for road conditions, fleet mix, vehicle type), AV services can solve real transit needs, such as filling transit gaps or providing first-mile last-mile transit connections.

Shared
When part of mass transit, AVs are more accessible (e.g., democratizing cutting-edge, costly technology to entire communities) and sustainable (e.g., reducing SOVs, pollution, and congestion.)

Efficient
Deploying AVs with skilled operational expertise and smart booking, routing, and dispatching software maximizes vehicle usage, improving unit economics for operators and experience for riders (e.g., wait & journey time).

Convenient
Customer facing tools (e.g., in-vehicle screens displaying ride information, rider apps for booking and live customer support) enhance the rider experience to increase trust, comfort, and safety.

Cruise

Jose Alvarado

Jose is currently the Manager of Government Affairs for Cruise LLC. Prior to his current role, he served as Acting Director of International Relations for Speaker Anthony Rendon, Government Relations Advocate for SEIU-UHW, one of the largest healthcare unions in the country, and as a Legislative Assistant for Assemblyman Rudy Salas (D-Bakersfield) and Senator Loni Hancock (D-Berkeley).

What is Cruise?

Self-driving.

Our mission is to build the world's most advanced self-driving vehicles to **safely** connect people with the places, things, and experiences they care about.

Zero-emission.

Cruise AVs are **all-electric**, and our entire fleet in California is powered by 100% renewable energy.

Shared.

Cruise will own and operate our fleet, with the goal of providing **shared** transportation services.

Our Product: Seamless Integration

Sensor Technology

Sensor diversity provides confidence that the self-driving system can detect, track, and classify objects around it in various driving conditions.

Cameras

Cameras help classify and track objects so the Cruise AV can make confident real-time decisions.

Cruise AVs use multiple cameras to create a 360° field of view with no blind spots. Cameras help the Cruise AV identify pedestrians, vehicle types, construction zones, and traffic light states.
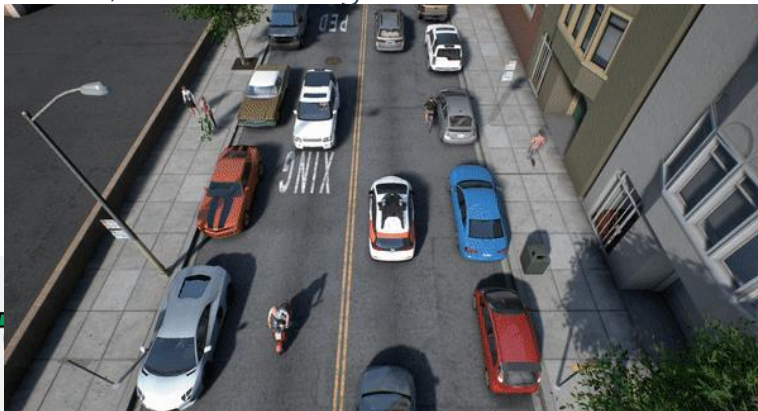
LiDAR sensors

LiDAR sensors use an array of lasers to measure the distance between objects, down to the centimeter, and create a 3D visualization of the world.

LiDAR helps the Cruise AV determine where it is in the world and reliably know where all nearby pedestrians, vehicles, and other objects are located.

Radar sensors

Radar sensors use radio waves to quickly measure the speed and trajectory of moving objects.

Each Cruise AV is equipped with multiple radar sensors, which measure the direction of travel and speed of moving objects like cars on the road.

Working with Local Governments and the Community in the San Francisco Bay Area

Dan Mitchell (dan@nuro.ai)

Dan has worked at Nuro for almost four years, leading the first commercial deployment of a zero-occupant vehicle (Arizona '18).

Prior to joining Nuro, Dan co-founded Sheprd, an 'Uber for Kids' child transportation startup in Boston, MA, as well as worked for a variety of political campaigns in federal, state, and local elections. Dan earned an M.B.A from UCLA Anderson and a B.A. in Political Studies from Pitzer College.

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What is Nuro working on?

Autonomous Technology

- 360° Vision with no blind spots; Programmed to be a cautious, defensive driver; Autonomy decisions focus on safety, not comfort

Zero-Occupant Delivery Vehicle

- A smaller novel vehicle designed to keep what's on the outside safer than what's inside

Commercial Delivery Services

- Magical customer experience while traveling at lower speeds, on safer routes

Nuro Highlights

Investments and Partnerships

- Over $2 billion in venture capital investment; commercial partnerships with Kroger nationwide grocery stores, Domino's Pizza, FedEx, CVS, Walmart, and more to be announced soon.

Commercial Deployments

- Public deliveries in Scottsdale, Arizona and Houston, Texas with zero-occupant vehicle on public roads

San Mateo Deployment as part of COVID response at Event Center

- R2, Nuro's zero-occupant vehicle, assisted with food and medical supply deliveries as part of the County response

CA Deployment Permits (3 of 3)

- Autonomous Testing with a Safety Driver (2017), Driverless Testing (Apr. 2020), AV Deployment (Dec. 2020)

Houston Research Pilot with Paratransit Customers

- Research Pilot with Houston METRO/Texas A&M Transportation Institute delivering groceries to paratransit users

Zoox

Mark Rosekind

Mark is a passionate safety professional with more than 30 years of experience promoting innovation through science and leadership in complex environments.

In April 2017, Dr. Rosekind joined the executive team at Zoox. In September 2020, he was appointed the Distinguished Policy Scholar in the Department of Health Policy and Management at the Johns Hopkins Bloomberg School of Public Health. Previously, Dr. Rosekind was appointed by President Obama as the 15th Administrator of the National Highway Traffic Safety Administration (NHTSA), serving from 2014 to 2017.

Zoox

Panel #2: AV Trends for Public Sector Pilots and Deployments

Virginia Lingham, Moderator

Panelists

Adam Burger

Senior Transportation
Planner, Valley
Transportation Authority

Peter Calcaterra

Senior Transportation
Planner, Connecticut
DOT

Jack Hall

ITS CV/AV Program
Manager, Contra Costa
Transportation Authority

Shaina Quinn

Innovative Mobility
Solutions Program Manager,
Utah Transit Authority

Adam Burger

Senior Transportation Planner

Innovation Program Caretaker

Valley Transportation Authority

VTA AVTAR Shuttle

Serving Palo Alto VA Hospital

Operates on private roads

Local Motors Olli Shuttle

Level 4 automation

Human driver onboard

Starts Q2 of 2022

VTA/WRTA Collab

VA Hospital to Palto Alto TC

Operates on public roads

Green Power EV Star Vehicle

Level 4 automation

Human driver onboard

Starts Q2 of 2022 in Youngstown

Starts Q3 of 2022 in Palo Alto

Peter Calcaterra, Connecticut DOT

Peter is a Senior Transportation Planner at the Connecticut Department of Transportation (CTDOT) in the Office of Strategic Planning and Projects where he manages and coordinates a broad range of critical statewide and regional transportation policies, planning programs, projects, and studies. Over the last five years Peter has led the CTDOT's efforts in preparations for connected and automated vehicles (CAV) and currently heads the CTDOT's CAV program. Peter was the primary author of the CTDOT's first-ever, statewide strategic plan for CAV published in February 2021. Peter serves as the technology and policy lead for the CTfastrak Automated Bus Project, which is a first in the nation project to deploy full-size, automated, connected and electric buses in revenue service. Peter is also currently working with various state, regional and national partners to advance public sector readiness for CAV technologies, policies and infrastructure. Peter is a graduate of Fordham University in New York City, where he received his bachelor's degree in Urban Studies.

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Full-Size Automated Bus Operations on CTfastrak

- **Background**
  - Public Transportation in Connecticut
  - CTfastrak Fixed Guideway & BRT Service Routes
  - Mix of Transit Vehicles (30 ft – 60 ft) & Speed Limits (20 mph – 45 mph)
  - Modern Stations with Raised Platforms, Crosswalks, Real-Time Signage & Ticket Vending
  - Five (5) At-Grade Signalized Intersections

- **CTfastrak Automated Bus Project**
  - Vision – Automated Bus Operations on Fixed Guideway
  - Partners
  - Dynamic Driving Tasks (DDT) & DDT Fallback
  - Safety Driver
  - Primary Use Cases (Platooning & Precision Docking)
  - Bus Electrification
  - V2X Communications at Signalized Intersections
  - Human Factors Research with USDOT Volpe
  - Perception & Adoption Surveys with UConn
  - Timeline & Budget

Jack Hall

As the ITS CV/AV Program Manager for the Contra Costa Transportation Authority, Jack provides project management for CCTA projects, assists local agencies with delivery of their Measure J projects, and helps manage implementation of Intelligent Transportation Systems in Contra Costa. Jack has 26 years of experience as a California Professional Engineer and served nine years in the United States Air Force.

AV Trends: Where we are....

Meet Olli Made by Local Motors

- Made in the USA
- 3D Printed
- 8.2 feet tall
- 6.73 feet wide
- Max speed 25mph
- Entirely electric

Next Generation Shared Autonomous Vehicle

Bay Area Mobility on Demand -

- Public/Private partnership **to develop app to provide real-time, multimodal trip planning options** based on origin and destination data.
- Received **$8 million federal ATCMTD Grant.**

Goals and Objectives

- Encourage use of greener modes of travel through incentives for qualifying trips
- Reduce VMT and improve air quality
- Increase accessibility to all modes, including shared and active transportation
- Optimize trip planning ability for more reliable travel

Automated Driving Systems Grant

A total of 73 applications competed for 8 grant awards. **CCTA was the only local agency to win a grant.** The other winners were state departments of transportation and universities.

3 Projects supporting the future of mobility

- Rossmoor First Mile/Last Mile Shared Autonomous Vehicles
- County Hospital Accessible Transportation
- Personal Mobility on Interstate 680

GoMentum Station Improvements & Offerings

LANE VARIETY

1. Two-into-one lane merge
2. One to three lane roads (10 to 30 ft wide)
3. Bi-directional and unidirectional lanes
4. Bike lanes

ROADWAY INFRASTRUCTURE

5. Overpasses and railroad tracks
6. Grid system similar to city blocks
7. Two 600 ft. tunnels for sensor and communication testing
8. Parking lot doubles as a low speed vehicle dynamics area

TRAFFIC CONTROL

9. No left/right turn intersections
10. Residential traffic circle
11. Programmable traffic lights
12. Pedestrian crosswalks

V2X Signal Lab and Fire House Improvements

Dynamic Personal Micro Transit

A new mobility option being explored at GoMentum Station.

AV Trends: Where we are going…

- **GoMentum Station facilitates public and private collaboration, which may lead to:**

  - Economic development and creation of jobs

  - Private investment into infrastructure and advancing transfer of property

  - State-of-the-art technology incorporated into site and creation of training programs

  - Establishment of a permanent innovation zone/center

  - Expansion of County drone program and expanding GoMentum program to Byron Airport

  - Planning and development of County emergency service training facility

  - GoMentum established as testbed of choice for Silicon Valley, ahead of Castle AFB in Merced

Creating Opportunities for Concord and Contra Costa County

Utah Transit Authority (UTA)

Shaina Quinn

Shaina is a Program Manager in UTA's Office of Innovative Mobility Solutions (IMS), focused on testing connected and automated vehicles and on-demand services. Shaina has over 15 years of experience helping people love the way they travel.

UTA Innovative Mobility in Action

Automated Shuttle Pilot

- Public-private partnership
  - UTA & Utah Dept. of Transportation
  - Easy Mile, WSP

- In 8 locations and 4 seasons

- Key learnings
  - Vehicle automation is here
  - Niche platform
  - Transit potential

Breakout Groups

Breakout Group Protocols

Participants will be randomly assigned to a breakout room with 1 panelist and 1 facilitator to discuss the application of AVs in the County in a small group setting

- The breakout group discussion will last 25 minutes
- Then participants will share what they discussed during the prioritization exercise

Breakout Group Questions

1. What are some applications of AV deployments would you like to see in SMC and where might be a good fit?

2. What are some of the initial steps that might need to occur toward a pilot's deployment?

3. What do we see as some of the biggest concerns with AVs in our communities with safety and equity?

Breakout Room #1

Facilitator: Lauren Tsoi
Panelist: Jose Alvarado (Cruise)

Breakout Room #1 Notes

- AV's for people with disabilities
  - What does good AV driving look like for visually impaired?
  - What are the different vehicle types that can accommodate people with mobility challenges?
  - How do AV's get smarter to accommodate people with different disabilities?
- Relationship with local cities important to:
  - Understand range of use cases to test within local city
  - Understand where to test pilots
  - Understand 1st/last mile and roads less traveled conditions (not just major streets), where demand may be in suburbs or smaller cities

Breakout Room #2

Facilitator: Jeremy Halpern
Panelist: Peter Calcaterra (CT DOT)

Breakout Room #2: Notes

- In retirement homes, seniors rely on Uber/Lyft/taxis.
  - Two AV pilots in major senior communities and they love it
- AVs could be used to better serve seniors, access jobs or hospitals or first/last mile connectivity
- Using fixed guideway, particularly BRT, is low hanging fruit to test out AVs.
- We can't just talk about private AV cars. Transit needs to be a focus
- Infrastructure upgrades: priority one is maintenance such as clear lines and signs. Connectivity to intersections is a plus and is particularly useful for less heavily-funded AV companies
- Safety is a primary concern
- City streets will be more complicated

Breakout Room #3

Facilitator: Lori Low
Panelist: Dan Mitchell (Nuro)

Breakout Room #3: Notes

- Infrastructure:
  - Quality of roadway and signage important. AV should be part of overall solution and can work with green infrastructure.
  - Sharing of bike and pedestrian plans helpful to companies
  - Consider widening bike/ped paths/bridges so room for small AV
- Possible Applications in SMC
  - Pilot at corporate campuses or schools such as Stanford. Corporate partnership funding.
  - Short-haul shuttles from Caltrain to office parks (add'l vehicles could run in clock/counterclockwise loops)
  - 101 Express lanes to ECR express possible pilot opportunity
  - Running smaller buses instead of articulated to increase options for customers
  - Partnering with transit agencies for paratransit
- Concerns
  - Potential for increased congestion
  - How anticipate number of vehicles to ready ourselves
  - What happens to a share vehicle when it's empty

Breakout Room #4

Facilitator: Virginia Lingham
Panelist: Jack Hall (CCTA)

What are some applications of AV deployments would you like to see in SMC and where might be a good fit?

- V2I (Vehicle-to-infrastructure) to make buses smarter
- Pedestrian information to shared with the street infrastructure to avoid the conflict between bus and pedestrian
- Bus yards
- California Connected Vehicle Test Bed on El Camino Real
- Dumbarton corridor
  - Glydways seems like a good fit for Dumbarton, that's been testing at Glydways. ROW is the toughest issue.
- Express lanes - link up with related work being done on the I-680 corridor
- Paratransit needs for shorter distances to replace dedicated manned services.
- Special events.
- Feeder service to high-speed transit station with 5-10 person vehicles.
- VTA is coming out with their Phase 2 BART stations.
- Technology and unions. Action: Work with the unions.
  - Unions aren't likely to reject technology, but need to understand it so they can bargain over it.

SAN MATEO COUNTY
Transportation Authority

samTrans

What are some of the initial steps that might need to occur toward a pilot's deployment?

- Focus on funding and go after the money. Once the idea is on paper it makes this easier.
    - o Consider local sales tax measures.
    - o Work with your congressman to get ear marks and other discretionary funds.

- Maintain good lane marking, striping, and pavement conditions

- Update or improve the interface at traffic signals – procure new controller and equipment

- Fiber backbone is important. it takes time to fund and build that out.

- Leverage "Broadband for All" initiatives by including AVs in those plans.

- Begin work on data management plans and strategies.

- It takes baby steps to build the comfort level, especially with the unions. Act now.

- Documentation is key.

What do we see as some of the biggest concerns with AVs in our communities with safety and equity?

- Look at what IoT is doing and consider following their lead to make sure AVs are safe and secure.

- Re: equity - how do we take steps to make sure that the technology is available to everyone?

- The new infrastructure bill has a big push for broadband, can that be leveraged to help bring everyone up to speed?

- Safety and equity are serious concerns.

- Accessibility is also a concern. Need to make sure ADA considerations are well considered.

- Safety on the vehicle when no one is driving the bus.

- Jobs will change. E.g. the operator now has a primary role to provide a tourism focused service instead of driving the bus.

- Acceptance by the public. Acceptance might not happen as you'd expect (e.g. vax)

- Accessibly. Reschooling starts now.

Breakout Room #5

Facilitator: Peter Skinner

Panelist: Shaina Quinn (UTA)

Breakout Room #5: Notes

- How can cities best use autonomous vehicles/autonomous technology to help reduce traffic congestion.

- Shared vehicles: Important features for constituents are: consistency of availability, safety and cleanliness.

- Cities need to have clear vision/strategic plan of what they need in terms of autonomous vehicles vs having companies approach them and tell them what they require.

- How do we get transparency related to safety data when it's a competitive environment between companies. Cities need to be forward in requesting anonymized data to better understand evolution of AV's and their safety record. Current state isn't good enough in terms of useful data.

Breakout Room #6

Facilitator: Patrick Gilster
Panelists: Adam Burger (VTA), Meghan Grela (Via)

Breakout Room #6: Notes

- Public-private partnerships needed
- First-/last-mile shuttle in Brisbane (address hilly terrain)
- Shuttle applications are likely first
- Focus on improvements to safety - Policy decisions for safety first over infrastructure investments will be important
- Backbone routes and structure would be important to address in the near-/mid-term (guideways or other infrastructure for safety/capacity)
- Collaboration is needed now and a forum for knowledge sharing
- Connected transit infrastructure/technology can speed up service (BRT and AV applications)
- Bus boarding and AV tech is important
- Countywide coordination needed for regional success
- Equity – Long range planning for job transitioning, maintaining employer workforce
- Equity – VTA improves equity through getting modal opportunities to more people that can't or don't rely on the cars
- Equity – Mass transit and shared AVs opens up access to people with disabilities and other underserved communities

Report Back/Live Poll

Question 1

What type of participant are you?

Participant Type	Percentage
San Mateo County jurisdiction	52%
Interested member of the public	16%
Regional or state agency	16%
Private company or economic group	12%
Other	4%
Community-based/advocacy organizations	0%
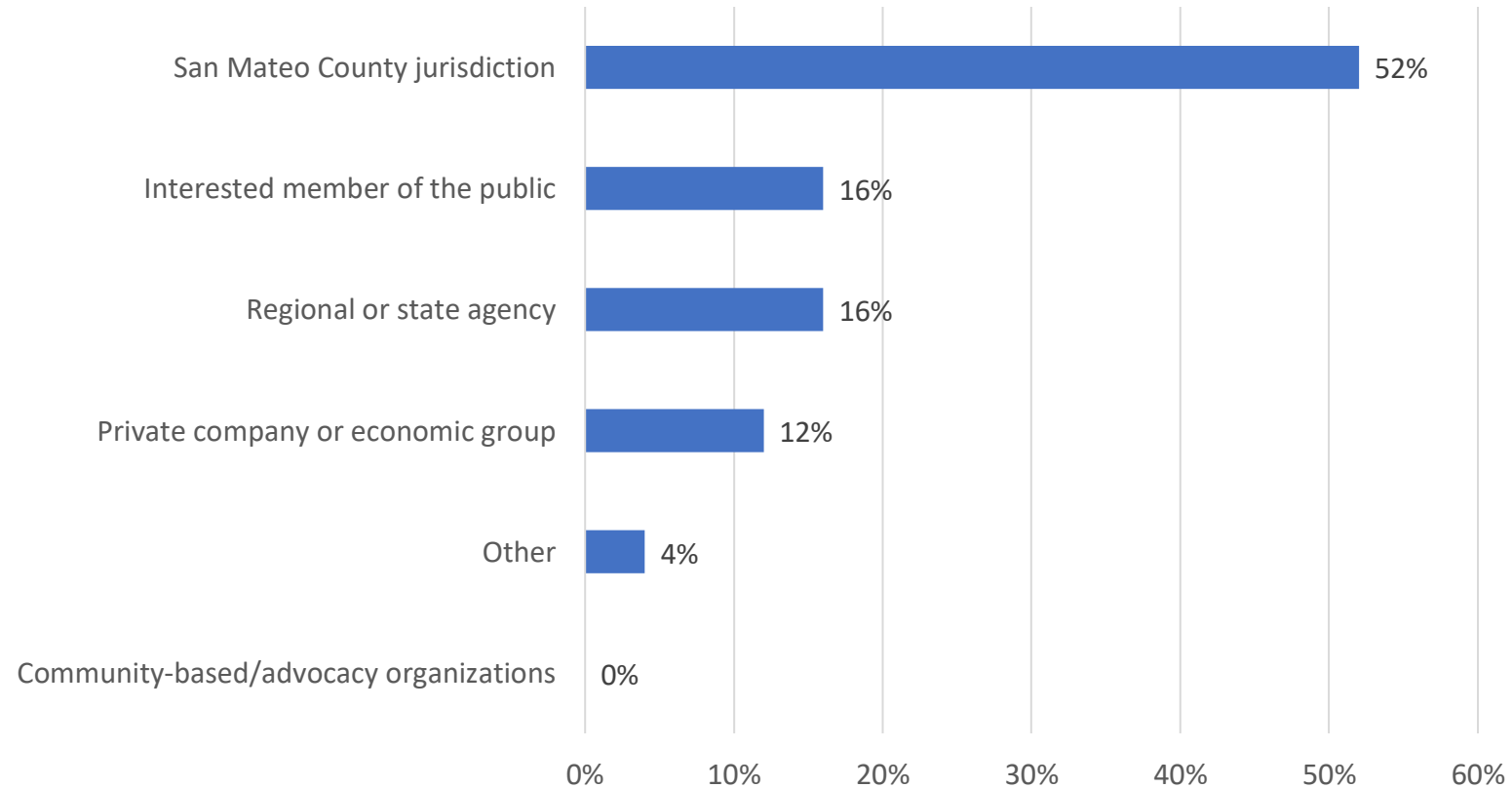
Question 2

Do you think your city/town would be interested in developing or testing a pilot project? (select one)
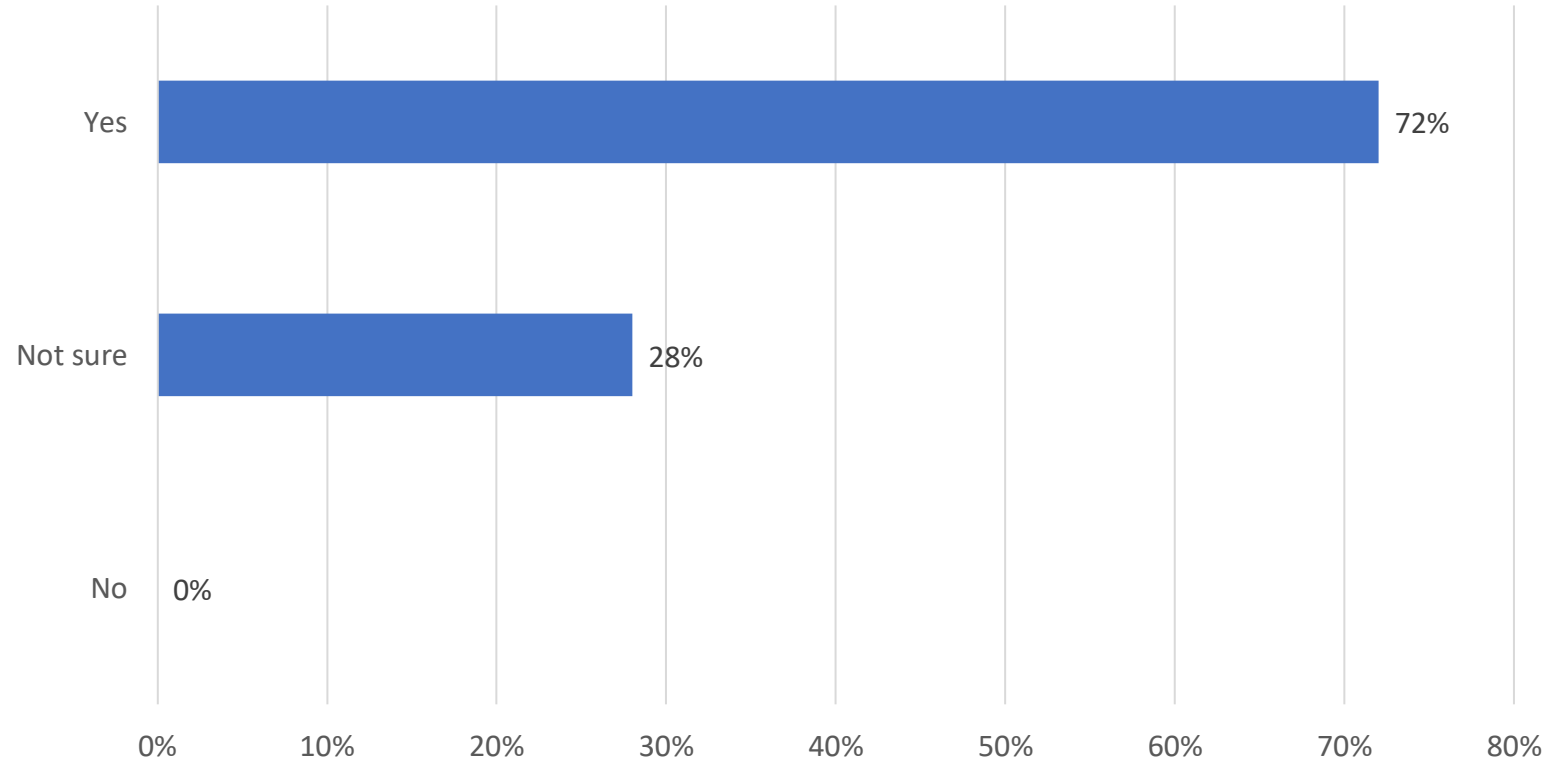
Question 3

What types of AV opportunities or applications do you think could be good candidates in your city/town? (select up to 3)

Category	Percentage
First/last-mile transit access (Shared AVs/Shuttles)	92%
Paratransit or senior services	83%
Connected transit vehicles	42%
Deliveries	42%
School trips	38%
Other	0%
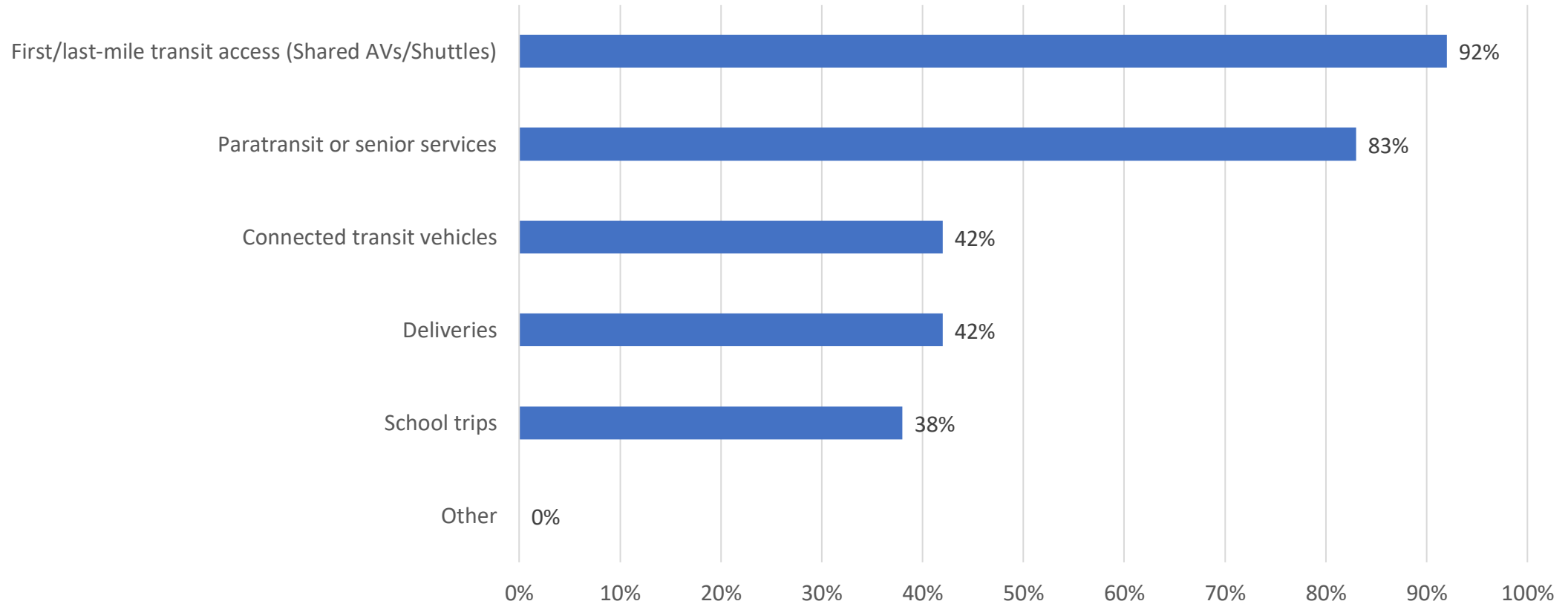
Question 4

What short-term local actions do you think are needed first to begin preparing for future potential AV deployments/pilots? (select up to 3)

Action	Percentage
AV Action Plan or planning/feasibilities studies	65%
Infrastructure improvements (signals, street striping, curb space)	62%
Community engagement	62%
Staff resources or technical assistance	35%
New/modified policies or General Plan update	27%
Identification of local AV champions	19%
Other	8%
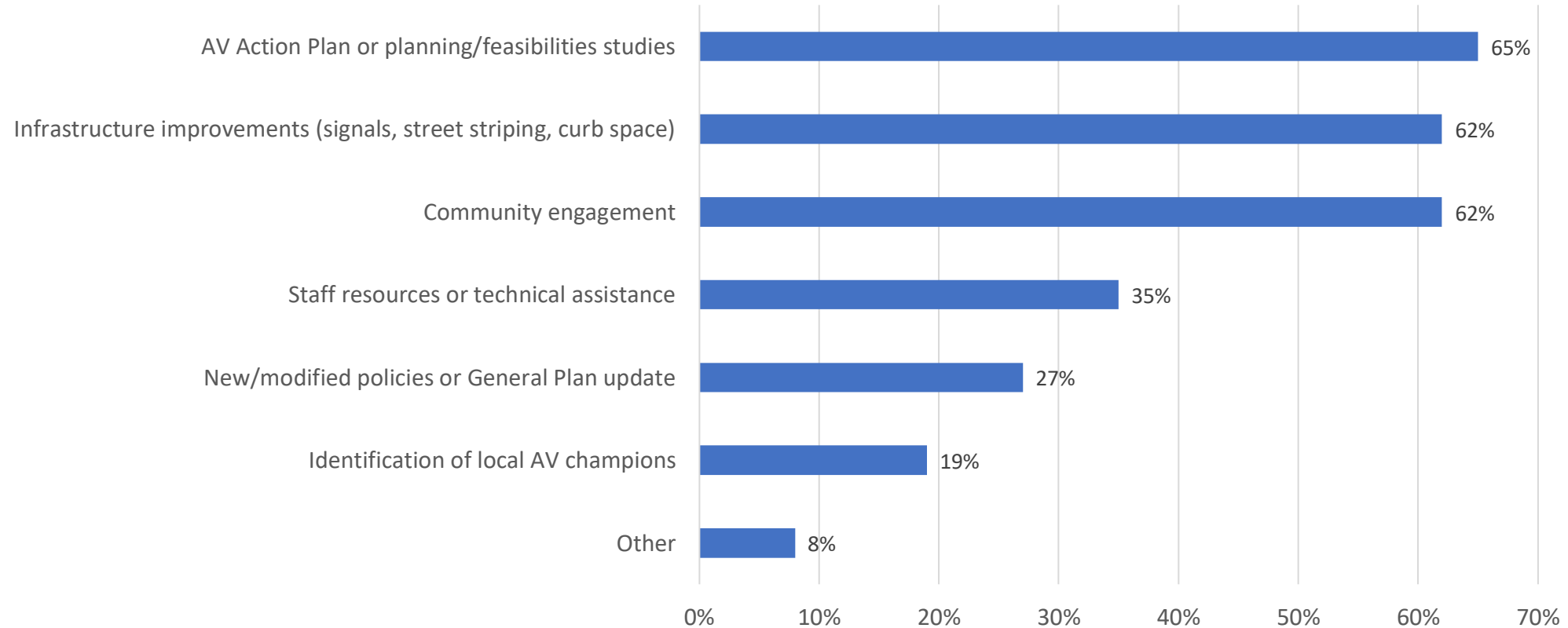
Question 5

What countywide support or coordination would be beneficial to promoting AV or connected transit opportunities in San Mateo County? (select up to 3)

Category	Percentage
Countywide planning study/action plan	75%
Dedicated AV coordinator/planner/engineer	55%
Knowledge sharing of funding opportunities	45%
Dedicated AV working group	40%
Additional workshops or technical trainings	35%
Recurring updates within existing working group(s)	20%
Other	5%
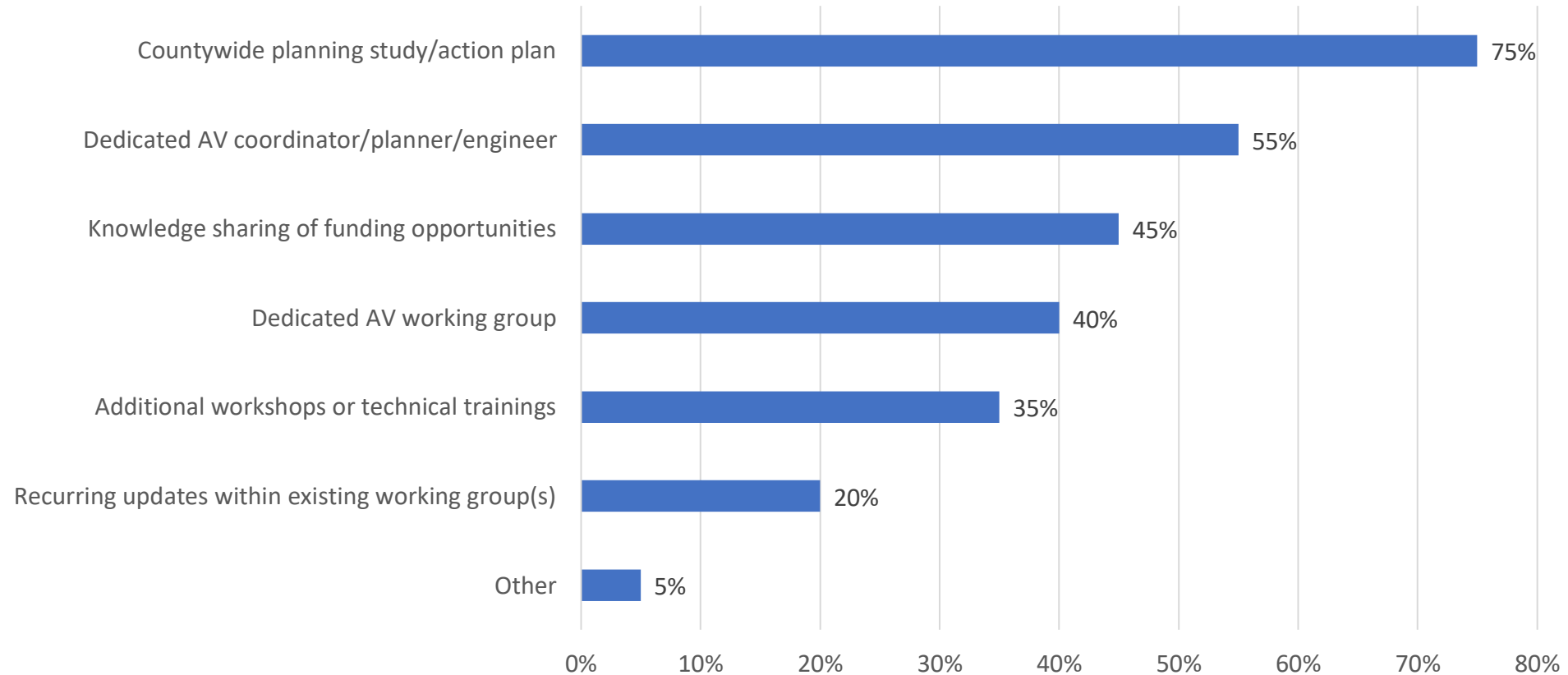
Summary and Wrap Up

Panel 1: Chat Questions & Answers

For all industry presenters, how does your ADS technology perceive, interact with, and operate through signalized intersections? Does your ADS stack require connectivity with the intersection (e.g. V2X SPaT and MAP data)? If your ADS stack does not require connectivity with the intersection, are you open to receiving connectivity from the intersection?

- Nuro vehicle systems are currently built for driving on public roads as they exist today, not requiring any additional smart city infrastructure. We are always on the lookout though for additional ways we can improve safety of our vehicles and roadway infrastructure. Please reach out to dan@nuro.ai if there are specific technology or partnerships you would like our team to consider exploring integrating with our systems.

Mark mentioned that it's likely that truly ubiquitous AV ride-hailing available to all is two, maybe three decades away. I'm interested in knowing just how soon app-based requests (for short trips within city limits) our panel thinks is feasible. Are your companies close to deploying apps for public use, if only in limited pilot launches?

- Just last week, Nuro announced a new public commercial pilot in partnership with 7-Eleven. Customers in the Mountain View operating area can place an order via the 7NOW delivery app to experience autonomous vehicle delivery services today. Read more about this on the Nuro blog: https://medium.com/nuro/nuro-brings-commercial-autonomous-delivery-to-california-for-the-first-time-starting-with-7-eleven-ab26b895a6fa

Panel 1: Chat Questions & Answers

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- Via deploys and currently operates several AV deployments that leverage app-based ride-hailing for public usage. Through service-branded apps (please Figure 1, Botride below) riders can select their pick-up and drop-off locations, book, and pay for their rides. Via's AV Rider App also enables riders to review their wait time and journey time statuses in real-time, as well as communicate with rider support. If the AV service is composed of both AVs and conventional vehicles, riders can use the Rider App to view and select their preferred vehicle option (please Figure 2, RAPID below). Finally, the Rider App can facilitate a seamless driverless ride-hailing experience, such as by instructing riders on how to board the vehicle by scanning their QR codes.
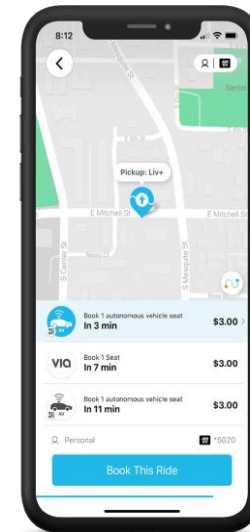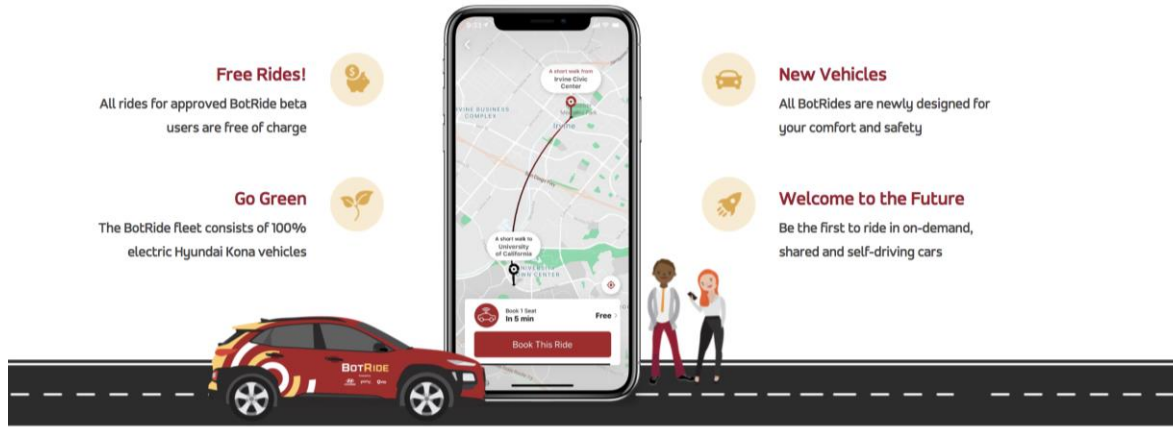
Panel 1: Chat Questions & Answers

How can we promote public/private partnerships?

- Deploying AVs in mass transit through public and private partnerships offers a unique opportunity to maximize the benefits of AVs -- for riders, operators, and AV providers alike. When scoped and designed properly -- accounting for cities or transit agency goals, current transit patterns, and local topography -- AV services can solve real transportation needs. And, when part of shared public transit, AVs are accessible to a broad range of riders and are sustainable. Finally, augmenting AV services with technology-enabled software for AV booking, dispatching, and routing maximizes vehicle usage, while customer-facing tools like rider apps and in-vehicle screens enhance the rider experience to increase trust, comfort, and safety. Encouraging partnerships between cities / transit agencies, transit technology players, and AV providers across all stages of an AV deployment -- from service design to operational implementation -- will ensure AVs provide useful, efficient, and equitable transit solutions.

Can the panel elaborate more on the idea of cities identifying backbone routes for AV (geofencing), and balancing the need for first/last mile solution that will put people exactly where they need to go?

- Balancing the needs for first/last mile solution will require ongoing coordination between AV operators and public agencies. Tracking the roads that AV providers operate on, and the most popular routes, will help identify those key corridors and routes of significance that will also help meet TDM goals. Public and private interests and priorities may or may not naturally align, so coordination is necessary to ensure that TDM goals are met.

Panel 1: Chat Questions & Answers

Each new EV or hybrid doesn't require city by city "outreach", etc. The need for it with AVs suggests there are safety or other issues with them that still necessitate special community and law enforcement outreach that would be unthinkably superfluous for today's human-driven vehicle manufacturers. Please comment on why such outreach is an issue and what it would take for AVs to be ready enough not to require such.

- With a zero-occupant vehicle, it's important for us to work with the Departments to provide additional training as there may not be an individual on-site to provide requested documentation (license, registration, insurance), or assist in moving the vehicle in the event of a crash. There is a lot we all can learn by having this dialogue. You can read about Nuro's approach to working with Law Enforcement on our blog here: https://medium.com/nuro/how-nuro-works-with-emergency-response-providers-e00c346780c3

I'm curious about your routing algorithms. At this point, AVs aren't pervasive enough for their routing algorithms to have a significant impact on congestion on the grid. However, to what extent are companies planning on implementing greedy vs. system-optimal routing algorithms, and is network management on the mind of public jurisdictions?

- Ongoing coordination between AV operators is needed to better understand how the transportation network will route vehicles in the future. It is feasible that network optimization may conflict with individual AVs routing within the system at times. Additional testing and scaling up of technology deployments will help everyone understand this potential impact.

- Public jurisdictions are interested in how to potentially optimize existing roadway and highway facilities through increasing the capacity of these facilities by allowing vehicles to operate closer together. Alternatively, opportunities may exist for public jurisdictions to influence how portions of their networks are used by used such as limiting access to AV fleets or using curb space management policies to identify potential drop-off/pick-up areas.

Panel 1: Chat Questions & Answers

For Zoox, unlike Instacart and other human delivery services that drop orders on one's porch, how do handle the problem of getting deliveries out of the vehicle when the recipient is not ready or able to unload the delivery from the vehicle?

- At Nuro, when we have deployed our zero-occupant R1 and R2 vehicles into commercial services, we have seen a behavior change fairly quickly from customers, being ready and waiting for their order to arrive at a specific time, rather than when other delivery services provide a wide range. In practice it has been exceedingly rare that someone is not home for a delivery. You can see what that interaction is like with R1 in our grocery delivery service in Arizona in this video: https://www.youtube.com/watch?v=XKXbacNQGI8

Panel 2: Chat Questions & Answers

Please discuss automated/driverless transit rail and what is preventing its widespread implementation in the US on systems like BART or Caltrain despite its being a far, far easier technically than steering vehicles on open public roads, and which has long been solved and operating in reliable revenue service outside the US for decades (as with Vancouver's SkyTrain, or in Paris, Asia, or São Paulo Brazil).

- See response on the next slide

Panel 2: Chat Questions & Answers

Automating non-steerable fixed guideway conveyances is a near "no-brainer". And since the vehicle can only accelerate or brake or sound a horn or bell … it's an order of magnitude easier technically. Why isn't this being more widely implemented in the US as it has long been deployed and working extremely well for decades in other countries?

- The first two questions share a similar premise: if operating driverless transit on a fixed guideway is technologically simpler than operating transit in mixed situations, why isn't driverless fixed guideway transit being pursued more? There are several reasons, which are listed below, but let's first note that the technology that makes fixed guideway systems driverless is probably different from the technology that autonomous vehicles would need. For example, a simple sensor on a driverless train may detect when it is approaching a stop and instruct the train to slow down whereas autonomous cars use cameras, LIDAR and sophisticated software to decide whether to change speeds.

- It is expensive. Building a new fixed guideway, which likely requires some amount of tunneling and/or aerial structures so that it is grade-separated, is expensive. To justify the high cost of construction, the travel demand that the service would serve needs to be high and would almost certainly be provided by high-density land uses that are adjacent to the line and its stations. Where density and high travel demand already exist, tunneling or building aerial structures will be expensive, disruptive and unsightly. Beyond the guideway, specialized vehicles would likely be needed for the service. Vehicles need places for storage and maintenance, which requires land. New staff and new training would be needed. It all adds up to be a very big expense.

Panel 2: Chat Questions & Answers

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- **Legacy systems may preclude driverless transit or may not fit the service need.** Where transit demand exists in sufficient quantity to justify the high cost of constructing fixed guideways, there are likely already existing transit services that may be occupying the needed right-of-way. Those services may be older rail systems that need to be retrofitted (at substantial cost) to make them driverless or they may have at-grade sections where the transit vehicle interacts with other vehicles and people, precluding a driverless solution.

- If bus systems, which operate at-grade with mixed traffic, already exist, improving transit service may take the form of bus-only lanes, transit signal priority, increasing route frequency, increasing vehicle capacity and extending the span of service. Because buses operate on city streets with rubber tires, buses can go anywhere that is paved and many routes often overlap in common segments. Removing this flexibility and replacing it with a fixed guideway that can only serve places the guideway goes may not be the model of transit needed.

- **Older technologies still work fine.** Caltrain is a successful service despite requiring train operators. Why ditch what works, at substantial cost to the agency, instead of building around an existing success? Building upon success often has smaller, incremental costs to make things better that are much less risky, not disruptive to current riders and are more palatable politically.

Panel 2: Chat Questions & Answers

What about the challenge of the established automobile corporations and their desires to sell EVs to everyone vs MaaS?

- This question seems to ask if there is a conflict between a consumer preference to own a personal vehicle for travel or to travel by hailing/renting a vehicle when needed. I'm not sure that these are in conflict. A society's desire to travel will result in some amount of vehicle miles that are traveled. That total of miles will require some number of cars to serve. Hailed/rented cars will probably have shorter lifespans than privately owned cars as they will accumulate miles more quickly with frequent use and deadheading (time spent traveling to rider requests). Ultimately, the quantity of cars that are sold probably tracks more closely with miles driven, not the ownership status of those vehicles.

Why is it the county's job or place to promote the for-profit AV industry? What's the nexus?

- The goal of planning for AVs and connected transit is to promote the equitable deployment and availability of these technologies in all communities and for all income levels. It is important for local agencies to understand what types of applications of AV technology may be on the horizon or already here that can benefit freight, deliveries, first-/last-mile shuttles, transit, freight, deliveries, and more that look beyond a single-occupancy AV vehicle.

Thank You!

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