TOWARD A SHARED FUTURE: STRATEGIES TO MANAGE TRAVEL DEMAND

PERSPECTIVE PAPER

SEPTEMBER 2018

HORIZON

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STUDY PARTNERS

ASSOCIATION OF BAY AREA GOVERNMENTS
METROPOLITAN TRANSPORTATION COMMISSION

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EXECUTIVE SUMMARY

The San Francisco Bay Area is the global center of technological innovation and a region of rich natural beauty. It is a desirable location to live, work and play and has been growing and thriving economically. The transportation system, however, has not kept pace with this growth, mainly due to limited land availability and financial resources. The result has been increased traffic congestion that has negative impacts on productivity, climate and quality of life.

This paper proposes eight strategies for a more mobile Bay Area by 2050, a place where everyone has a suite of travel options to use on demand, regardless of where they live, work and play. A more mobile Bay Area can be achieved by building on and supporting changing travel and ownership preferences arising from new mobility services and technological innovation.

These strategies traditionally have been called "Transportation Demand Management," as they focus on pricing mobility fairly and reducing the demand for vehicle travel by improving the reliability, flexibility, convenience and cost of other modes. The strategies in this paper were chosen for their potential to reduce congestion or vehicle miles traveled (VMT)[1] and their ability to achieve Horizon's Guiding Principles to make the Bay Area more Affordable, Connected, Diverse, Healthy and Vibrant.

The eight strategies work together to achieve a vision for 2050 when all transportation, regardless of mode or roadway used, can be consumed on a per-use basis (where transportation is provided as a service rather than having to be owned), with land use policies supporting active and multi-passenger options.

1 Strategies to manage travel demand:

1. Multi-Service Trip Planner and Transportation Wallet (Mobility as a Service)
2. Free Feeder Services to High-Capacity Transit
3. Ridesharing and Teleworking
4. Tolling All Highways and Bridges
5. Cordon Pricing

2 Strategies to change land use policies to manage travel demand:

6. Parking Tax
7. Vehicle Trip Reduction Requirements on Development
8. Parcel Lockers and Freight Consolidation Centers

The synergies between these eight strategies promote choice, better connectivity and improved interoperability between all services, both public and private. For example, without better services that are easy to access, pricing cannot be introduced to effectively reduce travel demand.

This paper is the second in a series of Perspective Papers contributing to Horizon, a regional initiative exploring how the Bay Area can thrive in an uncertain future. The Horizon initiative is a comprehensive Bay Area planning effort, led by the Metropolitan Transportation Commission (MTC) and the Association of Bay Area Governments (ABAG), to go beyond transportation and housing policies and to consider economic development, resilience and the effects of emerging technologies for the next long-range transportation and Sustainable Communities Strategy, Plan Bay Area 2050. Each Perspective Paper is meant to explore strategies that help to achieve regional goals, and to start the discussion to determine the final set of strategies in Plan Bay Area 2050. The papers use a "blue sky" planning approach to developing strategies that are not constrained fiscally or politically.

The next step of the Horizon process, Futures, will test this long list of strategies against a variety of potential political, technological, economic and environmental challenges that would impact the lives of Bay Area residents. Working with stakeholders and residents, MTC and ABAG will identify a suite of transportation, land use, economic development and resilience strategies to "win the future," regardless of what happens in the decades ahead. **Toward a Shared Future: Strategies to Manage Travel Demand** identifies high-impact policies to help manage travel demand and achieve VMT reductions while supporting Horizon's five Guiding Principles, as defined by Bay Area residents.

CHAPTER 1
INTRODUCTION

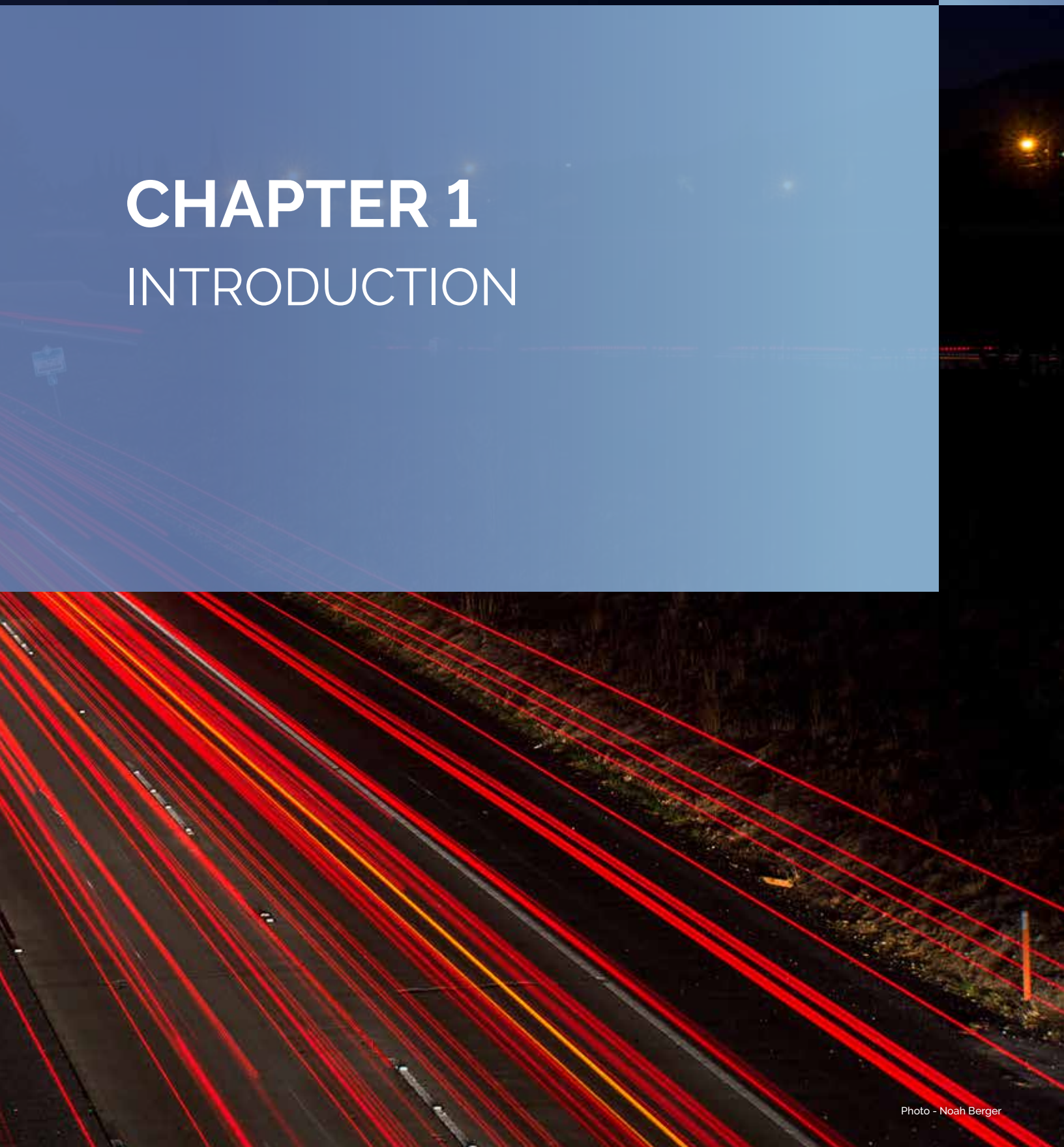

Photo - Noah Berger

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INTRODUCTION

Traffic congestion occurs when too many people want to travel at the same time each day. Fundamentally, congestion is a sign of a successful society and economy with people going to work, school and other places during the same hours.

In the Bay Area, the majority of people traveling during peak or "rush" hours use personal vehicles, which is the prevailing travel mode choice throughout the United States. Many reasons contribute to this choice, including the fact that many Bay Area residents live in low-density areas where public transit is not efficient or convenient to use. With 75 percent of the Bay Area's commuters driving their own vehicles to move at the same times of day[2] (**Figure 1**), the region's road system cannot handle the demand and forces residents to wait in line for limited road space. According to the Brookings Institution, waiting in line is the definition of congestion.[3]

This paper proposes eight high-impact strategies to reduce congestion and vehicle miles traveled (VMT)[4], as well as the associated negative impacts on productivity, climate and quality of life. Together, the strategies offer the greatest potential to support a more mobile Bay Area by 2050—a place where everyone has a suite of travel options, regardless of where they live, work and play—and to achieve Horizon's Guiding Principles, as defined by Bay Area residents: Affordable, Connected, Diverse, Healthy and Vibrant.

These eight strategies have been culled from a wider set of 42 strategies, many of which have been piloted or deployed in other parts of the world and to some extent, the Bay Area. Such strategies have traditionally been called "Transportation Demand Management" because they focus on reducing the demand for vehicle travel by improving the reliability, flexibility, convenience and cost of other travel modes.

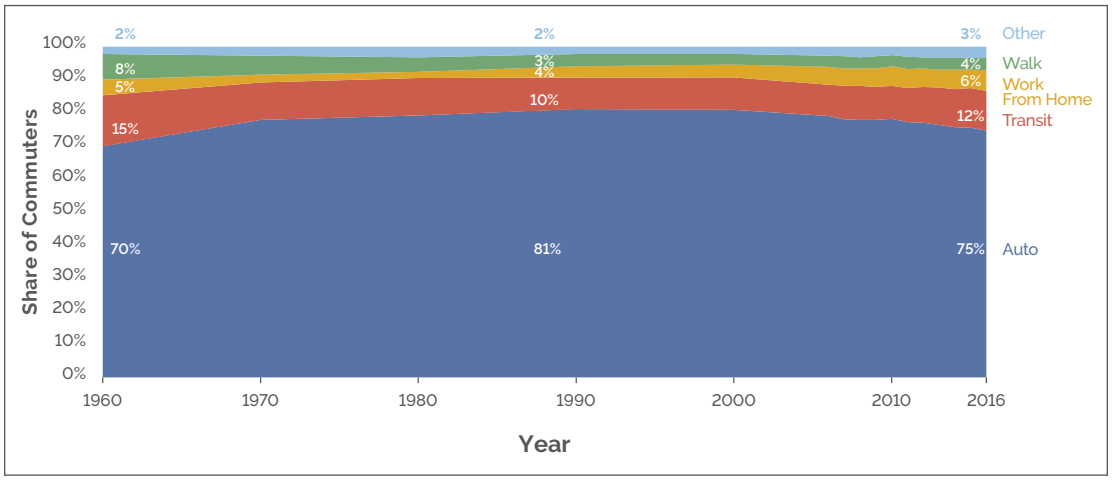
Transportation demand management (TDM) strategies offer a range of different approaches to make the most effective use of the transportation system with:

- Technology to make better use of underutilized roadway capacity;
- Public transit innovations to increase convenience and serve more Bay Area communities;
- Pricing strategies to reflect the supply and demand for roadway space; and
- Land use policies that support travel by shared modes and efficient delivery of goods and services.

The rapid, dynamic pace of technological innovation provides opportunities to make the transportation system more efficient, effective and equitable. On-demand service, available at any time when needed, and autonomous technology can be integrated into transit systems in mid-to-low density areas to provide nimble and cost-effective service that connects residents to high-capacity, long-distance bus and rail corridors. Free-floating shared services, such as scooters, bikes and vehicles, can be made more easily accessible. With improved travel information, little time would be required to figure out which service to use and how to pay for it. In addition, increased applications of dynamic road pricing, where fees fluctuate depending on demand; solo driving reduction requirements for new developments; and parking fees can effectively manage demand and help fund enhancements to the system.

This paper is organized in four chapters. In Chapter 2, the paper outlines the existing challenges as well as the emerging trends that can help to mitigate the challenges. Chapter 3 explains the framework under which the priority strategies were developed, and Chapter 4 describes the strategies in further detail. Chapter 5 concludes the paper with a brief discussion of the next steps for these eight strategies and the Horizon initiative.

Figure 1. Historical Trend for Commute Mode Choice - Bay Area[5]



SOURCE: U.S. Census Bureau: Decennial Census (1960-2000) - via MTC/ABAG Bay Area Census

Background and Purpose of the Perspective Paper

This paper is the second in a series of Perspective Papers contributing to Horizon, a regional initiative exploring how the Bay Area can thrive in an uncertain future. The topics of the other papers include:

- Autonomous vehicles (released June 2018)
- Regional growth strategies
- Bay crossings
- Future of jobs
- Regional governance
- Possible other topics

The Horizon initiative is a comprehensive Bay Area planning effort, led by the Metropolitan Transportation Commission (MTC) and the Association of Bay Area Governments (ABAG), to go beyond transportation and housing policies and consider economic development, resilience and the effects of emerging technologies for the next long-range transportation and Sustainable Communities Strategy, Plan Bay Area 2050. Each Perspective Paper seeks to identify strategies to improve regional outcomes under a wide range of future conditions. This paper identifies high-impact policies to support Horizon's Guiding Principles and help to achieve the VMT reduction targets.

Photo - Karl Nielsen

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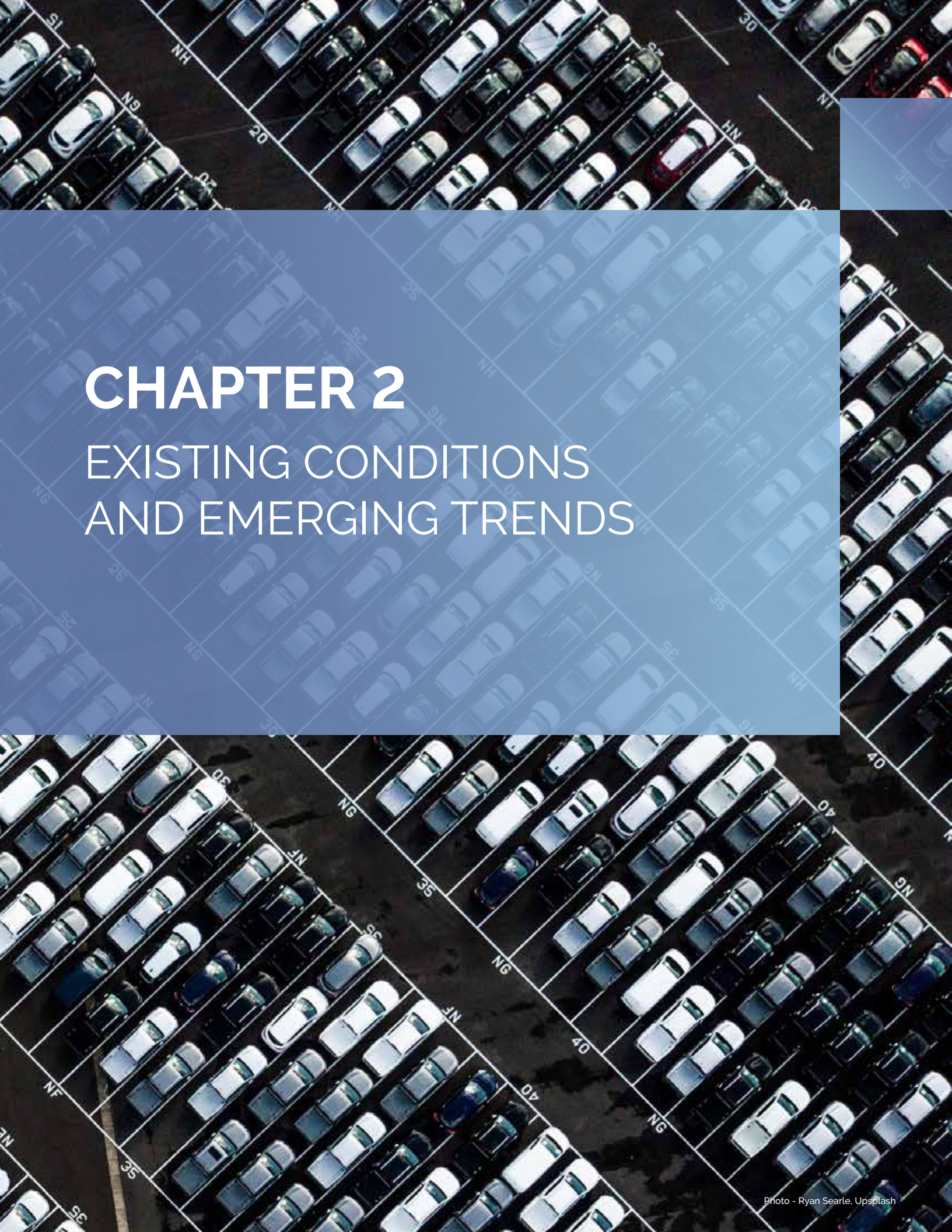
The five Guiding Principles developed for Horizon stem from over 10,000 unique responses received from residents across the Bay Area, answering the question, "What are the most pressing issues we should consider as we plan for life in 2050?" The Guiding Principles are meant to help prioritize policies that ensure the Bay Area of 2050 is:

- **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:** Bay Area residents support 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 is an innovation leader, creating quality job opportunities for all and ample fiscal resources for communities.


STOP

CHAPTER 2

EXISTING CONDITIONS AND EMERGING TRENDS



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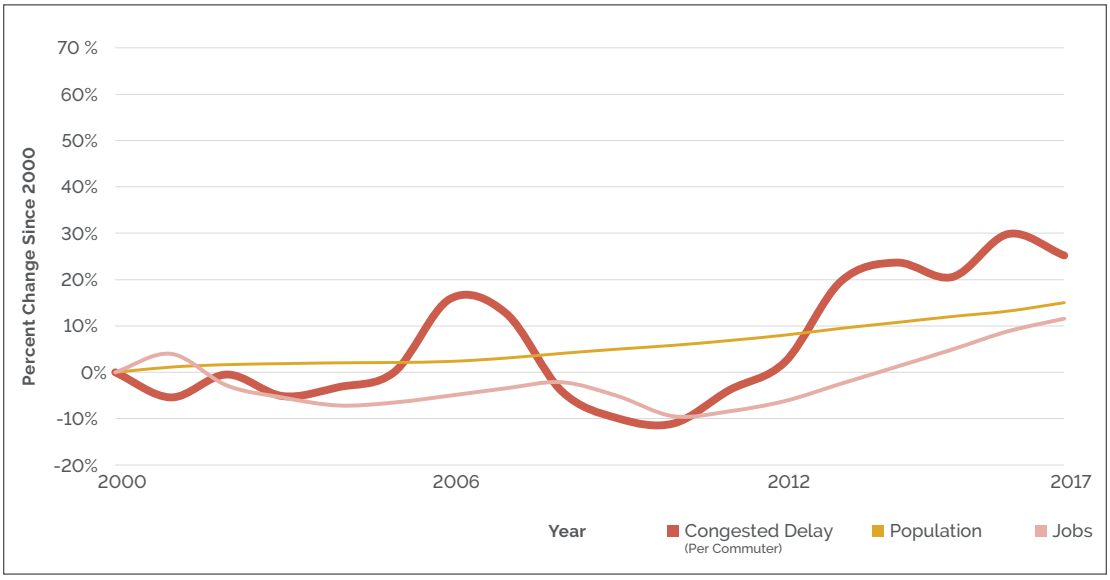
EXISTING CONDITIONS AND EMERGING TRENDS

Bay Area traffic congestion affects residents' health, safety, economic opportunity and enjoyment of the region's natural amenities. Getting around in the Bay Area can be stressful, costly and time-consuming, especially for travelers with limited means or options. Many Bay Area residents commute long distances and may have no choice but to purchase a vehicle because they do not have access to other types of transportation options. At the same time, new private-sector mobility providers (such as Bird, Lime, Lyft, Jump, Uber and many others) are introducing transportation choices that help some people move around more easily but also can add to congestion. Understanding the current challenges and risks can guide the development of a system that can move more people in fewer vehicles while meeting regional climate and quality of life goals.

The Bay Area Ranks Third Among Major U.S. Metro Areas for Congestion

Time spent in highway congestion has been on the rise for Bay Area commuters over the last two decades. Since the peak of the dot-com boom in 2000, per-commuter congested delay has increased 25 percent, while population has grown 15 percent and jobs 12 percent, as shown in **Figure 2**. Nearly all of the growth in gridlock has occurred during the last five years.[6] The Bay Area has the third-worst major metro area freeway delay in the United States, surpassed only by Los Angeles and New York,[7] with commute times reaching a record high of over 32 minutes in 2016.[8]

Figure 2. Change Since 2000 – Population, Jobs and Time Spent in Congestion

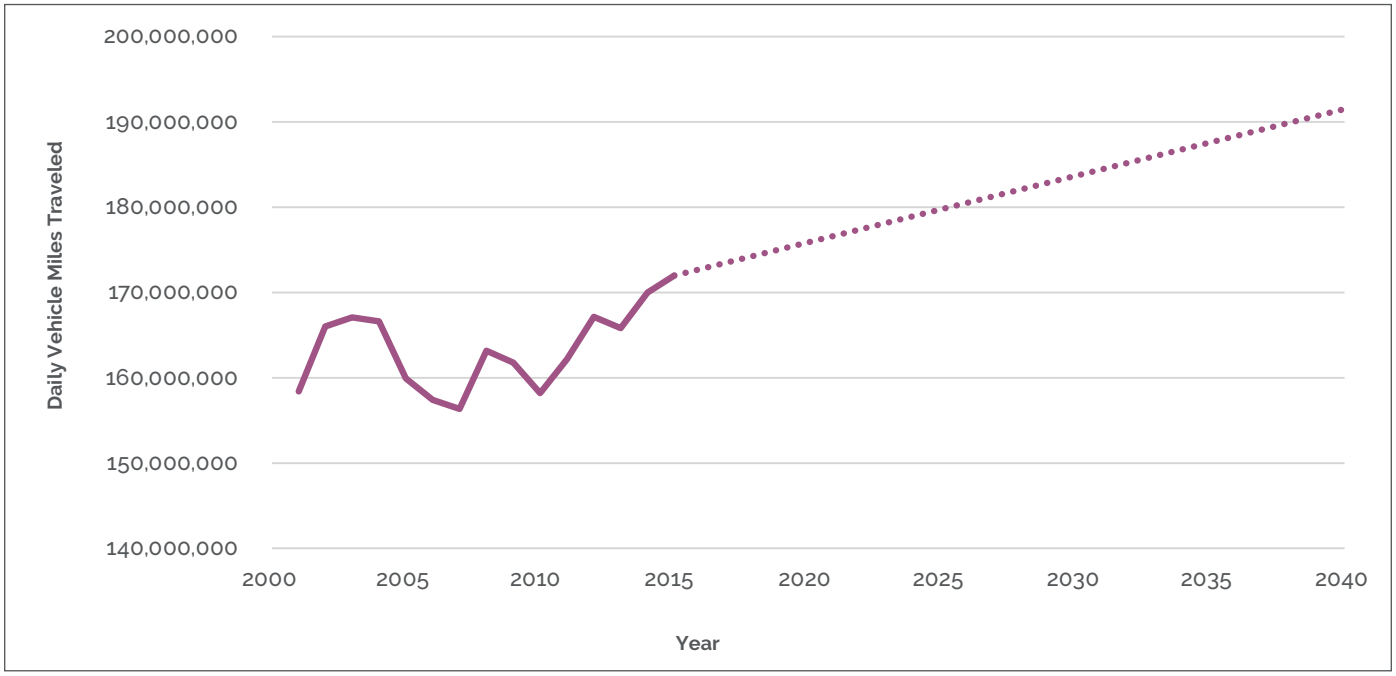


Congestion has outpaced growth in population and jobs, increasing 25% since 2000.

SOURCE: California Employment Development Department; California Department of Finance; INRIX/MTC Analysis

The increase in congestion is partly due to people traveling longer distances between jobs and housing as high housing prices have pushed people farther from their jobs and schools. The average distance traveled behind the wheel has spiked region-wide since 2010. The region has surpassed previous VMT records with Bay Area drivers now totaling 172 million miles traveled on a typical day; this equates to traveling to the moon and back 355 times. As shown in **Figure 3**, Plan Bay Area 2040, the region's current long range plan, projects a significant regional VMT increase by 2040 despite large investments in transit.[9] [10]

Figure 3. Regional Daily Vehicle Miles Traveled, Historic and Projected



SOURCE: Caltrans Highway Performance Monitoring System; MTC Analysis

The region's transit services are also crowded, and this is seen most prominently in the Transbay Corridor.[11] People traveling to and from downtown San Francisco on transit today typically experience overcrowded and uncomfortable conditions, particularly during peak commute hours. In 2015, BART operated at 110 percent of policy capacity and Muni Metro light-rail lines at 124 percent in the corridor. Additionally, ridership on AC Transit Transbay buses and on ferries nearly reached their policy capacity levels (94 percent and 96 percent, respectively). With transit in the corridor operating over capacity, even minor incidents like service delays and breakdowns can trigger major ripple effects throughout the entire system.[12]

In the Bay Area, efforts to provide mobility choices and reduce congestion are undertaken by public agencies on city, county, regional and state levels; by non-profit organizations, including transportation management associations and community organizations; and increasingly by the private sector. **Table 1** provides a snapshot of the breadth of these activities.

Table 1. Activities to Reduce Vehicle Miles Traveled in the Bay Area*

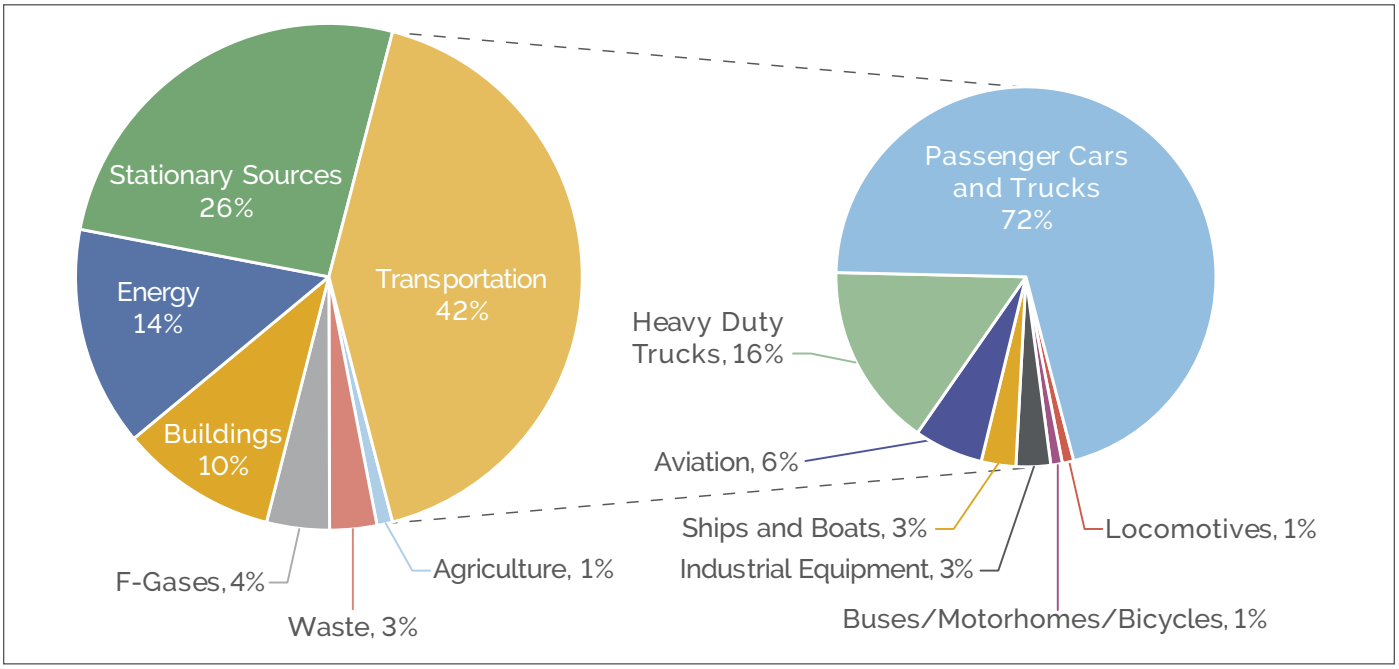
Programs to Provide More Transportation Options	Transit, paratransit, microtransit
	Shared services (bike, car, scooter)
	Company-specific long-distance bus services
	Ridesharing (carpool, vanpool), private sector carpool matching apps
	Emergency/guaranteed ride home
	Clipper®, local agency fare payment apps
	Vision Zero
	Bike infrastructure
	Ridehailing (taxis, Uber, Lyft)
Policies – Land Use and Transportation	Planning and technical assistance grants for Priority Development Areas
	Complete streets
	Vehicle trip reduction ordinances/trip caps
	Transit Oriented Development (MTC Resolution 3434)
	Commuter Benefits Ordinance
	Lifeline programs (for people with low income, disabilities)
	Community-Based Transportation Planning
	Guiding Principles for Emerging Mobility Services and Technology (San Francisco Municipal Transportation Agency)
	Parking Maximums
Parking and Pricing	Unbundled parking
	Express Lanes
	Parking pricing, tax
	Peak-period pricing for bridge tolls
Marketing, Outreach and Education	Personalized travel assistance programs
	Safe Routes to Schools
	Wayfinding
	Congestion Management Agency employer-based trip reduction outreach and education

*The table does not provide a complete inventory of VMT reducing activities in the region; the purpose is to provide an overview of the various programs and policies.

Emissions From Vehicles Are Contributing to Climate Change[13]

Motor vehicles are a major source of air pollutants that can damage public health as well as greenhouse gases (GHGs) that contribute to global warming and climate change. The impacts of climate change, including warmer temperatures, more extreme weather, more variable precipitation patterns and sea level rise, are evident today in the Bay Area and California. **Figure 4** shows Bay Area GHG emissions by source. Transportation accounts for 40 percent of the Bay Area's GHG emissions, and passenger cars and light-duty trucks account for over 70 percent of the transportation emissions, showing the need to focus on reducing the use and reliance on combustion engine vehicles. Though the transportation fleet is projected to become emission-free over time, thus lowering climate impacts, VMT reduction policies also are needed to ensure that the Bay Area remains a vibrant place where residents can move around conveniently and reliably.

Figure 4. 2015 Bay Area Greenhouse Gas Emissions by Source [14] [15]



SOURCE: Bay Area Air Quality Management District

Technology Has Enabled New Mobility Options and Is Changing Travel Preferences

The introduction of the smartphone, advances in GPS and internet connectivity, and availability of "big data" have enabled an explosion of "new mobility" products and services.[16] New mobility refers to transportation options that are customizable, on-demand, enabled by digital technology, driven by real-time data and that often provide curb-to-curb transportation.[17] These services are not owned or maintained by the user but are used according to travel need and preference. The technology behind these services allows quick access to a variety of options, such as sharable scooters, bikes and vehicles, whether rented or hailed through a smartphone. New mobility options are effective at providing connections to long-distance rail or bus lines.

Photo - David Paul Morris

Moving From Ownership to Service

Transportation primarily has been an asset-oriented industry, in which a person buys, owns and drives a personal vehicle. This convention is starting to shift toward a service or pay-per-use model largely due to new mobility services. One key indication of this shift is declining vehicle ownership in the United States, which was down 2.5 percent in 2016 from peak ownership rates in 2006.[18] Additionally, since 1983, the share of people with driver's licenses has decreased in the U.S. for certain age groups. Most notably, the share fell from 80 to 60 percent for 18-year-olds. At the same time, the share decreased by 13 percentage points for those in their twenties, by 8 percentage points for those in their thirties, and by 3 percentage points for those in their forties.[19] As a result of these trends, new vehicle sales are expected to decline over the next decade.[20] The strategies in this paper seek to reduce traffic congestion in the context of these changing mobility preferences and declining vehicle ownership trends.

The benefits of shifting from vehicle ownership to a pay-per-use model include lower costs and better access to up-to-date technology, maintained by service providers that can leverage economies of scale.[21] Services and technology are available on an as-needed and/or subscription-based model, with flexibility being one of the core principles.[22] This growing trend of paying for transportation services on an as-needed basis provides significant opportunity to reduce congestion if implemented in a manner that reduces the number of vehicles on roads and complements active transportation and transit use, especially in major cities.[23]

CHAPTER 3

FRAMEWORK FOR THE FUTURE

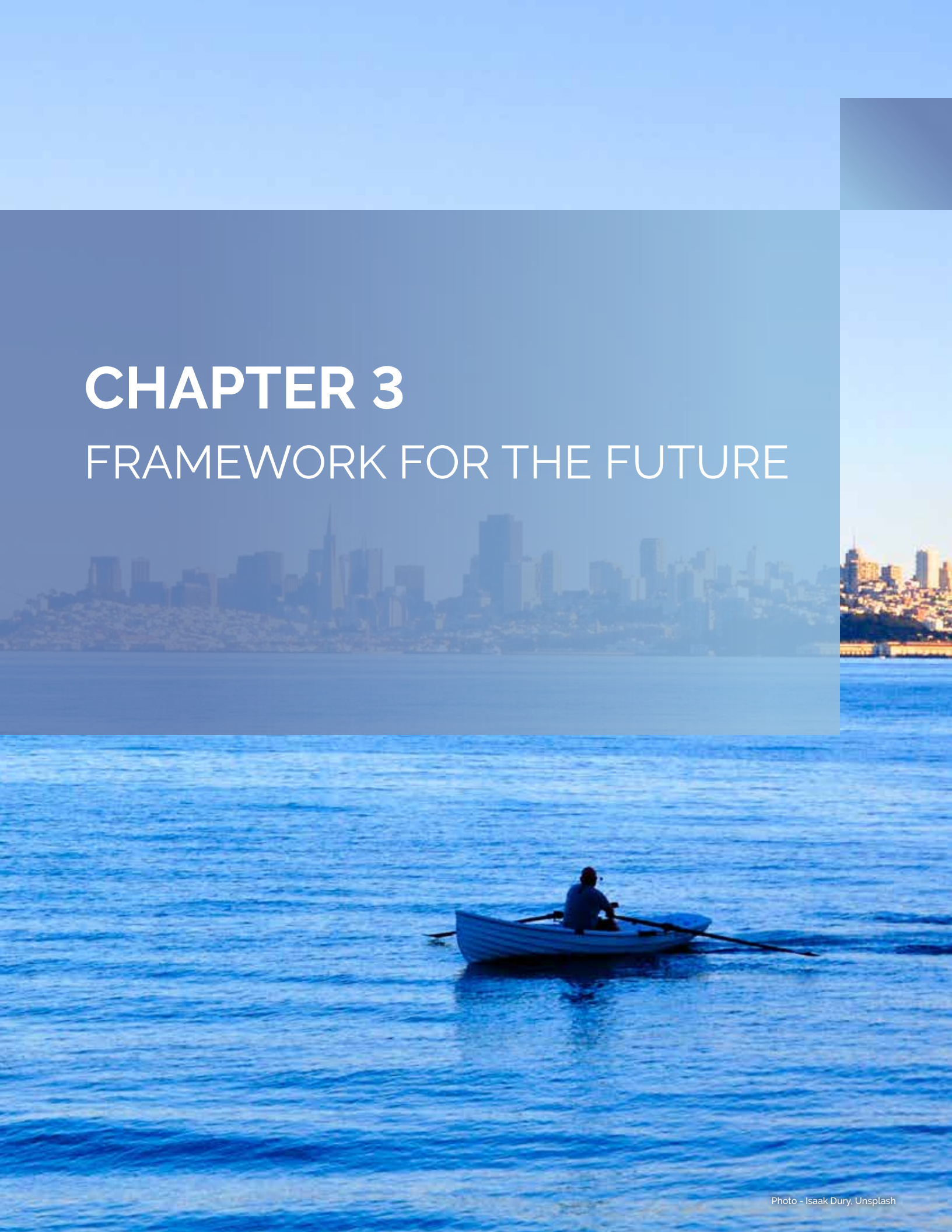


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Photo - Karl Nielsen

FRAMEWORK FOR THE FUTURE

As the Autonomous Vehicle Perspective Paper[24] raised, autonomous vehicle (AV) technology has the potential not only to reduce highway congestion but also to create even more congested roads; unsafe street conditions for all roadway users; insecure data; and exclusive, expensive services that do not benefit all residents. The Bay Area's infrastructure, now and in the future, does not have the capacity to support this increased number of vehicles, even with connected technology that will allow vehicles to travel at closer distances to each other. Therefore, encouraging travel with services that are part of a fleet, such as scooters, bikes, transit, cars and others that pop up in the future, will need to be integrated into transportation and land use policy and planning in order to achieve a reduction in the number of vehicles on the road.

VMT reduction and encouraging travel in shared services can only be accomplished through a comprehensive approach in which transportation options are seamless and ubiquitous; driving costs are not subsidized as they are now; and transportation, goods delivery and land use development are planned together. Toward these ends, MTC and ABAG compiled a set of over 40 transportation strategies, many of which have been implemented in areas around the world. These strategies, listed in **Table 2**, in large part have not been carried out in the Bay Area, though some have been put into place at the local level.

Based on a review of the available literature and evidence from the application of these strategies, MTC and ABAG focused on each strategy's relative ability to manage travel demand and reduce VMT, indicated as High, Medium or Low in **Table 2**. Likewise, the timeframe needed for the implementation of each strategy is divided into three categories: Short-Term (5-10 years), Mid-Term (10-20 years) or Long-Term (20+ years). Based on this review as well as alignment with Horizon's Guiding Principles, eight strategies were selected that show the most potential to reduce vehicle trips. These strategies will be evaluated across a series of divergent futures, or planning scenarios, in the next stage of the Horizon effort. Some of the strategies would be politically difficult to implement today, but changing travel preferences and emerging technology solutions can provide opportunities to address these challenges.

These eight strategies will be discussed in detail in the next chapter.

Table 2. Strategies to Manage Travel Demand

	STRATEGY	VEHICLE TRIP REDUCTION POTENTIAL	SHORT-, MID-, LONG-TERM*	IMPLEMENTING AGENCY (STATE, REGIONAL, LOCAL)
TRAVEL OPTIONS	1.1 Free transit	Medium	Short-term	Regional / Local
	1.2 Inclusion of fare payments in trip planning apps	Low	Short-term	Regional
	1.3 Linked / seamless transportation accounts	Medium	Short-term	Regional
	1.4 Flat-rate transportation packages	Medium	Short-term	Regional
	1.5 Shared, electric, connected, and autonomous vehicle fleets	Low	Mid-term	Local
	1.6 Enforced vehicle occupancy rates	Medium	Short-term	Regional
	1.7 Mobility hubs	Medium	Mid-term	Regional
	1.8 Rationalization and integration of transit	Low	Mid-term	Regional
	1.9 Ridesharing	Medium	Short-term	Regional / Local
PRICING	2.1 Parking tax	High	Short-term	Regional / Local
	2.2 Dynamic parking pricing	Low	Short-term	Regional / Local
	2.3 VMT pricing	High	Long-term	State / Regional
	2.4 CBD cordon pricing	Medium	Mid-term	Regional
	2.5 HOT/Express lanes	Low	Mid-term	State / Regional
	2.6 Major increase in bridge tolls	High	Short-term	Regional
	2.7 Fee/subsidy schemes for shared-use rides	Medium	Mid-term	Regional
	2.8 Car free zones	Medium	Long-term	Regional
	2.9 Emission-free zones	Medium	Mid-term	Regional
	2.10 Pay-as-you-drive insurance	Low	Short-term	State / Local
	2.11 Gas tax increase	Medium	Mid-term	State
	2.12 Variable sales tax for new vehicles	Low	Short-term	State / Regional
	2.13 Toll all freeways and bridges	High	Long-term	Regional
GOODS DELIVERY	3.1 Urban consolidation centers	Medium	Long-term	Regional
	3.2 Parcel lockers/neighborhood delivery pods	Medium	Short-term	Local
	3.3 Electric-assist delivery bicycles	Low	Short-term	Local
	3.4 Shift to move off-peak/night delivery	Low	Short-term	Local
	3.5 Drones	Low	Long-term	Regional / Local
	3.6 Autonomous urban freight delivery vehicles	Low	Long-term	Regional
DEVELOPMENT AND MOBILITY PLANNED TOGETHER	4.1 Adjust parking requirements	Medium	Short-term	Local
	4.2 Shared parking	Low	Short-term	Regional / Local
	4.3 Incentives for unbundling parking in new developments	Low	Short-term	Regional / Local
	4.4 Vehicle trip reduction requirements on developments	Medium	Short-term	Regional / Local
	4.5 Required vehicle trip reduction strategies for corridor plans or other community plans	Low	Short-term	State / Local
	4.6 Replace parking minimums with mobility subsidies	Medium	Short-term	Regional / Local
	4.7 Requirement for developers to include workspace in multi-unit residential developments	Low	Short-term	Regional / Local
SOLO DRIVING COMMUTE REDUCTION	5.1 Commute trip reduction – employers (aggressive/enforced)	Medium	Short-term	Regional / Local
	5.2 Discretionary trip reduction – retail and event venues	Medium	Short-term	Regional / Local
	5.3 Telework tax credit	Medium	Mid-term	Regional / Local
	5.4 Compressed work week / Flex-time tax credit	Low	Mid-term	Regional / Local
	5.5 Eliminate free/subsidized employee parking	Medium	Short-term	Local
	5.6 Regional network of telework/co-work centers	Low/Medium	Long-term	Regional
	5.7 Parking cash-out	Medium	Short-term	Local

*Short-term = 5-10 years. Mid-term = 10-20 years. Long-term = 20+ years


TOUCH CARD
BELOW
CLIPPER.

CHAPTER 4

STRATEGIES TO MANAGE TRAVEL DEMAND

Photo - Noah Berger

Photo - Noah Berger

STRATEGIES TO MANAGE TRAVEL DEMAND

From the full list of strategies, MTC and ABAG selected eight strategies for evaluation, based on their potential to reduce vehicle trips and their alignment with Horizon's Guiding Principles (Affordable, Connected, Diverse, Healthy and Vibrant). The results of the evaluation will inform regional policy and investment recommendations for adoption in the next regional transportation, housing and land use plan, Plan Bay Area 2050. The eight strategies are organized in two categories:

1 Strategies to manage travel demand:

1. Multi-Service Trip Planner and Transportation Wallet (Mobility as a Service)
2. Free Feeder Services to High-Capacity Transit
3. Ridesharing and Teleworking
4. Tolling All Highways and Bridges
5. Cordon Pricing

2 Strategies to change land use policies to manage travel demand:

6. Parking Tax
7. Vehicle Trip Reduction Requirements on Development
8. Parcel Lockers and Freight Consolidation Centers

The Vision

The vision for the Bay Area in 2050 is that all transportation, regardless of mode or roadway used, can be consumed an a per-use basis, with pricing schemes prioritizing active and multi-passenger options. The eight priority strategies build on the changing travel and ownership preferences appearing as a result of the new mobility services and technological innovations, and support a future where all Bay Area residents have convenient, integrated travel options to consume on demand. Pricing structures can make the most effective use of available transportation resources and provide residents with a reliable travel experience. The strategies also include development regulations and incentives so that new residential and commercial developments inherently do not prioritize solo driving. Finally, by changing land use and zoning to support goods movement, more efficient and convenient delivery models would be available to assist those interested in car-free living.

Photo - Kelley L. Cox

Together, the strategies promote choice, better connectivity and improved coordination between all services, both public and private. The synergies between these strategies achieve this vision; for example, without better services that are easy to access, pricing cannot be introduced to effectively manage travel demand. Collectively, they move the region toward achieving the Guiding Principles.

Travel Demand Management Through Service-Based Transportation

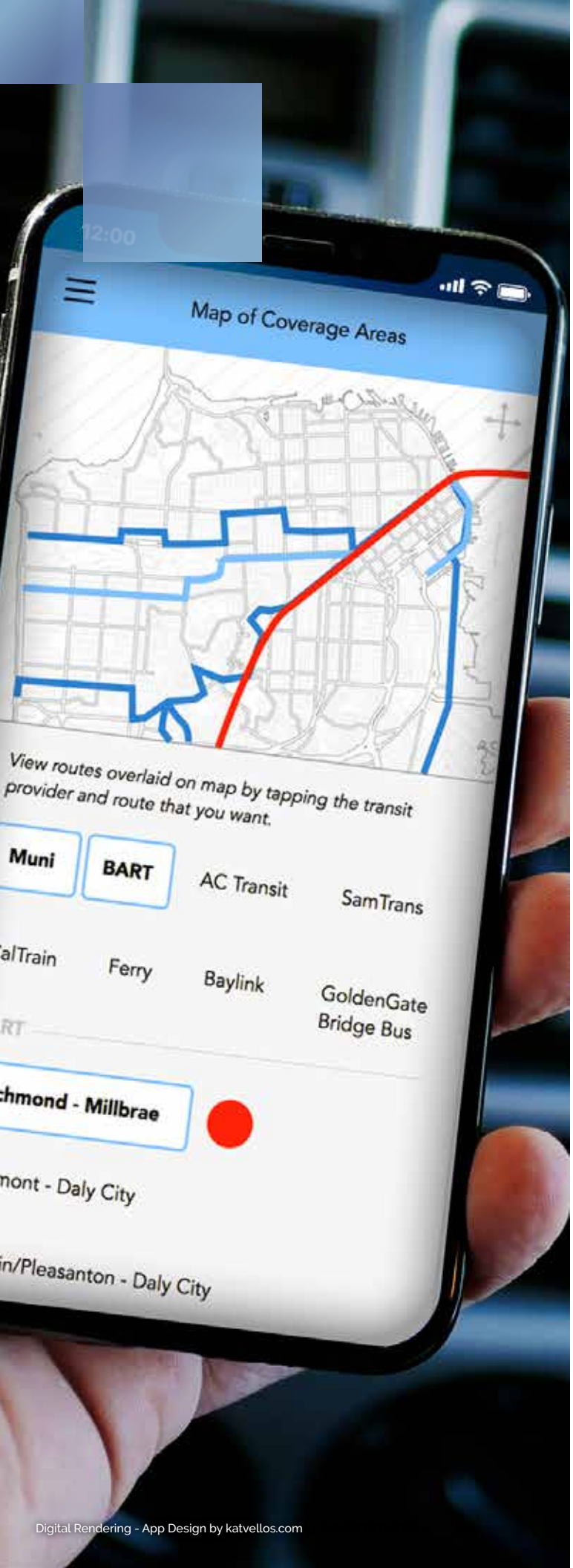
With the advent of the mass-produced car, transportation largely turned into an asset-oriented industry, in which a person buys, owns and drives a personal vehicle. As described in Chapter 2, the arrival of new mobility services is changing transportation consumption again by beginning a shift to a pay-per-use model with two components:

Mobility as a Service refers to a mobile platform that provides customer-centric, on-demand, multi-modal transportation. Users plan and pay for trips on a per-use or subscription basis through a single platform. Mode choice is influenced through pricing and incentives. Travelers benefit in that they can fund one account to pay for both publicly and privately provided transportation options (e.g., bikeshare, transit, tolls, ridehail services such as Lyft and Uber, and others). They can also plan trips from point A to point B, possibly using several modes, through one interface to see their choices and how the modes connect.

Infrastructure as a Service is the idea that the use of and access to public infrastructure, particularly parking and roads, should be subject to pay-per use fees that more closely align with the costs of providing the infrastructure and its demand.[25]

Five of the eight strategies support a service-based transportation system:

- Multi-Service Trip Planner and Transportation Wallet (Mobility as a Service)
- Free Feeder Services to High-Capacity Transit
- Ridesharing and Teleworking
- Tolling All Highways and Bridges
- Cordon Pricing



Digital Rendering - App Design by katvellos.com

STRATEGY 1: Multi-Service Trip Planner and Transportation Wallet (Mobility as a Service)

Future Benefit

Collectively, a trip planner and a transportation wallet (payment mechanism) are intended to provide flexibility and choice competitive with personal vehicle ownership. The ability to link any shared transportation service (bike, scooter, transit, ridehail, AVs and other future options) into a single-payment experience can encourage Bay Area residents to shift from owning and using vehicles to using a variety of travel modes on a pay-per-use basis.

The primary customer benefits include:

- Simplified planning and paying for trips across multiple operators, public or private;
- Access to the latest technology;
- Incentives designed to reward certain types of traveler behavior;
- Discounts available for certain types of travelers; and
- User-centric transportation service without the need to own a vehicle.

This concept, which is evolving and growing, is enabled by technological advances and typically is referred to as Mobility as a Service (MaaS).

Examples From Today

Several ongoing and planned MaaS pilots can provide preliminary results and guidance.

- **Helsinki, Finland.** The Whim app offers three different bulk packages covering public transit, taxis and rental cars, each featuring varying degrees of limited or unlimited trips. The most expansive package, "Whim Unlimited," costs 500 Euros per month and offers unlimited rides on all modes and taxi rides under 5 kilometers. This price point was designed to be approximately equal to average vehicle ownership costs in Helsinki.

- **Germany.** With Hannovermobil, subscribers pay a monthly fee (slightly more than a standard transit pass) to access public transit, carshare, long-distance rail and discounted taxi rides.
- **Vienna, Austria.** The SMILE Project provides information, booking and payment to bring together 14 Austrian mobility partners, public and private, from public transport companies to sharing providers, taxis and parking garages. Total usage is around a few thousand individuals.[26]
- **Los Angeles, California.** LA Metro is building a cloud, account-based system to integrate its existing transit fare payment system, the Transit Access Program (TAP), with other public and private transportation services to create a one-stop shop for service payment and sign-up, called TAPForce. By adding funds to the "TAP Wallet," customers will be able to use their TAP cards, and soon the TAP mobile app, to pay for bike share, parking, toll lanes, carshare, electric vehicle charging stations, ridehailing services and micro-transit in addition to all transit services. The system facilitates administration of discounts and incentives across modes. The system is planned for launch in fall 2018.
- **Houston, Texas.** The Houston District of the Texas Department of Transportation's goal with ConnectStar is to leverage a third-party platform, Metropia, which provides a one-stop shop for various modes of transportation, to benefit drivers and carpoolers, transit riders and those who bike by linking trip information and payment.[27] The app aims to allow users to shop for multi-modal rides in a simple manner and also serves as a platform for implementing dynamic pricing strategies to manage traffic demand. This pilot further embodies MaaS by creating user-customized features such as suggested routes and targeted deals.
- **Minnesota.** The Minnesota Department of Transportation is developing a MaaS platform to serve as a revenue collection mechanism as an alternative to the gas tax, with app development being funded through a FHWA grant to find fuel-tax funding alternatives.[28]
- **Phoenix, Arizona.** Valley Metro Rail was awarded a Mobility on Demand Sandbox grant to develop a MaaS platform that expands an existing transit app to include real-time information; singular accounts for public and private modes (e.g. Uber, Lyft, Grid Bike Share, Zipcar); and trip planning features, such as showing users the cost of fuel saved, amount of carbon dioxide (CO2) saved from using sustainable travel modes and travel time.[29]

Potential Impact

The research suggests vehicle trips can be reduced with a MaaS platform's trip planning tools and interoperability between services. Private vehicle use and auto ownership could be halved and transit ridership could increase by roughly 50 percent.

Results from Whim's first year of operation, 2016, show the following shifts in trip mode share among users: private vehicle use dropped from 40 percent to 20 percent, public transit rose from 48 percent to 74 percent and taxis increased from 3 to 5 percent.[30] At least 6,000 users were registered a few weeks after Whim's launch, equating to approximately 1 percent of Helsinki's population.

Hannovermobil saw 50 percent of users give up vehicle ownership but the program was very limited in scope (1,300 users).[31] [32] [33]

The SMILE Project found 48 percent of respondents used public transportation more often than before and 21 percent reduced the use of their private vehicles. SMILE also encouraged intermodality, with 26 percent of users combining car and public transportation more often and 26 percent combining bike and public transportation more often.[34] Total usage is a few thousand individuals, and this niche early-adopter market is likely different in demographics and preferences than the broader traveler population.[35]

The U.S. examples are still under development, and data related to program impacts are not yet available. To realize the full benefits, a complete range of mobility options must be incorporated into a unified MaaS system. In the immediate future, MaaS systems should include all privately and publicly provided services, including transit, shared modes (bike, scooter, car) and ridehailing (Uber and Lyft). As future services become available, these can also be incorporated into the MaaS services, including shared AV fleets.

With easier access to all services, MaaS systems could be a tool to increase use of ridehailing services, which could lead to more vehicles on the road. Therefore, incentives for encouraging use of shared ridehailing, carpooling, bikes, scooters and transit could achieve the Horizon Guiding Principles. The platform offers a convenient means to implement incentive schemes, which could include lower rates for first/last mile ridehailing trips connecting to long-distance rail and bus lines and higher prices for zero- or single-occupant trips. Additionally, fare programs based on household income could be effectively administered through the platform for public and private services, building on the Regional Means-Based Transit Fare efforts currently underway.

Primary Guiding Principle

Though this strategy aligns with all of the Horizon Guiding Principles, it primarily achieves a more Connected Bay Area. Bay Area residents more easily can use a coordinated transportation system with the ability to plan and pay for trips using multiple modes and services through a single platform.

STRATEGY 2: Free Feeder Services to High-Capacity Transit

Future Benefit

As described in the Autonomous Vehicles Perspective Paper, freeways will continue to have capacity constraints, even with the efficiency advantages that AVs are expected to bring. Rail and high-capacity bus services will remain the most efficient way to move people to primary employment destinations and other activity centers. Using AVs to provide on-demand feeder service in suburban and rural communities, however, can be an effective replacement for traditional transit service, which is typically expensive to provide and inconvenient to use in less dense areas. Free AV services, in vehicles appropriately sized for ridership demand, could feed into rail and expanded high-capacity express bus services to improve mobility and accessibility throughout the Bay Area.[36] Feeder services could be funded by the revenues raised from the tolling, cordon pricing and parking tax strategies described later in the chapter.

Examples From Today

Several cities have eliminated fares for a variety of reasons, including the need to reduce fare collection costs, improve mobility options to individuals with lower-incomes, enhance economic development and viability, and reduce traffic congestion.

Fares eliminated on selected routes:

- **Seattle, Washington.** Buses in the downtown district (program ended in 2012)
- **Kansas City, Missouri.** KC Streetcar in the downtown district
- **Miami, Florida.** Elevated driverless people mover in the downtown district
- **Jacksonville, Florida.** Skyway route in the downtown district
- **Baltimore, Maryland.** Four fare-free routes in the downtown district

Fares eliminated for the entire transit system:

- **Chapel Hill, North Carolina**
- **Corvalis, Oregon**
- **Tallinn, Estonia**

Potential Impact

The research suggests transit ridership would increase with a decrease in fares. Several transit fare reduction scenarios show that a 50 percent reduction in transit fares could lead to a 15 percent increase in transit ridership.[37] However, not every new transit rider will shift from driving alone. Some new transit riders will shift from rideshare, bicycle or pedestrian modes, and some may be induced to travel when they otherwise would not have made the trip.

- **Chapel Hill, North Carolina,** eliminated fares in 2002 and saw a ridership increase from 3 million to over 7 million rides per year. Chapel Hill Transit has also increased transit service by about 20 percent.[38]

- **Tallinn, Estonia,** made transit free to all residents in 2013 and saw 3 percent increase in ridership, of which 1.2 percent could be attributed to the free fares. The remaining 1.8 percent increase was attributed to service improvements and new priority lanes for buses.[39] [40]

- **Seattle, Washington,** provided free transit within the downtown area from 1973 to 2012. By 2012, more than 10 million rides per year were logged inside the free-fare area.[41] [42]

Replacing traditional transit routes with these feeder services in suburban and rural areas, adding more capacity to existing high capacity services and creating new express bus routes on highway corridors without rail service are a few options to effectively increase transit ridership. Since this strategy could create crowded conditions, increasing capacity on the rail and bus lines to which the free feeder services connect would need to coincide with this strategy.

Photo - Contra Costa Transportation Authority

A few planning efforts are addressing current transit crowding issues, including the Core Capacity Transit Study, which identifies specific projects and strategies to alleviate overcrowding in the San Francisco core.[43] Additionally, the current long range transportation and land use plan, Plan Bay Area 2040, directs $21 billion to transit expansion projects throughout the region.[44] Both these and other efforts will be critical in making this an effective strategy.

The other strategies identified in this paper also can provide support. MaaS can help alleviate transit crowding by incorporating incentives for off-peak travel, potentially building on and expanding the BART Perks pilot program[45] to other public and private providers. The pricing and parking strategies discussed later in this chapter could fund the free feeder services and additional high-capacity rail and bus services.

Primary Guiding Principles

Though this strategy aligns with all of the Horizon Guiding Principles, it primarily achieves an Affordable and Diverse Bay Area. Free feeder transit services could provide enhanced mobility for residents of all income levels. These feeder services, especially paired with the MaaS strategy, also could remove barriers to economic opportunities by simplifying transit use for people at all income levels.

STRATEGY 3: Ridesharing and Teleworking

Future Benefit

This strategy uses technology, incentives and operational improvements to achieve a reduction in travel demand through more efficient use of the Bay Area's transportation network. Reducing travel demand by 3 to 5 percent can yield a 50 percent drop in congestion-related delays. This is the percent reduction observed on holidays, such as Indigenous Peoples/Columbus Day, when some residents do not travel to work.[46]

Ridesharing consists of two to 15 passengers who share a ride, generally using a participant's own vehicle in the case of carpooling, or a company-provided or leased van in the case of vanpooling. Passengers may share the operating expenses and the driving responsibility. Currently an estimated 16,000 empty seats cross the Bay Bridge on a daily basis, as most vehicle trips crossing the Bay Bridge are made by solo drivers.[47] Filling these seats could allow more people to travel without having to add road capacity to the transportation network. As automobiles transition to connected and autonomous vehicles, pricing and incentives to increase pooling will be critical to preventing a significant increase in congestion.

Teleworking, also known as telecommuting, replaces travel to and from the worksite with telecommunications technologies. A tax credit could be offered to employers implementing telework policies and could reimburse employers for telework-related expenses such as computers, hardware, software, phone systems, remote connections to company servers and broad-band internet services. In addition to saving time and money for employees, teleworking can be an effective strategy for reducing drive-alone commute trips.[48]

Examples From Today

Ridesharing

A number of ridesharing programs are currently active throughout the United States. To encourage carpooling, public agencies and employers provide programs for commuters to find others traveling the same route between their homes and workplaces. Some agencies offer additional incentives, including $2 to $3 credits for the cost of the ride to drivers and riders. In addition, informal carpooling, referred to as casual carpooling or slug lines, emerged in the 1970s in San Francisco and Washington, D.C., and has steadily grown. The examples below focus on programs provided by Bay Area agencies.

- **MTC** has provided carpooling matching for Bay Area residents since the early 2000s. The program started as an online ridematching service and has evolved as new technologies emerge. In 2014, MTC grew the program by establishing zero-cost partnerships with private-sector carpool matching apps.

Photo - 511 Rideshare

- **San Mateo County** invested $1 million in carpool incentives for weekday a.m. and p.m. peak trips that began or ended in San Mateo County. As part of the pilot program, San Mateo County offered riders $2 off trips with Scoop, a carpooling app, and provided drivers a $2 bonus for driving with Scoop.[49]

- **The Contra Costa Transportation Authority** implemented a similar program to San Mateo County's but with a total budget of $100,000.[50]

A number of agencies as well as employers provide a fleet or incentives for vanpooling. Vanpooling is currently a qualified transportation fringe benefit under Section 132(f) of the Internal Revenue Code. Section 132(f) provides a way for employees to pay for their commutes by public transit, vanpool or bicycle on a tax-free or subsidy basis. Parking at a fee-based park and ride lot or at the workplace is also an allowable pre-tax deduction. Carpooling, however, is not considered a qualified fringe benefit, as vehicle occupancy could not be verified when the code was written, though recent advances in technology have made verification feasible. MTC's 511 Rideshare program provides incentives for vanpooling, including no long-term financing for leased vans, free bridge tolls for registered vanpools with 11-15 seats, dedicated support services from 511 and up to $500 in gas cards for starting a new vanpool.[51]

Teleworking

- **Virginia's Telework Tax Credit** provides individual employers up to $50,000 in tax credits each year for telework-related expenses. The tax credit applies to employers who incur eligible telework expenses, such as expenses for computer hardware and software, data processing equipment, telecommunications equipment, and high-speed Internet connectivity equipment, up to $1,200 for each new participating employee in telework. In addition, the credit can be used for up to $20,000 to conduct a telework assessment in order to assess equipment and training needs, barriers/issues, and develop telework policies and procedures, etc. The credit is subject to specific requirements, such as

Photo - John Huseby

requiring the employer to have a signed telework agreement with each new teleworking employee and to file an application to reserve a portion of the credit, which is limited statewide to $1 million per year.[52]

Potential Impact

Ridesharing

MTC offered a "First Trip Credit" in the first half of 2018 to carpool riders and drivers who downloaded the Scoop carpool app and took a first trip. Over 9,000 riders and drivers used the credit and took 267,000 one-way person trips as members of a carpool during the six-month time period. These trips include the first subsidized trip and subsequent trips made during the survey period. About 75 percent of the participants were riders, thereby reducing vehicle trips, and of those, 60 percent would have otherwise driven alone or been driven by a ridehail service if they had not used the carpool service. The estimated cost per vehicle trip reduced was $1.85.

In San Mateo County the $1 million allocation resulted in about 175,400 vehicle trips reduced. The average daily expenditure for incentives was $3,000 for an average daily vehicle trip reduction of about 800 cars.[53]

To add more impact, carpooling tax incentives could be administered at the state and federal level. With the occupancy technology integrated into most carpooling apps, the number of people in a vehicle can be verified, and therefore carpooling tax benefits could be added under Section 132(f). The State of Washington offers a Commute Trip Reduction Tax Credit for all employers and property managers who provide financial incentives to their employees for ridesharing, carsharing, using public transportation and non-motorized commuting. This tax credit is valued at up to $60 per employee per a fiscal year, up to $100,000 per employer/property manager annually.[54]

Lastly, increasing efficiency and flow in carpool/high-occupancy vehicle lanes could be accomplished through operational improvements, enforcement and occupancy policy changes. Operational improvements on highways and arterials, including transit signal priority, bus queue jump lanes or bus-on-shoulder lanes can give time savings advantages to high-occupancy vehicles and can be highly impactful in reducing travel demand.

Teleworking

Teleworking can reduce congestion during peak periods by eliminating trips entirely. According to the Society for Human Resource Management, results from a 2014 survey reveal that 48 percent of employers offer one or more flexible work arrangements to employees, including telework, flex time and compressed work weeks.[55] The Virginia Telework program conducted an evaluation of its program through surveys of participating employers and found that 5 percent of participating employees had never teleworked previously. Of the 15 participating employers who responded to the survey, they estimated a daily VMT reduction of approximately 9,000 miles.

The State of California could offer state tax credits to businesses that implement telework policies and incur operational expenses. Employers could be required to submit documentation for the number of days each employee worked from home per year, as well as their approximate commute distance, for purposes of estimating emissions and congestion savings. This program could also be administered as an incentive program, with a fund source that is administered by a local or regional agency.

The other strategies identified in this paper also can provide support to this strategy. Carpool matching could be leveraged as a choice within a suite of MaaS options. The pricing strategies presented in the next section could include discounts to encourage residents to pool with others.

Primary Guiding Principle

This strategy primarily aligns with the Connected Guiding Principle. With a reduction in the number of commuters on Bay Area roads, congestion delay can be decreased and system reliability improved for residents and freight carriers.

STRATEGY 4: Tolling All Highways and Bridges

Future Benefit

Tolling highways and bridges in the Bay Area supports a future where roadways are consumed on a per-trip basis, at costs that change to reflect demand. Tolling can reduce peak traffic congestion, make limited road capacity more efficient and improve travel time reliability. Tolling also could encourage more shared use of autonomous vehicles, thereby limiting VMT growth that might result from AVs and ridehail services. Universal highway tolling could layer additional advantages for express buses and very high-occupancy vehicles if operating rules varied by lane.

Tolls that change to reflect demand can help disperse peak or "rush" hour traffic to make better use of highway capacity. Corridors to be considered for dynamic pricing could be those that experience the most congestion, including those with existing or planned express lanes. Candidates include all lanes on any freeway corridor where average speeds are less than 35 mph in peak periods (consistent with MTC's definition of "congested delay"). Pricing could be on a per-mile basis, with price levels variable based on prevailing speeds in real time.[56] Pricing could also be reduced for residents choosing to pool with others in either their own vehicle or a ridehail service (both of which could be autonomous by 2050), supporting the carpooling portion of the previous strategy. The revenue from tolling could be used to improve transit, maintain roads and support other shared travel options.

Examples From Today

Some European countries have universal tolls on all highways:

- **Austria.** Vehicles weighing less than 3.5 tons are required to purchase a sticker for specific time periods (10 days, €9; 2 months, €26; 1 year, €87) to access highways. Vehicles weighing over 3.5 tons are subject to mileage-based fees. In addition to the highway tolls, tolls are collected for facilities, such as bridges and tunnels on highways.[57]
- **France**. All highways are tolled, based on segments.[58]
- **Switzerland.** Annual sticker required for use of highways for all vehicles (€40 annually).[59]

While universal highway tolling does not exist in any U.S. metropolitan area, a number of tolled roadway facilities currently operate. Eight Bay Area bridges have tolls, most with toll rates of $5 for a single occupancy vehicle and $2.50 for a carpool (the Golden Gate Bridge has higher tolls). Tolls for tunnels between New York and New Jersey are significantly higher: $12 and $10.50 for peak and off-peak hours, respectively, with carpool vehicles charged $6.50 during peak periods.

In addition, many state departments of transportation are converting high-occupancy vehicle (carpool) lanes to high-occupancy toll (HOT) lanes or building new HOT lanes. In the Bay Area, MTC and several partner agencies are working to build a 550-mile Bay Area Express Lanes network by 2035.[60] Four express lanes currently operate in the Bay Area: Interstate 580 in eastern Alameda County, Interstate 680 in Contra Costa County, Interstate 680 in Alameda County and state Route 237 in Santa Clara County.

Other California tolled express lanes can be found on Interstate 15 in San Diego County, state Route 91 in Riverside and Orange counties, and U.S. Highway 101 and Interstate 10 in Los Angeles County. Tolls on the I-15 express lanes vary depending on congestion levels; the SR 91 express lanes use a variable pricing system based on the time of day.

Potential Impact

The potential of this strategy to reduce vehicle trips depends on the magnitude of the tolls. As the price of driving increases, VMT will decrease as drivers shift to other modes, shorten trips or forego discretionary trips altogether. A report published by the Federal Highway Administration synthesized several prominent studies on travel demand relative to fuel cost, finding a doubling of the cost of driving would reduce driving by 10 to 63 percent.[61]

Tolled highways could divert traffic to local roads. Such diversion can increase wear and tear on local roads, reduce safety, increase air and noise pollution, and generally reduce the quality of life in impacted neighborhoods. In areas where traffic diversion is a threat, other policies would need to be considered, including restricting freight access, applying tolls to parallel local roads, establishing one-way streets during peak periods or installing traffic calming infrastructure to reduce an influx of vehicles seeking alternative or free routes.

Tolling often is criticized as unfairly impacting drivers with low incomes. However, tolling and user fees have been found to be more equitable for lower income residents than sales taxes when funding transportation.[62] Regardless, the tolling scheme could be structured to provide discounts for low-income households, similar to discounted programs offered by utility companies for low-income households, or be incorporated into the Regional Means-Based Fare program.

Packaging road pricing with capacity increases in transit as well as active and shared services is critical to the success of this strategy. Bay Area residents will need feasible transportation options to choose from when weighing the costs of paying for their use of public roads.

Primary Guiding Principle

This strategy primarily aligns with the Connected Guiding Principle. As per-use fees respond to highway demand, system reliability is improved for Bay Area residents and freight carriers.

STRATEGY 5: Cordon Pricing

Future Benefit

Cordon pricing refers to the practice of charging a fee for vehicles entering a specified geographic area, usually a downtown or central city. Like tolling, cordon pricing is a mechanism to make the per-use cost of roadway consumption visible to the user. Cordon pricing can be static or vary by time of day, vehicle type or current traffic conditions. In the Bay Area, cordon price zones could be implemented around downtown Oakland, San Francisco, San Jose and other areas that will grow by 2050 to be job-rich and cultural destinations. Providing more access to travel options, as explained in Strategies 1 and 2, is integral to implementing cordon pricing in order for Bay Area residents to have transportation choices to weigh against the costs of paying for public road usage.

Examples From Today

Several large cities impose cordon pricing in their downtowns, including London, Milan, Singapore and Stockholm. In London, vehicles are charged once per day if they enter the downtown area no matter how often they travel in and out. Stockholm and Singapore charge each time the vehicle passes the cordon.

Stockholm and Singapore have dynamic cordon pricing. In Stockholm, pricing is higher at peak travel periods. In Singapore, the system is being revised to integrate parking, VMT and information on pricing structures. Each vehicle will have an in-unit device that will track the vehicle as it passes payment points as well as miles traveled. The device will show real-time traffic and expected payments to help drivers plan their trips. New York City has proposed collecting fees for vehicles entering the southern part of Manhattan.[63] The San Francisco County Transportation Authority studied possible cordon areas in the downtown and financial districts of San Francisco.[64]

Potential Impact

Cordon pricing has been shown to reduce vehicle trips in cordoned areas if priced appropriately. London initially saw a decrease in traffic in its cordoned central business district. In recent years, however, an increase in delivery and car service vehicles has contributed to a rise in traffic congestion in the area.[65] Because vehicles in London are only charged once per day, delivery and ridehail vehicles may be less sensitive to the fee, showing the need to pair this strategy with incentives to encourage travel in multi-passenger services or consider a congestion pricing scheme to reflect new mobility service models such as charging on a per crossing or per occupancy basis.

Photo - Mario Roberto Duran Ortiz

Photo - Noah Berger

Between its implementation in 2006 and 2012, traffic in Stockholm's cordoned central city decreased by about 29 percent. Studies have shown that vehicle traffic in Stockholm was not transferred to other areas of the city after cordon pricing was established.[66] [67]

Cordon pricing often is criticized as unfairly impacting drivers with low incomes. However, tolling and user fees have been found to be more equitable for lower income residents than sales taxes when funding transportation.[68] Regardless, the pricing scheme could be structured to provide discounts for low-income households, similar to discounted programs offered by utility companies for low-income households, or be incorporated into the Regional Means-Based Fare program.

Packaging road pricing with capacity increases in transit as well as active and shared services is critical to the success of this strategy. Bay Area residents will need feasible transportation options to choose from when weighing the costs of paying for their use of public roads.

Primary Guiding Principle

This strategy primarily aligns with the Connected Guiding Principle. As per-use fees respond to highway demand, system reliability is improved for Bay Area residents and freight carriers.

Figure 5 demonstrates how highway tolling and congestion pricing could be implemented in the Bay Area. The green lines show a possible network of dynamically priced corridors, and the blue dots highlight the downtowns of the region's major cities that may benefit from cordon pricing.

Figure 5. Highway Tolling and Congestion Pricing Opportunities[69]

SOURCE: Metropolitan Transportation Commission. Autonomous Vehicles Perspective Paper

Managing Travel Demand Through Changes in Land Use Policies

The remaining three of the eight strategies focus on changing land use policies to support service-based transportation:

- Parking Tax
- Vehicle Trip Reduction Requirements on Development
- Parcel Lockers and Freight Consolidation Centers

STRATEGY 6: Parking Tax

Future Benefit

Levying a tax on spaces in parking lots or garages can, in the short run, reduce the number of vehicle trips and raise revenue to provide transit and active transportation improvements. In the long run, it can decrease the amount of parking provided and free up land for other uses, including housing.

As autonomous vehicles (AVs) permeate the vehicle fleet, the need for proximate parking will decrease. AVs will be able to drop off passengers at their destinations and either drive to the next passenger, find parking in a more consolidated location or return to a home base. When all vehicles are fully autonomous, parking demand could drop by as much as 90 percent.[70] A Parking Tax therefore can be a medium-term strategy to reduce parking demand.

Examples From Today

A number of municipalities, including cities in California, have implemented parking taxes:

- **San Francisco** applies a 25 percent tax on all spaces in parking lots or garages. The tax generates $84 million in revenue per year; with the passage of Proposition A in 2006, 80 percent of the parking tax revenue is dedicated to transportation, via the San Francisco Municipal Transportation Agency.[71]
- **Oakland** collects an 18.5 percent parking tax, generating on average about $9 million in revenue a year.[72]
- **Los Angeles** implemented a 10 percent parking occupancy tax on off-street, non-residential parking in 1990. In 2016, the City collected about $107 million in revenue from the tax.[73] [74]
- **Chicago, Illinois,** initially imposed a flat tax based on fee ranges (e.g., $1.00 tax for hourly parking fees of $2-5, $1.75 tax for hourly parking fees of $5-12, and $5.00 for fees over $12). In July 2013, Chicago implemented an 18 percent tax on weekends and 20 percent on weekdays for daily parking, and a 20 percent tax for weekly and monthly parking.[75] In 2016, the City collected $136 million in revenue from the tax.[76]

Photo - MTC Archive

- **Pittsburgh, Pennsylvania,** has the highest parking tax in the country at 37.5 percent (since 2009). From 2004 through 2006, the tax was as high as 50 percent.[77] In 2016, the city collected over $55 million in parking tax revenue.[78] Recently, the Pittsburgh Urban Redevelopment Authority has started redirecting tax revenues associated with new parking developments to affordable housing projects.[79]

Potential Impact

Shifting from free to priced parking typically reduces drive-alone travel by 10 to 30 percent.[80] Applying a 25 percent parking tax, similar to San Francisco's rate, could result in a 7.5 percent reduction in parking demand. The effects of an increase in parking prices will vary by location. Introducing priced parking in locations where parking was previously free will have a greater effect on parking demand than a similar price increase in locations where parking was already priced. The impacts and feasibility of a parking fee will vary widely depending on the supply, market rates, land values, access to other travel options, and other factors in and around each location. In brief, the type and magnitude of the tax levied would need to reflect the circumstances of each city.

At many locations in the Bay Area where parking is priced, on-street parking tends to be underpriced relative to off-street parking.[81] This creates the problem of drivers circling excessively to find on-street parking, contributing to local congestion and leaving off-street parking facilities underutilized. Therefore, this strategy would need to consider increasing on-street parking prices so they are commensurate with, or higher than, off-street rates. In addition, some jurisdictions own and operate their own parking facilities, often with low or no parking charges. These jurisdictions should match market rates to help the area manage vehicle travel. Locally levied fees will also raise revenue for local government.

In locations where off-street parking is free, imposing a new fee would present major challenges. Large parking lots at suburban shopping centers and office parks would need to install access controls or provide payment options coupled with frequent enforcement. This would be impractical and prohibitively expensive in low-density portions of the Bay Area, and would likely create spillover problems as well. For these areas, a parking tax could be assessed on the developer or land owner, which would serve the purpose of discouraging the building of excessive parking supply.

Generally, assessing a tax on developers or land owners could incentivize them to build less parking as part of new construction, as long as local policies do not set minimum parking requirements (laws requiring new buildings to include a fixed number of parking spaces based on an assumed demand for parking generated by the buildings' use[82]) that negate the impacts of the tax on reducing drive-alone travel. The provision of parking adds significantly to development costs, with construction of typical surface parking costing around $20,000 per space; garages and structures about $50,000; and underground spaces about $80,000.[83] [84] For example, local parking requirements add 32 to 45 percent to the construction cost of office buildings and 67 percent to 93 percent to the cost of shopping centers.[85] These examples illustrate the magnitude of the cost to provide parking, and the strong incentive for developers to reduce the parking provision.

For drivers, impacts of a new parking costs will depend on where and how they are applied. In locations with high existing parking prices (downtowns), the drivers who already pay for parking tend to have higher incomes, so the new tax would fall on those who can most afford it. Parking taxes imposed in locations where parking was previously free might impact some low-income drivers, including low-wage service workers at some retail and office locations. To mitigate these impacts, discounts could be provided for qualified drivers below a certain income threshold.

Packaging parking taxes with capacity increases in transit as well as active and shared services is critical to the success of this strategy. Convenient transportation options will need to be provided for Bay Area residents to weigh the costs of paying for parking and if developers reduce the number of parking spaces provided.

Primary Guiding Principle

This strategy primarily aligns with the Healthy Guiding Principle, reducing the environmental footprint of single-occupant vehicle trips and the amount of land paved for parking cars. The strategy also supports the Affordable Guiding Principle as it lowers development costs, which can lead to more affordable housing being built.

STRATEGY 7: Vehicle Trip Reduction Requirements on Development

Future Benefit

This strategy would require developers to implement strategies to reduce single-occupancy vehicle trips generated by commercial and residential developments. Trip reduction targets would be set by limiting the number of vehicle trips into and out of the site or by requiring a certain mode share split. To be effective, the requirement would transfer to subsequent property owners and be well-enforced. In today's development environment, most developers are required to provide parking, which supports and subsidizes vehicle ownership. This strategy requires developers to shift their focus from an emphasis on vehicles to how residents and employees will access their sites.

One of the results of this strategy is that developers may provide transit services or subsidies, create walkable environments and build other amenities to make it easier for residents or workers to be less dependent on personal vehicles. This strategy builds on the Trip Cap strategy in Plan Bay Area 2040[86] that focuses on reducing vehicle trips to and from workplaces, mainly within campus settings. Vehicle Trip Reduction Requirements on Development applies to all types of trips and to all developments, both commercial and residential, in any location.

Examples From Today

Several cities and counties have implemented vehicle trip reduction requirements for new developments:

- **San Francisco's** SHIFT program applies to all developments and changes of use. Developers identify trip reduction targets and choose from a menu of transportation strategies to meet the target. Strategies range from shuttle services to bicycle and carshare parking spaces. The program was adopted by the San Francisco Planning Commission in February 2017, and impacts have not yet been estimated.[87] [88]

Photo - Karl Nielsen

- **City of Buffalo, New York,** passed an ordinance in 2016 requiring developments over 5,000 square feet and renovations over 50,000 square feet to submit a vehicle trip reduction plan as part of development approval. Plans are required to include (1) an estimate of travel demand by mode (vehicular, transit, pedestrian and bicycle) for the proposed development; and (2) strategies to be implemented that will reduce vehicle trips and parking demand. The first status reports will be submitted later in 2018; as such, impacts have not yet been estimated.[89]
- **Fairfax County, Virginia,** requires developers to encourage the use of transit, ridesharing, biking, walking and other sustainable options in order for their development plans to be approved. Various factors, such as accessibility to transit and type of development, help to define the level of participation needed. The vehicle trip reduction plans are tied to the land, so that if/when the developer sells the development to a property owner upon completion of construction, the requirements are transferred to the new property owner.[90] Published results are not available.
- **Arlington County, Virginia.** Arlington Transportation Partners (ATP) and Arlington County Commuter Services manage a program that coordinates the design and implementation of vehicle trip reduction projects in large building projects. Applicable developments are required to create a plan, which includes a detailed site plan, transportation plan, parking plan and vehicle trip reduction strategies.[91] Published results are not available.

Potential Impact

Since the cities listed in the previous section passed vehicle trip reduction requirements recently, findings on VMT impact are not yet available. The level of VMT reduction resulting from this strategy will depend on several factors, including:

- **Amount of development:** Because the strategy would apply only to development or redevelopment, its impacts will be greatest in areas experiencing the most growth.
- **Development size threshold for application:** Similar to the San Francisco and Buffalo programs, the requirement would apply only to new developments and major renovations over specified size thresholds. The lower the thresholds, the more developments that would be affected and the greater the VMT reduction.
- **Stringency of plan requirements:** Some developer-oriented vehicle trip reduction strategies are much more effective at reducing VMT than others. If given a menu of vehicle trip reduction strategy options for compliance, developers will typically select the lowest cost options. Thus, VMT reduction will depend greatly on the types of strategies that are required.

- **Level of enforcement and compliance reporting:** Developers may ignore vehicle trip reduction plan requirements if they are not enforced or may offer programs initially but then fail to maintain the services or infrastructure. Maximum VMT reduction will only be achieved if consistent enforcement of the vehicle trip reduction plan requirements, as well as required regular reporting and periodic verification, are maintained.

Trip caps that focus on reducing vehicle trips to and from workplaces may provide an upper bound estimate of the potential for VMT reduction. The Mountain View district-wide trip cap for North Bayshore demonstrated a 34 percent reduction in employee vehicle trips per day. Examples of how companies in the North Bayshore area have complied with the trip cap include joining and maintaining ongoing membership in the Mountain View Transportation Management Association, providing transit subsidies or passes, hiring an on-site commute coordinator and organizing a fleet of bikes for local access.

This strategy could increase the cost of new development and major renovations, unless local minimum parking policies were revised to require less parking to offset the cost (as could occur under the Parking Tax strategy). In order to minimize the impact on building affordable housing, developments could be granted compliance flexibility or even a waiver. However, lifting the requirement for TDM plans for these types of housing could deprive residents access to new TDM services.

Primary Guiding Principle

This strategy primarily aligns with the Healthy Guiding Principle, reducing the environmental footprint of single-occupancy vehicle trips and the amount of land paved for parking costs.

Photo - Noah Berger

Photo - Wikimedia.org - Philafrenzy

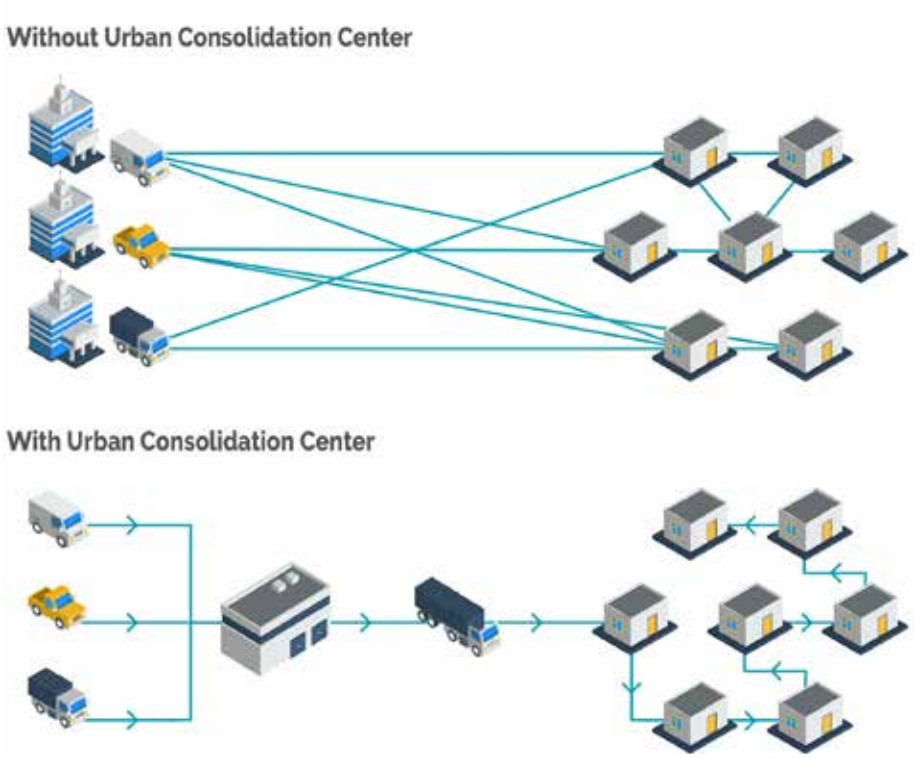
STRATEGY 8: Parcel Lockers and Freight Consolidation Centers

Future Benefit

As e-commerce grows 15 to 20 percent per year, providing freight consolidation centers will help to reduce delivery vehicle VMT by collecting and storing freight at central locations to enable more efficient delivery. Consolidation can occur at different scales, such as urban consolidation centers, microconsolidation centers and parcel lockers. This strategy supports more efficient and convenient delivery models to assist those interested in car-free living.

Urban Consolidation Centers (UCCs) are distribution centers where suppliers can send packages for delivery consolidation. Delivery vehicles sort packages and maximize truck capacity for efficient delivery, as shown in **Figure 6**. UCCs are typically located outside of an urban area, as they require a fairly large building footprint.

Figure 6. Comparison of UCC and Standard Delivery System[92]



SOURCE: McKinsey & Company

Microconsolidation Centers (MCCs) are smaller consolidation centers that allow redistribution of goods from larger vehicles to smaller urban modes, including bikes.[93] MCCs require less space than UCCs and can even operate in shared, temporary and/or unconventional spaces, such as unused parking lots at night, because deliveries can be transferred directly from a heavy-duty freight truck to smaller vehicles.

Parcel lockers are secure lockers where customers can pick up medium-sized packages using an electronic code. Some lockers are climate controlled, allowing customers to pick up groceries. The United States Postal Service (USPS) and private delivery companies, such as Amazon, currently provide parcel lockers as an option for delivery. From a customer's perspective, conveniently located lockers provide a free alternative to home delivery, especially in unsecured buildings. Lockers can be located in public buildings, such as libraries, or in commercial buildings, such as grocery stores. Customers can combine trips to a store or other frequented destination with a package pickup. Parcel lockers are easy to install, inexpensive to operate and have been successfully implemented in cities across the world.[94] Over 2,000 Amazon lockers currently are operating in the United States.[95]

Although the responsibility of implementation of UCCs and parcel lockers falls largely to private entities, the public sector can encourage development in a number of ways:

- **Guidance** with delivery patterns and appropriate areas for UCC, MCC and parcel locker locations. Too few locations will be insufficient to consolidate and distribute deliveries across the Bay Area, and too many locations would result in minimal VMT reductions.
- **Incentives for Developers/Property Owners** to install and operate parcel lockers. Private companies (such as Amazon) often pay property owners fees to include the lockers onsite but additional subsidies may help expedite installation.
- **Requirements for Developers** to provide a goods movement plan or consideration for new developments, including residential.
- **Delivery Movement Restrictions** to certain time periods in specified areas. Package deliveries at UCCs/MCCs could occur at any time, whereas delivery to final destinations could be restricted to off-peak.[96] Peak-period deliveries could also be charged with a congestion fee.

Examples From Today

UCCs, MCCs and parcel lockers have been constructed in cities around the world, with some evidence of success in reducing VMT and congestion. Many of the documented examples and associated research are in Europe or Asia. UCCs, MCCs and parcel lockers typically are privately owned and operated.

- **City of London, United Kingdom, MCC.** Office Depot launched an MCC in 2009 to deliver parcels within the City of London as a pilot project aimed to reduce congestion and emissions. The trial proved successful from the company's perspective in transport, environmental and financial terms, and a permanent program officially launched in 2010. The center transfers parcels from a suburban depot to the MCC onto electric vans and tricycles for final delivery.[97]
- **West Sussex, United Kingdom, Parcel Lockers.** West Sussex tested the operation of Amazon lockers at three library locations in exchange for fees to use the library space. No demands were placed on library staff, and the lockers were well-received by customers.[98]

Potential Impact

Research and modeling suggest that UCCs can have a substantial impact on VMT.[99] [100] A UCC facility generally can allow companies to see a 45 percent reduction in total mileage while still delivering the same amount of goods.[101]

The results from the Office Depot pilot showed that the use of the MCC together with the complete replacement of the diesel van fleet with electric vans and tricycles led to a 20 percent reduction in the total distance driven per parcel delivered between the suburban depot and the customer delivery locations. The total CO2 equivalent emissions per parcel delivered were 54 percent lower in May 2010 than before the trial in October 2009.

Parcel lockers could reduce vehicle emissions by up to 70 percent in the densest, most conveniently located areas.[102] The convenience of parcel lockers remains preferable so long as the distance the customer needs to travel by car to reach the locker does not exceed 0.6 miles in an urban context and 3.7 miles in a suburban one. Parcel lockers not only reduce VMT but also can reduce emissions from delivery vehicles idling while the driver carries a package to the final destination.

Parcel lockers also reduce the percentage of unsuccessful deliveries that result from the receiver not being home to collect the package, which require additional miles for second and third attempt deliveries.[103] A parcel locker delivery company operating in Poland found roughly 95 percent reduction in delivery emissions per parcel by using the lockers.[104]

For additional VMT and emission reductions, low-emission delivery services can be employed to transfer packages from parcel lockers to customers. Cargo e-bikes can often bypass traffic and reach destinations more quickly than standard delivery trucks.[105] E-bike delivery already has replaced up to 60 percent of inner-city vehicle routes in some European countries.[106] Transitioning freight to electric last-mile delivery vehicles as opposed to large or even mid-sized trucks could reduce VMT and emissions significantly.[107]

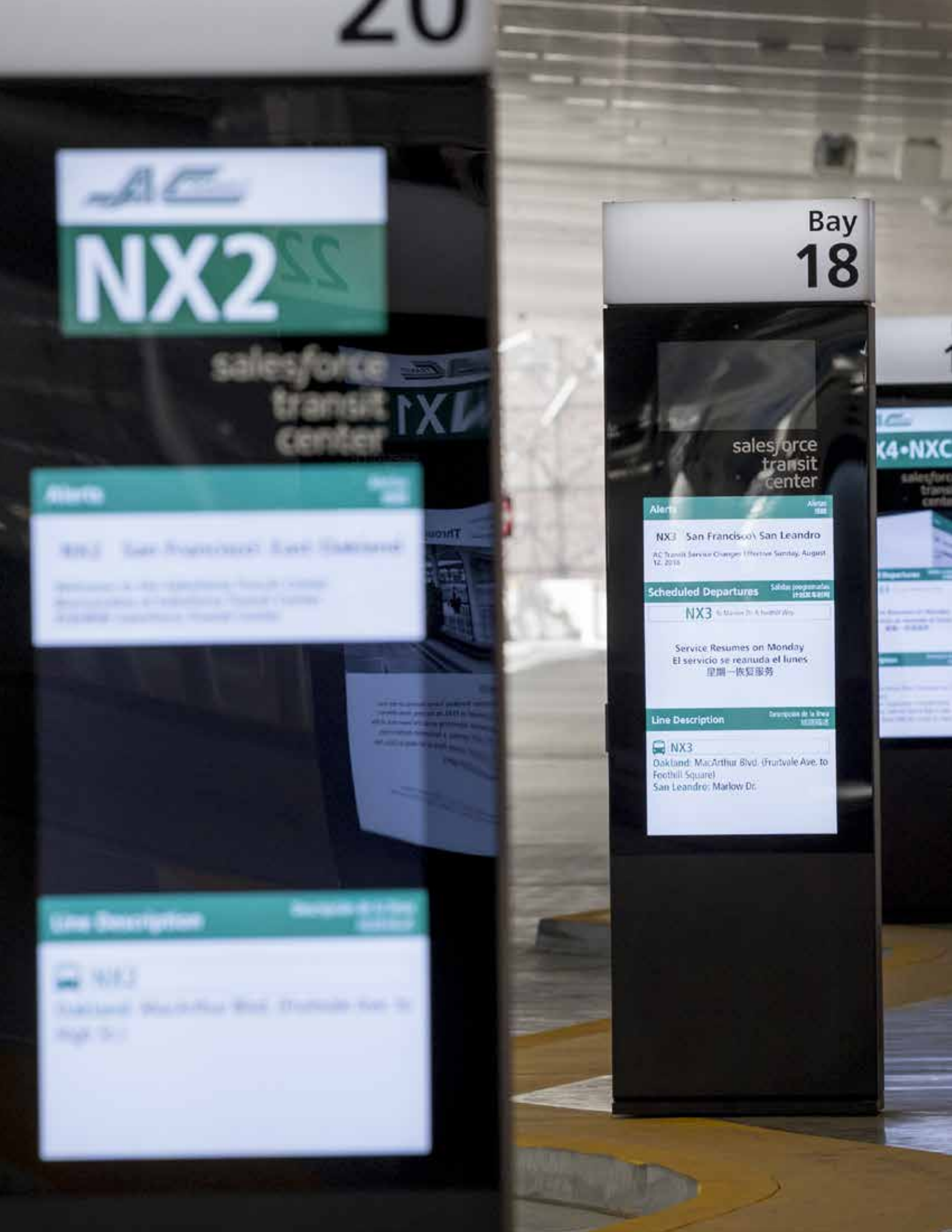
Figure 7. Example of a Delivery Cargo Bike [108]

Photo - UPS

Primary Guiding Principle

This strategy primarily aligns with the Vibrant Guiding Principle, supporting the efficient movement of goods and services.

Photo - UPS


NX2
salesforce transit center
Bay 18
salesforce transit center
Alerts
NX3 San Francisco\ San Leandro
AC Transit Service Changes Effective Sunday, August 12, 2018
Scheduled Departures
NX3
Service Resumes on Monday
El servicio se reanuda el lunes
星期一恢复服务
Line Description
NX3
Oakland: MacArthur Blvd. (Fruitvale Ave. to Foothill Square)
San Leandro: Marlow Dr.

CHAPTER 5

CONCLUSIONS AND NEXT STEPS

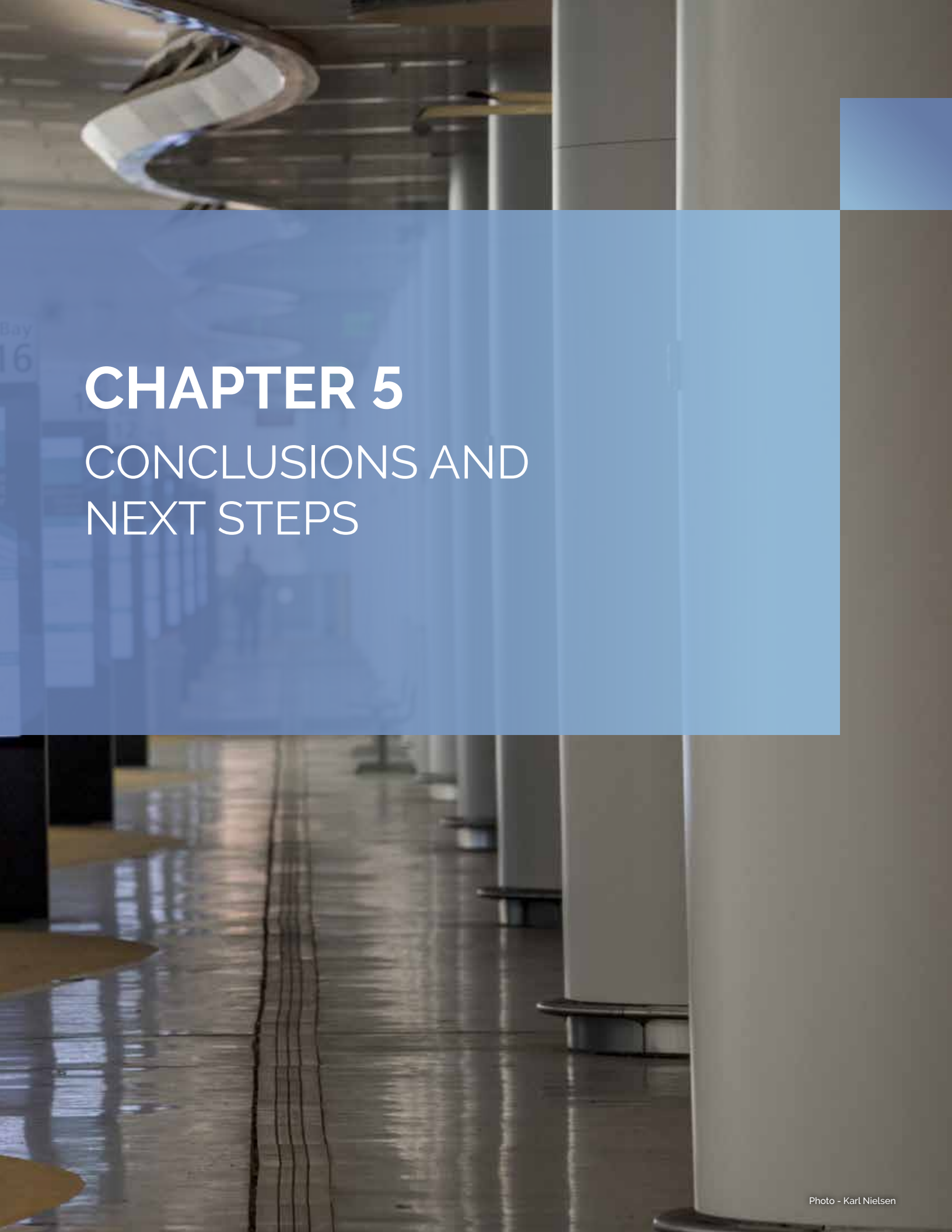


Photo - Karl Nielsen

Photo - Elie Khoury, Upsplash

CONCLUSIONS AND NEXT STEPS

The Bay Area faces stark choices in the coming decade. With rising congestion, limited roadway capacity and growing conflicts over smartphone-enabled "new mobility" options, strategic policy decisions will need to be made to ensure that today's challenges—ranging from affordability gaps to rising housing and transportation costs to land uses inhospitable to pedestrians—are ameliorated in the years ahead. The strategies in this paper offer potential solutions to mitigate these challenges and move the region toward achieving the Guiding Principles defined by Bay Area residents as part of MTC and ABAG's Horizon initiative: Affordable, Connected, Diverse, Healthy and Vibrant.

The Perspective Papers are the beginning of a conversation about strategies to solve regional challenges. Following the release of this and other Perspective Papers, MTC and ABAG staff will engage stakeholders in identifying which of the strategies from the Perspective Papers can overcome the various challenges facing the region across a series of divergent futures, or "what if" planning scenarios that have varying assumptions on the economy, technology and the environment. Following the Futures analysis and stakeholder engagement, a short list of strategies that are most effective in overcoming regional challenges will be recommended.

The short list will undergo further analysis to weigh the benefits of strategies with their potential implications. For example, strategies like free feeder services could be beneficial in reducing vehicle travel demand, but this strategy might introduce new challenges, including crowding on the high-capacity rail and bus lines to which they connect. This type of discussion will take place in the Horizon's Futures planning context and will help determine which strategies should be included in Plan Bay Area 2050, the Bay Area's Regional Transportation Plan and Sustainable Communities Strategy.

ENDNOTES

EXECUTIVE SUMMARY

1 VMT is a basic measure of the amount of vehicle travel generated in a specified geographic area. One vehicle traveling one mile constitutes one vehicle mile, regardless of its size or the number of passengers. VMT refers to the number of vehicle miles traveled within the region during a typical weekday. VMT is a common measure of roadway use and economic activity and has a strong correlation with congestion.

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