DESIGNING FOR FUTURE MOBILITY

DEVELOPING A FRAMEWORK FOR THE LIVABLE FUTURE CITY

PERKINS+WILL

January 2018

ACKNOWLEDGMENTS /

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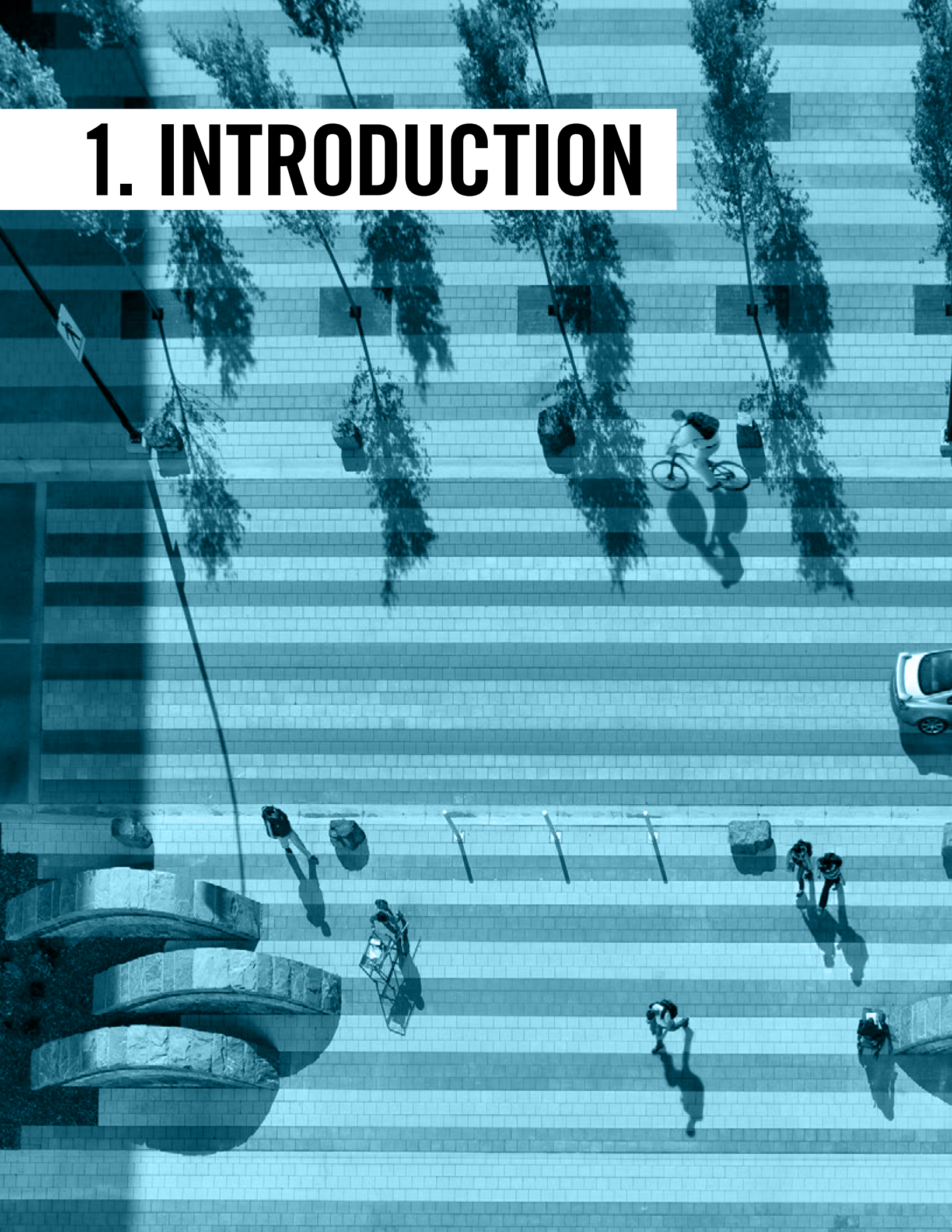
TABLE OF CONTENTS /
Designing For Future Mobility

1. INTRODUCTION




Why not get on board with a secure electricity and gas rate? No seriously, why not?


Why not get on board with a

Overview

This report aims to re-frame the conversation about future mobility to focus on people instead of technology.

We are experiencing today a technologically-driven shift in the transportation industry that is transforming the way we move, and live, in cities. New mobility options and the imminent introduction of self-driving vehicles are profoundly changing the way we plan, design, and build transportation infrastructure. However, the impact of these technologies on livability and urban design have been underrepresented in this conversation, while decision-making has been paralyzed by uncertainty about an unpredictable future.

This report aims to re-frame the conversation by focusing on the type of city we want to inhabit; and asking how future mobility can support this vision. The proposal lays out future mobility principles for planners, designers and policy-makers; describes a series of proactive, present-day design opportunities for the built environment; and presents a future city vision that embodies livable city principles and a people-first approach to mobility.

It is critical that we take the initiative today to understand and shape the future of mobility in a positive and purposeful way. By establishing a set of values to guide design decisions, and acting immediately to shape desirable outcomes, we are optimistic that the city of the future will be a safer, healthier, happier and more sustainable place to live.

This report is organized into three sections:

1. An assessment of autonomous vehicles and other disruptions to urban transportation and their potential impacts;
2. A series of defining principles intended to help shape conversation and action towards positive outcomes; and,
3. A framework of design opportunities for future mobility that can be implemented today in support of livable city principles.

Spring Street & West 3rd Street, Los Angeles (1902)

Disruptions now underway in urban mobility are likely to usher in the most significant changes to cities that we will see in a generation.

Spring Street & West 3rd Street, Los Angeles (2016)

What is at stake?

When automobiles were first introduced to cities in the early twentieth century, urban rights-of-way were dynamic spaces shared between pedestrians, bicycles, horse-drawn carriages and trolleys. Within just two decades, roadways had been completely given over to the new "horseless carriages" and the car had radically changed the way we inhabit and design our cities and regions—including many impacts that have been detrimental to the human, ecological, experiential and equitable health of our communities. Over a long spectrum of time, incremental evolutions and changes to mobility technologies can have profound impacts on the built form and livability of cities.

Today, we are on the threshold of a similarly transformational change in the way we move, and live, in urban areas. Disruptions now underway in urban mobility are likely to usher in the most significant changes to cities that we will see in a generation.

Given that the infrastructure projects we're planning, designing and building today will be around for the next 100+ years, it is critical that we are thinking about the impacts that disruptive technologies such as shared mobility and self-driving vehicles will have—starting now. Public officials, planners, engineers and other city builders are recognizing that it is critical to meet these potential impacts head on. What is less clear is how to respond to such an undefined, indeterminate, and unknown set of circumstances. This document offers an overview of what we see as the most important emerging trends in urban mobility, how those shifts are likely to impact the way we we design cities, and a set of guiding principles and areas of focus to begin shaping the future of mobility today.

The opportunities, and risks, for building livable future cities are transformational. We are at an exceptional moment in the history of mobility and urbanism—and we are excited about engaging with the next generation of design challenges for our cities.

2. BACKGROUND RESEARCH


THE
RAMA
EPIC
UBER

SELF-DRIVING

NETWORKED

SHARED

ELECTRIC

Current trends

We are witnessing an exponential growth in several technologically-driven shifts in the transportation industry today, each with the potential to dramatically upend the way we get around cities. We have broadly categorized these trends into four major disruptions.

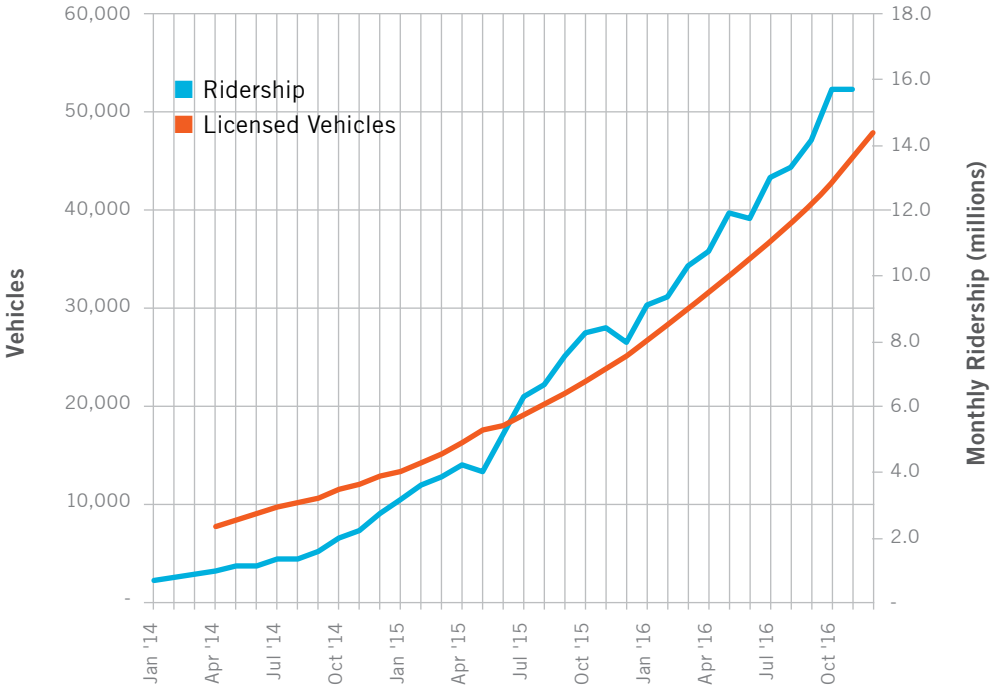
Self-driving vehicles

Self-driving vehicles have been getting a lot of attention, capturing the imagination of planners and the public alike. Technology that allows vehicles to navigate themselves, without a human behind the wheel, has been decades in the making.[1] Over the last five years, autonomous technology has gained significant traction with improvements to sensory and mapping technology, an influx of new industry players, and investments in the billions of dollars across the private and public sectors.

Proponents of fully autonomous vehicles suggest a broad array of benefits to society, including reduced mobility costs, greater convenience, and a dramatic reduction in the number of traffic collisions and related fatalities. There is still much debate about how the widespread use of self-driving vehicles might affect road congestion, travel behavior, and settlement patterns resulting from the ability for users to make more productive use of travel time.

Today, there are vehicles navigating urban roadways that have achieved various levels of conditional automation—allowing for the vehicle to assume full responsibility for navigation under certain circumstances. While current applications are largely limited to test pilot projects, it is expected that the number of self-driving vehicles on city roads will accelerate in the near term. In fact most of the largest automobile manufacturers and tech companies have committed to making fully autonomous vehicles available on the market within the next five years.[2] How soon and to what extent the technology becomes widely available is still very much an open question and will largely depend on the resolution of technological, safety, and regulatory concerns.

FIGURE 1: USE OF RIDE HAILING SERVICES[10]



Networked transportation

Mobile phones, apps, and the vast communication network that supports their use are quickly becoming the most important tools used for moving around cities. In the same way that these devices have transformed the way that many people consume media, goods, and services, mobility is similarly evolving to become an on-demand service. Decisions about how to get from A to B are increasingly being made with the assistance of networked devices that also enable users to make payments, compare options, and plan routes.

An entire industry of transportation network companies ("TNCs", e.g.: Lyft, Uber, etc.) has emerged, providing on-demand rides by connecting drivers and passengers via mobile apps. Such services have been steadily gaining in popularity (refer to Figure 1), particularly in the densest areas of population and employment[3] and largely for trips that are relatively short in length and duration. However, studies in cities where ride hailing has become widespread suggest that their use has resulted in an increase in the number of vehicle trips made and distance traveled, often at the expense of public transportation and other shared or active modes.[4]

The use of networked platforms has also resulted in the creation of immense amounts of data, available in real-time, about how and where trips are made—with great potential for assisting in the planning of transportation services.

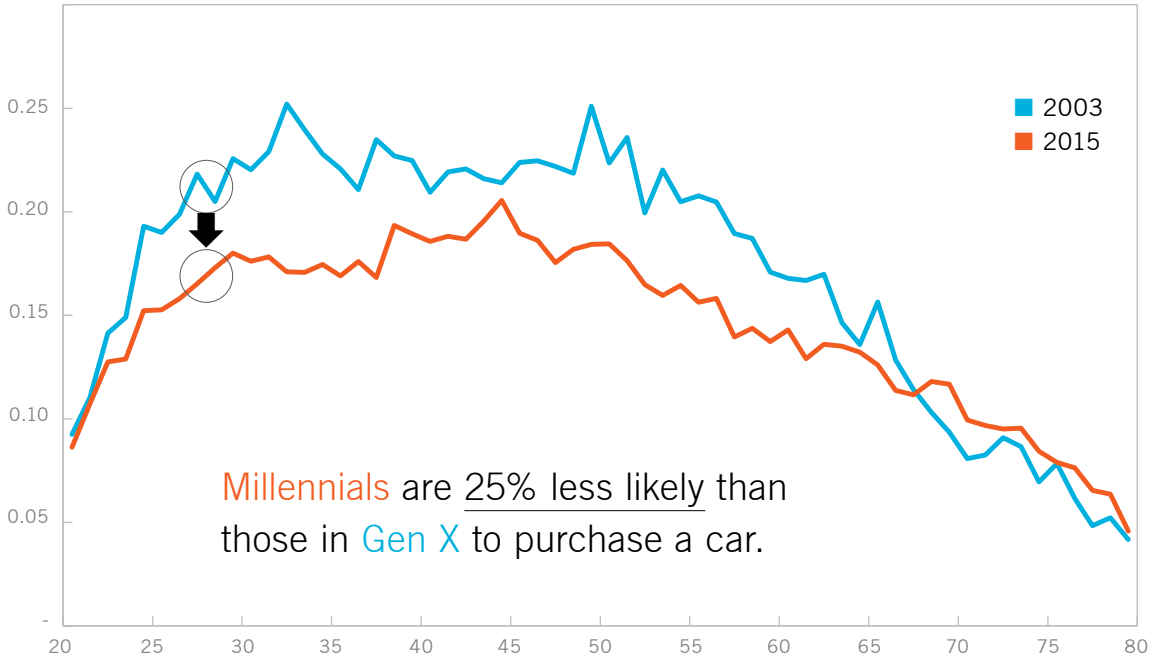
The rapid growth in adoption of mobile technologies and their use for planning day-to-day travel is expected to continue and to accelerate with the growth of mobility as a service (MaaS), which has the potential to link different modes of travel together on the same digital platform to integrate movement and ease of payment across many different mobility providers (both public and private) with a single account as an on-demand or subscription service.

Shared mobility

Largely as a result of the benefits offered by networked access to mobility options, an increase in the use of shared transportation modes is making it more convenient and more affordable for many people to access mobility services on an as-need basis instead of through ownership. This is most clearly observable in the emergence of car sharing, bike sharing, and ride hailing services in many cities and the uptake in these shared modes for trips.[5]

The shift towards shared instead of privately owned transportation modes offers significant opportunities for city planning. While privately owned vehicles sit unused roughly 95% of the time, shared modes result in a much

FIGURE 2: CAR LOAN ORIGINATIONS PER CAPITA, BY AGE[11]



more efficient utilization of a vehicle fleet with a corresponding reduction in the number of cars and storage space needed to deliver the same number of trips within cities.

Vehicle sharing programs have been most successful in densely populated areas serviced by multiple transportation options. For users that do not rely on driving daily, vehicle sharing has proven to be a less costly alternative to car ownership and operation.[6] Since the beginning of the 21st century there has been a general trend across most age demographics towards fewer people obtaining a drivers license, and a lower likelihood to purchase a car than in the past (refer to Figure 2). Studies indicate that people who participate in vehicle sharing programs are likely to sell their vehicle or delay purchasing one, and tend to use public transportation more often while relying less on driving overall.[7]

Electric propulsion

The movement of people and goods today are predominantly powered by petroleum based fuels which account for over a quarter of greenhouse gas emissions in North America. However, steady improvements in the range and performance of electric vehicles have accelerated a global shift towards cleaner forms of mobility.

While electric vehicles represent less than one percent of total vehicles purchased, their total number of sales has gone from less than 100,000 five years ago, to over 2 million globally in 2016, including a 60% year-over-year increase in the last year.[8] If coupled with improvements in the broader energy grid, these shifts could dramatically reduce carbon emissions from the transportation industry and improve air quality in cities.

The shift to electric vehicles will likely be accelerated by recent national commitments to the Paris Agreement on Climate Change and the stated intent by many countries to phase out the internal combustion engine—the Netherlands and Norway by 2025, India by 2030, Britain and France by 2040.[9] China has also announced that plans are underway to implement a ban on gas-powered vehicles. These global trends, along with the pressure on major automobile manufacturers to address this coming demand, are expected to usher in a shift to North American markets as well.

The overlapping of these disruptive transportation trends will likely amplify the impacts on how we get around cities. How these trends will continue to change and ultimately interact with the built environment is a question that many experts are now trying to understand and predict.


SHARED MOBILITY
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Definitions, Industry Developments, and Early Understanding
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The Impact of Autonomous Vehicles on Cities


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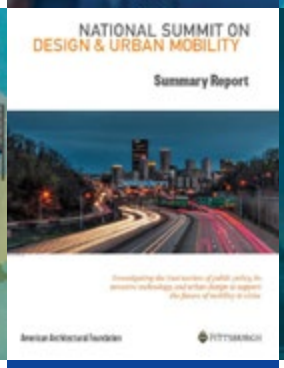
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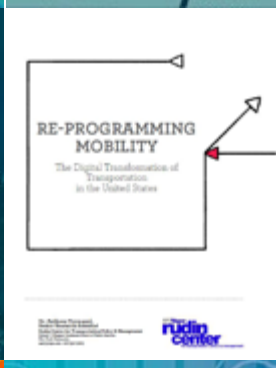
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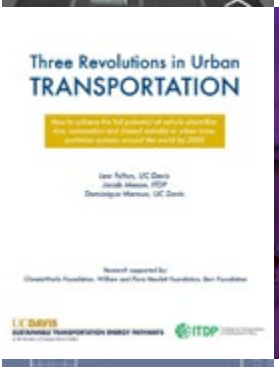
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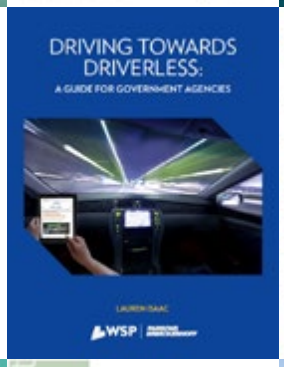
Implications for Transport Planning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DRIVERLESS:
A GUIDE FOR GOVERNMENT AGENCIES
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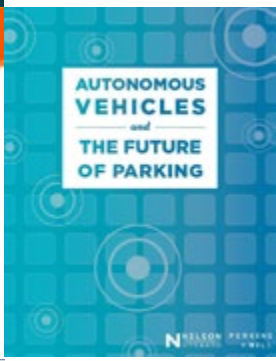
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THE FUTURE
OF PARKING
NELSON PARKING


BLUEPRINT
FOR
AUTONOMOUS
URBANISM
NACTO


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Disruptive Transportation:
The Adoption, Utilization, and Impacts of Ride-Hailing in the United States


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perspective towards 2030
How the convergence of disruptive technology-driven trends could transform the auto industry


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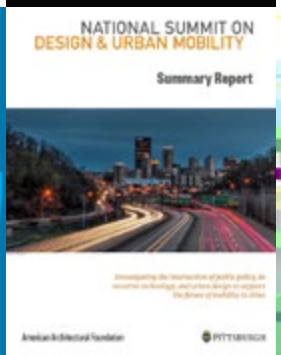
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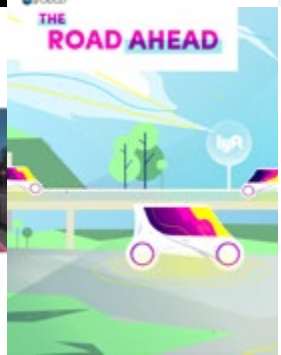
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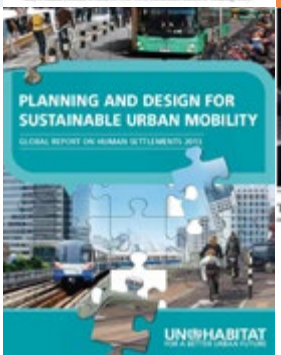
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UN HABITAT


The Future of Autonomous Vehicles Is Shared

Projections

Predictions about the future of mobility highlight the broad range of potential impacts, both positive and negative, on cities.

How will these changes evolve over time? And how will they ultimately impact the way we live and move around cities? There is no shortage of ideas when it comes to projecting how and when these disruptions to urban mobility will reach critical thresholds.

What is clear is that the impacts on infrastructure and travel behavior will be profound. Projections for any of these disruptions tend to fall into either an evolutionary or revolutionary track, depending on the uptake of new technologies and the various political and regulatory obstacles which will impact these trends. The reality is that the adoption of these technologies is likely to continue to be incremental, with an extended and perhaps indefinite overlap between current practices and various transformational outcomes.

While it is impossible to know with any certainty what form these transformations will take in the future, there is some emerging consensus around potential impacts of various scenarios that is useful in developing a strategy for planning.

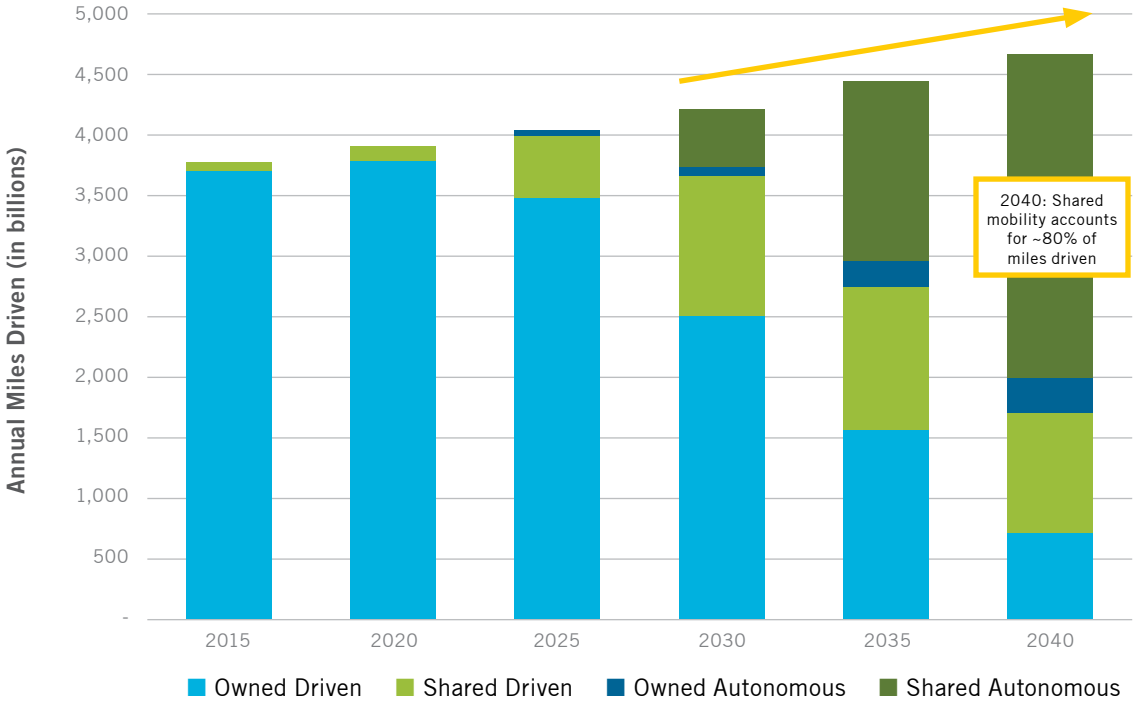
Adoption timeline

Any projections for future trends involving these various transportation disruptions come with an enormous caveat—predicting the future is a notoriously difficult thing to do. The popular Futurama exhibit at the 1939 World's Fair in New York projected a city filled with self-driving cars by 1960. On the other hand, few predicted that most North American adults would carry a hand-held supercomputer everywhere they go by the early 2010's.

When it comes to self-driving vehicles, most experts believe that they will be operating on urban streets by 2025, without any human back-up by 2030, and with the potential for a completely autonomous vehicle fleet some time after 2050 (refer to Figure 3). Of course, the rate of adoption is largely dependent on highly variable factors such as economic, legal and legislative obstacles, as well as general public acceptance. The adoption of these technologies will certainly be uneven across different types of cities and demographics.[12]

Likewise, it is expected that vehicle sharing and ride hailing will continue

FIGURE 3: PROJECTED AUTOMOBILE MILES DRIVEN, BY MODE TYPE[22]



to accelerate as a significant mode for urban mobility. Coupled with the emergence of self-driving technology, shared modes could account for the majority of all trips as soon as 2035.[13] Again, a myriad of external factors are likely to impact the extent to which shared mobility becomes a predominant mode of transport.

Cost of travel

It is largely believed that coupling autonomous operation and vehicle sharing will reduce the cost per mile of travel to below the cost for personally operated vehicles or even public transportation today. More affordable options for mobility could certainly benefit many people. However there are also risks, depending on the types of mobility that are prioritized.

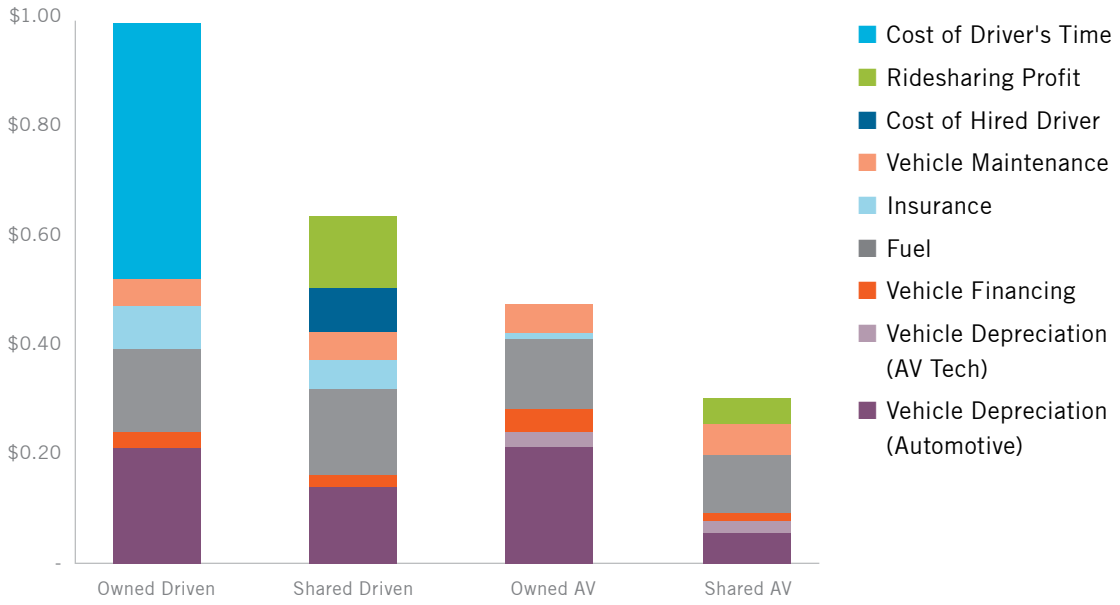
Beyond the financial cost of mobility, another potential impact of autonomous vehicles is a decrease in the perceived "cost" of time for users. Throughout human history, people have generally allocated themselves a relatively consistent budget of time (roughly one hour) to travel each day—known as Marchetti's Constant.[14] This has influenced the physical extent of cities over time as new technologies increase the distance that can be covered in a set period of time. Self-driving capabilities could not only increase travel speeds on freeways due to networking and more efficient use of roadways, but also challenge the assumption that time spent in transit is generally "unproductive" time for the driver. Because time previously spent behind the wheel could instead be used for work, entertainment or even sleep, the disincentive to make long trips on a regular basis would be greatly diminished. This could certainly result in an increase in the sprawl and auto-dependence of urban areas, encouraging people to live further away from the places they work and play.

Vehicle miles traveled

It is well understood that decreasing costs, coupled with increased convenience, tends to induce additional demand for a service—this has been true across many economic studies, as well as in many previous innovations in transportation.[15] With decreases in the cost of mobility (refer to Figure 4), and the replacement of trips formerly made by public transport, the resulting shift of more trips to low-occupancy vehicles would likely result in an increase in congestion compared to the current condition. This could be exacerbated by the fact that many people who are not able to drive themselves today, including children and the elderly, would also have increased access to mobility with the introduction of self-driving vehicles.

Autonomous vehicles are largely expected to result in an increase in the number of vehicle miles

FIGURE 4: PROJECTED COST PER MILE BREAKDOWN, BY FUTURE STATE[23]



traveled (VMT), between 5% and 60% compared with today, more than offsetting any potential roadway efficiencies that autonomous vehicles may offer.[16] It is worth noting that VMT has already been shown to be increasing due to the uptake in ride hailing services in major metropolitan areas.

Parking requirements

A significant shift to shared vehicles could have profound impacts on the amount of space that is required for storing cars. While cars today spend the vast majority of every day sitting in a parking spot, simulations have shown that if shared vehicles were to replace privately owned for all trips, only 10% of the existing vehicle fleet would be required, with a corresponding reduction in the number of parking spaces needed in cities.[17] Given that automobile-related uses make up around a quarter of the total land area in North American cities, reducing the space needed for storing cars would free up vast amounts of land for other uses such as redevelopment and regeneration of green space.

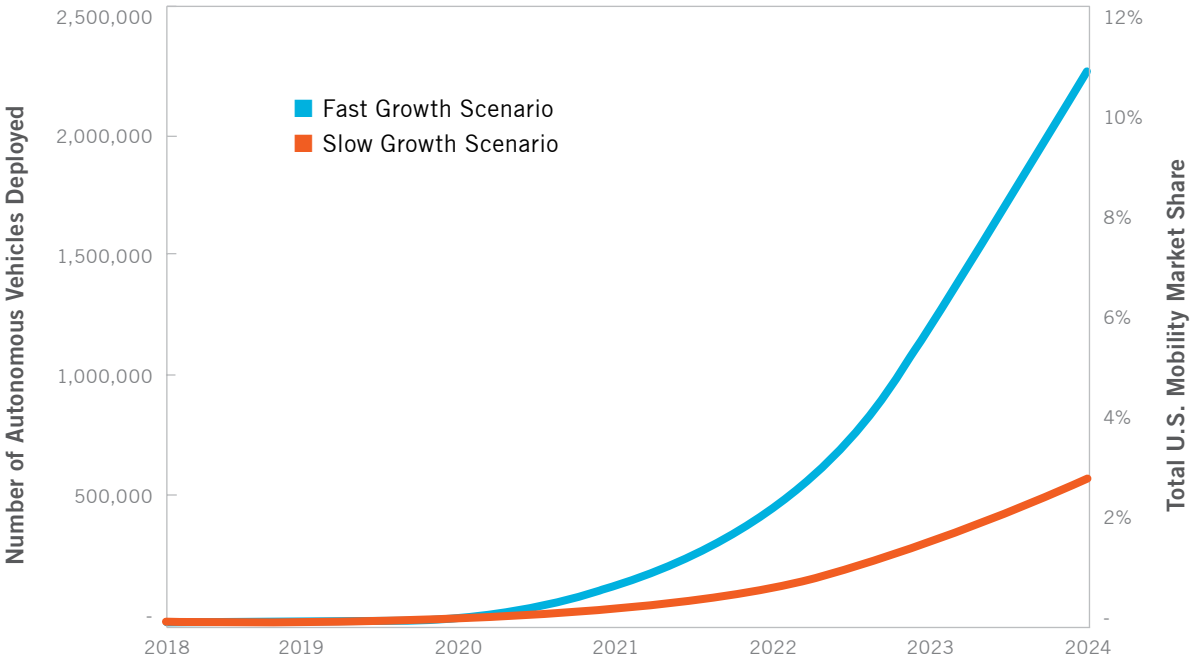
The extent to which shared self-driving vehicles become the dominant form of personal mobility is still very much an open question. While shared modes have continued to trend upward, it is not yet clear to what degree self-driving technology may accelerate or reverse these trends; or to what extent most people would be willing to forego the convenience of private ownership.

Even if a large percentage of automobiles remain privately owned, parking demand is still likely to drop though less dramatically than in a shared scenario. Autonomous navigation and networked parking data would allow vehicles to utilize existing parking much more efficiently while still offering door-to-door service for passengers.

Public safety

One of the primary benefits touted for self-driving vehicles is the expectation that they will result in much safer roadways, with the introduction of automated detection and crash avoidance technologies. The impacts on public safety could be significant. Today 1.2 million people around the world are killed annually as a result of automobile-related deaths.[18] The vast majority of these accidents are caused by human error that could theoretically be eliminated through automation. Studies suggest that between 80% and 90% of collisions and fatalities could be avoided with widespread adoption of autonomous vehicles.[19] The benefits could be seen most clearly among the most vulnerable street users: pedestrians and bicyclists. Making streets safer for walking and biking would result in the additional benefit of greater public health offered by active modes of transportation.

FIGURE 5: ESTIMATED GROWTH RATE OF AUTOMATED MOBILITY IN TOP MARKETS[24]



Greenhouse gas emissions

Studies suggest that the impact of future mobility on climate-altering greenhouse gas emissions could be reduced by half—or result in a 100% increase—depending on the factors that come to dominate urban transportation.[20] Such a broad range of possible outcomes speaks to the uncertainty and wide range of variables that are at play, including impacts on congestion, fuel efficiency, crash avoidance, and right-sizing vehicles.

Of these factors, the most significant impact on carbon emissions is the potential trend towards increased vehicle miles traveled. If coupled with a reliance on low-occupancy vehicles, whether shared or owned, this could dramatically increase the negative environmental impacts of the transportation sector without the implementation of significant changes to fuel sources and efficiency for vehicles. The extent to which electric vehicles and clean energy grids expand, as well as shifting more trips to more efficient multi-occupancy vehicles or active transportation, will be critical in mitigating greenhouse gas emissions and the broader environmental impacts of mobility in the future.

Privatization

One of the significant differences between current and past disruptions in mobility is a shift from public to private participation in the delivery of infrastructure. While public works projects invested in roadway and mass transit infrastructure have shaped much of the transportation landscape we see in cities today, it is information technologies, digital platforms, and start-up platforms that are playing an ever greater role in changing the way we move today.[21]

The integration and coordination of public and private sector roles highlights a unique shift that will be critical to the success of implementation. Planners will need to balance the role of the public in managing social and economic equity, with the cost and service efficiencies that are likely to emerge from the private sector.

Planning for changes to transportation will also be challenged by working across multiple jurisdictions and different levels of public sector governance to achieve coordinated solutions. Access to data across public and private sectors, and the ability to process and synthesize that information, will be critical to informing policy and shaping positive change.

Opportunities + challenges

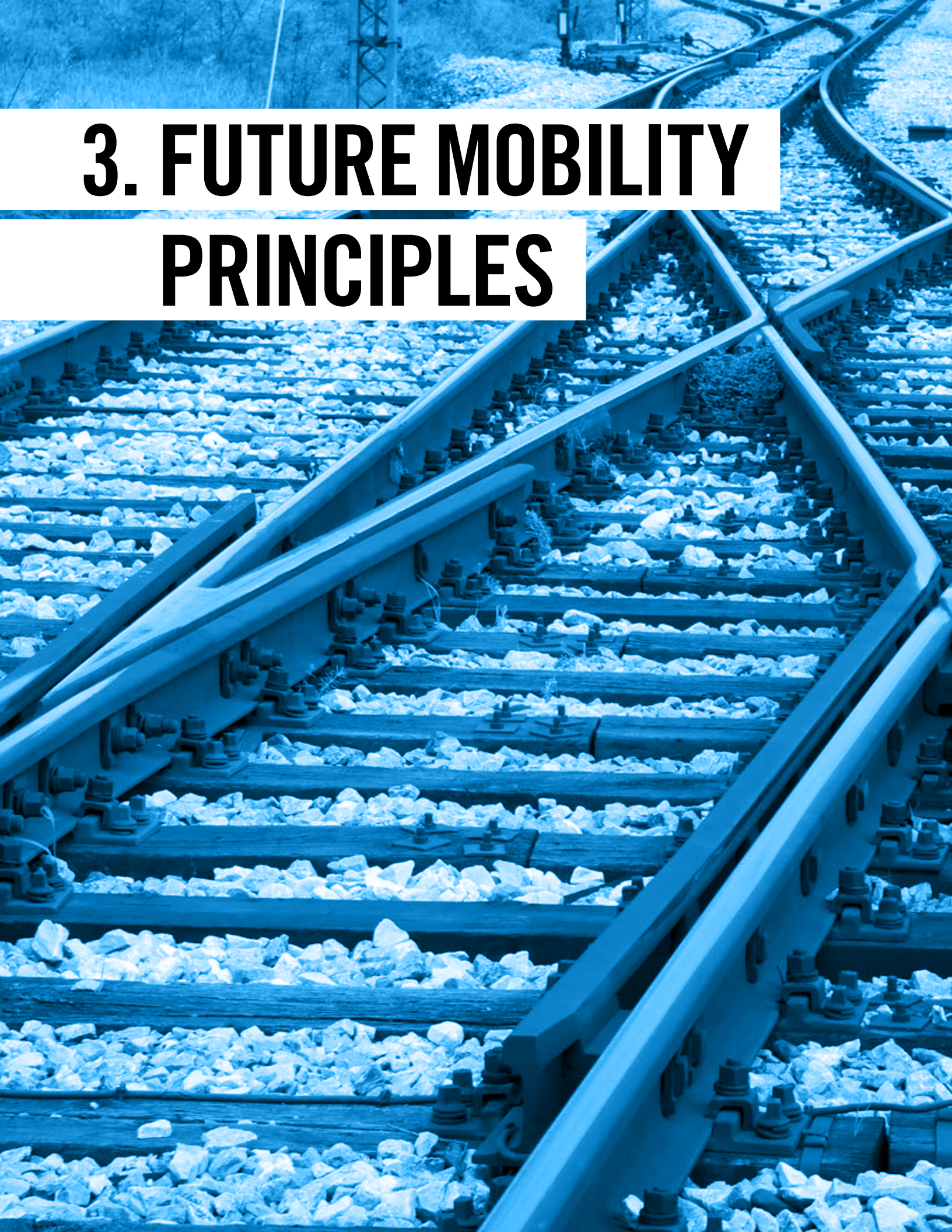
How do we reconcile these dramatically different potential outcomes when thinking about designing the city of tomorrow?

There is no question that the trends we're seeing today in urban mobility will have a significant impact on cities and the quality of life within them. These trends and their impacts will continue to compound and evolve over time, making the potential range of outcomes increasingly broad and difficult to predict.

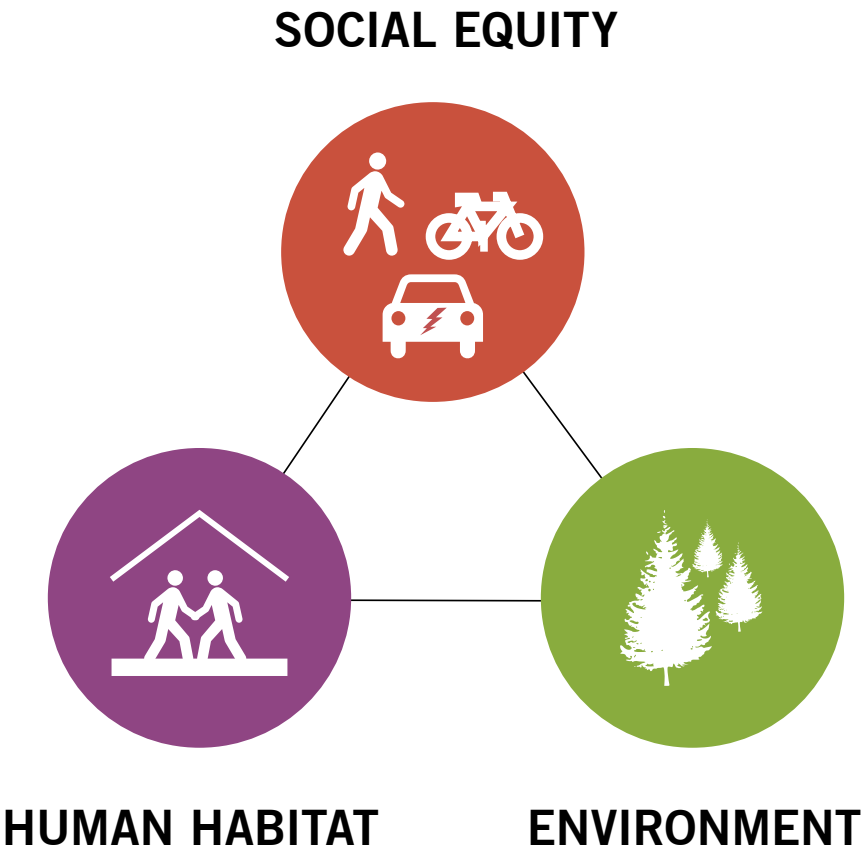
The opportunities to improve the livability of cities are both numerous and profound. From freeing up space currently used for storing and moving cars, to reducing costs and improving service, to making cities safer and cleaner—there exists an immediate possiblity to improve the urban environment and the way we move through it in meaningful ways.

At the same time, there is a flip-side to many of the factors that offer so much promise for cities. Increases in traffic, incentivization for people to live further apart, limitations on access to mobility, and negative environmental impacts are some of the potential impacts that could be realized depending on how new technologies are adopted and what is prioritized.

How do we reconcile these dramatically different potential outcomes when thinking about designing and planning the city of tomorrow? Future mobility will be highly disruptive to cities—for better or for worse. How we collectively design for that change will have a profound effect on capitalizing on opportunities and mitigating challenges. It will be critical for those of us interested in the future of cities to be clear about the type of city we want to see and the values that will enable us to get there.



3. FUTURE MOBILITY PRINCIPLES


SOCIAL EQUITY
HUMAN HABITAT
ENVIRONMENT

Livable city goals

How will these changes affect the built environment and impact the livability of our cities? Before exploring this question it is important to first define what we mean by a livable and sustainable city. What type of a city do we want to live in and pass on to the next generation? For the purpose of this study, we have used the following criteria, which include broadly accepted goals and ambitions of cities today,[25] [26] to inform the way we might evaluate decisions and values about the future of mobility and urban design:

SOCIAL EQUITY

- Provide access to high quality and affordable transportation for all.
- Ensure access to green space, schools, jobs and daily needs for all.
- Promote the exchange of goods, services and ideas.

HUMAN HABITAT

- Foster a vibrant public realm that supports a broad range of outdoor activities.
- Support compact and complete neighborhoods that minimize our impact on natural habitat while promoting community and active mobility.
- Design cities that are safe and accessible for people of all ages and abilities.

ENVIRONMENTAL

- Prioritize transportation and infrastructure that has a low impact on the environment.
- Provide a functioning network of ecological networks and services.
- Support resilient environments that can adapt and respond to ecological changes.

SHARED

MULTI-
OCCUPANCY

MULTI-MODAL

ELECTRIC

Future mobility principles

What should we be advocating for given the broad range of possible outcomes, opportunities, and risks inherent in each of the trends that are shaping mobility? In order to answer this fundamental question, we propose a values-based approach to guide decision-making, urban design, and policy based on the following principles:

1. MAKE IT SHARED
2. PRIORITIZE MULTI-OCCUPANCY VEHICLES
3. PUT ACTIVE TRANSPORTATION FIRST
4. INCENTIVIZE LOW CARBON

Fundamental to all of these principles is a people-first approach—focusing on how we move people, not vehicles; creating social space instead of storing cars; giving people choice and promoting healthy lifestyles; and prioritizing modes that result in a cleaner and more sustainable environment.

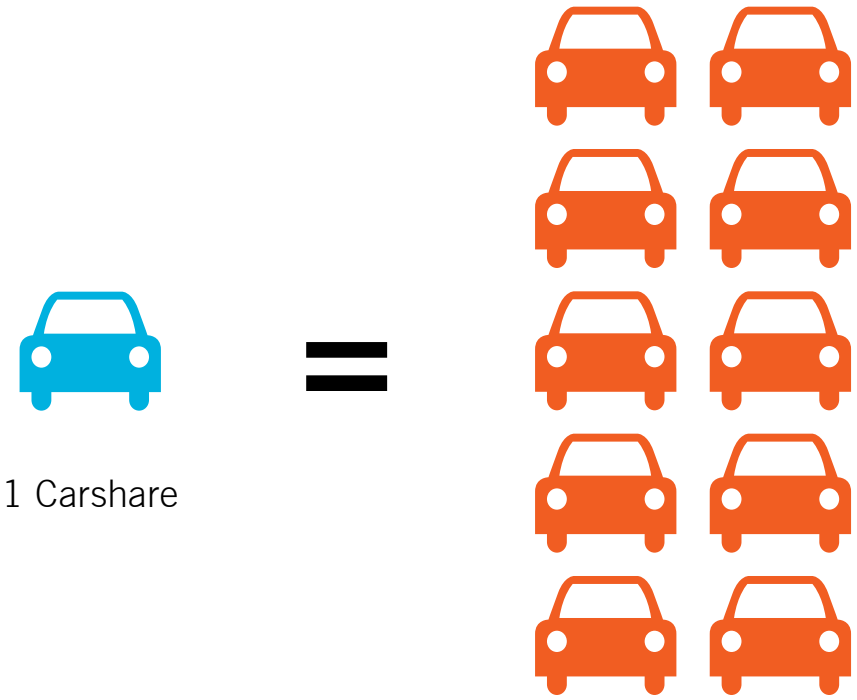
By adopting these key principles, we believe there is the potential to reduce the amount of space needed to operate and store vehicles, while increasing the capacity to move more people throughout our cities. The outcome will be healthier cities that realize a significant reduction in carbon emissions while creating meaningful space for people to move, interact, and connect.

PRINCIPLE 1: MAKE IT SHARED

Transportation policies should favor shared modes of all types over private ownership as a way to reduce the total number of vehicles in cities.

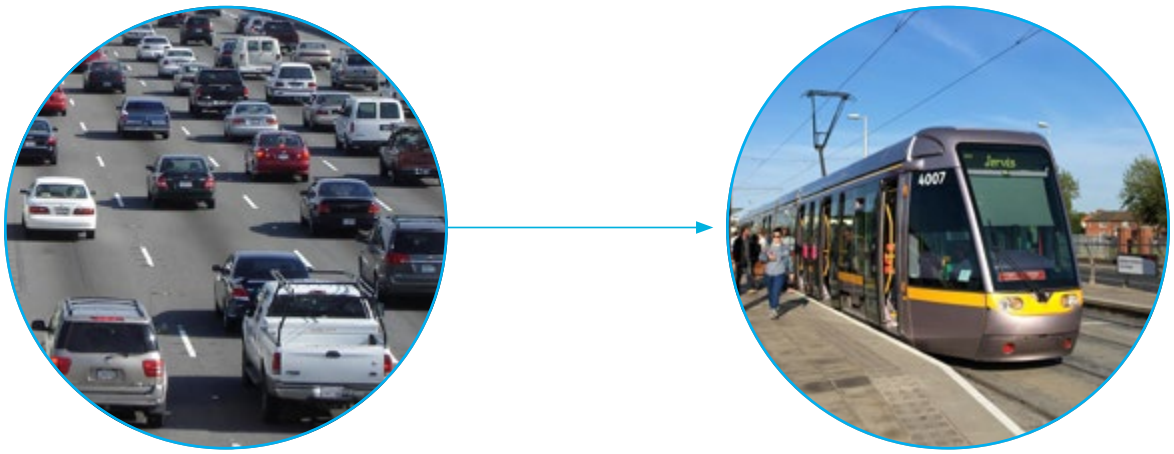
When vehicles are shared instead of privately owned, more space is made available for other uses. The average vehicle today sits unused 95% of the time, demanding an enormous amount of space in cities to store cars that sit idle.[27] Studies suggest that for every car share or rideshare vehicle on the road, as many as ten private vehicles are either unloaded or not purchased (Refer to Figure 6). Given that road and parking infrastructure take up around 30% of the area of most cities, there is a great opportunity to convert much of this space to higher-and-better uses that support livability.

FIGURE 6: DISPLACEMENT OF PRIVATE VEHICLES BY CARSHARING[28]



SINGLE-OCCUPANCY

MULTI-OCCUPANCY



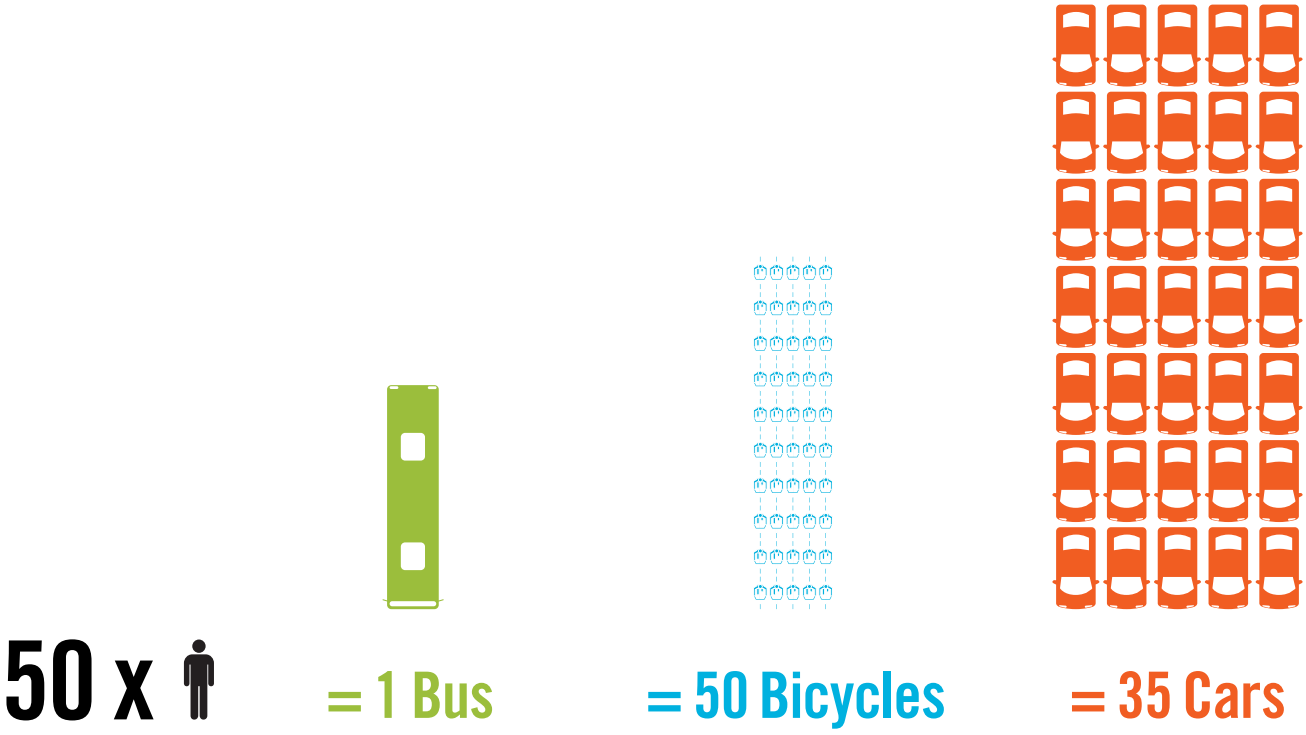
PRINCIPLE 2: PRIORITIZE MULTI-OCCUPANCY

Transportation policies should always prioritize high occupancy vehicles while supplementing public mass transportation through shared and self-driving modes.

Roadway capacity is a limited resource in every city, with the amount of space allocated per user having a direct impact on congestion and travel delays.

Even in a scenario where vehicles are shared, if ride-hailing or car share trips still tend to be made in single-occupancy vehicles, cities could face a significant increase in congestion and greenhouse gas emissions.[29] Sharing or self-driving mobility on its own does little to address this geometry problem, especially if accompanied by an increase in vehicle miles traveled—which is why prioritizing multi-occupancy vehicles becomes even more important for future mobility. Public and active transportation modes will continue to be the most efficient, space-effective ways to utilize scarce road space now and into the future. Pairing shared vehicles with a quality, high-capacity public transport network has also been shown in simulations to have a significant decrease in the number of parking spots required and minimizing delays during peak travel times.[30]

FIGURE 7: ROAD SPACE REQUIREMENTS, BY MODE



AUTO-DEPENDENT

MULTI-MODAL

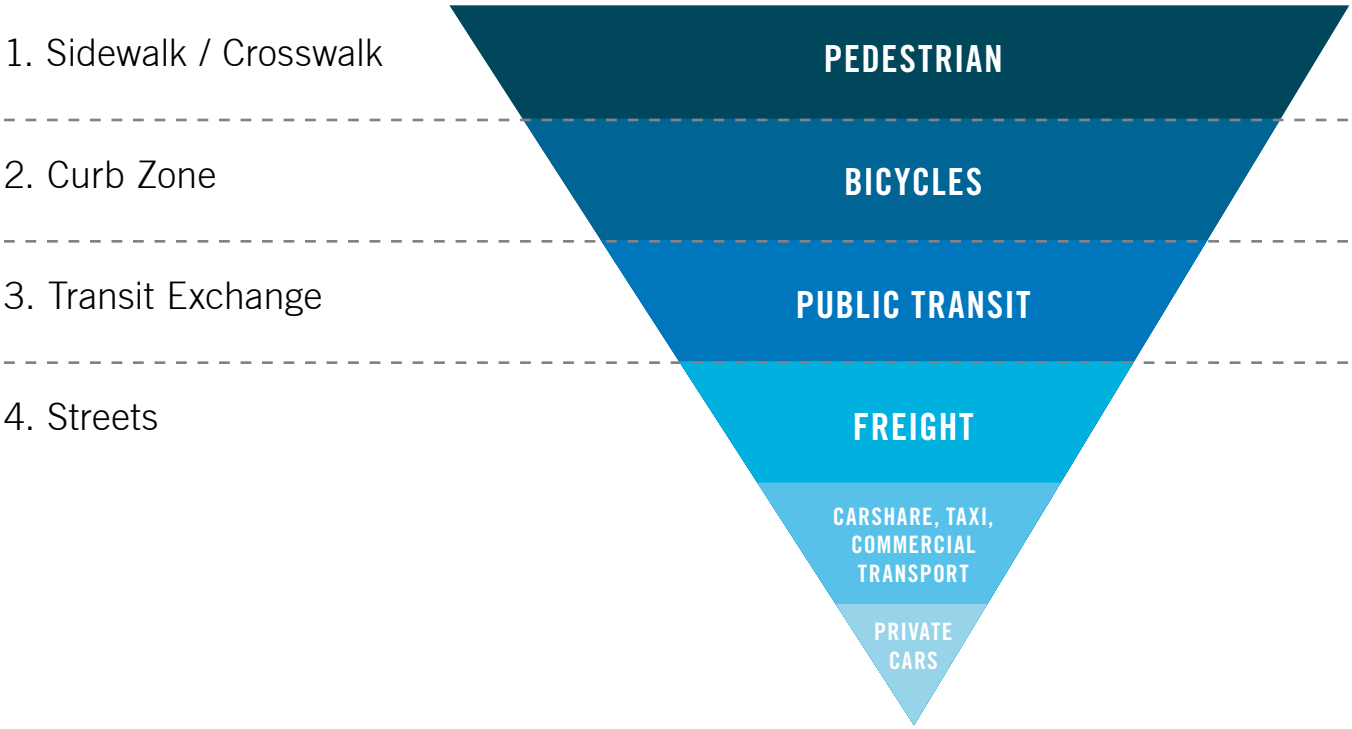
PRINCIPLE 3: PUT ACTIVE TRANSPORTATION FIRST

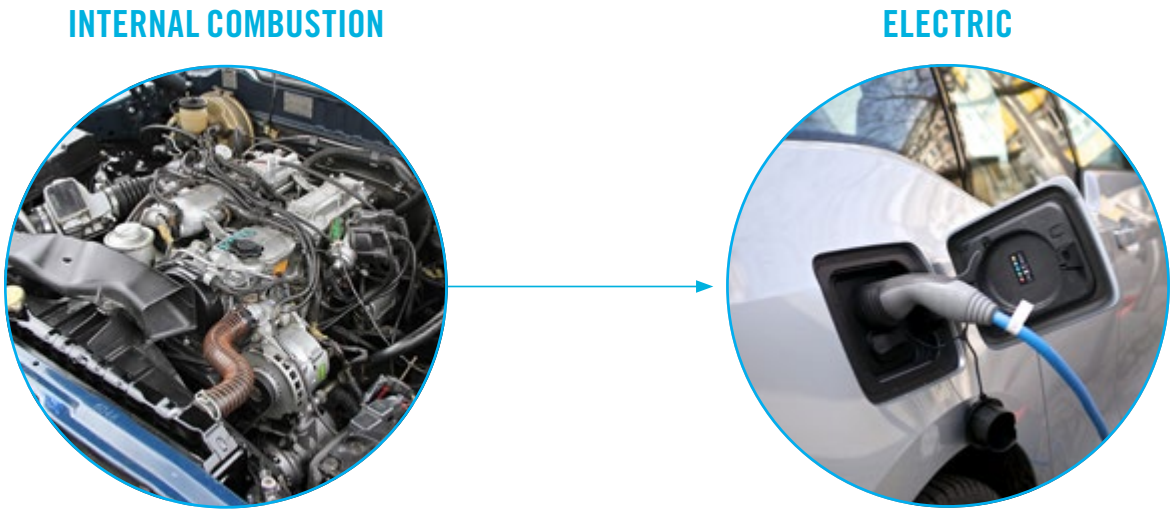
Decisions around future mobility should put active transportation first by considering a broad range of users and prioritizing pedestrians and bicyclists over private roadway users where different modes come in contact.

A key principle of a high-quality mobility network is to provide people choices in how they move around cities. Resiliency—not becoming overly reliant on a single mode or supplier of mobility—is a critical step and requires a consideration of both cost and distribution of access to multiple modes. Beyond furthering choice for residents, cities realize an enormous public health benefit and individual well-being by prioritizing active forms of transportation—walking, bicycling, etc. Well documented benefits include reductions in obesity, cardiovascular disease, dementia, and overall mortality rates.[31]

Users of active transport are also the most vulnerable users of the street, resulting in a disproportionately high percentage of fatalities and serious injuries on roadways. It is critical to implement the design of routes that are safe and inviting for all users. This means fundamentally limiting speeds and giving priority and maximum visibility to people over vehicles in the design of streets.

FIGURE 8: PRIORITIZATION OF MODES





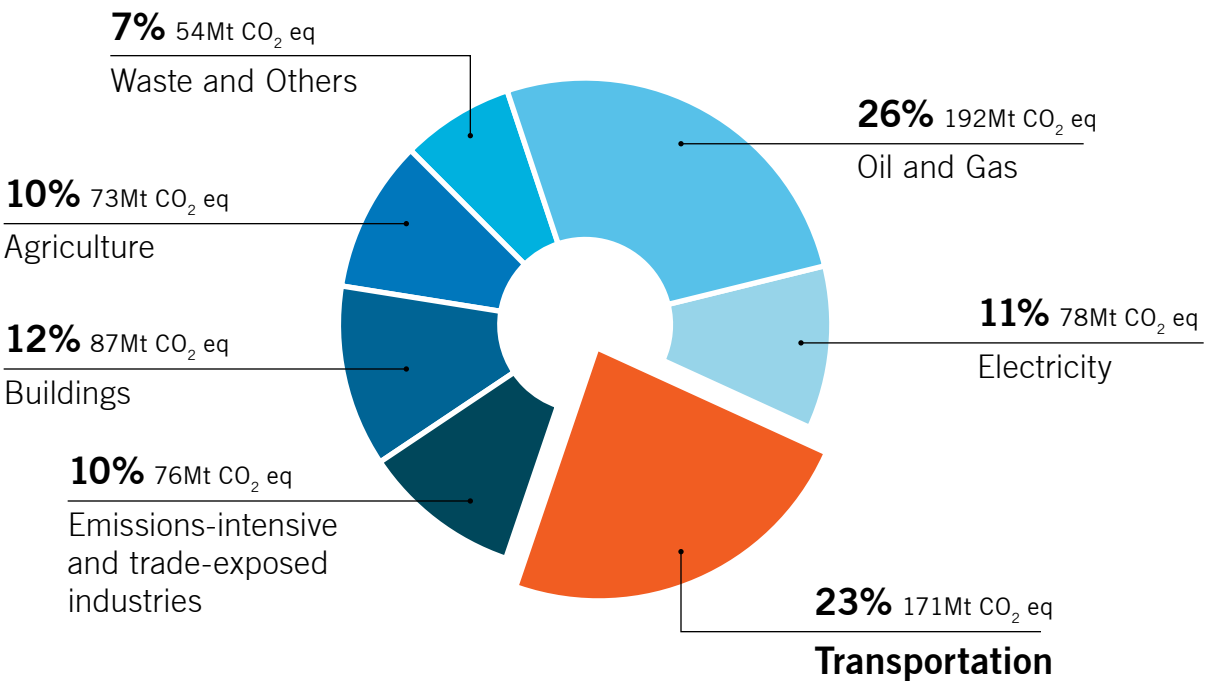
PRINCIPLE 4: INCENTIVIZE LOW CARBON

Policy must aggressively incentivize low carbon forms of mobility and improve the infrastructure needed to make them a convenient and affordable choice for most users.

The impacts of climate change are one of the most profound challenges that we will face over the next generation. Transportation continues to play a significant role in the amount of greenhouse gas emissions and air pollutants released into the atmosphere—accounting for between 20 and 30% of all emissions we produce (refer to Figure 9). Carbon emissions are affected by fuel efficiency and energy source, which have been improving over time through better fuel efficiency and the increase in electric vehicles. But emissions are also a product of the number of trips and miles traveled, which continue to increase globally and are expected to do so into the future as a result of changes in mobility.

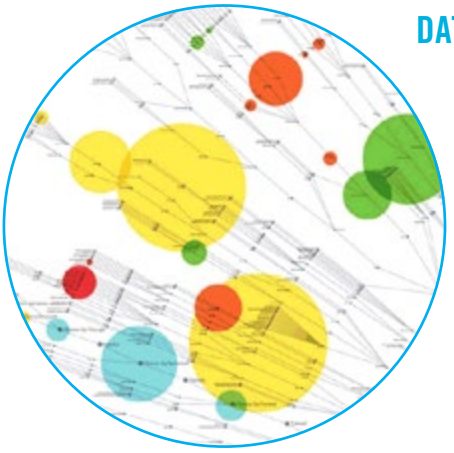
Studies have shown that automation of a vehicle fleet could reduce greenhouse gas emissions by half, or nearly double them, depending on whether clean electric or carbon-based fuel comes to dominate.[32] Promoting more efficient multi-occupancy trips and no-carbon active mobility will also need to play a significant role in lowering greenhouse gas emissions from the transportation sector.

FIGURE 9: CO_2 EMISSIONS, BY SECTOR[33]



DESIGN FOR ADAPTABILITY

BE NIMBLE, DATA-DRIVEN



COLLABORATE + COORDINATE

PILOT EVERYTHING!

Policy values

The roles of planning and policy making offer perhaps the greatest opportunity to influence change and set the stage for positive impacts. To take advantage of this opportunity, the future of mobility will demand a different approach to the way public and private agencies respond to, and anticipate, changes that will shape the livability of their respective jurisdictions.

First, as discussed in the previous section, policy makers should outline and keep their focus on key principles—putting people and livability first and focusing on the best outcomes for cities instead of simply technological advancements. A vision-based model will allow planners to take forward-thinking and proactive steps towards those goals, always asking how evolving technologies fit into the goals that have been put in place.

Plans should not ignore the existing context and jump immediately to an idealized future scenario, but rather take an incremental approach—building on what's already in place and managing the inevitable and potentially protracted transition phase. Flexibility in approach and adaptability in the built environment will be key as outcomes are still very uncertain and likely to evolve over time.

The digital revolution in mobility has already produced a wealth of information that will be crucial to understanding trends and shaping policy. Agencies should ensure that private operators are transparent with data so that it can be leveraged for the public good, allowing decision makers to be nimble and data-driven in their approach.

Transportation is intertwined with almost every aspect of city and regional planning, requiring a redoubling of coordination and collaboration between departments, disciplines, jurisdictions and public/private actors. Addressing housing affordability, making appropriate land use decisions, and ensuring that transportation regulation is intelligently integrated with the local municipalities that will be most impacted are all examples of the importance of a coordinated and collaborative response to mobility issues.

Finally, agencies should be unafraid of testing ideas as a way of gathering information and gauging impacts. Small and bottom-up approaches to rethinking standards can quickly and inexpensively inform more comprehensive approaches to planning and infrastructure. A "pilot everything" approach will also help policy making keep pace with the rate of technological change.

4. DESIGN OPPORTUNITIES


WOP MAY
libra

OFF-STREET BUILDINGS + PARKING

CURB + SIDEWALK ZONE

TRANSIT EXCHANGE

ROADWAYS

Designing a livable city framework

We believe that proactive planning, engineering and design—focusing on what makes our cities livable places—is essential to ensuring the most beneficial outcomes for cities and for the people who work, play, learn and live in these communities. Anticipating changing technologies should not be a matter of wait-and-see, but rather an active re-making already underway in cities around principles of livability, asking how changes in mobility can help to achieve the goals they've set out. It's a process of bottom-up thinking and experimentation. It's a process of working collaboratively, deftly, and being open to change. And ultimately, we believe it's the best way to approach an open-ended design problem filled with uncertainty and a broad range of possible outcomes. If properly leveraged, current disruptions in mobility can be powerful tools towards enabling a much more livable city in the future.

The following design opportunities have been grouped into four urban typologies which will interact in different ways with the evolution of mobility:

1. Off-street parking + buildings
2. Curb + sidewalk zones
3. Transit exchanges
4. Roadways

These design ideas and the typologies into which they are grouped in no way represent the full range of opportunities available to planners and designers considering the future of mobility. They are instead meant to be provocations that speak to key conditions found in many urban areas. They also represent ideas that could be tested immediately in existing urban areas and new developments. They also come, uniformly, from a relatively simple premise: put people first in the design of cities.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Off-street parking + buildings

The most effective strategy may be limiting the amount of parking that we build today.

Parking for automobiles takes up an enormous percentage of land area in cities today—valuable space that could instead be leveraged for housing, open space or other uses that contribute to the livability of cities. With a shift to more shared modes of mobility, there is an opportunity to recapture much of the parking space in cities for more valuable purposes.

We can start by re-thinking off-street parking, first in temporary ways to support interim events such as pop-up food vendors and markets, and ultimately redeveloping underutilized surface parking for higher-and-better uses.

Parking that is built as part of new developments should be considered in the context of a future in which demand is much lower, requiring designers to consider a flexible approach that allows for different uses over time. All new parking should also incorporate electric charging capability in anticipation of near-term changes in power source for vehicles.

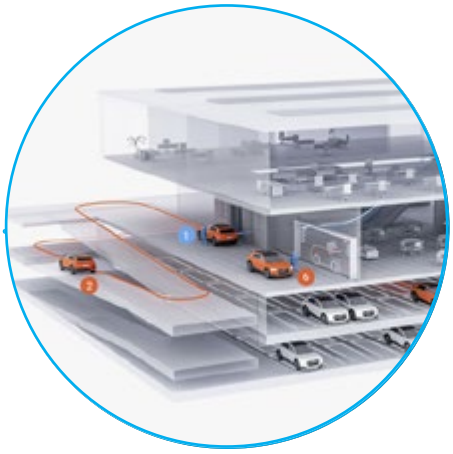
The most effective strategy may be limiting the amount of parking that we build today, and utilizing existing and future parking space in the most efficient way possible. In the same way that shared vehicles offer the benefit of reduced parking space requirements, sharing parking stalls among different users makes better use of a limited resource. Because parking demands vary over time and over the course of a day, networked and shared district parking can increase effective parking capacity without increasing supply. Reducing parking requirements for new developments also has the added benefit of reducing the construction costs and ultimately the cost of living if parking is decoupled from housing.

Finding ways to reduce, re-use and think creatively about how and where vehicles are stored means more space for the types of uses that are fundamental to livability: more and less-expensive housing, more public space, and more recreational space for people.

Reimagining parking

1. REDUCE OVERALL PARKING SUPPLY IN NEW DEVELOPMENT

Reduce minimum parking requirements or replace with maximums and encourage district parking networks to utilize existing parking more efficiently within neighborhoods.



2. FUTURE-PROOF NEW PARKING

Consider future non-parking uses when designing structured parking. Prioritize flat slab construction to maximize flexibility.

3. MAKE ALL NEW PARKING ELECTRIC-CAPABLE

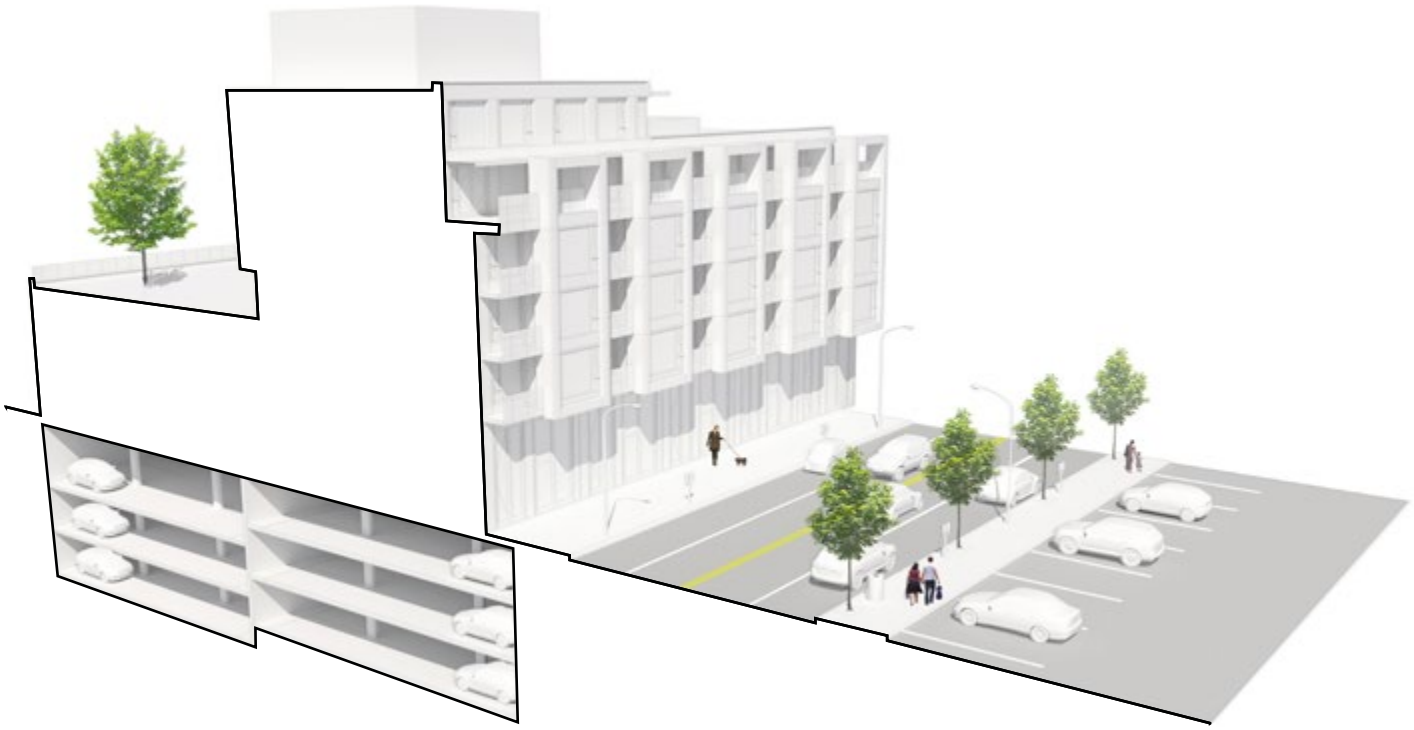
Integrate fast recharging stations within new developments and provide capacity for universal electric charging of new parking spaces.

4. IDENTIFY OPPORTUNITIES TO ACTIVATE SURFACE PARKING

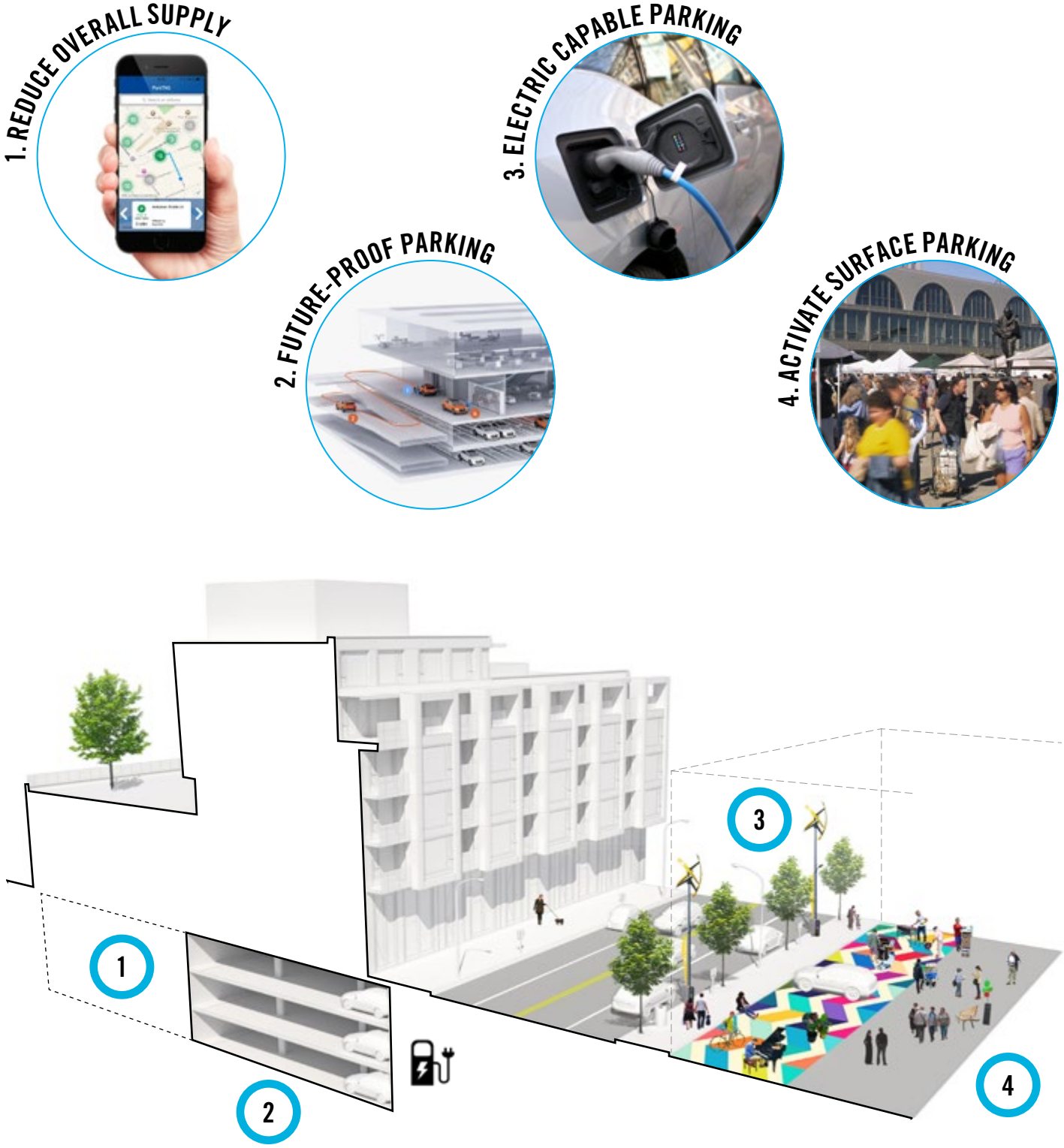
Design or retrofit surface lots to actively promote non-parking uses until future redevelopment to highest and best use.

Reimagining parking

With the broad range of shared transportation options on the horizon, municipalities and developers can take proactive steps today to reduce and future-proof parking that is required as part of developments, and rethink existing parking within cities. Promoting shared “district” parking and eliminating parking minimums would allow for a more efficient allocation of space and free up projects to integrate creative shared mobility options from the start. Electric vehicle charging should be ubiquitous given that a shift in vehicle fuel sources is expected to occur well within the lifetime of today’s buildings.



Existing Parking Typology



Future Parking Typology


BUFFALO
EXCHANGE

Curb + sidewalk zones

Demand for the curb is likely to change—less space for parking and greater opportunities for expanding spaces for people.

The threshold between the roadway and building frontages has evolved to become a hard line between the realm of the pedestrian and that of the automobile. Demand for the curb zone is likely to change as we move into the future of mobility—less space for parking, more demand for pick-up and drop-off zones, and greater opportunities for expanding spaces for people.

As we look forward to a future where parking space is less in demand for vehicles, but drop-off zones may become more important, we should think about designing curb space for ultimate flexibility, allowing for adaptation over time. An important first step includes the introduction of people-first spaces—parklets, cafe seating, green space, etc.—as a way of staking a claim for an improved public realm within valuable street space that may become redundant in the near future.

It will become increasingly important to put people first at crosswalks and other intersections between different modes. Particularly in a self-driving dominant future, there may be pressure to create separations between people and roadways to ensure the most efficient flow of networked vehicles is not disturbed by the unpredictable behavior of pedestrians and bicyclists. In a people-first model, pedestrians should be given priority at crossings and wherever different modes intersect.

Changes in mobility will transform the way in which we think about and utilize the threshold between street and sidewalk in cities. As these changes evolve, the emphasis must be on prioritizing the types of uses, such as space for people, bikes, and high-occupancy vehicles, that will support livable city principles.

Reimagining curb + sidewalk zones

1. PRIORITIZE PEDESTRIANS AT INTERSECTIONS

Always put people first at crosswalks and other intersections between different modes, including self-driving cars.

2. MAKE CURB ZONES FLEXIBLE

Reimagine curb space as a flexible zone that can be used for parking, drop-off or adapted to public realm over time.

3. RECAPTURE ON-STREET PARKING AS PUBLIC REALM

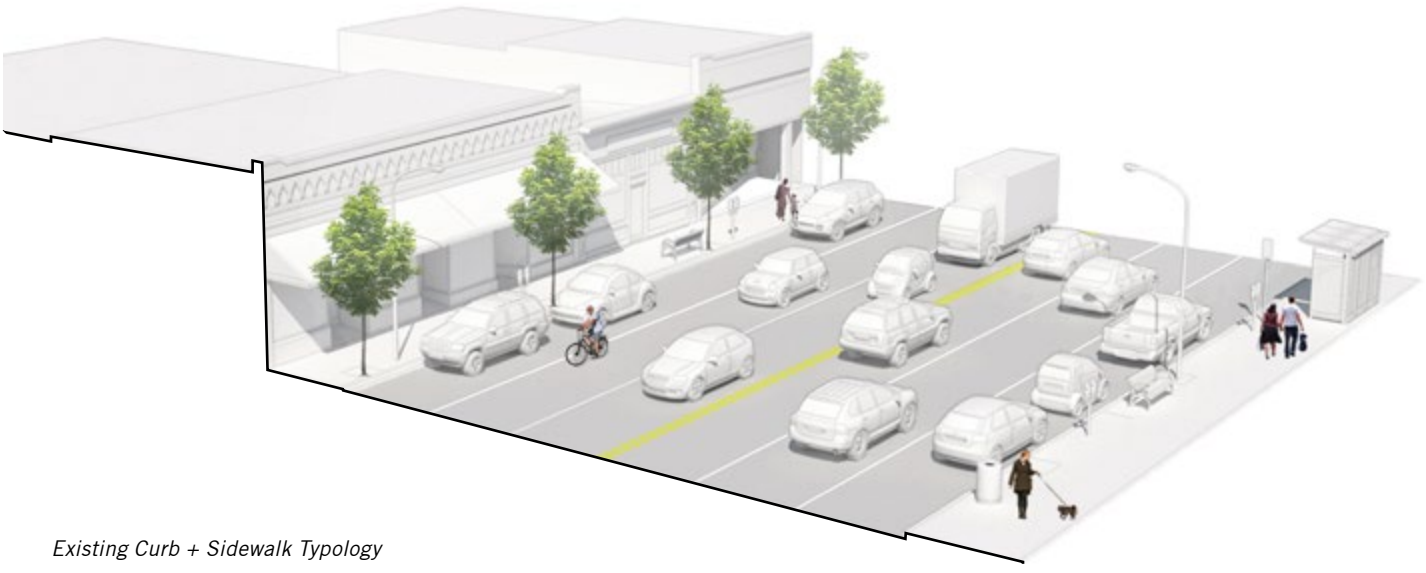
Identify opportunities to recapture curb space currently used for on-street parking as expanded public realm to improve walkability and social connectivity.

4. PRIORITIZE HIGH OCCUPANCY LOADING ZONES

When considering locations for shared vehicle loading and drop-off, prioritize high-occupancy modes through space allocation or curb demand pricing to encourage efficient use of roadway and curbside capacity.

Reimagining curb + sidewalk zones

Curbside zones currently filled with on-street car parking could see a dramatic reduction in demand as mobility transitiitions to more shared and autonomous modes. At the same time, it is expected that demand for curbside pick-up and drop-off areas will increase. By designing curb space as a “flex zone” that can accommodate a range of uses, cities can anticipate future change while at the same time capturing opportunities to prioritize space for people in the near term. As with all decisions, the safety and well-being of people should be prioritized in any redesign, including always putting people first at crosswalks and other points where multiple modes converge.



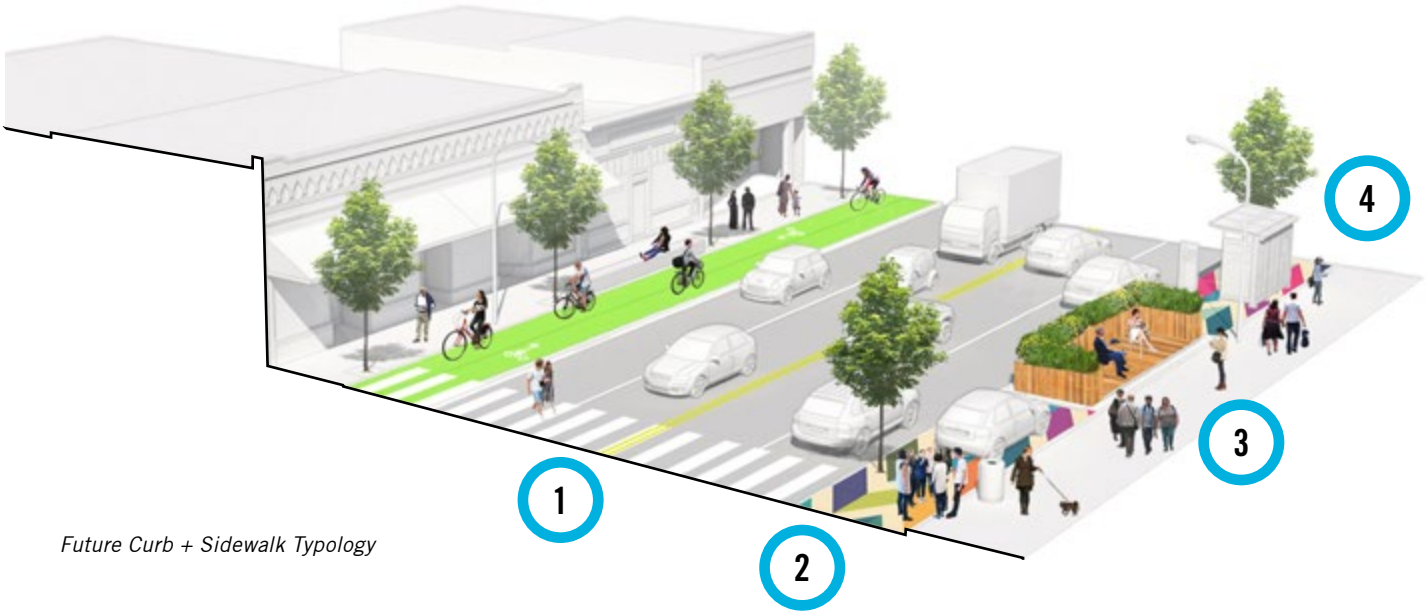
Existing Curb + Sidewalk Typology

1. PEDESTRIAN-FIRST INTERSECTIONS

3. RECAPTURE ON-STREET PARKING

2. FLEXIBLE CURB ZONES

4. PRIORITIZE HIGH OCCUPANCY LOADING



Future Curb + Sidewalk Typology


WINNERS
WINNERS

Transit exchanges

As we enter a future of automation and shared mobility, the role of high quality, high capacity transit will only become more important.

Public transit plays an essential role in freeing up roadway capacity, providing mobility choice for many travelers, and reducing the environmental impacts of transportation in large cities across North America. As we enter a future including automation and shared mobility, the role of high quality, high capacity mass transit will only become more important in delivering these benefits to urban areas.

Transit stations tend to be stand-alone structures today. As part of a new shared mobility ecosystem we need to start thinking of transit exchanges as hubs for the daily life of a city and region. This means designing transit stations that provide easy and intuitive links to a broad range of first and last mile transportation options for users—including bicycles, shared vehicle links, and the integration of places to work and live that make exchanges destinations in and of themselves.

It will also become increasingly important to share dynamic information about these various mobility options and integrate those options in a seamless way through the hub. As the transportation system becomes more "networked," transit hubs will play a central role in facilitating connections between public and private modes.

While automation and shared services offer the potential to revolutionize on-demand transit services and provide critical first and last connections within the transport network, high capacity corridors served by public transit will be essential to alleviate congestion from an overreliance on low occupancy on-demand services.

Without a vital high capacity transit system, it will be exceedingly difficult to deliver high functioning transportation within a livable city context in the future. Investing in and seamlessly integrating transportation nodes into communities is a crucial step in building a sustainable mobility future.

Reimagining transit exchanges

1. MAKE EXCHANGES INTO AMENITY HUBS

Integrate amenities, services, and housing with transit to reinforce the exchange as a central hub in daily life.

2. CREATE SPACE FOR SHARED MOBILITY OPTIONS

Designate space adjacent to transit exchanges for shared mobility options. Connections and wayfinding between modes should be direct and intuitive.

3. INTEGRATE DYNAMIC SIGNAGE AND WAYFINDING

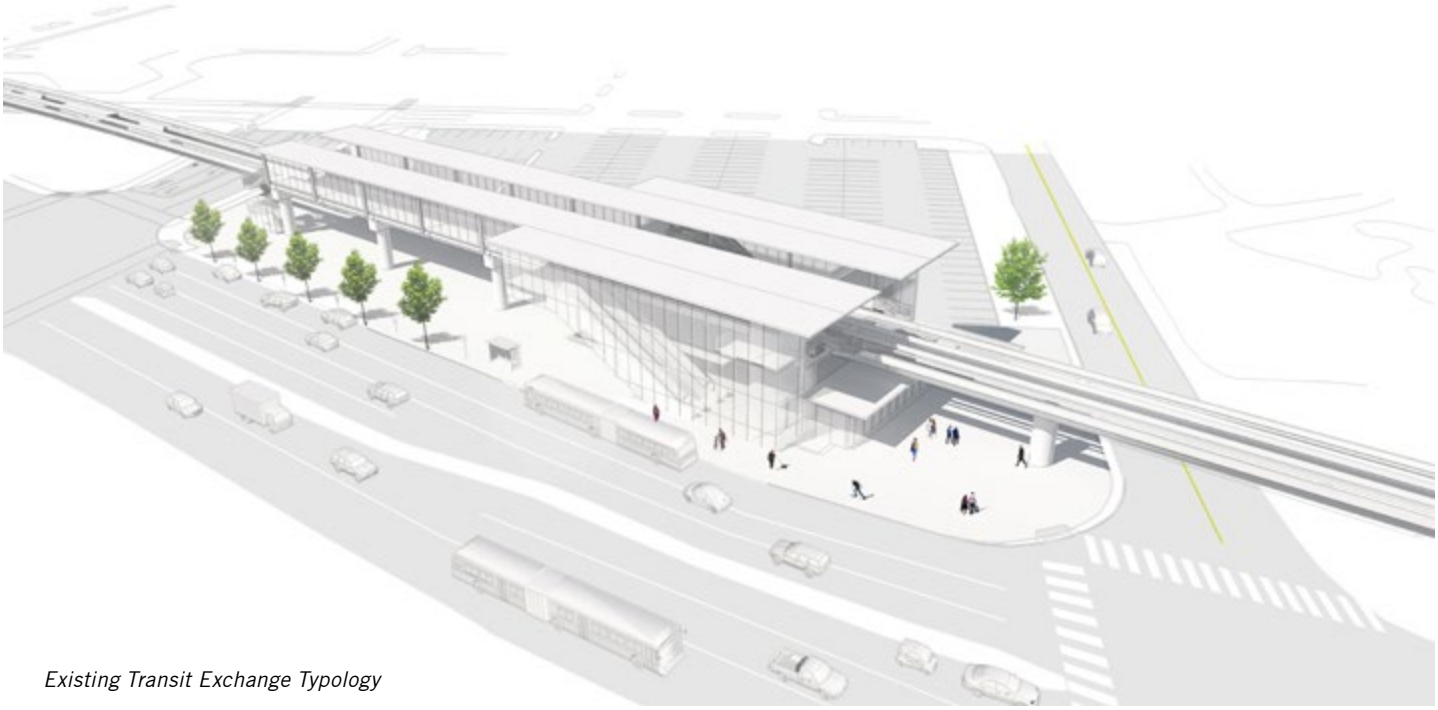
Integrate dynamic signage and wayfinding to easily link passengers with other transport modes and surrounding amenities.

4. INVEST IN HIGH CAPACITY CORRIDORS

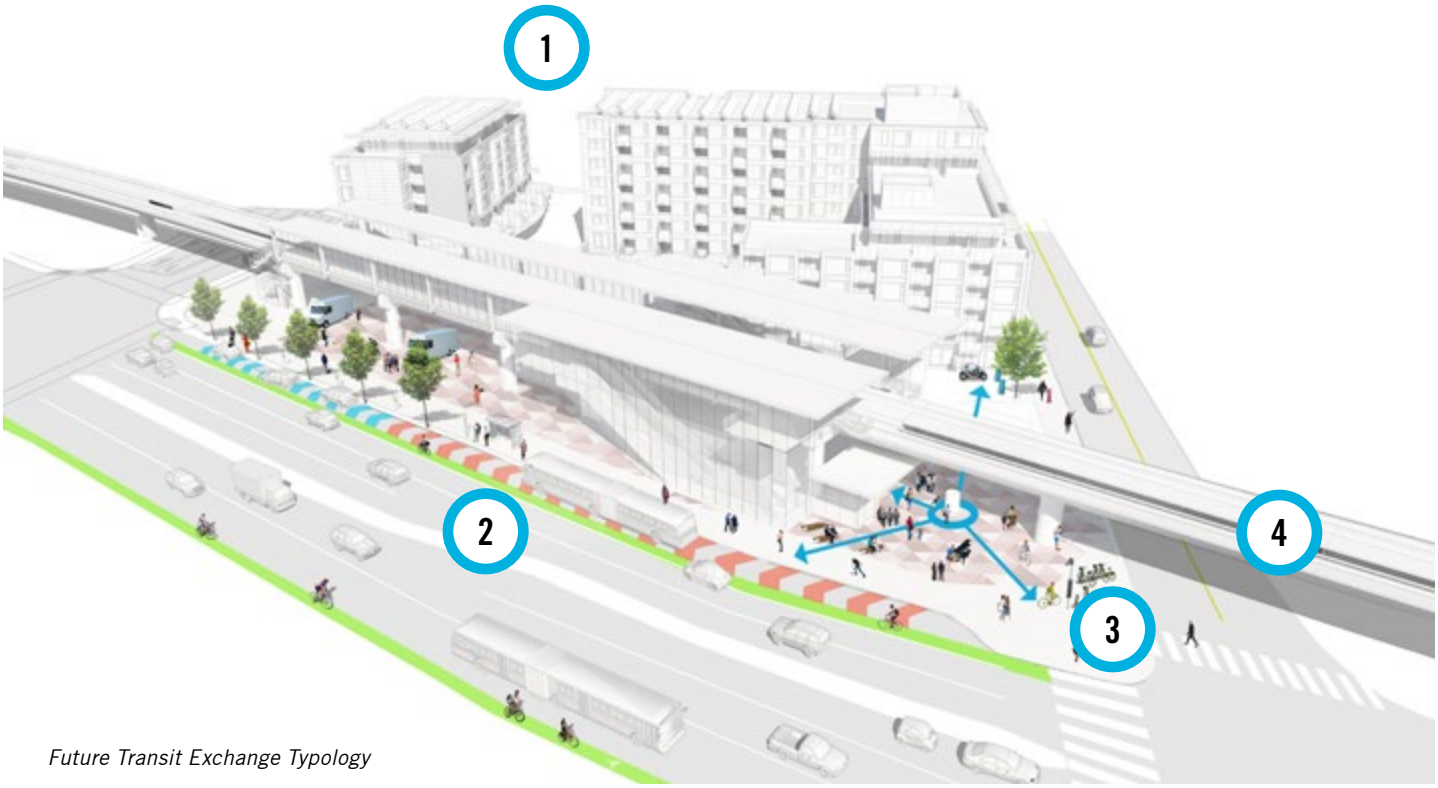
Focus investment on high quality, high capacity transportation corridors that make transit “on the way” for major destinations.

Reimagining transit exchanges

The transit exchange becomes an even more critical hub of mobility in the future city. Beyond simply moving transit passengers along fixed routes, the exchange becomes the critical link within an expanded set of mobility options. The transit facility should host multiple connections including links to local and on-demand transit, safe and convenient access for bicycles and pedestrians to integrated networks and a broad range of amenities in close proximity, and provide on-demand and dynamic wayfinding to make these connections seamless and convenient.



Existing Transit Exchange Typology



Future Transit Exchange Typology


The Galle
at Eau Cl
JOKE ART
illustrations
personal portraits
commissions
eyecandy modern
www.joke-art.com
EXCHANGE

Streets

The future of mobility will be about increasing roadway capacity through high occupancy uses to free up space for more public, people-first uses.

City streets serve a broad range of functions and come in a wide variety of shapes and sizes. Today, the vast majority of street space is dedicated to the automobile—however the future of mobility will be about using public rights-of-way for a broad range of public uses, and focusing on increasing capacity through the promotion of high occupancy modes.

There is no one-size-fits-all approach when it comes to redesigning roadways for future mobility. There are different opportunities inherent in the many various street types, from high capacity transit corridors and arterials; to underutilized residential streets and laneways.

A key consideration in roadway design will be reallocating road space in support of the most efficient modes available—more space for high capacity automated transit and active transportation. In this way, existing rights-of-way will be able to carry as many or more people per hour as today, but using less overall space.

New York's Times Square is a great example of enacting people-first streets in an incremental way. The intersection was closed down to traffic, temporarily and relatively inexpensively at first, to test and monitor potential impacts. What planners and engineers found was that there was a huge demand for this type of public space in the city, resulting in improved foot traffic and retail activity as well as benefits for improving traffic congestion in the immediate neighborhood.[34]

Another example that is currently being enacted in Barcelona is the "superblock," termed by Salvador Rueda. The concept involves focusing vehicular traffic on main arterial streets, freeing up streets within these larger blocks as people-first places that can accommodate vehicles under certain circumstances or at limited speeds.[35]

The fundamental principle for future mobility street design is that the street should be considered first and foremost as a place for celebrating and moving people, not just vehicles.

Reimagining streets

1. PRIORITIZE MOVING PEOPLE, NOT VEHICLES

Reallocate roadspace and prioritize lanes for high capacity transit and active transportation to move people more efficiently. Ensure links to multiple transportation options are easy to access for all.

2. DESIGN FLEXIBLE STREETS TO ACCOMMODATE PEOPLE

Identify a network of streets with limited vehicle access to create opportunities for community gathering, green space, and active transportation networks.

3. MAKE SPACE FOR ACTIVE TRANSPORTATION

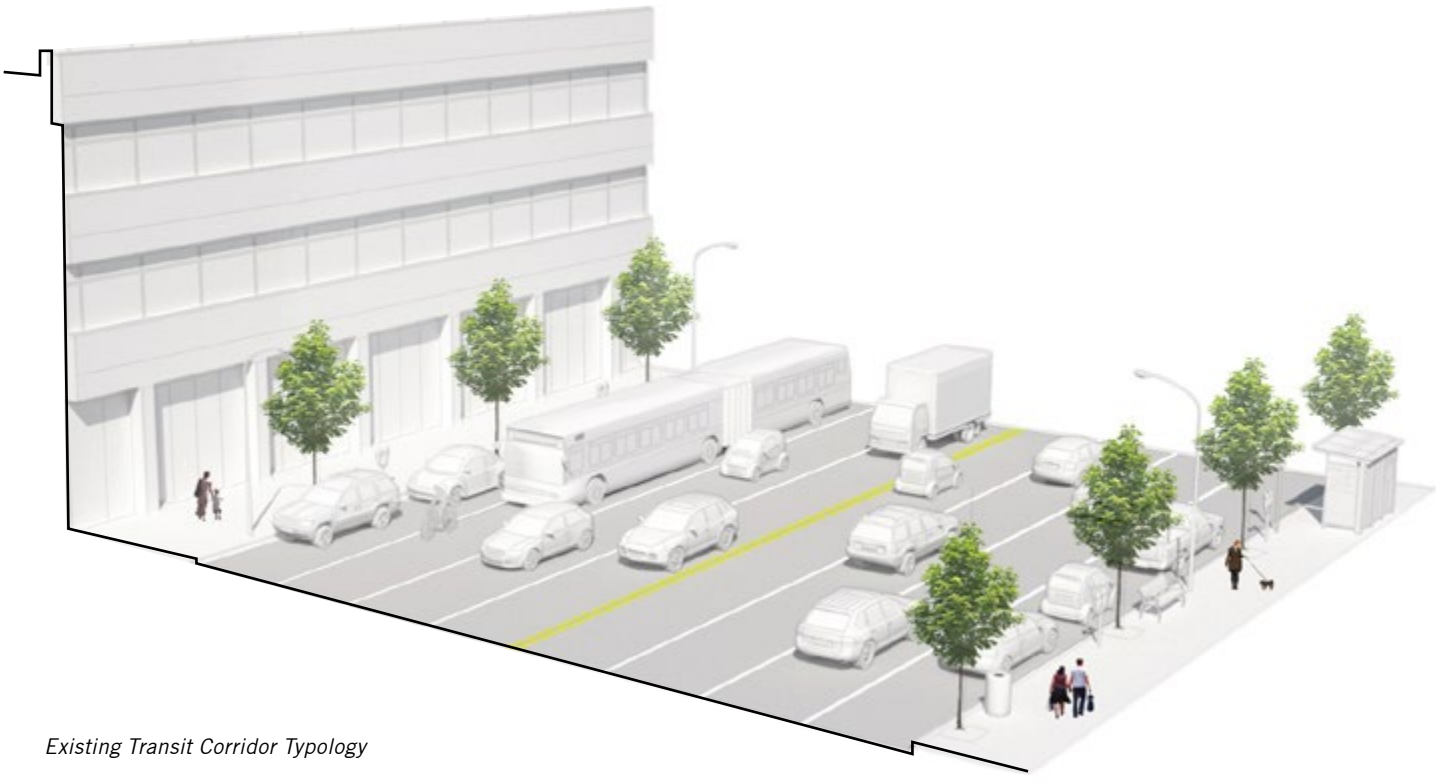
Create space for bicycle lanes and expanded pedestrian zones to increase mobility choice along corridors. Make connections to transit safe, accessible, and simple to use.

4. IMPLEMENT DEMAND MANAGEMENT TO REFLECT PRIORITIES

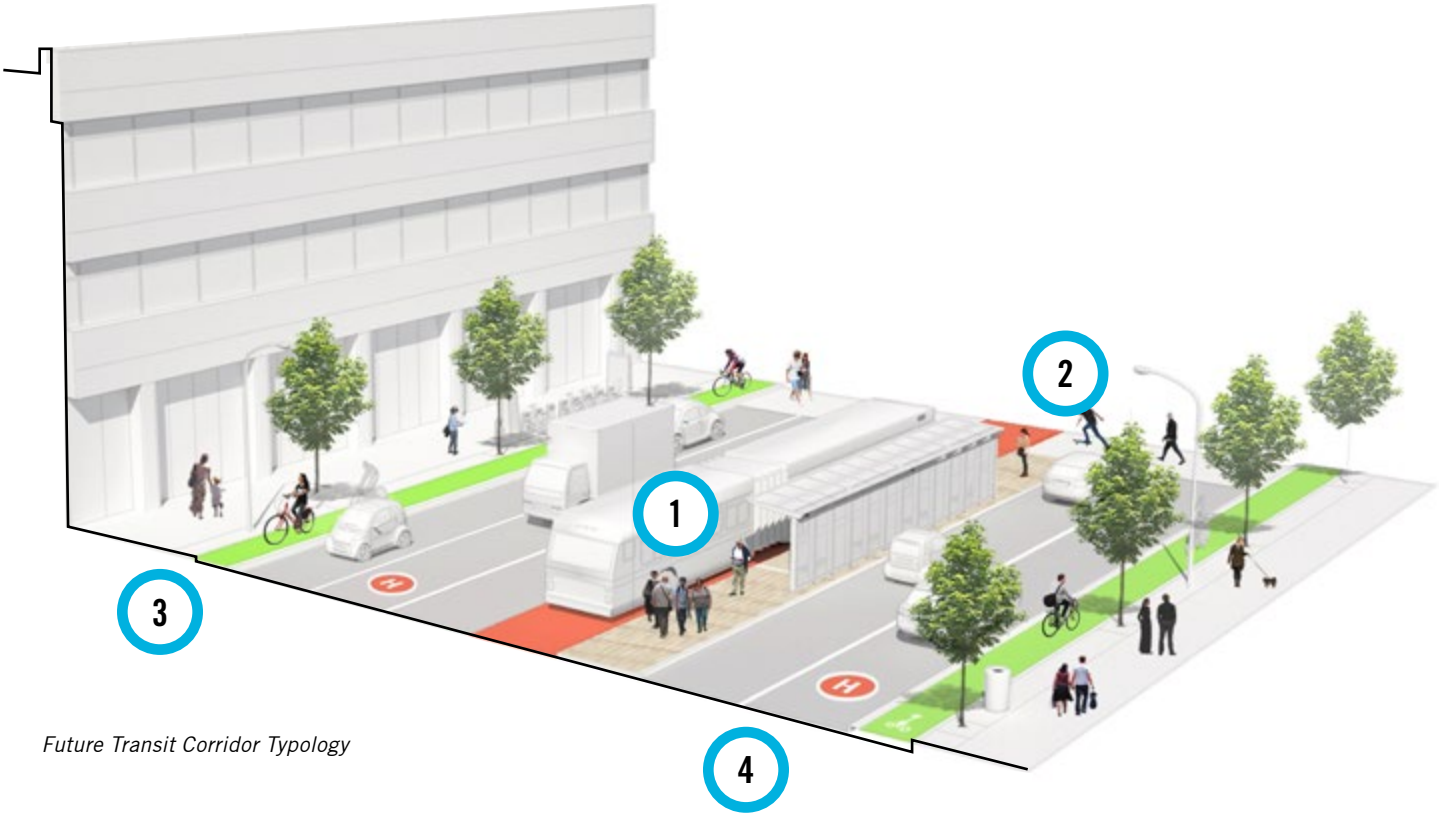
Explore policy options to incentivize trips using the most efficient, high occupancy transportation modes to free up roadway capacity.

Reimagining streets: Transit corridor

With automation, the level of service along transit corridors in the city could be amplified to make mass transit more convenient and appealing. These corridors should prioritize high-occupancy modes, including the use of dedicated lanes and easy, accessible connections to stops and supporting modes. A key benefit of transit-first corridors is a dramatic increase in the maximum carrying capacity of roadways by replacing individual vehicular trips with shared, high-occupancy modes forming an integrated network across the city.



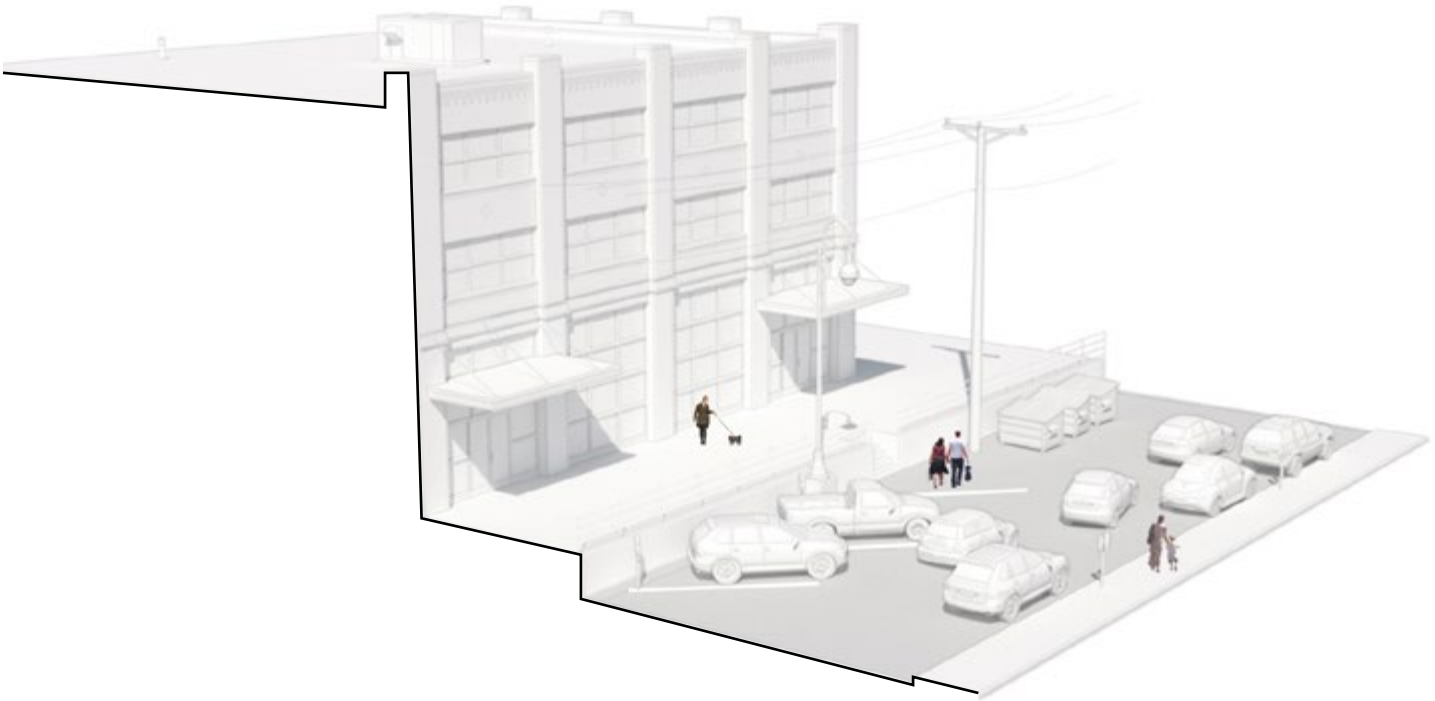
Existing Transit Corridor Typology



Future Transit Corridor Typology

Reimagining streets: Shared space

With an emphasis on shared modes and high-quality transit options, more streets could be converted to pedestrian uses on a full or part-time basis. The concept of the “woonerf,” roads in which interventions have been made to slow or eliminate vehicle access, is popular today in car-light cities around the world. Shared streets improve safety and increase activity and social engagement—a next generation public space for cities. Such streets could be programmed to allow for service or low speed access during designated times of the day.



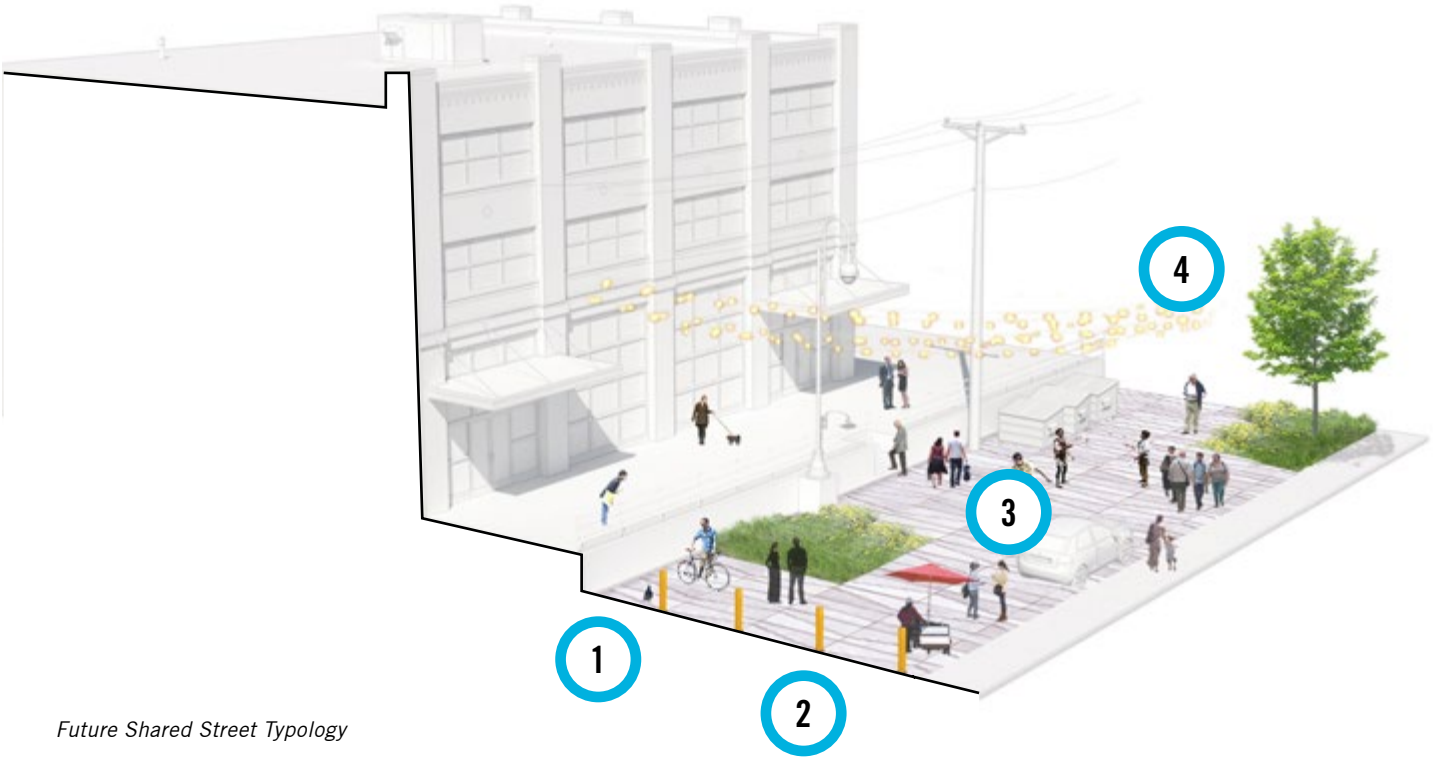
Existing Laneway Street Typology

1. LIMITED VEHICLE ACCESS

3. FLEXIBLE STREET SURFACE

2. SMART TRAFFIC CALMING

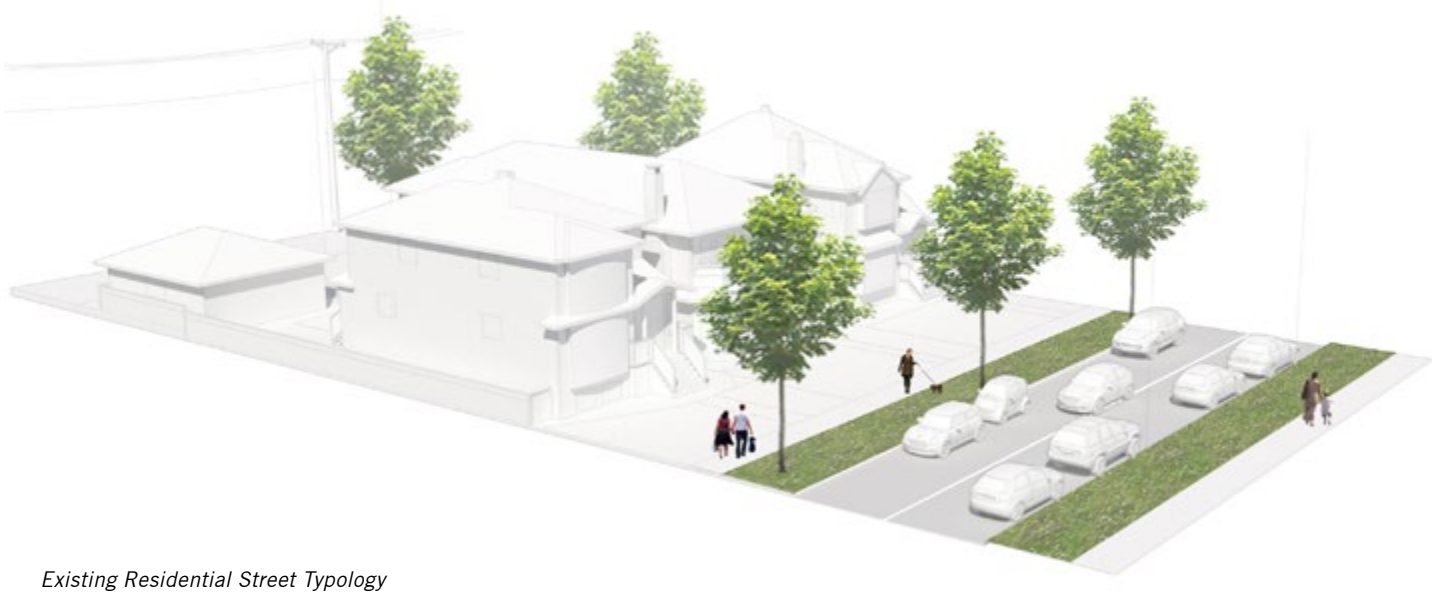
4. ACTIVE REPROGRAMMING



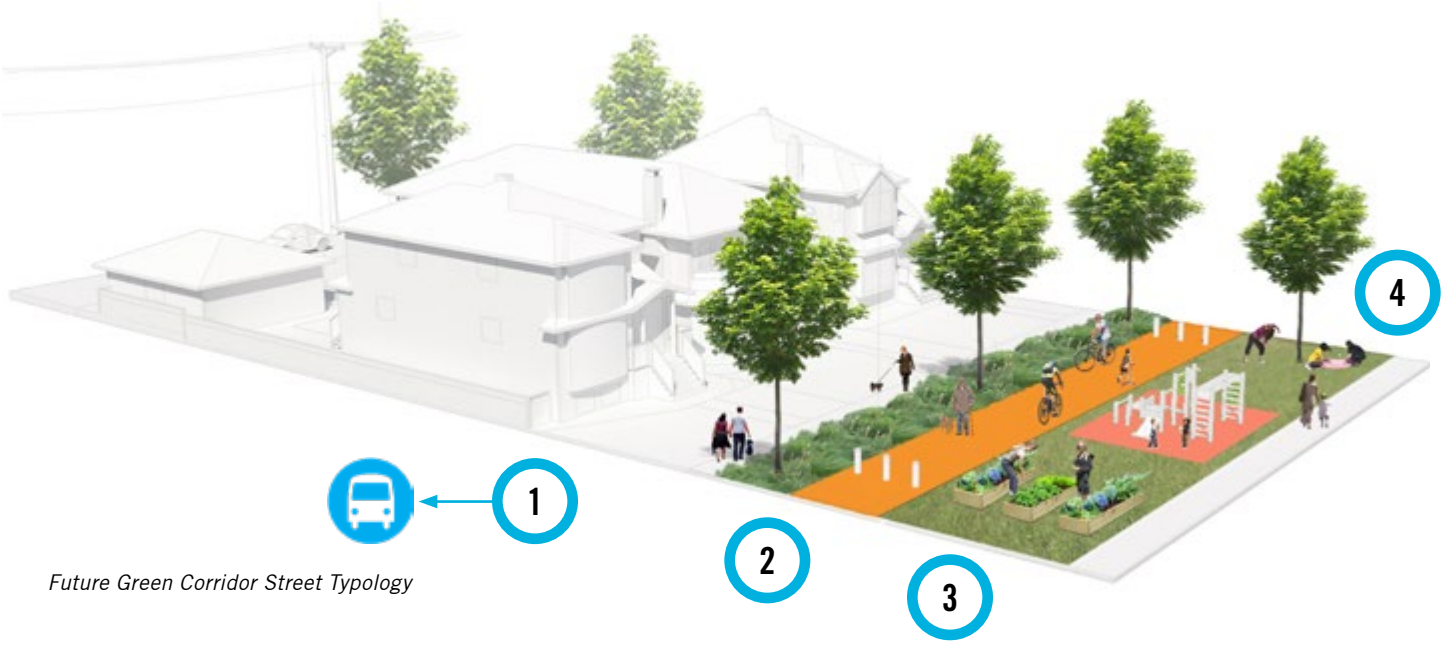
Future Shared Street Typology

Reimagining streets: Green corridors

With a reduced demand for vehicle storage, road corridors that already have a low use intensity could be reimagined as linear corridors solely for people and ecological functions. With automobile uses reduced and displaced to adjacent streets and laneways, these linear parkways become a central focus of community activity, bicycling, and walking within their neighborhoods. They also provide a unique opportunity to reintroduce green space into the city, with all the accompanying benefits—supporting ecological functions, a healthier microclimate, and space for recreation.



Existing Residential Street Typology



Future Green Corridor Street Typology

CASE STUDY / WILSHIRE BOULEVARD

Wilshire Boulevard, existing

A collaboration between Perkins+Will, Nelson\Nygaard, and Lyft[36] questioned how an existing city street, currently lacking meaningful places for people and overloaded with car traffic, could be redesigned to more efficiently move people and improve the public realm.

Wilshire Boulevard in Los Angeles is a classic example of so many major streets in North American cities, where 70% of vehicular traffic is single occupancy and congestion regularly slows all vehicles to a crawl. Sidewalks are physically able to carry even more people than the ten lanes of traffic, but they are devoid of activity and are not designed to be welcoming or engaging for people to use (Refer to Figure 10).

Present /

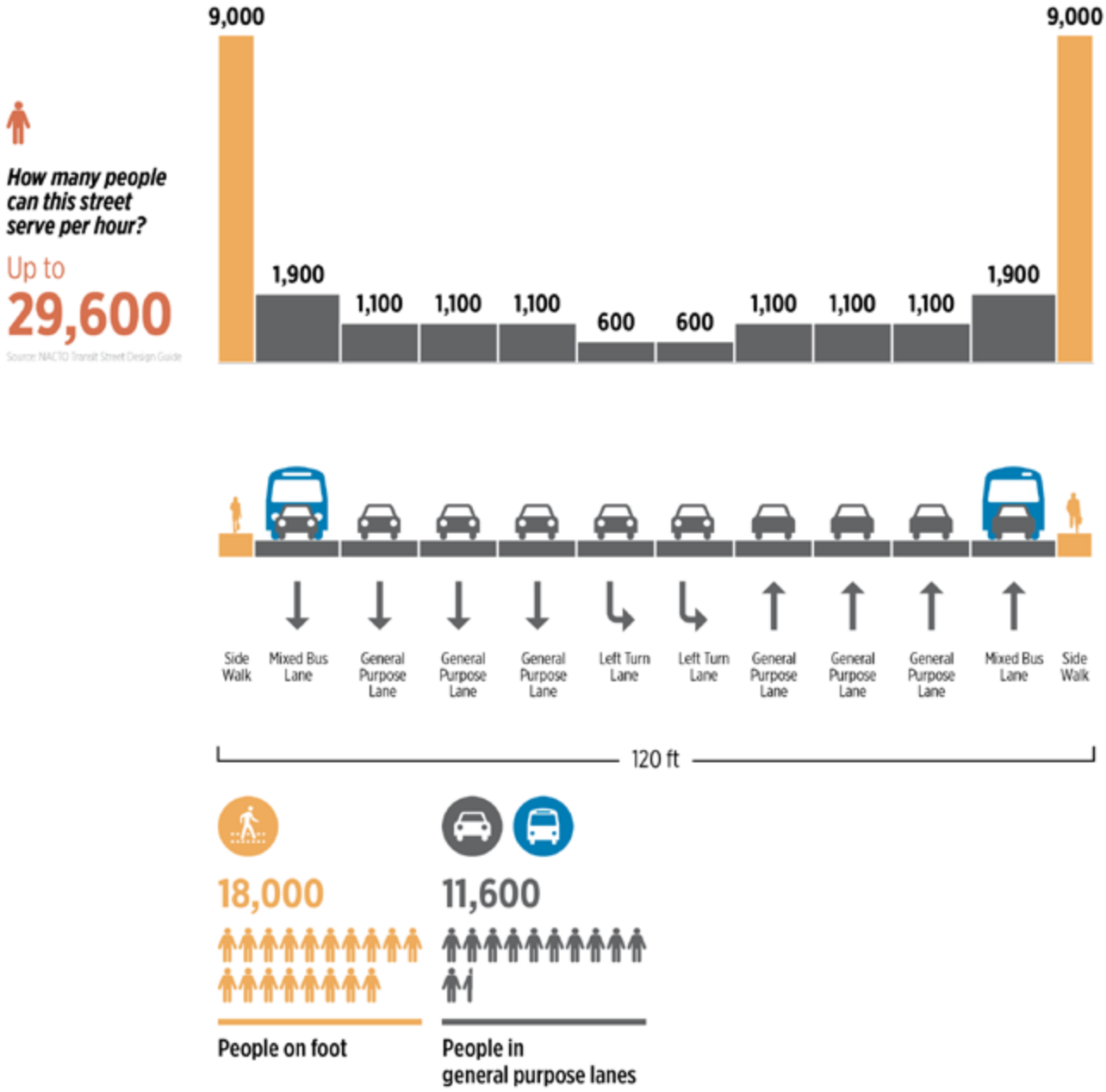


FIGURE 10: PRESENT WILSHIRE BOULEVARD ROADWAY CAPACITY[37]

CASE STUDY / WILSHIRE BOULEVARD

Wilshire Boulevard, proposed

The proposed re-design includes the introduction of lanes dedicated to autonomous transit vehicles, with space for loading and exchange, separated bicycle tracks, and increased space for pedestrians and vegetation. By focusing on low-cost, high-frequency mass transportation options, the same street is able to serve more than two times as many passengers within the same right-of-way.

The options available to people for moving along the street are increased dramatically, including active transportation modes that support a high quality of life and street activity. In this future scenario, nearly three times as many people can be accommodated along Wilshire Boulevard, with the biggest shift resulting from the rededication of lanes predominantly used today by single-occupancy cars to instead accommodate shared transit (Refer to Figure 11).

Future /

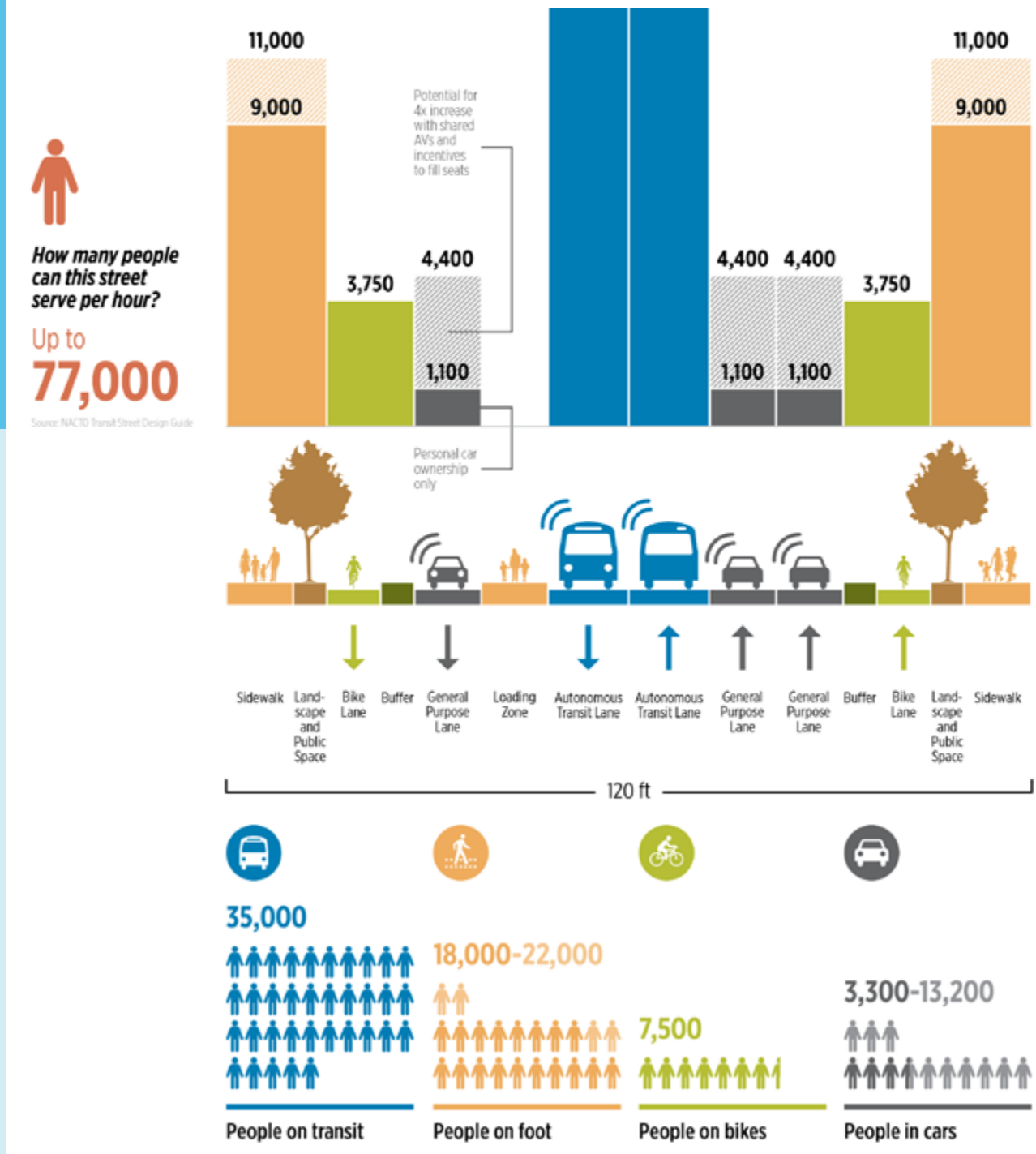
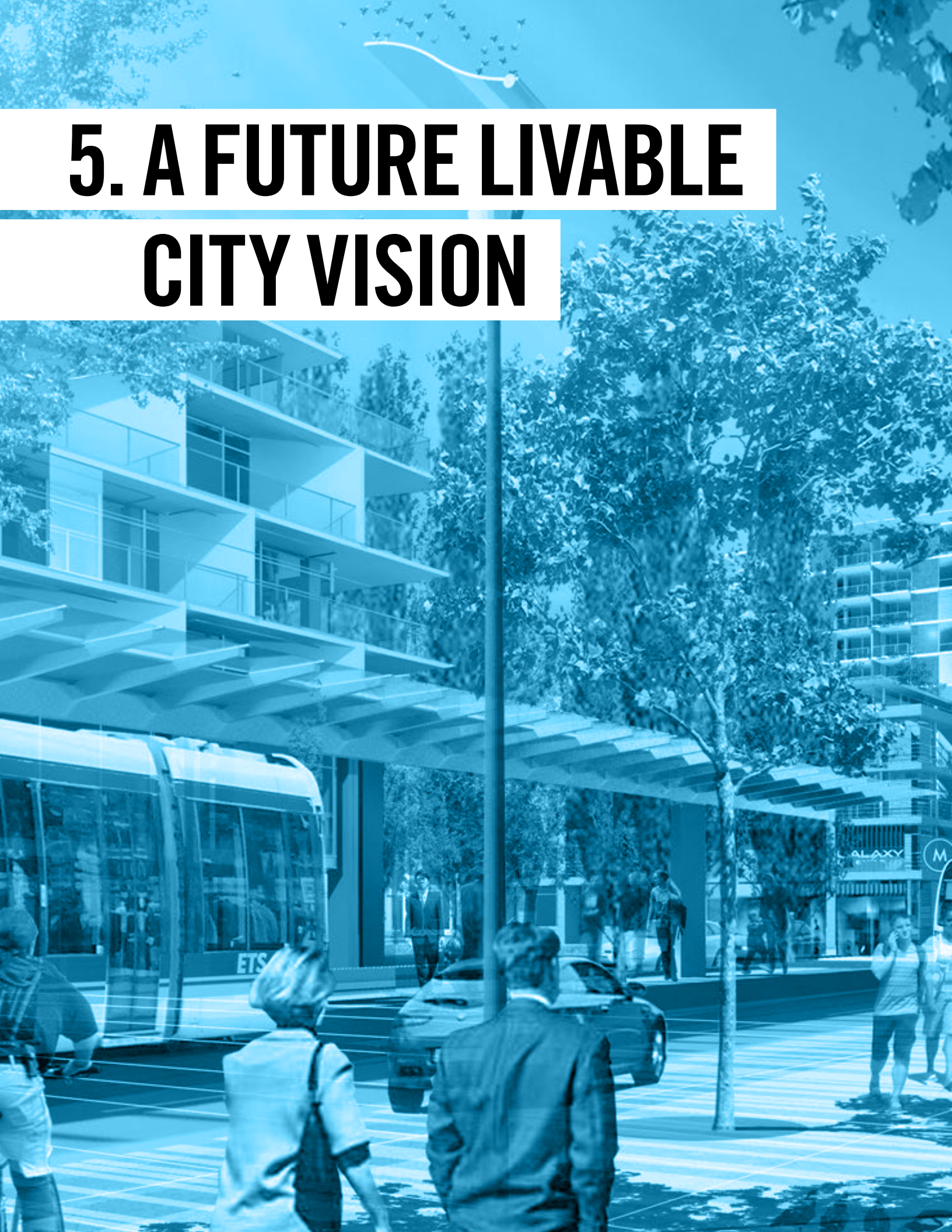


FIGURE 11: FUTURE WILSHIRE BOULEVARD ROADWAY CAPACITY[38]

5. A FUTURE LIVABLE CITY VISION

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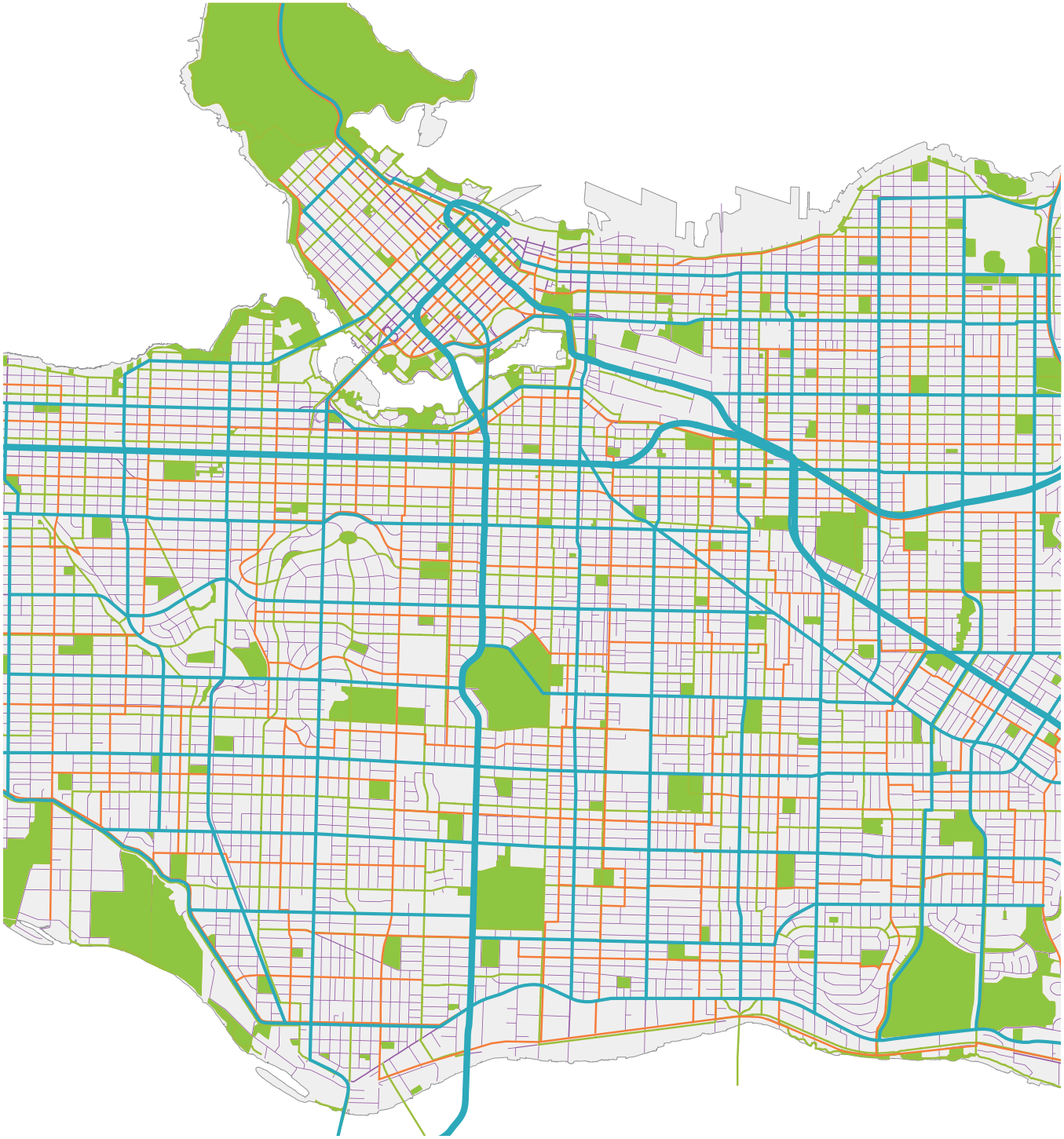


Future Vancouver Street Network

A future livable city vision

We propose a strategy that eliminates the need for private automobiles and repurposes our cities to allow for a full and invigorating public life.

Using Vancouver, British Columbia as the site for this thought experiment, we have imagined a future city that embodies the livable city principles and integrated approach to mobility described throughout this report.

Our future vision for Vancouver dramatically reimagines how we live and move around our city. We believe it is possible to travel easily and enjoyably through a resilient urban environment that is safe for our children, supports local economies and promotes social equity. Transportation accounts for one quarter of Canada's Greenhouse Gas (GHG) emissions and more than one third of the City of Vancouver's GHG emissions. We propose a strategy that eliminates the need for private automobiles and repurposes our cities to allow for a full and invigorating public life. Our work is based on the mobility principles discussed throughout this report including an emphasis on shared modes, prioritizing high occupancy vehicles, putting active transportation first, and incentivizing low carbon mobility.

We recognize that the city is an always-evolving organism—never a completed project and never achieving an idealized state. This vision is intended to describe some of the design opportunities identified elsewhere in this report at the larger city scale and highlight some of the benefits that could be realized. Ultimately it will require a shift in policy, design, and behavior by all of us to realize the potential benefits that are possible in a new mobility future.

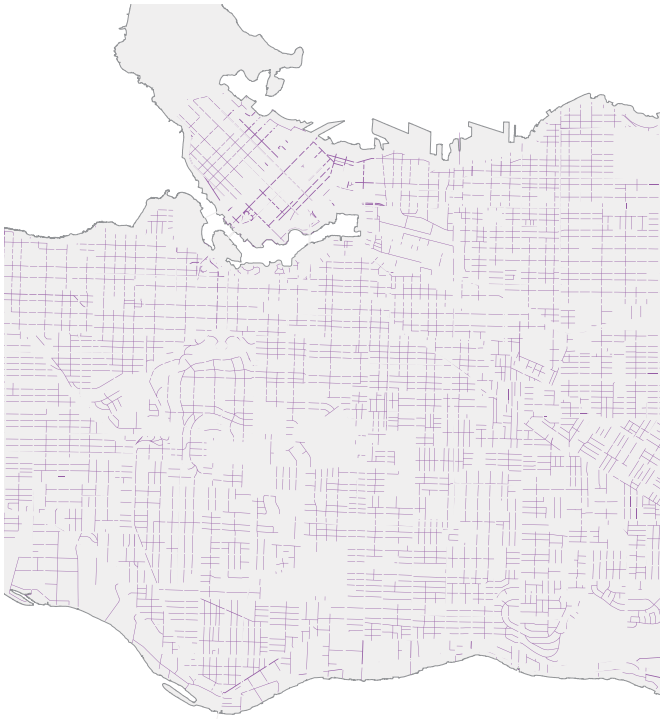
As the saying goes, Rome was not built in a day—but the design decisions we make today will have profound impacts on the evolution of our cities. We need only to look back 100 years on the emergence of the private automobile as our primary form of transportation to understand the significant role mobility has in shaping the life of our cities.

High-frequency transit streets

An extensive network of transit priority corridors bring high speed, efficient transportation within a five minute walk of 96% of city residents. The mixed-use urban districts that emerge along these networks are highly walkable and support a mix of amenities, jobs, and services.

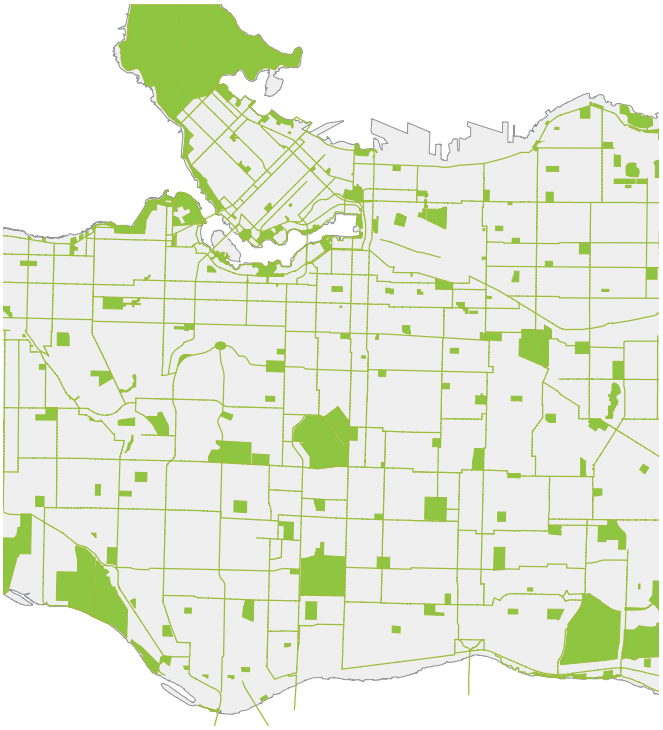
Secondary streets

A network of secondary streets continues to support vehicular movement, servicing and deliveries throughout the city, with access to shared modes allowing existing parking and curbspace to be freed up for other uses. Automobiles are still a vital part of urban functions, but are less dominant in everyday urban life.



Shared streets

Underutilized roadways previously reserved only for vehicles are reclaimed to allow for a variety of purposes such as green space, community gathering and places for children to play. Dynamic management allows these flexible spaces to alternate between public and service uses as needed.



Green corridors

An expanded bicycle and active transportation network provides a well-connected system of green spaces within the city. These reclaimed streets support biodiversity and habitat areas while providing a connection to local and regional parks for residents.

Shared

With an extensive shared mobility network, space that was previously reserved solely for the use of moving and storing cars is reclaimed for green space and biodiversity corridors, space for sustainability infrastructure, affordable housing and development, and places for play and gathering.

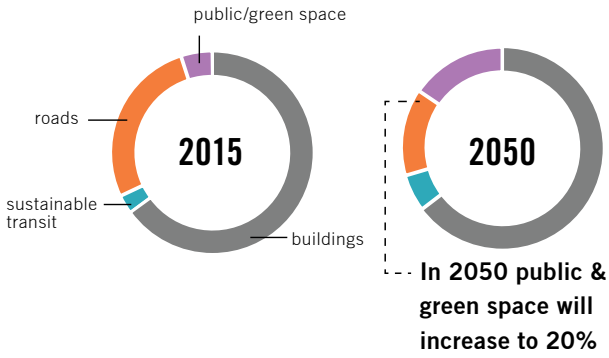


FIGURE 12: ALLOCATION OF PUBLIC REALM

Multi-Occupancy

An extensive network of automated transit priority corridors brings high-speed and efficient public transit within a 5 minute walk of nearly every city resident. The urban districts that emerge around these corridors are highly walkable and support a rich mix of housing, amenities, jobs and services.

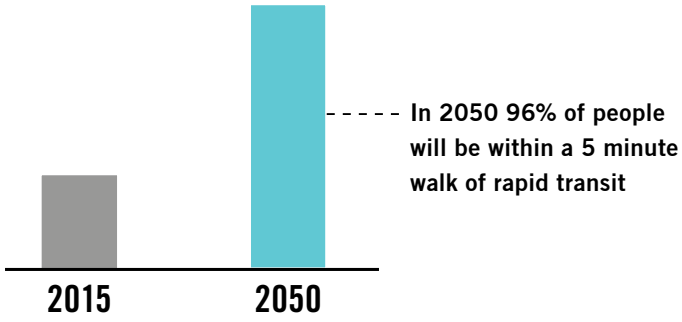


FIGURE 13: PERCENTAGE OF POPULATION WITHIN WALKING DISTANCE OF RAPID TRANSIT

Active Transportation

The existing bike network is extended and well connected as a system of bicycle priority corridors. Biodiversity corridors are integrated with these streets and connect residents to local and regional parks, and habitat areas.

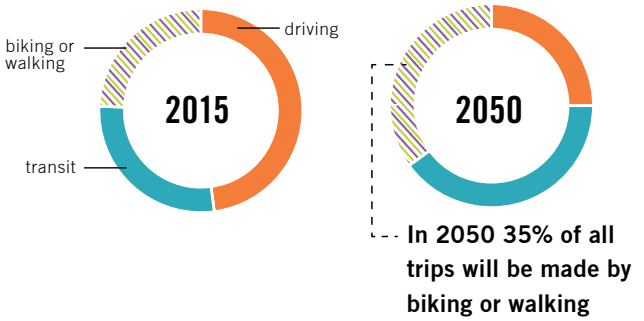


FIGURE 14: TRANSPORTATION MODE SHARE[39]

Low Carbon

With an abundance of options for public transit and active mobility, cars are still a vital part of urban functions but are less dominant in city life. Extensive charging infrastructure supports a predominantly electrified fleet of vehicles on the city's streets.

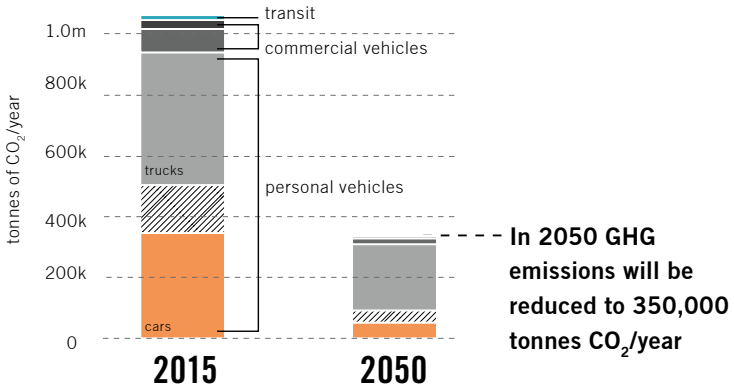


FIGURE 15: CO_2 EMISSIONS BY TRANSPORTATION MODE[40]

We are at an exciting and important moment in the evolution of urban mobility. Mobility disruptions already underway serve as a call to action for all of us—we each have an important role to play in shaping this future through design, planning, engineering, and broader behavioral shifts. It is important to remember that the future impact of emerging trends are not predetermined—rather these technologies are a tool to be leveraged to achieve this livable city vision. By focusing on a principled and people-first approach to re-shaping mobility, we believe that we will achieve a more livable and sustainable future city to pass on to the next generation.

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