



**Policy of today,  
mobility of tomorrow:  
Global Mobility Policy Index**

## **Future Mobility IL**

December 2019



Future Mobility IL (FMI) is a nonprofit, public benefit organization established in 2018 that puts Israel at the forefront in effective and sustainable MAAS (Mobility as a Service) implementation.

The organization advances economically beneficial and competitive traffic congestion solutions and strives to reduce the number of traffic accidents, decrease the emission of pollutants associated with motorized vehicles, and cut transportation costs for both people and goods. By reducing traffic congestion, FMI garners social, environmental and economic benefits while spearheading long-term change in Israel and abroad. Creating a platform that brings together relevant stakeholders including the public, the non-profit sector, research and academic institutions, technology companies, infrastructure companies, industry, trade, investors and others – FMI joins the needs of the different sectors while ensuring the implementation of easily adopted solutions that positively impact the wellbeing of individuals and the economy.

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# Preface

Israel is said to suffer the worst traffic congestion among the OECD (Organization for Economic Cooperation and Development) countries.<sup>1</sup> Even though public transportation ridership is at 850 million a year, only 21% of commuters choose public transport while 69% choose their private vehicle<sup>2</sup>. According to government officials, the estimated cost of traffic congestion to the economy is upwards of \$10 billion per annum.

These challenges are not unique to Israel. Traffic rates, costs and pollution have been steadily increasing in cities throughout the world due to poor public transportation infrastructure, immense private vehicle usage and lack of emphasis on the use of its alternatives. However, policymakers around the world have performed tremendous work and this has allowed some cities to maintain efficient transport systems and mobility alternatives for their residents.

As a public policy organization, Future Mobility IL understands that all existing systems are the result of proper policymaking. For this reason, we have chosen to research the mobility policy of the most sustainable and innovative cities around the globe. This research is meant to provide the necessary data to reflect a comprehensive view of mobility policy in 21 cities, ranked by their level of pro-activity and innovation. This research may assist city mayors, transportation authorities and government officials in improving their understanding of the field and assist them in making better decisions for the benefit of the citizens. The information may also interest other public and private sector organizations that are involved in the transportation and mobility fields.

# Executive Summary

## Methodology ▶

### 21 cities

Chosen for innovation in the field of sustainable mobility and their efficient transportation systems.

### 8 Mobility elements

Mass Transit

Parking

Tax Incentives

Shared Transportation

Shared Micro-mobility

Future Of Cars

MaaS Support

Walkability

## Top ranked city ▶



### London

Demonstrating activism in the majority of the Global Mobility Policy Index elements, placing public transport in the center and supporting it with complementary steps. Showing great openness for innovative ideas and unpopular policy measures.

## Followed by ▶



### Helsinki

Known for its pioneering and comprehensive MaaS solution.



### Singapore

Pioneer in congestion tax together with great approach towards AVs.



### Amsterdam

Offers efficient and public transport alongside other shared mobility solutions.



### Oslo

Strict parking policy combined with congestion tax and LEZs.

## The bottom of the list ▶



### Moscow

Great bus system is not enough, in the city that prefers cars over pedestrians.



### Boston

Although many TNCs operate in the city, its tax policy still supports private car.



### Tel Aviv

Micro-mobility prosperity can't cover the lack of public and shared transport solutions.



### Seattle

Shared mobility is well developed, but public transport is still behind.



## Policy recommendations ▶

Cities have to improve **bus systems**. The key to efficient and fast public bus transport are bus priority methods via traffic lights or by bus lanes. To allow a smooth and integrated journey, technology innovations in digital payments or smart fare systems may be helpful. Technology innovation may be also helpful for enforcement of policies.

Adequate **parking policy** which is based on limiting parking spots and raising their prices – is the key for reducing incentives for private car use. Parking minimum requirements should be removed and replaced with parking maximum.

**Tax Incentives** are the basis of every MaaS ecosystem. Technology innovations assist in collecting road pricing fares remotely and refrain from investing in expensive infrastructures. Revenues should be re-invested in public transport and other private car alternatives. Moreover, defining low emission zones should reduce air pollution and balance the congestion in city centers for the mid-term (until clean vehicles presence will be dominant).

**Shared transportation** is an effective alternative to the use of private vehicle with a single driver. Although TNCs may contribute to traffic congestion, correct regulation which taxes empty trips will balance its negative effects. Private and semi-private micro-transit initiatives shall supplement public transport and may replace regular buses in low density zones. Finally, carpool incentives should be offered to increase carpool usage rates.

**Micro-mobility** is a great 'first, last mile' solution, and more. Users demonstrate their desire for use of micro-mobility tools and policymakers should take this into consideration. However, order must be restored. Adequate regulation that keep the sidewalks for pedestrian only should be drafted, alongside investments in infrastructure that separate micro-mobility users from cars.

**Electric and autonomous vehicles** are important foundations of the mobility revolution by lowering emissions, minimizing car accidents and providing cost savings for MaaS suppliers. Government goals and roadmap should be published, setting targets for car sellers and the automotive industry. Subsidy packages for electric vehicles should be offered to create a critical mass in the market. Charging infrastructure is a field where

**MaaS** is not a far-fetched dream. Private car alternatives mixed with technology innovations created a convenient ground for MaaS services, and they indeed spring like mushrooms after the rain. The key is to demand that mobility providers share their data, upgrade the ticketing systems to be fully digital and allow the selling and payment for public transport tickets via third parties.

**Walkability** is most natural method and the basis of every trip plan, whether it's by public transport, private car or micro-mobility. Therefore, streets should be adjusted for pedestrians, including shades corridors, trees and wide sidewalks that create walkable environment. Policymakers should remember that not every street has to allow the passage of cars - pedestrian only areas are a huge success in city centers with high pedestrian volume.

# Methodology

21 cities were chosen for innovation in the field of sustainable mobility and for their efficient transportation systems according external researches. Tel Aviv was added to the list of cities, as the representative and center of the most congested metropolitan in Israel, the main focus of Future Mobility IL work.

Our goal was to research the policy and regulation standards that led these cities to become global leaders of the mobility world. The research focused on mobility elements: Mass Transit; Parking; Tax Incentives; Shared Transportation; Shared Micro-mobility; Future of Cars; MaaS Support; and Walkability. Some of the elements are a combination of several sub-elements: “Mass Transit” represents public transport bus service and other mass transit systems, “Tax Incentives” represents congestion fees and low emission zones, “Shared Micro-mobility” represents shared bikes and e-scooters, and “Future of Cars” represents electric vehicles and autonomous vehicles. The mobility puzzle includes many other fractions which certainly have major influences on this field, such private micro-mobility or traffic management, however, under the scope of this research they are not covered. We also added a bonus topic - Working Hours Flexibility, that in our perception is a key mobility policy that has a strong influence on congestion. This topic research was not limited to the 21 researched cities only. To gather the information, we used publicly available information, including media reports, press releases and other reports, as elaborated at the Endnotes chapter.

Each of the elements was researched by several metrics, such as innovation, openness of regulation, enforcement and efficiency. The metrics are unique to the subject they assess. Where local governments or municipalities lack the ability to outline policies, we have researched the wide-country or state position. This mainly involve autonomous and electric vehicles.

After processing the data, we used external advisers and Future Mobility IL’s internal knowledge for complete the following:

1. Weigh the elements according their importance in shaping the entire mobility policy and the influence they have on mobility in practice.
2. Rank the elements according the metrics that were researched and provide them with a number between 1-5. At the time of writing, we assume that the data we possess is sufficient to provide the ranks of 1,3 and 5 only. We expect to extend the ranking diversity in the following research. Ranks as 2 or 4 are shown where an average between 2 sub-elements was determined.
3. Combine the weights and ranks in order to form the Global Mobility Policy Index.

This paper summarizes some of the findings in the researched subjects:

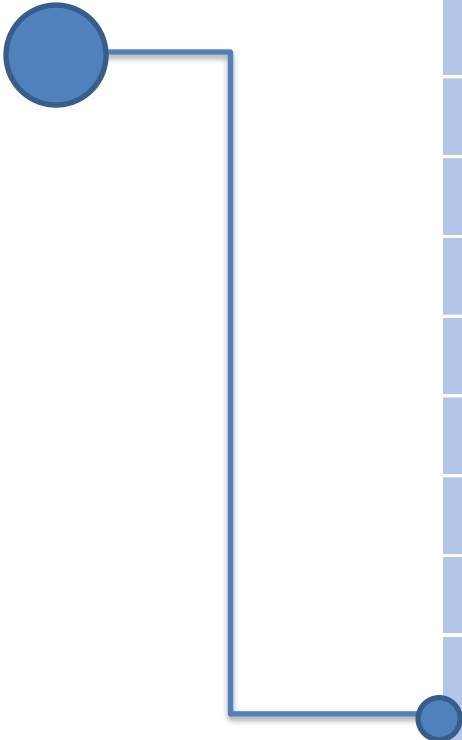
1. **Public Transport Bus Service:** As Israel's public transport system relies mainly on bus service, we focus on this topic rather than other mass transit systems, although the Global Mobility Policy Index includes all transit systems. We cover operational systems such as BRT and BHLS and bus priority systems that support it; the creation of bus lanes or busways, the enforcement measures taken to minimize the use of other vehicles and the permit given to some; the ticketing systems, in particular those that allow for smooth pay and switch between alternative suppliers.
2. **Parking:** On-street parking management regimes, including elimination of parking spaces and raising parking prices; parking minimum requirements, as per the global trend of replacing them with parking maximum requirements; innovations in the field of parking space and demand-responsive pricing.
3. **Tax Incentives:** Congestion fee, its efficiency and the issue of reinvestment of its revenues; enforcement measures taken; low emission zones that reduce pollution.
4. **Shared Transportation:** Regulation for transportation network companies; the government taxation systems designed to cope with externalities and increased congestion; backlash; car-sharing and carpooling services; micro-transit services.
5. **Shared Micro-mobility:** The "first and last mile" solution; bike-share services, private and cities-owned; e-scooters and their dominant across cities.
6. **Future of Cars:** Electric vehicles - National programs to boost the disruption of electric vehicles; government goals; incentive for clients and tax reduction given by governments. Autonomous vehicles - Mass transit pilots, as the forefront of implementation efforts; national legislation that supports the technology development; pilot sites that allow better playground for the tools.
7. **Support of Maas:** API's for maps and other services; open data, as a catalyst for implementation; MaaS platform as the aggregator of all services and seamless ticketing and payment methods support diverse alternatives and increase attraction.
8. **Walkability:** Walkable city structure, which may contain green spaces and areas for pedestrian only; safety measures taken by cities to mitigate pedestrian collisions; investments made by cities to improve walkways and incentivize people to walk more.
9. **Bonus: Work Hours Flexibility:** Although not one of the Global Mobility Policy Index elements, we cover in this paper the importance of flexible work hours as a transport demand management method; government initiatives to support employers that change the work hours of their employees in order to reduce the number of cars; overtime laws that serve as a barrier to flexible work hours; suggested plans and pilots been conducted around the world.



## Global Mobility Policy Index elements, weights, sub-elements and metrics

Element	Weight	Sub-element	Metrics		
Mass Transit	18%	Public Transport Bus Service	<ul style="list-style-type: none"> <li>Bus Operations</li> <li>Enforcement</li> <li>Funding</li> <li>Inclusion of other Vehicles</li> </ul>	<ul style="list-style-type: none"> <li>Hours</li> <li>Speeds</li> <li>Length</li> <li>Technologies</li> </ul>	<ul style="list-style-type: none"> <li>Public Opinion</li> <li>Segregation</li> <li>Side</li> <li>Ticketing</li> </ul>
		Other Mass Transit Systems	<ul style="list-style-type: none"> <li>"Public transport supply" rank in 2019 Deloitte City Mobility Index</li> </ul>	<ul style="list-style-type: none"> <li>"Public transport reliability" rank in 2019 Deloitte City Mobility Index</li> </ul>	
Parking	13%	-	<ul style="list-style-type: none"> <li>Parking Price</li> <li>Parking Policy</li> <li>Responsibility</li> </ul>		
Tax Incentives	13%	Congestion Fee	<ul style="list-style-type: none"> <li>Congestion Fee</li> <li>Reinvestment</li> <li>Other Forms of Traffic Control</li> <li>Revenue</li> </ul>	<ul style="list-style-type: none"> <li>Exemptions</li> <li>Effectiveness</li> <li>Responsibility</li> <li>Technology Used</li> </ul>	
		Low Emission Zone	<ul style="list-style-type: none"> <li>Exemptions</li> <li>Low Emissions Zone</li> <li>Reinvestment</li> </ul>		
Shared Transportation	13%	-	<ul style="list-style-type: none"> <li>Active TNCs</li> <li>Non-Rideshare Regulation</li> <li>Basic Regulations</li> <li>Amount of Operating Vehicles</li> </ul>	<ul style="list-style-type: none"> <li>City Approach</li> <li>Operation Limit</li> <li>Amount Trips</li> <li>Start/Stop of Operation</li> </ul>	<ul style="list-style-type: none"> <li>Insurance</li> <li>Licensing</li> <li>Backlash</li> <li>Tax</li> </ul>
Shared Micro-mobility	13%	Bikeshare	<ul style="list-style-type: none"> <li>Amount of Operating Vehicles</li> <li>Fines and Enforcement</li> <li>Helmet Requirement</li> <li>Companies Operating</li> </ul>	<ul style="list-style-type: none"> <li>Parking</li> <li>Amount of Users</li> <li>Licensing</li> <li>Types of Vehicles</li> </ul>	<ul style="list-style-type: none"> <li>Age Limit</li> <li>Areas to ride</li> <li>City Investment</li> <li>Prices</li> </ul>
		E-Scooters	<ul style="list-style-type: none"> <li>Companies Operating</li> <li>Amount of Operating Vehicles</li> <li>Fines and Enforcement</li> <li>Helmet Requirement</li> </ul>	<ul style="list-style-type: none"> <li>Age Limit</li> <li>Amount of Users</li> <li>Ride/Speeds Areas</li> <li>Parking</li> </ul>	
Future of Cars	10%	Electric Vehicles	<ul style="list-style-type: none"> <li>Amount of Total cars</li> <li>Percentage of Total cars</li> <li>Tax Reductions/Incentives</li> <li>Local Initiatives</li> </ul>	<ul style="list-style-type: none"> <li>National Programs</li> <li>Gov. Goals</li> <li>Infrastructure</li> </ul>	
		Autonomous Vehicles	<ul style="list-style-type: none"> <li>Experiments</li> <li>National Funding</li> <li>National Legislation</li> <li>Pilot Site</li> </ul>		
MaaS Support	10%	-	<ul style="list-style-type: none"> <li>API's</li> <li>Open Data</li> <li>MaaS Platform</li> <li>Seamless Ticketing</li> </ul>	<ul style="list-style-type: none"> <li>Payment</li> </ul>	
Walkability	10%	-	<ul style="list-style-type: none"> <li>Effect on People's Behavior</li> <li>Walking Paths Policy</li> </ul>		

# Index Results



<b>Position</b>	<b>City</b>	<b>Rank</b>
1	London	4.56
2	Helsinki	4.48
3	Singapore	4.44
4	Amsterdam	4.36
5	Oslo	4.36
6	Stockholm	4.35
7	Madrid	4.26
8	Paris	4.1
9	Seoul	4
10	Berlin	3.97
11	Tokyo	3.91
12	San Francisco	3.8
13	New York City	3.77
14	Milan	3.69
15	Sydney	3.34
16	Chicago	3.32
17	Hong Kong	3.02
18	Moscow	3.01
19	Boston	2.85
20	Tel Aviv	2.84
21	Seattle	2.82

# Mobility Policies





# Public Transport Bus Service

Many cities are improving their city infrastructure to decrease congestion and become more sustainable. There are many options cities have to improve bus systems, such as seamless and digital ticketing services, physical barriers or painted lines between lanes, Smart Bus Priority technology — which prioritizes public transport at traffic stops — and many other innovative features. These systems exist with features designed to prioritize productivity, speed, or comfort.

There is a spectrum for how many of the following strategies a city may wish to implement. A city may choose which features to include without implementing a full change, i.e. creating separated roadways for only peak congestion hours.

## Operational Systems

There are two main types of bus systems in use. The Bus Rapid Transit (BRT) system, incorporates smart traffic technology, separated lanes for buses, payment systems prior to boarding, and prioritizes speed and comfort to increase ridership and rates of arrival.<sup>3</sup> A Bus with a High Level of Service (BHLS) system, focuses more on reliability and quality rather than speed.<sup>4</sup> This involves features such as comfortable seating arrangements, WiFi on board and other attributes that affect the passengers ride experience. Many cities have adopted some, but not all of these features, such as smart traffic technology and precision curb docking, but not full separate lanes. Oslo, for example, has vehicles that are long and flexible allowing for sharp turns as well as 4 entry/exit doors to decrease the time spent boarding/departing the vehicle.<sup>5</sup>

## Bus lane vs. Busway

The difference between a bus lane and a busway is the type of structure which divides the lane from the rest of the road. A bus lane is simply divided with paint or signs rather than a physical barrier. A busway with a physical barrier separating it is easier to enforce but far more costly.<sup>6</sup> A painted lane or signage can easily be removed or painted over if the lane proves ineffective.<sup>7</sup> However, a busway may be safer as it prevents other

vehicles from turning or stopping in the busses' path.<sup>8</sup>

## Enforcement Measures

Several cities around the world use camera-based enforcement to monitor the exclusion of other vehicles from using or parking in the separated bus lanes. This enforcement can be operated by the municipal government or a privately contracted company. The local police department or a traffic control agency may also be in charge of these measures with tickets and fines to control public adherence. The city of Helsinki currently installing 70 new traffic enforcement cameras for automatic traffic control.<sup>9</sup>

## Inclusion of Other Vehicles

Rules regarding the use of other vehicles in the bus-only lane drastically vary across the globe. Almost all allow the inclusion of emergency vehicles. Some allow turning vehicles or taxis loading and unloading passengers, while others allow various High Occupancy Vehicles to use the lane. Some cities allow other vehicles to enter the lane during non-peak congestion hours, for example, Hong Kong.<sup>10</sup> One tactic is to have a mix of completely separated lanes and some that only run during certain hours depending on traffic. The inclusion of bicycles in bus-only lanes is controversial because some consider it a safety hazard.

## **Ticketing System**

Advanced ticketing systems may be called by different names such as Smart Ticketing, Seamless Ticketing and eTicketing. It's not just about replacing the paper tickets, but providing passengers the ability to load, in a single device (smart card, mobile phone, credit card, smart watch) multiple tickets and subscriptions, without having to deal with ticket sale points and be able to switch between suppliers smoothly. The system may use interoperable smart fare management (such as prepaid single or multiple tickets, pay-as-you-go, and post-pay) to ease the complexity of different zones and perhaps save costs. The media used have high transaction speed, low operational costs, as well as greater efficiency and security. Moscow has significantly improved its ticketing system by launching a unified chip card "Troyka," which is currently used by more than 90 percent of passengers. In the last few years a variety of alternative payment methods were added, including credit card, Pay Pass/Pay Wave, Apple Pay/Samsung Pay/Android Pay, and Yandex Money. Helsinki's public transport authority, HSL, has published its mobile app HSL Mobile which offers to buy HSL single tickets and day tickets conveniently directly to the mobile phone. Later, MaaS Global established "Whim" app, which uses HSL mobile ticket and combines it with other services such as taxis, city bikes and car rentals.

## **Bus Priority**

Bus priority or transit signal priority (TSP) are methods used to coordinate transit vehicles and traffic signals to reduce the time buses are stopped at traffic lights along a corridor and therefore improve bus travel times. There are many technologies available these days and many suppliers are eager to implement their products at local municipalities and governments. Chicago uses timesaving features include queue jump signals to give buses a head-start at intersections. Tokyo implemented PTPS – (Public Transportation Priority Systems), which gives priority to public transport such as buses by means of bus lanes, warnings to vehicles which are illegally running in the bus lane, and traffic signal preemption. According to NYCDOT, after implementing TSP technologies in hundreds of interchanges around New York, bus travel times were reduced by 14% during weekday peak morning and evening commuting periods. Results vary by corridor and time of day, but can range from 0.7 percent to a 25 percent reduction in travel times.<sup>11</sup>

## **Public Opinion**

Increased speeds and improvements in passenger experience on board has increased passenger use and opinion across the board. A more reliable service for commuters with technology that accurately represents bus times and whereabouts is key to consumer satisfaction.<sup>12</sup> Boston ran a pilot bus lane program and 94% of riders said they wanted the program made permanent after travel times were decreased by 25% during rush hours.<sup>13</sup>

# Cities Performance

## Bus Service

### High Performance

Amsterdam	Berlin	Helsinki	London
Moscow	New York City	Paris	San Francisco
Seoul	Singapore	Stockholm	Sydney

### Medium Performance

Chicago	Hong Kong	Madrid	Milan
Oslo	Tel Aviv	Tokyo	

### Low Performance

Boston	Seattle
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## Other Mass Transit

### High Performance

Oslo	Tokyo	Helsinki	Madrid
Singapore	Stockholm	Hong Kong	

### Medium Performance

Chicago	Paris	Milan	Seoul
Tel Aviv	San Francisco	London	Amsterdam
Berlin	Moscow	New York City	Sydney
Boston	Seattle		

### Low Performance



## Key Stories

New York City has 305 cars per 1,000 citizens (8.5 million people in total).<sup>14</sup> It is estimated that “New Yorkers ride the bus over two million times each weekday.”<sup>15</sup> The city has a select Bus Service which incorporate features of Bus Rapid Transit (BRT) such as dedicated bus lanes, off-board fare collection, and transit signal priority to offer faster and more reliable service on high-ridership bus routes.<sup>16</sup> While New York buses are currently among the slowest in the country, a 2019 proposal, the “Better Bus Action Plan,” is set to improve bus speeds by 25%.<sup>17</sup> The money for this program goes to the Metropolitan Transit Authority (MTA) which receives its funding from state taxes and tolls.<sup>18</sup> The MTA and New York Police Department are collectively in charge of monitoring a camera-based enforcement system of the bus lanes. With the addition of separate bus lanes, average travel times have been reduced by 12% at peak hours. There is a total of 50 miles of Bus Priority networks with more expected in the coming year.<sup>19</sup>

Amsterdam has a population of 2.3 million people in the greater Metropolitan area. It has 37 kilometers of separated bus lanes with fare integration technology for easy transfer between other modes of public transport. The system uses BRT and BHLS technology with precision curbside docking and an integration with the rail system. The BRT network was called Zuidtangent (now “R-Net”) and it contains two key routes, with over 40,000 passengers per day.<sup>20</sup> Since its installation, there has been a 47% increase in ridership.<sup>21</sup>



# Parking

Parking is one of the key elements of car-use behavior nowadays, and it affects other mobility segments, such as public transport and walkability. The parking issue grows from year to year as a result of the increased use of vehicles and the development of urban areas. Today, parking policies and proper transportation system regulations are an integral part of major cities planning.

## **On-Street Parking Management Regimes**

Increasing the price of parking or altering rates depending on congestion times incentivizes people to use public transportation instead of a car. New York City is notorious for its extremely high price of parking (\$32.97 for just two hours). Amsterdam plans to remove 11,200 parking spaces from the city center, increase the parking prices as well as increase the price of residents permits to park within the city. The space will be used for bike lanes, trees and wider sidewalks. Oslo has removed over 700 parking spots and replaced them with bike lanes. Helsinki's price for residential parking permits has been rising since 2014 and will continue to rise until 2020, raising the price from €120 to €360 per year. This trend can be seen in other cities such as Singapore, New York City and London. Researches state that by ensuring that around 20% of parking spaces are available at any given time, much of the cruising in the city will vanish<sup>22</sup>. Seattle follows this and adjusts meter rates to reach the goal of two open spaces per block. Performance-based parking program sets rates between a minimum of \$1.00 per hour and a maximum of \$4.00 per hour. The SDOT director has the authority to set rates within these amounts by location, time of day, and other considerations.

## **Parking Minimum**

Parking minimums (also called minimum parking requirements) do not in fact solve the on-street parking problems they are intended to solve. Without parking minimums, park-

once-and-walk districts with "Walkable Parking" can emerge in formerly car-dominated locations, which helps foster a transition to more multimodal transport.<sup>23</sup> In 2016, Tel Aviv amended its Building and Planning Law and changed the parking minimum to parking maximum. The standards for commercial and business uses saw a reduction in required parking spots, as opposed to residential uses, since owning a private vehicle in household was still considered a basic need. San Francisco only lately eliminated parking minimum, joining other big cities in the United States in doing so.<sup>24</sup> In Tokyo, the law requires residents to prove they have access to a local parking space and obtain a "parking space certificate" in order to register a car.<sup>25</sup>

## **Innovation**

Cities around the globe are implementing innovative solutions that are both helping the user experience and the parking management efforts, in order to implement a new and pioneering parking policy. In 2011, San Francisco implemented the SFpark initiative that included demand-responsive pricing, a mobile app that informs the drivers about available parking space, pay by phone options and an open data code. In Sydney, drivers spend an average of 156 hours per year searching for parking. The city is installing a number of smart parking elevators to increase overall parking capacity, while eliminating on-street parking. In 2016, Berlin began a pilot program in partnership with Siemens' Mobility Division, for detecting open parking spaces by radar-



based systems. Data from the sensors is transmitted via mobile radio sensors to

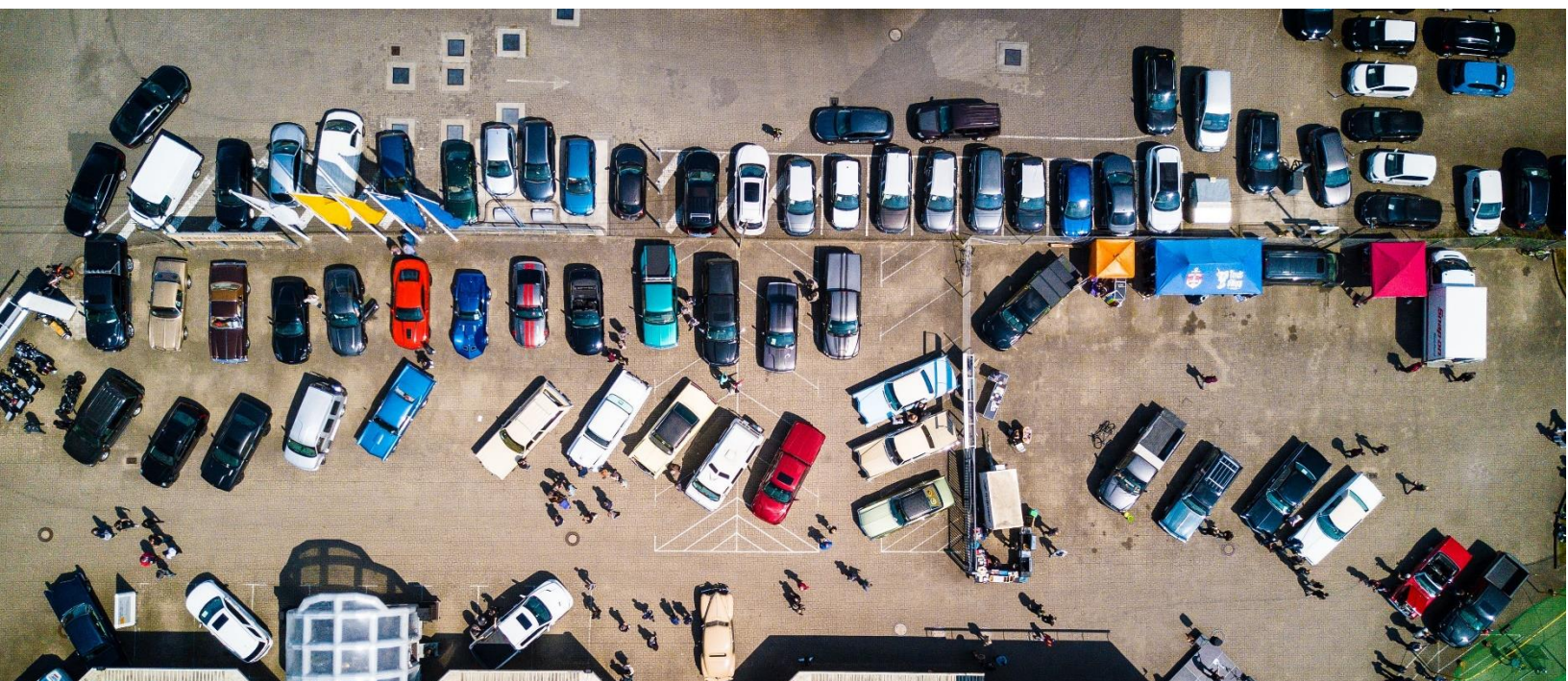
Berlin's traffic management control center, and from there, via an app to the users.<sup>26</sup>

## Cities Performance

Parking									
High Performance				Medium Performance				Low Performance	
Amsterdam	Chicago	Helsinki	London	Berlin	Boston	Milan	Moscow	Hong Kong	Tel Aviv
Madrid	New York City	Oslo	Paris	Stockholm	Seattle				
San Francisco	Tokyo	Seoul	Singapore						
Sydney									

## Key Stories

San Francisco Municipal Transportation Agency (SFMTA) adopted in 2017 the 'Demand-Responsive Pricing Program' which uses 'smart pricing' to vary the level of parking charges based on demand. This expanded a trial program, SFpark, from 7,000 of the city's parking meters to the full 28,000. Under the trial program, blocks that continually exceeded 80% occupancy incurred a \$0.25 hourly price increase, prices at blocks with medium-high occupancy of between 60-80% stayed the same, while those under 60% occupancy decreased in cost by \$0.25 per hour. A minimum meter charge of \$0.50 per hour and maximum of \$8.00 represented the lower and upper charge limits of the system. Meters were 'connected' through wireless sensors and charges were varied by block. The impacts of the trial were impressive. Cruising declined by 40%, the number of blocks at parking stress fell by 16% and the utilization of underutilized blocks increased by 31%. Moreover, the city generated an additional \$2 million in net parking revenue per year despite average meter rates falling by 4% and city-owned garage rates falling by 12% based on pre-dynamic pricing levels.<sup>27</sup>



# Tax Incentives

In an effort to reduce traffic and pollution and increase public transportation and other alternatives, cities throughout the world have implemented congestion fees. A congestion fee is a charge which a city applies to vehicles that enter a predefined zone within the city limits, typically the city center. While the times of effect, the pricing, and the regulations vary from city to city, the basic scheme remains the same. Presently, only a handful of cities charge congestion fees. While most cities do not charge for congestion, many cities, specifically in Europe, do have low emissions zones in city center areas in an attempt to reduce pollution.

## **Congestion Fee and Reinvestment**

After paying the operations costs, cities usually reinvest the money raised from congestion fees into city infrastructure and/or public transportation. In Milan, over 60% of the funds were transferred to improving public transportation while over 20% went to the development of sustainable mobility.<sup>28</sup> Oslo has a similar method while London puts more than 80% of funds into public transportation.<sup>29</sup> In every city, traffic has been greatly reduced in the taxed area. Singapore saw a 24% drop in cars on the road in the taxed area and a 10 km/h increase in average car speeds.<sup>30</sup> From 2012 to 2015, Milan saw traffic decrease by nearly 30% and public transportation usage increase by 5%<sup>31</sup>, while London has seen a 25% decrease in congestion.<sup>32</sup> Most cities also have fee exemptions for two-wheel vehicles and electric vehicles.

## **Enforcement**

Enforcement for congestion fees comes in the form of cameras positioned around the

city which read either the license plates of vehicles or some form of transmitter on the cars. When the vehicle enters the zone, the drivers are then charged, no matter the purpose of their visit or how long it is planned to be.

## **Low Emissions Zones**

While most cities do not have a congestion fee, they still take measures to reduce pollution. Many European cities within the EU have adopted low emissions zones and ban nearly all diesel vehicles. The limits are usually effective during the day, but some are active all day long. In terms of enforcement, cameras around the zone track violators while in other cases, police manually track vehicles by mandatory stickers that show the car is clean enough to enter the limited zone. Fines for violators are usually hefty, but in some cases the polluting vehicles may pay a fee to enter the zone.<sup>33</sup> Madrid saw a congestion drop by an average of about 24% and CO<sub>2</sub> emissions fall by 14% a month after the low emissions zone implementation.<sup>34</sup>

# Cities Performance

## Congestion Fee

High Performance				Medium Performance	Low Performance			
London	Milan	New York City	Oslo	New York	Amsterdam	Berlin	Boston	Chicago
Singapore	Stockholm				Helsinki	Hong Kong	Madrid	Moscow
					Paris	San Francisco	Seattle	Seoul
					Sydney	Tel Aviv	Tokyo	

## Low Emission Zones

High Performance				Medium Performance		Low Performance			
Amsterdam	Berlin	London	Madrid	Helsinki	Hong Kong	Boston	Chicago	Moscow	New York City
Milan	Oslo	Paris	Seoul			San Francisco	Seattle	Singapore	Stockholm
Tokyo						Sydney	Tel Aviv		



## Key Stories

New York City has not officially implemented its congestion fee program, it is scheduled to go into effect at the start of 2021.<sup>35</sup> The plan will likely charge drivers entering Manhattan below 60th street \$12-\$14 and trucks will be charged \$25.<sup>36</sup> At the moment, the congestion fee exists only for TNCs and taxis, who are charged \$2.75 and \$2.50 respectively per trip south of 96th street.<sup>37</sup> People who live within the zone will only be charged when they are reentering the zone after previously leaving. The city plans to use the money raised from the congestion fee to help begin the process of restoring the subway system and help fix other areas of transportation, such as busses, tunnels and bridges.<sup>38</sup> New York City will be the first city in the United States to implement a congestion fee, but there is currently a bill proposal in Boston for a potential congestion fee.<sup>39</sup>

*London's* congestion fee is one of the best known in the world. Since 2003, the city of London has been charging drivers who wish to enter the city's center.<sup>40</sup> With a charge of £11.50-14 per day, the London congestion zone operates from 7 a.m – 6 p.m, Monday through Friday, and brings in a total revenue of 250 million pounds per year (2017).<sup>41</sup> In order to track vehicles, the city has a series of cameras around the zone which track each cars' Vehicle Registration Number and charges the driver accordingly.<sup>42</sup> In terms of exemptions, two wheeled vehicles, registered wheelchair accessible vehicles carrying a disabled individual, and taxis (but not TNCs) are exempt from the fee.<sup>43</sup> While London has seen its center city traffic drop by 25% in the last decade, the congestion fee is not the only reason.<sup>44</sup> The city has added over 300 buses to its fleet and has seen an increase in its public transportation ridership.<sup>45</sup> Private car usage in the zone has indeed dropped (39% from 2002 to 2014), however, TNC usage as a primary form of transportation increased by 29.2% (more than 18,000 ride-share vehicles entered the zone a day in March 2018).<sup>46</sup>





# Shared Transportation

Shared transportation is an effective alternative to the use of private vehicle with a single driver. It is a transportation strategy that allows users to access transportation services on an as-needed and on-demand basis. It offers a variety of transportation modes, depending on the rider's destination, his requirements and the price he is willing to pay. As a tool to reduce car use, the mode is supposed to be more costly than public transportation, but cheaper than the use of car, by all its means (annual costs, insurance, fuel, parking, fees etc.).

A TNC (Transportation Network Company) is a company which connects customers with hired drivers to take them to a prearranged location using a digital network or application with digital payments.<sup>47</sup> Otherwise known as ride-hailing or ride-sharing, major companies in this field include Uber, Lyft, Grab and Didi, among many others. TNCs provide individuals with an alternative to basic taxi hailing and users tend to view it as easier to access and cheaper than taxis, creating major tension between the two industries.<sup>48</sup> Another service of TNCs is Micro-transit, which has recently transformed its implementation to subsidized public-private partnerships. Regulations for TNCs vary by country. As TNCs have been said to increase congestion in various cities,<sup>49</sup> many municipalities have begun taking measures to limit their usage, but still the TNCs remain a prominent mode of transportation in most major cities.

While not considered TNCs, the car-sharing and carpooling industries are other forms of shared mobility which offer similar services to TNCs and can be the key to decreasing congestion and pollution.

## Regulation

While regulations for TNCs are vastly different depending on the city and the country, one commonality between most cities is that TNC drivers must have some form of chauffeur or for-hire license administered by the city. Additionally, as TNC pickups are by definition orchestrated over a digital network, TNC drivers are not allowed to pick up passengers from the roadside anywhere, as that right is reserved for taxis. While some cities regulate TNCs the same as taxis, others treat them as a separate entity. The business model employed by TNCs is much more likely to succeed if they are treated differently and drivers face eased restrictions when entering the market.<sup>50</sup> Cities also tend to prioritize driver's rights and many cities have limits on how long TNC drivers may work in a 24 hours window. New York City has taken driver

safety one step further than the rest as it has created a minimum wage for TNC drivers of \$17.22 to ensure drivers do not overwork themselves or become impoverished.<sup>51</sup>

## Tax

In addition to the regulations imposed on TNCs, a few cities have levied taxes in various forms. Interestingly, four of the five cities in this research that have some type of TNC tax are located in the United States (New York City, Chicago, Boston and Seattle) with Sydney being the fifth. Additionally, San Francisco is considering a TNC tax. For the most part, each city levies a per trip tax of \$1 or less to either contribute to some form of a taxi fund or to help improve public transportation. New York City deviates from the rest of the group as its tax is part of its congestion fee scheme. Every rideshare, carpool or taxi that enters Manhattan south

of 96th street must pay a fee of \$2.75, \$0.75 or \$2.50 respectively.<sup>52</sup> The funds raised have gone to restoring the subway and improving other public infrastructure.<sup>53</sup>

### **Backlash**

Since Uber launched in 2011 and opened up the ride-hailing floodgates, TNCs have made their mark all over the world. However, accompanying TNCs rise to prominence have been a plethora of issues surrounding the industry. In New York City, 6 taxi drivers took their own lives citing economic ruin at the hands of ride-hailing as their chief motivation. In response to the deaths and an increase in congestion, New York City decided to stop administering new ride-hail licenses.<sup>54</sup> In Seoul, taxi drivers have taken to the streets the mass to protest the rise in ride-hailing with some even setting themselves on fire in protest.<sup>55</sup> Major protests by taxi drivers have taken place throughout Europe in Paris, Madrid and Berlin, among others. Taxi drivers are concerned that their license plate price will drop in addition to an income cut.

### **Car-sharing and Carpooling**

While TNCs continue to grow and get mixed up in constant controversy, two fairly constant industries around the world are car-sharing and carpooling. Car-sharing is a short-term car rental service in which people can rent vehicles via an app for short periods

of time (i.e. 1 hour) before returning the vehicle. While this service is oftentimes facilitated in a peer-to-peer manner with privately owned vehicles, there has been a major rise in ride-share companies — such as Car2go and ZipCar — which have fleets of vehicles owned by the companies themselves and are parked freely around cities, available for public use. Cities such as Seattle, San Francisco, Tel Aviv and Sydney have implemented designated parking spaces around the city. In terms of carpooling, it is similar to ride-hailing in the sense that the applications pair drivers with passengers, but it is regulated differently. For the most part, drivers are strictly only allowed to pick up passengers on or near their own route and can only charge the costs of operations. Carpooling is an effective means to decrease private car usage and has been strongly promoted in cities such as Sydney.<sup>56</sup>

### **Micro-transit**

Another form of transportation, lies between TNCs and public mass transit, is Micro-transit or Vanpool. While some cities may have their own municipal vanpool service or a local operating company, ViaVan has been at the forefront of the movement recently. Its algorithm allows drivers to pick up passengers that are heading in similar directions to the passengers already on board the van, which is ordered through an app.<sup>57</sup>

## Cities Performance

Shared Mobility										
High Performance				Medium Performance			Low Performance			
Amsterdam	Berlin	Boston	Chicago	Milan	Paris	Tel Aviv	Tokyo			
Helsinki	Hong Kong	London	Madrid							
Moscow	New York City	Oslo	San Francisco							
Seattle	Seoul	Singapore	Stockholm							
Sydney										

## Key Stories

San Francisco is where the ride-hailing phenomenon began. While San Francisco is one of the largest ride-hailing markets in the United States with over 45,000 TNC vehicles which provide over 170,000 trips a day (June 2017), it is also much more than just a ride-sharing hub.<sup>58</sup> There are over 4,000 car-sharing vehicles through Zipcar (2019)<sup>59</sup> and Getaround (April 2018)<sup>60</sup> with reserved spots located around the city as well as 500 vanpools (January 2019).<sup>61</sup> San Francisco currently plans to increase its vanpool fleet to over 800 the next few years and currently has a program which offers subsidies to vanpools to reduce costs and increase ridership.<sup>62</sup> As for TNCs, they are regulated by the California Public Utilities Commission (CPUC) and not the cities themselves. With that being the case, TNCs are required to turn over nearly all data collected to the CPUC.<sup>63</sup> With this information, a study was conducted which found that TNCs were responsible for nearly 30% of the traffic increase in San Francisco from 2010 to 2016.<sup>64</sup> In order to decrease congestion, San Francisco is now considering a proposal which would tax TNCs 3.25% per trip.<sup>65</sup>

Hong Kong has built up quite a large TNC industry over the years, with over 80,000 registered drivers between its two largest firms, Uber and Hong Kong-based Flytaxi (April 2019).<sup>66</sup> The drivers are required to hold hire car permits, administered by the Hong Kong Transport Department.<sup>67</sup> Additionally, in an effort to increase TNC accessibility and make drivers more willing to pick up all passengers, TNC drivers are not allowed to know the passengers' desired destination until they enter the vehicle.<sup>68</sup> Hong Kong would like to increase its public transportation ridership instead of rideshare ridership, however, city's officials know that they must first improve and expand upon existing infrastructure.<sup>69</sup> The car-sharing industry, which could greatly help in Hong Kong's desire to reduce private car usage, doesn't exist in the city as there are no regulations yet, safety procedures or dedicated parking spots.<sup>70</sup>

# Shared Micro-mobility

Originally designed to help with the problem of ‘the first, last mile’ — the commute from where public transportation drops off to the desired location, or from starting point to the pickup location — micro-mobility has expanded to something much greater. Micro-mobility, which is made up of vehicles such as bikes, electric bikes and electric scooters, is meant to be a cheap, non-polluting form of alternative transportation in traffic-laden cities. Cities such as London, Paris, and Seattle are in the process of investing hundreds of millions of dollars into improving micro-mobility infrastructure in hopes that more people will ditch their polluting vehicles for a green alternative. Numerous cities have their own city-owned bike-share programs which garner tens of thousands of rides a day. But while there has been some success, controversy surrounding dockless bikes and e-scooters has caused setbacks, as riders often ride on sidewalks and park their vehicles in walkways, upsetting pedestrians.

## **Bike-share**

Bike-sharing, the pooling of bikes for multiple users, comes in two main forms: docked and dockless.<sup>71</sup> Docked bike-sharing schemes have up to hundreds of locations around a given city at which users may rent or return their bikes. Docked bike-sharing is almost always city owned and the bikes are usually completely manual. Some cities, such as Paris and Milan, also offer electric bike options. In terms of pricing, most cities offer charges for the first 30 minutes to an hour and then charge each additional half or full hour. Some cities also offer subscriptions which allows users to pay a set amount up front in order to rent bikes for the month or year. Dockless bike-sharing, on the other hand, is run by private companies. Dockless bikes, which come in both electric and manual forms, are able to be picked up and dropped off wherever the user likes and may be activated with an application. This, however, can create issues as bikes may be left in pathways and get in the way of pedestrians. New York, for example, has made an effort to resolve this issue but ruling that dockless bikes must be parked at least three feet away of unobstructed pedestrian sidewalk usage.<sup>72</sup> Seattle goes even further with its rule stating bikes should be six feet out of the way.<sup>73</sup> However, both cities have

struggled with enforcement and are yet to make much real progress on the issue. E-bikes are generally treated the same as regular bikes in the US, Australia and Europe so long as they do not exceed speeds, when pedal-assisted, of 20 mph in the US and 25 km/h in Europe and Australia.

## **E-scooters**

Around the world, many cities have been hesitant to allow the entrance of the e-scooter market. New York, London, Sydney and Amsterdam, among more, are all yet to approve the introduction of e-scooters into their city limits (outside of a few small pilot programs). E-scooters, which follow a similar system to dockless bikes, are parked freely around cities and can be accessed through each individual company’s application. While they provide a very easy, very accessible mode of transportation, issues have arisen regarding their regulation and major backlash has ensued. Cities have taken different stances on regulations. In Moscow, for example, scooter riders must follow the same rules as bikers.<sup>74</sup> Other cities, like Chicago and Paris, treat them as their own entity. Regardless of the regulations, scooter users still wind up riding on sidewalks and in pedestrian zones, parking in walkways, violating traffic laws and can cause a

nuisance to drivers. The scooters' safety has been taken into consideration after multiple deaths due to scooter and automobile collisions in Europe.<sup>75</sup> Yet, the fact remains

that, when properly regulated with a built-up infrastructure, e-scooters may provide a great form of alternative green transportation that can help alleviate congestion.

## Cities Performance

Bike-share											
High Performance				Medium Performance			Low Performance				
Amsterdam	Berlin	Boston	Chicago	Hong Kong	Stockholm	Moscow					
Helsinki	London	Madrid	Milan								
New York City	Oslo	Paris	San Francisco								
Seattle	Seoul	Singapore	Sydney								
Tel Aviv	Tokyo										

E-Scooters											
High Performance				Medium Performance				Low Performance			
Amsterdam	Chicago	Madrid	Moscow	Berlin	Boston	Helsinki	Milan	Hong Kong	London	New York City	Oslo
Paris	San Francisco	Singapore	Stockholm	Tokyo				Seattle	Seoul	Sydney	
Tel Aviv											



## Key Stories

Paris is one of the premier micro-mobility cities in the world. With over 15,000 bikes as part of its city owned Velib Metropole docked bike-share, 30% of which are electric,<sup>76</sup> and around 20,000 e-scooters,<sup>77</sup> accessible, green, alternative mobility is everywhere. Velib Metropole is one of the model bike-sharing systems and its model has been copied by cities all around, including London and Chicago.<sup>78</sup> Paris is currently in the process of creating protected bike lanes, connecting preexisting lanes and adding 10,000 parking spaces — a €150 million project.<sup>79</sup> While there is no age limit to ride either bikes or scooters, children under 12 must wear a helmet while operating a bicycle. There is a €90 fine for violators.<sup>80</sup> Like in most cities, a license is not needed to ride an e-bike unless it goes over 25 km/h with pedal assistance.<sup>81</sup> With so many e-scooters, Paris has been subject to strict criticism from annoyed and affected citizens. In an effort to reduce the social harm of e-scooters, the city is discussing implementing a 20 km/h speed limit, which may be decreased to 8 km/h in areas with heavy foot traffic.<sup>82</sup> Paris also initiate heavy fines of €135 for riding on the sidewalk and €35 for anti-social parking, parking that disrupts foot or car traffic.<sup>83</sup>

Tel Aviv is considered to be a micro-mobility paradise, thanks to good weather, short distances (a mere 52 square kilometers of relatively flat land) and lack of parking. Tel Aviv Municipality's Tel-O-Fun service offers over 1,900 bicycles available in 200 docking station around the city. The service has suffered an extreme competition from the private sector, as electric bicycles and scooters have become wildly popular with over 400,000 imported tools to the little country. Another competitor is Chinese-Mobike, spreading dockless bicycles over the city. However, the winds of change came with the global e-scooters firms, led by Bird and followed by Wind and Lime, which deployed their scooters in August 2018. Criticism wasn't late to come, saying they are a danger, often discarded in the middle of sidewalks and causing multiple injuries to the users. on August 2019, Tel Aviv Municipality published its pioneer regulation, limiting the companies to 2,500 tools per operator and requiring them to share data. The municipality designated parking areas for e-scooters and bicycles in addition to the 140km of bike lanes allocated in the city. Tools left outside of parking areas or block sidewalks are subject to confiscation. Companies are subjected to additional rules such as equal service throughout the city and maintaining a plan to encourage riders refraining from riding on the sidewalks. Publications state that scooters already saved 90,000 car trips, with numbers keep to rise as over 200,000 users have used the service.





# Future of Cars

## Electric Vehicles

An electric vehicle uses rechargeable batteries to power electric motors, which are used for propulsion. Unlike a hybrid vehicle, which is gasoline-powered motor that uses a battery to improve efficiency, electric vehicles are powered solely by electricity. Electric vehicle technology has progressed significantly over the last decade, and today, countries around the world are looking to electric vehicles as a solution for reducing the pollution and smog resulting from the use of conventional vehicles. Moreover, the electric vehicles play a significant role in the MaaS (Mobility-as-a-Service) revolution, as the services field may well adjust itself to the electric infrastructure requirements and benefit from reduced operational costs.

### **National Programs:**

In an effort to reduce pollution and to promote the use and purchase of electric vehicles, many nations around the world have established national programs regarding electric vehicle use, production, and infrastructure. For example, in Italy, new gas stations must install charging stations for electric vehicles under law.<sup>84</sup> In France, “Crit’Air” air quality certificates provide low emission vehicles with favorable parking arrangements and privileged traffic conditions, and give drivers access to “low emissions zones.” In addition, France’s “Invest for the Future” program gives grants to communities to install charging infrastructure.<sup>85</sup>

### **Government Goals:**

Governments around the world have established goals and guidelines for the future of electric vehicles in their countries, in an effort to establish electric vehicle infrastructure and to promote cutting back on fossil fuels. For example, the Netherlands plans to only sell zero-emissions cars by

2030,<sup>86</sup> Moscow plans to replace their entire bus fleet with electric buses within three years,<sup>87</sup> and the Helsinki Regional Transport Authority plans to have a third of their fleet electric-powered by 2025.<sup>88</sup>

### **Tax Reductions and Incentives:**

Battery prices may go down, but many nations have looked at tax reductions and incentives as a way to persuade those concerned that electric car isn’t the best financial deal and promote electric car purchase. In addition, many nations use tax incentives to persuade businesses and residences to install charging infrastructure. For example, France gives tax incentives to low-emissions vehicles, taxes higher-emissions vehicles at a higher rate, and awards an array of tax bonuses for private citizens, collective residences, and businesses through the ADVENIR program and National Operators Project.<sup>89</sup> In California, the “Clean Vehicle Rebate Project” issued more than \$480 million in rebates for more than 218,000 electric vehicles between 2010 and 2017.<sup>90</sup>

## Countries Performance

Electric Vehicles									
High Performance				Medium Performance				Low Performance	
Netherlands	Germany	Finland	China	Massachusetts, USA	Illinois, USA	New York, USA	California, USA	Russia	Australia
United Kingdom	Spain	Italy	Norway	Washington, USA	Singapore	Israel			
France	South Korea	Sweden	Japan						

## Key Stories

Norway is well-known around the world for its innovative and effective approach towards promoting electric vehicles. Norway offers massive tax exemptions for drivers switching from fossil fuel-powered vehicles to electric vehicles, offers discounts on toll roads, and allows electric-vehicle drivers to use bus lanes.<sup>91</sup> Norway has more than 10,000 publicly available charging points and more than 1,500 fast-charging points.<sup>92</sup> Norway plans to end sales of fossil-fueled cars by 2025, and is well on its way, with almost 60% of new cars sold in Norway during March 2019 being entirely electric-powered.<sup>93</sup> Unsurprisingly, the proportion of electric vehicles compared to total vehicles in Norway is far higher than anywhere else in the world.<sup>94</sup>

*Sweden's* government has set a goal to reduce greenhouse gas emissions by 70% by 2030, and to cut greenhouse gas emissions entirely by 2045;<sup>95</sup> their efforts regarding electric vehicles factor heavily into their plans to do so. In order to more efficiently allocate subsidies, Sweden created a new category of vehicle in addition to “green” vehicles, called “super-green” vehicles, so fully electric vehicles would receive additional bonuses.<sup>96</sup> Sweden has also heavily invested in electric vehicle infrastructure through the “Klimatklivet” program, which has granted funds for over 14,000 charging points.<sup>97</sup>

## Autonomous Vehicles

An autonomous vehicle, also known as a robotic vehicle, a self-driving vehicle, or a driverless vehicle, is a vehicle that is capable of sensing its environment and moving with little or no human input. While autonomous vehicle technology is far from fully developed, a number of countries and companies have poured money into this field, developing and testing autonomous solutions for private vehicles and taxis, mass transit, and freight trucking. In addition, many countries have set to amending their traffic laws in order to adapt them for the emergence of autonomous vehicles.

### Mass Transit Pilots

Autonomous buses and minibuses are at the forefront of the implementation of autonomous technology. Many different cities and countries around the world are looking to autonomous vehicles to counteract traffic and congestion issues, and autonomous buses and minibuses are uniquely prepared for that mission. Some countries have permitted autonomous mass transit pilots in order to test autonomous buses and minibuses in real-world conditions. For example, Sweden's transport agency has allowed a driverless bus service running on public roads in northern Stockholm, which is free to use.<sup>98</sup>

### National Legislation

In order to better prepare for a future in which autonomous vehicles share the road with non-autonomous vehicles, countries around the world are moving to edit and amend their traffic laws. For example, everything from car insurance (the UK parliament's "Autonomous

and Electric Vehicles Act" adapts the existing car insurance framework by extending compulsory insurance to autonomous vehicles as well as drivers)<sup>99</sup> to drivers' licenses (the Netherlands' infrastructure minister announced a system for "driving licenses" for self-driving cars)<sup>100</sup> to even the color of lines on the road (Finland's "Road Traffic Act" funded the repainting of the yellow lines on its roads to a more AV-friendly white)<sup>101</sup> have been adapted for an AV future.

### Pilot Sites

Many nations on the forefront of the autonomous vehicle revolution have established pilot sites, dedicated to testing autonomous vehicle technology and prototypes. Singapore, Japan, South Korea, Spain, the Czech Republic, and Hungary have all established pilot sites, giving them the ability to attract developers and vendors, for a further implementation of the autonomous systems in the hosting country.

## Countries Performance

### Autonomous Vehicles

High Performance				Medium Performance				Low Performance
Netherlands	Germany	Massachusetts, USA	Finland	Illinois, USA	China	Spain	Italy	
United Kingdom	Norway	France	California, USA	Russia	New York, USA	Washington, USA	South Korea	
Singapore	Sweden	Japan		Australia	Israel			

## Key Stories

Singapore has teamed up with Nanyang Technological University to establish the Centre of Excellence for Testing and Research of Autonomous Vehicles (CETRAN), a pilot site designed to recreate the country's extreme tropical weather.<sup>102</sup> In addition, Singapore is planning to introduce self-driving minibuses in several areas, including a university campus.<sup>103</sup> Finally, Singapore has established a government organization specifically for dealing with autonomous vehicles, improving government-private sector coordination and reducing confusion.

The Netherlands, rated the best country for autonomous vehicles by KPMG's Autonomous Vehicles Readiness Index, is working with its neighbors to develop autonomous vehicle technology specifically for freight trucking, and plans to launch more than 100 driverless truck platoons from Amsterdam to Antwerp and from Rotterdam to the Ruhr Valley<sup>104</sup>. The Netherlands is also taking a leading role in developing a legal framework for autonomous technology, introducing new laws that will encourage autonomous vehicles, and announcing a "driving license" for self-driving cars.<sup>105</sup>

# MaaS Support

Mobility-as-a Service (MaaS) is the integration of various forms of transport services into a single mobility service, accessible on demand. The key concept behind MaaS is to put the users at the core of transport services, offering them tailor made mobility solutions based on their individual needs, unlike traditional transit that is often planned according mass statistic records. As such, MaaS uses public transport network efficiently and effectively to enhance mobility and accessibility. Until recently, one had to combine multiple transportation services, applications and payment methods on a single journey. MaaS offers route planning and payment via cell phone, smart watches and credit cards - during or after the trip. Due its complexity, MaaS is still a challenge for cities and central governments.

## API's

The first important technological requirement for MaaS implementation is the availability and provision of open and standardized Application Programming Interfaces (APIs) from the mobility service providers. By enabling Open API standards, third party developers can be provided with the programmatic access to proprietary mobility service solutions.<sup>106</sup>

## Open Data

Shared and open data gathered from smart devices and connected infrastructure will underpin mobility solutions that support integrated, efficient and sustainable transport systems. The data may be useful for all the stakeholders – the customer, the public transport operators, the MaaS providers and the government. Public transport operators often share their data, but other operators rarely do that and keep it as their propriety. Open data policy will solve this and catalyst the implementation of MaaS.<sup>107</sup>

## MaaS Platform

MaaS implementation will most likely use an aggregator app, offering seamless service door-to-door experience, including first and last-mile solutions. Today, every company offering mobility service does that through its own mobility platform. For example, Uber

and Lyft uses their unique mobility platform to offer their service. However, the line between an aggregator and mobility platform is blurred when mobility providers integrate other third-party mobility services such as public transport or bike sharing. Most of providers would like to be aggregators and not to be aggregated – which set a challenge for the city or government. This often led the city to step in and create its own MaaS service, such as Whim in Helsinki.

## Seamless Ticketing and Payment

The variety of transport modes that one may use on single journey make it harder to always have the right ticket at hand. A smart ticketing system, that make the journey simpler, will include an option to pay to all mobility services and might include also other services such an option to pay in different places as stores, restaurants and etc. In Seoul, the Tmoney is a transportation card that can be used on public buses, subways and in taxis, but can also be used as a method of payment at affiliated stores. In terms of aggregation, all operators have to allow third party's payment or the ability to sell their service. Often, public transport tickets are regulated and can't be sold by third parties, which may be a barrier to MaaS or an incentive for the local government or city to establish its own MaaS platform.

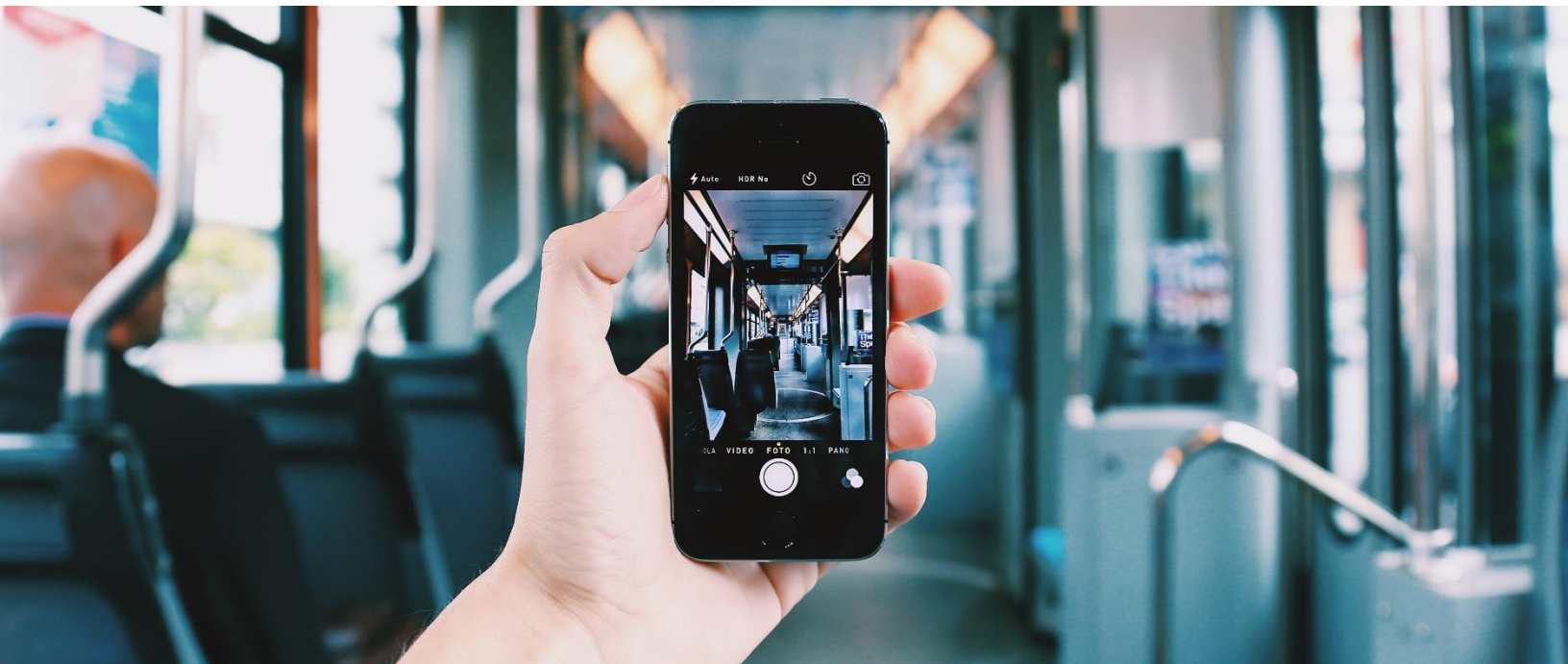


## Cities Performance

MaaS Support											
High Performance				Medium Performance				Low Performance			
London	Helsinki	Singapore	Stockholm	Amsterdam	Oslo	Madrid	Paris	Sydney	Chicago	Boston	
Berlin	Tokyo	Milan	Hong Kong	Seoul	San Francisco	New York City	Tel Aviv				
				Seattle	Moscow						

## Key Stories

Helsinki is often held up for being the first city to offer a comprehensive Mobility-as-a-Service (MaaS) service. The Finnish transport ministry set a strategy for MaaS back in 2011, placing the foundations for MaaS Global's "Whim" that was launched in late 2016. To support it, Helsinki has limited private car incentives and improved public transport services. Currently, Whim app has over 8,500 subscribers that combine, plan, and pay for public transport, taxi, car rental, car sharing and city bike trips, within a single app. All services include unlimited usage of public transport and a number of taxi rides. Payment is handled in app, through pre-pay or post-pay using a credit card linked to the account. The numbers show the power of MaaS services - Whim users make 2.15 trips per day with public transportation compared to 1.6 trips made by the average citizen; 42% of all city bike trips are combined with public transportation; Whim users combine taxi three times more often with public transportation compared to the average Helsinki region user. result is reduced congestion, less reliance on personal mobility, and a greatly enhanced travel experience. Whim delivers an attractive and competitive alternative to car ownership, and as such, reduces its utility, congestion and gas emissions.



# Walkability

A city with infrastructure that is more cohesive to walking is vital in the transportation transformation. Decreasing the use of vehicles and promoting walking or micro-mobility services is part of the solution to the “first mile, last mile” problem, or the issue of how people get from their homes or work to a station of public transport, if none is near. Limiting the number of cars and shifting the focus from vehicle to pedestrian priority requires structural and technological improvements for walking.

The main element to increasing the number of people walking involve how a city is eliminating car use, whether it be through creating more parks (decreasing road space), increasing the prices to park in congested city centers, or prioritizing pedestrians in traffic zones. The addition of scenic walking paths, rest areas and conveniently located benches make a remarkable difference in today's most popular cities.

## Walkable City Structure

A walkable city has networks of walkways that connect people to public transportation and involve structures for sitting and resting along the way. Increasing green space is a key factor in getting residents to make the switch from the comfort of their private vehicles to the outdoors.<sup>108</sup> New York City contains the massive Central Park, as well as converting an old train track into a scenic waterfront walkway (the High Line) and is considered the most walkable city in the United States.<sup>109</sup> Seoul, for example, has increased its walking paths from 81 in 2016, to 141 in 2018.<sup>110</sup>

## Pedestrian Safety

Stockholm's Vision Zero puts focus on road engineers to protect pedestrian's safety. This involves reducing speeds, increasing roundabouts, and creating streets and traffic lights to reduce risk to walkers and bikers above all else.<sup>111</sup> Smart technology exists to prioritize the pedestrian above vehicles. London has such smart traffic light technology where cars and bikes will have to yield to people.<sup>112</sup> San Francisco's WalkFirst has combined public engagement with technical and statistical analysis of where

and why pedestrian collisions occur on city streets, and updated knowledge about the effectiveness and costs of various engineering measures proven to reduce pedestrian collisions.

## Incentives

Mayor of London proposed a new Transport Strategy named TFL Healthy Streets Portfolio, worth £2.1bn that will focus on creating more welcoming and inclusive streets to enable more Londoners to walk. Moscow municipality Renovated streets to increase pedestrian flow by 3. In mayors' \$2 billion "beautification project", 233 streets have been renovated, walking areas were enlarged by up to 200%, and dozens of brand-new picturesque pedestrian areas were provided. Singapore created many waterfront paths and forested parks, alongside 384 pedestrian overhead bridges with fitted shelters for bus stops. Its Walk2Ride \$300 million initiative has reached recently a major milestone of 200km of covered walkways. Tokyo's Metropolitan Government offers workshops that teach residents how to create green rooftops, wall surfaces, railroad areas, parking lots, and offers tax incentives for such efforts.<sup>113</sup>

## Cities Performance

### Walkability

High Performance				Medium Performance				Low Performance	
Amsterdam	Helsinki	London	Madrid	Berlin	Boston	Chicago	Milan	Tel Aviv	Moscow
New York City	Oslo	Paris	Seoul	San Francisco	Seattle	Singapore	Hong Kong		
Stockholm	Sydney	Tokyo							

## Key Stories

New York consistently ranks as the most walkable city in the United States and one of the most pedestrian-friendly cities in the world. Designer and artisan boutiques, sidewalk pizzerias, world-class restaurants, and street musicians all contribute to make New York a compelling place to get around on foot. One of the city's main thoroughfares is Fifth Avenue, which leads from Washington Square Park in the South to Harlem in the north. Pedestrian rezoning and commercial regeneration occurring along the Hudson and East Rivers and in neighborhoods across Manhattan, Brooklyn, and the outer boroughs. Central Park alone has more than 58 miles of walking paths. On the island of Manhattan, a subway station is a block or two far, making it accessible within 10-15 minutes' walk. The entire city has the urban density that supports walking to nearly everything. Many New Yorkers live their whole lives without ever owning a car. New York City's extensive sidewalks, bike lanes, bike share programs and public transportation help to make it as walkable as it is. The city has three especially walkable neighborhoods: Little Italy, Chinatown and NoHo. New York's pedestrian crossings are well-organized, making it straightforward to cross even busy major thoroughfares. In addition, streets are numbered logically, making it easy to navigate.



## Bonus: Work Hours Flexibility

Flexible work hours may be part of Transport Demand Management (TDM).<sup>114</sup> Congestion occurs in urban centers during peak hours of the day. To decrease the number of vehicles on the road at one time, several urban development research institutions have proposed pacing the time frame of when employees go to/from work. Workplaces that offer flexibility in working hours reflect a new developing approach: managing congestion through voluntary behavioral change. Flexible workplaces combine the various options of work hour flexibility to reach a more holistic approach and achieve transportation benefits, such as spreading out rush hours and organizational benefits, such as raising employee productivity and satisfaction.<sup>115</sup>

Working from a remote location or from one's home can improve productivity by decreasing travel times and allowing employees to fit their work life into their home life more effectively. Shifting work hours can prove difficult since many institution and other commitments hours are fixed such as school systems, outside clubs or activities and meal times. Overtime laws and government incentives such as tax cuts can help to decrease the number of people on the road at the same time.<sup>116</sup>

### Government Initiatives

Government tax cuts and incentives can encourage private companies to switch the work hours of their employees in order to reduce the number of cars on the road at peak congestion hours. The governor of Tokyo held a two-week campaign for people to alter their work hours, and since then more than 260 companies have adhered to this practice.<sup>117</sup>

### Overtime Laws

Government overtime laws affect a country's congestion if they are strict on working extra hours. If an employee is allowed to work less hours one day and more hours another, they can come in at different times. Countries such as Britain, Canada, New Zealand and Ireland have mechanisms defined by law that set appropriate processes and clear criteria for regulating flexible work conditions on the company level. As part of these programs, an employee submits a request to the employer for flexible work conditions. The employer might approve or decline the request

according to set parameters within a defined timeframe and rejection of the request must have reasonable grounds defined by law.<sup>118</sup>

### Suggested Plans

The mayor of Houston initiated a pilot project titled "Flex in the City" (2006) which is now continued by private companies in which employers alter their employees' schedules for two weeks to improve peak travel time.<sup>119</sup> The city's 2006 Flex in the City effort resulted in an estimated \$16.8 million savings.<sup>120</sup> In Singapore, the LTA (Land Transport Authority) launched "Travel Smart Network," which gives monetary incentives for companies to support employees using public transportation during off-peak hours. A business can receive up to 160,000 Singapore dollars (\$120,000 U.S.) for allowing such arrangements and additional funds might be available for applying other employment principles the government program supports. Since its launch in 2012, 12 companies have taken part in the program.<sup>121</sup>



## Key Stories

In 2009, Brisbane, Australia launched the ‘flexible workplace pilot,’ whose results showed the advantages of this holistic approach and its effect on driver behavior and rush hour congestion. The pilot was a month long and included 20 private and public organizations which employ 900 workers in Brisbane’s business center. Participants were offered three options for work flexibility: work hour flexibility, a condensed work week or working from home. During the pilot, morning rush hour travel (7 – 9 a.m.) was reduced by 34% and evening rush hour travel (4 – 6 p.m.) was reduced by 32% among participants. Thus, an estimated 6,100 private vehicle kilometers were avoided. 92% of participants said they would like to continue the flexible work arrangement; an increase of 68% was reported in employee productivity and an 80% increase in work-life balance.<sup>122</sup>



# Full Rankings

Position	City	Rank	Mass Transit	Parking	Tax Incentives	Shared Mobility	Shared Micro-mobility	Future of Cars	MaaS Support	Walkability
1	London	4.56	4	5	5	5	3	5	5	5
2	Helsinki	4.48	5	5	2	5	4	5	5	5
3	Singapore	4.44	5	5	3	5	5	4	5	3
4	Amsterdam	4.36	4	5	3	5	5	5	3	5
5	Oslo	4.36	4	5	5	5	3	5	3	5
6	Stockholm	4.35	5	3	3	5	4	5	5	5
7	Madrid	4.26	4	5	3	5	5	4	3	5
8	Paris	4.1	4	5	3	3	5	5	3	5
9	Seoul	4	4	5	3	5	3	4	3	5
10	Berlin	3.97	4	3	3	5	4	5	5	3
11	Tokyo	3.91	4	5	3	1	4	5	5	5
12	San Francisco	3.8	4	5	1	5	5	4	3	3
13	New York City	3.77	4	5	2	5	3	3	3	5
14	Milan	3.69	3	3	5	3	4	4	5	3
15	Sydney	3.34	4	5	1	5	3	2	1	5
16	Chicago	3.32	3	5	1	5	5	3	1	3
17	Hong Kong	3.02	4	1	2	5	2	4	5	1
18	Moscow	3.01	4	3	1	5	4	2	3	1
19	Boston	2.85	2	3	1	5	4	4	1	3
20	Tel Aviv	2.84	3	1	1	3	5	4	3	3
21	Seattle	2.82	2	3	1	5	3	3	3	3

# Disclaimer

This report was drafted by Future Mobility IL, an independent nonprofit established in 2018. The views expressed herein are those of the authors only and are based upon their independent research and knowledge. While every effort has been made to ensure the accuracy of the material in this document, Future Mobility IL will not be liable for any loss or damages incurred through the use of this report. Data is constantly changing. Future Mobility has made every effort to ensure the quality and accuracy of the data. Most sources are publicly available. City-level data was used wherever possible, though in some cases only national-level data exists.

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The team would like to thank Bennett Bramson, Rachel Bauman and Samson Seley from Onward Israel program for their invaluable assistance in developing and researching the Global Mobility Policy Index, and to Noam Kleitman Gottlieb and Noga Meir for their assistance along the way.

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