2021 edition

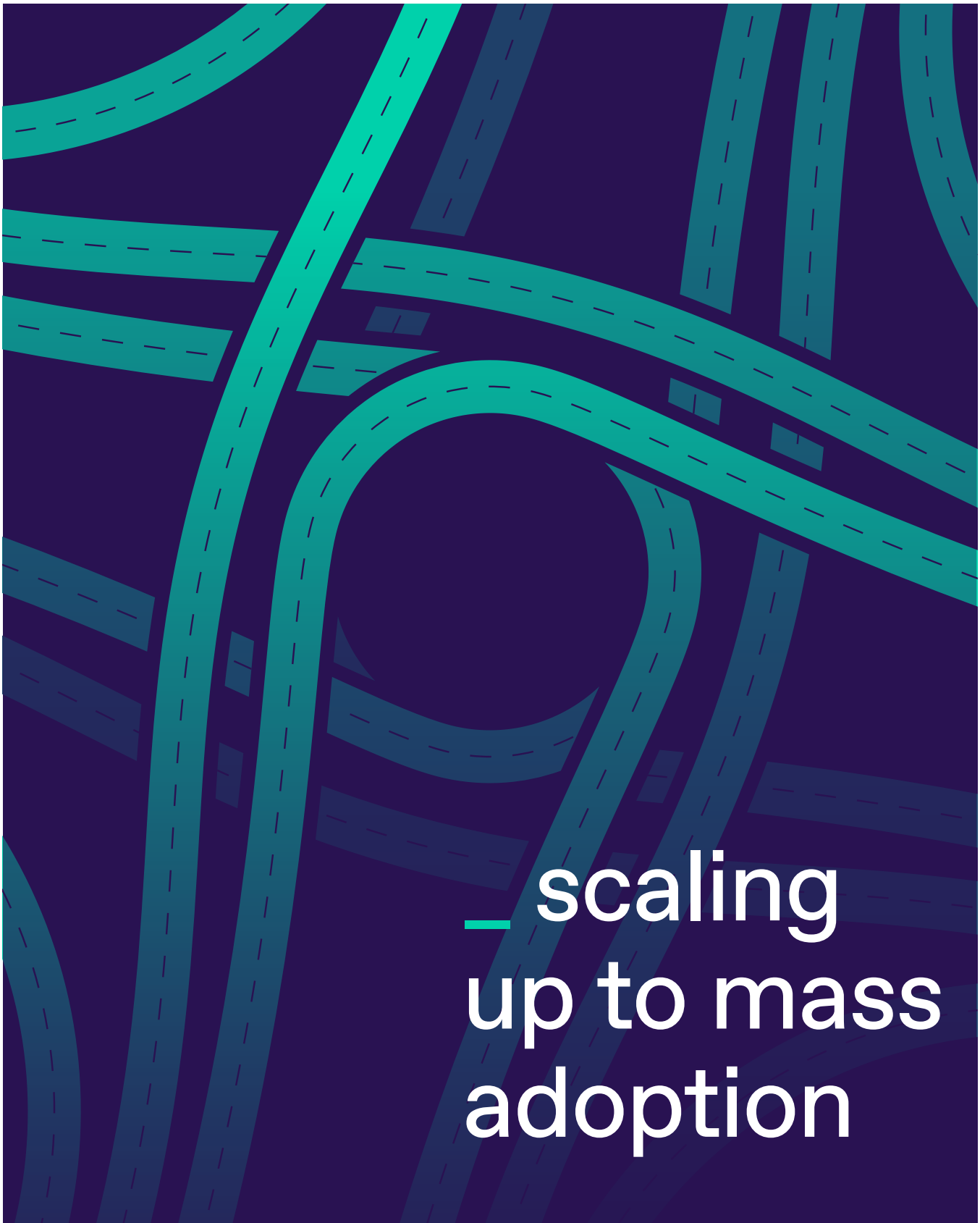
ev city casebook _

Urban Foresight

iea

Electric Vehicles Initiative

hevtcp



_ scaling up to mass adoption

50 cities_

20 countries_

5 continents_

10 policy recommendations to scale up EVs globally_

this is the third ev city casebook_

_ a global analysis of inspiring ideas, policy pioneers and city-led innovation in electric vehicles.

PROJECT PARTNERS _

Urban Foresight

Urban Foresight® is a multidisciplinary innovation practice that is dedicated to accelerating the next generation of technologies, services and policy frameworks for cities. We work with ambitious organisations around the world on projects that improve lives, protect the environment and boost local economies.

urbanforesight.org

iea

The IEA is at the heart of global dialogue on energy, providing authoritative analysis, data, policy recommendations, and real-world solutions to help countries provide secure and sustainable energy for all.

iea.org

ELECTRIC VEHICLES INITIATIVE
AN INITIATIVE OF THE CLEAN ENERGY MINISTERIAL

The EVI Global EV Pilot City Programme (EVI-PCP) aims to build a network of cities to work together on the promotion of electric mobility. It is a multi-government policy forum dedicated to accelerating the introduction and adoption of electric vehicles worldwide.

iea.org/programmes/electric-vehicles-initiative

hevtcp

The HEV TCP, with a membership of 19 countries, collaborates on shared projects (Tasks) to better understand and address technical and non-technical challenges, and provide guidance to policy makers.

ieahev.org

WHO IS THIS CASEBOOK FOR?

City managers
Officials in city administrations who are looking to make decisions, build alliances, and design policies to move to mass EV adoption.

City political leaders
Elected figures who are looking for inspiring examples of social, economic, and environmental change.

National policy officials
Individuals working at national level who have an interest in EV policy, either setting nationwide frameworks for EVs or collaborating with cities.

Managers in procurement, transport, and economic development
Operational leads in local government functions who can play a direct role in EV uptake.

EV and transport industry
Organisations and individuals working in electric mobility, manufacturing, and transport operations who want to better understand how cities see the challenge of mass EV adoption, and how mature markets have evolved.

Media, research and other stakeholders
This guide is intended to be useful to anyone with a broad interest in EVs, to understand what cities can do to secure a sustainable, dynamic future.

INTRODUCTION _

GETTING TO MASS EV ADOPTION

Since the first EV City Casebook in 2012, cities around the world have overseen huge changes in mobility.

Electric cars, buses, and taxis have rapidly increased in numbers, moving beyond early pilots and trials. New forms of micromobility and smartphone-based transport systems have grown in popularity. Cities have broken new ground in these innovative technologies and new policy ideas.

Currently, most governments have targets for continued EV growth. Many cities are planning to ban fossil-fuelled vehicles altogether. There is unprecedented momentum around EVs, and a recognition of the role they play in cleaner, more sustainable cities.

But this progress needs to be sustained. By any scenario, avoiding catastrophic climate change will require further reductions in greenhouse gas emissions from transport. In most countries, EVs still represent a minority of new vehicles sold. Some EV types, like buses and heavy goods vehicles, are developing quickly but are still relatively nascent technology.

So, the task facing policymakers across the world is to accelerate the move to mass adoption – and step towards a future of total transport decarbonisation.

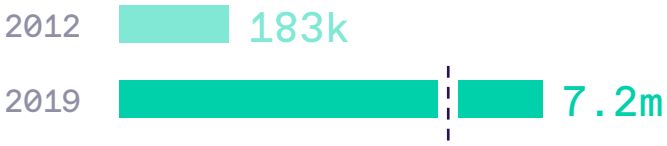
What kind of policy, financial and legal tools can they use to speed up adoption? How do cities need to work with vehicle manufacturers, energy providers and their citizens to create support for faster change? How does policy on EVs need to link up with exciting developments in autonomous vehicles, connected devices, and mobility as a service? How can cities learn from their counterparts around the world, to move to mass EV adoption?

This casebook is a showcase of cities building better, cleaner mobility through EVs – designed to inspire others to move towards mass electric mobility.

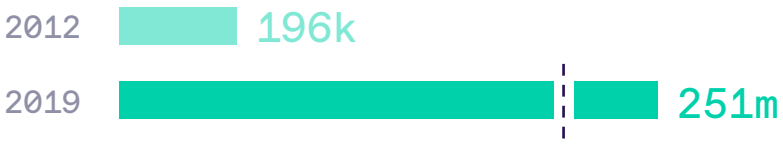
electric vehicles worldwide _

GLOBAL EV STOCK _

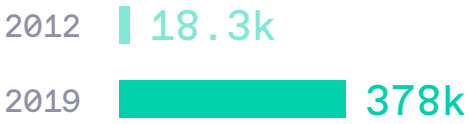
CARS _



2- & 3-WHEELERS _



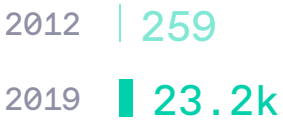
LIGHT COMMERCIAL VEHICLES_



BUSES _

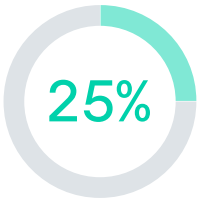
*all in China

MEDIUM & HEAVY DUTY TRUCKS _



Electric Vehicles are defined as Battery Electric and Plug-in Hybrid Electric Vehicles

2- & 3-WHEELERS _



of all 2 & 3 wheelers worldwide are electric

The majority are in Chinese cities that ban two-wheelers with internal combustion engines.

LIGHT COMMERCIAL EV _

~70,000 sold in 2019

25,000 in Europe

43,000 in China

MICROMOBILITY _

600 CITIES IN OVER 50 COUNTRIES HAVE E-SCOOTER, E-BIKE &/OR ELECTRIC MOPED SHARED MOBILITY SCHEMES.

GLOBAL SHARED E-SCOOTER TRIPS ARE EXPECTED TO QUADRUPLE _

CONTENTS _

HOW IS THIS CASEBOOK STRUCTURED?

This casebook highlights inspiring examples from around the world of cities which have taken actions to accelerate mass adoption of EVs. _

05_

global case studies of ev innovation

The first five chapters profile different vehicle modes. Each chapter presents case study cities, with a brief description of their approach and key insights from their journey towards mass electric vehicle use.

59_

policy guidance for cities

An EV Policy Maturity Model is outlined, to provide guidance to cities in benchmarking progress and to help cities identify where to further develop their efforts.

83_

references

This casebook was informed by over 50 interviews with city managers and experts, covering cities in over 20 countries across the world. In total, these cities have populations of 160 million people. Insights were also drawn from desk research and the global networks of the Electric Vehicles Initiative (EVI), the Hybrid and Electric Vehicle Technology Collaboration Program (HEV TCP), and partners.

GLOBAL STUDIES OF EV INNOVATION _

07_ Buses

11 _ Shenzhen _ China
14 _ Santiago _ Chile
15 _ Izmir _ Turkey
15 _ London _ UK
16 _ Kolkata _ India
16 _ Vancouver _ Canada

17_ Taxis

21 _ Dundee _ UK
24 _ Nairobi _ Kenya
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27_ City Fleets

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GLOBAL STUDIES OF EV INNOVATION _

buses _

In the next five years, almost a million electric buses are expected to be on the road

Rapid advances in technology, with electric buses improving range, power, and reliability, are encouraging cities around the world to electrify these services.

In the next five years, almost a million electric buses are expected to be on the road. But the market is still relatively immature and there are still technical and operational challenges, such as the capital cost of EV buses. Many cities have invested in legacy diesel buses, and have a mix of public and private bus providers.

How have cities overcome these challenges? How have cities worked with manufacturers and private firms to rapidly scale-up the use of electric buses?

RECOMMENDATIONS _

Cities should look to scale up bus electrification by:

01 _

Direct leadership with targets, contractual incentives, and requirements

Cities generally have significant influence over bus fleets, either through direct ownership, procurement, or licencing their operators. To move from small numbers of electric buses to mass uptake, cities should use this influence to set clear targets, require low-emissions vehicles, and directly lead change.

02 _

Partnerships or joint ventures with technology, manufacturing, and grid companies

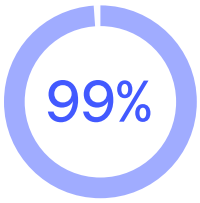
Buses have challenging power and reliability needs. Successful cities have built close partnerships in manufacturing, utilities and energy generation early on, to ensure these standards are met, and that sufficient charging capacity and grid management processes were in place before increasing uptake.

03 _

Focus on lower-income groups and the equity of clean air

In many cities, bus use is more extensive in lower-income groups. Buses are often a major contributor to urban pollution. EV buses therefore represent a major opportunity to frame electrification as a matter of social justice: this can be emphasised by focussing on electrifying the routes which serve poorer communities, and stressing the improvements to public health through cleaner air.

GLOBAL VIEW _



of the world's deployed electric buses are in China

PROJECTED GLOBAL ELECTRIC BUS MARKET VALUE (USD) _

2019
42.3bn

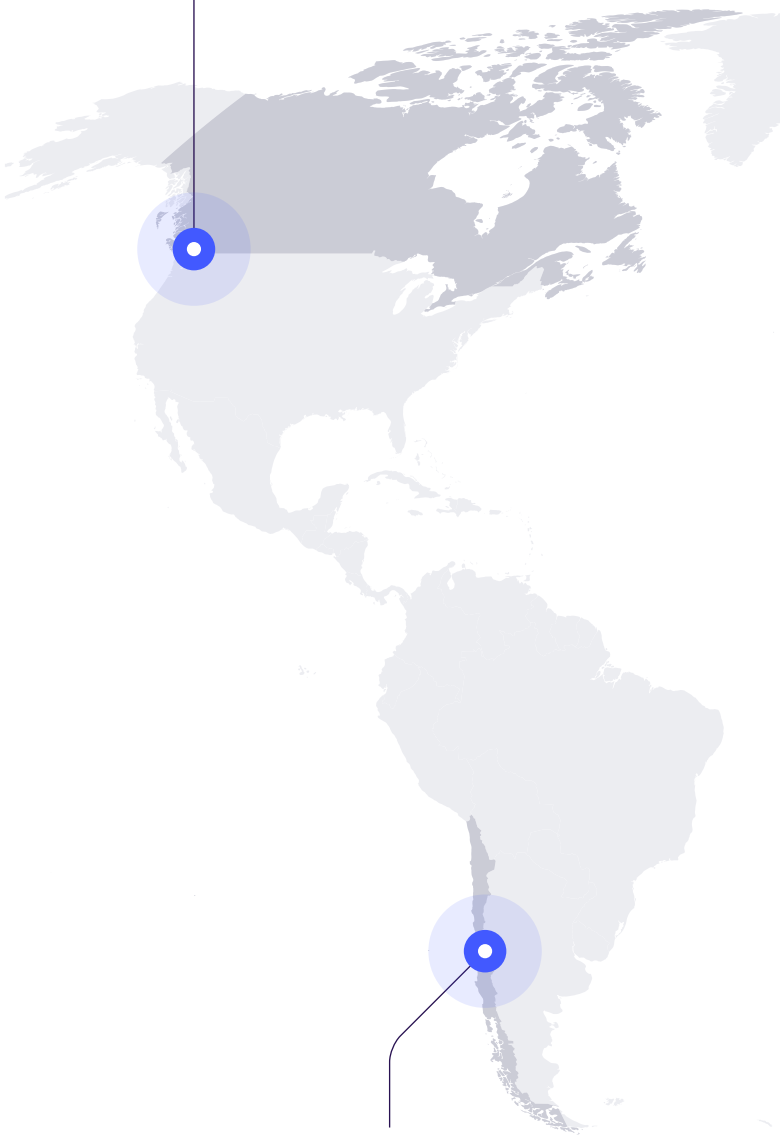
2026
214.5bn

GLOBAL ELECTRIC BUSES REGISTERED _

Total in 2020
417,000

136,500
Registered in 2019

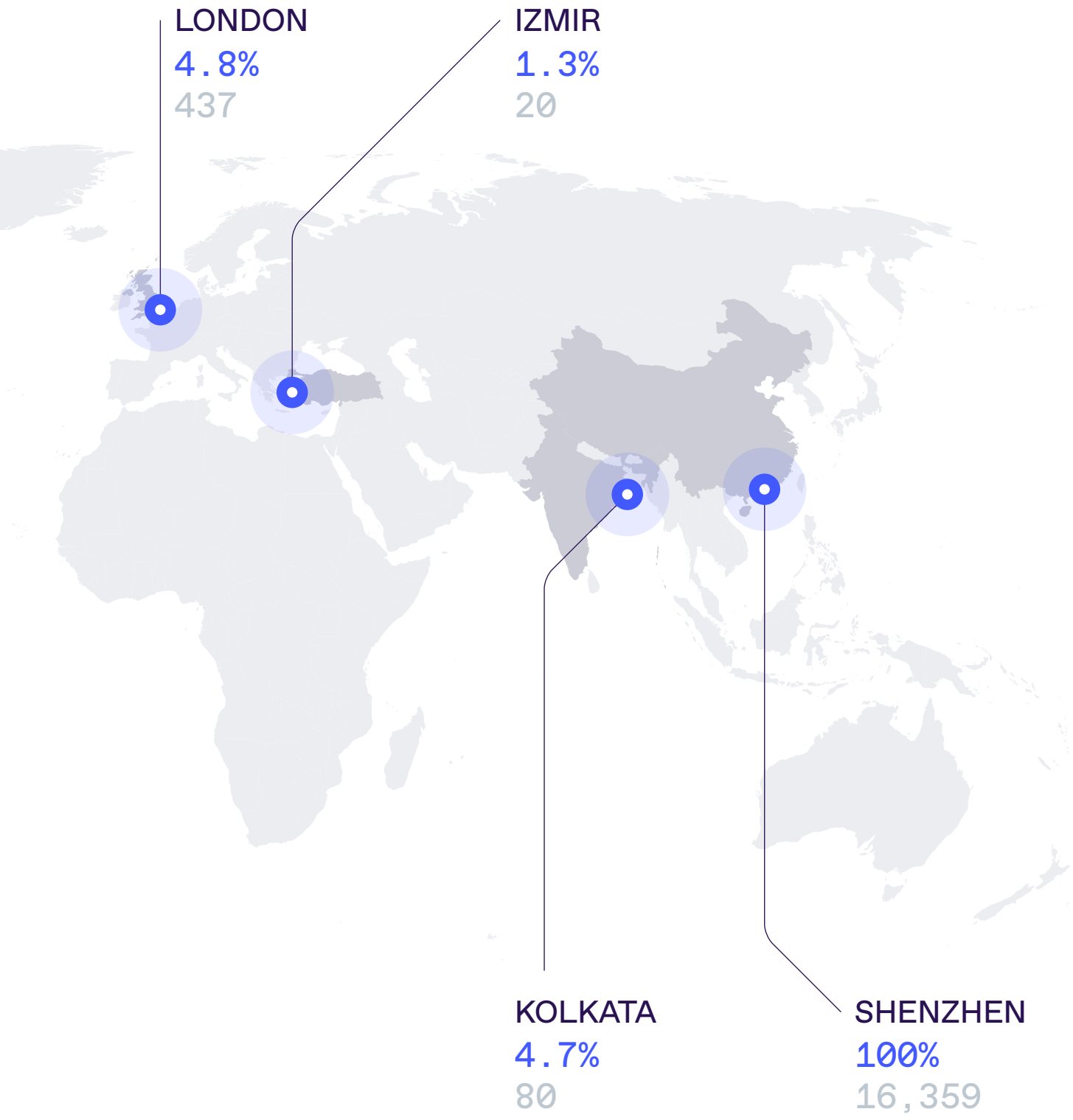
835,200
Projected total by 2026



VANCOUVER
0.3%
4

SANTIAGO
8%
776

Map shows percentage of total bus fleet that has been electrified and the number of electrified buses.



CASE STUDY _

SHENZHEN _ CHINA

Robert Bye/Unsplash

Shenzhen faced rapid population growth, from one million people in 1990 to over 12.5 million today. This expansion placed significant pressure on air quality and congestion, leading to new policies to tackle transport emissions . Public transport accounted for 30% of urban air pollution from transport, even though it only constituted 2% of vehicles on the road.

The policy response was to both direct citizens to use public transport, and rapidly electrify bus services.

The city's authorities reported existing high utilisation of the public transit fleet, as the majority of the city's commuters are 'captive riders' - those whose lower income makes buses the only viable transport option. By capping the number of new vehicle licence plates granted each year, private ownership of vehicles was limited and demand for effective and efficient public transport further increased.

City leaders committed to fully electrify the entire bus fleet of 16,359 vehicles by 2017. This was a complete switchover of the existing service, with no increase in the overall number of buses in the fleet, and no increase in customer fares. To this date, Guangzhou is the only other city in the world to have achieved this.

Shenzhen was the first city in the world to fully electrify its bus fleet in 2017.

Shenzhen's electric bus fleet now consumes 72.9% less energy than in 2016, resulting in a total reduction of 1.353 million tons of CO_2 per year.

Full bus electrification has been achieved through fiscal incentives, rapidly deployed infrastructure, and optimisation of scheduling.

Fiscal Incentives

The three major bus operators in the city were incentivised to make the transition with an annual subsidy of USD 75,500 for each vehicle, 80% funded by the Shenzhen city authorities and 20% from central government. This brought electric buses into price parity with diesel buses. Each electric bus had to travel more than 60,000 km each year (a distance representing sustained use in the city's network) before the supplier received the subsidy.

> "Shenzhen's electric bus fleet now consumes 72.9% less energy than in 2016."

Charging Infrastructure

The city has introduced 510 bus charging stations with a total of 8000 charge points. Many of these are also open to private cars, which brings in additional income.

Optimising scheduling

The majority of buses are charged overnight when energy tariffs are lower. The buses have a 250 km range, so operating schedules were changed to include a recharging session for any service over this length.

Industry partnership

The bus manufacturer BYD is based in Shenzhen. To speed up the development of new vehicles, the city adopted a partnership model, where it helped BYD refine its technology by giving detailed technical feedback on early versions of its electric buses.

KEY PLAYERS _

SHENZHEN _ CHINA

Local and national government in partnership

Shenzhen's efforts were led by the City Mayor's office, but underpinned by clear direction by the central Chinese government. As well as support for bus subsidies from central government, Shenzhen also became a pilot city for the introduction of New Energy Vehicles (see box).

Vehicle manufacturer

More than 80% of the electric buses deployed have been supplied by BYD. The close partnership between the city and manufacturer sped up adoption, and gave the city greater assurance in making the switch. For example, BYD developed a 'lifetime guarantee' so that any faults or battery failures would be covered by the manufacturer.

NEW ENERGY VEHICLE (NEV) POLICY

The New Energy Vehicle (NEV) policy is a long-term supply-side policy to increase the number of EVs manufactured and sold in China. This mandates the number of NEVs (fully electric, plug-in hybrid, hydrogen fuel cell vehicles) which are produced in the country by each manufacturer. Credit targets are assigned by NEV type and manufacturers must meet their average annual NEV credit target.

The Chinese government identified 5 pilot cities, testing new technologies and attempting to drive down costs by rapid scaling-up of infrastructure and vehicle numbers. The pilot ran from 2009 to 2020.

Zhang Yat Ming Sumsum/Wikimedia Commons

CASE STUDY _

SANTIAGO _ CHILE

Santiago de Chile has changed its bus service procurement model to rapidly accelerate bus fleet electrification.

With a population of over 7 million people, Santiago de Chile is one of the largest metropolitan areas in South America.

The city has historically suffered from high levels of particulate emissions and deteriorating air quality. Chile's national government also committed to the Paris Agreement and Atmospheric Decontamination Plan and its successor agreements and targets.

As a result, Santiago's leadership has increasingly worked to reduce transport emissions. In 2018, the city became the first in the region to demand its vehicle suppliers for public transport meet Euro VI emission standards and, in late 2020, the first electric buses entered circulation.

Santiago now has the largest deployment of electric buses in absolute numbers of any city outside China, with 776 electric buses in operation. It also has the first electric corridor with segregated lanes in South America, with access to bus depots with charging infrastructure at either end of the electric bus corridor.

> "Overcoming challenges in the procurement process, including defining technical specifications to ensure operational efficiency and interoperability, is a key element in a fleet-wide electrification strategy for public transport"

Procurement

Santiago is now changing its procurement of city bus services to encourage electric buses. The model was changed to separate the operation of services from the provision of vehicles - and though it is not mandatory for suppliers to use electric buses, contract lengths for services are 14 years, compared to the standard 10 year contract, if the supplier's fleet is more than 50% fully electric.

Industry Engagement

Utility companies, operators, consulting institutes, and manufacturers have been working together to understand grid capacity needs, carry out pilot tests, analyse route selection and build business and service models. To tackle the challenge of the high capital cost, an innovative financing mechanism was developed. Vehicles were purchased by utility companies and leased to bus operators, allowing the up-front costs of bus procurement to be separated from operational costs.

CASE STUDIES _

IZMIR _
TURKEY

A solar power plant at the bus depot provides surplus energy for Izmir's electric bus fleet.

The City of Izmir has been a testing ground for electric buses. The city municipality signed agreements to reduce greenhouse gas emissions by at least 20% by 2020.

The transportation company of the metropolitan municipality (ESHOT) tested 20 electric buses on all of its 340 routes to better understand electric bus performance under a range of conditions, and determine which routes were suitable for electric buses.

> "We generate enough power with our Solar PV to transition our fleet to electric buses."

A key part of the project is the installation of 10,000 m² of Solar PV (with a total power supply of 835 kW) on the bus depot roof. The daily energy needed to power the first 20 buses is exceeded by this provision, saving 3,776 tonnes of CO2 annually. ESHOT has chosen to only charge buses overnight at the depot, to utilise this energy without the need to rely on opportunity charging.

Now Izmir has a strategy in place to build on this technical understanding of EV use and this energy infrastructure, by scaling up to reach 400 buses by 2024.

LONDON _
UNITED KINGDOM

Strategic direction from the Mayor and the integrated transport authority has resulted in the largest electric bus fleet in Europe.

Mayoral policy to reduce air pollution in London has paved the way for the largest electric bus fleet in Europe. There are now 437 electric buses, operating across 27 bus routes. 4.8% of the fleet operates with e-buses.. This has been achieved through buy-in from Transport for London (TfL) and the Mayor and the drive from all stakeholders to have zero emission buses in the fleet.

TfL has successfully overcome challenges and managed timescales for infrastructure installation and vehicle acquisition. For example, ensuring bus depots have enough power capacity with adequate infrastructure installation is important for the start dates of new contracts and routes awarded with electric buses. Electric buses can take up to 12 months to build depending on the specification, building this into timescales of bus deployment is imperative.

KOLKATA _
INDIA

Kolkata is tackling air pollution by incorporating electric buses into multimodal transport routes across the city.

The Government of West Bengal procured 80 electric buses and deployed them on routes in densely populated, polluted, and congested areas – so that they had the greatest impact on improving air quality and ensured equal access to public transport.

With a complex mix of existing transport systems, the city was keen to ensure that new forms of transport integrated with old. So these routes were designed to connect with ferries, trams, and passenger rail to create seamless multi-modal transportation in the city – ultimately leading to faster uptake by the public.

> Kolkata, the city of joy, has run an electric tramway for more than a century. The city is now also taking a leading role to introduce electric buses for public transport."

This will be complemented by using procurement to drive uptake further, with future contracts issued by the city's transport authority requiring providers to use electric or CNG buses.

VANCOUVER _
CANADA

Interoperable overhead charging of electric buses.

The Canadian Urban Transit Research & Innovation Consortium (CUTRIC) worked with a consortium of bus manufacturers, transit agencies, city authorities and electricity providers to demonstrate the feasibility of interoperable high-powered overhead pantograph charging in cities.

Vancouver was the first city to deploy the buses in full revenue service. Four electric buses were deployed in the fleet. They were designed to charge with the high-power pantograph chargers based on the Oppcharge (opportunity) protocol, which provides a standardised, interoperable technology for charging buses and large vehicles "on-route". The demonstration evaluated how the technology operated and could be expanded to additional routes to enable the broader adoption of electric transit buses.

Sharing data was at the heart of the project: Vancouver shared its experience and data with two other transit agencies in Canada, York Region Transit and Brampton, which are deploying EV buses across 2020 and 2021.

taxis _

Taxis offer one of the strongest cases for electrification: they are high-mileage, intensively-used vehicles which many cities already regulate or licence.

However, taxi industries can be resistant to change. Concerns over range and charging time are genuine.

The cities in this chapter understand these dynamics, and work hard to engage their taxi operators – and build infrastructure and policy that creates a compelling commercial basis for a switch to EVs.

RECOMMENDATIONS _

Cities should look to scale up taxi electrification by:

01 _

Thinking long-term about incentives and infrastructure

Many cities are aware that high-mileage users like taxis could be important to long-term business models for charging networks. Cities are designing incentives with an awareness of the trade-offs between short-term uptake and long-term sustainability: initially delivering comprehensive taxi-only or shared infrastructure, and introducing low tariffs, but thinking about how these features evolve in future.

These features vary by city, but the concept is to consider the long-term future of incentives and infrastructure policy as early as possible.

02 _

Licence requirements

Requiring taxis to be electric to receive licencing is a powerful tool to drive mass uptake. It can set deadlines by which a taxi has to switch to EV, reduce costs for EVs, or give faster approval for EV licences. Early-stage EV taxi programmes often begin with some kind of incentive or discount in licencing: mass uptake can be driven by moving these regulations to EV-first or EV-only approaches.

03 _

Using familiar vehicle types

Taxi vehicles vary significantly by city. Successful cities have often focussed on electric versions of familiar vehicles – working with the grain of traditions of rickshaws, two-wheelers or distinct taxi-cab designs.

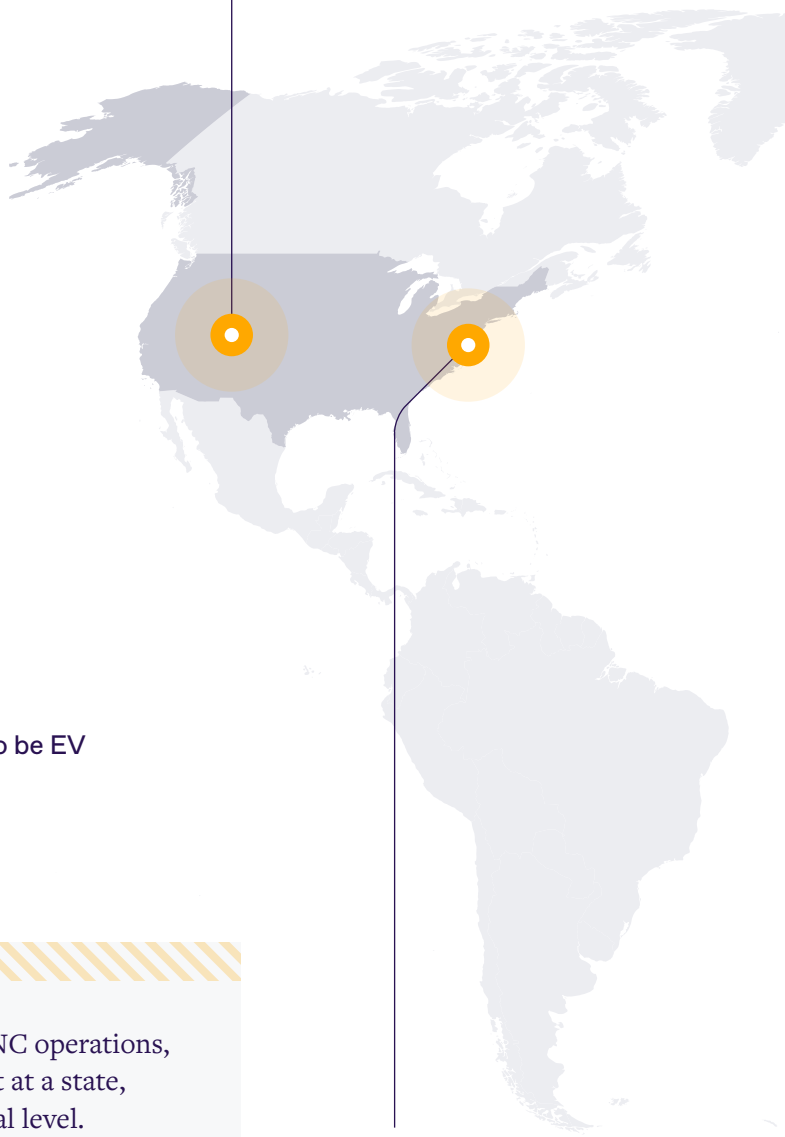
GLOBAL VIEW _

ONLY 2

cities worldwide have 100% electrified taxi fleets - Taiyuan & Shenzhen

USD163bn

Expected total global revenue from taxi and ride-hailing services in 2020



TAXI & RIDE-HAILING COMPANIES LONG TERM ELECTRIFICATION TARGETS _

DIDI

1M
EVs available currently

10m
EVs available by 2028

UBER

100%
shift to EV by 2040

OLA

20%
of fleet to be EV by 2021

RIDE-HAILING & TNCS

Recent years have seen the disruption of the traditional Taxi & Ride-hailing model by Transport Network Companies (TNCs). Companies such as Didi, Uber, Lyft, Ola, and Grab offer an app-based booking system. Different licencing laws in different countries mean that in some cities there is no control or city-level regulation over TNC operations, with regulation set at a state, regional or national level.

Trips from these global ride-hailing companies are growing fast. In the USA, trips with TNCs have exceeded taxi trips in many cities: for example, in Washington DC TNCs account for approximately 60 million trips, compared to just 9 million taxi trips per year.

Number of Electric Taxis and Private Hire Vehicles

City Population

DUNDEE
134
149K

TAIYUAN
8,292
3.9M

KIGALI
50
1.1M

NAIROBI
11
1.8M

AHMEDABAD
UNKNOWN
8.1M

CASE STUDY _

DUNDEE _ UNITED KINGDOM

Alpegor / Adobe Stock

Dundee, Scotland's 4th biggest city, is recognised as one of Europe's leading cities in the deployment of electric vehicles.

Harmful NO_x and particulate matter levels led to an air quality management zone being created in 2012, and the city has looked to electrification as the central component of its strategy to improve air quality.

Dundee has a typical taxi fleet for a small city, with over 700 taxis serving a population of 150,000. The first electric taxi was introduced in 2015, and through a combination of regulation, incentives, and direct financial support, almost one in five (19%) of taxis and private hire vehicles are now purely electric. The city's council, taxi operators, and vehicle companies now share a commitment to improving the environment for Dundee's citizens.

Dundee has worked closely with the taxi industry to deliver a range of policy changes, incentives, and infrastructure to support and encourage the trade to make the switch to electric vehicles.

> Installation of three rapid charging hubs across the city has accelerated the electrification of the taxi fleet."

Using licencing to scale up electrification

To encourage electrification of the taxi fleet, significant changes to taxi licensing policy were introduced following extensive engagement with the industry. All new private hire licences (known as 'plates') have to be electric for the life of the plate, and if a driver wishes to change a personal plate into a company plate, then it would have to be electric for the lifetime of that plate.

Public Charging Infrastructure

In 2018 Dundee City Council installed three charging hubs with 6 rapid charge points at each hub. These hubs have registered over 100,000 charging sessions per year. Over 65% of usage at these hubs is from commercial organisations. Taxi companies report that the creation of this infrastructure was crucial to their willingness to switch to EVs.

Financial support for taxi owners

Annual safety inspections fees are £11 lower for electric taxis, passing on the savings from avoiding emissions test and engine oil tests on to the vehicle operator.

Until November 2019, EVs had access to free electricity at charge points and free parking in any Dundee City Council bay. The tariffs introduced are designed to cover costs only and still lead to operational savings for drivers, but were created to build better long-term sustainability into the business model for the city.

KEY PLAYERS _

DUNDEE _ UNITED KINGDOM

City authority

Dundee City Council identified and introduced key policy changes that are supporting the transition to a 100% zero emission taxi fleet – but the crucial element in the city's success was consensus and sustained support from elected politicians, officials, and wider public sector institutions.

Working Group

Strong communications and engagement meant that industry needs were understood and acted on. A long-standing Taxi Liaison Group was used to discuss plans well in advance, with discussion of incentives, pressures on taxis, and feedback on the location of charging infrastructure. Around 2 years of planning and discussion took place before the first EV taxi was rolled out. With the council and taxi trade unions represented, the group offers a shared forum to agree the role of taxis in the city's ambitions.

EV Champion

New firms have often recognised that new technology and licencing can be a source of competitive advantage, prompting others to follow their innovation. One taxi firm was instrumental in driving change in the sector: David Young, the owner of the 203020 taxis, introduced a fleet of 30 electric vehicles in 2015 and became a passionate advocate who encouraged other businesses to follow his lead. This kind of peer-to-peer promotion is seen in the city as influential, given taxis are a tightly-knit sector.

National Government

Funding from both Scotland's devolved government and the UK's national government supported the development of the charging hubs in Dundee.

Urban Foresight / Dundee City Council

CASE STUDY _

NAIROBI _ KENYA

Private provision of charging hubs to support an electric ride-hailing venture.

NopiaRide, a private provider, is installing charging hubs to support the expansion of its electric ride-hailing fleet. These EVs are designed to mitigate urban air pollution while retaining the potential of a new flexible service for mobility in the city. Three hubs equipped with DC Fast Chargers were built in shopping malls cross the city. NopiaRide (which is backed by the EV car share company EkoRent from Helsinki) is scaling up from 50 EVs to the goal of having 1,500 vehicles on the road by the end of 2021 – led in part by driver demand, because the lower running costs of EVs has resulted in a 30-50% increase in earnings.

CASE STUDY _

KIGALI _ RWANDA

Partnerships between utilities and vehicle manufacturers to bring about an electric ride-hailing scheme.

Rwanda's capital, Kigali, is aiming to leap-frog traditional fossil fuel transport with a partnership between Volkswagen and Siemens. Volkswagen has a plant in the city, and in December 2019 launched a ride-hailing app called Move, developed by a local IT start-up. It launched with 50 electric cars and 15 charging stations built by Siemens.

CASE STUDIES _

TAIYUAN _
CHINA

Financial support led to rapid transition of the entire taxi fleet.

All 8,292 taxis in Taiyuan were electrified in an eight month period as a result of a planned taxi fleet renewal supported by financial subsidies. The city was due to re-licence its fleet, and as that approached, the city developed strong incentives to encourage every taxi to switch. BYD opened a factory in the city to support the transition. Subsidies were introduced to cover around two-thirds of the cost of a new vehicle. This reduced the capital costs of a typical electric taxi from around RMB 309,000 (USD 46,000) to only RMB 109,800 (USD 14,500). This was achieved through subsidies of RMB 100 from the Municipal government, RMB 50,000 from the Provincial government and RMB 50,000 from Central government.

WASHINGTON DC _
USA

Purpose-built EV charging to support taxi electrification.

To encourage taxi drivers to switch to electric-only vehicles in Washington DC, dedicated taxi charging points were built at the central transport hub of Union Station. Two Level 3 charge points were installed which can only be used by taxis – not by TNCs or the general public – thanks to a partnership between a taxi operator, city government, and private infrastructure operator, ChargePoint.

> “Investing in a charge point in central station dedicated for the taxi industry.”

Charging fees were set at a favourable rate of USD 4.50 compared to around USD 9-11 for charge points elsewhere in the city. The infrastructure has proved popular with the 97 electric taxis in the city, with between 800 to 1000 charging sessions daily in 2019.

DENVER _
USA

Changes to the EV tax credit supporting electrification of TNCs.

Legislators opened up Colorado's electric vehicle tax credit program to rental companies and businesses with fleets. As part of a series of tax incentives to encourage electrification, Colorado enabled this EV tax credit to be used for TNCs – an incentive which few US states offer. This has resulted in over 200 Kia Niros being deployed for Lyft drivers who can now lease the vehicles at a cheaper rate. These drivers also pay a weekly fee that will give them all-you-can-charge access to electricity from several different providers.

AHMEDABAD _
INDIA

Serving first and last-mile journeys with e-rickshaws.

E-rickshaws are quieter, faster, cleaner and cheaper to operate than traditional auto rickshaws. In India they offer similar opportunities and challenges to e-scooters in other countries. Ahmedabad has invested in public transport, including introducing a new rapid bus service in 2009 and construction of a new metro starting in 2015 – but the city still faced significant congestion in central locations, as a result of first- and last-mile connections from bus stations being taken by rickshaw.

In response, the Ahmedabad Municipal Corporation provided a parking dock for e-rickshaws in the city, the regional government introduced subsidies to stimulate adoption, and at the end of 2020 issued a tender to buy 5,000 e-rickshaws to sell on to drivers.

GLOBAL STUDIES OF EV INNOVATION _

city fleets _

Urban freight is responsible for one-quarter of urban transport emissions in most advanced economies.

City centres across the world are busy with fleets owned by logistics firms, municipalities themselves, and private businesses. These city fleets tend to be high mileage and concentrated in city centres, operating in a commercial context with tight margins and time pressure for journeys: so persuading them to switch to EVs requires sustained incentives and encouragement.

Working with businesses to address these challenges and switch these fleets to electric is essential if cities are to achieve their decarbonisation goals.

RECOMMENDATIONS _

Cities should look to scale up city fleet electrification by:

01 _

Shifting procurement from some EVs, to EV-by-default

Many cities looked to procurement of EVs in municipal fleets to begin their electrification journey. Mature EV cities now operate procurement so that municipal fleets buy EVs in all but exceptional circumstances.

02 _

Road access and use tools

Many city fleets, like logistics companies and business owners, want access to city centres or business districts. Policy tools like clean air zones, congestion charging, clean-logistics zones, or lane use can be effective in moving from early to mass adoption of EVs by these vehicle users.

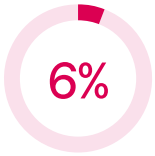
03 _

Business engagement programmes

City fleets have a wide range of ownership models, and hugely variable patterns of replacement cycles and vehicle lifespans. Comprehensive communications plans for a business audience are important to understanding their concerns, persuading firms to make the switch to EVs, and generating support from a wide range of stakeholders.

GLOBAL VIEW _

URBAN FREIGHT CO2 EMISSIONS _



of global transport GHG emissions

of European city urban transport emissions

GLOBAL LOGISTICS MARKET _

USD6TN
Estimated market worth by end of 2020

4.5%
Annual growth forecast

45%
of global spend is from Asia Pacific

GLOBAL LOGISTICS COMPANIES ELECTRIFYING

Multinational logistics companies are developing long term plans to transition significant parts of their fleets to electric. Many have started publishing targets. DPDHL has already deployed more than 10,000 electric StreetScooters – an electric delivery van made to prescribed specifications. Amazon has ordered 100,000 Rivian e-trucks, 10,000 electric rickshaws, and 1,000 e-cargo bikes. UPS has ordered 10,000 trucks from the London based start-up Arrival. FedEx has deployed 1,000 Chanje V8100 electric delivery vehicles with plans to electrify 42 FedEx stations in California to allow the deployment of more vehicles in the future.

E-commerce has increased freight volume in cities and shifted logistics vehicles to local streets and arterials. As the EV market grows, electrification of logistics vehicles can play a significant role in reducing air pollution in cities.

CASE STUDY _

STOCKHOLM _ SWEDEN

Micael Widell/Unsplash

Stockholm is a growing city, with forecasts estimating a population increase of 25% by 2030 from the current one million people.

Decarbonising transport whilst extending services to meet population growth is high on the agenda for city officials. The city has a decarbonisation target of 2040, and the key mechanism for reducing its fleet emission has been the innovative Clean Vehicles in Stockholm programme. This has been run by the City of Stockholm since 1994, and focusses on driving adoption through procurement.

Stockholm has supported EV adoption in its municipal fleet by delivering a leading procurement strategy that considers EVs first for any vehicle replacement and transport service.

The strategy has focused on a range of clean vehicles – those with tailpipe emissions less than 50 g CO_2/km, including ethanol, biogas, hybrid, and plug-in hybrids. The city's fleet now consists of 99% clean vehicles of which 27% are fully electric, and has a specific target of completely decarbonising by 2030.

EV-first procurement

Ensuring procurement considers EVs first was key to Stockholm's transition to electric. When a new vehicle is considered for purchase, the fleet manager assesses the needs of the department to see if choosing an EV is possible, or if e-bikes or cargo bikes might be suitable. To help staff consider this switch, a suitable EV is available to test drive for a couple of weeks to reduce any concerns. The fleet manager ensures there is a single annual procurement to create lower costs for the authority, replacing 100 vehicles per year across the city's departments.

> "A progressive procurement framework helped to deliver our low carbon transport ambitions."

Charging ahead of demand

Deploying charging infrastructure has been a key challenge. Some council sites are rented or vehicles are parked on street, so the city had to increase provision elsewhere and in its own sites. There are dedicated charge points for the city's own vehicles, reducing reliability concerns from staff.

KEY PLAYERS _

STOCKHOLM _SWEDEN

Senior Government officials

National political leadership catalysed the decarbonisation of the municipal fleet in Stockholm. This started with the 1994 EV programme, and top-down political support has continued in the development of the programme.

Municipal Fleet Lead

The city's Central Fleet Management has played a central role in electrification. The Fleet Managers assess each new vehicle request to ensure that electric vehicles are procured first if they can fit the purpose.

Gemma Evans/Unsplash

CASE STUDY _

MODESTO _ USA

With financial assistance, Frito Lay has led one of the biggest electrifications of logistics in the world.

"Proud to use an entirely sustainable fleet of vehicles as part of a holistic approach to reduce the plant's carbon footprint."

Frito-Lay is a food manufacturer with a major plant in Modesto, California. This will become its first to use an entirely sustainable fleet of vehicles, enabled by governmental financial support and the assistance of CALSTART. Frito-Lay is deploying 15 Tesla semis, 38 Volvo natural gas-powered semis, six electric Peterbilt box trucks, 12 electric forklifts and three electric yard tractors. This was supported by a USD 15.4 million grant from the California Air Resources Board, a USD 13.5 million in matching funds from Frito-Lay with another USD 1.8 million coming from American Natural Gas. This support is driving one of the largest electrifications of a private logistics facility in the world.

CASE STUDY _

BERLIN _ GERMANY

Over the past six years 1000 electric logistics vehicles (including delivery vans, e-bikes, and e-trikes) have been deployed across several of DHL's Berlin depots for delivering parcels and letters.

The push for zero-emission delivery led the company to adopt and integrate new vehicles such as cargo bikes for urban deliveries. It built electric into each part of the delivery journey across a modern logistics firm operating at scale - as well as manufacturing its own StreetScooter delivery van for its fleets. There are now over a thousand e-bikes and e-trikes in Berlin delivering parcels and letters for DHL. The company has a target that by 2025, 70% of first and last mile trips will be electrified, up from the current rate of 35-36%. All charging of the logistics fleet takes place in DHL's depots, and DHL has three infrastructure partners for development of further facilities.

CASE STUDIES _

HAIKOU, HANAN _ CHINA

The first province in China to announce official targets to shift to clean energy vehicles in municipal fleets by 2030.

In 2019, Hainan became the first province in China to announce official targets for a transition to 100% clean energy vehicles for its fleets set out in "Development Plan of Clean Energy Vehicles in Hainan Province". This will be achieved through three five-year phases, which will initially target public fleets, such as government vehicles and buses, and will apply to private passenger and commercial fleets in later years. In 2020, Government, bus, taxi, postal/logistics service, and car share services must purchase EVs when updating their fleets.

The regional strategy sets out a clear technology roadmap. It recognises that as an interim step, plug-in hybrid and natural-gas vehicles might be necessary – but as costs reduce and technology matures, battery electric and fuel cell vehicles are the ultimate goal.

LOS ANGELES _ USA

Supporting electrification of municipal fleets across the USA by the Climate Mayors Electric Vehicles Purchasing Collaborative.

The City of Los Angeles is electrifying its entire government fleet, with more than 800 electric vehicles already deployed.

One of the key mechanisms to support the city government's fleet electrification is the Climate Mayors' Purchasing Collaborative: an online platform and resource portal that guides and encourages city leaders and public bodies across the USA to buy EVs collectively, reducing costs and sharing best practice on implementation. This was launched by the Los Angeles Mayor Eric Garcetti in 2018, and participating cities have collectively committed to purchasing more than 2,000 EVs to date. For example, one of the other cities in the collective, Austin, Texas, has now deployed 330 EVs in its municipal fleet.

ROTTERDAM _ THE NETHERLANDS

Creating a fast-charging plaza to support a 2025 zero-emissions target.

A fast charging plaza was built in Rotterdam, with eight parking spaces to support zero-emission parcel transport in and around the Rotterdam city centre – meeting the city's overall 2025 zero-emissions target for logistics.

The FLEX EV consortium included a range of organisations, including the Dutch transport research agency TNO, a charging infrastructure provider, electric truck developer EMOSS, and logistics firms DHL and Road Runner couriers – all working together to design logistics fleets around the charging plaza.

This was made possible with financial support of EUR 1.9 million (USD 2.24 million) from Demonstration Climate Technologies and Innovations in Transport (DKTI-Transport), a Dutch government scheme to support demonstration projects which might have potential to move to mass adoption.

OSLO _ NORWAY

Catalysing electrification of logistics by introducing a LEZ.

Oslo has implemented a Low Emission Zone in the form of three toll rings around the city, where the toll rates are dependent on type of fuel. Toll rates for diesel cars are the most expensive, while EVs pay only 50 per cent of petrol cars for entering the different zones. Zero-emission trucks (weight above 3.5 ton) are exempt from paying the toll. This has incentivised logistics companies to deploy zero emissions vehicles. For example, DB Schenker has opened a zero-emission city hub with 23 electric vehicles, including electric trucks, vans and bicycles. Every day, around 800 consignments in Oslo will be delivered from this depot using an electric vehicle.

GLOBAL STUDIES OF EV INNOVATION _

shared mobility _

Shared mobility schemes include some of the newest and most exciting technologies in transport.

Car share schemes have grown in popularity, while scooters, e-scooters, bike share schemes and e-bikes have all rapidly increased in numbers, fuelled by new apps and mobile technology.

These forms of shared mobility can directly replace car use. They usually have lower manufacturing and battery costs. So they have the potential to lead mass adoption faster and more easily than other technologies. How can cities use these innovations to get to mass electric mobility? How can EV efforts integrate with these other technologies?

RECOMMENDATIONS _

Cities should look to scale up shared mobility electrification by:

01 _

Clear principles for space and use of micromobility schemes

Concerns over street clutter, access to charging, and space use can create opposition to micromobility schemes from political and business stakeholders. Clear locations for storage and charging, and clear road and pavement access rights for e-bikes, e-scooters and micromobility schemes can take advantage of these exciting new technologies, without undermining support for them.

02 _

Future-proofing for digital integration between systems

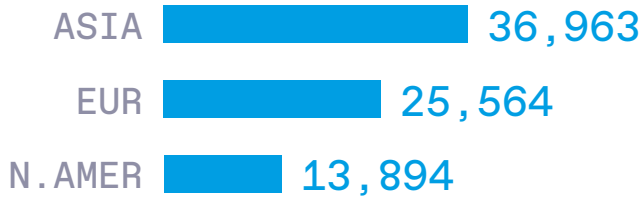
Even if cities encourage private markets in mobility, city administrations play a major role in making systems coherent for their citizens. In practice, mass EV adoption is more likely if systems are digitally integrated, with single ticketing, charging and access systems – even if the providers compete with each other. Cities should see their role as enabling future integration and modal switch away from private petrol and diesel cars more likely, by brokering data and information-sharing protocols.

GLOBAL VIEW _

OVER 600
cities, across 50 countries, offer shared mobility devices

OVER 2900
e-bike sharing schemes operate worldwide

NUMBER OF SHARED E-BIKES _



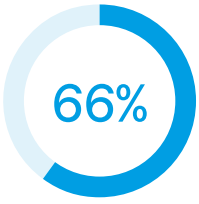
PROJECTED GROWTH OF SHARED E-SCOOTERS _

USD41.98BN
Projected value of shared e-scooter market by 2030

85,000
Shared e-scooters available in North America, 2018

CAR SHARE SCHEMES AVAILABLE WORLDWIDE _

3128 CITIES IN 59 COUNTRIES OPERATE CAR SHARE SCHEMES



of these 59 countries have introduced EVs as part of a car share fleet in at least one of their cities

OVER 236 OPERATORS

managing either free-floating, station based or peer-to-peer car share services

Number of car share EVs

Number in micromobility fleet

CASE STUDY _

MADRID _ SPAIN

Giuseppe Buccola/Unsplash

Madrid is a city with low private car ownership – only around one in five residents own a car. This is due to good public transport provision, high population density, and concerted policies to reduce car use.

The city introduced a Low Emission Zone in central Madrid but faced growing poor air quality issues outside the central zone. To tackle this, 'Madrid 360' was introduced in January 2020 as a larger area restricting access for highly polluting vehicles.

> "Competitive car share market along with our Low Emission Zone is pushing our switch to EVs."

100% electric vehicles benefit from free parking on-street and in public car parks with no time limit, and plug-in hybrid vehicles pay 50% of the parking cost with a time limit of 2 hours.

The LEZ is monitored by ANPR cameras which use the national database to ensure vehicles adhere to legislation.

Users have access to over 2,000 electric vehicles in the city.

Multiple car share schemes are operating in Madrid in a dynamic, competitive market.

Policy framework for private provision

Car share schemes have operated within the city since 2016, two years before the LEZ was established. The car share services are all private initiatives which are not regulated by the city government.

There are few to no barriers to setting up car share schemes - with no subsidies, no allocated bays, and no direct intervention from the city. But thanks to the LEZ's overarching regulation of vehicle use, car share operators have still switched to EVs – and so public policy goals of reducing emissions have still been advanced.

Digital spin-offs from major autos

Some of the car share schemes operating in Madrid are backed by large organisations involved in the automotive industry. Share Now is owned by Daimler AG and BMW, Zity is backed by Renault, and PSA Groupe operate Emov. All the companies that operate car share schemes in the city have their own app to book vehicles. There is some initial work ongoing to integrate these apps together into the 'MaaS Madrid' app – a good example of how electrification policy interacts with emerging mobility as a service concepts.

Reducing user need to charge

Users of the car share schemes are not required to plug vehicles into charge points. Instead, companies remotely monitor the state of charge of vehicles and collect them to recharge them when necessary. This enables 'free floating' car schemes, rather than cars based at fixed locations – making it much easier for a user to access cars.

KEY PLAYERS _

MADRID _ SPAIN

	FLEET SIZE & TYPE _	PRICING MODEL (USD) _
ShareNow	500 Smart cars	0.22 - 0.36 per minute (plus 0.39 per km above 200km)
Zity	658 Smart cars and Renault Zoes	0.21 - 0.31 per minute. Flat rates for 4, 8 and 24 hours.
Emov	500 Citreon C-Zero	0.22 - 0.36 per minute (plus 0.31 per km above 250km)
Wible	500 Kia Nero Plug-ins	0.29 per minute 7.06 per hour Beyond Madrid boundaries, 5.88 per day with 100km inc.
Wishlife	35 Nissan Leaf, Renault Zoe, Tesla Model 3, Jaguar I-Pace & VW e-Golf	0.94 first 10km 0.47 per km for further distance

CASE STUDY _

PARIS _ FRANCE

Building on a successful bike share scheme, the city is regulating operators who have now deployed thousands of electric bikes and e-scooters.

Paris is globally recognised for its work in shared micromobility, and a combination of regulation, financial support, and spatial policy has built on this reputation in newer technologies.

Road Space Allocation

Paris faced challenges in potential conflicts over use of public space. Many bikes and micromobility vehicles drive and park on sidewalks, often in central areas with high density of pedestrians. This led to concerns over the impact on pedestrians, particularly elderly and disabled citizens. To resolve this issue, the City created 2500 stations with 15,000 parking spots reserved for e-scooters. Docked e-bikes have approximately 32,000 parking spaces across the city.

> "Regulation is key to successful to shared micromobility schemes."

Rules and Regulations

Legislation has been enacted nationally and by city authorities to ensure devices benefit the city. Since 2019, micromobility operators (except the Velib scheme) pay a fee to operate in the city. These operators are limited on the number of devices they can deploy in the city. Free floating micromobility devices can only park in the 2,500 spaces the city has allocated for this purpose, or in car/motorcycle on-street spaces.

Financial support

The Velib docked e-bike sharing scheme was procured with financial support from the city. The management contract is for 15 years (starting in 2018) held by a syndicate of 31 local authorities in and around Paris.

KEY PLAYERS _

PARIS _ FRANCE

	Lime	Doot	Tier	Velib	Jump
VEHICLES _	5000	5000	5000	6000	500
	Electric foot-scooters	Electric foot-scooters	Electric foot-scooters	Electric bikes	Electric bikes
CHARGING _	Free-floating	Free-floating	Free-floating	Public station-based	Free-floating
FINANCING _	Self-financed, pay a fee to the city	Self-financed, pay a fee to the city	Self-financed, pay a fee to the city	Subsidised by the city, under city contract	Self-financed, pay a fee to the city

Robin Berg/We Drive Solar

CASE STUDIES _

UTRECHT _
THE NETHERLANDS

An innovative car share scheme linking microscale renewables to EV charging.

We Drive Solar consists of a fleet of around 70 EVs in Utrecht which are charged through roof-mounted Solar PV in a microgrid. The vehicles park in charging plazas which We Drive Solar owns. The company focuses on people who would use the cars on a regular basis.

> "Organic growth of car share vehicles enabling reduction in car ownership for residents."

The project is particularly innovative as it uses the vehicles along with bi-directional charging infrastructure as 'mobile storage' on the microgrid. EVs offer fast response, short term storage to balance the grid, with only a million vehicles needed to balance the grid in The Netherlands, We Drive Solar is a solution that supports the grid and encourages EVs.

The initiative has been supported by a multitude of partners including the municipality of Utrecht, Renault, Last Mile Solutions (the charging station management service provider), and Elaad NL(the knowledge and innovation center of the Dutch grid/network operators on EV and smart charging). We Drive Solar operations are expanding sustainably across other cities such as Rotterdam, Amsterdam, and The Hague.

MILAN _
ITALY

Long term vision for electric car sharing with policies to ensure electrification of services for new vehicles from 2024.

Milan has multiple car share schemes operating EVs, including ShareNow and Sharengo. These schemes are a mixture of free floating and station-based car share services, with dedicated charging infrastructure associated with EV car share parking spaces.

The services are let under contract from the city government for up to seven years, and from 1st January 2024 the car share companies are obliged to switch to electric vehicles for any new purchases or substitutes into the scheme. The car share companies have to pay the city authority EUR 1,200 (USD 1,428) per year per space, but this is waived if the vehicle is electric. 17% of the 3,000 car share vehicles in the city are now electric.

CASE STUDIES _

COPENHAGEN _
DENMARK

Bike sharing scheme supported by the city authority.

Copenhagen has adopted a new vehicle sharing platform for its e-bike fleet. Bike sharing has been commonplace in Copenhagen since the 1990s, and a new partnership between the Italian technology and engineering firm SITAEL, and Bycyklen, a Danish cycling start-up, won a tender led by the city to create a new platform. It now has over 2000 electric bikes available across the city.

The scheme has features to help its effective management, such as a safe locking system for the vehicles, a satellite geolocation feature, and access to usage data and diagnostic information of fleets in real time.

From a user perspective, the app enables riders to undock vehicles with their smartphone, look up vehicle availability, take advantage of promotions to support bikes' redistribution operations, and make automatic payments for sharing sessions.

SANTA MONICA _
USA

First city to see the spread of dockless e-scooters

In 2017, Santa Monica became the first city to see hundreds of e-scooters deployed across the city. With no municipal regulation, permits, or requirements, and a high number of tourists visiting the city to use the devices, it was viewed by micromobility providers as an ideal test ground.

In September 2018, these e-scooters became regulated with permits from the city. These were issued to four companies with a vehicle cap.

Throughout the 18 month pilot, data was collected to understand how people used the vehicles, what the challenges were, and how they could be addressed. As a result, Santa Monica still has the early dynamism of a start-up market in micromobility – with no requirement for suppliers to provide docks – but in the context of publicly-regulated market which the city's authorities can shape.

> "As one of the first cities to see dockless micromobility take off – practically overnight – we paved the way in regulation to create a framework for these companies to operate."

SINGAPORE _
SINGAPORE

Congestion charging and license plate auctions have created an optimum environment for a highly utilised car share scheme in Singapore.

The car share operator in Singapore, BlueSG, operates a car share scheme of over 1,000 EVs across the city. When users hire the vehicles, they need to be returned to designated BlueSG spaces.

For many residents and visitors, car sharing is the only viable option. Policies have been introduced to discourage private car ownership. Singapore auctions number plates to the highest bidders, which last for 10 years, and has reduced the number of privately registered vehicles in the city. The introduction of congestion charging has also discouraged drivers from entering the central zone in their own vehicle.

SHANGHAI _
CHINA

Local and national government have supported the development of a car sharing scheme, resulting in over 6,400 shared EVs in Shanghai.

Shanghai was one of the Pilot Cities of the NEV programme. The EVCard programme, one of the first car share schemes in China, launched in 2014 which has expanded to over 2,470,000 private users as of September 2020.

This saw the Shanghai city government offer financial support to private operators for all aspects of car share scheme electrification including platform development, charging infrastructure deployment, and operating costs. The city offers free parking spaces to car-sharing operators, and in the suburban district of Jiading, car-sharing is further subsidised by EUR 5,180 (USD 6,089) per NEV per year.

GLOBAL STUDIES OF EV INNOVATION _

private transport _

Private vehicles are one of the most advanced EV markets, with carmakers competing fiercely to push new models with longer ranges and better charging times.

Cities play an important role in backing up this organic shift in the car market, using a combination of hard regulatory power – discouraging private cars from city centres – through to encouragement by investing in charging infrastructure.

What lessons can we learn about how to accelerate the transition?

RECOMMENDATIONS _

Cities should look to scale up private vehicle electrification by:

01 _

Addressing charging ‘blackspots’ in public, workplace, and residential settings

Most cities have some charge points in central locations or hubs. Mass adoption requires roll-out into residential areas and workplaces, and setting city-wide policies (such as planning) which maintain EV-first principles, or considers alternatives such as car-share schemes.

02 _

Target policies on lower-income groups

The cost of requiring lower-income groups to buy new vehicles is a common concern. A link between income deprivation and the scale of subsidy for an EV can address these equity concerns.

03 _

Have a consumer information strategy

Scaling up requires both a source of trusted information on EVs and charging, with consistent messaging and reassurance from cities, and also consideration of how communications can change behaviour. A clear consumer-facing communications strategy should be designed early on in scale-up programmes.

GLOBAL VIEW _

TOTAL EV CARS ON THE ROAD WORLDWIDE _

2010
17,000

2019
7.2M

PROJECTED VALUE OF GLOBAL BATTERY MARKET (USD) _

2019
35.16BN

2027
133.46BN

PROJECTED TOTAL GLOBAL 2 & 3 WHEELER EVS_

2019
350M

2030
400M

32 COUNTRIES CURRENTLY HAVE NATIONAL EV DEPLOYMENT TARGETS _

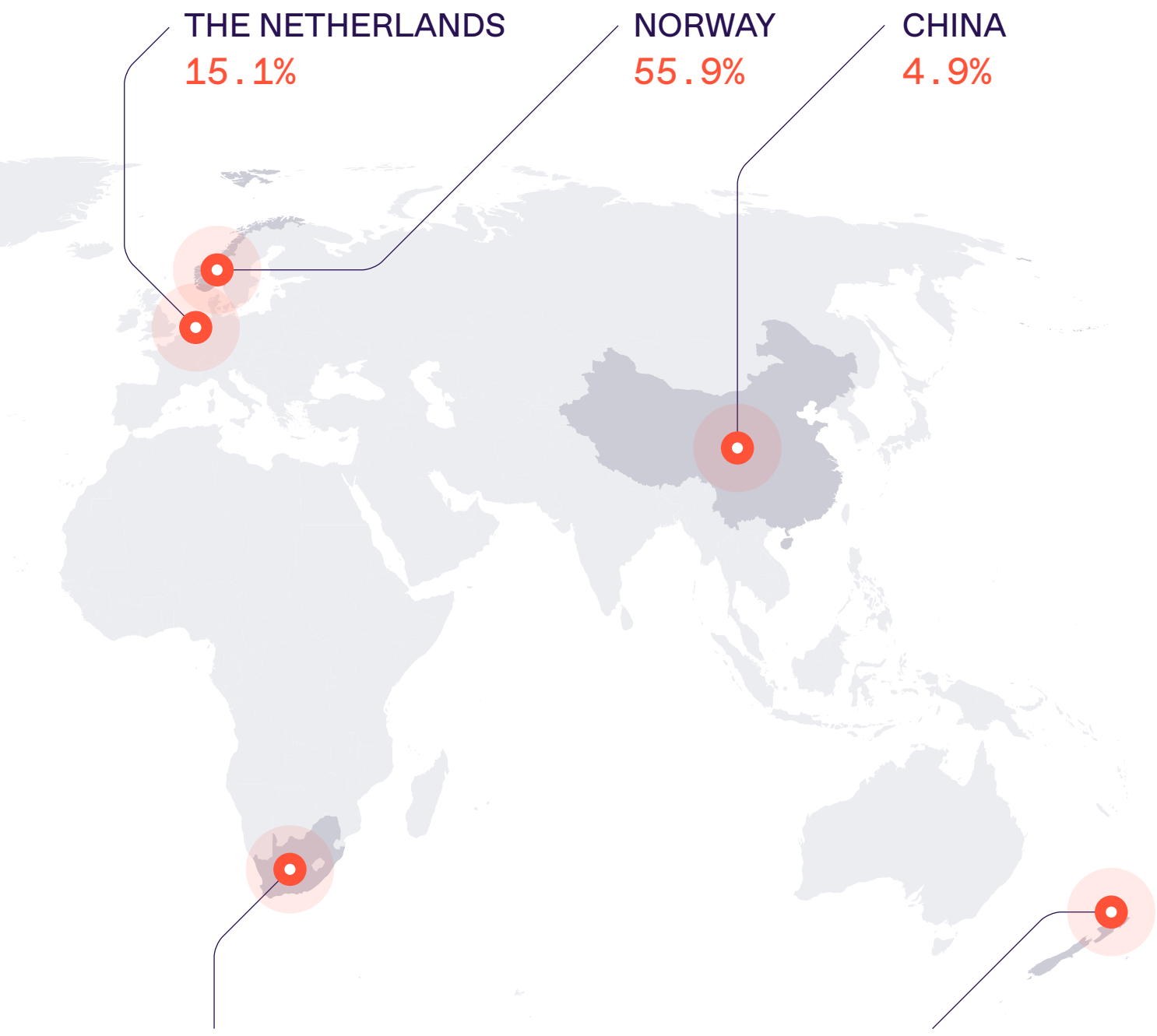
NORWAY
100%
zero-emission vehicle sales by 2025

LONDON, UK
100%
zero-emission vehicles by 2050

HAINAN, CHINA
100%
EVs by 2030

PARIS, FRANCE
0%
diesel cars by 2024 & petrol cars by 2030

This map shows the percentage of new car registrations that were electric in 2019.



CASE STUDY _

SAN FRANCISCO _ USA

© Joonyeop Baek/Unsplash

Cities in California have long faced high urban air pollution, and low-carbon transport has been a state-wide priority for some time. In line with this agenda, San Francisco has pursued a low carbon agenda.

The City Government is currently updating the City's Climate Action Plan, which will put forward a roadmap to meet San Francisco's net zero ambition by 2050, while simultaneously advancing socio-economic goals. The city sees climate change as a matter of equity, with decarbonisation viewed as beneficial to lower-income communities.

San Francisco prioritises 'transit-first', to encourage its 880,000 residents into shared mobility, but private vehicles are still rapidly electrifying as a result of policies to support adoption of low carbon vehicles.

Long-term support for organic market growth.

In 2015, the EV Working Group was formed to spearhead EV adoption. In 2017, it developed the City's EV Roadmap, targeting six key areas with concrete aims for 2020 to 2025. The EV Roadmap put forward an accelerated path toward electrification of all

> We continue to look for new ways to support the electrification agenda in the region through the EV Working Group.”

forms of private transportation.

In 2018, the City secured funding from the California Energy Commission to create an EV Ready Community Blueprint. The Blueprint details actions and timelines, identifies potential barriers and challenges, and assigns roles and responsibilities to City departments and supporting partners to achieve the city’s electrification future.

This series of policy changes - building on state-wide initiatives over the last 20 years - has led to 18% of new cars purchased in 2019 being electric, which puts the city on target to hit its aim for 100% by 2030.

This combination of long-term policy with specific, granular planning has led to an organic growth of EVs – with market demand encouraged through a combination of investment, regulation and incentives.

Regulation to increase EV use

Introduced in January 2018, the EV Readiness Ordinance requires new residential, commercial, and municipal buildings to have sufficient electrical infrastructure to simultaneously charge vehicles in 20% of parking spaces. New buildings will initially be required to have 10% of parking spaces ‘EV ready’ with the capability to expand from there in order to meet tenant needs.

Streamlining charging infrastructure processes

In 2020, the city began working with the global organisation of city leaders, C40, to define the potential for on-street fast charging in San Francisco and to establish guidelines and criteria to help develop a viable pilot program to expand on-street fast charging.

KEY PLAYERS _

SAN FRANCISCO _ USA

Electric Vehicle Working Group

The Electric Vehicle Working Group aims to identify actions and policies to continue EV growth in San Francisco. Led by the Office of the City Administrator and the San Francisco Department of the Environment, the Working Group contains representatives from fifteen City departments and agencies joined by stakeholders representing regional and state agencies, non-government organizations, and industry partners. The Working Group develops recommendations to transform the marketplace for EVs in the private sector.

Gemma Evans/Unsplash

CASE STUDY _

OSLO _ NORWAY

Norway's national target is for 100% of new cars to be zero-emission by 2025.

Norway has a national target to become to become net-carbon neutral by 2050. The City of Oslo went a step further with a target to become a carbon neutral city by 2030 – with transport electrification playing a key role.

The Norway EV Association has 80,000 members and works with the government to promote EV policy and advocate for better charging infrastructure, lobby for EV-friendly policy, and raise the profile of EVs to consumers.

A combination of policies has led to a rapid transition from 75% of new sales being diesel in 2010 to 75% EV in 2020, with more than 300,000 EVs now on the road.

The importance of charging infrastructure

The utilisation rate of public charging infrastructure is high enough to be profitable for the charge point operators in the city, and cover its maintenance costs. Interoperability led to a better user experience, with only one RFID card and consistent pricing across the city.

Adapting rules and regulations

The city allowed EVs into bus lanes to incentivise uptake. After uptake increased, this incentive was tightened so that only high-occupancy EVs (i.e. a vehicle with a driver plus at least one other passenger) could use the lanes.

In 2017, a regulation was introduced which mandates that new buildings must have at least 50% of the parking facilities equipped for electric car charging.

Financial support

National targets and purchase tax exemptions supported the transition in Oslo. The largest fiscal incentives are the purchase/import tax and VAT exemptions. Vehicle purchasers who buy a new EV are exempt from these taxes, reducing the cost of a new vehicle by around a quarter, and bring the capital cost of EVs in line, if not lower than, their conventional alternatives.

Norway has the highest percentage of EVs in new car sales of any country in the world.

CASE STUDIES _

AMSTERDAM _
THE NETHERLANDS

Supporting high EV adoption by building a comprehensive interoperable charging network.

In 2009, the Dutch Government introduced its first climate action plan for delivering large scale adoption of EVs to tackle transport emissions. Amsterdam now has the highest number of charge points of any city in Europe, and the key to this success has been the national adoption of standardisation for public charging. Its charge points are interoperable: meaning that not only do users receive a consistent experience, but competition within the market is encouraged - while retaining a degree of control for public authorities in setting standards.

> "Interoperability has been instrumental in supporting the consumer charging experience."

To ensure that the infrastructure installed does not become redundant and is future-proofed, the standardisation and interoperability are regulated by the Central Interoperability Register (CIR). The CIR was established to ensure that all cards or tokens issued for charging infrastructure across the Netherlands by active service providers would be supported on any charge point.

In 2014, The Netherlands Knowledge Platform for Public Charging Infrastructure (NKL) was formed. This independent, not-for-profit organisation took up the development of the Open Charge Point Interface protocol (OCPI). This supports connections between Mobility Service Providers and Charge Point Operators via a Charge Point Management Service (CPMS). The CPMS is responsible for keeping track of the status of the charging points, for communicating with external parties about its locations and charging sessions, and to provide an interface for aggregators to control the charging speed of the charging stations. These protocols are now seen as the standard in Europe and North America.

CAPE TOWN _
SOUTH AFRICA

City-level planning paving the way for electric mobility

The City of Cape Town has a climate change action plan with the aim of achieving carbon neutrality by 2050. One element of this is using renewable energy for EV charging stations. In collaboration with the United Nations Industrial Development Organisation (UNIDO)'s Low Carbon Transport – South Africa (LCT-SA) Project, two EV charging stations including solar photovoltaic carport systems have been donated to the city. The City of Cape Town's Electricity Generation Department also commissioned a study through ETH Zürich to identify locations across the city for electric vehicle charging infrastructure, including at shopping malls, filling stations, large parking areas, and at-home charging. This study included modelling of the expected increase in demand, aggregated to the main substation level of home electric vehicle charging.

AUCKLAND _
NEW ZEALAND

Private rollout of publicly available charging infrastructure to stimulate private EV car adoption.

A fully private charging route was installed in New Zealand's North Island, centred on its largest city, Auckland. The longest distance between charge points is 83 km. The network of Rapid DC chargers was built by ChargeNet NZ, the largest privately owned and operated DC fast charging network in the Southern Hemisphere. The company worked with 18 electricity suppliers, 17 local and central government departments, 14 corporate entities, and 3 not-for-profit organisations to install the route. To ensure a low-carbon system, ChargeNet NZ also partnered with electricity retailers that supply certified carbon-neutral electricity.

LIUZHOU _
CHINA

Residents were invited to test drive EVs and provide feedback to the vehicle manufacturer resulting in more than 10% of new car sales being electric.

Consumer engagement was key in the transition to electric in the industrial city of Liuzhou. In 2017, there was a 10-month Baojun E100 microcar test drive campaign, as vehicle manufacturer SAIC-GM-Wuling, which is based in the city, looked to increase EV sales. With over 15,000 participants, over 70% of these people then opted to buy electric.

Participants were encouraged by the city's authorities to give feedback to the manufacturer so that vehicles could be improved, with 13,000 recommendations made by citizens. Residents were also encouraged to identify new parking spaces in the city for these microcars, with financial rewards if they were adopted by the municipality.

The municipal authority supported private EV adoption with policies including a vehicle purchase subsidy, a reserved parking space for EVs, free parking, charging subsidies, and bus lane access. The municipal authority also supported the development of the public and private charging infrastructure network with a target of building 2,600 public and private charge points in 2020.

policy guidance for cities _

common challenges in scaling up _

EVs present many technical and policy challenges, but getting beyond early stage projects and moving through successive levels of maturity has its own particular issues, including:

Building in long-term sustainability to incentives and investment.

Almost all early-stage EV programmes involve financial and regulatory incentives to switch to EVs. But as the number of EVs increases, funding these tools can become unsustainable. Discounted charging, licence fee reductions, or subsidy for EV purchase/leasing can become financially unviable for cities. Some tools become impractical when EV use moves beyond early adoption, such as road space allocation for EVs.

Moving beyond some of these incentives is difficult, particularly as reducing incentives rapidly can undermine scaling-up. Many cities therefore identified their greatest challenge as working out what kind of incentives are appropriate, after early EV programmes.

Social equity concerns increase with uptake of electric vehicles.

EV prices are coming down and lifetime cost comparisons with petrol and diesel cars are attractive. But many citizens and city leaders are concerned that discouraging or banning petrol or diesel vehicles from accessing cities altogether still has the potential to further entrench inequalities. This can include concerns over vehicle types like taxis or small business logistics, which in many cities are owned or operated disproportionately by lower-income individuals.

COMMON CHALLENGES IN SCALING UP_

EV development is more advanced in smaller vehicles.

The EV and battery market is most advanced in smaller, lighter vehicles such as cars, vans, scooters and bikes. But many cities face emissions challenges from larger vehicles, such as buses, lorries, and HGVs. When larger vehicles often have demanding standards of reliability, safety, and power, many cities identify the immature technology of these vehicles as a challenge to mass adoption. Some cities benefit from strong local EV industries, which can help mitigate against this feature of the EV market – but many others, particularly in small advanced economies, have no similar cluster of manufacturers with which to develop new approaches.

Policy levers sit at different levels of government.

Increasing EV uptake is intimately connected with regulation and funding, and with incentives and targets. Not all cities control these levers. Cities in the USA, for example, recognise that converting Transportation Network Companies such as Uber or Lyft to electric is critical to mass EV adoption: but these companies are generally regulated at a state level.

Increasing need for integration with wider energy networks.

Initial EV pilots require new infrastructure, but can usually be implemented without significant impact on wider power networks and suppliers. This is not the case for mass EV use, which can require a more fundamental rethink of a city's entire power needs and sources.

10 lessons on what has worked well in scaling up _

01 _

Setting ambitious scale-up targets, backed up by achievable action plans.

City leaderships noted that setting public targets has more impact in scaling-up EV programmes than in earlier, start-up phases. These targets can include total EV numbers, a proportion of vehicles being EVs, a target for infrastructure roll-out, the complete electrification of a particular fleet, or emissions reduction targets.

In earlier phases, this kind of broad goal can look too abstract, or too ambitious given the scale of early electrification projects. But once a city has a basic level of publicly available charging infrastructure and is moving towards strategic planning on a range of EV issues, then setting a city-wide target can be effective. If it is also backed up by a clear action plan – and is therefore credible – an ambitious target can galvanise different partners, focussing internal management, and give confidence to private investors and vehicle owners on the seriousness of policy intent.

For large cities, setting specific targets for electrification of certain vehicle types can even give enough confidence to stimulate the market: Shenzhen city authority's decision to completely electrify its buses led to a partnership with a manufacturer, for example – the clear signal from public authorities creating space for a close research and development relationship.

02 _

Formal governance structures with a broad range of stakeholders working to a common vision.

EV uptake is a complex policy problem. It requires the input of multiple organisations. Cities which showed sustained progress set a vision and engaged a wide range of private, public, and civic organisations in translating that vision into reality. San Francisco's EV working group, for example, is seen as a gold standard of policy co-creation between public leadership and a range of interested parties, and is credited with identifying a practical role for each organisation.

Early EV programmes can often be managed effectively without dedicated staff, or by identifying informal resource. Mass uptake requires either dedicated resources, or for EV policy to be built into every other aspect of a city's governance and take account of local, regional and national policies. As important, the best EV cities have clear accountability and clarity on who is driving EV uptake, working under clear and sustained senior and political sponsorship.

03 _

Showing EV benefits across different aspects of public policy

Cities which have mature EV systems see their budgets holistically. Factoring in reduced maintenance fees and lower running costs, many EV fleets represent good value over their entire lifetime. Many cities see electrification as part of a wider growth strategy, aiming to build a reputation for quality of life and liveability. In the long-term, EVs could even reduce some spending pressures like healthcare costs driven by urban air pollution.

But many cities have different financing arrangements for different fleets. This means that financial planning can be as short as a 1-2 year horizon and transport budgets often sit separately to wider social expenditure.

The full benefits of EVs are only visible if a city has a budgeting process which captures long-term costs and savings, and demonstrates long-term benefits across a range of public policy priorities.

04 _

Long-term planning in incentives

Direct financial subsidy remains important for increasing uptake beyond early adoption. Almost all cities have some kind of national (or state/regional level) financial incentive to purchase or use an EV. Some which have sufficient financial autonomy or resources, such as Shenzhen or Shanghai, have driven mass adoption by going further, offering an additional incentive to switch, topping-up national policies.

They recognise, however, that other incentives might have to adapt to reflect increasing EV uptake. This can include:

Avoiding sudden changes to financial incentives.

Scaling up requires financial incentives to be clear, predictable and long-term. Even if cities ultimately intend to reduce subsidies as the EV market matures and the need for public subsidy is reduced, sudden reductions in incentives can deflate markets and stunt uptake.

Focussing on creating a market incentive for EV uptake.

The most successful cities set a framework which encourages EVs – but also aim to make EV use a competitive necessity in dynamic, innovative markets. Madrid, for example, designed its clean air zones to take advantage of the city's existing market in

car share schemes, by limiting access to the city centre for petrol and diesel cars. This created a competitive advantage for the firms that moved fastest – and supported the rapid transition of an entire category of vehicle – but without creating long-term liabilities for the city. Many cities ultimately aim to create this kind of system where users are incentivised to use EVs through commercial pressures and competitive dynamics, rather than purely through subsidies.

Adapting road access incentives.

After initial impacts begin to wane, incentives can be tweaked to focus on different types of user, and move beyond early adopters. Where early programmes might give additional priority to EVs in road space, for example, mature incentives move to EV-first or EV-only systems for all road space. Conversely, incentives can be changed to prompt further changes. Oslo, for example, initially encouraged EVs by allowing them to drive in bus lanes. As uptake increased, this became unsustainable – there were too many EVs in the lanes. The city responded by stopping lane access for EVs, unless they were high-occupancy vehicles or part of car-share schemes – encouraging not just EVs, but a particular vehicle use. Cities have to be prepared to adapt, or remove, this kind of incentive as uptake increases and EV use becomes increasingly the norm.

Considering EV discounts, rather than free services.

Cities reported that in general, it is easier to increase existing charges than it is to introduce new ones – for the simple reason that user consent is more likely if the principle of paying is already established.

One option is therefore to design systems with some level of user cost for EV services (such as licence costs, charging rates, parking charges, or congestion charges) established in principle, even if rates are low or heavily discounted. This makes it easier for cities to avoid revenue dependency on high-pollution vehicles, and easier to find future sources of revenue to make EVs financially sustainable – but without stunting adoption.

Sharing capital costs.

In most cities, early-stage EV investments are small-scale and affordable for fleet owners, cities, and investors – or national subsidies have reduced costs and risk. Scaling up requires much larger investment. However, systems running at scale also create an opportunity to create new business models to share value, particularly in bringing in private investors where a clear opportunity can be defined. Santiago de Chile's buses, for example, were funded by utility companies buying buses – taking the risk and investing capital – and leasing them to operators, who could then expand their EV fleets without additional pressure on their balance sheets.

05 _
Leading by example

Many cities led by example in early-stage EV projects. This leadership remains important for getting to mass adoption: many cities directly own or control fleets, or they commission services from private providers and retain significant contractual leverage. Some other city fleets might require outside influence or incentives, but these directly-

influenced fleets are in practical terms easier to direct as targets for electrification. Cities should feel empowered to require EV uptake in these fleets.

06 _ Direct relationships with manufacturers and technology providers

The cities which have seen the fastest transitions have engaged directly with manufacturers to develop and deploy new technology. Manufacturers can benefit from faster iteration and feedback on technology, while cities can shape vehicles and infrastructure which suits their history and geography.

07 _ Moving infrastructure from mass roll-out to responsive systems

The availability of appropriate, accessible and cost-effective charging remains a precondition of EV uptake.

Cities that have moved beyond early-stage EV programmes recognise that they will require a clear, predictable process to respond to demand. This is because while early EV projects are likely to be led by cities themselves or enthusiastic partners, mass EV adoption will take place in a context of higher consumer awareness and demand. One risk is that potential demand emerges before infrastructure is ready – unexpected demand from a particular sector, area of a city, or type of vehicle. Cities on the path to scaling up will therefore develop clear processes by which potential EV users can request new infrastructure, and decisions on funding, installation and maintenance are made quickly and consistently. This demand-driven approach can complement data-driven approaches for identifying sites of further chargepoints, and can also include building EV use into housing and planning policies, so that new developments are suitable for EVs.

08 _ Building resilience in infrastructure contracting and energy systems

Maintenance represents a significant pressure and cost base in large-scale EV systems. Contracts need to be designed to reflect a city's future needs. This could include minimum maintenance and warranty periods, often 5 years or more; requiring providers have local engineering staff to prevent any sudden shortfall in assistance; building into contracts specific maximum downtimes, failure rates and response times which reflect the expected technical requirements at scale; and working with grid and utilities companies to ensure robust governance and coordination in wider generation and distribution operations.

09 _

Future-proofing for digital innovation.

EVs have a major role to play in 'mobility as a service': transport systems which move beyond private vehicle ownership and integrate different transport options into a single user-centric, real-time system accessed by smartphone. Some cities which currently have competing apps – like Madrid's different car share schemes – are now creating common standards to bring private competition into city-managed apps. Cities looking to scale up can learn from this experience, and begin establishing the protocols on data-sharing and back office functions that can future-proof their systems for new innovations in mobility.

10 _

Establishing social equity outcomes of EVs.

As EV use increases, concerns about social equity need to be addressed and communicated. This could include tailoring incentives to disadvantaged groups – such as California, which identifies disadvantaged areas and gives greater financial incentives for EV adoption – or focussing them on leasing private vehicles, which can make EVs more affordable. Cities can prepare research and advocacy to demonstrate that pollution has a significant healthcare impact – helping to frame EV use as a matter of social justice.

How has the coronavirus changed cities' plans?

This project was conducted through the Covid-19 pandemic. Countries' experience of the virus has varied, but cities involved in this project which were affected by Covid-19 reported three broad conclusions:

Some types of EV have new uses and opportunities.

Far from undermining support for EVs, some types are seen as more attractive in light of the pandemic. Private EVs offer the opportunity to follow government instructions to avoid contact with other people, but without polluting city centres and with lower carbon emissions overall – balancing public health and environmental policy aims. Many cities have seen restrictions on shops and physical retail, leading to increased e-commerce and increased use of logistics vehicles – making their electrification a higher priority. Micromobility schemes for personal transport, such as e-bikes and scooters, are now seen as an alternative to forms of transport which involve close contact such as buses and railways, and many cities have redesigned urban space during the pandemic to shift away from private cars, which can suit these forms of e-mobility.

Increasing EV uptake remains a policy priority.

Policy goals of decarbonisation, cleaner air and building sustainable cities remain priorities for cities. Even if some implementation projects were delayed, and cities which experienced lockdowns or restrictions saw drops in vehicle numbers, the overall purpose of EV plans has not been dramatically changed.

Mass public transport is expected to recover, but the short-term picture is unclear.

Most cities saw significant drops in usage of mass transit systems, if they experienced lockdowns or forms of virus restriction. Some have curtailed services and reduced provision as a result. But in most cases, this is seen as a temporary situation until the pandemic is substantially over, and most cities expect volumes to recover in the next 6-12 months.

Marc Heckner/Unsplash

a maturity model for cities: how do we benchmark progress? _

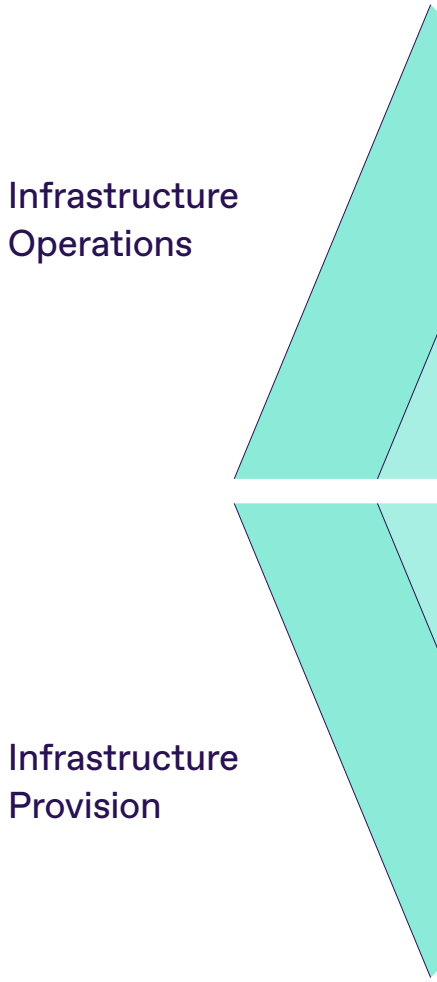
Cities sit in radically different political, financial and policy contexts.

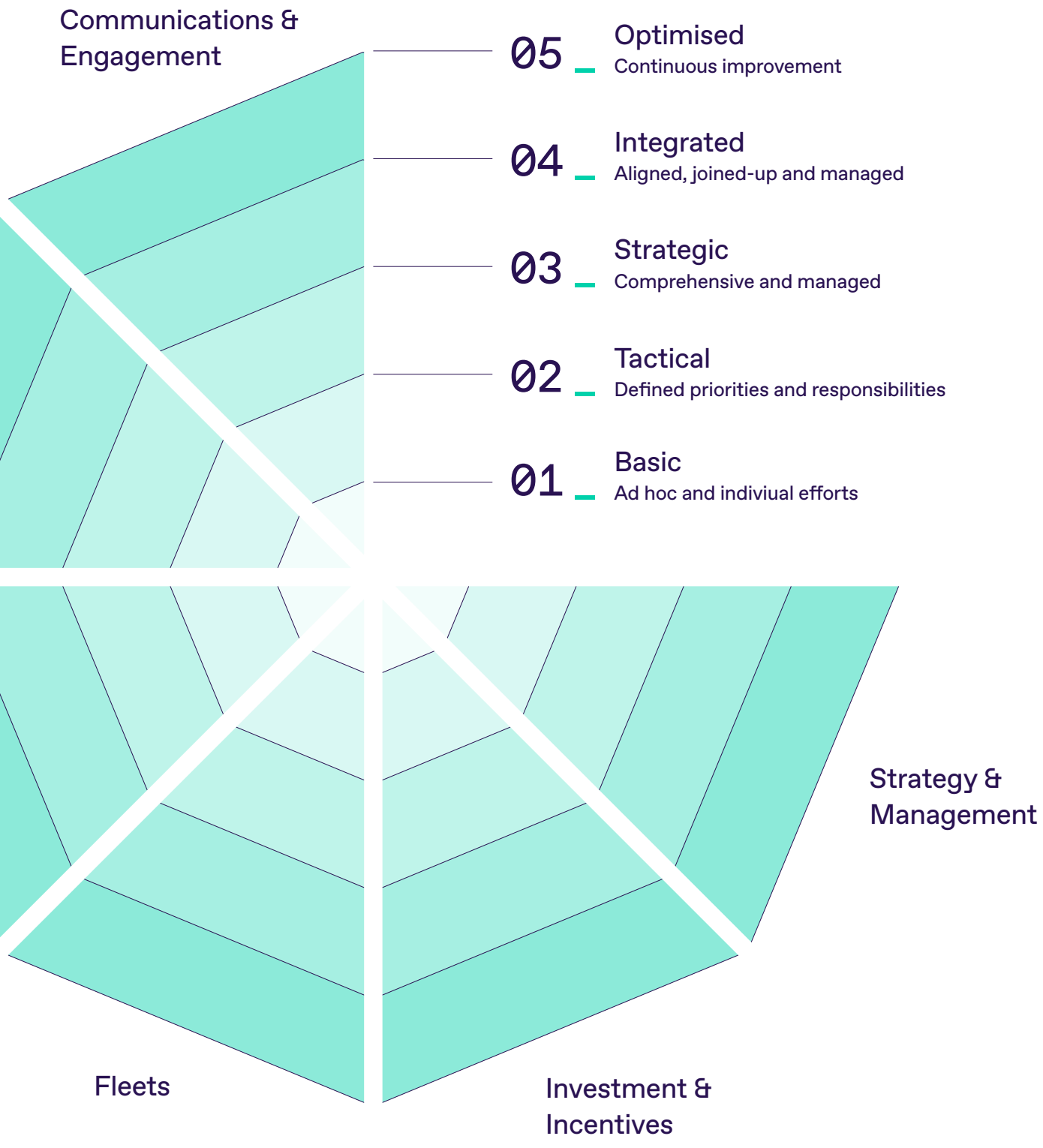
They range from metropolises to small cities, from emerging regions to advanced economies. Some cities have significant financial autonomy and direct powers, while others are limited to softer influence and policy leadership.

With this diversity, how can city leaders learn from their peers elsewhere in the world?

To answer this question, Urban Foresight developed a maturity model for EV uptake. This is a tool that allows cities to benchmark their progress by level of maturity, across a range of policy areas.

The following pages set out the overall dimensions and levels in the model, and then detailed tables help cities gain a sense of how their current programmes compare.




Communications & Engagement
05 Optimised
Continuous improvement
04 Integrated
Aligned, joined-up and managed
03 Strategic
Comprehensive and managed
02 Tactical
Defined priorities and responsibilities
01 Basic
Ad hoc and indiviual efforts
Strategy & Management
Fleets
Investment & Incentives

MATURITY MODEL _

STRATEGY & MANAGEMENT _

	01 _	02 _
	Basic	**Tactical**
	Ad hoc and indiviual efforts	**Defined priorities and responsibilities**
Strategy _	Ad hoc pilot projects and reactive investments	Defined needs linked to priorities for investment
Management _	Responsibility for EVs is allocated to an officer(s) as an extension of their core duties	Dedicated EV officer(s) with senior support
Governance _	No formal governance	Defined monitoring and evaluation processes to measure the impact of investments and policies

03 _

Strategic

Comprehensive and managed

Published strategy including a vision and roadmap of actions to accelerate deployment of EVs and infrastructure, with support from private sector for policies

Dedicated EV officers with defined processes for cooperative working across different services/ policy areas.

Dedicated steering group to guide and scrutinise investments

04 _

Integrated

Aligned, joined-up and collaborative

EV strategy that considers integration with related policy areas (e.g. transport, energy, land use, economic development, environment, health) and wider city stakeholders

Collaborative delivery team comprising representatives from across local government and wider public and private sector

Collaborative governance that includes key public and private sector partners

05 _

Optimised

Continuous improvement

EV commitments and priorities embedded into all relevant local strategies and policies, including by private sector

Embedded practices and processes across local government and key partners that facilitate private sector led delivery

Collaborative governance and co-creation of policies and strategies with fleet end users

MATURITY MODEL _

INVESTMENT & INCENTIVES _

	01 _ Basic	02 _ Tactical
	Ad hoc and indiviual efforts	Defined priorities and responsibilities
Investment _	Funding on a project-by-project basis	Dedicated budget for vehicles, infrastructure, and incentives
Incentives _	Ad hoc incentives	Targeted “high impact” incentives
Procurement _	Ad hoc procurement of EVs for pilots and trials	EVs “where possible” fleet procurement policy

03 _

Strategic

Comprehensive and managed

Strategic financial plan and budget linked to defined objectives

Comprehensive suite of financial and non-financial incentives

Formal policies to prevent further procurement of fossil fuelled vehicles

04 _

Integrated

Aligned, joined-up and collaborative

Public and private funding combined to achieve strategic objectives

Local government incentives complemented by widespread business incentives for employees and customers

Shared commitments to phase out fossil fuelled transport across key public and private stakeholders

05 _

Optimised

Continuous improvement

Fully commercial markets catering for all user needs with limited need for public funding

Comprehensive suite of public and private incentives alongside measures to discourage use of fossil fuel vehicles

All suppliers of municipal goods and services are required to use EVs

MATURITY MODEL _

FLEETS _

	01 _ Basic Ad hoc and indiviual efforts	02 _ Tactical Defined priorities and responsibilities
Municipal fleets _	Pilots, trials and ad hoc running of a small numbers of EVs	Formal business case and political commitments supporting a significant electrification of light duty vehicles in targeted service areas
Commercial vehicles _ Such as taxis, logistics, businesses	Pilots and trials	Targeted incentives and driver training to encourage use of EVs
Buses _	Pilots and trials	Targeted incentives and driver training encourage operators to use of EVs

03 _

Strategic

Comprehensive and managed

Large numbers of EVs used across all service areas supported by a formal business case, fleet renewal strategy and time-bound commitment to phase out all fossil fuelled vehicles

Formal strategy, partnerships, and dedicated resources to accelerate EV uptake and phase out fossil fuelled vehicles

Formal strategy, partnerships, and dedicated resources to accelerate EV uptake and phase out fossil fuelled vehicles

04 _

Integrated

Aligned, joined-up and collaborative

Working practices and duty cycles redesigned to facilitate greater electrification of fleets

Controls implemented to phase out fossil fuelled vehicles

Controls implemented to phase out fossil fuelled vehicles

05 _

Optimised

Continuous improvement

Complete phasing out of fossil fuelled vehicles with operating practices and renewal strategy to maximise financial and environmental benefits

Complete phasing out of fossil fuelled vehicles

Complete phasing out of fossil fuelled vehicles with a sustainable renewal strategy to maximise financial and environmental benefits

MATURITY MODEL _

INFRASTRUCTURE PROVISION _

	01 _ Basic Ad hoc and indiviual efforts	02 _ Tactical Defined priorities and responsibilities
Public charging _	Ad hoc deployment at “easy” locations	Infrastructure installed at key destinations
Workplace charging _	Ad hoc provision of workplace charging by employers	Financial and technical support for employers in providing workplace charging
Residential charging _	Ad hoc provision of public charging in residential neighbourhoods	Financial and technical support to help individuals install charging at home

03 _

Strategic

Comprehensive and managed

Comprehensive citywide public network including charging clusters and hubs, with systems to respond to demand from users

Support for employers in understanding future needs for workplace charging and to deploy necessary infrastructure

Shared plan with landlords, multi-unit dwellings, and residents to roll out charging, with process to respond to requests for charging

04 _

Integrated

Aligned, joined-up and collaborative

Citywide public network that is complemented by private networks and an extensive regional network

EV promotion aligned with corporate sustainability and travel to work initiatives

Requirements for charging infrastructure to be included in all new developments

05 _

Optimised

Continuous improvement

Comprehensive regional networks that are continuously upgraded and expanded to meet the changing needs of end users

Effective charging strategies that minimise operational costs, maximise environmental benefits, while maintaining charging opportunities for employees

All homes have easy access to a charge point, with solutions for properties without dedicated parking and to maximise the use of off-peak electricity from renewables

MATURITY MODEL _

INFRASTRUCTURE OPERATIONS _

	01 _ Basic Ad hoc and indiviual efforts	02 _ Tactical Defined priorities and responsibilities
Back office & digital platform _	Separately administered charging networks, customer service and user accounts	Aggregation of real-time information on the location and availability of all charging infrastructure
Maintenance _	No formal maintenance and servicing arrangements	Regular maintenance and servicing of infrastructure
Grid integration _	Grid impact assessments for infrastructure connection	Green electricity for public infrastructure and use of stationary storage and renewables at charging hubs to reduce peak loads

03 _

Strategic

Comprehensive and managed

Ability to locate, reserve and pay for charging at any location via a single digital application

Systematic approach to proactively solve known issues and efficiently deliver maintenance

System level control of charging to utilise renewable energy, shave peak demand and fill demand valleys

04 _

Integrated

Aligned, joined-up and collaborative

Commercial and technical integration with platforms for public transport and shared mobility services

Collaboration with suppliers and end users to track and manage against service level agreements and availability expectations

Managed charging integrated with local building loads, behind the meter storage, and a global aggregator to reduce peak power loads

05 _

Optimised

Continuous improvement

Seamless user experience as part of a Mobility as a Service platform

Efficient operations driving continuous improvements in availability and performance

Smart charging at scale with bidirectional charging to provide grid support services

MATURITY MODEL _

COMMUNICATIONS & ENGAGEMENT _

	01 _ Basic	02 _ Tactical
	Ad hoc and indiviual efforts	Defined priorities and responsibilities
Marketing & communications _	Ad hoc communications activities such as events and online content	Dedicated resources and targeted activities to raise awareness and promote the benefits of EVs
Business engagements_	Ad hoc business-focused information and events	Dedicated resources to promote knowledge sharing between organisations
Skills _	Dependence on external initiatives	Targeted local activities and partnerships to improve necessary commercial and technical skills

03 _	04 _	05 _
Strategic	**Integrated**	**Optimised**
Comprehensive and managed	**Aligned, joined-up and collaborative**	**Continuous improvement**
Sustained marketing and communications programme across multiple channels	Joined-up EV promotion programme across the public and private sector, including demarketing of fossil fuel vehicles	Personalised content across multiple channels and mechanisms to collect feedback and engage with the public
Dedicated programme of commercial and technical support to encourage organisations to invest in EVs	Supplier and fleet accreditation initiatives to encourage investment in EVs and promote the green credentials of fleets	Wide ranging business-led communications activities with organisations widely recognised as being more competitive and efficient based on their use of EVs
Comprehensive programme to develop necessary skills to meet short-term and future demand	Integration with wider education and skills initiatives	Sustainable pipeline of skilled individuals with continually improving knowledge that responds to changing needs of the market

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Yukiko Hamatani
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AMAT Milan City
Valentino Sevino
Director of mobility

Austin Energy
Karl Popham
Manager, Electric Vehicles & Emerging Technologies

Bobby Godsey
EV Program Specialist

Cameron Freberg
Utility Strategist

BloombergNEF
Siyi Mi
Electrified Transport Analyst

Nick Albanese
Head of Intelligent Mobility research

Andrew Grant
Intelligent Mobility research associate

Allen Tom Abraham
Southeast Asia research associate

BYD
Nellie Zhang
Senior Marketing Coordinator

CALSTART
Cristiano Façanha
Global Director

Dan Welch
Senior Project Manager

Kevin Leong
Program Manager

Chase Lecroy
Senior Project Manager

Kelly Leathers
Associate Project Manager

Capital Region of Denmark
Gent Grinvalds Harbro
Programme Manager, CPH Electric

Jens Pederson
Senior Consultant

Centro Mario Molina (CMM) Chile
Sebastián Galarza Suárez
Transport & Energy Sector Lead

City of Alexandria, Virginia
Megan Oleynik
Transportation Planner

Bill Eger
Energy Manager

City of Oslo
Sture Portvik
Manager, Electro mobility

City of Paris
Natalia Ciciarello
Shared Mobility Development Project Manager

Thierry Bourdas
Electrical mobility project manager

Jonathon Couppe
Mobility Specialist

City of Santa Monica
Ariana Vito
EV Program Coordinator

City of Santiago
Daniela Soler Lavín
Head of Efficient Transport Unit

City of Stockholm
Eva Sunnerstedt
Head of Unit, Clean Vehicles and Fuels,

Clever Shuttle
Moritz Oesterlink
Director of Business Development

CUTRIC
Josipa Petrunic
Project Manager: Electric Bus and Coach Bus

Aditya Ramesh
Project Manager: Electric Bus and Coach Bus

Deutsche Post DHL Group
Michael Lohmeier
Vice President Clean Mobility Solutions & Services

Uwe Bensien
Media Relations

Dundee City Council
Gary McRae
Formerly Fleet Manager

Emma West
Low Carbon Project Manager

Fraser Crichton
Corporate Fleet Operations Manager

Dutch EV Association
Ellen Hiep
Director

Elbil
Sveinung Kvalø
Senior Advisor

Silje Fines Wannebo
Advisor

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Francesco Vellucci
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Enterprise Holdings
Murray McAdam
Business Travel Consultant, Scotland & N. Ireland

EPM, Medellin
Gian Paolo Montoya Rivas
Market regulation and transactions manager

ESHOT
Hakan Uzkat
Department manager

EVA Scotland
Elinor Chalmers
Director

Formula E-Team (Holland Mobility)
Bert Klerk
Formerly president

Global Car Sharing Company
Mr. Yong JIN
Director of Development Planning Department

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Michael Tietjen
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Heliac
Michael Rask
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Carol Burelle
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Isabel del Olmo
Head of Transportation

International Energy Agency
Marine Gorner
Analyst. Coordinator of the Electric Vehicles Initiative

Alison Pridmore
Analyst

Jacob Teter
Analyst

Jacopo Tattini
Analyst

Ekta Bibra
Analyst

Per Anders Widell
Analyst

Lyft
Jon Walker
Sustainability Policy Manager

Madrid City Council
Maria Dolores Ortiz Sanchez
General Director of Planning and Infraestructures Mobility

Medellin City Government
Carolina Franco Bánó
Senior Knowledge Management Professional

Netherlands Enterprise Agency
Sonja Munnix
Senior Advisor

NKL Nederland
Roland Ferwerda
Director

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Jón Ásgeir Haukdal Þorvaldsson
Specialist

Rocky Mountain Institute
Ben Holland
Senior Associate

San Francisco Government
Tessa Sanchez
Energy and Zero Emission Vehicle Coordinator

Timothy Doherty
Manager – Policy and Long-Range Planning

Shanghai International Automobile City (Group) Co., Ltd.
Grace Li
Deputy Director

Swedish Energy Agency
Martina Wikström
Research Programme Manager. Sustainable Transport

TERI
Dr. Shashank Vyas
Associate Fellow

Mr. Alekhya Datta
Fellow & Area Convenor

Mr. Ram Krishan
Research Associate

Tokyo Metropolitan Government
Takeaki Orihara
Deputy Director, Next Generation Energy Promotion Section

Transport for London
Rhona Munck
Strategy and Planning Manager | City Planning

Lucy Hayward-Speight
Transport Strategy & Planning Manager – Air Quality & Environment

Mark Poulton
Vehicle Technology Manager / Principal Technical Specialist

Alex Gilbert
Senior Energy Strategy Manager

TUBITAK RUTE
Ahmet Avsar
Chief Researcher

UC Davis
Gil Tal
Director, The Plug-in Hybrid & Electric Vehicle (PH&EV) Research Center

UITP
Jaspal Singh
Senior Expert – IT and Development

University of Newcastle
Oliver Heidrich
Researcher

University of Ulsan
Ocktaeck Lim
Researcher

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Oliver Lah
Managing Director, UEMI Secretariat

uYilo e-Mobility Programme
Hiten Parmar
Director

Voi
Lucy Yu
Director of public policy

WBTC
Mr. Rajanvir Singh Kapur (IAS)
Managing Director
Mr. Debabrata Guha
Senior Engineer

We Drive Solar
Robin Berg
CEO

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For further information, please contact:
info@urbanforesight.org

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