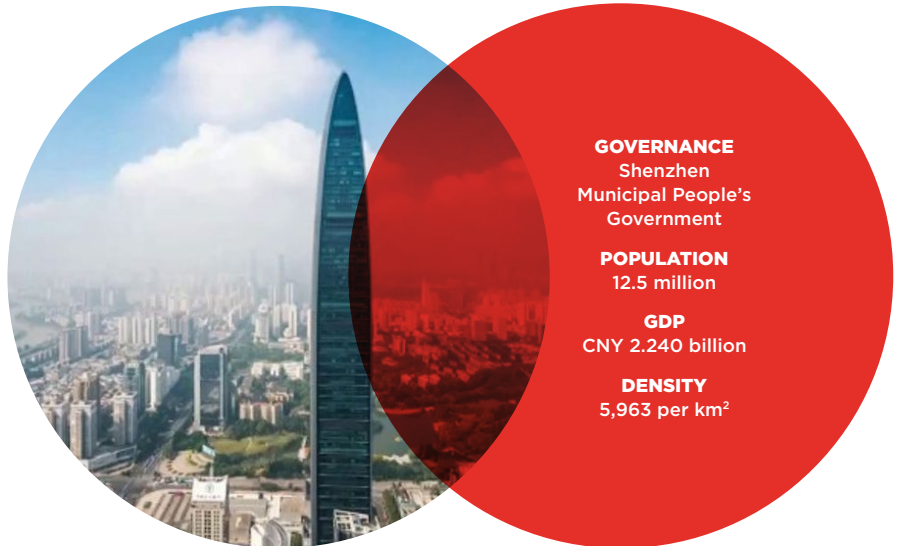


# 深圳

## SHENZHEN

### SWITCHING TO AN ELECTRIC MOBILITY SYSTEM IN THE CITY

*Developing electric mobility in the public bus system and beyond*



**GOVERNANCE**  
Shenzhen  
Municipal People's  
Government

**POPULATION**  
12.5 million

**GDP**  
CNY 2.240 billion

**DENSITY**  
5,963 per km<sup>2</sup>

## AT A GLANCE

### THE INITIATIVE

In 2017, Shenzhen became the first city in the world to electrify all public buses with a view to cutting emissions, reducing noise pollution and improving air quality. The initiative also helped to further develop electric mobility. The adoption of new service models incentivises manufacturers to design vehicle components so that they are maintained and kept in use, retaining value. There are now over 16,000 electric public buses (e-buses) on the road.

In addition, the city has engaged heavily in urban infrastructure, incorporating more than 500 bus charging stations and 5,100 bus charging points.

While e-buses have replaced fuel vehicles - which were estimated to be contributing towards 20% of the city's air pollution - further development is underway to increase the provision of renewable energy sources in line with circular economy principles. Work is also underway to improve battery technologies to encourage their reuse, charging speeds and suitability for a wider range of vehicles.

### TIME FRAME

In 2009, Shenzhen was selected by the national government as one of 13 electric vehicle pilot cities. In 2017, the city became the first in the world to reach a goal of 100% electrically run buses. Further work is ongoing, including on opportunities to expand the programme to other vehicles such as taxis.

### FOCUS AREAS

The focus has been on the mobility sector as a whole, including infrastructure, electric vehicle technology, and business models.

### FINANCE

This public mobility initiative has been supported by a combination of national government funding and subsidies from the Finance Commission of Shenzhen Municipality.

The project financing has also made use of, and benefited from using, cost-effective service models.

## LEAD POLICY LEVERS



**ROADMAPS  
AND  
STRATEGIES**



**CONVENING  
AND  
PARTNERING**



**URBAN  
PLANNING**



**PUBLIC  
PROCUREMENT**



**FISCAL  
MEASURES**



**FINANCIAL  
SUPPORT**



**LEGISLATION  
AND  
REGULATION**

For more see [Policy Levers](#)

**CORE TEAM AND PARTICIPANTS**

Directly overseen by the Shenzhen Mayor, various departments within the municipality are involved in the implementation:

- The Development and Reform Commission of Shenzhen Municipality, which receives direction from the National Development and Reform Committee of China and coordinates local implementation
- Urban Planning, Land and Resources Commission of Shenzhen Municipality, which identifies suitable developed and underdeveloped land and oversees locations of the charging points and stations
- District government, which supports the provision of land permits for the charging points and charging stations
- Transport Commission of Shenzhen Municipality, which facilitates e-bus movement by granting preferential road access.

**OUTCOMES TO DATE**

In 2011, two years after being selected as an electric vehicle city pilot, Shenzhen hosted the Summer Universiade, a world student games event, at which 200 e-buses and 300 e-taxis were deployed. The first fully electrified bus route was launched in 2012.

Starting in 2015, bus companies have been able to rent e-buses and batteries from manufacturers through service models, relieving the bus companies of large upfront investments and the need for technological expertise, thereby increasing the uptake of vehicles.

The national piloting scheme has encouraged the development of the electric vehicle industry in China, which was estimated to be worth CNY 100 billion in 2017. Many companies across the value chain have also benefited from this development. For example, BYD, the largest Chinese electric vehicle producer headquartered in Shenzhen is now selling e-buses to 300 cities in Japan, Europe, the USA and other countries globally.

The lessons from the pilot are being extended to other mobility forms. Shenzhen now has electrified 16,000 buses and 23,000 taxis in the city.

**THE JOURNEY****ORIGINS**

The development of this initiative is heavily driven by local and national policy with a view to cutting emissions, reducing noise pollution and improving air quality - in addition to managing current overcapacity of electric power. The Shenzhen New Energy Industry Development Plan 2009-2015, the Shenzhen New Energy Industry Development Policy and the 13th Five-Year Plan for Strategic New Industry Development, together reinforce the priority of developing this sector.



Photo credit: Shenzhen Eastern Bus Group

**THE ROUTE TO A CITY-WIDE E-BUS SYSTEM**

Shifting to a 100% electric vehicle system creates opportunities and potential for additional revenue streams. As organisations make use of new business models that improve material management and costs, and receive public financial support, it encourages the initiative to scale, and infrastructure and technologies to develop.

**Vehicles**

Prior to 2016, an e-bus was priced at approximately CNY 1.8 million. Through the use of service models, third-party financial institutions purchase the assets and rent them to bus operating companies who are thus relieved of large upfront capital investments. For example, eight-year rental agreements are arranged through a third-party financial institution which, for a limited time period, take on the financial risk if the vehicle or components fail. Shenzhen Eastern Bus Company (a state-owned organisation) and Shenzhen Western Bus Company Ltd (a public-private organisation) have both rented e-bus services from locally headquartered BYD and other manufacturers via third-party financial institutions such as China Development Bank Leasing and China Construction Bank Financial Leasing. In such service models, manufacturers remain responsible for maintenance and repair of the key components, keeping them in use. It also incentivises circular designs for durability and reuse.

Bus manufacturers are also provided with national government subsidies, which are matched by the city government. In the case of Shenzhen, bus manufacturers can apply for approximately CNY 500,000 from each, totalling around CNY 1 million to be deducted from the price. As the electric vehicle industry matures, the national and municipal subsidies have reduced and will eventually cease.

### Batteries

At the end of their usable life, batteries will be sent to government approved recyclers with a view to extracting useful materials, such as rare earth elements. This practice is expected to grow with the development of Extended Producer Responsibility policies which are due by 2020.

Many electric vehicle batteries are estimated to start reaching end of life status in 2019, which will increase the quantity of batteries available for recycling, in turn augmenting the demand for the required recovery skills and technologies. Material sourcing, design for multiple use, and design for recycling are amongst the circular economy priorities for the EV industry.

### Electric charging technology and infrastructure

The technology and infrastructure required for charging vehicles involves large capital investment. In addition to government subsidies, new partnerships have been key. Shenzhen Eastern Bus Company, for example, partnered with charging point manufacturing businesses, which post-construction, are also responsible for the maintenance and upgrade of charging points. Charging point manufacturers receive a service fee through units of electricity used, which facilitates further development of the infrastructure. The Shenzhen Eastern Bus Company's e-bus versus charging point ratio reached 2:1 as at the end of 2018.

One charge will sustain an e-bus for a full day, meaning that charging can take place at night when buses are not in use and when demand on the grid is less. Rapid charging technology is under development to increase charging speeds that improve bus turnaround rates. Regulations are also applied to ensure new charging facilities complement population size and land availability.



Photo credit: Shenzhen Eastern Bus Group

### MEASURING PROGRESS

Combustion engine buses used to contribute to 20% of air pollution, but through the transition it is now estimated the city will see an annual reduction of 4.316 million tons of particulate matter. In addition, the average GHG emissions per e-bus kilometre is 40% less than a diesel vehicle, which, as of 2017, had reduced carbon emissions in the city by 0.63 million tons.

A further benefit is that the e-buses produce less noise and heat, thereby contributing to a reduction in urban noise pollution and heat island effects.

At present, renewable energy sources only make up approximately 1% of the total energy mix in the initiative and further development is required to increase this. China's 13th Five-Year Plan also highlights the overall requirement for a shift from fossil fuels. The partners in the initiative are also looking at metrics to capture the material benefits resulting from the increased focus on remanufacturing and public transport use.

## REFLECTIONS

**Policy providing a mandate for change.**

A combination of national- and city-level policy measures have created the enabling conditions for an electric mobility system in the city to develop. This includes the national government's ambition to expand the electric vehicle sector, China's 13th Five-Year Plan, the Strategic New Industry Development Plan, the Shenzhen New Energy Industry Development Plan 2009-2015, Shenzhen New Energy Industry Development Policy, and Shenzhen's status as China's first Special Economic Zone, permitting Shenzhen to have bespoke trading and business rules to stimulate economic activity and innovation.

**Enabling innovation through the use of new business models and financial support.**

Financial support from national subsidies and match funding from the city government has enabled the initiative to grow enough to become self-supporting. In addition, the provision of e-buses on a rental basis has also alleviated initial capital outlays, mitigated against potential ongoing financial risks for the bus companies, and supported the refurbishment and reuse of components and parts.

**Development of the broader electric vehicle industry has also been encouraged through the pilot.**

For example, incentives such as free licence plates for e-vehicle drivers and the removal of a passenger levy for fuel in e-taxis. Improvements in urban air quality and reduced noise are also bringing broader environmental, health, and productivity benefits to the city.

**In a circular economy, power is generated through renewable resources and materials are kept in use.**

Research to increase the percentage of renewable energy provided to the charging poles is underway, as is the research to improve the circularity of battery technology.

## FOR MORE INFORMATION

Website: [www.english.sz.gov.cn](http://www.english.sz.gov.cn)

Contact: This case study has been developed in partnership with ICLEI East Asia.

This case study is part of [Circular economy in cities](#), Ellen MacArthur Foundation