



# PROMOTING THE UPTAKE OF ELECTRIC VEHICLES TO REDUCE POLLUTION IN BEIJING CITY, CHINA

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**ACTION AREA:** Mitigation

**FOCUS AREA:** Delivering

**COUNTRY:** China

## SECTORS

**INVOLVED:** Transport

**TIMEFRAME:** September 2013-Ongoing

**CASE SUMMARY:** The poor air quality in Beijing city in 2013 prompted the central and Beijing governments to implement stringent pollution control measures. This included the promotion of green transportation such as electric vehicles. The central government has since implemented a range of policies that has actively publicised EVs, while investing in infrastructural support and incentivising the buyers. The Beijing government has created local policies that have helped meet the central government targets. These measures have led to a rapid uptake of EVs across the city, with co-benefits such as significant reductions in air pollution, fuel consumption and urban heat in Beijing.

The case constitutes a good practice as the measures involved engagement with a variety of both private and governmental stakeholders and are based on a sound scientific analysis. There exists a high level of government support, and concerted action between the central and Beijing governments in terms of a wider variety of complementary legislation. This has encouraged technological innovation and capacity building in the country while ensuring EVs are easily affordable for consumers.

By promoting EVs and reducing pollution, Beijing is encouraging economic and social development in accordance with China's Nationally Determined Contribution (NDC). Thus, China is not only becoming a global leader in EV manufacturing, but also in green innovation and climate change mitigation.





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**BACKGROUND:** ————— Between 1998 and 2013, the population of Beijing grew by 70 percent, while its energy consumption increased by 77 percent. The rapid urbanisation was also reflected in the number of motorized vehicles in Beijing, which rose by 303 percent between 1998 and 2013 (UNEP, 2016). This unfettered urban growth has severely deteriorated the air quality in the city, leading to serious impacts on the environment and human health.

In August 2008, Beijing hosted the summer Olympic Games. In order to meet the air quality standards required for the event, stringent measures were put in place. Two million government vehicles were taken off the roads, while the odd-even ban, which is based on license plates, kept private vehicles off the roads on alternate days. The changes observed afterwards were significant; there was an over 50 percent reduction in CO<sub>2</sub>, particulate matter (PM) and nitrogen oxide (Shen et al., 2011). The Chinese government subsequently recognised the contribution of petrol and diesel-based vehicles to air pollution, and began promoting Electric Vehicles (EVs). Provincial governments were encouraged to include environmental concerns in their policy making. However, in 2013, China experienced its worst pollution-related smog since 1961, with PM<sub>2.5</sub> levels being recorded at over 800 micrograms in Beijing (BBC, 2013). The central government immediately implemented the "Action Plan for Prevention and Control of Air Pollution" in September that year in order to improve air quality in Beijing city, which was worst hit by the smog. Part of this plan was the promotion and uptake of EVs in the city. Since then, a number of policies have been put in place by both the central and local governments to encourage the growth of EVs in the vehicle market. For instance, the central government's 12th and 13th Five Year Plans (FYPs) have emphasised the importance of a strong domestic EV market. The centre has also instituted subsidies, which the local Beijing government is mandated to match, as well as tax breaks, in order to make EVs affordable for consumers.

China's interest in green vehicular technology is not only to reduce CO<sub>2</sub> emissions and improve air quality. In a world with limited non-renewable resources, the country wishes to reduce its dependency on fossil fuels. Promoting EVs has also led to the creation of a local EV manufacturing industry, increasing the country's technical expertise in the field. With the world rapidly shifting to renewable and clean energy technologies, China's focus on EVs makes it a potential leader in EV manufacturing, and ultimately, sustainable and green urban transport.

**ACTIVITIES:** ————— In response to the critical pollution levels across Chinese cities in 2013, the central government increased its focus on implementing measures that reduce pollution, and create green cities in China. This has included an aggressive and widespread promotion of EVs, through agendas given in the 12th and 13th FYPs and Made in China 2025. These national agendas have been used as a blueprint by the Beijing government, which creates and implements focused legislation that helps meet the national targets. For instance the central government in its 13th FYP (2016-2020) set a target of 5 million EVs across the country by 2020. To meet this target, the Beijing government has committed to putting 400,000 EVs on Beijing roads by the same deadline. Additionally, the State Grid Corporation of China announced that it would increase the public charging stations for EVs across the country to 170,000 by 2020, with maximum concentration in cities. The Beijing government has accordingly created a construction plan wherein it has committed to providing the space and infrastructure to build 38,000 public charging stations in Beijing city itself.

In September 2013, the central government implemented an "Action Plan for the Prevention and Control of Air Pollution" across the country. For Beijing city, the action plan proposed to drastically reduce and maintain the PM<sub>2.5</sub> concentration at less than 60 micrograms. The Beijing government, accordingly, instituted measures to help increase green cover, shut down coal plants, reduce the number of high emission, Internal Combustion Engine (ICE) cars, and increase the uptake of EVs in the city.

In cooperation with the central government, the Beijing government has initiated various activities particularly aimed at promoting EVs in Beijing city.

### **1. FINANCIAL INCENTIVES TO DRIVE DEMAND FOR EVS** (Strompen & Jingzhu, 2016)

- Since January 2009, the central government's Electric Vehicle Subsidy Scheme (EVSS) provides subsidies for both public and private procurement of EVs in Beijing. Electric buses are given a subsidy of RMB 500,000 (approx. USD 72,000) by the Centre, which is matched by the local government. For private EVs, the Beijing government is required to match the central government subsidy of RMB 3000/kWh (approx. USD 434/kWh), up to a maximum of RMB 60,000. In 2017, the total subsidy provided by the government for EVs and charging stations equalled RMB 3.3 billion (approx. USD 490 million).
- Since 2014, private EVs are exempt from the central government purchasing tax of 10 percent.
- In February 2018, the centre decided to only subsidise passenger cars that have a range of over 400km on a single charge. This shift in subsidy has led car manufacturers to innovate and produce better car models with more efficient batteries.

### **2. NON-FINANCIAL INCENTIVES TO MAKE EVS MORE ATTRACTIVE**

- The Beijing government cut the ICE car quota for the city by a third in 2015, with licenses given only through a lottery system. This has made it more difficult for car buyers to obtain ICE licenses, with 2000 applicants for every license that is given out (Yue, 2018).
- While each ICE license costs around USD 14,000, EV licenses are given out for free on a first come, first serve basis (Yue, 2018). As per the „Measures for Promotion and Application of New Energy Vehicles in Beijing“ (2018), EV owners do not need to go through the lottery system. They are also given special license plates to distinguish them from ICE vehicles.
- All registered EVs are granted free parking in public parking lots, and can use designated bus lanes while driving (Lu, 2018).
- ICE cars are divided into five categories based on their license plate numbers, with each category being banned on the roads on one day per week. This restriction is not applicable for EVs (Yali Zheng, personal communication, October 11, 2018).

### **3. LEGISLATIVE ACTIONS TO PROMOTE EVS**

- China's 12th FYP (2011-2015) made EVs a priority for the nation, with a target of 1 million EVs on the road by 2015. This has been increased to 5 million EVs by 2020, in the 13th FYP (2016-2020). To help meet this national target, the Beijing government enacted the „Action Plan for the Promotion and Application of New Energy Smart Vehicles in Beijing (2018-2020)“, which sets the goal of 400,000 EVs in the city by 2020. This plan is based on 89 policies, which were introduced by the central and Beijing governments between 2006 and 2018 and aim at promoting New Energy Vehicles in Beijing city (Bai and Sun, 2018).
- Prior to 2017, foreign EV manufacturers had to form joint ventures (JV) with local companies in order to access the substantial central government subsidies and sell EVs in China. These new JV brands sold for a higher price than locally manufactured EVs. A 2017 central government guideline opened up the Chinese market for EVs to foreign players, allowing the latter to own more than 50% control of the brand. This has led many large car manufacturers, such as Tesla and BMW, to plan manufacturing units in the country. The move is expected to promote competition, innovation and ultimately, provide a wider range of affordable car options to consumers.



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- The 13<sup>th</sup> FYP (2016-2020), however, continues to support the growth of Chinese local EV brands. This is further emphasised in the Made In China 2025 plan, which puts the target for domestic car manufacturers at 3 million cars per year, or 80% of the Chinese EV market. The goal is being partly met by the State-Owned Enterprises, one of which, Beijing Automotive Industry Holding Co., Ltd. (BAIC), is headquartered in Beijing city. In the first half of 2018, BAIC accounted for almost 30% of the total EVs sold in Beijing (Green Car Congress, 2018), thereby helping to create a strong domestic EV market in China.
- The central government's New Energy Vehicle Mandate (2017), which will come into effect in 2019, is aimed at phasing out government subsidies for EVs. It establishes a strict quota for car manufacturers to produce EVs. Those who exceed the quota get credits, while those who do not meet their quota will have to make up their deficit by buying credits from companies with excess. By doing so, China expects that big ICE-car makers will either have to manufacture more EVs or be forced to subsidise smaller EV manufacturers.
- To fulfill the mandate of EV promotion under the various central government FYPs and Action Plans, the Beijing government included EVs in its yearly work plans. This included the adoption of EVs in the local government fleet, public transport and sanitation services. In 2018, the Beijing government mandated that only fully electric vehicles will be registered as taxis, while the present fleet of 70,000 taxis will also be converted to EVs. The Beijing Public Transport Group has committed to increasing the number of electric buses in the city to 10,000, or 60% of the total bus fleet, by 2020 (China Daily, 2017).
- To promote the private EV market in Beijing, the "Beijing Electric Vehicle Promotion Action Plan (2014-2017)" mandated that 170,000 EV licenses were to be reserved for private purchasers for those four years.

### 4. INFRASTRUCTURAL SUPPORT AFTER PURCHASE OF EVS

In 2018, the total number of charging piles across Beijing city amounted to 130,000, including 93,000 for private, 20,000 for general public and 17,000 for public transportation vehicles (Green Car Congress, 2018). The 2020 construction plan for Beijing aims to increase the charging outlets to 435,000, including 360,000 home charging outlets. The Beijing government has also ensured the cost of charging EVs remains low by capping the service fees taken by utility providers. Due to the positive policy signals from the government, the private sector is also participating with innovative measures such as charging apps, which can be downloaded and used by consumers to identify and reserve the nearest public charging facility.

### INSTITUTIONS

**INVOLVED:** — At the central government level, the promotion of EVs is a collaboration between the Ministry of Science and Technology (MOST), Ministry of Finance (MOF), Ministry of Industry and Information Technology (MIIT) and the National Development and Reform Commission (NDRC). These are further supported by ministerial agencies, such as the Environmental Protection Agency (EPA), State Planning Commission (SPC), State Economic and Trade Commission (SETC) and the Electric Vehicle Standardization Committee (EVSC). In addition, the Beijing local government is an active participant in the process, formulating and implementing policies that favor EV uptake in Beijing city.

**COOPERATION WITH:** — The promotion of EVs constitutes a concerted effort by the central and Beijing city governments that include the participation of government-owned and private car manufacturers, utility providers, battery manufacturers and academic institutions.

**FINANCE:** — Between 2009 and 2016, the Chinese government has invested RMB 33.4 billion (approx. USD 4.9 billion) in subsidies and tax cuts to consumers and manufacturers (ICCT, 2017). In 2016, the Beijing local government provided subsidies of RMB 1.69 billion (approx. USD 243 million), while in 2017, they amounted to RMB 1.64 billion (approx. USD 236 million) (Zhang, Bai & Zhong, 2018).

**IMPACT OF ACTIVITIES:** — The measures have led to a rapid increase in the number of EVs in Beijing city. The government of Beijing has led by example, and has mandated the conversion of government transportation to EVs. The total number of registered electric buses, sanitation trucks and taxis has increased from 290 in 2012 to 4229 in 2015 (Ma et al., 2017). This has further encouraged the public to purchase EVs, and as of June 2018, 290,000 people in the city have applied for EV licenses, which is over five times the Beijing government's EV quota of 54,000. For an overview of the impact of activities, see also Figure 1.

- **SIGNIFICANT REDUCTION IN POLLUTION:** The Beijing government met its target of reducing the PM2.5 level, which was 58 micrograms in 2017, a reduction of over 35% compared to the 2012 levels. It is projected that by further encouraging rapid technological development and EV uptake, Beijing can not only maintain this PM2.5 level, but also avoid 0.42 million tons of CO2 emissions by 2030 (Zhang et al., 2017).

- **SIGNIFICANT REDUCTION IN ENERGY AND FOSSIL FUEL CONSUMPTION:** The 2030 projections indicate that a widespread uptake of EVs (65% market share by 2030) can reduce the annual gasoline consumption of Beijing by 760,000 tons. This is about 17 percent of the city's total gasoline requirement (Zhang et al., 2017).

- **REDUCED URBAN HEAT ISLAND EFFECT:** In 2012, it was calculated that the average heat emission from an EV was 19.8% of an ICE vehicle. Thus, the total daily reduction in heat emission, if all the ICE vehicles in Beijing had been replaced by EVs, could have been  $7.29 \times 10^{14}$  Joules. This replacement could have decreased heat island intensity by 0.94°C, thereby reducing the usage of air conditioners in buildings. It would have also led to daily energy savings of 14.44 million kWh, and decreased the daily CO2 emissions by 10,686 tons (Li et al., 2015).

## WHY IS IT

**GOOD PRACTICE:** —

- **INNOVATION:** Because of increased demand for EVs and the government's emphasis on locally made cars with Chinese batteries, the program has strengthened the technological capacity of industries in the country to produce green technology. BYD, one of China's biggest manufacturers of EVs, created its own battery technology. The company has now expanded to the US, and is manufacturing electric buses for California. The opening up of the market to foreign players sparks increased competition, leading to further technological advancements and innovation.

- **SUSTAINABLE DEVELOPMENT BENEFITS:** In line with China's nationally determined contribution (NDC), China has made air pollution control the focus of its environmental reform. This is the primary factor used by both central and local governments to reshape the economy and development of the country. By mandating a domestic EV industry, China has created jobs while encouraging a clean mode of transport. The efforts made at the interface between environment, development and clean energy are well integrated into the NDC of the country.

- **STAKEHOLDER ENGAGEMENT:** The promotion of EVs has seen coordination across multiple ministries, such as the finance, science and technology and IT ministries, in both the central and Beijing governments. The research and academic sector was also closely involved, with universities being provided with state grants to conduct research on the various aspects of the EV program. Public



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opinion is solicited by the Beijing government for draft policies, in order to understand the former's perception and willingness to accept EVs. The Beijing government has also made the air quality values across the city available to the public, so that the monitoring and evaluation of pollution in Beijing is transparent.

- **SCIENCE-BASED:** The National High-Tech R&D program, or 863 program, which was instituted by the Ministry of Science and Technology (MOST), has identified EV research as a priority concern since 2001, and financed projects in this field. In the 10 years since, this program has provided RMB 2 billion (approx. USD 288 million) in funds to universities and car manufacturers to advance technological innovation and research the impact of policies, thereby helping to strengthen the EV market in China. Since 2009, policies built on this research have been implemented to promote EVs in the public sector and among private consumers. Between 2009 and 2011, the central government provided RMB 10 billion (approx. USD 1.4 billion) for R&D, in order to develop a domestic capacity in motor and battery technology, car design and management systems (Liu and Kokko, 2013). There are now over 140 battery manufacturers in China, and the country is expected to contribute to around 70% of the global battery market by 2020.
- **POLITICAL BUY-IN:** The central and Beijing governments have aggressively promoted EVs, providing subsidies for both consumers and manufacturers. By using EVs in the municipal transportation, the government has set an example for the public to follow. Coupled with several financial and non-financial incentives, this has led to a widespread uptake of EVs by the public.

### SUCCESS FACTORS:

- **LEADERSHIP AND POLITICAL COMMITMENT:** The primary reason for the success of EVs in China is the high level of support from the government, both in terms of subsidies as well as regulatory legislative action. A study by the International Council on Clean Transportation (2017) shows that the incentive package provided by the Beijing government is the key driver in the popularity of EVs among the public and for changing consumer preferences. The main appeal for private consumers is the preferential treatment for new EV license registration, which allows EV buyers to bypass the license lottery process (He et al., 2018). In addition, with the government promoting long range EVs, and backing it up with construction of charging stations across the country, many consumers are willing to buy EVs as their primary car, for both within and inter-city travel.
- **PROFESSIONAL AND TECHNICAL SUPPORT:** The EV policies of the central and Beijing governments are based on research conducted by academic institutions on the barriers to EV uptake and consumer requirements and preferences. Because of this research, the policies have been extremely focused, leading to high demand for EVs. This has created a huge market in the country, where car manufacturers are encouraged to advance EV technology in terms of car and battery efficiency and performance. China is now a global leader in battery technology. The Beijing government has also created an enabling environment for private utility providers, which has allowed widespread construction of charging points across the city.
- **STAKEHOLDER PARTICIPATION:** The central government receives technological inputs from private and government-owned car and battery manufacturers. The government has also provided grants to academic institutions to study the performance, acceptance and infrastructural requirements of EVs. The results of these studies are incorporated while creating targeted policies. The local Beijing government then uses the central government policies as blueprints, and includes public opinion to create policies that are appropriate for the city. For instance, due to the public's preference for tax rebates while buying EVs, the government announced these rebates will continue until 2020, instead of expiring in 2018 as previously announced (Jourdan, 2017).

**OVERCOMING BARRIERS / CHALLENGES:****WHAT WERE THE MAIN BARRIERS / CHALLENGES TO DELIVERY?**

**INFRASTRUCTURAL:** There has been a lack of supporting infrastructure, such as private and public charging points.

**FINANCIAL:** EVs are costlier than ICE cars.

**HOW WERE THESE BARRIERS / CHALLENGES OVERCOME?**

The Beijing government has provided grants to manufacturers for technological innovation in battery capacity. It has also built several charging facilities that are available to the public. Apart from this, the Beijing government has created an enabling environment for private charging utility providers, in order to increase the number of charging points across the city.

Government subsidies and tax breaks have made EVs popular with the public. Due to the high demand, the prices of the cars are falling. This, coupled with technological advancements and the opening up of the market to foreign players, make the cars more affordable, even if the government subsidies are removed by 2020.

**LESSONS LEARNED:**

- **ENSURE FOCUSED, YET FLEXIBLE POLICIES:** Policies favoring EVs must be flexible in order to adapt to an evolving market. In Beijing, the subsidies and incentives encouraged interest in EVs in the beginning. Additionally, the restriction on foreign car sellers to collaborate with local manufacturers created a strong domestic market. This led to a rapid uptake of EVs in the city. With the EV market in the city growing each year, the government is now looking to take a step back from the finances, reduce subsidies, and instead promote policies that will create a self-sufficient market.
- **INVOLVE A WIDE RANGE OF STAKEHOLDERS IN ORDER TO EFFECTIVELY CHANGE CONSUMER PREFERENCE AND BEHAVIOR:** The EV promotion in Beijing has involved government and private car manufacturers, as well as private utility providers. Supported by government grants, a number of studies were conducted by academic institutions to understand the public's willingness to pay, their perceptions of EVs and the barriers to uptake in Beijing. These were then used to formulate focused policies. Grants were also given to car and battery manufacturers to encourage technological innovation and increase the number of car models available to the consumers. See also Figure 2 for an overview of the stakeholders involved.

**HOW TO REPLICATE THIS PRACTICE:**

- **COORDINATE EFFECTIVELY TO FORMULATE COMMON GOALS:** All government ministries must come together in a coordinated manner to define a common goal. The requirements and barriers to this goal must be identified. This should then be used to develop policies that effectively address the barriers, establish a strong market system and promote technological development and innovation.
- **TAKE INTO ACCOUNT CHANGES IN THE ECONOMY:** As the market evolves, the stakeholders must monitor and identify these changes, in order to ensure future policy decisions continue to support the market without burdening the economy. As was seen in Beijing, the subsidies helped establishing a market for EVs. However, with the market rapidly increasing, these subsidies will be unsustainable in the future.



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- **ADJUST ECONOMIC POLICY INSTRUMENTS IF NECESSARY:** Some car manufacturers were found to be misusing the subsidy by selling unqualified or faulty cars. China has now decided to do away with the subsidy, and instead focus on policies that open the EV market to foreign investment, competition and innovation.

### CONTACT FOR ENQUIRIES:

- Yali Zheng, Representative (Ministry of Science and Technology, Government of China), Society of Automotive Engineers of China (SAE-China), zhengyl@sae-china.org

### FURTHER KEY RESOURCES:

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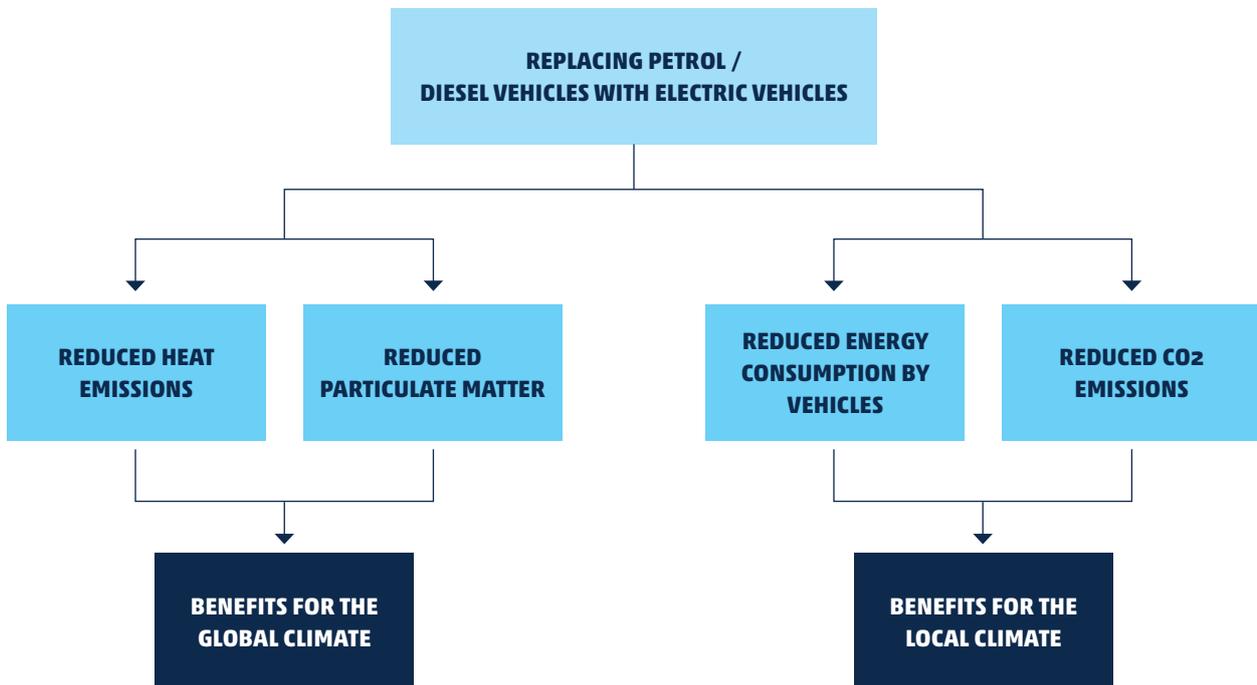


Figure 1: Impact of activities (Adapted from Li et. al (2015))

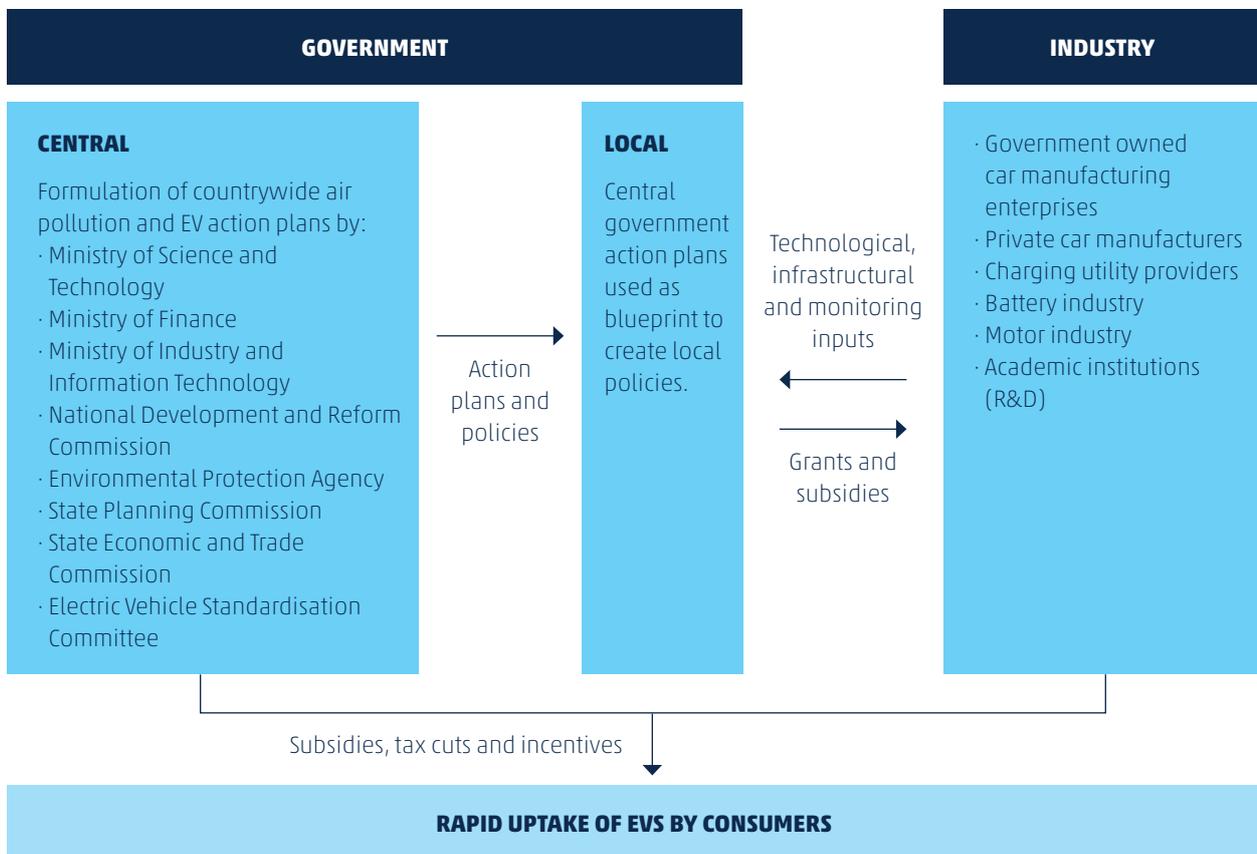


Figure 2: Overview of stakeholders (created by case study author)

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