

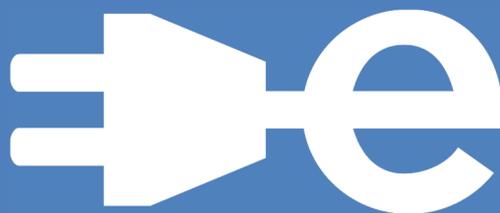


China

Top Sector E-Mobility

Opportunities for Dutch companies

A new rEVolution?



*Consulate General
of the Kingdom of
the Netherlands
Guangzhou*

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Focal point:

Consulate General Guangzhou
gnz-ea@minbuza.nl

Other participating offices:

Embassy Beijing
Consulate General Chongqing
Consulate General Hong Kong
Consulate General Shanghai
Netherlands Business Support Office Chengdu
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www.zakendoeninchina.org

This report was written by:

Ruben de Bie, Economic Policy Officer at the Consulate General in Guangzhou

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1 Introduction

The Netherlands has gathered a lot of expertise in e-mobility. Even though it can hardly be called the beating heart of the European car industry, e-mobility is increasingly becoming a valuable Dutch export commodity and China is becoming an ever more attractive market. After years of high expectations and low performance, this year China finally sees a significant increase in the sales figures of high-speed electric vehicles (EVs). In the first ten months of 2014 sales of electric vehicles surged five-fold compared to the same period in 2013, to an expected total of around 50 000 units for 2014. This brings along opportunities for Dutch business.

1.1 New policies

As reports of hazardous smog in Chinese cities are a recurring item in national and international media, clean air has become a major policy objective. New Energy Vehicles (NEVs) are recognized as a solution, for reducing overall emissions and local particulate matter (PM 2.5). Almost one third of PM pollution is created by the transport sector. NEV production is also a strategic sector for China, because it might improve China’s position in the automotive industry and reduce the country’s reliance on fossil fuels. These considerations have recently fueled new policies and public investments – especially in the field of electric mobility – which form the engine behind the industry’s sudden growth.

Main measures include higher purchasing subsidies and tax breaks for individual buyers. Even more important is the decree that at least 30% of government vehicles in a large number of cities bought in the period until 2017 have to be electric or hybrid. Many local governments have announced additional progressive policies, such as requiring new apartment buildings to install charging piles in their parking lots.

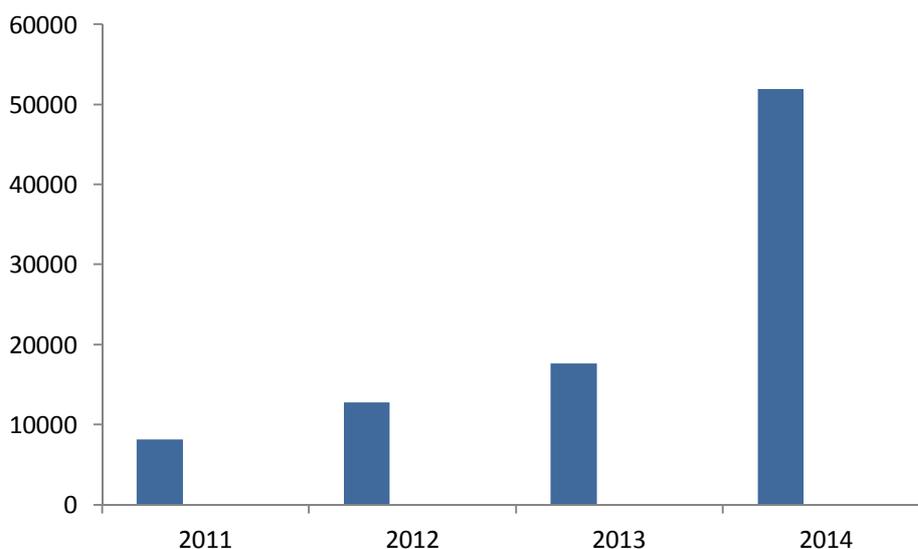


Chart 1 China’s Annual New Energy Vehicle Sales in Units
 Source: China Automobile Industry Association

1.2 Public transport

With the government taking the lead, a large share of the newly produced EVs in China are buses and taxis for public transport. While the media is talking about an 'electric bus boom', EV bus manufacturers are struggling to finish their orders in time. BYD has announced that sales revenue of e-buses will hit RMB 10 billion in 2014, up from 1 billion last year. The profitable e-bus market also attracts new entrants, such as a large metal-trading and chemical companies.

About one third of all EVs sold in China during the first three quarters of 2014 were commercial vehicles, while another large part of passenger vehicles was sold to taxi fleets, short-term rental companies and other work units. Public transport projects are more manageable in their implementation, and therefore are a logical starting point for China's rather government-led EV market.

1.3 Private passenger vehicles

Besides public transport, subsidies and improvements in the construction of charging facilities are also causing a jolt in the sales of passenger cars. Especially more attractively priced plug-in hybrid vehicles (PHEVs) and low-cost mini-sized pure battery-electric vehicles (BEV) have recently started performing significantly better, such as the BYD Qin and Kandi's EVs respectively.

International car manufacturers such as Volkswagen, BMW and Nissan expect China to become one of their main markets for EVs in the coming five to seven years, and are currently making big investments to launch new models. There are also new local players entering the field, since for instance Apple manufacturer Foxconn announced in October 2014 that it is working on a new low-cost electric car. These companies are betting that consumers' range anxiety will be resolved, and that they will soon be able to rely on effective charging infrastructure.

There are still many critics, who say that the market – and the BEV segment in particular – relies on temporary subsidies rather than sustainable business models. It is far from certain that EVs will be popularized in China soon. But in any case, manufacturers of cars, components and charging equipment which are able to enter now and sail along the current wave of sales, will likely also have a competitive advantage in the future.

1.4 Market access

Compared to Europe or in the US, foreign firms have rather limited access to China's e-mobility market. When it comes to electric passenger cars, foreign brands like Tesla dominate the high-end market – and they likely will be able to further improve their position here. However, the largest share of the Chinese market is served by relatively low-cost cars, buses, components and charging equipment, which are domestically produced by Chinese companies, or sometimes joint ventures. Especially with regard to securing projects in the construction of charging infrastructure, local companies have a distinct competitive advantage.

For almost all foreign e-mobility companies – especially those not operating on the high end of the market – it remains necessary to work together with a local partner. If you find the right partner, this can be a boon to your business.

1.5 Innovation

As the Chinese e-mobility market is becoming increasingly competitive, big bonus points are to be earned by whoever can introduce a technological game changer. The biggest opportunity for Dutch firms lies in marketing (and protecting) their innovations. Innovations, for example in DC fast charging, grid connection management, light materials and engines, can in some cases be made into profitable solutions for the Chinese market. If you have the key to a novel and feasible technical solution, there are high chances of finding an influential Chinese partner.

2 Developing EV in China

What comes first: electric vehicles or an EV charging network? It is a question of chicken or egg. Without charging facilities, there will be no electric vehicles on the streets. Without electric vehicles, haphazardly planting charging piles might turn out to be a waste of money. The popularization of EV is a process that has to go hand in hand with a gradually developing charging infrastructure. This is a daunting task, especially in a country the size of China.

The fragmented and stalled development of charging infrastructure over recent years has been symptomatic of the Chinese EV market in general. The new incentives for the construction of charging piles and stations might bring about some changes. It also offers concrete opportunities in the form of large-scale government-ordered projects. For a clearer picture of the available opportunities, let us have a closer look at the lay of China's EV land.

2.1 A faltering start

Reality has had a hard time to match the government's ambitious plans. After China launched the Ten Cities Thousand Vehicles pilot program in 2009, it also set the goal to have 500 000 EVs on the roads in 2015 and 5 million in 2020. Subsidies and government purchases also led to a temporary increase in sales at that time, up 46% in 2009 compared to 2008.

However, growth remained minimal in the following years. By September 2014 no more than 70 000 electric or hybrid vehicles were on the Chinese roads. Only 4 400 electric cars were bought by private buyers between 2009 and 2012, most of them in Shenzhen and Hefei. Charging equipment remains at a similar low, with for instance only 400 charging stations, while according to plan there should be 4000 stations in 2015.

2.2 Local standards and subsidies

Local protectionism has partly slowed down the development of the EV network in China. As in every country, there initially were no common national standards for charging methods, connectors, battery cells, charging network communications or network billing. During the different pilots of the Ten Cities program, local approaches were developed in cooperation with local manufacturers. This led for instance to the situation that electric cars from Shenzhen could not be charged in Beijing or Hangzhou, and vice versa.

As the main supplier of electricity in China, State Grid was given the task to construct and operate charging facilities nationwide. This also included developing charging standards and State Grid decided to focus on battery swapping rather than plug-in charging. However, even a giant the size of State Grid was not able to unite manufacturers to apply a single standard for batteries. There were also disagreements about the direction of the industry between national agencies such as Ministry of Science and Technology, Development and Reform Commission and

the Ministry of Industry and Information. In the meantime, local governments and companies started building different types of recharging points.

Local subsidies have produced locally strong EV brands, but these have hardly been able to hit the market nationwide. Shenzhen, with its showpiece EV manufacturer BYD, has for example from the start been issuing a local subsidy to EV buyers that equals the national subsidy (35 000 – 60 000 RMB). However, buyers in Beijing do not profit from this stimulus. Moreover, these buyers might run into trouble when they try to register for a license plate with their BYD EV in Beijing, because it might not be on the municipal government list of approved vehicles. According to insiders, many local governments require car makers to have local factories or a certain number of dealerships before granting such privileges.

How will BYD participate in the building of charging stations?

“We will only participate in some cities, but cannot in many other cities. We are not even included in the discussions. Every city has a new-energy-vehicle promotion office. Only with their approval can we join the meeting and have the opportunity to get involved in the construction. Cities have promised to reduce local protectionism, but it will take time.”

WANG Chuanfu, CEO of BYD, September 2014

2.3 Restructuring the EV landscape

Faced with the threat of a fragmented EV market without national charging standards, government and industry are working together to turn the tide. Uniform charging standards are a crucial element of a unified market. When German Chancellor Angela Merkel visited China in July 2014, it was decided on the top political level that China and Germany would unify their charging standards. A number of large e-mobility corporations have now confirmed that practically all new charging equipment has the same 7-pin Type 2 plug as the Netherlands.

Everything becomes fluid under pressure. One of the reasons standards are being developed right now, is due to a regulation, published in July 2014, requiring many municipal governments to increase the percentage of EVs to 30% of newly-bought vehicles in 2016. The policy also gives them the responsibility to build a sustainable charging system, for public transport as well as other EV usages, not necessarily focused on private vehicles. October 2014 also saw the publication of a new green logistics policy by the State Council, which emphasizes the electrification of urban freight. State Grid has been pushed to open construction of EV infrastructure to private investment. There now is heightened competition between bidders to give government and other parties a compliant as well as advanced offer to project tenders.

Other central regulations focus on directly subsidizing the purchase of EVs. For instance, a number of NEVs are exempt from purchase tax on cars from September 2014 through 2017, which reduces the vehicle price by roughly 10%. But the tax break only counts for 17 models from 11 manufacturers, which are almost only domestic brands or Sino-foreign joint ventures. The national purchase subsidies of 35 000 – 60 000 RMB for BEVs and 30 000 for PHEVs, which have been available since September 2013, will expire in 2015, but are expected to be extended. More

and more local governments are announcing additional supportive measures, either in the form of purchasing subsidy, free license plates, free charging or free toll roads.

2.4 Hurdles

The government is taking new steps, but there are still some hurdles to overcome. While technical standards, such as for AC/DC power supply, and charging port identification and communication are being developed quite rapidly, systems such as network billing are proving more difficult. A nationwide system for charging network operation is still quite far away.

More importantly, one of the main problems with constructing charging facilities for private vehicles is securing a location in China's cities. Both parking spaces and gas stations are difficult to come by, which hampers the development of a charging network. Especially AC slow-charging has run into much trouble. For instance, property management of most apartment complexes does not support the construction of charging piles in its heavily contested parking spots. This is a crucial charging location for private EV use among urban Chinese.

Without a feasible location to charge for EV owners, even handing out free license plates does not help much. License plates in China are difficult to procure and cost up to more than USD 10 000, some EV owners can get one for free. However, when earlier in 2014 in Beijing around 1400 people were granted a free EV license, around 70% gave it up, because they failed to purchase an EV. Half of them said they did so because there was no realistic place to charge. To improve this situation, some local governments are now requiring new residential buildings to have charging equipment, but this is not expected to quickly change the existing situation.

2.5 A sense of direction

The main difficulties with popularizing EV in China have not yet been resolved. The average consumer is not yet tempted to buy an electric car him or herself. Neither is it likely that there will be a fully functional nationwide charging network in the coming few years. However, government and industry are working towards feasibility with a more unified strategy than before. And the market seems to start responding, or at least give rise to new initiatives for the use of EVs in China.

3 Market Trends and Opportunities

A bird in the hand is worth two in the bush. Plans, policies and public investments can serve as a katalyst, but they cannot go without the two most important ingredients: product and customer. As electric buses, taxis and hourly rentals of EVs are becoming profitable in China, it becomes clear that there are other ways to make currently available EV technology viable, except through b2c passenger car sales. On top of that, the introduction of new models and jumping sales numbers have caused the competition to heat up and reinvigorated the market for product innovation.

3.1 Market for electric vehicles

In general, foreign and joint-venture car manufacturers have invested a lot more in their e-mobility R&D than domestic Chinese counterparts. Cumulative investment in the development of EVs by 13 most prominent Chinese car makers (including Chang’an, BAIC, BYD, JAC) adds up to almost USD 3 billion, which is less than a third of Toyota’s annual R&D spending on alternative fuel vehicles. Some have speculated that Chinese firms are waiting for the market to take off, to then catch up with existing technologies. However, that may not be the only side of the story, as recent figures show that there is also a market for low-cost vehicles in China, which require less research.

Limited range and range anxiety are still the biggest hindrance for b2b and consumer confidence. This is less the case for public transport companies, which can rely on subsidized pure battery electric vehicles to become profitable within a few years, thanks to limited distances and available charging infrastructure. Small BEVs are also suitable for hourly car-renting schemes, such as Zhejiang Kandi Electric Vehicles (a joint venture of Kandi Technologies and Volvo parent company Geely Automobile) is already laying out in Hangzhou and a few other cities.

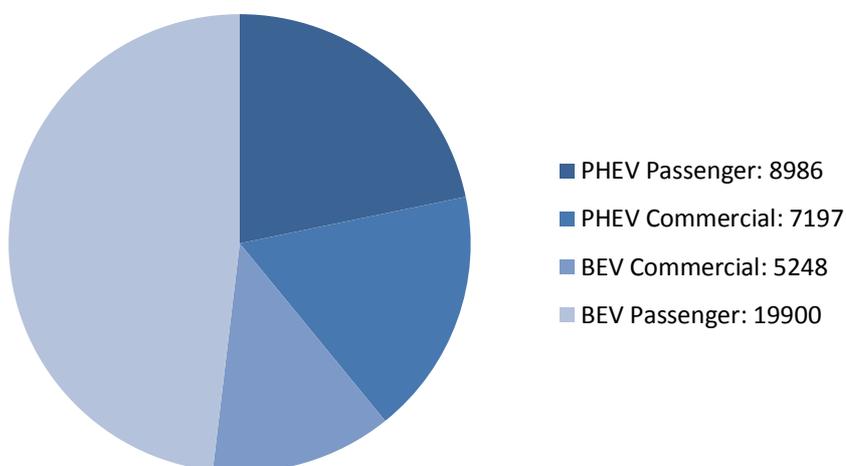


Chart 2 EV Sales by Type in Units for January-September 2014
 Source: Ministry of Industry and Information Technology of China

For long-distance commercial transport of passengers and goods, there are no known pilot projects with BEVs yet. Although most private cars drive less than 60 kilometers on average per day, individual consumers are not very willing to buy pure BEVs, which are bound to get stranded outside the major cities. The average Chinese car buyer, which includes many first-time buyers, wants to be able to drive from Beijing to Shanghai, even though in practice intercity driving is rather rare.

As you can see in Chart 2, the sales of plug-in hybrids surprisingly lagged behind fully electric passenger vehicles during the first nine months of 2014. This shows that there is not yet much of a market for EVs for mainstream individual customers. According to industry specialists, most BEV passenger vehicles belong to institutional buyers and households with multiple cars. Households purchasing a BEV seem to either go for a luxury sedan, such as the Tesla Model S (almost 3000 units sold in January-September 2014) or a lightweight low-cost vehicle, such as the Chery QQ3 EV (almost 6000 units over the same period). With subsidies, these mini-sized BEVs are actually considerably cheaper than the average traditional car with an internal combustion engine (ICE).

Car Model	Average reported retail price in RMB	Vehicle Type
Tesla model S	734000	BEV
BMW i3	450000	BEV
Kandi SMA7000 BEV	70000	BEV
Chery QQ3 EV	100000	BEV
BYD Qin	200000	PHEV
BMW i8	516000	PHEV
Toyota Prius	250000	PHEV
Audi A3	280000	ICE
Geely Englon SC7	66000	ICE
VW Santana	104000	ICE

Chart 3 Relative pricing of a few popular EV models

There are slight indications that the average individual consumer is getting more interested in electric driving. The number of domestic hybrid passenger car sales increased 1600% year on year, in the first three quarters of 2014. Almost all PHEVs sold in 2014 were BYD Qins. The model might have created a breakthrough for PHEVs, by entering the mid-range market, which the Toyota Prius failed to do in China – possibly due to higher pricing. But then again, the reported 8986 PHEVs are still only a fraction of the more than 13 million cars sold in China in January-September 2014. Normal hybrids, running on energy generated while driving or braking, are barely subsidized (RMB 3000), and have thus not been able to enter the Chinese market successfully.

3.2 Competition from natural gas vehicles

Another thing to keep in mind is that China also has a relatively large natural gas vehicle market and industry. Currently there are more than 1.5 million vehicles in China that run on liquified natural gas (LNG) or compressed natural gas (CNG), and 3000 natural gas stations. With natural gas trading about 30% cheaper than diesel after China's recent gas deal with Russia, natural gas is a profitable alternative,

especially for public transport and logistics companies. A 12-meter EV bus still costs around RMB 1.5 million, while the lower investment in a natural gas bus becomes profitable after little more than a year.

Natural gas vehicles also emit approximately 30% less CO₂ than diesel, and produces close to zero PM 2.5. China is expanding the amount of natural gas stations, hoping to reach 12 000 stations in 2020. Herewith natural gas is a strong competitor of electric vehicles in the coming years, but if there is a possibility of combining both technologies this might reap considerable benefits.

3.3 Market for components

Although technical details are beyond the scope of this report, a few things can be said about components of the EV product chain. There have been high investments in China batteries and other parts of the power train. With around 10% of the world's known lithium reserves in Chinese soil, Chinese organizations have put particular focus on the development of lithium iron phosphate (LFP) and other lithium-ion batteries. Chinese companies are producing a number of EV components for export already.

Electric vehicles for the Chinese market already are practically fully domestically produced. This includes parts of the use chain such as charging piles, which are quite developed and comparatively cheap in China. However, not all parts are up to standard for export, especially to Western markets. For instance, Chinese-manufactured electric buses for the European market still contain about 70% imported components – such as doors from the Dutch brand Ventura – which are then assembled in China.

There are predictions that with economic priorities on high-tech manufacturing, China will strengthen its competitive position in EV components. Heightened competition between Chinese companies due to a heating domestic market makes improvements of various parts of the vehicle and use chain an asset that is much sought after.

3.4 Trends and opportunities

Market researchers expect the total turnover of China's EV industry to grow with at least an average 50% per year over the next three years. Opportunities can be found across the board, from vehicle parts and materials to project planning. Some major opportunities lie in the field of charging. According to a recent report from CCID Consulting, one of China's largest research firms, China's EV charging industry will grow from USD 574 million in 2013 to USD 5.3 billion in 2016, a tenfold increase in three years.

Opportunity 1: DC quick-charging solutions

Trend: As the parking situation in China's cities will keep large-scale slow charging difficult for years to come, companies are now looking for ways to charge quickly. Recently, the government has introduced a so-called GBT fast-charging standard, to stimulate development. Both public and private DC charging networks are

expected to be rolled out more rapidly in the near future, but the market is still open for new solutions. Some EV manufacturers and governments are looking at the possibility of implementing wireless charging.

Example: Denza has this year started a partnership with Swiss-Swedish ABB for DC charging. Denza, a joint venture between Daimler and BYD, has recently launched its first EV, and is combining vehicle sales with fast chargers. ABB has invested considerably in China and now has 19 000 employees.

Opportunity 2: Components of electric vehicles and charging equipment

Trend: With a heating market and heightened competition, the rewards for product innovation are also becoming higher. Technical innovations demanded by the Chinese market can reach from applications of light materials to engines and communication equipment. As is universally the case, range limitations are one of the main holdbacks for EV sales in China, and inventions to increase vehicles' travel distance are becoming very valuable. But technologies relating to other capacities can be equally valuable.

Example: In 2010 Zhuhai Yinlong Energy acquired a majority share in NASDAQ-listed Altair Nanotechnologies, whose lithium-titanate (LTO) battery technology has enabled Yinlong's e-bus branch to grow. The advantages of the technology are an increased amount of charging cycles and battery efficiency at the low temperatures of north China.

Opportunity 3: Charging infrastructure projects for buses, taxis and logistics

Trend: Many cities are designing systems for electric public transport, but there are also car-sharing programs and express delivery companies exploring opportunities. Such projects can lead to opportunities in planning (for instance with GIS tools) and charging equipment management technologies (such as load balancing). Most large projects will not in whole be tendered to foreign companies, but might benefit from the expertise of foreign suppliers or other partnerships.

Example: Potevio has formed strategic cooperations with Sinopharm, EMS, SF Express, Jingdong and others to jointly promote the application of green logistics in pharmaceutical and express fields. The pilot with SF consists of 10 vehicles in Beijing and Shenzhen each, and will likely be expanded soon.

Opportunity 4: Chinese EVs on the European market, especially public transport

Trend: Chinese companies are able to produce relatively cheap EVs in large quantities. So far, Chinese cars have not been able to get a firm foothold on the European market, neither electric nor combustion-type. As the Chinese industry is maturing, sales of BYD buses and taxis in Europe are indicating that there might be some changes to the status quo.

Increasingly more European city governments are looking at electrifying their public transport. Many of the components of Chinese e-buses for export are from Europe (such as Siemens engines), and there might be room for Dutch companies (such as

engine builders) in the Chinese export-oriented market. Since the demands of European public transport companies and drivers are different from Chinese customers, there is potential for Sino-European coproduction.

Example: Dutch Helmond-based Ebusco has started selling e-buses in Europe, which are assembled and partly manufactured in China. The company has sold a bus in Finland and two in Norway, and is now showcasing its new pure aluminum buses throughout Europe, which runs 300km with 90 passengers on one charging.

4 Regional Markets, Projects and Industries

Most automobile traffic in China stays within urban areas, and e-mobility can only develop from these regional cores. Local governments are the lead characters of China's progressing EV history. These governments have recently been publishing new regulations and plans, which lay out concrete projects for the short term. The areas around Shanghai (Jiangsu) and Guangzhou (PRD) are host to most important players in the EV industry, but production and part of R&D are also developing quite rapidly in more inland cities (Wuhan, Chongqing, Chengdu).

4.1 Beijing (Embassy)

There are no official data available for the number of EVs in Beijing, but according to news reports earlier this year, there were about 1000 private cars, 950 taxis and 300 battery-swapping e-buses on the roads. Beijing has 4 large-scale charging stations, three of which are open to the public. There were around 560 charging piles in the city, which were expected to increase to 1000 by the end of 2014. EVs included in the Beijing New Energy Vehicle catalogue are eligible for a total of RMB 114 000 in subsidies from central and local government.

In July 2014 Beijing Municipal Government promulgated its new EV Promotion Action Plan for 2014-2017. Main measures include (more details can be found in the original policy document):

1. In 2014, at least 900 electric buses shall be in operation, and this number will reach 4500 by the end of 2017.
2. All newly operating taxis shall be EVs, and current taxis will be replaced by EVs step by step; all taxis in 10 suburban districts shall become EVs.
3. Develop demonstration projects of EV sharing and short-term rentals.
4. Promote the use of EV in logistics sector.
5. Promote EV as the official cars purchased by governmental organizations.
6. Promote EV for the use of sanitation vehicles; more than 50% of the new sanitation vehicles should be EVs.
7. Encourage companies and individuals to buy EVs; 170 000 EV license plates will be supplied, of which 20 000 for 2014.
8. Infrastructure:
 - a. Construct 3 large charging stations for public buses.
 - b. Construct charging piles for taxis at a rate not lower than 1:3.
 - c. Build 10 000 charging piles at public parking spaces, parking place of large malls, and gas stations which have the capacity and facilities.
 - d. The focus of 2014 is to build 1000 fast charging piles in airports, train stations, public parking spaces, and service area along highways.
 - e. For newly developed residential projects, at least 18% of the parking space has to be equipped with charging piles.

The local automobile companies Beijing Automobile Group and Chang'an Group are both producing EVs.

4.2 Chongqing (Consulate General)

According to official statistics, there were 1578 new energy vehicles running in Chongqing by the end of 2012. Among these automobiles, there were 531 public

buses, 320 service cars, 25 taxis and 702 private vehicles. These automobiles are independently developed by Chang' an Automobile and Hengtong Bus. The amount of EVs in Chongqing has been growing steadily, with 1046 new vehicles over 2014.

According to plans from November 2014, Chongqing hopes there will be 3000 more new energy vehicles added to its roads in 2015. Private buyers will get 1:1 local subsidy with central level subsidy, which will reduce the price of a new RMB 150 000 EV to RMB 35 000 (USD 5700) per vehicle. Purchase of buses gets a local subsidy of RMB 160 000 per vehicle. In total the Chongqing government has reserved for 2015 around USD 44 million for purchasing subsidies and USD 2.5 million for charging infrastructure. Next year should see the construction of 5 large charging stations, 11 quick-charging poles and 275 slow chargers.

4.3 Guangzhou (Consulate General)

Like many municipalities all over China, local governments in the region of CG Guangzhou have in recent months started to give a new push to EV. This trend is most obvious in largest cities of the Pearl River Delta (PRD): Guangzhou and Shenzhen.

In October 2014, there were around 9000 new energy vehicles in Shenzhen, up from 7000 in March. About half of Shenzhens EVs is for public use. This year, the electric taxi fleet in Shenzhen is expanding from 850 to 1850, now operated by multiple companies instead of, as previously, only one. Shenzhen's local manufacturers, particularly BYD, have been able to strengthen their market position from the stimulating measures already in place, such as low charging rates. However, high investment in charging infrastructure in Shenzhen has also led to big losses. China Southern Power Grid announced that it made a RMB 13 million loss in 2013 on its seven battery-swapping stations in Shenzhen.

While Guangzhou has long been lagging behind Shenzhen in terms of its EV market and infrastructure, it is now quickly becoming more competitive. At the moment, Guangzhou residents looking for an EV go to Shenzhen for their purchase because of the local subsidy, which matches national purchase subsidy, but Guangzhou has recently decided to do the same from January 2015. Also on the construction of charging piles by individuals, Guangzhou has recently decided to follow Shenzhen in giving a 30% subsidy.

New regulations and plans of Guangzhou municipal government furthermore stipulate that:

1. 18% of newly built apartment complexes need to have EV charging facilities
2. 10% of newly constructed public parking spaces will be equipped with a charging pile
3. 40 charging stations will be completed in the coming months, and the government is striving to reach 100 stations by the end of next year.
4. In the coming two years, the government will place 10 000 charging piles

Other places in CG Guangzhou's resort are also investing in EV projects, both inside the PRD (such as Shunde) and outside the PRD (such as Fuzhou). Fujian Province has since September been publishing new policies and projects in Fuzhou, Xiamen and Quanzhou – including EV rentals, public transport and charging facilities.

Moreover Fujian Province recently announced the construction of 60 large charging stations along two coastline highways.

The South of China is one of the national hotspots for the EV industry. With factories of for example FAW-Volkswagen, Dongfeng-Nissan, Chang'an-PSA, GAC, BYD and Wuzhoulong, the automotive industry is strongly present in the PRD. This is supported by increasing activities in R&D and production of electric vehicles and grid equipment.

4.4 Hong Kong (Consulate General)

As of September 2014, there are 986 EVs in use in Hong Kong, up from less than 100 in 2010. There are around 1000 charging points. Among these charging locations, over 100 medium EV charging points and ten are quick chargers. The Hong Kong government is working with the private sector in expanding the EV charging infrastructure in Hong Kong. For instance, BYD aims to install 47 EV chargers in HK.

Hong Kong Government has been promoting the use of EVs in the past decade. In 2011, the following financial incentives were implemented:

1. The first registration tax for EVs is waived till end March 2017. Furthermore, enterprises which procure EVs are allowed 100% profits tax deduction for the capital expenditure on EVs in the first year of procurement.
2. A HKD 300 million Pilot Green Transport Fund has been put in place since March 2011 for application by transport operators and non-profit-making organizations providing services to their clients and goods vehicle owners, encouraging them to try out innovative green and low carbon transport technologies (including EVs).
3. The government allocated HKD 180 million for franchised bus companies to purchase 36 electric buses for trial runs to assess their operational efficiency and performance under the local conditions. The trial is expected to commence progressively in the first quarter of 2015.
4. The government has purchased 147 EVs for its fleet and expected to purchase another 74 EVs to be delivered for various departments in 2015.

At present, 34 EV models from seven countries have been type-approved by Transport Department of Hong Kong. These include 22 models for private cars and motorcycles, 12 models for public transport and commercial vehicles. Major imported EVs brands are BMW, Tesla, BYD, Mitsubishi, Nissan, Renault, Detroit, Porsche, Daimler and Toyota for private cars. E-buses in Hong Kong are from BYD, Wuchoulong and Mitsubishi. The two EV producers in Hong Kong have joint ventures with EVs producers in Mainland. These are:

1. EuAuto Technology, which developed an electric automobile, branded Mycar, since 2007. The production facilities are located in Dongguan and the vehicles are sold to HK, France, Austria and UK.
2. Great Dragon International, a subsidiary of Dah Chong Hong (DCH), engaged partnership with a Shandong-based company to produce electric buses.

4.5 Hubei (NBSO Wuhan)

Hubei province's EV market and industry is most developed in the cities of Wuhan and Xiangyang. At present, there are around 1000 EVs in Wuhan and 300 EVs in Xiangyang. The electric vehicles are mostly buses for public transport, as well as some EV taxi, cleaning vans, courier vans, post vans. Wuhan has functioned as a spot for demonstrative operation of various EVs, such as the Nissan Leaf Zero Emission Demonstration program. EVs for private use are still quite limited, and they largely lack charging facilities. There are yet 20 EV charging stations in Hubei (4 in Wuhan, 3 in Xiangyang) and 350 AC charging piles (142 in Wuhan, 50 in Xiangyang).

Local and provincial governments still uphold the ambition to increase the number of EVs to 10 500 in Wuhan and 5000 EVs in Xiangyang in 2015. This should be achieved in part through the following regulations. First, the central government purchase subsidy for PHEV and BEV is in some locales matched with local subsidies, up to a combined 60% of the vehicle sales price. Second, Hubei's toll roads and charging facilities are free for EV users.

The province also aims to have 379 EV charging stations and 47 000 charging piles by 2020. In order to achieve this, local-level State Grid's monopoly on constructing charging facilities is being opened to private investment. Moreover, charging infrastructure is given preferential land use policy and financial support from local government. It has recently become compulsory to construct EV charging facilities for many newly-built residential neighborhoods and large parking areas.

Wuhan has in recent years become stronger in EV research as well as production, mostly owing to the strong R&D support from Wuhan University of Technology and Dongfeng Motor Design and Engineering Institute, and industrial investments of BYD and King Long. With around 30 EV and component manufacturers, which form the complete EV industrial chain of the Dongfeng Motor NEV Platform, Xiangyang is also an upcoming production base.

4.6 Jiangsu (NBSO Nanjing)

The statistics show that in Jiangsu Province, until the end of October 2014, 3651 EVs have been put on the market (2,028 in Nanjing, 132 in Changzhou, 715 in Suzhou, 294 in Nantong, 413 in Yancheng, and 69 in Yangzhou). Among those 3,651 EVs, 994 are pure EV cars (215 EV privately owned, others are taxi's), 1,458 are pure EV passenger buses, 323 are pure EV special vehicles, 40 are plug-in EV cars, 836 are plug-in hybrid buses. The total number of pure EV buses accounted for 25% of nation's total. Currently Jiangsu has built 47 charging stations in those six cities, as well as 2288 DC charging piles.

Jiangsu has the plan to put 15,135 electric vehicles into operation by the year of 2015. In order to speed up the process and the development, Jiangsu has adopted a series of measures, which include organizing "supply and demand" meetings, conducting market surveys, allocating subsidy to EV buyers and raising special funds for building charging facilities. Based on new regulations from the Jiangsu government, in newly constructed living compounds and public parking places, a certain percentage of each parking lot has to be reserved for charging of EV. An example is the city Huai'an (in Northern Jiangsu), which has planned to have 4,800 EV's by the year of 2020, for which it wants to build 15 charging stations. In the long run, the city aims at 10,000 EV's and 21 charging stations by the year of 2030. The Huai'an government plans to invest 183 million RMB for the construction of these charging stations.

In total, Jiangsu has around 100 auto manufacturers. 23 of these have been listed in the Directory of Recommended Models for Demonstration and Application of Energy Saving and New Energy Vehicles, while 14 are in the production of electric vehicles and/or hybrid vehicles. These are:

1. Nanjing Golden Dragon Bus Co., Ltd.
2. Nanjing Auto Group Co., Ltd.
3. Jiangsu Alfa Bus Co., Ltd.
4. FAW Bus (Wuxi) Co., Ltd.
5. Kinglong Auto Industry (Suzhou) Co., Ltd.
6. Zhangjiagang Jiangnan Vehicle Manufacturing Co., Ltd.
7. Jiangsu Green Wheel EV
8. Dongfeng Yueda KIA
9. Zhongda Bus Group
10. Aoxin New Energy
11. Yangzhou Asia Star Bus
12. Jiangsu Jiu Zhou Vehicles
13. Jiangsu NEOC Bus
14. Nanjing Special Vehicle Manufacturing Plant

Besides Jiangsu local producers, some vehicle manufacturers from other provinces and countries also have established their production bases in Jiangsu. For instance, BYD invested 3 billion RMB in Nanjing for EV production. Toyota invested 2 billion RMB in an R&D center in Changshu (in Suzhou) in developing hybrid and recharging technology for the application in the production of FAW Toyota Motors and GAC Toyota Motors.

4.7 Liaoning (NBSO Dalian)

Although provincial and municipal governments in Liaoning encourage the use of new energy and new technology, not many electric vehicles are used. The two main cities of Liaoning, Dalian and Shenyang, have public transport EV pilots. In Dalian, there are about 30 electric buses running through the tourist area, and about 200 electric cars from Dongfeng-Nissan are used as public taxi. There are 4 charging stations and around 200 AC charging piles. In Shenyang, there are about 140 electric buses in the city, with 3 charging stations, and 300 AC charging piles.

There are new plans to gradually expand Liaoning's EV program. By the year 2016, the Liaoning government intends to construct 10 electric bus charging stations and 1000 electric vehicle AC charging piles. The Liaoning government also gives local subsidies to its citizens to purchase EVs, and hopes to reach approximately 5000 private vehicles by 2016.

The automotive industry is one of the leading industries in Liaoning province, with about 10 automotive manufacturing companies in the region, and a yearly production capacity of about 1 million vehicles. All of Liaoning's most prominent automotive manufacturing companies, such as Brilliance Auto Group, SG Automotive Group, Chery Dalian Factory, Dongfeng Nissan Dalian Factory, produce electric vehicles.

4.8 Shandong (NBSOs Jinan and Qingdao)

There are currently 5 cities in Shandong which have been approved by the central government as demonstration cities for the popularization and utilization of new energy vehicles, namely Qingdao, Linyi, Zibo, Weifang and Liaocheng. By the end of 2013, Shandong had constructed 28 charging stations and 651 AC charging piles throughout the province.

So far, public transportation is the largest end user of new energy vehicles in Shandong. In Qingdao and Linyi, 450 and 151 new energy buses have been in service in Qingdao and Linyi respectively by early 2014, accounting for over 10% of the total local bus fleet. By end of 2015, Qingdao plans to have 1550 more e-buses, which accounts for 40% of the bus fleet. The current promotion scheme promises subsidies of RMB 400 000 when purchasing an e-bus of over 10m long, with a price for 12m e-bus of around RMB 1.5 million. In addition, Qingdao plans to have 2500 electric passenger vehicles by 2015, including 500 public service vehicles and 2000 taxis. To stimulate individual EV use, the government of Qingdao also matches national government purchase subsidies.

Several auto makers in Shandong have been involved in the electric vehicle business, most of them producing e-buses. For example, Zhongtong Bus, a public listed company located in Liaocheng was exclusive e-bus supplier for the Beijing Olympic Games in 2008. Yixing Electric Vehicle, located in Linyi, is another company licensed to make e-buses. Yantai Shuchi Bus has developed their e-bus model jointly with Wuhan University of Technology, and finished the prototype in 2013. As the senior sponsor of International Horticultural Exposition 2014 Qingdao, Qingdao AUCMA Electric Vehicle has developed golf cars, sightseeing Buses, cargo trucks, patrol cars, and other utility vehicles in five series and more than thirty models of electric vehicles. For EV service, a most important move is the latest cooperation between Qingdao TGOOD and EVE Energy. The two public listed companies just signed an agreement in November of 2014, to establish a joint venture for design, construction and operation of EV charging network.

4.9 Shanghai (Consulate General)

There are around 9000 EV passenger cars with Shanghai license plates (compared to 1 410 000 combustion-engine cars). Around 300 charging piles are publicly available in Shanghai, which is an overcapacity at present, as they are not fully used yet. The relevant authorities use a social networking tool to pinpoint availability of charging stations. Another 1700 piles are located in governmental or private areas. In total there are around 100 operational EV buses in Shanghai, which charge on existing trolleybus cables or at dedicated charging stations.

Most notable among Shanghai's EV support measures, electric vehicles buyers are exempted from an expensive license plate purchase, of RMB 70 000 or more. Different districts furthermore provide more compensation for purchases. Jiading District has been designated as an EV test zone for local and international car companies, and is also setting up a vehicle sharing program.

EV buses are locally built. They are optimized for short distances: they are lightweight, carry small batteries and can be charged at random places. Their range is 20 km, and need 5 to 7 minutes for charging. The set-up is modular. Most

modules can be replaced within 2 hours, so that a bus is only out of operation for a short time in case of defects. Main local EV manufacturers include Shanghai Aowei Technology development Co (buses/trucks) and the Shanghai International Automobile City group (passenger vehicles).

4.10 Sichuan (NBSO Chengdu)

There are more than 1000 charging spots in Sichuan, most of them are located in its capital city Chengdu. To facilitate EV sector development, Chengdu built 14 DC charging stations, and 688 AC charging poles. More than 1000 EVs are being used in Sichuan, mainly public buses, government cars and public service vehicles.

To further encourage the topic of EV, several plans and policies have been issued. The Sichuan government has appointed two cities (Chengdu and Luzhou) to launch the following pilot projects: from the beginning of 2014, if both governments purchase new vehicles, the EV percentage shall not be lower than 30% of the total purchasing amount. Other cities have been required to meet the same targets by the end of the year 2016. The Sichuan government also set up the goal that by the end of year 2015, 10,000 EV vehicles should have been produced and its industrial output volume should amount to 10 billion RMB.

In total there are 24 vehicle manufacturing companies, 6 assembling companies, and 18 component companies in Sichuan. Almost all of the EV companies in this region are located in Chengdu. This includes the only local complete-vehicle production company Sichuan Fulin Group, but also for instance Volvo, which produces its S60L hybrid model in Chengdu. Another promising manufacturer is Laintem Motors, which focuses on producing e-buses for longer distances.

**Embassy of the Kingdom of the Netherlands**

4 Liangmahe Nanlu
Chaoyang District, Beijing 100600
Tel: + 86 10 8532 0200
E-mail: pek-ea@minbuza.nl

Consulate General Shanghai

10/F Tower B, Dawning Center, 500 Hongbaoshi Road
Changning District, Shanghai 201103
Tel: + 86 21 2208 7288
E-mail: sha-ea@minbuza.nl

Consulate General Guangzhou

Teem Tower, 34/F, 208 Tianhe Road
Guangzhou 510620
Tel: + 86 20 3813 2200
E-mail: gnz-ea@minbuza.nl

Consulate General Chongqing

54/F, Yingli International Finance Centre, 28 Minzhong Road
Yuzhong District, Chongqing 400012
E-mail: cho-az@minbuza.nl

Consulate General Hong Kong

Room 2402B, 24/F, Great Eagle Centre, 23 Harbour Road
Wanchai, Hong Kong SAR
Tel: + 852 2599 9200
E-mail: hon-ea@minbuza.nl

NBSO Chengdu

6/F, West Building, La De Fang Si,
1480 Tianfu Avenue, Chengdu, 610041
T. +86 (0)28 8511 4047
E-mail: nbsochengdu@nbsochengdu.com

NBSO Dalian

4910 World Trade Center, 25 TongXing Road
Zhongshan District, Dalian 116001
Tel: + 86 411 3986 9998
E-mail: nbsodalian@nbsodalian.com

NBSO Jinan

Room B1, 3/F, Building 2, Shuntai Plaza 2000 Shunhua Road
Jinan, 250101
Tel: + 86 531 8606 5138
E-mail: nbsojinan@nbsojinan.com

NBSO Nanjing

Suite 2316, Building B, 23/F, Phoenix Plaza
1 Hunan Road, Nanjing 210009
Tel: + 86 25 8470 3707 / 8470 3708
E-mail: nbsonanjing@nbsonanjing.com

NBSO Qingdao

A-2505, Top Yihe International, 10 Hong Kong Middle Road
Shinan District, Qingdao 266071
Tel: + 86 532 6677 7515 / 17
E-mail: nbsoqingdao@nbsoqingdao.com

NBSO Wuhan

Tower I, Room 1306, 568 Jianshe Avenue
Wuhan 430022
Tel: + 86 27 8576 6511
E-mail: nbsowuhan@nbsowuhan.com

Netherlands Economic Network in China:

www.hollandinchina.org, www.zakendoeninchina.org, www.laihelanzuoshengyi.org