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7. Public procurement for innovation elements in the Chinese new energy vehicles program

Yanchao Li, Luke Georghiou and John Rigby

INTRODUCTION

China began to use public procurement as an explicit instrument of innovation policy (that is, public procurement for innovation or PPI) in 2006 when the National Medium- and Long-Term Program for Science and Technology Development (2006–2020) (hereafter MLP (2006–2020)) was announced. During 2006–2009 the central government launched further policy measures to implement PPI (for a detailed account see Li, 2011). The main (intended) approach to implementation was through ‘innovation catalogues’. These were lists of innovative solutions, accredited by the Ministry of Science and Technology (MOST), contained within ‘PPI catalogues’. They were to be produced by the Ministry of Finance (MOF) to guide government procurers in buying innovative solutions (Li and Georghiou, 2014). A second instrument, ‘signalling catalogues’, that is, lists of technologies that are identified as being much needed in China by the central government, were recognized as a complementary instrument to better link demand and supply (ibid.). This catalogue approach can be regarded as being what Edler and Georghiou (2007) termed ‘general procurement’, that is, an organized, ‘routine’ PPI mechanism where innovation becomes an explicit criterion in the tendering process.

The implementation of this approach in China has, however, come to a standstill, as a result of both domestic obstacles and international pressures. Domestically, a major challenge is created by the Chinese government procurement system, which is distinct from that of signatory countries to the World

Trade Organization Agreement on Government Procurement (WTO-GPA) in that it adopts a much narrower definition of government procurement (Wang, 2009; Li and Georghiou, 2014). The definition only considers procurement activities conducted by public organizations relying on fiscal funds (for example, procurement of office products and stationery by government agencies and public schools) as government procurement, while procurement activities conducted by state-owned enterprises and by some specialized ministries (for example, the former Ministry of Railways) are outside the scope of the Chinese Law on Government Procurement.

Our fieldwork has suggested that this regulatory arrangement significantly constrains the use of procurement to stimulate innovation, as many sectors that are likely to nurture innovations are beyond the authority of government procurers. Also, the fragmentation of the wider public procurement market in China (that is, public procurement which is within the scope of WTO-GPA but outside the scope of the Chinese government procurement system, taking a substantial proportion of China's public spending) allows serious regional protectionism to continue (Li and Georghiou, 2014). On the international side, China's drive towards 'indigenous innovation' (O'Brien, 2010) and especially the adoption of PPI, have led to deep concerns about China's protectionism from its major trade partners, in particular the USA (USCBC, 2010, 2011a, 2011b) and the European Union (EU) (EUCCC, 2011). After rounds of high-level discussions in July 2011, four key national policies underpinning innovation catalogues were abandoned (Li and Georghiou, 2014). The national-level PPI mechanism, which used the innovation catalogues approach, was officially abolished. Nevertheless, in the course of the fieldwork reported in this chapter, we identified other channels of PPI policies in China. These are summarized in Table 7.1.

One important channel is through national demonstration programs (see Table 7.1, last column), that is, lead market initiative (LMI) type measures (CSES and Oxford Research, 2011), which is a mix of demand-side innovation policy instruments to 'pull' and accelerate the commercialization and market transformation processes. The procurement elements of these programs could be within or outside the scope of China's narrowly defined government procurement regulations, depending on whether government agencies are the end-users or not. Procurements stimulated by these programs can be regarded as being what

Table 7.1 *The range of national policies promulgated for innovation procurement*

Forms	Routinized mechanism via accrediting catalogues	Signalling catalogues of equipment and other strategic technologies	Demonstration programs for strategic and emerging areas
Rationale	Enhancing communication between suppliers and procurers	Signalling national demand; technology roadmapping	Creating lead markets; systemic mix of policy instruments
Implementation (based on fieldwork)	Ambiguous national measures; regional autonomy in developing local mechanisms; diversified across regions	Governmental departments regularly launch catalogues to inform suppliers; strategic procurement takes place from time to time	Targeted at various sectors, for example, LED lighting, solar energy and new energy vehicles (NEV)
Current status	Withdrawn in July 2011 in response to international concerns	Relatively on track; facilitated technology advancement in a variety of ways	Results diversified across sectors; achievements as well as challenges

Source: Li and Georghiou (2014).

Edler and Georghiou (2007) termed 'strategic procurement', which 'occurs when the demand for certain technologies, products or services is encouraged in order to stimulate the market' (p. 953). These programs are targeted at promising and strategically important sectors, for example, the sector we look into in this chapter, new energy vehicles (NEVs).

This chapter undertakes an exploration of policies for procurement of innovation, with the main aim being to bring to light the details and difficulties involved in implementing the policy in China. In particular, an examination is made through the lens of city-level procurement activities stimulated by central-level innovation policy initiatives in China. The particular case examined is that of NEVs, for which we gathered both primary data

(interviews) and secondary data (policy documentation). We firstly outline the context of the Chinese NEV program, and then move on to investigate cases of NEV procurement in two participant cities. We conclude by discussing some of the key issues identified from the cases.

THE NEV DEMONSTRATION PROGRAM IN CHINA

According to the scope defined by the Chinese government,¹ NEVs include hybrid vehicles, plug-in hybrid electric vehicles, battery electric vehicles and fuel cell vehicles. Research and development (R&D) on NEVs in China has been supervised by the MOST since the early 1990s, mainly in the form of high-tech R&D programs (Sun, 2012). In China, the development of NEVs has been considered necessary for several reasons. As a result of the high growth rate of the economy, the demand for vehicles has been increasing quickly. The country suffers from a severe energy shortage and environmental pressure (World Bank, 2011). China has made a commitment to the United Nations to reduce its carbon emissions by 40–45 percent, the development of NEVs being recognized as an important way of realizing this target (State Council, 2011a). Meanwhile, although China is now the largest and fastest-developing market for vehicles in the world in terms of both manufacturing and sales (Lin and Wang, 2012), engine-related technologies have been imported from developed countries and controlled by multinational automobile suppliers, while domestic firms occupy only a small share in the traditional vehicle market (*ibid.*). Therefore, the government is determined to capture the opportunity of developing new types of vehicles and further escalate the automobile industry (State Council, 2012).

After years of R&D support, the central government more recently considered it timely to facilitate the commercialization of NEV technology. Major suppliers had developed their prototypes, which were in need of market access (Gong et al., 2013). Since 2009, a variety of innovation policies have been announced to support NEV commercialization, covering not only the supply side but also the demand side of the market. This engaged additional government agencies (beyond the MOST) along the supply chain. In Table 7.2 we briefly classify the key NEV-related innovation policies adopted in China to present our overall

Table 7.2 Classification of NEV-related innovation policies in China

Overall policies		Supply-side policies	
Policy type	Authority	Policy type	Authority
Implementation measures for indigenous innovation strategy	State Council	R&D programs for example, 863 projects (the National High-tech R&D Projects)	MOST
Stimulating policies for emerging technology sectors	State Council	R&D funding for public institutes, universities and state owned enterprises	MOST
Development plan for energy saving and new energy vehicles (2012–2020)	State Council	Networking measures for example, alliances, incubators and training	MOST, MIIT
Demand-side policies			
Category	Policy type	Authority in charge	
NEV program focused polices	Overall measures detailing implementation approaches	MOF, MOST, MIIT, NDRC	
	Funding/subsidies related measures	MOF	
	Catalogues of approved NEV models	MIIT	
	Regulations on other issues for example, safety, infrastructure building	MOF, MOST, MIIT, NDRC	
Regulations	Regulations on tax reduction, NEV supplier qualification, emission, and government procurement procedures for NEV	National Bureau of Taxation, MIIT and MOF	
Standards	Standards on oil-saving rate testing and charging facilities etc.	MIIT	

Sources: Derived from policy analysis. Policies were found on websites of the State Council, related ministries, and the policy section on the China NEV website <http://www.chinaev.org/DisplayView/Vip/Policy/Index.aspx> (accessed February 19, 2013).

understanding of the policy context. The corresponding institutional set-up and division of labor were elaborated by Liu and Kokko (2013). The most systemic policy measure is the Energy-saving and New Energy Vehicles Demonstration, Promotion and Application Program² (hereafter 'the NEV program'), which aims to create lead markets for NEVs in selected cities.

Initiated jointly by the MOF, the MOST, the Ministry of Industry and Information Technology (MIIT) and the National Development and Reform Commission (NDRC) in January 2009, the NEV program aimed to promote the use of around 1000 NEVs in each of a series of selected cities during 2009–2012 (MOF et al., 2010b). In total 25 cities were selected as participants for the public sector demonstration, whereby government agencies or public transport companies (which are state-owned) were to be given subsidies when purchasing buses, taxis, government cars, environment maintenance vans and mail delivery vans using NEV technology.

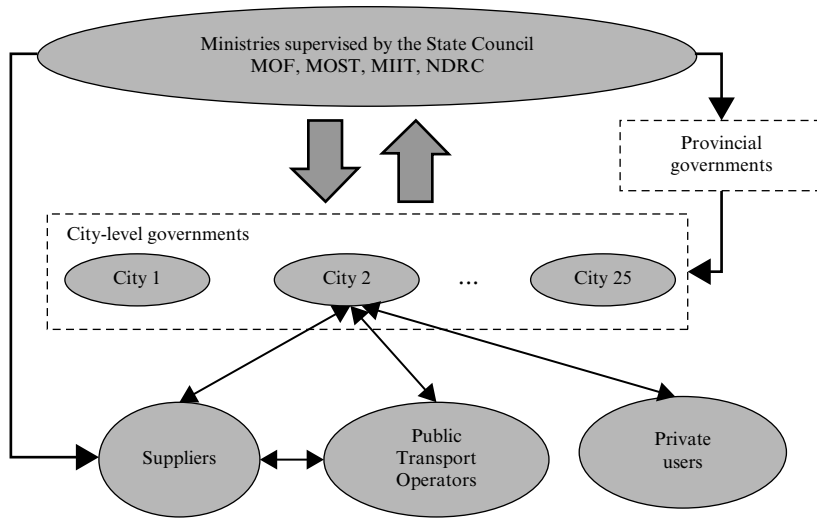
Both cities investigated in this chapter, Jinan and Shenzhen, were participants throughout the period 2009–2012. In addition, Shenzhen was one of the six participants selected for the consumer NEV demonstration (MOF et al., 2010a), which allowed citizens in Shenzhen to enjoy subsidies when purchasing NEVs for their own use.

According to a ministerial-level interviewee who was involved in the program, the selection of participant cities was conducted on the basis of proposals submitted by the candidate cities. Cities were required to design realistic implementation plans and ensure that they fulfilled the goals by the end of 2012. Expert groups were then organized by the ministries to carry out fieldwork to evaluate the potential of candidates. Selection criteria included the size of the local market, the status of the local automobile industry and financial conditions of local governments as well as a consideration of the national industry strategy. Geographically, most of the selected cities were located in the eastern and middle part of China, and were mainly municipalities, provincial capitals or medium-sized cities. For some cities that had relatively small local markets but good industrial potential, the option exists to form 'city clusters' to participate (Gong et al., 2013). For cities enjoying the private consumer subsidies from the MOF, additional criteria needed to be fulfilled, such as consumption capacity of citizens and traffic conditions in the locality. The amount of the subsidies was set

according to the overall price difference between NEVs and traditional vehicles with similar performance characteristics (MOF and MOST, 2009). Both provincial and city-level governments were obligated to provide additional subsidies to procurers and to provide special funding for infrastructure construction and maintenance (ibid.).

The ministries also stipulated that, to be subsidized, procurers had to choose NEVs from the *Catalogues of Recommended Vehicle Models for NEV Demonstration Program* produced by the MIIT (MOF and MOST, 2009; MOF et al., 2011). Detailed criteria for products included: the oil-saving rate of hybrid cars had to be above 5 percent compared to traditional vehicles with similar performance characteristics, while the oil-saving rate of hybrid buses had to be above 10 percent; the warranty of batteries and other key segments provided by manufacturers had to cover three years (or 150 000 kilometres) or longer; the manufacturing capacity of key components suppliers needed to reach a certain threshold (MOF and MOST, 2009). Meanwhile, the procurers were required to organize a public tendering process to buy NEVs with clear specifications of the model, quantity, price and after-sales services (ibid.). We illustrate the design of the NEV demonstration program in a simplified way in Figure 7.1.

Following the central-level initiative, participant cities have had the flexibility to design their own form of implementation. They demonstrated strong enthusiasm to promote NEVs, since each city had its carbon emission reduction task allocated from the central and provincial governments (State Council, 2011b). However, cities with or without advantages in terms of traditional automotive technologies also wanted to take the opportunity to develop local NEV industries as an instrument of economic development (Gong et al., 2013). Although the original target set by the central government was 1000 NEVs for public use per city, most of the participants set up their own targets at a level far higher than this. For example, Beijing (with a population of approximately 20 million) aimed to promote the application of 5000 NEVs by the end of 2015, and Shenzhen (with a population of approximately 10 million) aimed to promote 24000 NEVs by the end of 2012 (CATARC, 2010). A wide range of policy instruments was used by localities. Besides typical measures such as consumer subsidies, tax reduction and public procurement, some cities issued favorable policies for NEV users to reduce their parking, toll and electricity fees; or in the case of



Sources: Based on policy analysis and interviews.

Figure 7.1 The design of the NEV program

Beijing, where people had to take part in a lottery to get a license plate for their new cars, NEV buyers did not have to go through the competition process. Some provinces followed the systemic approach adopted by the central government and initiated their own demonstration programs in their region to encourage more cities to become involved rather than just those selected by the ministries (Gong et al., 2013).

The progress of participant cities has been uneven, and none have in fact achieved their three-year targets (Gong et al., 2013) at the time of writing in October 2013. On average, only 38 percent of the targets set by cities for public use were realized by 2011 (Huang et al., 2012). The overall fulfillment ratio for both public and private uses was as low as 26 percent, primarily because of the unrealistic goals set by the cities in the first place (Gong et al., 2013). The actual quantity of NEVs promoted through the program during 2009–2012 was 27 400,³ approximately 23 000 of which were procured by public bodies and only 4 400 NEVs purchased by private consumers. In terms of production, there were more than 400 NEV models produced by 76 manufacturers listed in the *Catalogues of Recommended*

Vehicle Models for NEV Demonstration Program by October 2011 (Gong et al., 2013), although many of the suppliers were not yet capable of large-scale manufacturing (ibid.). The number of NEV charging and battery swapping stations and charging stations in China was 174 and 8107, respectively, by the end of 2012 (see the previous note). Although many issues such as regional protectionism were manifested during the demonstration program (as illustrated in Gong et al., 2013, and as we shall see in the case studies) and impacts in the longer run remain to be seen, our interviewees considered the program fairly effective in terms of raising stakeholders' awareness and promoting technological advancement.

METHODOLOGY TO BUILD THE CASES

The cases presented in this chapter form an integrated part of a broader, exploratory study (Li, 2013) on PPI policies and practices in China. They were built on the basis of a comprehensive analysis of the Chinese context in terms of the innovation system, the procurement system, and the identified PPI policy channels (as shown in Table 7.1). We distinguish three levels of governance: the macro, national level of policy-making; the meso, regional level of policy articulation; and the micro level of policy implementation. In particular, understandings of the policy processes at upper levels have been obtained primarily through documentation analysis supplemented with interviews with national and regional officials from science and technology (S&T), industrial and financial departments, while understandings of the implementation processes at the micro level (that is, the level where the two cases locate) have been obtained primarily through semi-structured interviews with various practitioners and stakeholders including public procurers, local government officials, suppliers and (occasionally) end-users.

It should be noted that across the participant cities there have been many procurements stimulated by the NEV program.⁴ We illustrate these by analysing two cases that took place in the cities of Jinan and Shenzhen. Primary data collection was carried out between December 2010 and May 2011 in both of the cities as well as Guangzhou (the capital of Guangdong province where Shenzhen is located) and Beijing (to gain insights from ministerial officials regarding the two cities' practices). To build the

cases ten interviews were conducted, of which two were with national officials in charge of the NEV program, two with local officials from the city governments (one of them was meanwhile a user of electric sedans), four with different NEV suppliers, and two with public transport operating companies (that is, procurers and users of coaches). For national officials, questions regarding the broader picture (for example, the two cities' overall progress, competitive advantages and weaknesses) were asked; for micro-level practitioners, questions regarding the procurement cycles (that is, demand articulation, selection procedures and criteria, stakeholder interactions, contract delivery, outcomes and lessons) were asked. We structure the cases into three parts, that is, the stage before the procurement, which we title as the 'pre-procurement' stage, the procurement process, and a short discussion about the outcomes and impacts.

CASES OF PROCUREMENT

Jinan: Procurement of Hybrid Coaches for National Games 2009

Jinan⁵ is the capital of Shandong province situated on the eastern coast of China. Historically it has been an important city in China in terms of its economy, culture and transport. In 2011 Jinan ranked twenty-third in Chinese cities' gross domestic product (GDP) ranking.⁶ According to the materials Jinan submitted to the ministries, its local administrative set-up for NEV demonstration is a group led by the mayor with heads of the local Development and Reform Commission (DRC), Bureau of S&T, Bureau of Finance, and Commission of Economy and Informationalization as group members. These organizations also set up a specialized office to monitor implementation. The main policies in the locality related to the NEV program include Shandong Provincial Government (2009a, 2009b, 2009c, 2009d) and Jinan City Government (2009a, 2009b), and the Implementation Measures on NEV Demonstration and Promotion in Jinan approved by the four supervisory ministries.⁷ Content analysis suggests that these policies are in general articulated based on the approach adopted by the central government (see Table 7.2), taking local circumstances (for example, challenges and opportunities faced by the local NEV industry) into account.

Some electric vehicle (EV) manufacturers in Jinan and other parts of Shandong have been focused on producing low-speed vehicles for rural areas, and their products are very popular among farmers. However, thus far the ministries have not announced any supportive measures for low-speed EVs, as many experts do not consider low-speed EV technology based on lead-acid batteries as a promising technology, since it can be very harmful for the environment.⁸ In this respect Jinan is trying to shift its industrial focus from low-speed EVs to leading-edge NEV technologies. The city government is trying to attract NEV key components suppliers to invest in the locality by offering access to a market created by the demonstration project (interview R4O_NEV). The NEV industry in Jinan has been in the nurturing stage since 2005 when the first battery factory was founded, and now several domestic automobile suppliers have opened local branches there.⁹

The pre-procurement stage: the need

As with the Beijing Olympics 2008, Shanghai EXPO 2010 and Shenzhen Universiade 2011 (see the section on 'Shenzhen: Procurement of NEVs for Universiade 2011'), the National Games of China in 2009 provided a good opportunity for the host city, Jinan, to improve its public transport infrastructure and demonstrate the use of NEVs. The Jinan government normally allocates 60 million yuan per year to the local public transport company (state-owned) as operation subsidies. In 2009 it decided to provide additional funding of around 40 million yuan to conduct public procurement of a batch of NEVs, and hence to support their use during the National Games and to kick off the implementation of the NEV demonstration program (interviewee R4O_NEV). The Jinan government set up technological requirements jointly with the public transport company. They required that the coaches should be 12-meter-long diesel–electric hybrid models with paralleled batteries, and their exhaust emissions should be less than China's national Tier IV standard.

The procurement process

With a total budget of 100 million yuan, coupled with subsidies from the central government, the Jinan government procured 100 hybrid buses on behalf of the operating company for the National Games of 2009. These NEVs operated between sport venues, coach stations and athlete hotels during the game, and

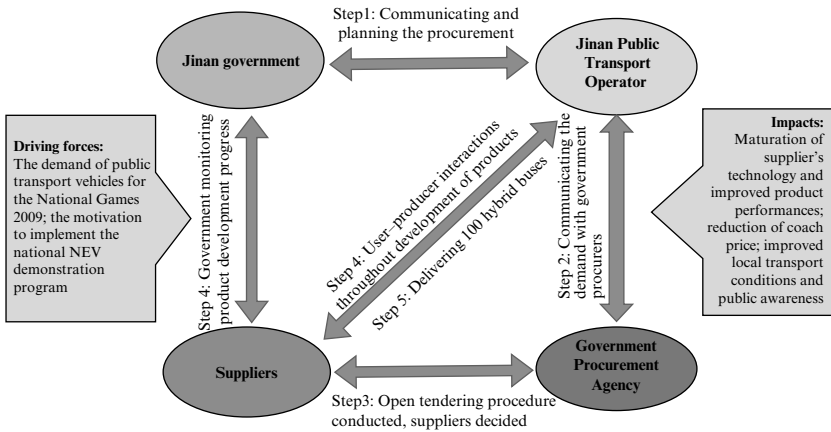


Figure 7.2 The procurement process of NEVs for the National Games 2009

served as regular buses on four of the public transport lines in Jinan afterwards. The overall process of procurement is illustrated in Figure 7.2.

According to the interviewees in Jinan, the government decided to buy hybrid coaches rather than electric ones for three reasons. The first was that hybrid vehicle technologies were more mature than EVs in early 2009 when the demonstration program had just begun. The second reason was the budget issue: each pure electric coach cost around 1.2 million yuan at that time (1.8 million yuan minus the national subsidy of 0.6 million yuan), while each hybrid coach cost around 0.95 million yuan (1.2 million yuan, minus the national subsidy of 0.35 million yuan). A third reason was that the locality was not able to build charging infrastructure for EVs in a short time with a limited budget (one charging station cost around 30 million yuan), and hence hybrid coaches were a good option.

The operating company then published an invitation to open tendering via the Shandong Government Procurement center, and nine manufacturers (qualified by the MIIT) submitted their bids. R4O_NEV (a vice-director of Jinan S&T Bureau) said the requirements they set were considered too high by most of the bidders at that time, and only two companies eventually provided acceptable product designs. Company A, a firm from Shandong province, obtained the top score and won a contract

for 80 coaches with a value of 87.4 million yuan; and Company B, from outside the province, achieved the second-highest score and won a contract for 20 coaches. Both companies signed the contracts in March 2009, and the deadline for delivering the coaches was the end of July 2009 as the National Games was starting in October.

Interviewees in both the Jinan government and the public transport company admitted that they preferred to buy products from company A, since the provincial government would provide its own subsidies (in addition to national subsidies) for the purchasing of NEVs from local companies (that is, situated in the province). If possible, they would even prefer to purchase from a supplier situated in the city, in the hope that procurement activities may contribute to the development of a local NEV industry.

Company A asked for an extension of the deadline to the end of September 2009, but despite this, it failed to manufacture all the needed products before the Games. Under the pressure of delivering products on time, it substituted the original key components (including the engine, the controller and the battery) with imported, good-quality alternatives to meet the requirements of the contract. According to national and provincial support policies for the demonstration program, only domestic products with 'indigenous IPRs' (intellectual property rights) could enjoy the subsidies, that is, in this case at least two of the three key components should be designed by native companies. Therefore, in order to fulfill the contract requirement and to get the subsidies, Company A spent the following months seeking to improve its products and gradually substituted the imported components with its own, improved products (key IPRs fully owned by company A). By early 2010, all 80 coaches had been equipped with domestically made components.

The procurer interviewee indicated that the prototype provided by Company A was qualified to enter the market according to the MIIT criteria. However, the manufacturing capacity of Company A was limited at the time, making the delivery of products on time difficult; and indeed the operating company was concerned about using such new products immediately, during the period of the Games. Jinan was one of the first cities procuring NEVs in the country after the start of the NEV program, and the national government was also concerned about the performance of the NEV technology. One interviewee

(R4P_NEV, a manager in the Jinan Public Transport Group) noted the inexperience of both parties to the contract: 'we were not experienced as procurers and they were not experienced as a supplier'. In consequence, the three parties agreed to extend the deadline of product delivery, and to temporarily replace the core components with imported ones to lower the risk and guarantee product performance.

By the time of interview (May 2011), the 80 coaches had been operating in the public transport lines of Jinan for more than one year. A manager in the operating company (interviewee R4P_NEV) believed that the quality of these coaches was very good, with an overall oil-saving rate of 26 percent (while the threshold for subsidizing was 20 percent). The performance of the key components was stable and the hybrid coaches could now operate as frequently as traditional vehicles at an overall rate of 98 percent.

Although the procurer company adopted an open tendering procedure for the procurement, it is worth noting that the operating company and Company A (both are state-controlled companies in Shandong province) had been in a co-operative relationship for a large number of years prior to the NEV program. According to interviewee R4P_NEV, products of Company A account for one-quarter of the total number of coaches in the Jinan Public Transport Group. One major reason for this co-operation is that Company A is located close to Jinan, and hence it can provide after-sales services more easily. A manager of the province's procurement team (interviewee R4F) said that he preferred company A as the supplier, because it was very familiar with the traffic conditions in Jinan and could follow the national and industrial changes quickly to satisfy the changing needs of customers. This long-term relationship provided a basis of trust for the procurer to choose Company A.

At the end of 2010, the operating company published another tendering invitation for 100 hybrid coaches. Company A won the contract, again due to its previous experience. This time it submitted the bid at a lower price (around 900 000 yuan per coach), while other companies failed to provide competitive offers.

A manager in the operating company mentioned that it had raised the testing standards for the second batch of coaches by ordering a prototype and conducting a comprehensive examination with technological experts. They made suggestions regarding battery configuration (the number and series of batteries

were changed according to predicted routine traffic conditions) and a higher oil-saving rate was realized. Interactions between the user and the producer helped to first identify problems and then find a solution that better satisfied the customer demand before the model was put into larger-scale production.

Outcomes, impacts and issues

One impact of this procurement was the maturation of Company A's technology and the improvement of product performance. As mentioned, Company A initially failed to deliver satisfactory products on time for the National Games 2009, and imported key components were used instead. The company then improved its products and replaced the imported components with its own by early 2010. In the second procurement, user–producer interactions facilitated further improvement of Company A's products. Another impact was the reduction of the coach price. In the second procurement, Company A submitted an offer that was around 25 percent lower in price than the first batch, beating other bidders in the tendering. A third impact was that the two procurements improved the conditions of public transport in Jinan to a certain extent, and improved public awareness of NEVs in the locality as well, since the four transport lines which the hybrid coaches are used on cover very popular routes in the city center.

The procurements in this case did not by themselves have much impact on the building of Jinan's local NEV industry, as the scale was rather small. It did facilitate incrementally gaining access to a wider market for the supplier. A recent search of secondary data in May 2013 suggested that, following the delivery of the second contract in this case, Company A won more contracts from the Jinan government as well as other cities in Shandong province; beyond Shandong, Company A has been gradually overcoming barriers created by regional protectionism and winning small-scale contracts (normally under 100 NEVs). A sales milestone of 1500 NEVs was achieved in early 2013, which is already a number coveted by most of the Chinese NEV suppliers.

However, despite Jinan being one of the first-batch participant cities and having conducted one of the earliest procurements of NEVs, it is now the slowest and the least motivated among the first-batch participants (Huang et al., 2012). Delay could result from a wish to avoid risky commitments in the

face of policy uncertainty. The motivation to carry that risk is reduced as Jinan lacks local industrial support, and hence has a reduced economic incentive to bear it.

Shenzhen: Procurement of NEVs for Universiade 2011

Our second case is located in Shenzhen. Situated in the Pearl River Delta, Shenzhen is the second-largest city (after the provincial capital, Guangzhou) in Guangdong, and the first special economic zone in China nominated by the State Council in 1980. It has developed from a small town into an internationalized city during the past three decades, and it is well-known for its impressive 'Shenzhen Speed',¹⁰ a label that signifies the technologically advanced character of the people and the area. Shenzhen is ranked fourth in the 2011 GDP ranking (after Shanghai, Beijing and Guangzhou) of cities in mainland China, and ranked as the most innovative city in China by Forbes.¹¹ The governance of the city is similar to that of Jinan, that is, an administrative group led by the vice-mayor with heads of the local Development and Reform Commission (DRC), Bureau of S&T, Bureau of Finance and Commission of Economy and Informationalization. Main policies in the locality related to the NEV program include Guangdong Provincial Government (2009, 2010), and Shenzhen City Government (2009a, 2009b, 2011).

BYD¹² and Wuzhoulong¹³ are the two major NEV manufacturers in Shenzhen. Founded in 1995, BYD started its business in battery manufacturing. In 2003 it purchased Xi'an Qinchuan Automobile factory and entered the car manufacturing and sales business. In 2008 it purchased the Ningbo Zhongwei Semiconductor factory and integrated the upper-stream supply chain of motor manufacturing for electric cars. In July 2009 it also purchased Changsha Meidisanxiang Coach Co. Ltd and through this acquired acceptance from the MIIT for manufacturing coaches. Now it is a privately owned high-tech enterprise with information technology (IT) and automobile businesses. The main advantage of BYD's NEV business compared to its competitors lies in the fact that almost all the upper-stream suppliers are from the BYD group, whereby they can control product price and maintain a maximum profit (interviewee R3S_NEV, a manager from Wuzhoulong Co. Ltd). BYD has adopted a localization strategy in many regions. In 2011 it had nine R&D and manufacturing bases across the country, including Guangdong,

Beijing, Shaanxi and Shanghai. BYD's headquarters are now in Pingshan District in Shenzhen.

In contrast to BYD, which focuses on battery and electric vehicles, Wuzhoulong Motors has had a clear strategy of developing energy-saving coaches since it was founded in 2000. Its core advantage lies in its vehicle material manufacturing technologies and its smart hybrid motor controller, which integrates an energy controlling system, automatic clutch controlling system and information management system. Approved by the Shenzhen government in 2005, seven hybrid coaches manufactured by Wuzhoulong became the first demonstration public transport line in the country. The average oil-saving rate of Wuzhoulong's products was 25–30 percent.

The pre-procurement stage: a pilot project

A pilot project was initiated by the Shenzhen government in 2008 to demonstrate the use of hybrid buses and electric cars in typical urban traffic conditions. This project was then approved by MOST as part of the 11th Five-Year 863 Key Program on Energy Saving and New Energy Vehicles, in order to provide a reference for further country-wide NEV demonstration. The budget provided by the Shenzhen government was 50 million yuan to cover the expense of purchasing and maintaining 30 hybrid buses and 20 electric cars. Wuzhoulong and BYD were chosen as the suppliers for the hybrid buses and electric cars, respectively. Three public transport lines were designed with ten hybrid buses in each of them. Twenty electric cars were then allocated by the local DRC to governmental bodies (for example, the S&T Bureau, Environment Protection Bureau and Transport Bureau), with charging and testing facilities installed accordingly.

According to interviewees, the procurement of hybrid buses was straightforward, while for electric cars the project group decided to adopt the mode of 'government renting' instead of 'government procuring', as the government bodies at that time had failed to get permission for the procurement from the local Bureau of Finance. The car model rented was an early version of F3DM,¹⁴ a plug-in hybrid compact sedan. The rental fee was fixed at 80000 yuan for two years, which, according to interviewee R3S_NEV, was much lower than the real cost, as the supplier provided a whole package of post-rental services, insurance and tax, and so on. Still, the supplier was very actively involved and grateful for this opportunity to promote its prototype.

User–supplier interactions were frequent during the two years. BYD set up a specialized service group for the project which had two major functions: a routine visit to the user organizations to collect feedback and a trouble-shooting service when they encountered any problems. Users were requested to provide feedback regarding vehicle functionalities. Although radical technological change was not stimulated by those interactions, many detailed improvements regarding product performance were realized. One example was that the dashboard, which used to be similar to traditional ones, was redesigned into a more user-friendly version displaying the dynamic battery level and operating mode, and so on. A ‘low-carbon’ version of F3DM was developed after this project, integrating a solar energy panel on top of the car and hence further saving energy.

The impact of this pilot project lies in the growing interest and familiarity among citizens in Shenzhen with NEVs, as government bodies volunteered to use them. The number of telephone enquiries about F3DM received by BYD increased significantly due to the demonstration effect. Early users were open enough to introduce their experience to the public. One of them (interviewee R3U_NEV) indicated that he was impressed with two things in particular: one was that the acceleration speed was very high, so the driving experience was superior; the other was that by using the new car he paid 80 percent less for energy costs, including electricity and petrol.

F3DM became well known, gradually gaining ground in the private market afterwards. By May 2011, BYD had sold around 600 units of this model to private consumers, the majority of whom came from Shenzhen city. Since Shenzhen was one of the demonstration cities for private user subsidies, the price of F3DM for local consumers was 80 000 yuan after the subsidies from central and local governments (the subsidizing amounts were 50 000 yuan and 30 000 yuan, respectively, covering 50 percent of the total price), compared with 169 800 yuan for customers from other regions. The project provided an opportunity for the government, the suppliers and the users to interact with each other, and hence build a relationship which led to the procurement of NEVs for the Universiade 2011 in Shenzhen.

The procurement process

The Universiade hosted by Shenzhen city in 2011 provided a major opportunity for the locality to implement an NEV

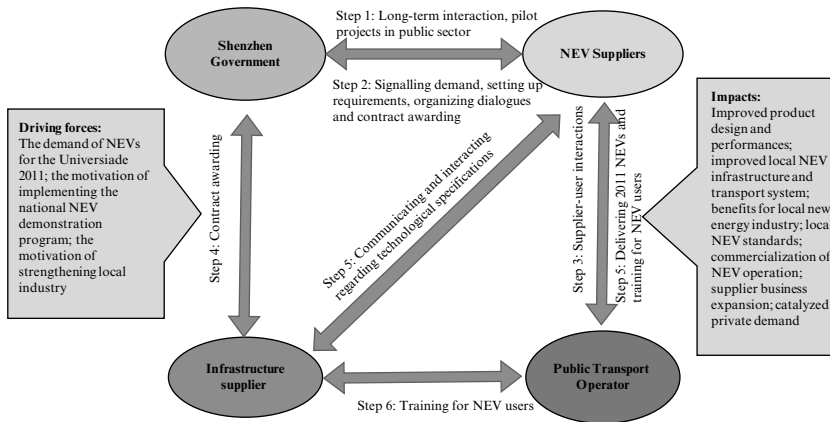


Figure 7.3 The procurement process

demonstration program through constructing the infrastructure and providing public transport. Since Shenzhen is well known as an innovative and active city, the local government set ‘green technology’ as one of the themes, and the NEV policy was one way of demonstrating this. This fortunately coincided with the national NEV demonstration program. The number of NEVs in Shenzhen increased significantly up to 2011 as a result of public procurement, exceeding the combined number in the Beijing Olympics in 2008 (around 500 NEVs) and Shanghai EXPO in 2010 (around 1300 NEVs). The procured vehicles covered a range of NEV types including hybrid, fuel cell and battery-supplied. The overall process of procurement is illustrated in Figure 7.3.

Performance requirements (including oil saving rate, charging speed, driving range and maximum speed) for the NEV in Universiade were set by the Shenzhen government in their announcement of the Implementation Plan for NEV Demonstrating Operation During the 26th Summer Universiade. The top priorities were indicated to be ‘safety, environment protection and a demonstration of the Shenzhen characteristics’. Four aims were outlined in the document: to get NEVs to make up more than half of the public transport; to cover the sports venues using a structured traffic network; to realize diversification of various NEV technologies; and to explore a commercialized way of operating NEVs. The government also specified technological configuration requirements with a clear

manufacturing schedule, and an organized expert group to monitor the production and construction progress.

As there were not many commercialized NEVs in the market, the Shenzhen government adopted a restricted tender procedure by sending out invitations to well-known suppliers to search for qualified products. According to interviewee R3S_NEV, the government compared available products and eventually decided to go for BYD and Wuzhoulong, as both of them were local companies and capable of providing good-quality products that the government knew about, and their income could add to local GDP growth. It was a great opportunity for Shenzhen to demonstrate its innovativeness by using a local product that was nationally leading-edge. The relationship between the government and the two local firms was built soundly from the early pilot project stage and other forms of communications; for example, interviewee R3S_NEV2 mentioned that whenever they developed new models, they would inform the government in order to see whether there were opportunities to use them.

Available sedan models provided by BYD included the plug-in hybrid car F3DM as mentioned above, and a newly developed pure electric model E6,¹⁵ both of which have been listed in national and local innovation catalogues, and in the catalogue of recommended NEV models produced by the MIIT. By May 2011, a batch of 50 E6 cars had been operating in Shenzhen as taxis for a whole year with a total mileage of 3 million kilometers. The electric coach model produced by BYD was K9, which was pure electric with a fast charging function (50 percent of the capacity can be charged within 30 minutes), and a solar energy panel on top to provide additional electricity. Based on BYD's testing result, K9 (with air conditioners turned on) consumed less than one-third of the energy used by a traditional coach.

Wuzhoulong proposed three models of NEVs. One was FDGFCL10, a ten-seater hydrogen fuel cell van with a maximum speed of 40 km/h, featuring a smart inductive electricity assisted steering system, 'stepless' driving system and a permanent magnet synchronous motor. A second model was FDG6120SDEG, a hybrid coach model equipped with lithium iron phosphate battery featuring an automatic series-parallel hybrid driving system, stepless series-parallel transmission function, automatic mechanical transmission technology and a diesel engine that met the requirement of the Euro-III emission standard. The ratio of electric power could reach 43 percent and the oil-saving rate

was above 30 percent. The third model was FDG6700EV, a pure electric coach model equipped with an engine produced by Shanghai Dajun, and a lithium iron phosphate battery.

Of the 2011 NEVs procured for the Universiade, BYD provided 200 pure electric buses (K9) and 300 pure electric taxis (E6), and Wuzhoulong provided the rest, a total of 1511 energy-saving and new energy buses. Based on the three technological models described above, Wuzhoulong designed six different types of vehicles for Universiade use, including 1350 hybrid single-layer buses, 20 hybrid double-layer buses, 53 pure electric buses, 26 pure electric vans, 60 hydrogen fuel cell sports venue vans and two hydrogen fuel cell coaches. Of these vehicles, the double-layered hybrid coaches and pure electric vans with exchangeable batteries were new to the country. All these NEVs were allocated to 77 public transport lines specialized for Universiade, covering all the sports venues and constituting an NEV transport network in Shenzhen.

The other part of the procurement was infrastructure construction. Shenzhen Bureau of Power Supply commissioned a local firm, Shenzhen Lineng Charging Station Co. Ltd (part of the Putian Group, which is controlled by the State-Owned Assets Supervision and Administration Commission of the State Council, SASAC), to conduct the work, and built the largest charging station thus far in the country, the Shenzhen Universiade Centre EV Charging station. The work included two parts: upgrading work for 25 existing charging stations that were already in use in Shenzhen before the Universiade; and building 34 new charging stations including 22 fixed stations with 161 fast-charging ports and 12 mobile stations with 125 charging ports. In total, the 59 charging stations were sufficient to provide power for all the NEVs during the event. Interviewees were unwilling to disclose what the Shenzhen government had spent on these vehicles and infrastructure.

Outcomes, impacts and issues

The first important outcome of the procurement was improvement of product design and performance. In response to the requirement set by the government, Wuzhoulong designed a two-layered hybrid bus model that was novel in the domestic market. The LED display system in the bus was improved due to interactions between users (drivers) and the supplier. The system now can display the vehicle's dynamic operating status

according to the user's set-up options and traffic conditions. There are different levels of authority for set-up options, for example regular options for everyday drivers and advanced options for engineers.

Another important outcome was that the local NEV infrastructure and public transport system were improved, mainly as a result of the event. The 2011 NEVs became part of the main transport system in Shenzhen. According to Shenzhen's plan in 2009, the city aimed to promote the use of 24 000 NEVs (both public and private sectors) in the locality by the end of 2012, and build 50 charging stations for buses, 2500 charging piles for government vehicles, 200 charging stations and 30 000 charging piles for the public. This procurement for Universiade provided practical experience for later-stage construction, and it considerably accelerated Shenzhen's progress towards achieving the target for the NEV demonstration program.

There have been benefits for the local new energy sector as a whole. Shenzhen is now building a national new energy industry base to promote nuclear, solar, wind and bio-energy technologies and electricity storage technology. The development of NEVs has provided an opportunity for the supply chain to explore the possibility of interdisciplinary innovation.

This procurement meanwhile contributed to NEV standardization in the locality. In 2010 the government organized infrastructure suppliers, including China Southern Power Grid Co. Ltd, to conduct research on existing standards and developed their Technological Standards of EV Charging System in Shenzhen and Standards of Monitoring System on NEVs in Shenzhen, making Shenzhen a pioneer in the country exploring a unified system of standards.

The demonstration during Universiade also attracted capital from the public to invest in NEV promotion. BYD, Wuzhoulong, Shenzhen Public Transport Group and China Putian Group have signed a contract together to promote NEVs in a more commercialized way by applying for commercial loans. For future construction work, the government only provides funding for hybrid bus charging stations, while charging stations for taxis, government cars and private cars will be built using capital raised from public sources.

The diffusion of products by BYD and Wuzhoulong has been effectively enhanced. Suppliers in this case received many invitations to tender from other regions and countries, since their

products performed very well for the event and their prices were competitive. Suppliers' collaboration with domestic and international business partners was enhanced as well.

There are other impacts that we have noted in the case: for example, product costs were lowered effectively, and public awareness of Shenzhen's NEV products was enhanced. Shenzhen gathered valuable experience for the NEV commercialized operation, and it was considered by the ministries as the pioneer among participant cities, winning the prize of the Annual (2011) Best Participant City in the NEV Demonstration Program.¹⁶

DISCUSSION

This chapter has examined two cases regarding city-level public procurement activities stimulated by the central-level NEV program initiatives. The cases were chosen to illustrate the characteristics and issues associated with concrete PPI processes. Table 7.3 summarizes the two cases, indicating both similarities and differences. Commonalities were the incremental nature of the technological development, and effective import substitution. Nonetheless, this was innovation procurement in the sense that the suppliers were set a functional specification against which they had to deliver. There is also a broader observation here. While import substitution of components does not necessarily lead to higher performance, it is often accompanied by lower-level process innovation that allows the supplier firm(s) to manufacture components more efficiently. Also shared by the two cases was the impetus arising from the desire to demonstrate green themes in major events and broadly similar governance. Looking at the differences, we may note sensitivity to the timing of the procurement, with Shenzhen able to pursue a more technologically ambitious route. This also reflected a major disparity in the strength of the industrial bases of the two cities. Although different in nature, both cases relied on close and long-standing relationships between buyers and suppliers. As the institutional infrastructure is largely not formalized, interpersonal relationships play a critical role in implementing policies in China, especially in regions. In the absence of a well-regulated competition environment, the best strategy for a company (which is normally the supplier for the public sector) to adopt is to maintain

Table 7.3 Cross-case analysis: identified issues

	Jinan	Shenzhen
Timing	One of the earliest procurements of NEV in China; high price; cautious move; no charging infrastructure so hybrid NEVs were chosen	Midterm of the NEV demonstration program; lowered price; ambitious move attempting to build infrastructure and use diversified types of NEVs
Driving force	Driven by 'green themes' in large-scale events; other examples include Beijing Olympics 2008, Shanghai EXPO 2010, Guangzhou Asian Games 2010	Very strong industrial base; several local NEV manufacturers which are leaders in the country; trying to strengthen the local new energy sector through large-scale NEV procurement
Local NEV industry status	Relatively weak industrial base according to the criteria set by the central government; trying to nurture local industry by using local market to attract NEV manufacturers	Undisclosed budget; 2011 NEVs based on various technologies (for example, pure electric, hybrid, and fuel cell) were procured to coordinate the project; supervised by a cross-ministry leading group
Budget and quantity	100 million yuan for the first 100, and 90 million yuan for the second 100 hybrid coaches	Restricted tendering organized by the city government; invitations to leading suppliers in the country were sent out and alternative designs were compared
Governance set-up	Cross-departmental administrative group to coordinate the provincial government procurement centre; designs were evaluated rather than actual products	Pilot projects and regular communications between the city government and the suppliers
Tendering procedure	Open tendering organized by the provincial government procurement centre; designs were evaluated rather than actual products	
Interaction mode between stakeholders	Long-term cooperation and trust between the operating company and the supplier company	
Type of innovation	Incremental; 'new to the country' or 'new to the region'; catching up with world leading technologies	
Outcomes and impacts	Improvement and maturation of the product; lowering of the price; moderate improvement of the local transport system; awareness-raising; hesitation about next moves	Improvement of product design, public infrastructure and the local transport system; contributed to local new energy industry and related standardization; diffusion to other regions

sufficient communication and interactions with key consumers and the government.

Within their own limited terms, both cases could be deemed to have been a success in that products were developed and came into use to socially beneficial effect. However, a broader economic perspective raises some fundamental questions. Most important of these is the apparent role of regional protectionism. In these and other cities, governments were as much motivated by establishing or strengthening an NEV industry in their region as by the benefits to the procurer. This in itself does not have to be a problem; it is one of the principles behind PPI. However, in these cases the results seem to have been achieved by suppressing competition or at least restricting it to local favoured suppliers. The effect of this is restriction of not only price competition but also technological competition. It can be predicted that this will result in wasteful overcapacity in China, and probably a delay of some years before the wider forces of competition and agglomeration rationalize the sector. Furthermore, by segmenting the market in this way, the incentives for each innovating firm are substantially reduced.

The setting of quantitative policy targets is also questionable. How should policy goals be modified to suit social challenges and promote an innovation orientation? What criteria should be used to measure the success of policy implementation? The central government set up the demonstration program by selecting a range of promising cities and allocating them certain quantitative targets to achieve; in terms of evaluation, the government introduced an elimination strategy to screen out laggards by the end of the third year. This policy measure is effective in terms of stimulating large-scale commercialization effort and raising awareness in a short time, but meanwhile it induced inter-regional competition and aggravated protectionism, which further leads to overcommitment of development goals and a danger of sightless and low-quality industry expansion. The competition between administrations cannot simply be reduced to economic rationality. There is a strong suggestion that 'face' and prestige are associated with activity in this sector, even to the extent that it has been called 'NEV fever'.

Chinese policy implementation mechanisms have sometimes been efficient and sometimes not. On the one hand, due to the strictly designed center-locality institutional structure of the political system and the top-down nature of most policies,

implementation processes in many cases appear to be much faster than in Western countries. Regions are normally competitors with each other. They respond to the stimulus of central government by designing coherent regional policies rapidly. If the policies are successful, regions can benefit their reputation with central government. However, as regions respond to central government policy, they may find themselves in conflict with their own local stakeholders. One consequence of this is that the targets and outcomes of policy implementation, which are set and evaluated quantitatively, are incapable of reflecting the actual development of the subjects which the policies are initially targeting. The Chinese have a saying to satirize this phenomenon, 'When the upper level government has a measure, the lower level government has a countermeasure', which reflects the exact fact regarding policy implementation in China. This is the resistance side.

The cases are also interesting in that they extend to efforts to catalyze private procurement of socially desirable goods (that is, greener vehicles). The issue here is the small number of cities where subsidies for private buyers were available. Due to the size of the country and uneven status of regional development, pilot programs are frequently adopted by Chinese governments to test policies. Early examples of this approach were the special economic zones introduced by Deng Xiaoping. Today, the selection of pilot regions is more critical and challenging as regions differ in a more complicated way. Major distinctions lie not only in economic status, but also in industry structure, market demand and competitive advantage. In this NEV case, the policy for subsidizing the private consumer only targets six cities in the country. This restrains the willingness for private consumption in other localities. For instance in Jinan, according to interviewee R4O_NEV, some citizens are interested in NEVs, but are hesitating to buy because Jinan is not one of the demonstration cities for private consumer subsidies, and NEVs at their original price are far more expensive than traditional cars.

To conclude: in many ways the story of NEVs has been one of attempting to create a lead market. The problem is that only a narrow range of instruments were used to do this: a highly targeted procurement process, a limited provision of charging infrastructure and some direct subsidies (leaving aside the complex combinations of local and national support). A true lead market would be based on provision of a wider range of

favorable framework conditions, for example in the domain of regulations and standards. Part of these framework conditions should be a fully competitive procurement framework, albeit one that maintains the flow of information between supplier and purchaser. Competition between authorities to provide the right conditions for firms is a positive force, but attempts to tilt the market in favor of particular companies can lead only to inefficiency and suboptimal technological development.

NOTES

1. This definition is provided by the State Council in the NEV Industry Development Plan (2012–2020), see http://www.gov.cn/zwggk/2012-07/09/content_2179032.htm (accessed February 19, 2013).
2. The program is also called ‘Ten Cities, Thousands of NEVs’ (*Shi Cheng Qian Liang*) by practitioners in China.
3. See http://www.most.gov.cn/ztl/kjzjbxsh/kjzjbxmt/201302/t20130204_99599.htm (accessed February 19, 2013).
4. NEV procurements covered by media include Beijing: <http://auto.qq.com/a/20130103/000017.htm>; Changchun: <http://www.d1ev.com/news-7625/>; Hefei: <http://news.hf365.com/system/2012/11/22/012755689.shtml> (accessed February 19, 2013).
5. See <http://www.jinan.gov.cn> (accessed May 31, 2013).
6. See GDP ranking of Chinese cities: <http://wenwen.soso.com/z/q278620515.htm> (accessed February 19, 2013).
7. See http://www.most.gov.cn/kjbgz/200905/t20090527_69944.htm (accessed February 19, 2013).
8. See http://www.nytimes.com/2012/04/20/business/global/rural-chinese-flock-to-tiny-electric-cars.html?_r=0 (accessed May 31, 2013).
9. For example, Geely Co. Ltd, <http://www.geely.com.sa/ec8-factory.html> (accessed May 31, 2013).
10. See <http://english.sz.gov.cn> (accessed May 31, 2013).
11. See ranking of the top 25 most innovative cities in mainland China by Forbes, http://www.china.org.cn/top10/2011-10/25/content_23721744.htm (accessed May 31, 2013).
12. BYD website: <http://www.byd.com.cn/views/home/indexe.htm> (accessed May 31, 2013).
13. Wuzhoulong website: <http://www.wzlmotors.com/en/> (accessed May 31, 2013).
14. Information for this model http://en.wikipedia.org/wiki/BYD_F3DM (accessed May 31, 2013).
15. For information on the E6 model see http://en.wikipedia.org/wiki/BYD_e6 (accessed May 31, 2013).
16. ‘Report on the development indicators of NEV demonstration program participant cities (2011)’, <http://www.evtimes.cn/plus/view-32531.html> (accessed May 31, 2013).

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