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A STUDY ON LIMITATION OF GOVERNMENT INITIATIVE MODEL FOR ALTERNATIVE FUEL VEHICLE (AFV) PROMOTION IN CHINA

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Abstract

Chinese responsibility for reducing Greenhouse Gas or carbon dioxide emission increases continuously. Chinese government suggested two targets; Alternative Fuel Vehicle output volume 500 thousand and AFV market share 5% by the end of 2011. However any of two targets did not come true. Therefore this study accessed the question, 'why Chinese government initiative model for AFV promotion has been so poor?' This study reviewed the transition process for AFV policies in China and made a structural analysis for three key policies since 2009. As a result the number of articles for related industries or factor endowments was relatively more than firm strategy or demand conditions. Also this study accessed the AFV strategy of Six SOEs from the perspective of social responsibility. Six SOEs have more concentrated on electric vehicle rather than hybrid vehicle with following the government leadership. However major EV or HEV models of them mostly were made by Joint Ventures being under control of foreign makers and the JVs have actually controlled over AFV business. So the limitation of Chinese government initiative model resulted from supplier-centric approach with targeting for public transportation and institution consumer, and it caused a failure to create the demand conditions of general customers.

Keywords: China's Automobile Industry, Alternative Fuel Vehicle of China, Electric Vehicle, Hybrid Electric Vehicle

1. Introduction

Alternative Fuel Vehicle (AFV) development already became a hot topic for global automobile making business. Currently each government actively involves in AFV development & commercialization to cut down greenhouse gas (GHG) emission and reduce oil consumption by car. Since the middle of 2000s, Chinese government has also made all efforts to make its own AFV business as the global number one in manufacturing and sales volume. In fact the market position of China has gone up continuously since 2009 when it became global top country in automobile production and sales volume. In 2014 Chinese automobile production and sales volume reached 23.7 million, 23.5 million respectively and its annual growth rate was 7.3%, 6.9% each. Chinese proportion for global automobile production went up to 27.2% in 2014 from 25.3% in 2013, 22.6% in 2012. Therefore the responsibility of China for reducing GHG or carbon dioxide emission by car also increases continuously.

Chinese government suggested the "Plan on Shaping and Revitalizing Automobile Industry (*Qiche chanye tiaozhenghe zhenxing guihua*)" in March 2009 that is one of key policies to stimulate the national economy during the time of global economic depression. The plan

presented two targets; AFV production volume of 500 thousand including Electric Vehicle (EV), Plug-in Hybrid Electric Vehicle (PHEV), Hybrid Electric Vehicle (HEV) and Fuel Cell Vehicle (FCV) and the market share of AFV should be reached 5% of whole vehicle sales volume by the end of 2011. Through the Plan Chinese government intended to invest a total of 10 billion RMB for AFV R&D from 2009 to 2012. However any of two targets did not come true. The number of AFV sold in China was only 7,181 and its market share only stayed on 0.04% in 2010. The market share of AFV in China did not go over 1% in 2012. Of course it would be too early to conclude that the Plan did not succeed because AFV commercialization project requires more time and resources in China as well as in other regions to make substantial social infrastructures like energy recharging center or battery switching place.

Actually it can be said that AFV development emerged one of key issues of Chinese automobile industry in 2004 when the National Development and Reform Commission (NDRC) published "Automobile Industry Development Policy (*qiche chanye fazhan zhengce*)." Through the policy, NDRC began to emphasize the fuel efficiency improvement of gasoline engine vehicle and the development of environment friendly cars covering EV, HEV or FCV etc. As a result, it already passed ten years after issuing the policy in 2004 but the performance is still very poor. In 2014 the AFV sales volume of China was 74.8 thousand with only taking 0.3% of whole vehicle sales volume, 23.5 million.[1] It should have a long way to go the market share 5% goal for AFV in China. Now this study tries to access the problems and issues originated from the government initiative model or AFV promotion in China. Above all this study considered that there has existed a limitation caused by a recognition gap between Chinese government and AFV makers or buyers. To do so at the next chapter, this study looked into the current condition of Chinese automobile industry and reviewed previous researches regarding the AFV promotion of China. Also this study analyzed the three key policies of China to develop the EV centric AFV business by applying four factors of Diamond model[2] suggested by M. Porter at chapter three. In addition the management strategies and sales performance of big Six State Owned Enterprises (SOEs) were reviewed at chapter four. Finally this study analyzed the discrepancy between Chinese government initiative model and AFV market conditions.

2. Previous Studies for AFV and Auto Industry Development Condition of China

2.1. Previous Studies for AFV of China

As the influence of Chinese market for global automobile industry goes up continuously, the researches for AFV business of China increase too. However most of the researches have been concerned with the perspective of the national energy policy or AFV operation system rather than the AFV making business or AFV makers' strategies. Generally the topics of researches for Chinese AFV business can be classified into three categories; the AFV supplier, the AFV customer and the facilitator, that is policy maker. Firstly, the researches for AFV supplier mostly access the technology of AFV itself or related infrastructure like the electricity supply network or the recharging facility. San Roman *et al.* (2011) argued that the integrated model for EV operation and the recharging system would be a new challenge for establishing business model. In particular they got a more interest in recharging mode as well as recharging infrastructure developer. They suggested three modes for recharging, EV home charging, public charging on street, dedicated charging station, and conceptually structuralized the infrastructure developer as two market agents; the EV charging manager and the EV aggregator.

[1] In 2014, total production and sales volume for AFV reached 78.5 thousand, 74.8 thousand respectively in China, and the performance was much better than the performance of pervious year because the production volume went up by 3.5 times, and the sales volume increased by 3.2 times. Among the AFV sales of China in 2014, the EV occupied 60.2% (45 thousand), PHEV (HEV) took up 39.8% (29.7 thousand).

[2] Diamond model of M. Porter is to analyze the competitive advantage of a region or a nation for doing a specific industry. Four factors of it includes the related & supporting industries, factor endowments conditions, firm strategy & industry rivalry structure, demand conditions. Choi (2012) accessed the institution factor of Chinese automobile industry by applying four factors to key policies for automobile industry.

Li and Quyang (2011) tried to calculate an optimal charging price for EV to ensure the profit of operators as well as to reduce EV users' expenditure compared with the gasoline engine vehicles. They regarded the charging station is very hard to make profit based on current energy prices, battery technology and costs. They presented the practical ideas to improve the feasibility of charging station in China, which include making a reasonable number of chargers, jointed station alliances, multiple energy supplement system, and vehicle-to-grid technology. However regarding charging station operation, Ito *et al.* (2013) investigated the potential demand for AFV charging station through the stated preference methods for Japanese sample. The potential demand was estimated on the basis of how much people are willing to pay for AFV under various refueling scenarios. Specifically they argued the battery-exchange stations can be efficient when EV sales exceed 5.6% of all new vehicle sales volume.

As to AFV technology itself, Ou *et al.* (2010) analyzed the effectiveness of possible reduction measures by various AFVs in order to access the greenhouse gas emissions in China's road transportation and the future trend of life cycle energy demand. They suggested four specific scenarios to describe the future cases where different AFV models are introduced, and presented policy implementation for the sustainable biofuel and high efficient EVs, and the low-carbon technology based coal fuel vehicles. Yao *et al.* (2011) argued that technology innovation in conventional gasoline or diesel vehicles is the most realistic, effective, and timely solution for China to meet the urgent challenges of energy saving and greenhouse gas reduction in a short time. But they suggested the biofuel would be a promising model because of the renewability and carbon neutrality in the long term. In addition, Shen *et al.* (2012) carried out a well-to-wheels life cycle analysis on total energy consumptions and greenhouse gas emissions for alternative fuels from 2010 to 2020 based on the estimates that specifically developed for Chinese transportation condition. The alternative fuels covered gasoline, diesel, natural gas, liquid fuels from coal conversion, methanol, biodiesel, electricity and hydrogen. As a result, they regarded the sustainable reduction of carbon emission would be assured only when the needed electricity is generated by zero or low carbon sources rather than by fossil fuels.

Secondly regarding the customer of AFV, Zhang *et al.* (2011) tried to access customers' awareness toward EV and examine the factors that are most likely to affect customers' decision making for EV in China. They conducted a questionnaire survey with 299 respondents from many driving schools in Nanjing. As a result they suggested key variables for three questions; which factors mainly affect customers' decision making on EV purchase, when customers intend to buy EV, and the reasonable price that customers assume for EV purchase. Zheng *et al.* (2012) reviewed the AFV demonstration program for pilot thirteen cities of China through the World Bank sponsored survey for local chief managers or engineers of the program during the summer of 2009. The survey focused on questions for six areas; goals and objectives of each city to participate in the program, AFV deployment plan, financial plan, monitoring and evaluation, challenges and risks, communication and collaboration. Through the survey, they examined the actual status for AFV deployment of each city and found out various obstacles of the demonstration program as well as suggested four recommendations to improve the performance of the program.

Thirdly, from the perspective of policy maker, Chinese government has actively taken an initiative in promoting the AFV supply project. Choi (2013) deeply took a notice of the expansion of government role in restructuring process for Chinese automobile industry even though there existed a dilemma of government intervention. Based on the five competitive forces model by M. Porter, he considered the AFV supply project as the increase of substitute threat as well as a great opportunity for new vehicle maker to emerge. Furthermore Choi (2013) estimated the structure change direction of Chinese automobile industry through the analysis for main policies and various performance index, and presented two critical issues concerning the government initiative model for the AFV business.

Zhang *et al.* (2011) traced the Chinese policy trend for AFV supply project by suggesting policy backgrounds of AFV projects and summarized main ideas and targets of them for each Five-Year Plan since early 1990s. Yang (2010) presented some beneficial policy ideas in fostering the EV promotion from the lesson regarding electric bike commercialization and

restriction policies of China. In particular, Yang (2010) thought the experience of China's electric bike boom as a success case due to the visible performance of limiting policies for the fossil-fueled alternatives, and argued that subsidies alone would not be a sufficient policy to increase the EV demand from the failure case of Taiwan's electric scooter policies. Now this study tried to differentiate itself by tracing the gap between AFV suppliers, that is Six SOE vehicle makers between Chinese government in accessing the AFV business. In particular the structure analysis of this study for three key policies will make a big contribution to grasp Chinese government position more precisely by understanding the specific contents of each policy.

2.2. Auto Industry Development Condition of China

The influence of China for global automobile industry has gone up continuously as its vehicle manufacturing capability and the market size increase simultaneously. The vehicle production & sales volume of China surpassed 10 million in 2009, and went over 20 million in 2013. The annual average growth rate for vehicle sales of China for last ten years, from 2004 to 2014 reached 16.5% but the annual average growth rate for recent five years since 2009 was 11.5%, which means that the annual growth speed has been relatively slow after vehicle market size went over 10 million in 2009. The passenger car making business has played a substantial role for the development of automobile industry of China. The number of passenger car production & sales volume of China was 19.9 million, 19.7 million respectively in 2014[3], and the passenger car ratio reached 84.0%, 83.9% each. Considering that fact that passenger car ratio of China was 71.6% in 2007, 76.2% in 2010, it will exceed 90% at around 2020.

Major vehicle makers of China were, so called the big 'Six SOEs,' SAIC (Shanghai Automotive Industry Corporation), DFMC (Dongfeng Motor Corporation), FAW (First Automobile Works), ChangAn (Chongqing ChangAn Automobile Corporation), BAG (Beijing Automotive Group Corporation) and GAIG (Guangzhou Automobile Industry Group) have substantially controlled over Chinese vehicle making business. The sum of their market shares in China went up to 79.2% in 2014 from 75.1% in 2011, 70.5% in 2007 (Table 1). These Six SOEs have maintained top six positions successively in the market share ranking of China for last ten years since 2004. Since early 1990s' Six SOEs have expanded continuously their own regional basis through Chinese local governments' supports and the alliances partnership with global automobile makers like GM, Toyota, Volkswagen (Choi 2014). SAIC occupied 23.8% of whole vehicle sales volume of China in 2014, and DFMC (16.2%), FAW (13.1%) followed it (Table 1). The market share of ChangAn, BAG, GAIG was 10.8%, 10.2%, 5.0% each in 2014. As time goes on, the market dominance of SAIC more and more increases with more widening the market share gap with other rivals.

[3] In 2014 among passenger car sales of China, the sales volume of sedan was 12.4 million (62.8%), the sales of MPV (multiple purpose vehicle) was 1.9 million (9.7%), the sales of SUV was 4.1 million (20.7%) and the sales of CUV (crossover utility vehicle) was 1.3 million (6.8%).

Table 1. Automobile sales volume trend for top ten makes of China (10 thousand, %)

Rank	2014			2013			2012			2011			2010		
	Maker	Sales volume	Market share	Maker	Sales volume	Market share	Maker	Sales volume	Market share	Maker	Sales volume	Market share	Maker	Sales volume	Market share
1	SAIC	558.4	23.8	SAIC	507.3	23.1	SAIC	446.1	23.1	SAIC	396.6	21.4	SAIC	356.4	19.7
2	DFM	380.3	16.2	DFM	353.5	16.1	DFM	307.9	15.9	DFM	305.9	16.5	DFM	261.5	14.5
3	FAW	308.6	13.1	FAW	290.8	13.2	FAW	264.6	13.7	FAW	260.1	14.1	FAW	255.8	14.2
4	ChangAn	254.8	10.8	ChangAn	220.3	10.0	ChangAn	195.6	10.1	ChangAn	200.9	10.9	ChangAn	238.6	13.2
5	BAG	240.1	10.2	BAG	211.1	9.6	BAG	169.1	8.8	BAG	152.6	8.2	BAG	149.0	8.2
Top Five Sum		**1,742.1**	**74.2**		**1,583.1**	**72.0**		**1,383.3**	**71.7**		**1,316.1**	**71.1**		**1,261.3**	**69.8**
6	GAIG	117.2	5.0	GAIG	100.4	4.6	GAIG	71.2	3.7	GAIG	74.0	4.0	GAIG	72.4	4.0
7	Huachen	80.2	3.4	Huachen	77.7	3.5	Huachen	63.8	3.3	Chery	64.2	3.5	Chery	68.2	3.8
8	GWM	73.1	3.1	GWM	75.4	3.4	GWM	62.5	3.2	Huachen	56.7	3.1	BYD	52.0	2.9
9	Chery	48.6	2.1	Geely	54.9	2.5	Chery	56.3	2.9	JAC	49.5	2.7	JAC	45.5	2.5
10	JAC	46.5	2.0	JAC	50.7	2.3	Geely	49.1	2.5	GWM	48.7	2.6	Huachen	44.7	2.5
Top Ten Sum		**2,107.7**	**89.7**		**1,942.3**	**88.3**		**1,686.3**	**87.3**		**1,609.1**	**87.0**		**1,544.1**	**85.5**

Source: China Automotive Industry Yearbook 2011 (pp. 469-470), China Automotive Industry Yearbook 2012 (pp. 480-481), China Automotive Industry Yearbook 2013 (pp. 489-490), China Automotive Industry Yearbook 2014 (pp. 392-393), China Association of Automobile Manufacturers.

Table 2 Passenger car sales volume trend for top ten makes of China (10 thousand, %)

Rank	2014			2013			2012			2011			2010		
	Maker	Sales volume	Market Share	Maker	Sales volume	Market Share	Maker	Sales volume	Market share	Maker	Sales volume	Market share	Maker	Sales volume	Market share
1	FAW VW	178.1	9.0	SGM	154.3	8.6	SGM	136.4	8.8	SGM Wuling	121.8	8.4	SGM Wuling	113.6	8.3
2	SVW	172.5	8.8	SVW	152.5	8.5	FAW VW	132.9	8.6	SGM	118.6	8.2	SGM	101.2	7.4
3	SGM	172.4	8.8	FAW VW	151.3	8.4	SGM Wuling	132.3	8.5	SVW	116.6	8.1	SVW	100.1	7.3
4	SGM Wuling	158.6	8.1	SGM Wuling	142.6	8.0	SVW	128.0	8.3	FAW VW	103.5	7.2	FAW VW	87.0	6.3
5	Beijing Hyundai	112.0	5.7	Beijing Hyundai	103.1	5.7	Beijing Hyundai	86.0	5.5	DFM Nissan	80.9	5.6	ChangAn	71.0	5.2
Top Five Sum		**793.6**	**40.3**		**703.7**	**39.2**		**615.5**	**39.7**		**541.3**	**37.4**		**472.9**	**34.4**
6	ChangAn	97.3	4.9	DFM Nissan	92.6	5.2	DFM Nissan	77.3	5.0	Beijing Hyundai	74.0	5.1	Beijing Hyundai	70.3	5.1
7	DFM Nissan	95.4	4.8	ChangAn	82.2	4.6	Changan	60.4	3.9	Chery	63.4	4.4	Chery	67.5	4.9
8	ChangAn Ford	80.6	4.1	ChangAn Ford	68.3	3.8	Chery	56.3	3.6	ChangAn	54.3	3.8	DFM Nissan	66.1	4.8
9	Dongfeng PSA	70.4	3.6	GWM	62.7	3.5	FAW Toyota	49.6	3.2	FAW Toyota	52.9	3.7	BYD	52.0	3.8
10	Dongfeng KIA	64.6	3.3	FAW Toyota	56.0	3.1	Changan Ford	49.4	3.2	BYD	44.9	3.1	FAW Toyota	50.6	3.7
Top Ten Sum		**1,202.0**	**61.0**		**1,065.5**	**59.4**		**908.4**	**58.6**		**830.8**	**57.4**		**779.4**	**56.6**

Source: China Automotive Industry Yearbook 2011 (pp. 469-470), China Automotive Industry Yearbook 2012 (pp. 480-481), China Automotive Industry Yearbook 2013 (pp. 489-490), China Automotive Industry Yearbook 2014 (pp. 392-393), China Association of Automobile Manufacturers (www.caam.org.cn)

Another noticeable thing is that the market share sum of top ten makers goes up continuously because it reached 89.7% in 2014 from 85.5% in 2010, 83.1% in 2007. So the level of market concentration for vehicle making business of China has increased constantly. Except Six SOEs among top ten makers of China, the makers of 7th ~ 10th place have changed by every year since 2004. Therefore it can be argued that the level of rivalry to enter top ten raking, more exactly to say, to occupy 7th ~ 10th place has been more severe than the level of rivalry among Six SOEs. In other words, the entry barrier for top six position has been much higher than the entry barrier for top ten position in China. Except Six SOEs, Chery, BYD, Geely, JAC (Jianghuai Automobile Corporation), GWM (Great Wall Motors), and Huachen Auto Group (Brilliance Auto) have competed each other to join top ten ranking.

However the level of competition for passenger car market is more intensive than the competition level for whole automobile market in China. For recent five years, the market share sum of top five passenger car makers went up to 40.3% in 2014 from 34.4% in 2010, and the share sum of top ten makers reached 61% in 2014 from 56.6% in 2010 (Table 2). But the market concentration degree of major passenger car makers was lower than the concentration degree of whole vehicle making business. In 2014 top four passenger car makers in China included FAW VW (Volkswagen), SVW (Shanghai Volkswagen), SGM (Shanghai GM) and SGM Wuling, and their market shares were laid on 8.1~9.0%. In fact it can be said that their market influence has increased continuously because any other makers except them did not enter top four place of passenger car sales volume in China since 2007. In particular, most of top ten passenger car makers were Joint Ventures (JVs) between SOEs and MNEs (Multinational Enterprises), so the passenger car market of China has been actually under control of global makers like GM, Toyota, Volkswagen, Nissan or Hyundai.

Table 3. Sales volume trend of global major regions for EV (PHEV) and HEV (unit)

Region	AFV Type	2009	2010	2011	2012	2013
Japan	HEV	349,570	482,700	455,700	863,000	838,500
	EV (PHEV)	990	2,600	13,660	26,800	30,900
	Sub-total	350,560	485,300	469,360	889,800	869,400
United States	HEV	292,500	275,000	276,500	434,500	495,700
	EV (PHEV)	-	330	18,300	53,400	101,400
	Sub-total	292,500	275,330	294,800	487,900	597,100
Europe	HEV	84,700	101,500	103,500	127,000	173,000
	EV (PHEV)	238	802	11,500	27,000	67,000
	Sub-total	84,938	102,302	115,000	154,000	240,000
China	HEV	900	1,490	2,580	1,416	3,038
	EV (PHEV)	4,300	5,691	5,579	11,375	14,604
	Sub-total	5,200	7,181	8,159	12,791	17,642
Other Regions	HEV	31,900	83,400	75,900	168,000	200,000
	EV (PHEV)	90	1,100	2,600	8,000	12,000
	Sub-total	31,990	84,500	78,500	176,000	212,000
Global Total	HEV	759,570	944,090	914,180	1,593,916	1,710,238
	EV (PHEV)	5,618	10,523	51,639	126,575	225,904
	Sub-total	765,188	954,613	965,819	1,720,491	1,936,142

Source: KAMA (2014 (a), p. 3), China Automotive Industry Yearbook 2010 (pp. 10-11), China Automotive Industry Yearbook 2014 (p. 372)

Now if looking at the AFV sales performance of China, it does not go beyond a mere window dressing display yet. In 2014 the total number of EV, PHEV and HEV sales in China went up to 74,763 with increasing rate 324% compared with former year but its ratio was only 0.3% of total vehicle sales volume (23.5 million) of China. Actually the sales performance of China for EV (PHEV) and HEV has been very poor if compared with the sales performances other regions. In 2013 the sales volume of Japan and United States for EV and HEV reached 838.5 thousand, 597.1 thousand respectively but Chinese sales volume was only 17.6 thousand which being only 2% of the sales volume of Japan (Table 3). For recent five years, from 2009 to 2013, the average annual growth rate (CAGR) of Japan, United States, Europe for EV and HEV was 25.5%, 19.5%, 29.7% separately, and the annual growth rate of China was 35.7%. Global sales volume for EV and HEV went up to 1.94 million in 2013 from 0.76 million in 2009 and the annual growth rate was 26.1%. It can be said that the growing speed of China for EV and HEV sales is relatively faster than other regions but its influence is still very weak.

Currently the main type of AFV at the global automobile industry is not EV but HEV. In fact HEV has already successfully entered an initial stage of the commercialization as well as taken the majority proportion of electric car sales volume. In 2013 HEV ratio in Japanese market reached 96.4%, and HEV ratio for the United States, Europe was 83.0%, 72.1% respectively. However the HEV ratio of China was only 17.2% due to a much higher ratio of EV (PHEV). It can be inferred that Chinese government has put a more emphasis on EV rather than HEV even though it was not yet the mainstream AFV model globally (China Association of Automobile Manufacturers, 2013, pp.60-61). Considering the fact that Japanese makers like Toyota, Honda has taken a strong leadership for the HEV sales performance.[4] Chinese government might want to avoid the scenario for its AFV market being under control of Japanese makers.[5] At (Table 3), for recent five years Japanese domestic market has occupied almost 50% of global HEV sales, and the United States followed it with taking around 30% share. Therefore Chinese government has made all efforts to establish a new standard for EV operation on the basis of its own big sized domestic market (China Association of Automobile Manufacturers, 2009, pp.58-59). The operation of EV requires the expansion of government role because it is a sort of comprehensive business model with covering the electricity network, recharging center design and civil engineering beyond just a vehicle making business (China Association of Automobile Manufacturers 2011, pp.24-25).

Table 4. Sales ratio trend of EV (PHEV) & HEV for total vehicle sales volume of each region (%)

Region	2009	2010	2011	2012	2013
Japan	7.61	9.79	11.15	16.57	16.17
United States	2.76	2.34	2.26	3.30	3.76
Europe	0.53	0.64	0.61	0.86	1.37
China	0.04	0.04	0.04	0.07	0.08

Source: KAMA (2014a, p. 3), KAMA (2014b, p. 6).

Until 2013 the overall sales performance of China for EV & HEV was so poor as to its proportion did not reach 1% of whole vehicle sales volume (Table 4). But the sales proportion of Japan reached 16.2% in 2013. In spite of Chinese government's aggressive stance to promote EV rather than HEV, its relative influence on the global EV market has been weak gradually for recent five years. At the global EV sales volume, Chinese proportion reached 54.1% in 2010, but it went down to 10.8% in 2011, 6.5% in 2013. The United States has emerged as the biggest

[4] Toyota took 72% of global HEV sales volume and Honda also occupied 15% share of HEV market in 2013 (KAMA, 2014a, p.3).

[5] In fact since 2010 Chinese government has supported 60 thousand RMB, 50 thousand RMB as a financial aid for buying an EV or a PHEV respectively but the financial aid for a HEV has been only 3 thousand RMB (China Association of Automobile Manufacturers, 2011, p.41; Choi, 2013).

market of EV (PHEV) since 2011, and its sales proportion went up to 45% in 2013.[6] Consequently it can be argued that government initiative model of China for AFV commercialization was rarely effective at least for recent five years. However Chinese government still maintains the EV or PHEV oriented incentive policies rather than HEV. There have been many arguments regarding which type of AFV should be a mainstream in China but it does not yet go ahead enough to be made as a policy (China Association of Automobile Manufacturers, 2012, pp.265-266).

3. Chinese Government Approach for AFV

The AFV development plan firstly emerged on the Eighth Five-Year Plan (1991~1995)[7] among lots of industrial policies of China (Zheng *et al.*, 2012, p.18). Ministry of Science & Technology (MOST) of China began to emphasize the necessity for 'R&D on the Key Technologies of EV' while regarding it as one of national key scientific and technological projects. Through the Ninth Five-Year Plan (1996~2000) period, the MOST promoted the 'National Clean Automobile Action' program together with other twelve governmental organizations while managing EV development as a mid-term or long-term project that needs at least 5~10 years. Furthermore MOST included the 'EV key project' in the national 863 program and considered the EV technology as a main direction of vehicle technology innovation during the Tenth Five-Year Plan (2001~2005) period (Zheng *et al.*, 2012, p.18). At the Eleventh Five-Year Plan (2006~2010), the MOST more intensified EV R&D activities with investing a total of 2 billion RMB as the 'Alternative Fuel Vehicles' Key Project' of the 863 program and began to search for general consumers' market beyond the institution customer for EV.

However NDRC also emphasized the necessity for the development of environment friendly vehicles including EV, HEV, FCV, Concentrated Natural Gas (CNG) as well as the fuel efficiency improvement through the article eight ~ twelve in the Part Three, Technology Policy of the 'Automobile Industry Development Policy (*qiche gongye fazhan zhengce*)' announced in 2004 (China Association of Automobile Manufacturers, 2005, pp.14-15). In addition NDRC published the 'Management Code for New Energy Automobile Manufacturing Standard (*xinnengyuan qiche shengchan zhunru guanli guize)*' in October 2007 (China Association of Automobile Manufacturers, 2009, p.44). Four ministries of Chinese central government, not only MOST, NDRC but also Ministry of Finance (MOF), Ministry of Industry and Information Technology (MIIT) had jointly carried out the 'National Fuel Saving & Alternative Fuel Vehicle Mass Supply Project (*guojia jienengyu xinnengyuan qiche daguimo tuiguang yingyong gongcheng*)' in other words, 'One Thousand EV for Each of Ten Cities (*shi cheng qian liang gongcheng*)' from January 2009 to December 2012.[8] The original goal of this project was at least one thousand AFV should be operated in thirteen major cities including Shanghai, Beijing, Chongqing, Shenzhen, Wuhan, Changchun, Hangzhou, Kunming, Jinan, Hefei, Nanchang, Dalian, Changsha, and its target ratio should be 10% of whole new vehicles by 2012 (China Association of Automobile Manufacturers, 2010, pp.10-11).

As a supplementary form of the 'Notice about the Demonstration Program of Promoting Energy Efficient and Alternative Fuel Vehicles (*guanyu kaizhan jienengyu xinnengyuanqiche shifan tuiguang shidian gongzuode tongzhi*)', MOF and MOST also made an announcement in January 2009 'Tentative Management Process of Financial Support for Fuel Saving and Alternative Fuel Vehicle Demonstration (*jienengyu xinnengyuan qiche shifan tuiguang caizheng*

[6] In 2013 Nissan was the biggest EV (PHEV) maker globally with occupying 22.2% share (about 50 thousand vehicle) of global sales volume, and Mitsubishi (13%), GM (13%), Tesla (12%), Renault (11%) and Toyota (10%) followed Nissan.

[7] Since the 'Reform and Open Door (*gaige kaifang*)' policy in 1978, Chinese government has updated its targets and general plans for national economy development by every five year. Currently the 12th Five-Year Plan goes on from 2011 to 2015.

[8] In fact the policy background for the 'National Fuel Saving & Alternative Fuel Vehicle Mass Supply Project' was the 'Notice about the Demonstration Program of Promoting Energy Efficient and Alternative Fuel Vehicles (*guanyu kaizhan jienengyu xinnengyuanqiche shifan tuiguang shidian gongzuode tongzhi*) announced by MOF and MOST on January 23 2009.

buzhu zijin guanli zanxing banfa)' in order for expanding tentative operation areas for HEV and EV, and primarily supplying them to public transportation and administrative agencies. Furthermore the General Office of Chinese State Council published the 'Plan on Shaping and Revitalizing Automobile Industry (*Qiche chanye tiaozhenghe zhenxing guihua*)[9]' in March 2009 which covered AFV production target of 500 thousand as well as AFV market share 5% by the end of 2011 (China Association of Automobile Manufacturers, 2010, p.8).

However, overall policy trend of China for AFV commercialization has been inclined toward EV rather than HEV and it has been pushed ahead by the government leadership rather than the private sector's initiative (China Association of Automobile Manufacturers, 2014, p.274). Now this study analyzed the policy structure and main contents by looking into three key policies for AFV commercialization since 2009. Those polices include 'Tentative Management Process of Financial Support for Fuel Saving and Alternative Fuel Vehicle Demonstration' announced in 2009 (the following called, the 2009 Policy), 'Energy Efficiency and AFV Industry Development Plan 2012~2020 (*jienengyu xinnengyuanqiche chanyefazhan guihua 2012~2020nian*) presented in 2012 (the following called, the 2012 Policy), and 'Guidance Opinion to Facilitate AFV Demonstration Project (*guanyu jiakuai xinnengyuanqiche tuiguangyingyongde zhidao yijian*)' announced in 2014 (the following called, the 2014 Policy).

The reason for taking more interest in the policies or plans announced after 2009 is the actual start-up of AFV business of China was done after that time. In order to analyze above three policies' structures and main ideas, this study classified the articles of each policy into four categories; Related industries article (R), Strategies of firm and structure of industry article (S), Factor endowments article (F), Demand condition article (D). Basically the content of each article should be covered by a category, but some articles would have double categories.[10] The original idea for those four categories came from the Diamond model by M. Porter (1990) to access the competitive advantage factors of an industry for a specific region or nation. So this study assumed that an organic and integrated structure among four factors would be also very important for the effectiveness of AFV policies in China.

Firstly, the 2009 Policy was composed of seven parts; 'General Rule,' 'Support Object and Method,' 'Support Condition,' 'Support Criteria,' 'Financial Support Application & Allocation,' 'Financial Support Control and Management,' 'Additional Rule' (Figure 1), and it had total seventeen articles. Chinese government presented the major AFV objects of financial support at the article four of Part Two, and the specific conditions & criteria of AFV that can be a supportable object at the article seven of Part Three, and article eight of Part Four. However among total twenty-two items of the 2009 Policy for classifying categories, the number of items for related industries of AFV was thirteen (62%). On the other hand, the number of items for factor endowments and the items for firm strategy & industry structure turned out to be only four respectively (Figure 2). There was nothing for demand condition item. That means Chinese government had much more interest in promoting the AFV related industries like recharging center construction, electrical grid or power plant operation for the demonstration plan.

[9] The main object of the plan was to facilitate the national economy recovery by Auto industry restructuring during the global economy depression period caused by the financial crisis happened at the United States in 2008.

[10] In fact some articles take very broad contents enough to cover four categories; related industries, strategies of firms, factor endowments, demand condition. But this study picked up only two key categories among them.

Figure 1. Structure analysis for 'tentative management process of financial support for fuel saving and alternative fuel vehicle demonstration' in 2009

1. General Rule
1. Policy Background & Goal **(R)**
2. Main Type of Fuel Saving & Alternative Fuel Vehicles **(S, F)**
3. Basic Principle for Financial Support **(R)**

2. Support Object and Method
4. Major Object of Financial Support **(R)**
5. One Time Subsidy Provision Rule **(R)**
6. Exclusive Purpose of Financial Support **(R)**

3. Support Condition
7. Specific Condition of Vehicle As a Support Object **(S, F)**
8. Obligation of Organization for Demonstration Project **(R)**

4. Support Criteria
9. Specific Criteria to Evaluate Fuel Saving & Alternative Fuel Vehicle **(S, F)**

5. Financial Support Application & Allocation
10. Financial Support Application Documents **(R)**
11. Financial Support Application & Evaluation Process **(R)**
12. Reporting Obligation of Local Government for Financial Support **(R)**
13. Financial Allocation Process of Central Government **(R)**

6. Financial Support Control and Management
14. Following-Up Control System for Financial Support **(R)**
15. Disciplinary Procedure for Violating Organization **(R)**

7. Additional Rule
16. Final Interpretation Entity; Ministry of Finance (MOF) and Ministry of Science & Technology (MOST) **(R)**
17. Activation Time for Various Types of Vehicle **(S, F)**

Figure 2. Structure analysis for 'energy efficiency & AFV industry development plan (2012~2020)' in 2012

1. Development Condition & Trend
→ **(S, F)**

2. Leading Ideology & Basic Principal
1. Leading Ideology (R)
2. Basic Principal (R, S)

3. Technology Route & Main Target
1. Technology Route (S, F)
2. Main Target
1) Performance of Industrialization **(S)**
2) Economics of Fuel Efficiency **(F, S)**
3) Technology Upgrade **(F)**
4) Complementary Relationship **(R)**
5) Management System **(R)**

4. Major Mission
1. Fuel Efficiency & AFV Technology Innovation Project
1) R&D for Core Technology of AFV **(F)**
2) R&D for Fuel Efficiency **(F)**
3) R&D System for Fuel Efficiency & AFV Technology **(F, S)**
2. Scientific Planning for Industrial Condition
1) AFV Production Capability **(S)**
2) Rechargeable Battery Manufacturing Cluster **(F, R)**
3) AFV Core Component Production Capability **(F, R)**
3. Application & Demonstration Region Expansion
1) AFV Demonstration Project Building Up **(D, R)**
2) Fuel Efficiency Vehicle Supply Expansion **(S, R)**
3) Development Potential for Various Fuel Sources Car **(F, R)**
4. Charging Station Construction
1) General Development Plan Making **(R, D)**
2) R&D for Charging Station Core Technology **(R)**
3) Business Model Development **(R)**
5. Electric Battery Reuse & Recovery Management (R)

5. Guarantee Measure
1. Institution for Standardization System & Entry Control **(S, R)**
2. Financial Support & Tax Preferential Treatment **(S, D)**
3. Banking Service Support **(S, R)**
4. Industry Development Friendly Environment **(S, F)**
5. Human Resources Training **(F, R)**
6. International Cooperation Synergy **(F, R)**

6. Plan Implementation (R)

Secondly, the 2012 Policy was organized by six parts; Development Condition & Trend, Leading Ideology & Basic Principle, Technology Route & Main Target, Major Mission, Guarantee Measure, Plan Implementation (Figure 2). Key ideas of the 2012 Policy were mostly put on Part Four, 'Major Mission' that includes five sub-topics as well as thirteen sub-articles. The five sub-topics cover 'AFV Technology Innovation Project,' 'Scientific Planning for Industrial Condition,' 'Demonstration Region Expansion,' 'Charging Station Construction,' 'Electric Battery Reuse & Recovery Management.' It can be said that the 2012 Policy was not only a revision for previous policies but also a comprehensive planning which taking a more scientific & detailed approach from a long-term perspective. In addition the 2012 Policy presented very specific targets in order to facilitate the AFV technology innovation by mentioning the industrialization performance, economies of fuel efficiency, technology upgrade, complementary relationship and management system at the Part Three. Therefore if considering the fact that the 2012 Policy continues until 2020, it will play a backbone role for other related policies in future.

As for the 2012 Policy, not only its scope but also its focus changed. Among total forty-six items, the number of items for AFV related industries was eighteen (39%), the number of items for factor endowments was thirteen (28%), and the number of item for firm strategy & industry structure was twelve (26%). The relative proportion of related industries decreased but the number of items for demand condition was still only three (7%). Overall the 2012 Policy took a more balanced approach for four categories than the 2009 Policy, and it would be a significant change that most items of 'Major Mission' of Part Four were concerned with the AFV production factors or makers' strategies. However it still rarely reflected the general customers' demand beyond the public transit or institution demand.

Figure 3. Structure Analysis for 'Guidance Opinion to Facilitate AFV Demonstration Project' in 2014

1. General Requirement
1. Leading Ideology **(R)**
2. Basic Principle **(R)**

2. Recharging Facility Construction
3. Recharging Facility Development Plan & Technology Standard **(R, F)**
4. City Plan & Corresponding Standard **(R, D)**
5. Recharging Facility Land Policy **(R, D)**
6. Electric Price Policy **(R, D)**
7. Recharging Facility Core Technology Breakthrough **(F)**
8. Recharging Facility Expansion for Public Institutions' Parking Lot **(R, D)**
9. Recharging Facility Construction Responsibility **(R)**

3. Firm Innovative Business Model
10. Post Sale Management System **(D, S)**
11. Investment & Finance System Innovation **(S, R)**
12. Synergy with Information Technology **(S, R)**

4. Leading Effect of Public Service
13. AFV Operation Expansion for Public Service **(D, R)**
14. AFV Operation Expansion for Firm, Administration & Party **(D, R)**

5. Policy System Upgrade
15. AFV Subsidy Policy **(S, D)**
16. Public Transportation Energy Price Subsidy **(S, D)**
17. Tax Benefit Policy for AFV **(S, D)**
18. AFV R&D Funding Route Diversification **(F, S)**
19. AFV Banking Service System **(R, D)**
20. New AFV Maker Entry Policy **(S)**
21. Each Maker's Fuel Efficiency Control System **(S)**
22. AFV Operation Policy Differentiation **(S)**

6. Eradication of Regional Protectionism
23. Integrated Standard & List **(S, R)**
24. Normative Market Order **(S, R)**

7. Technology Innovation and Quality Control
25. Technology Breakthrough Support **(F, S)**
26. Industry Technology Innovation Project **(F, S)**
27. AFV Quality Guarantee System **(F, D)**

8. Organization Initiative Capability
28. Initiative Capability of Local Government **(R)**
29. Inter-Departments' Cooperative Capability **(R)**
30. Public Advertisement & Public Relation Control **(D,S)**

Thirdly, the 2014 Policy was composed of eight parts; 'General Requirements,' 'Recharging Facility Construction,' 'Firm Innovative Business Model,' 'Leading Effect of Public Service,' 'Policy System Upgrade,' 'Eradication of Regional Protectionism,' 'Technology Innovation & Quality Control,' 'Organization Initiative Capability' (Figure 3). The 2014 Policy is to compensate for the insufficient points of the 2012 Policy, especially for the general users' demand. The Part Two, 'Recharging Facility Construction' as well as the Par Four, 'Leading Effect of Public Service' and the Part Five, 'Policy System Upgrade' are closely concerned to satisfy the general customers' needs. In addition at the Part Two, Chinese government presented very specific action plan for operating the recharging center in order to substantially improve general users' convenience. The supporting system for general users at the Part Five became a more realistic and user friendly one, and it began to look into each AFV maker's value chain from the business profitability perspective. In particular three articles at the Part Three, 'Firm Innovative Business Model' aimed to support the AFV makers' business activities through the web-based working process innovation. Also the Part Six, 'Eradication of Regional Protectionism' was for helping AFV makers accomplish the economy of scale by facilitating a nationwide domestic market development.

Table 5. Structure analysis result for three major promotion policies for AFV of China

Major Promotion Policies for AFV	R (Related Industries)	F (Factor Endowments)	S (Strategy & Structure)	D (Demand Conditions)	Total Items
1. Tentative Management Process Fuel Saving & AFV Demonstration in 2009	13 (62%)	4 (19%)	4 (19%)	0	22 (100%)
2. Energy Efficiency & AFV Industry Development Plan(2012~2012) in 2012	18 (39%)	13 (28%)	12 (26%)	3 (7%)	46 (100%)
3. Guidance Opinion to Facilitate AFV Demonstration Project in 2014	17 (33%)	6 (12%)	15 (29%)	13 (26%)	51 (100%)

As for the 2014 Policy, the number of items for demand conditions was thirteen (26%) among total fifty-one items, and the number of items for firm strategy & industry structure was fifteen (29%). Finally the proportion of items for AFV makers and users went over 50% of whole items but the proportion of items for related industries was still 33%. Overall the relative proportion for related industries continuously reduced but the proportion for firm strategy & industry structure or the proportion for demand conditions has gone up constantly (Table 5). It can be argued that Chinese government began to sincerely consider the general users' requirement or each maker's business model as a key success factor of the AFV promotion policy.

4. Six SOE Vehicle Makers' Approach for AFV

In response to many AFV promotion policies, most of Chinese vehicle makers have tried to launch various AFV models and develop it as a new business through the product diversification strategy. Currently lots of global automobile makers manage the AFV development from the social responsibility (SR) perspective. At the vehicle making business, AFV development already became a kind of 'must do' issue rather than a selective one in order to reduce greenhouse gas emission and gasoline consumption. Such a CSR approach became a general consensus in the automobile making business although which type of energy will substitute gasoline is still a controversial question for most of automobile makers.

Therefore, this study investigated the social responsibility (SR) reports of Six SOEs to check how Chinese vehicle makers manage the AFV business as an important topic of SR strategy. The major characteristics for AFV development condition of Six SOEs can be summarized as below four points (Figure 4). Firstly, the concept car launch or R&D goals of AFV has been oriented for the pure electric vehicle but actual sales occurred at the HEV business. SAIC released Roewe EV model (E50) and SGM Sail EV but the sales volume was only 409, 69 respectively in 2013. However HEV sales volumes including Roewe 750 HEV or SVW Santana HEV were more than EV. FAW also released various EV models like Weizhi EV, Oley EV or Besturn B50 EV but did not open any specific sales information of them. It can be inferred that most of EV models rarely went beyond a pilot production step.

Secondly, most of key models for EV, HEV were released by alliances partners that are Joint Ventures (JVs) of Six SOEs. As for DFMC, Nissan LEAF or Venucia EV are main models of AFV business, and Beijing Hyundai EV (E150), GAC Toyota Camry HEV, Guangqi Honda Accord HEV are also representative models for BAG and GAIG. In result it can be argued that foreign makers' influence on Chinese AFV business is still very strong like gasoline engine vehicle business in spite of the active intervention of Chinese government for AFV promotion.

Figure 4. AFV Development Condition & Strategies of Six SOE Makers from CSR Perspective

	Main Model (Sales in 2013)	CSR Approach	Main Target & Strategy
SAIC	Roewe 750 HEV(843), Nanjing R750 HEV(387), Roewe E50 EV (409), Roewe 550 Concept PHEV & FCV, SGM Sail EV(69), SGM Lacrosse HEV(350), SVW Santana HEV (9,015)	Environment & energy issue, Collaborate R&D, 'Goal-R&D-Performance' description, Responsive to government plan	During 12.5 Plan (2011~2015) Chinese AFV Market Share of SAIC 20%, R&D for EV, HEV, FCV, Passenger Car oriented
FAW	Weizhi EV, Oley EV, Besturn B50 EV, Besturn B50 PHEV, Besturn B50 HEV, Hongqi H7 PHEV, FAW-Toyota VIOS EV	Five Steps for green environment, R&D activities & AFV launch or Manufacturing plan centered description	Fuel Efficiency Improvement (20~30%) Target, EV focused R&D activity rather than HEV, FCV, Passenger Car oriented
DFMC	Dongfeng Nissan Venucia EV(216), Venucia e30 EV, Concept EV Viwa, Nissan EV 'LEAF' Taxi Demonstration	New Energy Vehicle Launch Plan '9+7 Project,' Zero Emission oriented R&D activity, Responsive to government plan	Two Tracks(V Blue) Plan; AFV & fuel efficiency improvement, Pure EV is a key goal but HEV(PHEV) are interim steps
ChangAn	Chongqing ChangAn CX30 EV (117), Aisvin LPG (315), E30 EV	Environment friendly & fuel efficiency vehicle R&D, but specific plan or strategy for it is very weak from CSR point	Passenger car EV focused R&D activity but specific sales target is very few, Active follower for government demonstration plan
BAG	Beijing Hyundai Concept EV BDCD-1 (100), E150 EV (1466), Concept EV C70GB & C30DS, Concept HEV 301BSG	Environment friendly & green management issue, Key task for sustainable growth, Emphasize user experiences for AFV launch	Diversified R&D strategies for AFV, Passenger car focused concept cars but commercial vehicles based performance
GAIG	GAC Toyota Camry HEV (5,547), Guangqi Bus HEV, Guanggi Honda HEV	Environment friendly vehicle, Industry ecosystem with HEV parts suppliers, Responsive to government plan	Synergy effect from Japanese alliance partners; Toyota & Honda, HEV focused R&D but rarely go beyond overall planning

Source: SAIC (2014, pp. 35-40), FAW (2014, pp. 62-73), DFMC (2014, pp. 62-72), BAG (2014, pp. 72-81), GAIG (2014, pp. 38-43), ChangAn (2014, pp.1-15), Six SOE's Social Responsibility Websites.

Thirdly, the AFV development goals and strategies of Six SOEs were largely influenced by government initiative plan. SAIC announced that its AFV market share should be reached by 20% through government promotion policies of the 12.5 Plan, and FAW tried to satisfy the

government guideline by improving the fuel efficiency by 30% by 2015. DFMC also has pursued the pure electric vehicle as a key model of AFV while regarding HEV as an interim model on transition period and ChangAn has been an active follower for the government initiative EV demonstration plans in Chongqing. In fact each local government of China has been deeply involved in the governance structure of SOE in each region; further most of SEOs have maintained a close relationship with local government as well as central government to deal with various national projects for a long time. Therefore it would be too natural for Six SOEs to follow the government initiative model for facilitating the EV or HEV commercialization.

Fourthly, Six SOEs manage AFV development as one of key issues for CSR activities. All of their SR reports include the performances for vehicle fuel efficiency, exhaustion gas reduction and EV or HEV operation at the environment protection chapter. FAW suggested 'Five Steps from R&D to production[11]' to launch the environment friendly vehicle and DFMC formulated the '9+7 Plan[12]' to facilitate the new energy research as well as zero emission vehicle release. BAG put a more emphasis on drivers' experiences in promoting EV or HEV but GAIG argued the importance of industry ecosystem in promoting AFV business[13] because it should configure a sustainable business model to operate AFV rather than develop a high quality AFV. In fact such a management philosophy came from Toyota and Honda which have been the long term JV partners of GAIG. However it can be argued that not only GAIG but also other SOEs' SR approaches for AFV have been under control of their alliance partners' ideas due to the technology gap and the relatively short SR history of Six SOEs. It also made Six SOEs take a responsive stance rather than a more progressive SR activity, so it resulted in causing Chinese government to intervene AFV business actively while increasing its initiative continuously.

5. Conclusion

Chinese government has tried to support its local vehicle makers, mostly Six SOEs to catch the leadership for the AFV business because it would be relatively easier for new entrants like Chinese local makers to commercialize new energy vehicles rather than the existing gasoline vehicle makers. Since the 'Automobile Industry Development Policy' in 2004, Chinese government has intended to increase the AFV sales volume but the actual performance is still very poor. In particular through the 'Plan on shaping and revitalizing Automobile Industry' in March 2009, Chinese government suggested two policy targets; the AFV production volume of 500 thousand including EV, PHEV or HEV and the market share of AFV should be reached 5% by the end of 2011. However any of two targets was not realized. The market share of AFV in China was only 0.07% in 2012, 0.08% in 2013. The AFV sales volume largely went up by 74.8 thousand in 2014 but the market share was only 0.3%. In order to accomplish the AFV market share 5% goal, it still has a long way to go in China. But the AFV market share in Japan reached 16.2% in 2013, and the AFV market share in the United States was 3.8%.

Therefore this study traced the reason why the performance of Chinese AFV development plan has been so poor with assuming that there existed a mismatch between government initiative model and market conditions. To do so this study reviewed main ideas for AFV promotion plans and policies of China since the Eighth Five-Year Plan. As a result four departments of Chinese government; NDRC, MOST, MOF and MIIT, have displayed a

[11] It classifies the purpose of FAW R&D for environment protection into five categories; commercial vehicle fuel saving, passenger car fuel saving, alternative fuel engine, transmission, exhaust emission reduction (FAW SR Report 2013: 64-66).

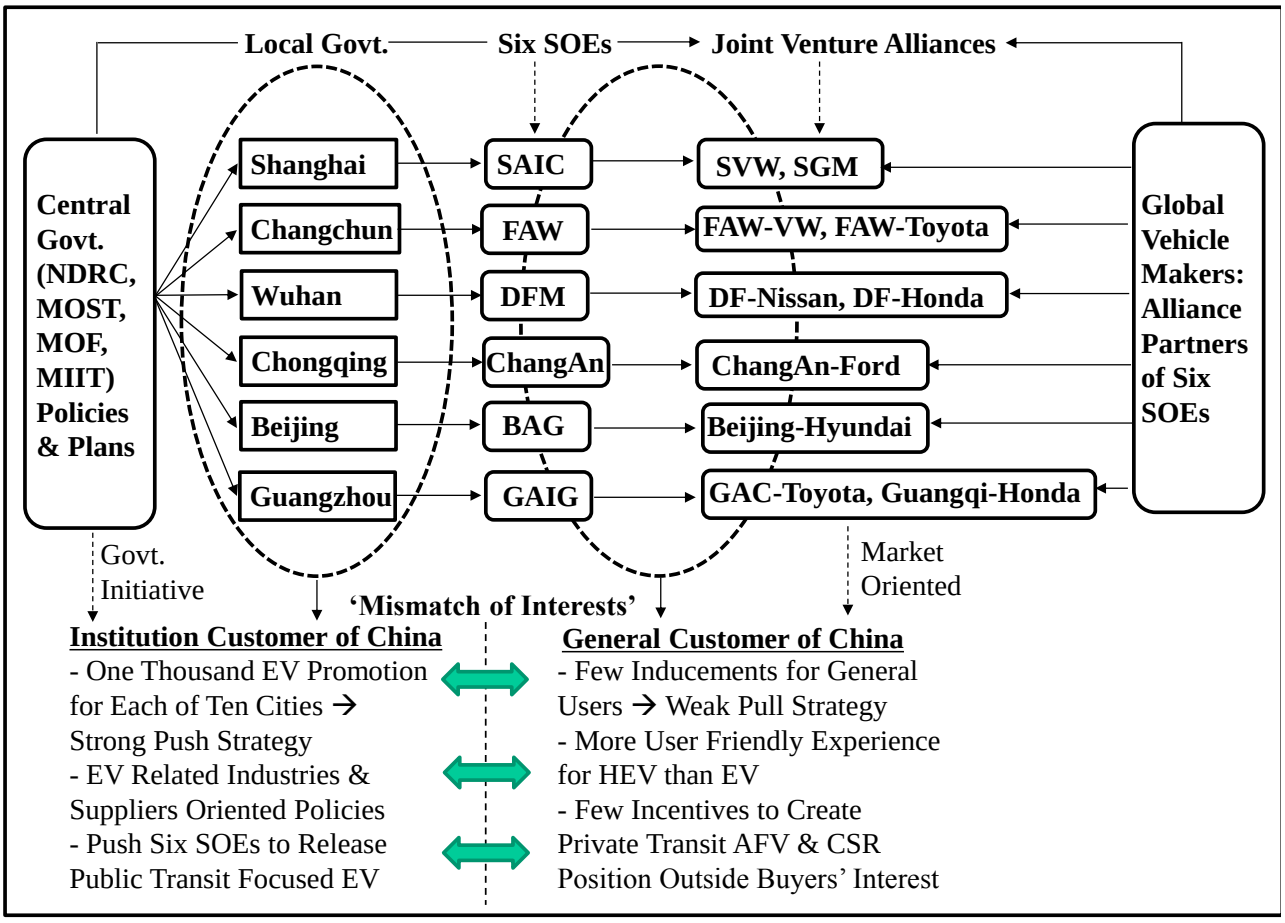
[12] It covers multiple platforms of DFMC from commercial vehicles to passenger car, combined multiple technology routes for EV, PEVE or HEV and built the corresponding promotion system to make the most feasible technology be commercialized in a short time (DFMC SR Report 2013: 69-71).

[13] Such a difference between BAG and GAIG resulted from the management philosophy of their JV partners. GAIG's partners, Toyota and Honda have relatively put a more emphasis on a close relationship with parts suppliers but BAG's partner, Hyundai has been more oriented the customer relationship with pursuing a vertical integration strategy for parts suppliers (Hyundai Motor Company Sustainability Report 2013, pp.60-77; Toyota Sustainability Report, 2013, pp.72-73;44-51).

collaborative leadership in designing and doing the government initiative model. In addition most of government approaches have managed the pure EV or PHEV as a key model of the AFV project, and strongly pushed ahead the EV-centric R&D funding as well as the EV friendly purchasing subsidies (China Association of Automobile Manufacturers, 2014, p.272). In order to grasp more scientifically the government initiative model, this study analyzed the structures and main contents regarding three key policies; the 2009 Policy, the 2012 Policy, and the 2014 Policy.

Among four factors; related industries, firm strategies & industry structure, factor endowments, demand condition, which came from the Diamond model by M. Porter, the number of items for related industries for AFV operation turned out to be much more than any other items in the 2009 Policy. But the 2012 Policy took a more balanced approach among the related industries (39%), the factor endowments (28%), and firm strategy & industry structure (26%). Another key factor, demand conditions began to be mentioned practically through the 2014 Policy because the share of its items went up to 26%. However the related industries still maintained the highest share (33%) among four factors at the 2014 Policy, which is closely concerned with the attributes of supplier oriented policies or government initiative model.

Figure 5. Mismatch between Government Initiative and Market Condition for AFV Business in China



Currently most of Chinese automobile makers manage AFV business from the CSR perspective as well as the product differentiation strategy. In particular, Six SOEs mostly covered the vehicle fuel efficiency, exhaustion gas reduction, AFV release performance at the environment chapter of their SR reports. In addition the AFV R&D activities of Six SOEs have been more inclined to EV or PHEV rather than HEV due to Chinese government policy priority.

Since the 'Automobile Industry Development Policy' in 2004, Six SOEs' strategies for AFV business have been largely influenced by government initiative plans or policies (China Association of Automobile Manufacturers, 2014, p.274; Montlake, 2013). However there still exists a substantial gap of AFV technology between Six SOEs and joint ventures' partners. Most of key models for EV or HEV have been launched by Joint Ventures which were collaboratively established among SEOs and global makers (China Association of Automobile Manufacturers, 2014, pp.275-276).

Furthermore joint ventures' HEV models turned out to have a much more marketing feasibility than Chinese EV models outside of China. Finally the mismatch between government initiative model of China and market condition resulted from the recognition gap regarding whether the EV will be able to become a mainstream or not in future among various AFV candidates (Choi, 2013; China Association of Automobile Manufacturers, 2012, p.266). It can be said that there exist two customer groups at Chinese AFV market, one is the institution customer, and the other is general customer (Figure 1). The institution customer includes the public transportation like bus or taxi as well as government official vehicles but the general customer covers an individual or a firm buyer for the private purpose. Usually the push strategy[14]is a popular sales method for the institution customer due to the fleet sales contract by public agency or government. At the central government position, each local government of China has been a great place to test AFV operation or maximize AFV demonstration effect. In fact Six SOEs of which governance structures being under control of each local government should have followed the local government's AFV demonstration project. So the AFV strategy of each SOE has been on the same line as local government movement that largely influenced by central government's ideas. Through the structure analysis for three key policies, the fact that relatively more articles were concerned with AFV related industries or factor endowments for AFV suppliers is also engaged in the government initiative.

However such a pull strategy of Six SOEs was rarely helpful to catch up the general customer minds. Before the 2014 Policy, the articles for demand conditions were almost few which mean Chinese government rarely suggested the incentives to create the private transit needs for using AFV from general buyers' perspective. Currently HEV has been more popular than EV or PHEV in Japan, the United States or Europe but Chinese government has driven EV or PEHV focused promotion policies. Such a market condition of China is definitely different from the global trend for AFV business even though it is too early to say which type of AFV will be a mainstream in the near future. Not only Six SOEs but also central government of China fully recognized the competitive advantage of HEV for driver's convenience, so Chinese government began to review the original plans relying mainly on the EV push strategy to local governments (China Association of Automobile Manufacturers, 2014, pp.274-275). It can be argued that how to cut down the mismatch between government initiative and market condition emerged as a big assignment for AFV business in China.

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[14] A push strategy and pull strategy suggest the movement of a product or information between two subjects. Consumers usually pull the goods or information they demand for their needs, but the firms or suppliers push them toward the consumers. Therefore the push strategy for production is based on demand forecasting by suppliers but the pull strategy is based on customers' actual demands or needs.

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