

Investment Opportunities in the Electric Vehicle Industry in Taiwan

I. Reason to Invest in the Electric Vehicle in Taiwan

A. Considering the International Energy price and Vehicles Regulations, Electric car would Become the Mainstream Product in the Future

14% of the global carbon dioxide comes from transportation systems, and 60% of the transportations use petrochemical fuel. Electric vehicles have better efficiency in terms of the energy utilization ratio of the fuel. Also, no carbon dioxide would be produced while using. As the pollution source of the power generator is easier to control, the advanced countries such as European countries, Japan and American thus consider electric vehicles the key development techniques. The Chinese authorities even regard the commodification of electric vehicles as an important national strategy. Electric vehicles apparently have become the target that all countries aim to invest in.

B. Taiwan has Related Basis and Industrial Clusters

Given the fact that electric vehicles need to employ lots of information and computer technology, and Taiwan is able to assist the electric vehicle business developer and application developers thanks to its capacity in both electric and electronic field. The vehicle industry in Taiwan is good at developing middle-small sized vehicles and motorcycles. Meanwhile, Taiwan is able to develop the techniques of small-volume, large variety production in response to the local market needs. With the development and application experience of low-speed vehicles, Taiwan is a suitable environment for the electric vehicle industry to develop.

The automobile components industry in Taiwan also has its strength as some of the vendors have already integrated into the international supply chain. For example, as for the electric vehicle produced by Tesla Motor, more than 70% of its components are procured in Taiwan, and the key raw material of the motor is made by the silicon steel produced by China Steel Chemical Corporation. As for the raw materials and downstream products that the electric vehicle motor need, Taiwanese vendors have been building the technique development. Aside from the participation of

International Collaboration on the plan of Future Steel Vehicle, the R&D center on material and motor is also established. Through the combination of both the industry and the academic field, Taiwanese vendors try to motivate the localization for the related techniques.

150 vendors in the Electrical and Electronic Manufacturers' Association have formed a technical alliance. Taiwan is able to provide an environment for the application for electric vehicles, and is suitable to serve as a pilot market. Moreover, considering the fact that the distance between south and north of Taiwan is very short, the commute time between each district is less than a day. Features such as apparently increasing needs for short distance car use in cities and the short driving kilometers within a single day make Taiwan a suitable environment for the development and testing of electric vehicles.

C. The Ideal Starting Point to Enter the New-Energy Automobile Market in China

Table 1. The Adjustment and Promotion Plan for the Automotive Industry in China

Policy	Planned Goal	Main Goal	measures
Expand market size	<ul style="list-style-type: none"> ● Consistently increase the sales in automobile ● Significantly improve the consumer environment of automobiles ● Optimizing the structure of the market demand 	<ul style="list-style-type: none"> ● Develop the consumer market of automobile ● Mature the modern automobile services 	<ul style="list-style-type: none"> ● Abate the vehicle purchase tax ● Initiate the “Automobiles in City & Country” plan ● Abolish the unreasonable vehicle purchase limitations ● Promote and regulate the automotive purchase Loans ● Promote and regulate the development of the pre-owned car market
Adjust the Industry Structure	<ul style="list-style-type: none"> ● Re-structure for improvement. Increase the market share of private 	<ul style="list-style-type: none"> ● Accelerate the re-structure of automobile industry ● Implement the 	<ul style="list-style-type: none"> ● Perfect the automobile corporation re-structure policy

Policy	Planned Goal	Main Goal	measures
	brands	Strategy of private Brand	
Develop New-Energy Automobile Technologies	<ul style="list-style-type: none"> ● Develop the production and marketing in electric vehicles ● Elevate the research and development level in automobiles ● Develop the independency for key automotive parts technology 	<ul style="list-style-type: none"> ● Support the independent innovation of enterprises ● Carry out the technology transformation projects ● Implement the new-energy automobile strategy ● Implement the automotive product export strategy 	<ul style="list-style-type: none"> ● Improve the technology development and increase the investment in technology transformation ● Promote the eco-friendly and new-energy automobiles ● Realize and perfect the “Automotive Industry Development Strategy” ● Accelerate urban transport infrastructures

Source: Compiled by CDRI

The New-Energy Automobile Technologies in China could be divided into three categories: Hybrid Power Technology, Pure Electric Technology, and Fuel Cell Technology. As for building the environment for new energy automobiles, Ministry of Technology is conducting a “one thousand vehicles in ten cities” pilot for new-energy automobile demo in 2009, which Chinese government gives direct subsidies to those who purchase new-energy automobiles. In 2010, Ministry of Technology, Ministry of Finance, Development and Reform Commission, and Ministry of Industry and Information Technology cooperated in this pilot, and renamed it into “Promoting Energy-Saving and New-Energy Automobiles in Public Area Demo Notification”. Currently, demo cities or regions went from the original 10 up to 40. In other words,

86 cities were promoting 330 thousand cars in total.

According to “Energy-Saving and New-Energy Automobiles Industry Plan (2012-2020)” from the State Council of the People's Republic of China, the sales of pure electronic vehicle and plug-in hybrid vehicle are expected to sum up to 500 thousand in 2015 and 2 million in 2020. The accumulated sales are expected to reach more than 5 million.

Table 2. The Tentative Policy of New-Energy Automobile Promotion Demo in China

Unit: RMB

Items	Contents
Demo City	Changchun, Dalian, Beijing, Tianjin, Tangshan, Jinan, Shanghai, Hangzhou, Suzhou, Chongqing, Shenzhen, Guangzhou, Xiamen, Haikou, Wuhan, Hefei, Zhengzhou, Changsha, Nanchang, Kunming
Objective	Buses, taxis, government vehicles, and vehicles for public hygiene and postal services that run fleet operation promotes the use of energy-saving and new-energy automobiles.
Applicable Vehicles	Hybrid Power Technology, Pure Electric Technology, and Fuel Cell Technology
Automotive Technology Standards	<ul style="list-style-type: none"> ● Saving at least 5% (or above) of fuel compared to ordinary vehicles, and at least 10% of fuel is saved on hybrid-power vehicles ● Key parts and accessories such as power cells guarantee 150,000 km in 3 years
Subsidy	<ul style="list-style-type: none"> ● Central Government: one-time subsidy with different levels depending on the technology used. Passenger vehicles: hybrid power (4-5 thousand per vehicle), pure electric system (60 thousand per vehicle), and fuel cell (250 thousand per vehicle); buses: hybrid power (50-420 thousand per vehicle), pure electric system (500 thousands per vehicle), and fuel cell (600 thousands per vehicle) ● Local Government: appropriate subsidy for the expense in automobile purchase, parts & accessories, and maintenance.

Source: CDRI, 2011

Both the ECFA effects and the Bridging Project make Taiwan the ideal starting point to enter the new-energy automobile market in China. Within the structure of economic cooperation between Taiwan and China, automotive parts and accessories were already included in the Early Harvest List, while electric product industry became one of the key items in the project. Since the China market’s demand for new-energy automobiles is relatively low and this market is therefore not suitable for mass production, Taiwanese vendors are more likely to serve such local market with its small-quantity and high variety productivity.

D. Taiwanese Vendors' Demands in Technology Upgrade and System Integration

As Taiwanese vendors have high demands in next-generation electric technologies and large electric buses, international vendors' strength in cell materials, motor controllers, light-weight motor materials, light-weight materials, cooling control, and electric bus chassis can just complement the local resources. The local vendors' demands in electric technologies and platform products are expected to attract international enterprises worldwide to develop such technologies in Taiwan. So far there are enterprises from Japan, China, and United States that have reached cooperation agreement with Taiwanese enterprises. In the future, more international enterprises in electric technologies will be introduced, satisfying Taiwanese enterprises' needs for such technologies.

II. Introduction to the Main Vendors in Taiwan

Below is the industrial supply diagram for electric vehicles industry in Taiwan

Raw Material	Battery Materials – Cathode Material	Battery Materials – Anode Material	Battery Materials – Battery Separator	Battery Materials – Battery Electrolyte	Battery Materials – Copper Foil	Motor Materials – Permanent Magnet	Motor Materials – Magnetic Sheet and Strip
Material Module	1. CAEC 2. Shang-hua 3. ALEEES 4. HIROSE 5. Battery Energy 6. LICO 7. MECHEMW 8. CoreMax 9. Tak 10. Guan-shih	1. Jhuang-yeh 2. China Steel 3. Chemical Corporation 4. Long Time Tech	1. Nan Ya Plastics Corporation 2. Coin 3. BenQ Materials	1. Nan Ya Plastics Corporation	1. Co-Tech	1. Delta 2. DaiDo Metal 3. Maigen e Metal 4. TECO	1. China Steel 2. Ta-Yea Steel
Sub-system /System	Battery Cell	Battery Module	Current Convertor Module	Electric Motor and Motor Controller	D.C. Motor Drive		
System Integration	1. PHET 2. AMITA 3. C-Life 4. PSI 5. Power Source Energy 6. Molichel 7. Chang Hong 8. Guan Shih 9. Exa Energy Technology 10. Lico	1. PHET 2. Molichel 3. Simplo 4. GWA Energy 5. DynaPack 6. Celxpert 7. LIFEB 8. HT Energy 9. Delta	1. Chia-li 2. TECO 3. Chroma 4. Ling Jhong 5. Rhymebus 6. Delta	1. Tatung 2. Shih-Lin 3. JustWin 4. TECO 5. Chroma 6. Holtek 7. Fukuta 8. Motion Technology 9. Ye Li 10. Universal Microelectronics 11. Delta 12. EVT 13. Shin Hsing	1. 2. 3.		
Self-Owned Vehicle Technology							
Other Technology	Battery System		Battery Management System		Battery Controller/System (Power Management System)		
	1. PHET		1. Chroma		1. Chroma		

2. HT Energy	2. Delta	2. HT Energy	
3. AMITA Technologies	3. KYMKO (Lite-On)	3. Delta	
4. Molicel	4. LiFeTech Energy	4. Rich Electric	
5. J. S. Power	5. Renesas	5. KYMKO (Lite-On)	
6. DynaPack			
7. Simplo			
8. All-New Energy			
9. Re-Deutsche			
10. Wiz Energy			
Integration of Development Technologies			
1. Industrial Technology Research Institute			
2. Delta			
3. SGS			
4. ARTC			
5. TARC			
6. Lite-On (STI)			
Bus	Minibus	Motorcycle and Other Mobility Scooter	Bicycle
1. Hanergy	1. China Motor	1. China Motor	1. China Motor
2. RAC Electric Vehicles	2. PHET	2. PHET	2. PHET
3. ALE EES	3. Yulong	3. E-Ton	3. Merida
		4. Meibruce	4. Giant
		5. SYM	5. Ideal
		6. KYMKO	6. Yin-ke
		7. PGO Scooter	7. Lianda-Loncin
		8. Yin-ke	
		9. Lianda-Loncin	
Charging Station		Vehicle Assembly	In-Vehicle Jack/Connector
1. Taiwan Power		1. Zhong Zhun	1. Hu Lane
2. CPC			
3. Leader			
4. AC Power			
5. Well Shin			

Source: CDRI, 2012

Figure 1. The structure of electric vehicle industry in Taiwan

A. Vendors of in-vehicle motors

1. Fukuta Motor

Specializing in electric motor production, Fukuta Motor cooperated with Tesla and ACP and produced world's first electric roadsters available on the market. Fukuta Motor became one of Toyota's official partners because of its partnership with Tesla.


With re-investment, Fukuta Motor founded Jin-Fu-Tian Technologies, Shanghai Sin-Yong Electronics, Yong-Tai-Fong Technologies, and Huan-Yu Inc. and formed an EV Green Energy Eco-Power Alliance to develop next-generation automotive motors by aligning with the trade and local R&D organizations. Fukuta Motor has succeeded in taking part in the global supply chain of electric parts and accessories. In the future, it is expected to have technology cooperation by partnering with vendors worldwide, starting a new era of electric commercialization.

2. Delta Electronics

Being very aggressive to gain some market share in automotive electronics in China, Delta Electronics demonstrates its capabilities in developing and manufacturing electric parts and accessories, and releases the retrofitted electric and hybrid vehicles based on SAIC Motor's and Changan Motor's form factors. Delta Electronics has been cooperating with Shanghai GM to develop motor systems and onboard chargers for Chevrolet Sail pure electric editions. It has also gained the opportunities to work with other automotive vendors in China and to supply electric power package modules.

Besides, Delta Electronics has developed electric charging and service systems, and is qualified to participate in the electric demo pilot in Taiwan. In terms of electric charging solutions, it is able to provide AC/DC charging equipments, charging station monitor systems and charging network management systems, with over 94% of transfer efficiency to considerably decrease the operating cost and carbon emission volume.

Table 3. The partnership between Delta Electronics and Shanghai GM

	Automotive Brands	GM Chevrolet Sail – Pure Electric Edition
	Manufacturers	Shanghai GM (new-energy vehicle catalog – batch 25)
Energy-Storage Systems	LiFePO4	Amperex Technology Limited
	Module Voltage 3.2 V / Total Voltage 307.2 V / Total Capacity 60 Ah	
Power Systems	Permanent Magnet Synchronous Motors (PMSM) and Motor Controllers	Delta Electronics
	Power 50 KW / Peak Power 85 KW	
Onboard Chargers	Delta Electronics	
	Input Voltage 96-264 V / Power 3 KW	
Charging Connectors	Amphenol PCD Shenzhen Co., LTD	
	Charging Socket ASZ52541 / Charging Socket ASZ52542	

B. Vendors of Battery materials

1. CAEC

CAEC's key products are lithium battery LiFePO4 materials, lithium batteries, polymer batteries, and technology transformation in lithium and polymer batteries consultant services. Its clients include Jinshan Battery, Formosa Plastics Chang-Gung, Ford, Chrysler, UMC, Pfizer, and Institute of Nuclear Energy Research, etc.

The battery LiFePO4 materials and production procedures from CAEC are highly competitive in the global market. It has developed next-generation iron-sodium cathode materials, which are combined with low-cost elements such as hydrochloric acid and oxalic acid and made into powders, potentially decreasing the production cost. After the foundation of a company invested by CAEC and Formosa Plastics, 10 production lines with 400 tons of powders will be implemented in Mai-Liao industrial park. The annual throughput is expected to reach 4,000 tons, supplying various power storage system plants for electric vehicles, large non-interruptive systems, LED streetlamps, and solar energy batteries.

2. LanYang Energy Technology

LanYang Energy Technology develops, produces and sells LiFePO4 batteries. Taking advantages of electrochemistry and electricity/electronics/electrical control technologies from Taiwan and China, it uses LiFePO4 cathode materials for power batteries with features of low cost, dense energy, secure stability, long life cycle and

eco-friendliness. The powder of LiFePO₄ can be applied to electric vehicles (such as e-bikes, e-scooters, e-cars and e-buses), portable electrical power tools, non-interruptive power supplies and solar energy storage systems. In alignment with Industrial Development Bureau, Bureau of Standards, Metrology & Inspection, Metal Industries Research & Development Centre, and Automotive Research & Testing Center, LanYang Energy Technology is now promoting the standardization of LiFe power batteries, and has implemented the standard module specs for three e-vehicles (24V/30Ah, 36V/30Ah and 48V/30Ah), accelerating the industrial standardization and verification processes in the future.

3. PiHsiang Energy Technology (PHET)

PHET's main products include Li-CO battery cells for 3C electronics. In 2005, PHET cooperated with Phostech Lithium based in Canada to develop LiFePO₄ battery material production technologies, and was authorized with patent. In the same year, PHET started producing LiFePO₄ batteries, and became the only professional vendor to provide such batteries made by PHET in Taiwan, with no risk of patent violation.

4. Advanced Lithium Electrochemistry (ALEEES)

ALEEES is a cathode-material vendor with a patent on LiFePO₄ materials. Its patented product, LFP-NCO, is characterized with the advantages of high quality and reasonable cost. Thus ALEES is able to provide LiFePO₄ materials to Asia and satisfy the demands in China and Asia markets. In addition to developing battery materials on its own, ALEEES participates in the design and manufacture of electric buses. So far this company has received a few orders from some Asian countries, and is expected to be one of its main vendors in professional batteries and electric systems.

C. Body design and manufacture

1. Hua-Chuang Automobile Information Technical Center (HAITEC)

HAITEC specializes in vehicle design development. In response to trend of energy saving, its motor system efficiency can reach up to 180 kw (about 240 hp) and

be applied to various types of vehicles, such as coupes, passenger vehicles, SUVs, and medium/large buses.

It currently focuses on the development of electric platform technologies and the research of plug-in hybrid vehicles (the development of which will be the focus in the future). HAITEC is expected to be the leader in developing all electric technologies.

2. RAC Electric Vehicles

RAC’s homemade pure-electric & low-chassis buses are the first electric buses certified by Taiwan government. Its key products and services include electric buses, electric parts and accessories, and electric commercial vehicle planning and **manufacture**.

III. The opportunities in Electric Vehicle Demo Pilot in Taiwan

In 2010, the Taiwan government approved “Intelligent Electric Vehicle Development Strategy and Action Plan,” setting up over ten pilots across the country and involving around 3,000 vehicles. This plan will promote the use of intelligent electric vehicles, innovative service modes and integrated infrastructures. Taiwan government invested 2.2 billion NTD to facilitate the implementation of electric vehicles in the main urban areas. The second period plan for 2014-2016 is under review of Executive Yuan.

Table 4. The progress of the electric Vehicle pilot in Taiwan

Project Name	Conducting Organization	Scale
Taipei Metropolitan Low-carbon Travel Plan	CarPlus, Nissan Taiwan and Luxgen	<ul style="list-style-type: none"> • 100 Vehicles • 102 Charging Stations
World’s Greater Taichung, Your Dream Eco-city: Green Transportation Project	Taichung City Government, Nissan Taiwan and Luxgen	<ul style="list-style-type: none"> • 100 Vehicles • 161 Charging Stations
Sun-Moon Lake Area Intelligent Electric Vehicle Pilot Plan	Hotaimotor and Easyrent	<ul style="list-style-type: none"> • 38 Vehicles • 32 Charging Stations

Project Name	Conducting Organization	Scale
Intelligent Electric Vehicle Pilot in Tainan city	Tainan City Government, Luxgen and CarPlus	<ul style="list-style-type: none"> • 28 Vehicles • 63 Charging Stations
New Taipei City Electric Vehicle Pilot Plan	New Taipei City Government, Luxgen and CarPlus	<ul style="list-style-type: none"> • 90 Vehicles • 44 Charging Stations
The City of Hope, Glamour and Technology	Hsinchu County Government, RAC Electric Vehicles and Yosemite Bus	<ul style="list-style-type: none"> • 21 Electric Bus • 21 Charging Stations
Green Kaohsiung and Pingtung Green Bus Transportation Project	South Taiwan Bus, Kaohsiung Bus, Pingtung Bus and RAC Electric Vehicles	<ul style="list-style-type: none"> • 22 Vehicles • 22 Charging Stations

Source: Pilot Project for Intelligent EV, Ministry of Economics (2014.05)

I. Summary

Since electric products and their parts/accessories are the key development techniques for automotive industry in the future, Taiwan and China have chosen them as one of the pilot in the Bridging Project. We expect that the growth of electric vehicles will soon come into being, and the demand will significantly increase after the infrastructures are gradually completed.

Taiwan has the technology and productivity for electric vehicles, and its vendors have demands in technology upgrade and international cooperation. Therefore international electric vehicle enterprises are able to find vendors to cooperate with, and items to work on in Taiwan, entering the China market through the Bridging Project. The domestic electric vehicle pilot will generate demands in electric vehicles, charging systems, and service networks, while vendors participating in the project can learn how to improve products and systems performance from various project items. Thus, the Living Lab that Taiwan provides is able to help local and global vendors accelerate the commercialization of technologies, prompting Taiwan to become the R&D center for international electric vehicle industry in the future.