China's Green Move – Vehicle Electrification Ahead

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Overview

In this note we examine China's ambitious goal to develop a fleet of 5 million electric vehicles by 2020 (the term "electric vehicles" used here includes plug-in hybrid electric vehicles and pure electric vehicles and does not include traditional hybrid-electric vehicles).[1] Such a fleet would represent 43% of the estimated global PHEV/EV fleet and 0.4% of the global passenger vehicle fleet (all engine types)[2]. Based on the goals and targets set forth in the Ministry of Industry and Information's (MIIT) recently released "China Energy Efficient and New-Energy Vehicles Industrial Plan 2012-2020," we develop a forecast of what we believe is achievable for production and sales and include a review of other market forecasts. China is planning to fund this ambitious goal with RMB115 billion (USD$18 billion). Even if China were to achieve 70% of its fleet goals by 2020 which is our central expectation, the country still will have achieved a Herculean accomplishment that will reduce the pace of GHG emissions and petroleum consumption as the country's emerging middle class becomes increasingly urbanized and mobile.

- China targets a domestically manufactured electric vehicle (PHEV and EV) fleet of 500,000 vehicles by 2015; a fleet of 5 million electric vehicles by 2020 and a manufacturing infrastructure capable of producing 2 million electric vehicles per year by 2020. We forecast substantial growth, though slower than China's national government goals. By 2015 we forecast a fleet of 366,00 vehicles, rising to 3.6 million by 2020 at which time we forecast 1.1 million vehicles per year in sales produced from a manufacturing base with year-end nameplate capacity of 2 million vehicles per year. This forecast reflects the significant challenges of establishing a new industry and finding the right level of subsidy and price point for electric cars, but still represents achievement of 70% of the national goal for electric cars on the road by 2020, a level we believe would represent a significant accomplishment in light of technical, manufacturing and end-market uncertainties.
- The key difference between our DBCCA Pragmatic Forecast and the Government Target Forecast concerns the pace of adoption, influenced by both progress solving vehicle technological constraints and ultimately providing appealing end-market pricing to encourage customer adoption. While China has national and regional subsidies to defray car purchase prices by between 29% and 35% to RMB100,000 – RMB220,000 levels, we believe these "post subsidy purchase prices" still are high and miss the core of the end-market. We believe 59% of auto market sales (the largest segment) exist in the RMB 50,000 – RMB 150,000 price range. We believe if China were to increase purchase price subsidies by 57% - 67%, to RMB110,000 – RMB200,000, an estimated 66% of the end-market could be potential purchasers compared to the 29% of the market now addressed by the current subsidies scheme. If China were to significantly increase the

[1] Please see p.6 for a more detailed definition
[2] Morgan Stanley "Electric Vehicle and Earnings Model," 28 February 2012, A. Jonas et al

purchase price subsidies, we believe this would have a material positive impact on the pace of end-market adoption and help close the gap between our DBCCA Pragmatic Forecast and the governments ambitions reflected in the Government Target Forecast, as well as lead to faster technology innovations and greater cost reductions. In our view such subsidies should be reviewed periodically for revision as volume production leads to reduced costs and thus less need for the same magnitude of subsidy. This phenomenon occurred in the solar PV and wind power sectors just as it has occurred in the communications and computer equipment sectors.

- We also examined market forecasts for PHEV and EV cars in China. Given the early stage of the industry, it is not surprising there is considerable variation in the forecasts with one firm estimating 2020 vehicle sales of 860,000 cars on the low end and another firm estimating 3.3 million cars on the high end. These estimates compare to our 1.1 million car sales estimate in 2020. In terms of cumulative 2020 fleet estimates, there is one other market estimate of a 2.9 million car fleet in comparison to our forecast of 3.6 million and the government target of 5 million.
- China will focus its development activities on developing key electric vehicle components (batteries, powertrain and control systems) and manufacturing methods. Approximately RMB60 billion (USD$10 billion) of funding has been announced by the government to support technology and manufacturing process development.
- China has announced plans to spend RMB30 billion (USD$5 billion) on demonstration and pilot programs and an additional RMB25 billion (USD$4 billion) to encourage the deployment of electric vehicles and put in place the necessary charging infrastructure.
- We believe if China’s electric vehicle industry grows as we forecast by 2020, it could create between 16,800 – 22,400 direct vehicle manufacturing jobs and an unquantifiable number of jobs in the component supply chain. By 2020 we estimate the annual production value output of China’s electric vehicles sector could approximate RMB159 billion (USD$25 billion) plus an additional RMB88 billion (USD$14 billion) to fund deployment of 7 million charging points by 2020. If China exceeds our forecast and achieves its goals by 2020, the above amounts would be 43% higher.
- Broad policy implementation, effectively executed, will be necessary for China to achieve its ambitious goals as it addresses both technology and cost impediments and formulates major new manufacturing platforms. Although a challenge, we believe the national and provincial governments are highly motivated to successfully develop electric transportation for pollution, strategic fuel and employment reasons.

Executive Summary

To jump-start the development of a domestic Plug-In Hybrid Electric Vehicle (PHEV) and Electric Vehicle (EV) industry, China has set forth ambitious goals for fleet size in 2015 and 2020 and for manufacturing capacity in 2020. Although many of the key powertrain and battery technologies are still being perfected, we see these goals as China's automotive equivalent of a "moon shot" aspirational goal. Figure 1, below, summarizes these goals. It is worth noting that China's goals and targets refer to "vehicles" and do not draw any target/goal distinctions between passenger/light duty vehicles on the one hand and larger engine-displacement trucks, buses, construction or agricultural vehicles on the other hand.

Figure 1: China's Electrified Vehicle Goals

Target	2015	2020
Cumulative PHEV/EV Fleet	500,000	5,000,000
Production Capacity PHEV/EV (vehicles per year)	No Target	2,000,000/year

Source: MIIT "China Energy-Efficient and New-Energy Vehicles Industrial Plan 2012-2020" and DBCCA analysis, 2012

Fully achieving the 2015 and 2020 government goals would be spectacular outcomes. Should China achieve these goals by 2020, China's PHEV/EV fleet of 5 million vehicles would represent 43% of the global PHVE/EV fleet and 0.4% of the total global passenger vehicle fleet (all engine types) based on global forecast data published by Morgan Stanley[3]. However, given the lack of clarity on timing of disbursement of government funding, the immaturity of several key technologies and uncertainty in consumer preference, price affordability and sensitivity and pace of adoption, we offer our own forecast ("DBCCA Pragmatic Forecast") for this brand-new industry in addition to a forecast formulated to achieve the government's goals and targets ("Government Target Forecast"). In both cases we estimate China will be successful in building the manufacturing base to a nameplate capacity of 2 million vehicles by 2020. Our DBCCA Pragmatic Forecast takes a more measured position on the pace of adoption in the end markets due to technology, cost and end market risks mentioned above. We discuss in more detail our manufacturing capacity ramp and market demand forecast methodology in the Electric Vehicles Forecast section of this paper. Our DBCCA Pragmatic Forecast reflects a 30% reduction to the government goals to capture the aggregate effect of these technology, cost and end-market risks.

Figure 2: Government Target Forecast and DBCCA Pragmatic Forecast

Government Target Forecast (000's)	2012	2013	2014	2015	2016	2017	2018	2019	2020
Domestic Fleet, Cumulative	20	72	226	515	939	1,510	2,316	3,482	5,065
Annual sales	**14**	**53**	**154**	**289**	**424**	**571**	**806**	**1,166**	**1,583**
Plant Utilization (% of Ramped Capacity)	100%	90%	90%	90%	90%	90%	90%	90%	90%
Realizable Ramped Manufacturing Capacity	14	59	171	321	471	634	896	1,296	1,759
Manufacturing Capacity, Installed EOY	21	96	246	396	546	721	1,071	1,521	1,996
Annual Capacity Expansion	15	75	150	150	150	175	350	450	475
DBCCA Pragmatic Forecast (000's)	2012	2013	2014	2015	2016	2017	2018	2019	2020
Domestic Fleet, Cumulative	20	56	164	366	663	1,063	1,627	2,443	3,551
Annual sales	**14**	**37**	**108**	**202**	**297**	**400**	**564**	**816**	**1,108**
Plant Utilization (% of Ramped Capacity)	100%	63%	63%	63%	63%	63%	63%	63%	63%
Realizable Ramped Manufacturing Capacity	14	59	171	321	471	634	896	1,296	1,759
Manufacturing Capacity, Installed EOY	21	96	246	396	546	721	1,071	1,521	1,996
Annual Capacity Expansion	15	75	150	150	150	175	350	450	475

Source: MIIT "China Energy-Efficient and New-Energy Vehicles Industrial Plan 2012-2020" and DBCCA analysis, 2012
Yellow-shaded data indicated government goals. Yellow-outlined data indicates information comparable to government goals.

[3] Morgan Stanley "Electric Vehicle and Earnings Model," 28 February 2012, A. Jonas et al

We believe if China can achieve 2020 fleet volumes approximating 70% of national goals, it will have demonstrated a significant accomplishment, selling more PHEV’s and EV’s in nine years that Toyota sold Prius’ in 14 years.

For comparative purposes, we provide selected forecast data compiled from published research by several sell-side firms with global automotive research expertise.

Figure 3: Sample Comparative Sell-Side PHEV/EV Forecast Data

Passenger/Light Vehicle	**2015**			**2020**		
Annual Sales (000's)	**PHEV**	**EV**	**Elec Total**	**PHEV**	**EV**	**Elec Total**
Deutsche Bank Securities Inc. (1)	210	314	524	1,318	1,976	3,294
Goldman Sachs	36	72	108	694	925	1,619
Morgan Stanley	127	42	169	559	301	860
Cumulative Fleet						
Deustche Bank Securities Inc.	NA	NA	NA	NA	NA	NA
Goldman Sachs	NA	NA	NA	NA	NA	NA
Morgan Stanley	NA	NA	355	NA	NA	2,869
DBCCA (2) Forecast Annual Sales	NA	NA	202	NA	NA	1,108
DBCCA (2) Forecast Cumulative Fleet	NA	NA	366	NA	NA	3,551
Goldman Sachs Commercial Vehicle Sales (HEV/PHEV and EV)			55			290
Government Targets						
Annual Manufacturing Capacity			No Goal			2,000
Cumulative Fleet Size			500			5,000

Source: Deutsche Bank Securities Inc., Goldman Sachs, Morgan Stanley and DBCCA analysis, 2012
Yellow- and red-outlined data indicate comparisons to government targets
Note 1: Deutsche Bank Securities Inc. is the US-based broker dealer entity
Note 2: Deutsche Bank Climate Change Advisors (DBCCA) is a unit of Deutsche Bank’s Asset Management division

PHEVs and EVs are both currently eligible for significant subsidies described in Figure 4 below. While those subsidies do serve to defray the car purchase prices by between 29% and 35%, we believe the “post subsidy purchase price” still falls high enough to miss the core of the end-market. Figure 4 indicates 59%, the largest segment of auto market, exists in the RMB 50,000 – RMB 150,000 price range. The current car purchase price subsidies span what we estimate to be approximately 29% of the market. Further, with the higher price points, the eligible customer segment is likely to be more discerning and may also have the resources to opt instead for foreign vehicles given perceptions of quality and social statement.

We believe if China were to increase purchase price subsidies by 57% - 67%, a much greater portion of the end-market could be potential purchasers. If the purchase price subsidies were to be expanded to a range of RMB 110,000 – RMB200,000, we estimate that would enlarge the target market, based on “post subsidy” purchase price, to approximately 66% of the total market opportunity. The consequence of this could be a virtuous cycle where lower prices drive higher sales and manufacturing volumes leading to lower costs as so successfully demonstrated in the solar and wind power sectors in Germany and other countries.

Figure 4: Estimated China Auto Sales Segmentation by Price – Circa 2011

PHEV/EV Subsidy Range	PHEV/EV Price Range (After Subsidies)	China Aggregate Car Price Range (RMB)	% of Sales	Cumulative % of Group
		< 60,000	22%	22%
		60,000 – 90,000	15%	37%
Low Subsidy RMB70k	~100,000	90,000- 130,000	24%	61%
		130,000 – 170,000	15%	76%
High Subsidy RMB120K	~220,000	170,000 – 280,000	18%	94%
		>280,000	5%	100%

Source: SOHU.COM market price and volume data and DBCCA analysis, 2012.

Introduction

In this note we explore what we view as the significant potential for electric vehicle development in China. While the next few years will likely see fierce debate over designs, technologies and costs, we do believe China has the resources and need to develop a significant electric transportation sector.

In September 1907, many roads in the USA were not paved. Gasoline stations and automobile mechanics were neither broadly available nor conveniently located, nor was there a repair component supply chain. Yet, in September 1908, the Ford Model T jerked and shuddered onto the roads. Starting the car the wrong way, one might end up with either a broken wrist or fingers. From this hostile environment mass-market automotive progress began.

We highlight these historical points to underscore that radical transformation is never an easy undertaking except for the naysayers. And that is easy to do these days with electric vehicles, in particular in China where so many other industrial transitions are simultaneously occurring. Pundits can point to costs, weak battery economics, power and usage constraints and lack of a recharging infrastructure. All of which are, for the time being, true. Yet, like the environment the Model T entered, we believe with concerted effort coordinated by the national and provincial governments and industry, these problems will become the dust in the rear view mirror as electric transportation replaces significant portions of China's transportation fleet in the coming decades.

We believe China is taking credible steps to bring electric vehicles into reality in its economy, one strained by limited domestic fuel resources, significant urban air pollution and an emerging middle class seeking the convenience of personal transportation. We are not at all discounting the challenges ahead, though we do believe they will be solved and that China's plans to incent development of vehicles, construction of charging stations and establishment of tax incentives for buyers will prove successful. Our note is segmented into 5 sections: an overview of the current transportation sector, a summary of the incentives and policy mechanism, summary forecast information, challenges and investment and job creation opportunities.

To avoid confusion we use the following terminology in this report:

- HEV- Hybrid Electric Vehicle is a vehicle with both an internal combustion engine and an electric motor and generator and a battery. The tractive force is produced by the electric motor which can be powered by the battery and internal combustion engine (via a generator). The vehicle uses regenerative braking to convert kinetic energy into electrical energy that is pumped back into the battery. An HEV requires a fossil fuel to operate and cannot be recharged form the electricity grid.

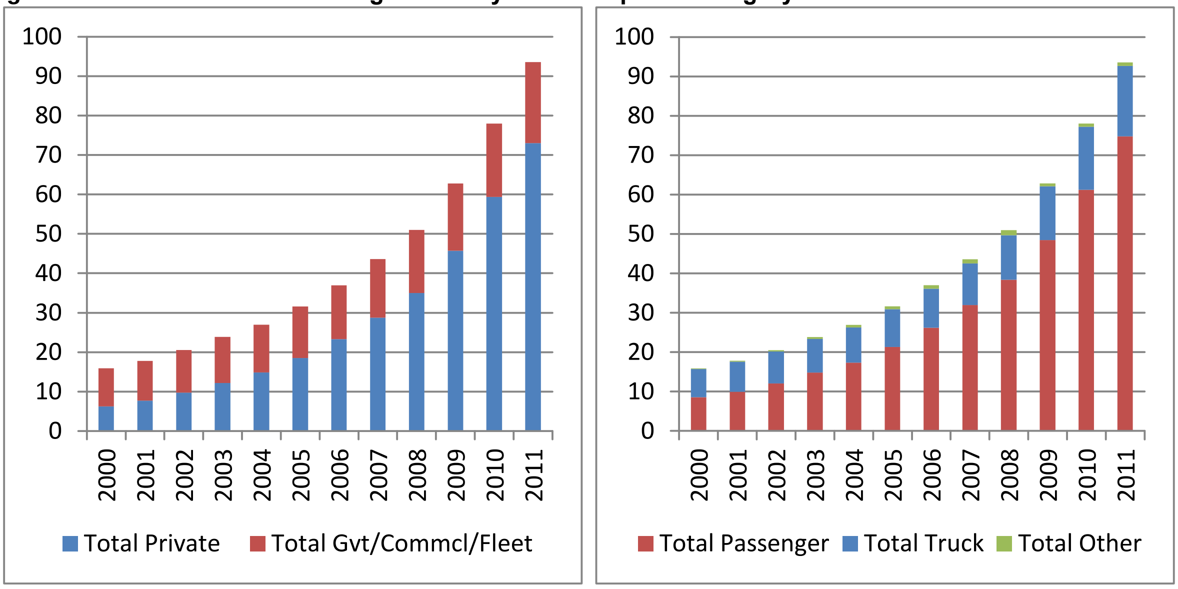
- PHEV – Plug-In Hybrid Electric is similar to an HEV except it has a plug and charger system to allow connection to the electricity grid. A PHEV can be fueled either from the electricity grid or with fossil fuel.

- EV – Electric Vehicle is a pure electric vehicle without any supporting internal combustion system. It is fueled solely from the electricity grid.

Section I: Transportation Background

China depends significantly on vehicular transportation to move both people and freight. In examining the electric vehicle opportunity later in this paper, we first provide in this section a brief summary of vehicular transportation in China. By the end of 2011, China’s total vehicle fleet reached 93.6 million of which 80% comprised passenger vehicles. Trucks, buses and other enclosed vehicles represented the balance. Of the total passenger cars, private ownership comprised 62.4 million, or approximately 85% of the passenger fleet. In addition to the enclosed vehicle fleet, approximately 100 million motorcycles and 13 million agricultural or “slow speed” vehicles rounded out the vehicular stock. Figure 5, below, illustrates the rapid growth in China’s vehicle fleet. During the period 2000-2011, China’s total vehicle fleet grew at an average compound annual rate of 17.5%; the passenger fleet grew at an annual 25% and the private passenger car fleet grew at an annual 29.4% rate.

Figure 5: China’s Vehicle Fleet Segmented by Ownership and Category



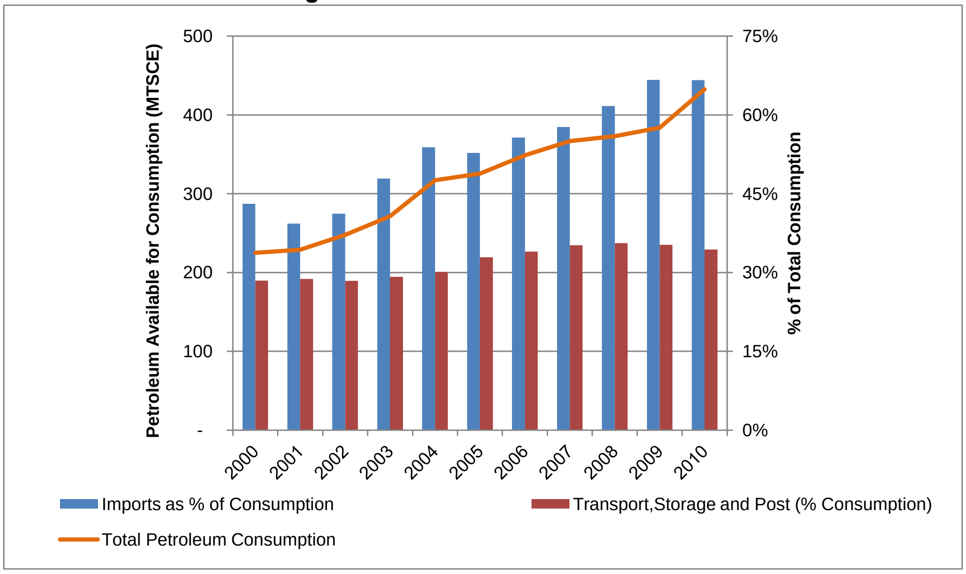
Source: China Statistical Yearbook, CEIC and DBCCA analysis, 2012.

This rapidly growing and fossil-fuel dependent fleet accounts for 30% of freight tonnage conveyed (based on freight-ton-km) and 54% passenger miles travelled (based on highway passenger miles). These percentages are based on highway use and do not include local freight and passenger traffic. It is clear vehicular movement of freight and people is a significant means of conveyance.

More than 99.5% of the vehicle fleet is now fueled with gasoline, diesel fuel or kerosene. Natural gas has just begun making inroads as a vehicle fuel and penetration remains in the tenths-of percent territory. We believe China’s dependence on petroleum-based fuels presents strategic challenges for China as well as serving as a tremendous catalyst for electric vehicle development.

China’s appetite for petroleum as a fuel is illustrated in Figure 6, below. In the 2000-2010 period, total demand for petroleum has increased at a compound average annual growth rate of 6.7%. During the same period, petroleum used as transportation fuel increased at a compound average annual growth rate of 8.8%. With increasing urbanization and growing household income, we believe vehicular demand for petroleum will continue to increase. China is sensitive to strategic risks associated with foreign fuel dependency and thus, we believe vehicle electrification is one solution that not only addresses a strategic issue, but also addresses the domestic pressure to reduce urban air pollution.

Figure 6: China's Petroleum Fuel Usage



Source: China Statistical Yearbook, CEIC and DBCCA analysis, 2012.

Current Transportation-Related Emissions

Emissions from transportation vehicles in China are an increasingly pressing issue, in particular in high-density urban areas. China's Ministry of Environmental protection reports that in 2011 that 27% of national NO_x emissions are attributable to the transportation sector. Further, in large cities between 41% and 70% of NO_x emissions are attributable to transportation vehicles[4]. In Beijing, 8% of particulate emissions ($PM_{2.5}$) in 2008 were attributed to transportation vehicles[5] while 15% of $PM_{2.5}$ emissions were attributed to vehicles in the summer months[6]. The International Energy Agency estimates that in 2008, transportation vehicles contributed to 14% of China's aggregate CO_2 emissions in that year.

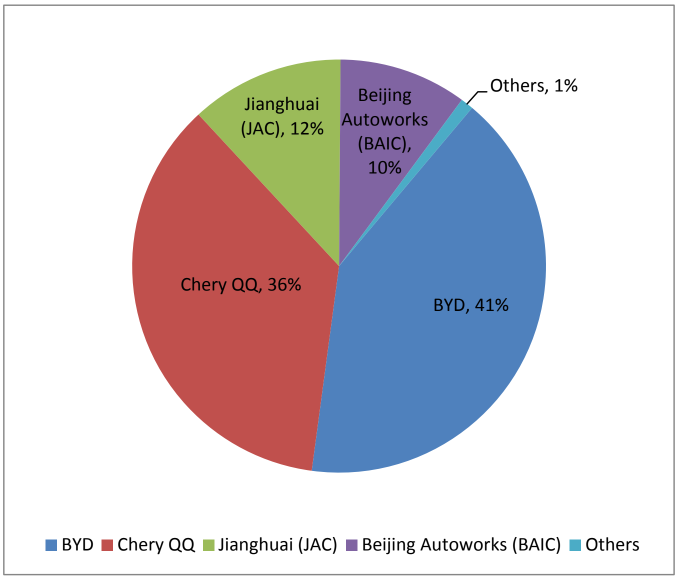
We believe that as China's vehicle fleet continues to grow, emissions will become yet another reason for country to explore alternatives to fossil fuel transportation.

Current Status of Electric Vehicles

According to data published by the China Association of Automobile Manufacturers, in 2011 China produced 8,368 HEV/PHEV/EV vehicles of which 8,159 were recorded as sold within the country. Of the 8,159, 68% were PHEV and PV cars which we believe the great majority were sold into either fleets or demonstration programs. The remaining 32% were traditional HEV models. BYD, one of China's leading automakers reported sales of 401 "E6" EV model cars and 613 "F3DM" PHEV model cars in the same period.

[4] "Atmospheric Environmental Protection in China: Current Status, development Trend and Research Emphasis," Yi, H. et al, Energy Policy 35, 907-915
[5] "Seasonal Trends in PM2.5 Source Contributions in Beijing, China," Zheng, M. et al, Atmospheric Environment 39, 3967-3976
[6] "Source Apportionment of PM2.5 in Beijing in 2004," Song, Y. et al, Journal of Hazardous Materials 146, 124-130

Figure 7: Current Electric Vehicle Market Shares – 2011



Source: China Association of Automobile Manufacturers and DBCCA analysis, 2012.

Charging stations are as important as the vehicles themselves and China has taken the global leadership position with approximately 11,600 recharging stations deployed by the end of 2011, representing 39% of total global recharging stations. China invested approximately USD$160 million in recharging infrastructure in 2011 to support electric vehicles, accounting for 37% of global EV recharging infrastructure investment.[7]

Section II: Electric Vehicles Strategy, Targets and Incentives

In March 2012, the national government released a high-level work plan containing information to steer electric vehicle development through 2015 and 2020. The work plan further clarified manufacturing and fleet targets when updated in early July. The urge for the development of electric vehicles is driven by several national ambitions:

- **Desire to Upgrade Industry** - The sale and manufacture of cars in China has surpassed 15 million units in 2011. Rapid growth of car ownership results in higher fuel consumption and import dependency. In order to achieve a national target diesel consumption of 5 litres/100 kilometer, hybrid vehicle designs will be an inevitable necessity.
- **Desire to Achieve Transportation Manufacturing Leadership** - With the automotive sector identified as one of China’s key “Super Seven” Strategic Emerging Industries[8], development of electric vehicles is an historic opportunity for China’s automobile industry. We believe the government is aiming for China to be a global technology leadership in electric vehicle design and manufacture with clear long-term export ambitions.
- **Desire to Achieve Technology Leadership** - China recognizes that it lags behind in key technologies and components compared to Western competitors. Lagging areas include: battery technology, fuel cell engines, automotive electrical power electronics integration, vehicle and powertrain management software/firmware and semiconductors.
- **Desire to Reduce CO2 by 40%** - In 2008 transportation vehicles accounted for 14% of China’s annual GHG emissions. To mitigate the GHG emissions from the transportation sector, China will have to develop and

[7] “EV Infrastructure: Who’s in pole position?,” Caroline Sindrey, Bloomberg New Energy Finance, April 2012
[8] See DBCCA note “12th Five Year Plan – Chinese Leadership Towards A Low Carbon Economy” http://www.dbcca.com/dbcca/EN/_media/China_12th_Five_Year_Plan.pdf

deploy a broad portfolio of natural-gas hybrid, plug-in hybrid, pure electrical and hydrogen fuel cell vehicles. In grappling aggressively with this problem, China could take a global leadership role vehicle technology.

Explicit Targets By 2015

Focus development efforts on 29 "breakthrough" technologies including:

- Batteries - Quality improvement, recycling, reduction of life-cycle cost and standardization
- Motor system - Hybrid engines/motor assembly (Integrated Starter Generator and Belt Driven Starter Generator) and electromechanical drive train (motor, transmission)
- Development of APU engine generating unit
- New materials - "Intelligent motor management system", IGBT (integrated gate bipolar transistor) chip packages for power switching and hybrid integrated drive system
- Electrical Control - Smart, high efficient, low noise control systems
- Chips - ITS (vehicle intelligence), V2G (vehicle to grid), V2H (vehicle to house), V2V (vehicle to vehicle) semiconductor and microprocessor technology
- Establish 3,000 or more "core technology" patents
- Expand demo and pilot programs beyond cities
- Commercial deployment pilot program in 5 cities
- Establish the full value chain for renewable cars, construction of infrastructure, launch of industrial standard system
- Cultivate expansion of OEM and EV component supply chains
- Establish manufacturing infrastructure that delivers a cumulative 500,000 PHEV/EV vehicle fleet by the end of 2015
- State Grid to build 2,351 battery exchange sites and install 220,000 charging stations

Explicit Targets By 2020

- Achieve an installed fleet of 5 million PHEV/EV vehicles
- Establish a PHEV/EV manufacturing infrastructure capable of producing 2 million vehicles per year.
- State Grid to have installed 10 million charging stations.

China's electric transportation strategy spans the decade through 2020. We expect the key emphasis will be on developing domestic manufacturing integration and component modularization methods and supply chains. Manufacturing and product emphasis is, we believe, likely to focus on a "barbell strategy" with small and economical vehicles for the emerging middle class and non-1st World export markets and at the other end of the spectrum heavier duty fleet vehicles. We believe China aims to execute this strategy in three phases:

1. Small Demo projects
    - 5000 electric/renewable vehicles put into operation in 2009 and 8,000 in 2010
2. 2010-2015 - Industrialization and Commercialization of Small EV's
    - Application of EV's primarily in public service sector
    - Aim for annual deployment rate of 500,000 vehicles by 2015
3. 2015-2020 – Large-scale commercialization of EV and next generation of EV
    - Increase interconnection of EV's and electricity grid

Incentives

To encourage end-market consumption of electric vehicles several tax benefits and purchase incentives have been announced. These benefits are targeted at the end-market and thus serve as positive catalysts for demand.

Tax Benefits

The Ministry of Finance has announced that "high efficiency" fossil fueled cars will be eligible for a 50% waiver of vehicle property tax and a 100% waiver for PHEV and EV electric vehicles. According to a new "vehicle and ship" tax law effective on 1 Jan 2012, small size vehicle would pay no more than 600 RMB/yr for engine capacity less than 2.0 liter. Government records indicate there are approximately 50 passenger vehicle models with engine displacement of less than 1.6L that would qualify.

Purchase Incentives

Figure 8, below, summarizes the national and regional subsidy caps for PHEV and EV cars. At the same time, high efficiency fossil fuel non-electric cars also receive a modest subsidy of RMB 5,000.

Figure 8: National and Regional Maximum PHEV and EV Car Purchase Subsidies - 2012

	PHEV Car Maximum Subsidy	EV Car Maximum Subsidy
National	50,000	60,000
Additional Regional Subsidies		
Beijing	50,000	60,000
Changchun	40,000	40,000
Hangzhou	30,000	60,000
Hefei	20,000	20,000
Shanghai	20,000	40,000
Shenzhen	NA	60,000

Source: various Government Offices and DBCCA analysis, 2012.

Other Incentives

As with wind and solar power, provinces and cities have their own host of local incentives. These benefits are highly regionalized:

- Shanghai: Electric Vehicles are entitled to recharge free anywhere in city
- Shenzhen: Southern Grid to install two recharge stations per car, one at the home and one at the workplace
- Beijing: PHEV and EV car purchases bypass the license plate auction process that restricts the number of new car purchases in any month.

Current Electric Vehicle Options

In Appendix 1 we detail the various vehicles in the PHEV and EV categories that are eligible for the above benefits. Overall, 3 PHEV and 45 EV passenger car/light duty vehicle models, 12 PHEV bus models and 161 fleet/commercial pure EV models that are identified by the national government as eligible for benefits. It is no surprise that the majority of the pure EV vehicles are typically fleet vehicles. Referring to Appendix 1, it is clear that bus and garbage truck models represent the bulk of the current EV category where the "top 10" models account for 53% of model enrollment.

Funding of Electric Vehicle Programs

Funding for these efforts is reported by the national government to be provided through the "864 project plan" and "973 project plan." The central government has announced plans to fund RMB115 billion (USD$18 billion) during the 2011-2020 period. The most recent work plan, however, does not elaborate further on the timetable for release of funds, nor does it address the ultimate budgetary source of the funds. Of the disclosed RMB115 billion of planned funding, RMB50 billion (USD$8 billion) is to be allocated for research and development and patent formulation for electric vehicle technology and manufacturing development; RMB30 billion (USD$5 billion) is intended to support electric vehicle demonstration programs; RMB 35 billion (USD$5 billion) is intended for use to encourage the use of electric vehicles which we interpret to mean public charging infrastructure and potential purchase price subsidies.

Section III: Electric Vehicles Forecast

The Chinese government estimates that the number of passenger cars (all engine types) on the road will reach 150 million by 2020 and 250 million by 2030. In comparison, Morgan Stanley research estimates 203 million by 2020[9], materially above the government's forecast. As a point of contrast, the US had ~255 million highway vehicles in 2011 of which ~194 million are passenger vehicles and small trucks.

LMC Automotive Ltd. forecasts that in 2015 China will purchase approximately 28 million vehicles of which 21 million are estimated to be passenger vehicles and 7 million are commercial vehicles. As a comparison, LMC Automotive estimates that in 2015 the US market will comprise sales of 16.4 million personal and commercial vehicles.

In terms of manufacturing resources, domestic manufacturers BYD, Chery, Geely and Great Wall, in 2011 we estimate, based on company reports and news releases collectively have annual manufacturing capacity of approximately 2.9 million vehicles per year. The balance of China's automotive sector is dominated by SOE-Western JV operations who we estimate have collective approximate manufacturing capacity of 13.3 million vehicles, or 4.6x that of the pure domestic manufacturers. Figure 9, below, illustrates estimated potential output capacity based upon company expansion announcements.

Figure 9: Estimated Current and Future Manufacturing Capacity, 2011- 2013

(000's of vehicles)	2011	2012	2013
Pure Domestic Manufacturers (BYD, Chery, Geely, Great Wall)	2,880	3,180	3,650
SOE-Western JV Manufacturers	13,253	15,735	18,145
Total	**16,133**	**18,915**	**21,795**

Source: China Association of Automobile Manufacturers, various company and news reports and DBCCA analysis, 2012.

Given the very early stage of PHEV/EV development in China, forecasts for these electric vehicles are subject to considerable uncertainty given technology immaturity, scaling of manufacturing capacity and consumer adoption. To address these uncertainties, we forecast two different scenarios. The first forecast, entitled "Government Target Forecast," illustrates a possible trajectory that would achieve China's world-leading goals for electric vehicle deployment and manufacture that are summarized in Figure 10 immediately below:

[9] Morgan Stanley "Electric Vehicle and Earnings Model," 28 February 2012, A. Jonas et al

Figure 10: China's Electrified Vehicle Goals [(1)]

Target	2015	2020
Cumulative PHEV/EV Fleet	500,000	5,000,000
Production Capacity PHEV/EV (vehicles per year)	No Target	2,000,000/year

Source: MIIT "China Energy-Efficient and New-Energy Vehicles Industrial Plan 2012-2020" and DBCCA analysis, 2012.
Note 1: China's goals and targets refer to "vehicles" and do not draw distinctions between passenger cars/light duty vehicles versus trucks, buses, construction or agricultural vehicles.

The second forecast entitled "DBCCA Pragmatic Forecast," represents our view that technological, manufacturing execution and end-market adoption may prove more challenging unless China is able to achieve superior world-leading innovation in battery and drive train technologies and manufacturing cost reduction. Both the "Government Target Forecast" and "DBCCA Pragmatic Forecast" can be found in Figure12 and Figure 13 , below. If China is able to develop innovative solutions to battery and drive train technological constraints and cost barriers at a pace faster than that of Western developers, we believe, contingent upon such potential world-leading advances, China may be able to expand the market faster than we forecast in our DBCCA Pragmatic Forecast.

Forecasting Methodology

The PHEV/EV market in China requires forecasting both the manufacturing side and demand side of the sector. Setting aside market adoption issues for the moment, China targets both installed fleet for 2015 and 2020 and manufacturing capacity by 2020. Thus both our Government Target Forecast and DBCCA Pragmatic Forecast scenarios are based on a common manufacturing base forecast. The key difference between the "Government Target Forecast" and our "DBCCA Pragmatic Forecast" is one of production output and end-market adoption. The nature of China's industrial system and provincial political-economic dynamics suggests that achieving the targeted manufacturing capacity is less of a risk, in our view, than achieving desired end-market demand which is effectively a reflection capturing buyers' aggregate sentiments concerning the fine balance of price, performance and ownership expectations.

Manufacturing Forecast

We assume plant expansion will begin modestly in the 2012 and 2013 period, commencing significant expansion in 2014 and beyond. In any large scale manufacturing exercise, new capacity expansion does not immediately "turn on" at full capacity. In the case of the auto sector, ramping up a new plant to full capacity can take up to 2 years. We assume that in the year a manufacturing expansion is completed, the incremental capacity contributes no more than 50% of its "nameplate" or rated capacity. In the second year of operations, we assume that manufacturing units can produce 90% of nameplate capacity. Thereafter, we assume the units are capable of producing at full capacity.

In both our Government Target Forecast and DBCCA Pragmatic Forecast models, we estimate the annual "end of year" (EOY) name plate capacity and the "ramped" or realizable manufacturing capacity that we estimate may be available for actual production. The rapid rate of manufacturing expansion through 2020 results in significant portions of nameplate capacity that in any year is not fully productive. Thus, significant differences exist between available "ramped" manufacturing capacity and nameplate capacity. Based on our 2020 manufacturing forecast, we believe ramped capacity capable of production will approximate 88% of nameplate capacity at the end of the year. We do believe China's goals will focus on nameplate capacity installed at the end of 2020 and that it is well within China's capability to put in place by 2020 2 million cars/year of manufacturing nameplate capacity.

End-Market Forecast

China aims to expand the PHEV/EV fleet vehicles on the road from current negligible levels to 500,000 by 2015 and to 5,000,000 by 2020. Should China achieve these goals by 2020, China's PHEV/EV fleet of 5 million vehicles would represent 43% of the global PHVE/EV fleet and 0.4% of the total global passenger vehicle fleet (all engine types) based on global forecast data published by Morgan Stanley[10]. This presumes that current technology constraints on battery performance and economics are solved as well as electric drive train designs are perfected and that a recharging infrastructure deemed adequate by potential consumers exist. In our DBCCA Pragmatic Forecast we capture these risks and believe the uptake of vehicles by the end-market may be 30% slower than implicitly envisaged by the government targets. Consequently, our fleet forecasts for 2015 and 2020 are more cautious than the government targets.

Typically China is successful when it comes to achieving major goal items linked to the five-year planning process. We believe China's PHEV/EV goals are ambitious and achievement of them would be a magnificent demonstration of technological and manufacturing prowess. Yet, since the sector is so new, we believe it may prove challenging to solve both technology and manufacturing problems on the supply side while the end-market consumer behaviors are uncertain.

In considering the end market, we believe the Chinese consumer exhibits similar "rational actor" behavior in choosing an automobile. Since an automobile is the second most significant expenditure for a family following purchase of a home, it is not surprising that comparative vehicle cost is an important issue. Other key factors are perceptions of performance, quality and status.

Considering price, Figure 11, below provides an approximate segmentation by price point of the recent sales data over the 2010-2011 period. Although the data is approximate, we believe it conveys the clear point that China's car market is accustomed to (and can afford) a low-price point vehicle.

Figure 11: Estimated China Auto Sales Segmentation by Price – 2010 and 2011

PHEV/EV Subsidy Range	PHEV/EV Price Range (After Subsidies)	China Aggregate Car Price Range (RMB)	% of Sales	Cumulative % of Group
		< 60,000	22%	22%
		60,000 – 90,000	15%	37%
Low Subsidy RMB70k	~100,000	90,000- 130,000	24%	61%
		130,000 – 170,000	15%	76%
High Subsidy RMB120K	~220,000	170,000 – 280,000	18%	94%
		>280,000	5%	100%

Source: SOHU.COM market price and volume data and DBCCA analysis, 2012.

Notice that in Figure 11 above, that 61% of the auto sales occurs at a price point of less than RMB 130,000. This is consistent with other market data indicating an approximate median price of RMB 100,000.

Currently the price for PHEV and EV's before subsidies can range from RMB 170,000 up to RMB 340,000. Thus, for example, after maximum subsidies of RMB 70,000 on the low end to RMB 120,000 on the high end, China's current crop of PHEV's and EV's might cost the consumer RMB 100,000 (low end) to RMB 220,000 (high end). Given the current price point segmentation, we believe "post subsidy" PHEV and EV offerings in China may not

[10] Morgan Stanley "Electric Vehicle and Earnings Model," 28 February 2012, A. Jonas et al

have the price appeal necessary to offset consumer concerns over battery replacement lifetime and costs, vehicle reliability, recharging accessibility and convenience. The current purchase price subsidy range we estimate addresses approximately 29% of the aggregate end market. If China were to increase the purchase price subsidies, we believe that could serve as meaningful tool to speed the pace of adoption which would then lead to higher manufacturing volumes reducing costs in a virtuous cycle.

To put these price points in perspective, we believe it is useful to examine urban household income. In 2011 the average urban wage in Beijing was approximately RMB 77,000 (USD$12,000). We do not have detailed income segmentation data to provide insight into the proportion of the market that could now afford a PHEV/EV. We do, however, believe that if China were to increase the purchase price subsidy to RMB 110,000 at the low end (from RMB 70,000) and to RMB 200,000 at the high end (from RMB 120,000), the "after subsidy" price points would meaningfully expand the accessible portion if the customer end-market. If China was to increase the purchase price subsidies as we describe above, we believe PHEV and EV offerings could address 66% of the market rather than the 29% now addressed.

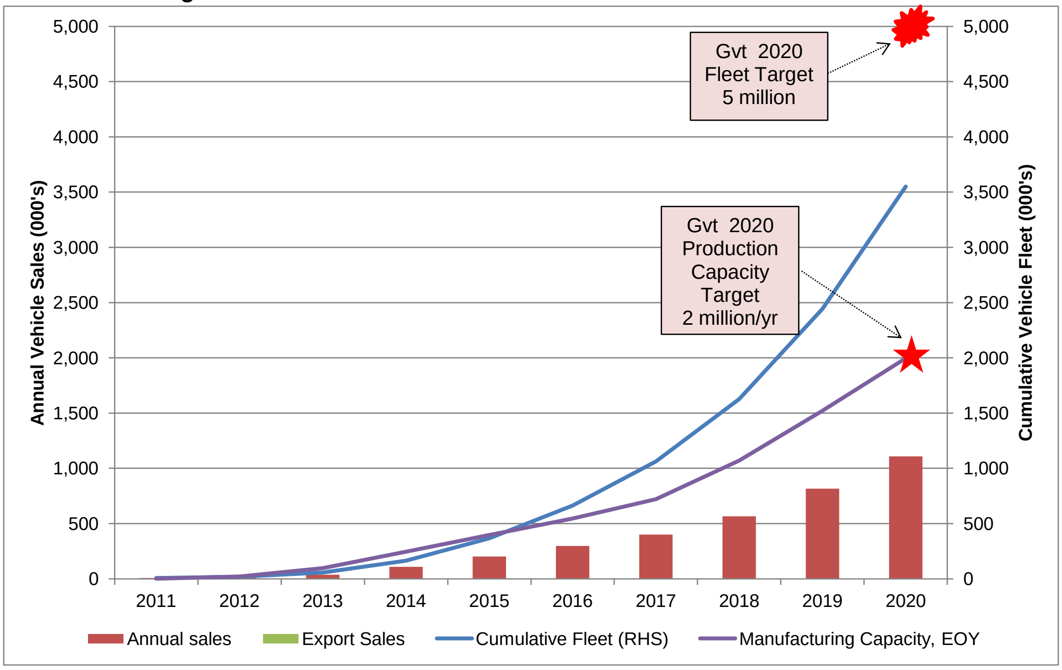
Beyond pricing and customer purchase dynamics, there are other dimensions to forecasting end market consumption of vehicles that typically include vehicle lifecycle wastage, replacement or scrapping trends. In our simple analysis we have not modeled these aspects given the significant unknowns surrounding final vehicle design.

Figure 12: Government Target Forecast and DBCCA Pragmatic Forecast

Government Target Forecast (000's)	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Domestic Fleet, Cumulative	20	72	226	515	939	1,510	2,316	3,482	5,065
Annual sales	**14**	**53**	**154**	**289**	**424**	**571**	**806**	**1,166**	**1,583**
Plant Utilization (% of Ramped Capacity)	100%	90%	90%	90%	90%	90%	90%	90%	90%
Realizable Ramped Manufacturing Capacity	14	59	171	321	471	634	896	1,296	1,759
Manufacturing Capacity, Installed EOY	21	96	246	396	546	721	1,071	1,521	1,996
Annual Capacity Expansion	15	75	150	150	150	175	350	450	475
DBCCA Pragmatic Forecast (000's)	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Domestic Fleet, Cumulative	20	56	164	366	663	1,063	1,627	2,443	3,551
Annual sales	**14**	**37**	**108**	**202**	**297**	**400**	**564**	**816**	**1,108**
Plant Utilization (% of Ramped Capacity)	100%	63%	63%	63%	63%	63%	63%	63%	63%
Realizable Ramped Manufacturing Capacity	14	59	171	321	471	634	896	1,296	1,759
Manufacturing Capacity, Installed EOY	21	96	246	396	546	721	1,071	1,521	1,996
Annual Capacity Expansion	15	75	150	150	150	175	350	450	475

Source: MIIT "China Energy-Efficient and New-Energy Vehicles Industrial Plan 2012-2020" and DBCCA analysis, 2012.
Yellow-shaded data indicated government goals. Yellow-outlined data indicates information comparable to government goals.

Figure 13: DBCCA Pragmatic Forecast Details



Source: MIIT "China Energy-Efficient and New-Energy Vehicles Industrial Plan 2012-2020" and DBCCA analysis, 2012.

We view China's electric vehicle goals as "stretch" ambitions. Achieving them would represent a remarkable achievement with a 5 million PHEV/EV fleet representing 43% of an estimated 2020 global PHEV/EV fleet[11]. However, with the challenges of battery design, development of domestic drive train systems and the refinement and cost minimization exercises to lower costs, we believe much work needs to be done and that China may be more likely to achieve creation of a more modest fleet by 2020 approximating 70% of national goals. This would represent a significant accomplishment for China as doing so would mean China would have sold more PHEV's and EV's in nine years than Toyota sold Prius' in 14 years.

There is considerable variance (and paucity) in long-term sell-side forecasts for electric vehicles in China. Figure 14, below sets forth sample published forecasts by three firms with global automotive coverage teams. Confusion can arise when distinctions are drawn between regular hybrid electric cars (HEVs) and plug-in hybrids (PHEVs) and pure electric cars (EVs). Further, not all firms have comprehensive or consistent forecasts across the three electric vehicle verticals. *In the case of China's goals for 2015 and 2020, PHEV's and EV's are all included with no specific sub-category targets. HEV's are not included nor do goals and targets for them exist.*

[11] Morgan Stanley "Electric Vehicle and Earnings Model," 28 February 2012, A. Jonas et al

Figure 14: Sample Comparative Sell-Side PHEV/EV Forecast Data

Passenger/Light Vehicle	2015			2020		
Annual Sales (000's)	**PHEV**	**EV**	**Elec Total**	**PHEV**	**EV**	**Elec Total**
Deutsche Bank Securities Inc. (1)	210	314	524	1,318	1,976	3,294
Goldman Sachs	36	72	108	694	925	1,619
Morgan Stanley	127	42	169	559	301	860
Cumulative Fleet						
Deustche Bank Securities Inc.	NA	NA	NA	NA	NA	NA
Goldman Sachs	NA	NA	NA	NA	NA	NA
Morgan Stanley	NA	NA	355	NA	NA	2,869
DBCCA (2) Forecast Annual Sales	NA	NA	202	NA	NA	1,108
DBCCA (2) Forecast Cumulative Fleet	NA	NA	366	NA	NA	3,551
Goldman Sachs Commercial Vehicle Sales (HEV/PHEV and EV)			55			290
Government Targets						
Annual Manufacturing Capacity			No Goal			2,000
Cumulative Fleet Size			500			5,000

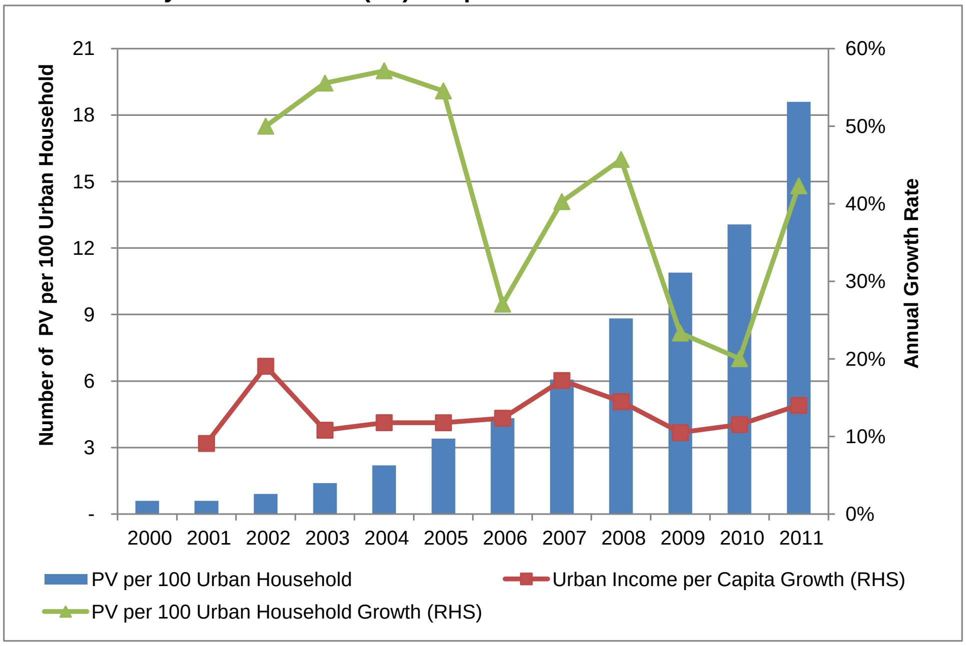
Source: Deutsche Bank Securities Inc., Goldman Sachs, Morgan Stanley and DBCCA analysis, 2012.
Yellow- and red-outlined data indicate comparisons to government targets.
Note 1: Deutsche Bank Securities Inc. is the US-based broker dealer entity.
Note 2: Deutsche Bank Climate Change Advisors (DBCCA) is a unit of Deutsche Bank's Deutsche Asset Management division.

We believe if China could achieve only 70% of the above hypothetical trajectory in Figure 12 and Figure 13, such an accomplishment would be an excellent outcome, resulting in a hypothetical annual sales rate of 1 million electric vehicles by 2020 in a market environment where Morgan Stanley forecasts global passenger vehicle sales (all engine types) of 106.8 million[12]. To put this hypothetical annual sales run rate in perspective, Toyota in 2011 reported sales of 253,000 Prius in Japan, 137,000 in the USA and 26,000 in Europe. Since introduction of the car in 1997, Toyota has sold 2.9 million Prius worldwide through 2011. Including all other hybrid cars sold under Toyota's various brands; cumulative sales for the 1997-2011 period are reported by Toyota to approximate 4 million cars.

In terms of demand, since it is "early days" for electric vehicles it is not possible to formulate a precise demand model in China. It is, however, worthwhile to consider the overall appetite for vehicles as well as increasingly strict emissions criteria.

[12] Morgan Stanley "Electric Vehicle and Earnings Model," 28 February 2012, A. Jonas et al

Figure 15: Urban Privately-Owned Vehicle (PV) Adoption Trends

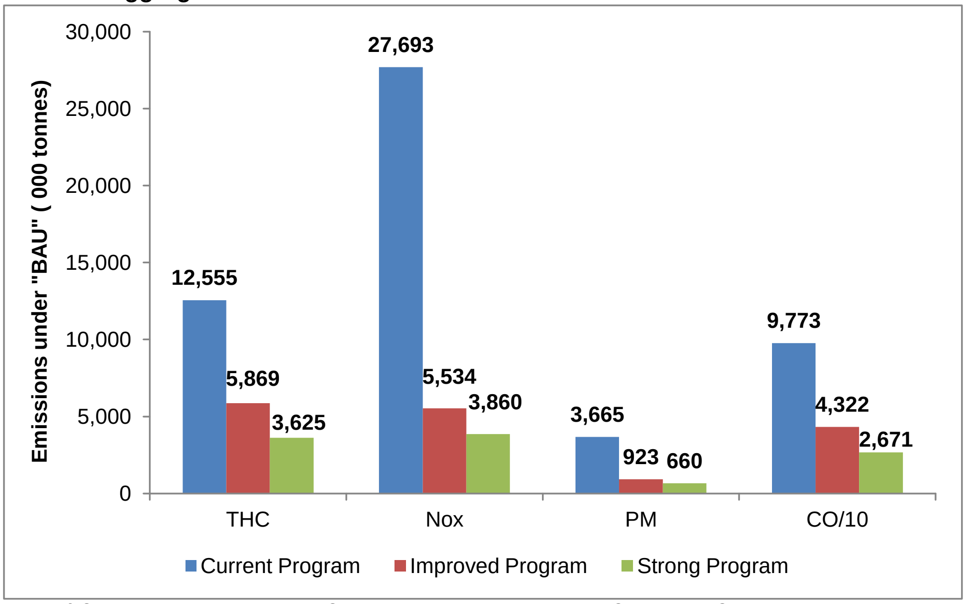


Source: CEIC and DBCCA analysis, 2012. PV = Privately-owned vehicle

Urban per capita income growth in China has grown at an average approximate 15% annual rate. This prosperity has delivered material spending power into the purses of urban families and has driven a dramatic increase in car sales as depicted in Figure 15. The penetration of privately owned vehicles, measured as the number of vehicles per 100 people, has expanded at a compound average annual growth rate of 41% from 2001 through 2011. With urbanization now at 50% in China and trends pointing toward approximate 65% urbanization levels by 2035, we believe the demand for vehicles in the urban areas will continue to increase. In particular, this large urban population may likely have a preference for smaller more efficient vehicles compared to those currently on the market. This preference may manifest as both a "price point" and "convenience" desire. We believe China's and the world's automakers will likely keep a close eye on the preferences of the urbanized Chinese consumer as they plan future electric vehicle designs.

While income and urbanization trends may drive aggregate demand for private cars, we believe the increasingly strict emissions measures to control NO_x and particulate emissions will also serve to push the market toward electric vehicles as an increasingly prosperous population becomes more mobile. Figure 16, below, illustrates the International Council on Clean Transportation's and China's Ministry of Environmental Protection's estimates of vehicle emissions by 2030 under a "business as usual" case as well as two other scenarios invoking stricter emissions criteria. Very simply, continuing to rely on traditional internal combustion engines (ICEs) for vehicular transportation will likely make it difficult for China to materially restrain the growth in emissions against a backdrop of an expanding vehicle fleet. Developing a commercial-scale domestic electric vehicles industry could, in our view, contribute meaningfully to emissions reductions vis-a-vis trade internal combustion engines.

Figure 16: Forecast Aggregate Vehicle Emissions Scenarios - 2030



Source: "Overview of China's Vehicle Emissions Control Program," International Council on Clean Transportation, 2010, and DBCCA analysis, 2012.

Section IV: Challenges

Electric transportation is in its infancy around the world. The majority of the electric vehicles on the road combine small internal combustion engines with batteries and electric motors for propulsion. Consequently, costs remain high due to complex drive trains and expensive batteries. PHEV's and EV's, far more modest in terms of current penetration compared to HEV's, are burdened by recharging point costs in addition to higher charging, battery and drive train costs. In our view, the industry (including the HEV sector) is in its infancy and thus manufacturing scale worldwide has not yet reached volume levels to have allowed meaningful cost minimization of electric vehicles.

In considering how successful China will be in scaling electric vehicles, it is useful to examine the current cost structure of electric vehicles and some forward looking approximations. The key differences between a traditional internal combustion car and a electric vehicle lie in the powertrain and fuel system. Aside from this, there are not many significant cost differences associated with building the vehicle. Internal combustion cars use a gasoline, diesel or natural gas engine coupled to a manual or automatic transmission to convey power to the wheels. In an electric vehicle, an electric motor provides the power through a different "infinitely variable" automatic transmission. Rather than carrying liquid fuel, a purely electric vehicle uses a large battery to store energy for the electric motor. The electric motor also acts as a generator when the car is braking, sending the recovered energy back into the battery. A hybrid-electric (HEV or PHEV) combines both power systems and thus is burdened with the costs of both motor systems. In Figure 17, below, we illustrate typical cost structures and approximate estimates for costs based on current technology trends and targets. We cannot be sure the cost reductions set forth below will occur on the approximate timetables discussed.

Figure 17: Electric Car Comparative Cost Structure Estimates

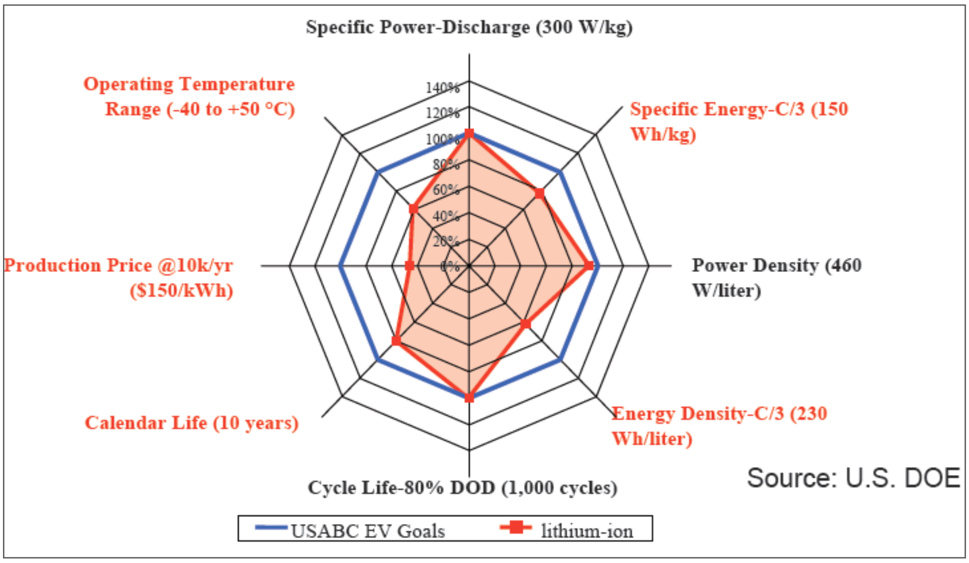
Component	Internal Combustion Engine (ICE)	Electric Vehicle (Current)	Electric Vehicle (~2015)	Electric Vehicle (~2020)
Powertrain (ex Battery)	$6,000	$10,000	$4,000	$3,600
Battery (1)	NA	$15,000	$8,000	$4,200
Non-Powertrain	$11,000	$11,000	$11,000	$11,000
Margin	$5,000	$3,000	$5,000	$5,000
Total	$22,000	$39,000	$28,000	$23,800
Premium vs. ICE	NM	77%	27%	8%
Cost Decline vs. Current	NM	NM	-28%	-39%

Note 1 - Assumes 24 kWh batteries in all electric vehicle examples. NA= Not Applicable; NM = Not Meaningful
Source: Interview with Dan Galves, Deutsche Bank Securities and DBCCA analysis 2012.

With global electric vehicle volumes still quite low compared to aggregate vehicle manufacture, we believe the key sub-components – electric powertrain and battery – have not yet been optimized. Though we cannot predict the pace of technological innovation, we do believe strongly that both technology innovation and cost scaling advantages on orders of magnitude more manufacturing volume will reduce costs. China has identified many of the key subcomponents in an electric vehicle as targets for development emphasis through 2020. With the proper application of policy mechanisms and incentives, we believe that China could be a key player in "cracking the cost code" and bringing a more economical electric vehicle platform to the world.

Battery technology in terms of both performance and cost remains a significant challenge for the sector. Figure 18 illustrates the key design parameters for an electric vehicle battery and the status of lithium-ion batteries using 2003 technology.

Figure 18: Desired Auto Propulsion Battery Characteristics



Source: "The Electric Vehicle Battery Landscape: Opportunities and Challenges," Center for Entrepreneurship & Technology (CET) technical Brief, 2009, and DBCCA analysis 2012.

Battery technology has continued to improve since 2003, the time period for which the lithium ion battery performance data above applies. We note that the greatest deficiency of lithium-ion batteries used in transportation was identified as manufacturing cost, not electrical performance. This challenge is a manufacturing engineering problem and, like so many other seemingly intractable problems, will be solved. We cannot forecast by when, though we are confident that ingenuity and materials science advances will decrease costs.

As a comparison, laptop battery costs of $2,000/kWh in the mid-90's and decreased by 88% to current costs of USD$250/kWh. Similarly, lithium-ion batteries for cars are currently priced at USD$600-USD$800/kWh and are forecast to decline to approximately USD$275/kWh by 2020[13]. More aggressively, the US DOE maintains a target cost of USD$150/kWh by 2020. We anticipate that much of the innovative development efforts in the coming years will be focused on improving battery cost and performance.

One topic that we think influences the pace of adoption is that of recharging methodology. The methods can be segmented into two groups: "recharge on board" or "recharge away from car." We will not discuss in detail the various recharge methods for recharging the PHEV/EV battery while in the car. There are several different methods utilizing low and moderate capacity on-board AC to DC converters as well as external high capacity converter charging methods. There are pros and cons to each one and some will be better suited for high volume fleet or mass transit applications while others are better suited for typical private car use.

The "recharge away for the car" method relies on a rapidly and easily replaceable battery that a "recharge center" or car repair center could remove in minutes and replace with a fully charged battery. To date, China's State Grid has built a total of 168 battery swap stations targeting the bus and taxi market, rather than the retail users. China's 168 battery swap stations make up approximately 87% of global recharge station development through the end of 2011[14]. This method of "refueling" a vehicle presents several issues for both the manufacturers and owners/operators. From a design perspective, swapping the battery on a routine basis requires fundamentally different vehicle design to provide for easy access. From an owner's perspective, this method of refueling is likely to only be practical for fleet vehicles with a trained workforce and facilities capable of fast and economical swapping. Should automakers choose to standardize a particular battery design and location in all types of vehicles, this method might be an option for the broader consumer market. Speed of swapping the battery with minimal vehicle disruption would be critical to the success of a battery swapping becoming a broad market refueling methodology.

There are no simple answers to the above questions. As various vehicles are developed for differing applications, we expect the technological Darwinian process to identify the best formulations for differing key markets. Until then, we expect the industry will be faced with having to develop and experiment with several different methods. Consequently, this evolutionary process could extend the time to large scale deployment and thus slow the pace of cost minimization. Despite these challenges, we see the market ultimately identifying the surviving innovative methods. Like any interconnection technology (rail, pipe or data connections), several years of market experience will likely be necessary to identify the winning methods and technologies.

Section V: Job Creation and Investment Opportunity

We can look to auto manufacturing sites in the America, Europe and Asia for touchstones on jobs creation opportunities. As an example, Hyundai's Ulsan plant produces approximately 1.53 million cars per year with approximately 34,000 employees. Toyota's Burnaston Derby site produces 200,000 cars per year with a workforce of 3,000 and General Motors' Ellesmere Port plant produces approximately 220,000 annually with approximately 2,800 workers. Figure 19, below, converts these statistics into a "cars/worker/year" metric. It is important to note that these figures include only those workers at the car assembly sites and do not include the myriad workers that produce components further down in the supply chain.

[13] *"Vehicle Electrification," Dan Galves, Deutsche Bank Securities, June 2012*
[14] *"EV Infrastructure: Who's in pole position?," Caroline Sindrey, Bloomberg New Energy Finance, April 2012*

Figure 19: Comparative Auto Production Measures

	Annual Plant Capacity (000’s vehicle/year)	Workforce Headcount (# of employees)	Cars/Worker/Year
Hyundai Ulsan	1,530	34,000	45
Toyota Burnaston	200	3,000	67
GM Vauxhall Ellesmere Port	220,000	2,800	79

Source: Various company press releases and DBCCA analysis 2012.

If an average of the above data - 63 cars per worker per year - is assumed for estimation purposes, China’s ambition of producing 1.5 – 2.0 million electric vehicles per year by 2020 would suggest an employee base for these new factories of approximately 24,000 – 32,000.

In terms of economic value, current prices for pure EV cars in China are ~RMB340,000 while PHEV’s are in the RMB150,000 – 170,000 range. Assuming a 25% cost reduction for PHEV by 2020 the price per car would be ~RMB113,000 – 128,000. Assuming EV cars might experience an approximate 55% cost reduction (see Figure 17, above), prices by 2020 might approximate RMB150,000 (USD$23,800) per car. Assuming a 70% PHEV/30% EV mix and using these assumed prices, we believe a hypothetical market size by 2020 might approximate RMB227 billion (USD$36 billion) in revenues for 1.75 million vehicles produced per year.

In traditional internal combustion vehicles, the engine-transmission powertrain represents approximately 27% of the total vehicle cost. By 2020, for electric vehicles the battery may represent 39% of vehicle cost and the electric drive train another 15%. Thus the economic value of the innovative electrical drive and energy system might approximate RMB86 billion (USD$14 billion) by 2020 based on the above price and volume assumptions set forth in Figure 12 and 17, above. We are unable to estimate component costs for the electric motor, regenerative braking circuitry, variable transmission and control systems. We do believe, however that these subcomponent areas, in addition to the rechargeable battery and charging systems, present significant innovation and investment opportunities.

Shifting focus to charging stations, China has a target of 10 million recharging points by 2020. Currently charging points in the US and Europe cost approximately USD$4,000. Assuming these costs can be reduced by 50% as a result of scale economies, the cumulative total investment by 2020 for 10 million charge points might be ~RMB 125 billion (USD$20 billion).

Appendix 1 – PHEV and EV Models Eligible for Tax Benefits, 2012

Passenger Vehicles - PHEV & EV & FC

Manufacturer	Chinese Name	Number of Vehicle Models	EV	PHEV	FC
Hunan Jiangnan Motor	湖南江南汽车制造有限公司	15	14	0	1
BYD	比亚迪汽车有限公司	4	3	1	0
Foton	北汽福田汽车股份有限公司	3	3	0	0
Zhengzhou Nissan	郑州日产汽车有限公司	3	3	0	0
Chery	郑州日产汽车有限公司	5	4	0	1
Faw Group	中国第一汽车集团公司	2	1	1	0
Chongqing Changan	重庆长安汽车股份有限公司	3	2	0	1
Geely	浙江吉利汽车有限公司	1	0	1	0
Faw-Volkswagen	一汽-大众汽车有限公司	1	1	0	0
Dongfeng Motor	东风汽车公司	1	1	0	0
Shanghai Volkswagen	上海大众汽车有限公司	2	1	0	1
Shanghai GM	上海通用汽车有限公司	1	1	0	0
Hafei auto	哈飞汽车股份有限公司	1	1	0	0
Zhejiang Haoqing (Geely)	浙江豪情汽车制造有限公司	1	1	0	0
JAC Motor	安徽江淮汽车股份有限公司	1	1	0	0
Soueast Motor (Fujian)	东南(福建)汽车工业有限公司	1	1	0	0
changhe-suzuki	江西昌河铃木汽车有限责任公司	1	1	0	0
Jiangling Motor	江铃控股有限公司	1	1	0	0
Haima	海马轿车有限公司	1	1	0	0
Faw Haima	一汽海马汽车有限公司	1	1	0	0
SAIC Group	上海汽车集团股份有限公司	3	0	0	3
BAIC motor	北京汽车股份有限公司	1	1	0	0
Great Wall Motor	长城汽车股份有限公司	1	1	0	0
Chongqing Lifan	重庆力帆乘用车有限公司	1	1	0	0
Total		**55**	**45**	**3**	**7**

Source: Ministry of Tax, Ministry of Finance and Ministry of Technology and Information.
EV= Electric Vehicle, PHEV = Plug-In Hybrid Electric Vehicle, FC = Fuel-Cell Vehicle

Mass Transport Buses - PHEV & FC

Manufacturer	Chinese Name	Number of Vehicle Models	PHEV	FC
Shanghai Sunwin	上海申沃客车有限公司	1	1	0
Yangzhou Yaxing Coach	扬州亚星客车股份有限公司	1	1	0
Anhui Ankai	安徽安凯汽车股份有限公司	1	1	0
Guilin Coach	桂林客车工业集团有限公司	1	1	0
Suzhou Jinlong (Higer)	金龙联合汽车工业(苏州)有限公司	2	2	0
Zhongtong Bus	中通客车控股股份有限公司	1	1	0
Jiangxi Kaima Bonluck Coach	江西凯马百路佳客车有限公司	2	2	0
Hunan CSR times Electric Vehicle	湖南南车时代电动汽车股份有限公司	1	1	0
Shenzhen Wuzhoulong Motors	深圳市五洲龙汽车有限公司	1	1	0
Chongqing Ruichi Motors	重庆五洲龙新能源汽车有限公司	1	1	0
Foton	北汽福田汽车股份有限公司	1	0	1
Shanghai Sunwin	上海申沃客车有限公司	3	0	3
Total		**16**	**12**	**4**

Source: Ministry of Tax, Ministry of Finance and Ministry of Technology and Information.
Notes: All above vehicle models are mass transportation vehicles.

Commercial Vehicles - EV

Manufacturer	Chinese Name	Number of Vehicle Models	City Bus	Coach and Large bus	Transporation Truck	Garbage Truck	Postal Truck	Sprinkler/ Cleaning Truck	Service Van/ Enginering Truck
Beijing Hualin Special Vehicle	北京华林特装车有限公司	22				19		3	
Anhui Ankai	安徽安凯汽车股份有限公司	16	10	5					1
Foton	北汽福田汽车股份有限公司	9	5			3		1	0
Shanghai Sunwin	上海申沃客车有限公司	9	9						
Shenzhen Wuzhoulong Motors	深圳市五洲龙汽车有限公司	7	6	1					
Dongfeng	东风汽车公司	6	3		2	1			
Zhengzhou Yutong	郑州宇通客车股份有限公司	5	5						
KingLong (Xiamen)	厦门金龙联合汽车工业有限公司	5	4	1					
Henan Shaolin Bus	河南少林汽车股份有限公司	4	3	1					
Nanjing Automobile	南京汽车集团有限公司	3		1				1	1
Changsha BYD	长沙市比亚迪客车有限公司	3	3						
Beijing Jinghua Bus	北京市京华客车有限责任公司	3	3						
Shanghai Sulong bus	上海申龙客车有限公司	3	3						
Shanghai Wanxiang (Daewoo)	上海万象汽车制造有限公司	3	3						
Jiangsu Alfa Bus	江苏常隆客车有限公司	3	2	1					
Jiangxi Kaima Bonluck Coach	江西凯马百路佳客车有限公司	3	3						
Hunan CSR times Electric Vehicle	湖南南车时代电动汽车股份有限公司	3	1	2					
Chengdu Shudu Motors	成都客车股份有限公司	3	3						
North Neoplan	北京北方华德尼奥普兰客车股份有限	2		2					
BAIC Motor	北京汽车股份有限公司	2		1	1				
Soueast Motor (Fujian)	东南(福建)汽车工业有限公司	2			1		1		
Zhengzhou Nissan	郑州日产汽车有限公司	2							2
GAC Bus	广州汽车集团客车有限公司	2	2						
Guilin Coach	桂林客车工业集团有限公司	2	2						
Sichuan Auto Industry Group	四川汽车工业股份有限公司	2	2						
Suzhou Jinlong (Higer)	金龙联合汽车工业(苏州)有限公司	2	1	1					
Zhongtong Bus	中通客车控股股份有限公司	2	1	1					
Beijing Tianlutong Tech	北京天路通科技有限责任公司	2						2	
Tianjin Qingyuan Electric Vehicle	天津清源电动车辆有限责任公司	2					1		1
Yancheng Zhongwei Bus (Zonda)	盐城中威客车有限公司	2	1	1					
Jiangxi Motor Group Specialty Vehicle	江西江铃汽车集团改装车有限公司	2							2
Shangdong Yixing Electric Auto	山东沂星电动汽车有限公司	2	2						
Chongqing Ruichi Motors	重庆瑞驰汽车实业有限公司	2			1		1		
Yangzhou Yaxing Coach	扬州亚星客车股份有限公司	2	2						
FAW Group	中国第一汽车集团公司	1	1						
Faw bus and coach (Dalian)	一汽客车大连客车厂	1	1						
Huanghai bus (Dandong)	丹东黄海汽车有限责任公司	1	1						
Ningbo Shenma Auto	宁波神马汽车制造有限公司	1	1						
JAC Motor	安徽江淮汽车股份有限公司	1							1
Shaanxi Auto	陕西汽车集团有限责任公司	1							1
Golden Dragon	厦门金龙旅行车有限公司	1	1						
Chongqing hengtong	重庆恒通客车有限公司	1	1						
Jilin Gaoxin Eelectric Vehicle	吉林省高新电动汽车有限公司	1	1						
Zhangjianggang Jiangnan Auto	张家港市江南汽车制造有限公司	1	1						
Kangdi new energy auto(Jinhua)	金华市康迪新能源车辆有限公司	1			1				
Anhui Ankai Vehicle manaufacturing	安徽安凯车辆制造有限公司	1	1						
Fujian Longma Environmental	福建龙马环卫装备股份有限公司	1						1	
Jiangxi Shangrao Coach	江西博能上饶客车有限公司	1		1					
China-Rising Motors	中上汽车有限公司	1	1						
Dongfeng Yangtse Motors	东风扬子江汽车(武汉)有限责任公司	1	1						
Changsha Zoomlion Heavy Industry	长沙中联重工科技发展股份有限公司	1							1
Zhuhai Guangtong Auto	珠海市广通汽车有限公司	1	1						
Changchun Huaao	长春华奥汽车制造有限公司	1	1						
Total		**161**	**92**	**19**	**6**	**23**	**3**	**8**	**10**

Source: Ministry of Tax, Ministry of Finance and Ministry of Technology and Information.

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