THE MOTOR INDUSTRY SMMT

UK TRADE & INVESTMENT

ACCESSING INTERNATIONAL MARKETS

CHINA

NEW VEHICLES, NEW MARKET, NEW OPPORTUNITIES

Fast track to the world UK

CONTENTS

1 PREFACE

Background

The first decade of the C21st has proved a turbulent time for the global automotive industry. Vehicle makers are struggling to maintain profitability, to adapt to the rise of emerging markets and to meet the costs and demands of new technologies. Some of these challenges are not new. One hundred years ago the battle between the internal combustion engine and electric vehicle propulsion was still undecided, and the epicentre of the industry was shifting - from its origins in Europe to the new industrial powerhouse of the USA.

In 2009, China decisively overtook the USA as the world's No 1 automotive market. Total vehicle sales in China reached 13.6 million. Even when the 650,000 heavy commercials are removed from the equation, this figure comfortably eclipses the 10.4 million car and light trucks sold in the depressed American market, and is close to matching the totals achieved for the whole European Union. Nor is China's pre-eminence likely to be a temporary phenomenon – current predictions for further market growth in 2010 range between 7% - 10%.

Furthermore, China's vehicle parc is notable not only for its size. It is also remarkable for the diversity of models on offer and the local presence of almost every global automaker, alongside more than 100 domestic manufacturers.

Total vehicle sales in China reached 13.6 million

Against this background, it seems certain that China will be both a market of significant opportunity and a key future battleground for the automotive industry – not least in the development and introduction of new-energy technologies. Indeed, it might be argued that the early implementation of alternative-fuel solutions – supported by positive government action and adopted by a wave of car owners with no traditional loyalty to the internal combustion engine – could give China global leadership not only in sales volume but also in new automotive technology.

About The Report

This report was commissioned by UK Trade & Investment and SMMT to inform and guide their future programmes promoting links between British and Chinese advanced engineering companies.

UKTI and SMMT have a well-established partnership for building business relations and partnerships between the British and Chinese automotive industries. Particular success has been achieved in marrying UK design and engineering skills to the growing needs of China's indigenous vehicle manufacturers. Recognising the twin facts that China will be the leading global automotive market in the next decade, and that expertise in NEV technology is a key part of the UK's Advanced Engineering portfolio, the two organisations wish to focus their next activities on new-energy vehicles. As a precursor to this, they wish to understand the current status, and likely future direction, of the Chinese industry / market in this aspect of future vehicle development.

The principal objectives of this report are:

- to explore, at first hand, the range and scope of projects initiated by China's automakers to develop low carbon and alternative-energy vehicles
- to define Chinese perceptions of, and attitudes towards, new-energy vehicles
- to identify the main development trends currently emerging in the Chinese market
- to investigate which technologies are attracting the greatest interest and resources
- to highlight which indigenous Chinese automakers are developing credible and adequately supported research programmes
- to indicate the best business opportunities offered by those programmes

The findings of the report are primarily drawn from a series of face-to-face interviews conducted in China during December 2009 with selected domestic vehicle manufacturers, technology providers, central and municipal government agencies, research centres and other relevant bodies. With an automotive industry as large, and geographically diverse, as China's, it would have been impossible to interview every company/organisation with an interest in new-energy vehicles. However, meetings were successfully conducted with automakers who account for more that 80% of China's total annual production.

The contents of those meetings have been verified and amplified by extensive desk research, conducted during the last quarter of 2009. Interviews have also been conducted with selected UK-based companies and experts to match their perceptions to the information derived from Chinese sources.

Acknolwledgements And Disclaimer

We gratefully acknowledge the assistance of all those companies and individuals – both in China and the UK – who contributed information, advice and opinions to the composition of this report.

2 EXECUTIVE SUMMARY

Unsurprisingly, in a country whose automotive market is so diverse and dynamic, there is no simple consensus on the development path for new-energy vehicles in China. However, some clear themes and trends are emerging, which should influence planning for future strategic engagement between UK and Chinese partners, and should guide the course, and content, of UKTI / SMMT business programmes in this sector. This Executive Summary seeks to highlight these key factors.

China will not lead the world into the era of new-energy vehicles. The Chinese government, industry and car-buying public are all adopting a cautious approach to new-energy vehicles. To date, the success of the Chinese auto sector, and the tastes of its customers, has been built around products and technologies already proven in mature markets. Such established exemplars are not available for new-energy vehicles, and, despite the rhetoric, many Chinese players are taking a "wait and see" approach, particularly in moving from the research phase to full industrial production.

China will take a conservative approach to adopting new technologies. China has a preference for proven technologies. Therefore, their progression along the road of alternative energy options will not be as rapid as some commentators suggest. The idea of a "disruptive" technology would discomfort many Chinese companies. In selecting overseas collaborators, they will seek evidence that the potential partner already has a successful track record in the relevant work field.

Most Chinese VM's are conducting some form of new-energy vehicle development.

Hybrid and electric vehicles are the preferred options in China. Because of the cautious approach to new technology, China is generally not looking beyond hybrid and pure electric vehicles at this stage. Fuel cells are regarded as a distant, and expensive, prospect, biofuels are not favoured over existing CNG options, and more radical concepts – e.g. hub motors or flywheel energy capture – have attracted little interest.

In the development of new-energy vehicles, there are clear "leaders" and "followers" amongst China's automakers. Most Chinese VM's are conducting some form of new-energy vehicle development. But there is a clear distinction between the "leaders" – companies with fully resourced and funded programmes with a realistic prospect of carry-through to production – and "followers", whose NEV development efforts are a more token gesture, and not a key part of their business strategy. In the main, the "leaders" are found amongst the larger state-owned VM's, although there are also some "new entrants" who merit attention.

Growth is fastest in the public transport (buses and coaches) sector. The development and production of hybrid buses and coaches is currently leading China's adoption of new-energy technology. This is partly attributable to convenience – no problems with space for the battery packs and set operating cycles which facilitate re-charging. Nickel-metal hydride batteries – a "proven" technology and cheaper than the lithium – are widely used. But the availability of significant government subsidies for new-energy bus and coach purchasers is another significant factor in their comparatively rapid growth.

Government support has yet to make a significant impact on NEV adoption. The government has invested substantial sums in NEV research and development projects, and it has established a framework of locations and events for demonstrator projects. However, it still has to tackle the major issues of infrastructure and subsidies for the private buyer, which are a major impediment to the expansion of new-energy vehicles in China.

Cost remains the top concern. China has not yet found a solution to the extra costs associated with new-energy technology. This instils in both producer and customer a reluctance to commit to NEV's.

Current emphasis is on meeting short-term targets, and delivering small-scale projects. China is host to a series of high profile events – the Beijing Olympics, the Shanghai Expo, the Asian games in Guangzhou etc – which are ideal for showcasing "green" vehicle fleets. Domestic vehicle manufacturers are still aligning their technical development and production levels to these short-term objectives, rather than planning integrated and long-term product roll-out programmes.

Volume production is still some way off. Chinese companies are genuinely unsure about how to transfer from the development and demonstrator phase to commercial production. Planning strategies based upon a gradual product roll-out programme, and a creation of market demand, are not well understood.

China has not yet found a solution to the extra costs associated with new-energy technology.

Business Opportunities

The most promising business opportunities are to be found through:

- The provision of technology and engineering expertise to support Chinese customers' development programmes. The current low volumes and the pressure to manufacture within China makes component supply a less plausible option
- Working with those larger Chinese VM's – identified as "leaders" in this report - who have long-term, adequately financed new-energy vehicle programmes
- Focusing on mainstream hybrid and pure electric technologies. Chinese companies are less interested in more radical or long-term new-energy solutions
- Being able to offer proven solutions, and to demonstrate a record of proven success. Chinese customers are reluctant to act as a new technology test bed
- Addressing areas of specific Chinese weakness – e.g. engine and battery management systems, integration systems and software, advanced transmissions

3 A SNAPSHOT OF...

"Caution" might be the word which best sums up current Chinese attitudes to development, production and ownership of new-energy vehicles. The rapid growth of China's automotive industry has, to date, been founded on the adoption (with minor local adaptations) of vehicles, technologies and business patterns already proven in other global markets.

With new-energy vehicles, there are no such global exemplars already in existence. Whilst some would argue that this "blank canvas" affords China the opportunity to seize the lead in future automotive development, the reality is that, throughout the automotive sector, there appears to be a prevailing "wait-and-see" attitude, and focus on small-scale projects, with a general reluctance to move to full scale production or implementation.

THE POTENTIAL GROWTH OF CHINA'S NEW-ENERGY VEHICLE MARKET

The Chinese market has long defied the best predictions of automotive analysts. Having spent most of the late 1990's speculating about when China would cross the 1 million car threshold, few commentators correctly foretold the breakthrough in 2002, and even fewer anticipated that one year later China would also have surpassed the 2 million mark. Similarly, at the end of the decade, the pundits were slow to recognise that China's wresting of the No 1 global position from the USA was a long-term, rather than a temporary, re-alignment in the world order.

Add to that background the on-going uncertainties about consumer acceptance of new-energy vehicles, and it becomes even more difficult to offer an accurate assessment of the future NEV market in China. Current predictions vary widely. One respected consultancy has even suggested that NEV's might account for up to 50% of the Chinese market by 2020. Compared to a predicted 10% share in other territories, this seems unduly optimistic.

On the Chinese side, estimates from government sources are consistently more bullish than the expectations expressed by the industry itself. The "official" targets project 500,000 NEV's in operation by 2012, growing to 10% of the total passenger vehicle parc by 2015, and 20% by 2020. This equates to approximately 17 million new-energy vehicles. A more modest – and perhaps more realistic – local estimate for Shenzhen suggests 24,000 new-energy vehicles operating there by 2012, including 15,000 private cars.

Government Attitudes

Premier Wen Jiabao has publicly exhorted China's domestic automakers to "develop vigorously" the key technologies for new-energy vehicles, and government spokesmen have predicted 500,000 NEV's on Chinese road by 2011. But, in practical terms, the Chinese government is not driving the promotion of new-energy technologies as aggressively as this vision might suggest.

CHINESE ATTITUDES TO NEW ENERGY VEHICLES

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Certainly, many of the companies and organisations interviewed for this report felt that there was insufficient direction and support coming from central government. Key areas of repeated concern were:

- lack of clarity in regulations and policy guidelines, leading to uncertainty about the preferred technologies for the future
- slow progress on the creation of a charging infrastructure
- uncertainties about what subsidies will be provided for private buyers of NEV's

For the Chinese authorities, a key strategic consideration remains energy conservation and limitation in the country's dependency on external energy resources, rather than purely environmental considerations. China currently imports two-thirds of her oil requirements, of which the automotive sector takes a steadily escalating percentage. To put a short-term brake on this growing automotive thirst, the government is targeting a reduction in conventional engine sizes. It has set a target of 40% market share for vehicles with 1.5 litre or smaller engines (15% for vehicles below 1.0 litre engine capacity), and active manipulation of taxation levels are already guiding the market in that direction.

Meanwhile the policy to reduce average CO2 emissions to 161 g/km by 2015 will only bring China into line with existing EU levels, and can best be achieved through up-grading internal combustion engines to Euro V levels. More demanding environmental targets will be required to encourage Chinese automakers to divert a larger proportion of their research resources away from conventional IC-powered vehicles (for which they also have an established clientele) into large-scale new-energy development programmes.

Industry Attitudes

The Chinese automotive industry is enjoying good times and robust growth. This success has largely been built upon the use of established vehicle models and technologies (with some minor, localised adaptations) and strong consumer demand for those products. The advent of new-energy vehicles poses a challenge and potential disruption to this established pattern of success.

Chinese automakers are now facing the need to map their own route through the new technologies, without the option of following a roadmap that has been tried and tested in other markets. They are also facing the challenge of successfully marketing a more expensive option to a customer base whose interest is, at best, unproven. It is not a position in which they feel comfortable.

This discomfort is reflected in a current reluctance to make a decisive move from research and prototype development to large scale production, except perhaps in the case of buses and public service vehicles. The difficulties of "industrialising the technology" were frequently cited during company interviews. Ideally, Chinese VM's would like someone else to pioneer NEV volume production and distribution, so that they can learn from the experience of others. There is also an unwillingness to commit to one particular technology path, with some companies even running separate teams for hybrid and pure electric research projects.

The Chinese auto industry is approaching an intersection where companies will have to take decisions about their preferred technology route and their degree of commitment. But, at the moment, they are trying to keep all options open.

NEW-ENERGY CARS LAUNCHING IN CHINA

New-energy models from Chinese carmakers:

Maker	Model	Type
BYD	F3DM + F6DM	PHEV
BYD	e6	Electric
ChangAn	Jiexun	Hybrid
Chery	A5 BSG	Hybrid
Chery	518	PHEV
FAW	Besturn	Hybrid
Zotye	Zhong Tai	Electric

New-energy models available from global carmakers:

Maker	Model	Type	Notes
Toyota	Prius	Hybrid	Assembled Changchun
GM	LaCrosse	Hybrid	Imported
Honda	Civic	Hybrid	Imported

3

Consumer Attitudes

China's new automotive consumers have less reason to display historical allegiance to the internal combustion engine than their Western counterparts, for whom an ICE-powered car has been a part of their whole lives. But they are, at the same time, cautious purchasers, who want not only an attractive price but also a proven and reliable product. And they are prepared to wait for the most opportune moment to buy.

Although new-energy vehicles are not yet widely available to private buyers, it is, at this stage, difficult to detect a pent-up consumer demand for new-energy vehicles in China. Until the recent arrival of imported hybrid versions of the Honda Civic and the Buick LaCrosse, the Toyota Prius, assembled in Changchun, was the only new-energy vehicle to be on general public sale in China. Its performance has been very disappointing. Launched back in 2005, it never achieved its modest annual sales target of 3,000 units, and last year less than 300 were purchased.

In mature automotive markets, the early adopters of new-energy vehicles are generally reckoned to be affluent "premium" buyers, who are willing to pay extra for a vehicle offering a certain social cachet – i.e. a statement of the owner's "green" credentials. However, as the Prius experience indicates, China's premium buyers have so far shown little appetite for spending extra money to display their commitment to a cleaner environment.

Hybrid & Electric Vehicles are the preferred option in China.

Thus it appears that, in China, the main buyers of new-energy vehicles will be cost-conscious consumers, who make their purchasing decisions on economic grounds rather than through altruism or the desire to be seen as a trendsetter. Given the substantial price differential between new-energy and conventional models, this presents a considerable challenge to the vehicle manufacturers – one that they are unlikely to be able to meet without a hefty government subsidy to bridge the price gap. Until such subsidies are clearly advertised and available, it is unrealistic to expect strong consumer demand for NEV's in China.

Even if and when the problem of the initial price differential is resolved, early consumer demand is likely to be muted by two further factors. Firstly, China consumers generally prefer products that have a proven track record of reliability, and secondly they will want re-assurance that new-energy vehicles can be maintained and serviced as easily, and economically, as their conventional rivals. Concerns are also expressed about the unproven safety of NEV's and the potential for fire within battery systems.

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DO TWO WHEELS SHOW THE WAY FORWARD ?

The phenomenal growth of electric cycles in China's cities since 2000 (a reported 24 million sales in 2008) has been taken by some commentators as an indication of how rapidly other forms of new energy transport could take off in the Chinese market. But local observers are less certain.

Firstly, they point out, a distinction needs to be drawn between electrified bicycles, which can be purchased for Rmb 1500 at the local supermarket, and genuine electric motorcycles, which are officially defined (in guidelines published only in December 2009) as weighing more than 40 kg and capable of speeds in excess of 12 mph. The simple "electric bike" is not subject to strict testing, safety and licensing requirement.

Secondly, the vast majority of two-wheelers are powered by basic lead-acid batteries, which can be removed and recharged from the domestic electricity supplier in the owner's apartment. So the expansion of the market is not dependent on the prior existence of an adequate charging infrastructure.

However, some features of the two-wheeler experience may be relevant to the future growth of new-energy passenger cars. It was the ban on conventional motor cycles, imposed by more than 200 Chinese cities, which originally stimulated the interest in electric-powered alternatives. And the majority of the production to meet that demand now comes from manufacturers who were not originally in the automotive sector ; Wuxi – not a base for traditional motorcycles – is now the production capital for electric two-wheelers.

THE CHINESE INDUSTRY PERSPECTIVE

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There is no shortage of new-energy vehicle programmes currently running in China. All companies planning to produce NEV's are required first to obtain approval from the National Reform and Development Council (now a division of MIIT). They are required to demonstrate that they have already achieved competence in either powertrain, drivetrain or systems management technology. The NRDC listing, issued in March 2009, contains 76 programmes being conducted by 27 different Chinese companies. This is certainly an understatement of the total range of activity.

Amongst the companies interviewed, there were notable differences in the scale, resources and rate of progress within their NEV-associated projects. Three distinct groupings emerged.

EXAMPLES OF LEADERS, FOLLOWERS AND NEW ARRIVALS

Leaders
For passenger cars:
SAIC
FAW
Guangzhou Automobile Group
ChangAn

For commercial vehicles:
Beiqi Foton
Zhengzhou Yutong
DongFeng Motor Co

Followers
Geely
Great Wall Motor Co
Lifan

New Arrivals
BYD
Tianjin Qingyuan Electric Vehicle Co
Zotye

"Leaders"

The "leaders" are defined as those established domestic automakers, who regard new-energy vehicles and systems as a key priority in their immediate development plan.

Within the "leader" group, there are companies whose product range covers both passenger cars and CV's, and some who operate in only one sector. In entering commercial production, those producing only passenger cars and LCV's are currently disadvantaged, because government purchasing subsidies are not yet available for those products

In some cases, companies have established a separate commercial entity specifically to handle their new-energy development – e.g. Chongqing ChangAn New Energy Automobile Co, DongFeng Electric Vehicle Co. It is reported that such re-structuring offers easier access to government funding.

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Guangzhou Automobile Group have lagged behind their domestic rivals in producing their own brand vehicles. But they are included in the "leader" group because they have placed new energy technology at the heart of their future vehicle development, and regard it as a route to overtake longer-established rivals. They intend to have a hybrid version of each new model, and have patented their own GEM (GAC Electro-Magnetic) drive system.

"Followers"

"Followers" is the categorisation of those auto companies who, whilst having new-energy programmes, place a much stronger emphasis on other aspects of their research and development work. Their main short to medium term objectives may – for example – be a new family of conventional internal combustion engines, or the expansion of their model range.

Geely Automobile, probably China's largest privately-owned automaker, has established its position in the market by producing competitively-priced and economical small/medium cars. Although new-energy projects are amongst the 70 separate programmes currently being undertaken by their 1,300-strong R&D staff, their top priorities are to expand their product range into C-segment cars and SUV's and to introduce a new generation of IC engines. They can, therefore, be included in the "follower" group.

"New Entrants"

"New entrants" are companies – sometimes component and systems suppliers, sometimes from outside the automotive industry - who have recently begun to make conventional and new-energy vehicles on the back of transferable skills originally acquired in their old core business. They may already possess new-energy expertise and products, but tend to be lacking in wider vehicle engineering know-how.

BYD is the most prominent example of a "new entrant." As a global leader in manufacturing lithium batteries for mobile phones and lap-tops, they are supremely confident of their abilities in electrical storage and power systems, and claim to be the market leader with their "dual mode" hybrid technology.

The best targets for UK companies and promotional activities would appear to be in the "leader" group. The "new entrants" might also need support in the broader areas of vehicle engineering.

A Note On The Strategies Of Global Manufacturers

To date, the global vehicle manufacturers have been more willing to display their NEV's at Chinese auto shows than to actually launch the products into the Chinese market. This is scarcely surprising. Firstly, they are reluctant to expose their newest technologies to imitation by local competitors, and secondly – unlike the soaring demand for conventional vehicles – there is not yet a demonstrable market for NEv's amongst Chinese consumers.

Toyota was the exception to this trend, commencing local assembly of the hybrid Prius in 2005. It was not a successful move, and the modest sales targets were never met, demonstrating clearly the Chinese customer's reluctance to pay any price premium for environmental reasons. By 2009, sales had declined to a paltry 271 units.

More recently, Nissan has taken with the challenge, and will introduce their electric vehicles as part of an agreement with MIIT and the Wuhan municipal government. However, that programme will not commence before 2011.

Overall, the reluctance of the global VM's to bring NEV products to China does mean that, should they wish to exploit it, there is a good opportunity for domestic manufacturers to pioneer the growth of the Chinese NEV market. In turn, this should offer business openings to companies with the skills and expertise to give independent support to the local VM's in their development programmes.

It is predicted that the market growth in this sector in 2010 will range between 7% - 10%.

The Component Sector

The Chinese automotive industry has traditionally featured vertically integrated supply chains, with major VM's supporting their own "families" of parts suppliers, whilst the component companies built to order and largely left product design and development to their OE customers. This structure means that there are few component makers with the skills and resources to adapt quickly to the different demands of NEV's. Several Chinese VM's expressed concern at the quality and reliability of local suppliers, and claimed that they preferred to buy key components from overseas sources.

An alternative structure, with the emergence of local consortia in which suppliers pooled technology resources to develop and build modular systems for new-energy vehicles, would certainly strengthen capabilities of the local component sector. But, despite some encouraging words from government, there is little sign of such consolidation taking place.

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From the Chinese perspective, the preferred option is for international suppliers to establish local manufacturing bases and joint ventures. But current volumes, and uncertainty about the pace of market growth, scarcely justify such an investment, unless the Chinese manufacturing facility is to be used also to supply global customers.

There are estimated to be approximately 20 Chinese domestic manufacturers, producing mainly NiMH and LiFePO4 batteries. There is scepticism amongst the VM's about the quality and manufacturing standards of some suppliers, with on-going concerns about safety and thermal management.

Currently, Chinese manufacturers can produce motors and magnets of satisfactory quality. However, they are struggling to develop effective engine control units, systems integration software and reliable thermal management systems.

The COMPONENT SUPPLIER: WANXIANG GROUP

Wanxiang Electrical Vehicle Co was established in 2002, as a subsidiary of Wanxiang Group, China's largest private component conglomerate. Its core business is the development and production of batteries, electrical motors and their associated control and integration systems. A new facility was opened in Hangzhou in April 2009 to house the company's 250 research and engineering staff.

Wanxiang EV claim as customers many of the leading Chinese VM's. They are particularly strong in powertrain systems for new-energy buses, and reckon that their products are currently running in over 100 demonstrator vehicles around China. They have completed seven projects under the national "863 plan." Negotiations are also under way with potential international customers.

They now favour the LiFePO4 battery in preference to earlier work on lithium-manganese, but still face challenges over energy density and cost. Present costs are quoted at Rmb 4 per Wh, with a future target below Rmb 2 per Wh Within 3/5 years, they expect to have an annual production capacity of 800 million battery cells. A new production plant opens in 2012, making electric powertrain components for commercial vehicles.

Wanxiang EV also produce a range of information platforms and intelligent terminals for monitoring vehicle usage and performance, which are in use in various NEV demonstration projects. They are designing, but not manufacturing, charging infrastructure equipment. In these areas, they have local collaboration agreements with Hangzhou City Public Transit Corporation and Zhejiang Electric Power Co (part of the State Grid).

THE RESEARCH INSTITUTE: BEIJING INSTITUTE OF TECHNOLOGY

Beijing Institute of Technology hosts the National Laboratory for Electric Vehicles, which, in various guises has been conducting research into EV propulsion since the late 1950's ! The laboratory has 25 full-time staff, supported by over 40 "experts", and around 80 students. It undertakes projects on behalf of central government ministries, municipal authorities and individual vehicle manufacturers

Its core strengths are in engineering research and vehicle / system testing, and it is in these roles that they are utilised by their industry customers. They are not actively involved in the development of battery technology and software system.

For the Beijing Olympics, BIT developed a rapid robotic battery changing system for commercial vehicles. They are seeking to undertake further work on battery exchange projects.

To date, involvement with international partners has been confined largely to information exchanges rather than full collaborative projects.

5 THE CHINESE GOVERNMENT PERSPECTIVE

It is generally recognised that, in all markets, government support will be necessary to encourage and facilitate the take-up of new-energy vehicles. In particular, governments have a key role to play in the construction of the charging infrastructure, setting a favourable taxation structure, and – at least in the short term - bridging the price gap between conventional and new energy vehicles.

The Chinese government has long regarded the automotive sector as "pillar industry", and has sought – not always successfully – to regulate closely its development. Past policies have principally focused on creating a strong indigenous industry, but now the government also has to address environmental and energy-consumption problems. In 2008, China became a nett importer of petroleum, and, with demand predicted to rise from 61 to 110 million tons by 2020, is facing the uncomfortable prospect of depending on overseas suppliers for 25% of future consumption. It is this "energy gap" rather than emissions targets that is at the forefront of current government concerns.

In view of these factors, the central government should be expected to play a decisive role in shaping the development path of new-energy vehicles in China.

Central Government Policy

At central government level, the responsibility for new-energy vehicle programmes does not rest within one ministry. The recently-formed Ministry of Industry & Information Technology (MIIT), which has absorbed the former functions of the NDRC, is responsible for setting the regulatory framework for new-energy vehicles. The Ministry of Science & Technology (MoST) has taken the lead role in the "863 project", and is a prime mover in the designation of the "thirteen sustainable cities."

There are some discernable tensions, and policy variations, between MIIT and MoST. MIIT seems to favour closer ties with global VM's, and has recently warned of Chinese companies without "the necessary qualifications" trying to enter the NEV market, in breach of the Administrative Rules issued in late 2007. On the other hand, MoST has been actively pushing the case for more independent development work by the indigenous Chinese automakers.

Funding comes ultimately from the Finance Ministry. A total of Rmb 10 billion has been allocated to fund new-energy R&D projects over the next three years, with a further Rmb 20 billion available to promote and implement the use of NEV's. There are frequent complaints from industry that the deployment of this second funding stream – particularly into charging infrastructure projects and subsidies for private vehicle buyers – is moving too slowly.

The "863 Programme"

The "863 Programme" takes its name from the date of its original conception (March 1986) as a plan to stimulate the development of advanced technologies in China. In 2003, and again in 2006, the programme was given a sharper focus on energy efficient technologies.

The programme approves and funds research projects conducted by selected domestic companies, universities and research institutes. Support is also available for testing and demonstrator trials, until products are deemed ready for commercialisation. Prior to 2005 the prime focus was on CNG and LPG development, but since then hybrid and electric vehicle R&D has come to the fore.

The "Thirteen Sustainable Cities"

China has selected thirteen major cities to be showcases for sustainable and environment projects – and will shortly add a further seven locations. The original thirteen are:

Beijing	Changchun
Changsha	Chongqing
Dalian	Hangzhou
Hefei	Jinan
Kunming	Nanchang
Shanghai	Shenzhen
Wuhan	

In February 2009, it was announced that subsidies would be made available for the municipal authorities and public utilities to purchase new-energy vehicles, with the objective of having 1,000 NEV's running in each of these cities. This trial will last until 2012, with local project offices collecting and reporting data on the reliability, performance and emissions of the vehicle fleets.

For hybrid passenger cars and light commercial vehicles, the rate of subsidy varies from Rmb 28,000 – 50,000, dependent on the level of fuel saving and the percentage of total vehicle power provided by the electric motor system. Pure electric vehicles qualify for a Rmb 60,000 subsidy. For hybrid city buses, over 10 metres in length and utilising either Ni-MH or Lithium-Ion batteries, the support ranges between Rmb 200,000 – 420,000. If lead-acid batteries are used, the rate is much lower (Rmb 50,000 – 80,000). A pure electric bus attracts a Rmb 500,000 subsidy.

One vehicle manufacturer described the process of accessing these rebates as "painful". There is also scepticism about the accuracy of the energy savings claimed for many hybrids.

In 2003, and again in 2006, the programme was given a sharper focus on energy efficient technologies.

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As yet, no subsidies are available to private buyers. There has been no confirmation of the levels at which they will be set or when they will be introduced – a major concern to auto industry leaders, who see government financial incentives as essential to removing the cost differential between new-energy and conventional vehicles.

The "thirteen cities" will also be test grounds the installation of charging infrastructure (see section 6 of this report). However, this is another area where lack of clear direction, and money, from the central government is causing concern.

Local Support And Incentives

The funding support from central government is normally disbursed through the relevant provincial and municipal authorities before it reaches the final beneficiary. The local agencies may choose to provide further backing and incentives within their own areas of jurisdiction.

In Chongqing, for example, the local government has supported the creation of a "New Energy Alliance" to bring together all parties interested in NEV production. Land has been made available, and tax subsidies offered, for creation of a special new-energy manufacturing base. This perhaps reflects concerns about a lack of local suppliers capable of meeting the needs of ChangAn's hybrid programmes. It is also planned to offer free parking spaces for new-energy vehicles – a useful "perk" in a crowded city.

Shanghai is another city offering tax breaks to encourage the formation of a new-energy cluster

Shanghai is another city offering tax breaks to encourage the formation of a new-energy cluster, in Jiading. It has also been indicated that purchasers of new-energy cars will be exempted from the monthly auctions of licence plates, the cost of which place an extra financial burden on car ownership within the city. Wuhan will restrict access into its East Lake Zone to alternatively fuelled vehicles. In Shenzhen, NEV's will benefit from a 50% reduction in road tolls and free annual inspection.

INFRASTRUCTURE

6

No other country in the world can match the speed and scale with which China currently plans, implements and constructs new infrastructure projects. China's road network already includes 35,000 km of expressway, and that total will double by 2020. Within the same decade, 97 new airports are scheduled to open. On the railways, China will lay down 26,000 km of new track by 2013, of which 9,200 km will be additions to her burgeoning high-speed network.

Against this background of unprecedented and unrelenting growth in infrastructure, China's current progress in developing, nationally, the charging network necessary to support the operation of electrically powered vehicles must be viewed as somewhat disappointing. The majority of companies and organisations interviewed for this report cited the lack of a charging infrastructure and unclear policies over its future creation as one of the main factors inhibiting the NEV market in China.

With a high percentage of the urban population living in flats and apartments, a much larger network of publicly available charging points will be needed in China than in those markets where most car owners can recharge their vehicles overnight in their private garages. The creation of such a network requires early engagement with property developers and builders to ensure that an adequate number of charging points are incorporated into both domestic and commercial sites. As yet, this is not a requirement of new building plans in China.

The question of who should finance the building of charging stations also remains unresolved. Government – both central and local – does not want to shoulder the burden alone, and is looking for partners from the commercial sector. Unsurprisingly, the vehicle manufacturers do not see it as their responsibility. In other markets, one possible route to corporate funding has been through the petroleum companies, who can offer not only financial backing but also a network of sites in the form of existing filling stations. This does not, however, appear a credible solution in China, whose state-owned oil companies have not previously displayed much willingness to modernise or move beyond their traditional offerings. (The protracted, and largely unsuccessful, battle to raise the quality of Chinese diesel fuel is one example of their intransigence.)

Small-scale networks are beginning to appear in the "thirteen sustainable cities". Shenzhen's trial project (see below) was financed and built through the local electricity supplier. The future planned expansion to 13,000 charging points will be backed by local government loans. The large fleet of new-energy vehicles which Shanghai will host during the World Expo will be served by ten new charging stations. In Wuhan, there are currently 30 charging facilities for the 350 NEV's on the city's streets. But the municipal authorities of Chongqing report that they find it difficult to identify sites for central charging station because of the city's hilly topography.

China will lay down 26,000 km of new track by 2013, of which 9,200 km will be additions to her burgeoning high-speed network.

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INFRASTRUCTURE TRIALS IN SHENZHEN

China Southern Power Grid (CSG) – the state-owned company responsible for supplying electricity across five southern province – has commissioned and put into operation, in Shenzhen, what is claimed to be China's largest charging infrastructure trial.

The network consists of two dedicated charging stations, located adjacent to major downtown transport interchanges, and 134 individual charging points, spread around public and residential parking lots. Six fast chargers are offered at the Dayun Centre facility, with three at the Hexie station ; each charger can simultaneously accommodate two vehicles. Slow, overnight charging is available at the individual points, giving a total charging capacity of 2,480 kVA.

The current tariff for users – Rmb 1.0064 per kWh for daytime hours, or Rmb 0.2495 between 11 p.m. and 7 a.m. – has been established in agreement with the local government pricing bureau. The company claims that the central government has not yet issued any guidance on pricing structure. Indeed, since there is a perceived lack of national standards covering infrastructure issues, CSG has felt obliged to develop its own technical and commercial guidelines, in consultation with local municipal authorities and Shenzhen-based automaker BYD.

The costs of establishing the trial stations, including the purchase of capital equipment, have been borne by CSG, and they do not expect to return a profit at this stage. For larger scale projects, they will seek to attract both international and domestic partners.

In the future, CSG expects to install almost 13,000 NEV charging points in Shenzhen, including 25 fast-charging and 25 slow-charging stations for public transport, 2,500 charging points reserved for government and official vehicles and 200 fast-charging stations and 10,000 slow-charging points for public use. They are confident that they will have sufficient generating capacity to meet the expected demand from new-energy vehicles, pointing out that domestic power outages in Shenzhen have been cut from 26.2 hours to 5.8 hours per annum since 2006.

TECHNOLOGIES AND TIMESCALES

7

The Chinese View Of Technology Options

Chinese companies have a seemingly unquenchable thirst for "technology", coupled with a firm wish to become its ultimate owners. It is a mind-set actively encouraged by government policy. Successive Five Year Plans for the motor industry have stressed the importance of successful enterprises acquiring independent technology capability.

However, most Chinese also want to feel confident that the technology they are acquiring is reliable, viable and commercial exploitable. They do not wish to act as "guinea pigs", and the concept of a "disruptive technology" is treated with great suspicion.

In the automotive sector, this approach naturally leads them towards the mainstream options of hybrid and pure electric vehicles, where they can see a steady, evolutionary process. They prefer conventional vehicle architecture and lay-out, with either nickel metal-hydride or lithium-ion battery packs for energy storage. Amongst the companies interviewed, there was little knowledge of, and only polite interest in, such alternatives as flywheel energy storage and independent hub motors.

Technology Gaps

The technology shortcomings most frequently cited by the Chinese companies themselves include:

- Adequate energy density from current batteries
- Thermal management and safety systems within battery packs. Several vehicle manufacturers are dissatisfied with the quality of locally-produced batteries
- Engine management and integration systems, and associated software
- Advanced and fully automatic transmissions

Strong interest is also shown in systems which can potentially simplify the infrastructure installation and reduce the cost of batteries and their supporting systems. In particular, there is a potential market for rapid battery-swap systems that can help to address these problems.

Chinese companies have a seemingly unquenchable thirst for "technology"

Cost Issues

In China, cost is king. New-energy vehicles present the government, industry and society with a novel problem – how to gain acceptance for a new product which is markedly more expensive than its well-established rival. China may be confident that it can produce NEV's more economically than anywhere else in the world ; but it does not yet see a route to making them more cheaply than conventional vehicles.

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Chinese manufacturers calculate that, even without taking R&D costs into consideration, their production-ready NEV's will cost twice as much as conventional counterparts. For example, BYD's F3DM ("Dual Mode") model is provisionally priced at Rmb 149,800 – whilst the best-selling standard F3 model is on the market at less than Rmb 70,000.

Battery costs are regarded as a major problem. One CV producer estimated that the battery pack accounted for 45% of the total cost of a hybrid bus. The current costs quoted by interviewees ranged widely from Rmb 10 – Rmb 4 per Wh, and most wanted the price to fall below Rmb 2 per Wh. It is notable that, whilst the existing price range in China is comparable with figures quoted in other markets, the Chinese expectation of future cost depreciation is much steeper.

Potential Timescales

There is no generally agreed roadmap that charts the likely growth of new-energy vehicles in the Chinese market. Different interviewees offered widely differing scenarios and timescales, from which it is only possible to extrapolate the most likely trends. The main debate centres around when, or whether, pure electric vehicles will supplant hybrid technologies. Government statements have indicated a wish to move as quickly as possible to full electric vehicles, but the industry view is generally more cautious.

One CV producer estimated that the battery pack accounted for 45% of the total cost of a hybrid bus.

Most companies feel that the mild hybrid and stop/start technology is already established, even if the vehicles are not yet available in the market. The next five years will see a steady spread in hybrid usage, though the extent to which the full, or plug-in, hybrid might replace previous versions remains uncertain. A small majority of interviewees expected electric vehicles to begin to capture a significant market share from 2015, although several others predicted that the change would take 10 - 15 years, due to problems with batteries and infrastructure. One company expected hybrids and PHEV's to dominate for 30 years.

Fuel cell propulsion was universally regarded as a distant option, at least 20 years over the horizon.

ROADMAPs TO THE FUTURE: CHINESE AND UK VERSIONS

In their report on the future of the automotive industry in the UK, the New Automotive Innovation and Growth Team predict the evolutionary process for hybrid technology from mild/micro systems to plug-in hybrid that will last for around ten years. Thereafter PHEV and pure electric vehicles will take a significant market share. Fuel cell options may become viable by the middle of the next decade.

Chinese predictions for their home market suggest a shorter lifespan for hybrid vehicles (because of the extra cost and complexity of their dual systems) and a faster adoption of pure electric powertrains. Fuel cells are seen as a distant, and uncertain, prospect.

CONCLUSIONS AND RECOMMENDATIONS

8

Summary

There is, in China today, a swelling tide of interest in, and work upon, new-energy vehicle programmes. As befits its new position as the No 1 global automotive market, China will become a key territory for the development and adoption of new-energy and low carbon technologies. But considerable uncertainty exists about the speed of progress and there are some significant obstacles to hinder the rapid growth and demand for NEV's.

The first of these is China's innately cautious approach to unproven products and technologies. So far, the success of the domestic automotive industry has largely been built on following well-established product and technology trends. The demand for "conventional" vehicles is undiminished. Therefore, despite the considerable amounts of money, time and resources that are being devoted to NEV development, many Chinese companies remain uneasy about their ultimate commercial success.

The second area of uncertainty is the attitude of the private Chinese consumer, whose purchasing power is now the main driver of growth in conventional vehicles sales. There is scant research or evidence to suggest that Chinese buyers are willing to pay a price premium for more environmentally-friendly vehicles. What Mr Wang Chuanfu, Chairman of BYD, calls "the dead knot" of commercialisation still has to be cut.

Finally, it must not be forgotten that, alongside the advent of new-energy vehicles, Chinese automakers still have considerable scope to up-grade and improve their conventionally powered products as a route to achieving fuel consumption and emissions target. There is an established demand for – and therefore revenue stream from – these vehicles, which NEV's cannot yet replicate.

The Key Chinese Players

For companies seeking to do business in China, it has always been important to identify the right partner. This holds true in the realm of new-energy vehicles. Virtually every Chinese vehicle manufacturer is conducting some form of new-energy programme, but there is a distinction to be drawn between those for who have made it a mainstream part of their future development strategy, and those who are "following the trend" whilst their real focus lies elsewhere.

For companies seeking to do business in China, it has always been important to identify the right partner.

The "leader" group is mainly composed of larger, state-owned VM's, with substantial resources and, in many cases, the advantage of a substantial launch customer in the form of the local municipal government. SAIC, FAW, GAC, ChangAn, Beiqi Foton, Yutong and DongFeng all come into this category.

The smaller, independent Chinese automakers have built their business success on offering derivative products for which there is an existing market demand. They are disinclined to dilute that success, and inflate their R&D costs, by pursuing new technologies for an uncertain market.

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A third grouping – the "new entrants" are companies who have come into the automotive sector because they already have some of the technology skills and products applicable to new-energy vehicles. BYD is the most notable example. These newcomers tend to be very confident in their core expertise, but they can present an alternative business opportunity through their need for support in other fields of automotive engineering – e.g. ride and handling, chassis engineering etc.

Chinese Caution

The development of new-energy vehicles takes the Chinese automotive industry into uncharted territory, where it cannot easily follow and adapt the successful business models and products from more mature markets.

In this new environment, the Chinese wish to tread carefully, and to minimise risk. They are seeking to follow a roadmap that is evolutionary rather than revolutionary, to utilise technologies that are mainstream and proven rather than radical and disruptive, and to find with partners who can display an established track-record, coupled with a long-term commitment to working in China.

They are also nervous about the potential extra cost of new-energy technologies, particularly as they move from the research and development phase to production and implementation. The top concern expressed by interviewees revolved around the challenge of "industrialising the technology", and the most frequent complaint was a lack of clear direction and financial commitment from central government.

Japan is recognised as the country where new-energy vehicles have the largest market share

International Competitors

Although China today presents a huge potential market for the promotion of new-energy vehicles and technologies, it certainly cannot be regarded as "virgin territory." There is an abundance of projects already underway, and well advanced, and in many areas local expertise and knowledge is good. There are also plenty of international competitors actively seeking business in the market.

When questioned on sources of international NEV expertise, most respondents mentioned the USA, Germany, Japan, and Korea. Japan is recognised as the country where new-energy vehicles have the largest market share, and Korea is seen as a source of battery and electronics expertise. Germany might appear a surprise choice, given that country's apparent preference for internal combustion technology. Its inclusion in the list is probably prompted by a general reputation for automotive engineering excellence coupled with the strong presence in China of German design engineers.

Those British design engineering companies, who have established a base in the Chinese market, are also widely known, but are perhaps not as well recognised for their NEV expertise as they would wish. Overall, the United Kingdom is not

currently perceived as a leader in new-energy technology and its applications in the market place.

There is a clear opportunity here to raise the UK profile, but it needs to be a long-term and co-ordinated campaign. The Test Bed UK project, as recommended in the NAIGT report, could be a suitable medium for promoting UK capabilities. But the campaign will need to run over an extended timeframe – probably 3/5 years – and be built around companies with the resources, and will, to make that long-term commitment to the Chinese market. It will also be important to identify, and engage with, the right Chinese partners.

The window of opportunity for this work may be limited. Already Nissan have signed a wide-ranging co-operation agreement with MIIT. If they, and other global VM's, start to bring their NEV products into the Chinese market in substantial numbers, and at affordable cost, the task of building UK recognition will become more difficult.

Recommendations For Future Action

- There is a need substantially to increase Chinese understanding of UK skills and capabilities in new-energy vehicles. This cannot be done overnight, but probably requires a programme of co-ordinated events and activities over at least a three-year timeframe. The activity programme needs to be supported by the regular dissemination – in Chinese – of news stories highlighting UK expertise and successes
- Within the programme, support should be focused on those UK companies who have both a demonstrable track-record in new-energy technologies, and also the resources – and the management will – to make a long-term commitment to China
- The programme should concentrate its major thrust on mainstream hybrids and pure electric vehicles
- The programme should target those Chinese automakers identified as "leaders" in new-energy vehicle development
- Geographically, the programme should target locations which are included in the "thirteen sustainable cities" list and also have a local automotive industry

There is a need substantially to increase Chinese understanding of UK skills and capabilities in new-energy vehicles.

9 APPENDIX I

Notes On Plans, Programmes And Products Of Selected Key Players

[Note: this appendix provides further details on the NEV projects of selected Chinese vehicle manufacturers, derived from the interviews conducted in December 2009. It does not claim to be exhaustive, and does not contain details information offered on a commercially confidential basis.]

SAIC Motor Corporation

SAIC have established a special New Energy Vehicle Division, located in the new automotive district of Jiading, to conduct their NEV programmes. (Jiading offers 2-year tax exemptions to new-energy businesses. The New Energy Vehicle Engineering Centre of Tongji University and Shanghai Electric Drive Co are also located there.) The division currently has over 250 engineering staff. Over the next three years, it is planned to invest Rmb 6bn in R&D, component manufacture and new production capacity for NEV's.

Three passenger car projects are under development:

- A mild hybrid version of the Roewe 750, expected to be market-ready in 2010. The control units and power electronics have been sourced from Delphi, with the lithium-ion batteries supplied by A123
- A PHEV version of the Roewe 550
- A pure electric vehicle, based on the new small A00 platform (similar in size to the Chevrolet Spark), projected for late 2012

A fleet of zero-emission and low-emission Sunwin brand buses is currently under production, for use at the Shanghai Expo. In total, SAIC will supply 120 12-metre electric buses (using both lithium-manganese and lithium-phosphate batteries), 250 electric visitor buggies, 36 super-capacitor buses and six fuel cell vehicles for the Expo. Following the amalgamation with Nanjing Auto, they have also been working on an electric version of the Iveco Daily van.

SAIC have recently concluded negotiations with A123 to establish a joint venture for battery systems manufacture. SAIC will have a 51% stake in the new company, which will be known as Shanghai Advanced Traction Battery Systems (ATBS). They also have a joint venture with Bosch – United Automotive Electronic Systems – to make electronic controllers.

Alongside their own-brand NEV programmes, SAIC have launched a hybrid version of the Buick LaCrosse, through their joint venture with GM.

DongFeng Motor Corporation

DongFeng Motor Corporation (DMC) has been slow to develop its independent car brand, and is still best known as a commercial vehicle manufacturer. Therefore, it is not surprising that their newly established DongFeng Electric Vehicle Co, which has approximately 200 staff, should be focusing their work principally on the CV sector.

In the short-term, their NEV strategy is directed to hybrid bus development. Seventeen mild hybrid buses were supplied for the Beijing Olympics and other demonstrator vehicles are already running in Wuhan. They expect to build around 350 for various trial projects in the course of the next year. By 2011, the objective is to "industrialise" hybrid production, at a rate of 2,000 vehicles per annum. They see further potential for developing CNG / hybrid powertrain solutions.

Pure EV development is proceeding at a slower pace, because they anticipate slower take-up from the market. 2015 is seen as the target for production launch.

DMC do not produce batteries or electric motors. They favour the Lithium Manganese battery, for which they have identified 3 – 5 potential suppliers within China. The main areas where outside help is sought are system integration, ECU's, and simulation technology.

China FAW Group Corporation

FAW claim to have been conducting new-energy research since 2002. Currently they have around 50 engineers engaged full-time on NEV projects, with another 200 providing support as required (out of a total R&D staff of 3,400).

Current focus is on hybrid technology, for which they predict a 30 – 50 year lifespan. Battery limitations are expected to constrain pure EV development for at least 10 years.

A hybrid version of the Besturn saloon was developed for the Olympics 2008 vehicle fleet, where it was claimed to have shown a 30% fuel saving. Those vehicles are now back with FAW, undergoing further development work. The Besturn features a 1.5 litre petrol engine, a water-cooled permanent magnet motor and a nickel-metal hydride battery pack.

Up to 2,000 parallel hybrid buses will be provided to Changchun and Dalian, under the "Thirteen Cities" programme. These will incorporate a 30KW AC motor and nickel hydride battery system with either a 6.6 litre (Deutz) diesel or a CNG-driven engine.

They have not received any substantive technology support from joint venture partner Toyota.

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Chongqing ChangAn Automobile Co

ChangAn is another automaker who has established a separate entity to lead their NEV programmes – under the title Chongqing ChangAn New Energy Automobile Co. They are also the major founding member of the Chongqing Energy Saving and New Energy Industry Alliance, which is intended to bring together 30 local enterprises and research organisations in a new low carbon manufacturing zone which will ultimately be able to produce 300,000 vehicles and 1 million engines per annum.

Their current programmes are focused around hybrid development, where they feel that "the market is already taking off." PHEV's and pure EV's are not expected before 2015. A team of 160 R&D staff currently work on new-energy projects, with 200 others providing support as necessary.

ChangAn have developed and put into small scale production a mild hybrid version of the Jiexun saloon, featuring a stop/start system marrying a 1.6 litre petrol engine with a 10KWH battery storage system. This is claimed to give a 20% fuel saving. The battery adds 48 kg to the overall vehicle weight.

The hybrid Jiexun currently benefits from a local subsidy of Rmb 36,000 – 43,000, plus three years' exemption from local road tolls (estimated at a further Rmb 7,000). To date, less than 100 are in use, mostly with Chongqing municipal agencies.

ChangAn have links to Electrovaya, the Canadian battery system maker, and also purchase from Guangzhou Large Electric Equipment Co. They are concerned that their local supply chain is lacking in new-energy expertise.

Guangzhou Automobile Group

GAC have been somewhat behind the other large, state-owned automotive conglomerates in establishing their independent brand and own-product development programmes. They therefore see new-energy vehicles as an opportunity to catch, or leap-frog, their competitors. The 30 R&D staff currently working on NEV projects will rise to 100 within five years.

GAC believe that uncertainties about battery technology and the lack of a charging infrastructure will give hybrids a period of dominance. In the short-term, they expect to have A- and B-class hybrids in production by the end of 2010, with a 1.8 litre internal combustion engine driving the front wheels and the rear wheels driven by a parallel electric motor. A 25 – 30% fuel saving is expected.

A futuristically-styled concept Advanced Hybrid Electric Vehicle (AHEV) has also been unveiled. This features the GEM (GAC Electro-Magnetic) hybrid system, which is claimed to be an innovative integration of generator, motor, power-splitter and CVT into a single system. It has been developed in collaboration with South China University of Technology, with GAC holding the intellectual property rights. It is married to a lithium-polymer battery pack.
GAC will purchase batteries and powertrain components from outside suppliers,

rather than attempt to produce in-house. They have established relations with Delphi, Johnson Controls and BAK – a Shenzhen-based maker of lithium phosphate batteries. They also have a share-holding link with Wanxiang Group.

Beiqi Foton Motor Co

Although Beiqi Foton has been running separate development programmes for hybrid and pure electric vehicles since 2006, the company admits that they are not technology leaders. They do, however, hold a strong position as one of China's leading manufacturers of new-energy commercial vehicles and a favoured supplier to the Beijing municipal authorities. Currently, they expect to make around 1,000 NEV units per annum, including 900 parallel hybrid and 50 pure electric buses, and claim that they could make more if their supply of batteries was better. 2010 is likely to be the first year of profitability for their NEV operations.

Approximately 120 R&D staff are engaged on new-energy projects. Beiqi Foton also works closely with selected academic institutions – e.g. Beijing Institute of Technology – particularly on testing programmes.

For their hybrid vehicles, control systems and software have been purchased from Eaton Corp. They have one main battery supplier, with whom they report recurrent problems in manufacturing processes and reliability of supply. An alternative "candidate" supplier is under assessment.

Beiqi Foton are developing a PHEV version of their Midi small van, and are now trialling a fleet of pure electric street cleaning and garbage vehicles, powered by a lithium-phosphate battery system and a 55kW permanent magnet motor. Although they provided three fuel cell buses for the Beijing Olympics, further development of this technology is not a high priority.

Geely Automobile

The Geely Group's stated policy for future vehicle development is to take "a balanced approach", keeping all options open. That is an ambitious objective for a company whose total production is currently 330,000 units. In reality, they anticipate devoting at least 70% of their R&D resources to "conventional" vehicles and especially to the development of a family (1.0 – 3.5 litre) of Euro V compliant IC power units, a turbo-charged small engine, and a common rail diesel. This chimes with the publicly stated scepticism of Chairman Li ShuFu about the short term prospects for NEV's in the Chinese market.

However, Geely will continue to investigate "various types of new energy technologies.....for potential future applications." Current programmes are focused on mild hybrid and stop/start systems on existing vehicle platforms. A concept car shown in 2008 featured a 1.6 litre engine, coupled to a 40 BHP hybrid drive train and a lithium-phosphate battery pack supplied by A123 Systems. PHEV's are regarded as too expensive for the Chinese market, although they do have a prototype range-extender, which may go into limited production.

For pure electric cars, Geely have struck a deal with Taiwanese Yulon Motor Co, who will develop and build a lithium-ion powered EV based on Geely's small Panda car. This recently-announced project will apparently run parallel with an independent programme to produce an electric version of the Eagle model.

Geely have also announced a new technology co-operation agreement with Johnson Controls, who, in turn, are partnered with Saft Groupe for the production of lithium battery systems.

Lifan Industry Group

Lifan Industry Group presents mixed messages in its approach to NEV's. Whilst they have established a separate new-energy company, and have displayed prototype electric versions of their 320 and 620 models, only 3% of their current R&D resource is devoted to this work. More emphasis is apparently being placed on conventional vehicle projects which will yield an immediate returns in lucrative sectors of the market – e.g. the introduction of a micro-van with a 1.3 litre IC engine, due to enter production at the end of 2009, and a new SUV platform, scheduled for the latter part of 2010.

Development work is undertaken with research institutes in Shanghai and Shenzhen, and they are forming a dual-clutch transmission JV with Borg Warner. Lifan admit to problems in fitting the battery system within the architecture of their 320 model, and also to a lack of engine control systems.

Despite the corporate rhetoric, the company appears to be more focused on diversifying its product range into sectors of proven profitability rather than taking a leading role in new-energy vehicle development.

Zhengzhou Yutong Bus Co

Zhengzhou Yutong Bus Co claim that they have invested more than any other commercial vehicle maker in alternative energy projects. NEV programmes have been running since 2005, and they launched their first series hybrid in 2007.

They now have two main development strands. Already in production is a range of parallel series hybrid buses, for city use. These utilise batteries and motors from Eaton Corporation, with Yutong tailoring the control system to individual customer requirements. Seventy units were produced in 2009 for various regional customers. Yutong believe that they are disadvantaged because the bug municipalities tend to favour local manufacturers.

Separately, they have a small team working on independent development projects – for example, the development of two pure electric 12-metre coaches. Battery cost is a key factor (they are currently using lithium-phosphate packs from a Hunan-based supplier), and they cannot currently chart a route to profitability. They hope to do work on hydrogen and fuel cell systems from 2011, but are inhibited by cost considerations and a lack of suitable hydrogen power sources.

Great Wall Motor Co

Great Wall Motor Co candidly states that their progress on new-energy vehicles has been "not very satisfying." They have only a small research team (40 out of a total of 2,000 engineers) working on NEV projects, and complain about a lack of clarity over technology standards and an absence of infrastructure.

To date, they have produced two pure electric show cars. The Kulla is a small two-seater EV running on a 67bhp brushless DC motor. The electric version of the Peri mini-car, which claims a range of 110 miles and a top speed of 80 mph, is equipped with lithium-ion batteries and a 50 kW electric motor. However, both these vehicles are reckoned to be at least two years away from volume production. Closer to commercialisation, but still at the development stage is a mild hybrid version of the Hover SUV, which features stop/start technology sourced from Bosch.

Great Wall, who are based in Baoding, do not expect to supply any test products to either the Shanghai Expo or the "13 cities, 1,000 vehicles" project.

Chery

Chery, who declined to be interviewed for this report, has been one of the early movers in leveraging overseas expertise to develop new-energy vehicles. A mild hybrid version of the A5 saloon, which formed part of the Beijing Olympics vehicle fleet, was developed with international expertise from the likes of Ricardo, Bosch and Johnson Controls.

They have also displayed an electric version of the small M1 car – code-named 518. This vehicle, powered by lithium phosphate batteries, is claimed to have a range of 75 – 100 miles, and a maximum speed of 75 mph. The target production price is Rmb 70,000 (cf Rmb 30,000 for the cheapest QQ petrol model).

BYD Auto Co

BYD is the most prominent, and aggressive, new entrant to the Chinese automotive industry. The Shenzhen-based company is a global leader in the manufacture of lithium-ion batteries and other components for laptops and mobile phones, and only entered the auto industry in 2003, with the purchase of Qinchuan Automobile.

Within China, the company is best known for its small economically-priced conventional cars, particularly the best-selling F0 and F3 models). However, BYD's international reputation (and the interest of major investors like Warren Buffett) has been largely driven by its rapid diversification of its battery making expertise into automotive new-energy products. BYD was the only Chinese company featured in a recent report on EV technology leaders around the world.

Their flagship cars are the PHEV F3DM and F6DM models. "DM" stands for dual mode, and refers to the combination of an all-electric powertrain with a hybrid drive system that incorporates a 1.0 litre petrol engine. The vehicles operate in

EV mode for short and urban journeys, with the hybrid system adding power and range for longer distances and higher speeds. The patented lithium-iron-phosphate battery is claimed to deliver 200kW and to have a range of 60 miles. The DM models have been widely displayed and are described as "production ready". An initial batch of 80 vehicles has already been supplied to agencies of the municipal authority. Some early test-drive reports have commented on the heavy steering and lethargic braking, which suggests that further ride and handling refinements may be necessary to compensate for the extra 400 kg battery weight.

BYD is also developing a pure electric car – the e6 – specifically designed around their LiFePO4 battery and permanent magnet synchronous motor. It is planned to offer four different power combinations, with a maximum range of almost 250 miles.

Strangely, the Chinese version of BYD's website makes much less reference to their NEV products than the English version. Although Chairman Wang Chuanfu is pressing vociferously for local subsidies to bridge the cost gap between conventional and new-energy products, it appears that the e6, at least, may be sold overseas before it appears on the Chinese market.

A very high degree of vertical integration is apparent in BYD's business philosophy, with the company seeking to produce virtually all components, and even its manufacturing equipment in house. Coupled with a strong confidence in their own technology leadership, their receptiveness to outside expertise and business partnerships appears limited.

Zotye Auto Co

Based in Yongkang, Zhejiang Province, Zotye Auto Co was originally supplier of body components, who only expanded into whole vehicle production in 2006 with an SUV closely modelled on the Daihatsu Terios. Just three years later, they surprised the automotive world by launching a pure electric version of this vehicle, with a claimed operating range of over 200 miles (city driving) and a top speed of 75 mph.

Although not officially disclosed, it appears that the lithium-ion battery system comes from Wanxiang Group. The battery pack is bulky and adds substantially to the weight of the vehicle. A short test drive suggested that there are ride and handling implications still to be addressed. Zotye state that the electric vehicle is their "strategic product", and that one third of their R&D resources are focused on its future development.

They claim to have achieved a 40% cost reduction in its first year of production. Battery costs remain a major concern. The electric version (at Rmb 120,000 – 200,000) still costs twice as much as the conventional vehicle. Zotye cite the extra cost, a lack of consumer subsidies, and slow progress on charging infrastructure as the key reasons why they do not expect to achieve mass production or sales in China for at least two years. In the meantime, they will start work on a hybrid vehicle.

Tianjin Qingyuan Electric Vehicle Co

Tianjin Qingyaun Electric Vehicle Co (TQEV) is a partnership between CATARC (the largest shareholder), Tianjin Lishen Battery Co, Tianjin Lantian Power Sources Co and Tianjin Automobile Industry Group established in late 2001 to develop and manufacture electric vehicles and their key components.

Originally focused on research projects, including a number under the national "863 Program", they now have ambitions to become a major NEV manufacturer, with an annual capacity for 80,000 electric vehicles and 100,000 powertrain systems. "Own brand" manufacture is currently confined to low-speed tourist buggies, sold into the US market, but they also have an electric version of the Hafei Saibao saloon and a small A-class car.

TQEV is now a nationally recognised centre for NEV development, and it is clear that they design, test and supply engine control and electric drive systems for a number of major Chinese VM's. They expect to have their technology in "a large proportion" of the NEV's supplied under the "13 cities, 1,000 vehicles" scheme.

Internationally, TQEV have co-operated on projects with PSA, Toyota and Argonne National Laboratory. They particularly wish to attract overseas partners who can offer whole vehicle design skills, improved battery technology, and component manufacturing capability.

A range of UK Government support is available from a portfolio of initiatives called Solutions for Business (SfB). The "solutions" are available to qualifying businesses, and cover everything from investment and grants through to specialist advice, collaborations and partnerships.

UK Trade & Investment is the government organisation that helps UK-based companies succeed in the global economy, and is responsible for the delivery of the two SfB products "Developing Your International Trade Potential" and "Accessing International Markets".

We also help overseas companies bring their high-quality investment to the UK's dynamic economy – acknowledged as Europe's best place from which to succeed in global business.

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