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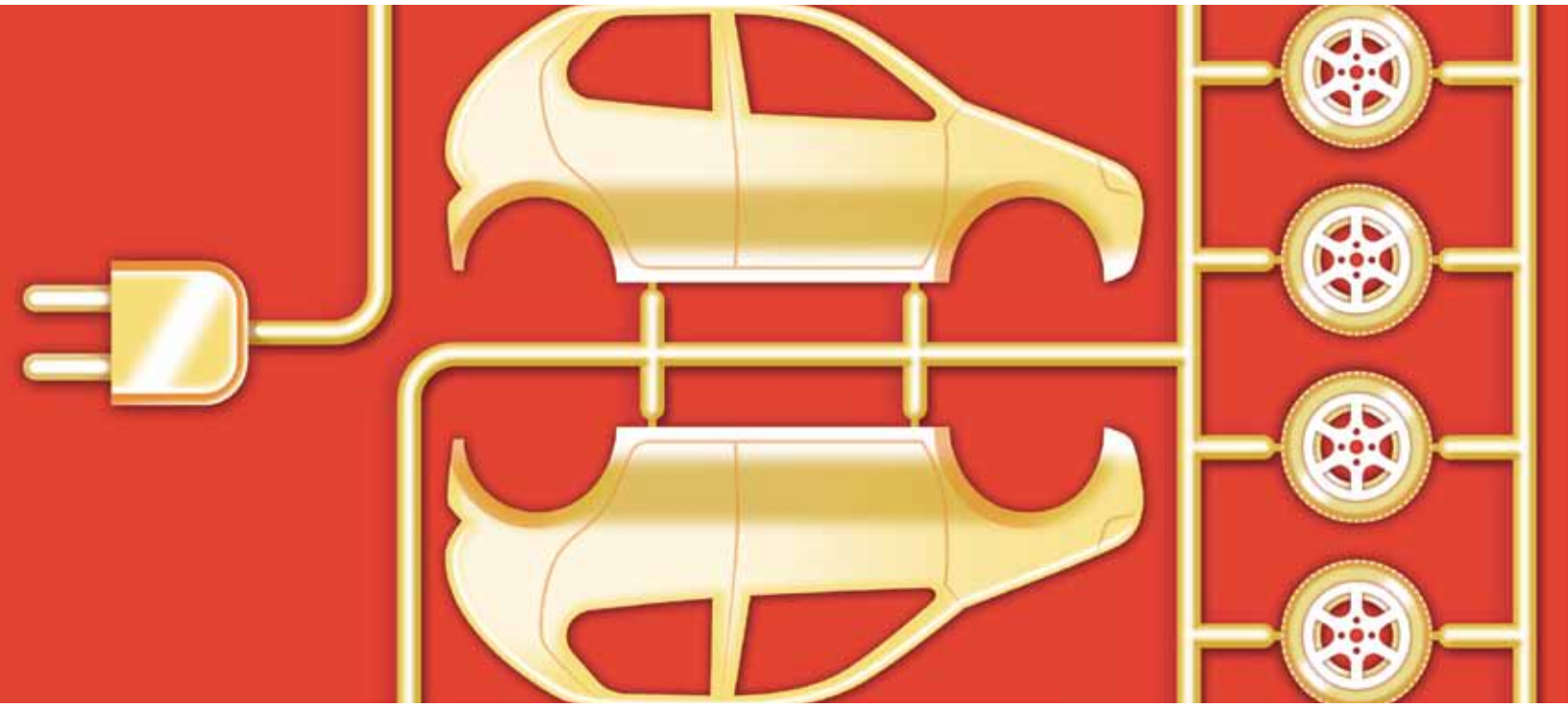
Recharging China's electric-vehicle aspirations

Despite setbacks, the country's strategy for building an electric-vehicle industry could still get back on track.

Axel Krieger, Philipp Radtke, and Larry Wang



China understands that embracing electric vehicles could help it not only to manage its energy dependency and environmental challenges but also to build a car industry that could leapfrog its global competitors in this emerging sector. But progress toward that goal has been disappointing, and the country needs a new strategy, McKinsey research finds. Automakers have produced only a fraction of the vehicles once expected. Ownership has fallen far short of projections, and the needed infrastructure has failed to materialize. Notwithstanding massive investment in battery R&D by automakers and suppliers, few vendors are qualified to provide batteries to the industry.

Despite such setbacks, electric vehicles continue to offer China enormous potential to achieve industry leadership and reduce the country's dependency on imported oil and its environmental impact. A phased introduction of electric vehicles—starting with more cost-effective and less technologically sophisticated extended-range, plug-in hybrids—and fostering their early adoption in public fleets could play to China's strengths and put the industry back on course to success. In April, the government indicated it was starting to move in this direction. But success will require better collaboration and coordination of efforts among government, automakers, and suppliers across the areas we lay out below.

A neat fit

Three years ago, the Chinese government unveiled an ambitious road map for expanding the country's electric-vehicle industry. It believed that moving to a future dominated by electric vehicles rather than cars with internal-combustion engines could deliver a number of major advantages for China.

First, electric vehicles would reduce consumption of oil-based fuels and boost China's energy independence: the cars would power up with electricity generated primarily from domestic coal. China otherwise faces the prospect that oil consumption will swell by 70 percent between 2010 and 2020, given current expectations for the per capita growth of vehicle ownership. The country would then find itself increasingly vulnerable to global supply fluctuations.

Second, electric vehicles could help reduce carbon dioxide emissions and air pollution, a significant problem in China, already the world's largest emitter. On a well-to-wheels basis, battery-powered electric vehicles can cut carbon dioxide emissions by about 40 percent compared with vehicles powered by internal-combustion engines. Local mobile emissions of both carbon monoxide and nitrogen oxides could fall by roughly 99 percent and 50 percent, respectively.

Third, a large domestic market for electric vehicles would give Chinese automakers an excellent launchpad to reach the world stage. In 2009, the government recognized that while domestic automakers probably couldn't catch up with their global rivals' internal-combustion-engine technology anytime soon, they had the potential to assume a leading position in the fledgling electric-vehicle segment. This approach could succeed, the

government hoped, if Chinese companies rapidly brought battery-electric vehicles to mass production and consolidated technological advances in batteries, traction motors, and power electronics.

Under this scenario, to abide by stricter Chinese-government regulations, foreign automakers would transfer increasing amounts of electric vehicle–specific intellectual property to their Chinese partners. Chinese suppliers would focus on building massive numbers of lithium-ion batteries and other electric-vehicle components to support the industry. What's more, the central government believed that it could overcome the absence of a battery-charging infrastructure through its control of the economy.

Why electric vehicles have yet to gain traction

Despite a concerted effort by the government and domestic automakers, the expected surge in electric-vehicle production and sales has not occurred. Automakers produced just 6,000 battery-electric vehicles and plug-in hybrid-electric vehicles in 2011, taking the industry just a fraction of the way to the half-million units of production capacity the government had originally expected for 2015.

The government's 12th five-year plan targets ownership of five million battery-electric vehicles and plug-in hybrid-electric vehicles by 2020. Yet just 1,000 of these vehicles were registered in the third quarter of 2011, less than 0.02 percent of new-vehicle registrations during this period. Despite investments totaling nearly 10 billion renminbi ($1.57 billion) in battery R&D by Chinese automakers and suppliers, few Chinese vendors are qualified to provide electric-vehicle batteries to the auto industry. Government-sponsored subsidies have failed to stimulate consumer demand. Electric-vehicle buyers in Shenzhen got 120,000 renminbi per vehicle for battery-electric passenger cars—some of the country's highest subsidies—but automakers sold only about 600 such vehicles there by 2011.

Planned infrastructure rollouts have also failed to materialize. The Ministry of Science and Technology had called for the construction of more than 400,000 charging piles by 2015. Yet the State Grid Corporation of China (the national power provider) and China Southern Power Grid combined built only about 16,000 charging piles in 2011.

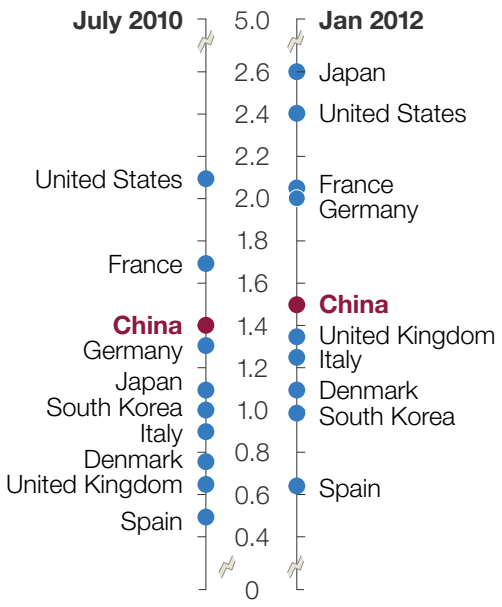
As a result, China has fallen behind not only its own goals but also other major automotive markets in its readiness to support an electric-vehicle industry. McKinsey's electric-vehicle index, for example, assesses a nation's electric-vehicle readiness in terms of supply and demand. China scores relatively low on both dimensions.[1] Furthermore, in overall electric-vehicle readiness, the country fell from third place, in July 2010, to fifth, in January 2012—behind Japan, the United States, France, and Germany (Exhibit 1). A number of things explain China's inability to reach its electric-vehicle targets.

[1]We measure supply using indicators such as the number of electric-vehicle models planned by automakers in a country. Demand measurement takes into account factors such as incentives offered to electric-vehicle buyers.

Exhibit 1

China has fallen behind other markets in electric-vehicle readiness.

McKinsey electric-vehicle index (EVI),[1]
5 = most developed, 0 = least developed



The EVI assesses a nation's readiness to support an electric-vehicle (EV) industry based on:

Supply

- EVs' forecast share of car production
- number of EV prototypes generated by national OEMs[2]
- government support for infrastructure and R&D

Demand

- EVs' share of car sales
- level of government subsidies
- customer driving experience

[1]Includes plug-in electric hybrids and battery EVs but not conventional hybrid EVs.
[2]Original-equipment manufacturers.

For consumers, purchase prices remain high: heavily subsidized battery-electric vehicles can cost 150 percent more than comparable cars powered by internal-combustion engines. That puts electric vehicles well beyond the reach of China's highly price-sensitive consumers.

In addition, the country's charging infrastructure is limited: for instance, Chongqing, China's largest city, with a population of more than 30 million, had only 150 charging piles by the end of 2011. And even if consumers want to buy an electric car, as of April 2012 they could choose among fewer than ten models of battery-electric vehicles and plug-in hybrid-electric vehicles. In addition, immature battery technology detracts from the quality of the electric-vehicle driving experience on all key dimensions—range, charging time, speed, and reliability.

The whole issue of rechargeable car-battery standards and infrastructure remains unresolved. At present, two competing options—battery swapping and battery charging—are under consideration. State Grid and one domestic automaker back battery swaps, while

other Chinese automakers (and foreign ones) prefer battery charging. Since few Chinese households in major cities have garages that can be wired to charge electric vehicles overnight, owners of battery-electric vehicles must rely on the very limited number of publicly available charging points.

Given the confusion over battery-recharging options and other industry standards, along with the affordability issue, Chinese and foreign automakers are on the sidelines, waiting to see what will happen. Foreign automakers also have ongoing concerns about the state of intellectual-property regulation in China. Meanwhile, the country has built significant production capacity for electric-vehicle components, especially lithium-ion batteries. But few suppliers can give automakers the production volumes, cost, quality assurance, and delivery capabilities they need.

Making electric vehicles work for China

Despite the setbacks to date, electric vehicles have enormous potential in China. Now is a good time for its auto industry to reassess electric-vehicle strategy thoroughly.

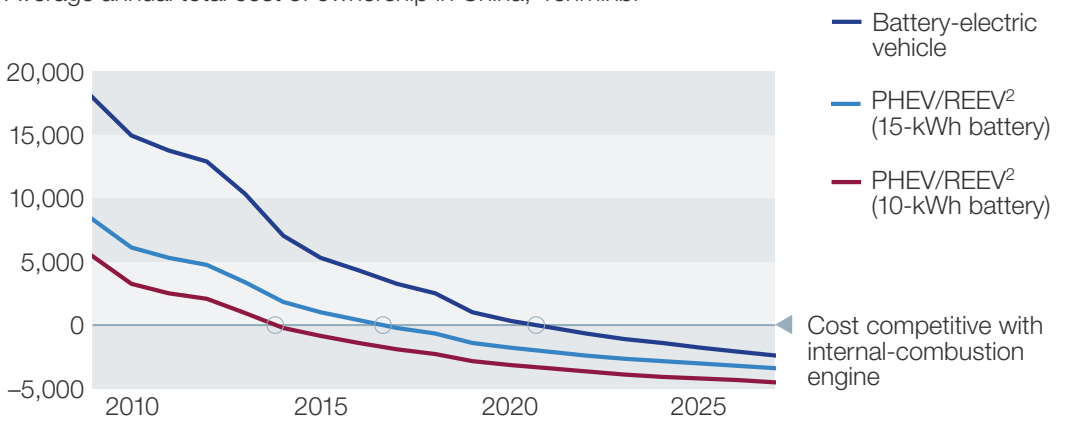
Our research suggests that in the near to medium term, China's industry should consider developing range-extended electric vehicles (REEVs), also called serial plug-in hybrid-electric vehicles. This bridging technology would give the industry time to develop an ecosystem mature enough to support the mass production of battery-electric vehicles. As that strategy recognizes, there is no shortcut to the day when battery-electric vehicles will dominate the market, given the technology's immaturity and current teething problems. REEVs—electric vehicles equipped with small internal-combustion engines whose sole purpose is to recharge batteries on the move—provide a number of advantages.

REEVs have less need for an extensive charging infrastructure than battery-electric vehicles: if it is not possible to plug in, a driver can rely on the small onboard internal-combustion engine to recharge. REEVs also potentially offer a much better price point than battery-electric vehicles, which can cost twice as much because they need a larger battery. We estimate that in China, REEVs with 15-kilowatt/hour (kWh) batteries will become cost competitive against vehicles with internal-combustion engines by 2017, while battery-electric vehicles won't pass this threshold until after 2020 (Exhibit 2). REEVs outfitted with smaller 10-kWh batteries will probably reach cost parity with internal-combustion engines as soon as 2014. Cars fitted with these smaller batteries would offer a 40-kilometer driving range, likely to meet the needs of most Chinese commuters. REEVs therefore can circumvent the barriers to mass adoption—driving ranges and charging times—that still beset battery-electric vehicles.

REEVs also represent a more cost-effective and less technologically challenging route for Chinese automakers than parallel plug-in hybrid-electric vehicles, which have a full-sized internal-combustion engine power train in parallel with an electric one. Most Chinese automakers still lag far behind their global rivals in the ability to manufacture power

Exhibit 2

Plug-in hybrid-electric vehicles have a significant advantage in total cost of ownership over battery-electric vehicles.



[1]Assumes: battery pack costs 3,700 renminbi ($580) per kWh in 2012, 2,700 renminbi per kWh in 2015, and 2,100 renminbi per kWh in 2020; based on assumption that China has 20% cost advantage, average driving distance of 16,000 km/year, energy consumption of 136 watt-hours per km, 30% additional battery power required for heating/cooling, 70% state-of-charge window, and fuel price consistent with US Energy Information Administration forecasts of crude-oil prices.
[2]PHEV = plug-in hybrid-electric vehicle; REEV = range-extended electric vehicle, one type of PHEV.

trains for internal-combustion engines and are therefore at a disadvantage for parallel plug-in hybrids. REEVs also offer a better technology bridge to battery-electric vehicles, since they are closer in terms of design.

Act now to shape the future

To realize China's potential, stakeholders across the electric-vehicle ecosystem should consider making a number of moves.

Fine-tuning government action

Policy makers could set a clear direction and provide an enabling environment. Two initiatives are essential: first, providing guidance on the industry's technology road map through targeted subsidies, R&D support, and standards and, second, developing regulations that ensure the protection of intellectual property. Unless the government undertakes such initiatives, global automakers and suppliers will probably remain on the sidelines.

Continued government support for both the demand and supply sides of the electric-vehicle equation can help to establish REEVs in the market. Consumer and fleet-

purchasing incentives, subsidies, and ongoing support (through tax reductions, free registration, and similar benefits) will encourage more consumers and businesses to buy REEVs. On the supply side, the government can encourage innovation by providing R&D subsidies to automakers and committing national scientific-research resources to the development of these vehicles. In addition, policy makers could consider giving automakers clean-energy subsidies for each green vehicle sold.

With the failure of the leapfrogging strategy, government policy makers have revised their approach to developing electric vehicles. In April, the Ministry of Science and Technology announced a new three-phase timeline. Under the new policy, China would mass-produce hybrid-electric vehicles through 2015, accelerate the development of plug-in hybrid-electric vehicles and battery-electric vehicles from 2015 to 2020, and make the transition to the wide adoption of battery-electric vehicles after 2020.

Building public fleets

Our analysis shows that public fleets—especially bus fleets—will probably represent the initial wave of electric-vehicle adoptions in China. First, as the world's largest maker of buses, Chinese automakers can rapidly reach manufacturing scale and reduce costs by securing large commercial orders. Buses can also address current limitations of electric-vehicle battery life by offering space to store extra batteries. City buses run fixed routes and are serviced and maintained in central garages, which would greatly facilitate battery charging or swapping.

Government subsidies and incentives for the purchase of electric vehicles for public fleets have already proved more effective than private purchases in stimulating the sector. A central-government subsidy program for public transport (as well as taxis and government and public-service vehicles) has been in effect since 2009. Thanks to that, battery-electric vehicles and plug-in hybrids accounted for 0.3 percent of new sales in the bus market in 2011—about ten times the penetration of electric vehicles in the passenger car segment. If these programs continue and current trends hold, we project that the total electric-bus fleet could grow to 100,000 units by 2016.

That could pave the way for broader consumer adoption in the future. Besides the heightened visibility these increasing sales in the commercial market would give to electric vehicles, they will enable China to reach critical mass in manufacturing scale and push the entire value chain to ramp up capacity and deepen its capabilities. These developments would help drive down costs, improve performance, and promote the rollout of a charging infrastructure.

Recalibrating automakers' strategies

For the reasons laid out above, we believe that Chinese automakers should shift their focus to REEVs, which will serve as a bridging technology until battery-electric vehicles mature.

While some Chinese automakers, such as Geely, have begun to produce plug-in hybrids, they haven't moved as quickly as foreign automakers. The plug-in hybrid lineup remains underdeveloped: of the approximately 35 electric-vehicle models slated for the Chinese market by 2015, only about 20 percent are plug-in hybrids.

Besides shifting to REEV power train technology, Chinese automakers should reassess their product strategy—for instance, by introducing relatively inexpensive electric-vehicle models for early adopters who are cost sensitive. REEVs could indeed make such a solution feasible: as noted above, we find that smaller REEVs with 10-kWh batteries will probably reach cost parity with internal-combustion engines as soon as 2014.

Building local suppliers' capabilities

Chinese automakers should cooperate with local suppliers to help them develop their capabilities and to create a supply base of low-cost electric-vehicle components. An automaker can transfer know-how by involving suppliers in its own development processes, work to increase the skills and capabilities of its suppliers' employees, and introduce its standard quality-management tools. It could also provide financial support to help suppliers acquire key assets.

Choosing a charging infrastructure

Battery swapping could be a short-term solution for some applications, such as city buses, which are maintained in central garages, have fixed routes of known distances, and can easily accommodate standard battery packs. Our research, however, suggests that charging will be the winning long-term model for replenishing batteries: it doesn't require highly standardized batteries and can facilitate the efforts of local Chinese automakers to export vehicles to international markets. Customers too will probably prefer the battery-charging option, especially after quick charging becomes commercially viable.

China can still realize its aspiration to become a global leader in electric vehicles, but achieving this goal will require a change of expectations and approaches by stakeholders across the electric-vehicle value chain. China's government, automakers, suppliers, and infrastructure providers must collaborate more closely in crafting a new strategy for the electric-vehicle segment.

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Axel Krieger is a principal in McKinsey's Beijing office, **Philipp Radtke** is a director in the Munich office, and **Larry Wang** is a principal in the Shanghai office.