Energy Challenges the Automobile Industry Faces in China

By Yimin Liu, Yong Yang and Erica Klampfl*

Introduction

In 2009, China's auto sales surged past the United States to reach a record level of 13.6 million units, compared with the United States' lowest annual sales in 27 years of 10.6 million units, including medium and heavy duty vehicles. This underscores China's importance to the global auto industry as it is the world's biggest market. However, as expected, this auto industry expansion in China has also resulted in a drastic increase in energy consumption.

This study will discuss the oil supply issue China is facing, corresponding energy and related auto industry policies China is implementing, the impacts of the aforementioned on the automobile industry, and the technological measures the Chinese automobile industry is taking to address these issues.

Fossil Energy Demand and Supply in China

China has limited reserves of oil and natural gas, and coal remains the leading source of energy in its industrial sectors. Domestic coal reserves surpass any other fuel source. At current rates of extraction, Chinese coal reserves will last 4 times longer than those for crude oil, which will be exhausted in about 11 years (Table 1). However, this does not factor in the potential future demand for coal in China from the production of coal-based synthetic liquids, which poses several concerns for the government, such as potential strains on water resources and shortages of coal supply. Around two thirds of China's electricity is generated from coal-fired power stations. In 2009, China's total annual electricity output was 3.65 trillion kWh: 81.7% (2.98 Trillion kwh) from thermal sources, 15% (554.5 Trillion kwh) from hydro power, and 1.9% (69.3 Trillion kwh) from nuclear sources.

	Crude Oil (Mt)	Natural Gas (Billion NM3)	Coal (Mt)
Identified Reserve (2007)	2117	1884	114500
Consumption (2008)	358	80.7	2740
Domestic Extraction (2008)	190	78.1	2793
Years to Depletion (at current rate of extraction)	11	24	41

Table 1
Domestic Crude Oil, Natural Gas, and Coal Reserves, Consumption and Years to Depletion

By itself, China is far from being able to meet the increase in energy demand because of its shortage of domestic crude oil and fast economic growth. In 1993, China became a net importer of oil, and it is now the world's third largest importer and second largest oil consumer. In 2008, oil imports accounted for more than 50% of China's total crude oil consumption. By 2020, imports are projected to reach beyond 75% of total crude oil consumption or as high as 800-900 million tons per year. China will likely have a refining capacity of 600 million tons by 2020; however, the government plans to control the capacity at around 450-480 million tons during that timeframe (Figure 1).

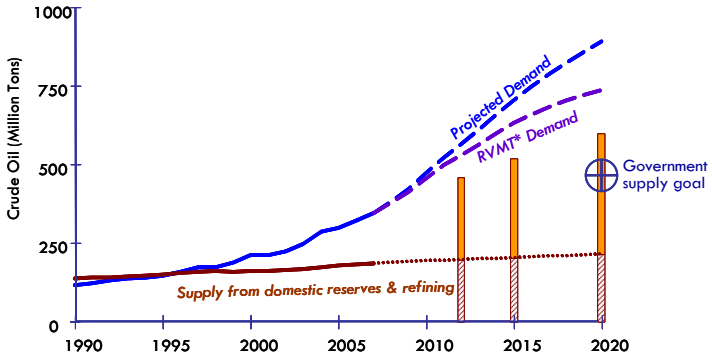

Figure 1
Demand and Supply of Crude Oil in China
RMVT= Reduced vehicle miles traveled, 75% of mile traveled in 2020.

Meanwhile, oil imports in China are limited by geopolitical risks: most of China's oil imports come through the Strait of Malacca, a passage vulnerable to war and political instability, and the majority of oil suppliers are located in unstable regions or battle zones (Figure 2). It is possible that energy demand will further exceed supply, and economic growth will be dragged down by energy shortages in China.

Energy Challenge the Automotive Industry Faces

Since 2002, vehicle sales have increased dramatically in China (about 1 million per year); however, according to the International Energy Agency, China's overall average vehicle ownership in 2008 is still just 38 vehicles per 1000 people, as compared with 815 vehicles per 1000 people in the U.S. Since per

* Yimin Liu is a Research Scientist at Ford Motor Company and can be reached at yliu59@ford.com; Yong Yang (yyang1@ford.com) is a Senior Economist at Ford Motor Company; and Erica Klampfl (eklampfl@ford.com) is a Technical Leader at Ford Motor Company.

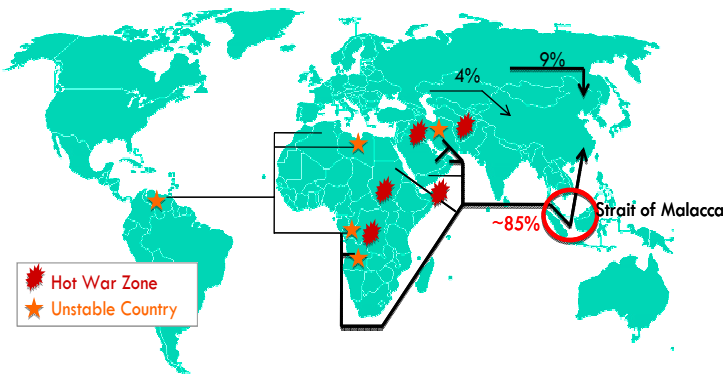

Figure 2
China's Imported Oil Suppliers and Transport Paths
Source: Presentation by Weijian Han at the University of Michigan

capita GDP grows in China at above 8% each year, it is expected that car ownership will increase quickly. The question is how much the vehicle fleet will grow before the energy constraint becomes too severe.

According to U.S. Department of Energy, China currently consumes about 7.8 million barrels of oil a day: 40% is used for transportation, including gasoline, jet, and diesel fuel, and 2% is used to fuel private cars. By 2020, it is projected that around half of China's oil will be used for transportation, and 10% of the total will be burned by private cars. Because of the country's growing demand for oil and increasing volume of vehicle sales, China's government has been aware of these problems for some time and has instituted a set of strong policies to achieve its energy goals. For example, the National Energy Administration (NEA) was established in July 2008 to approve new energy projects in China, set domestic wholesale energy prices, and implement the central government's energy policies. Since energy prices are controlled by the government, gasoline prices do not fluctuate with the international market. Even at the end of 2008 when gas prices in the world market dropped substantially, those in China decreased only moderately (Figure 3). Based on the trend of increasing gas prices in China over the past few years (from $2.38/gallon to $3.48/gallon in Beijing), we expect energy prices to persist upward over the next few years.

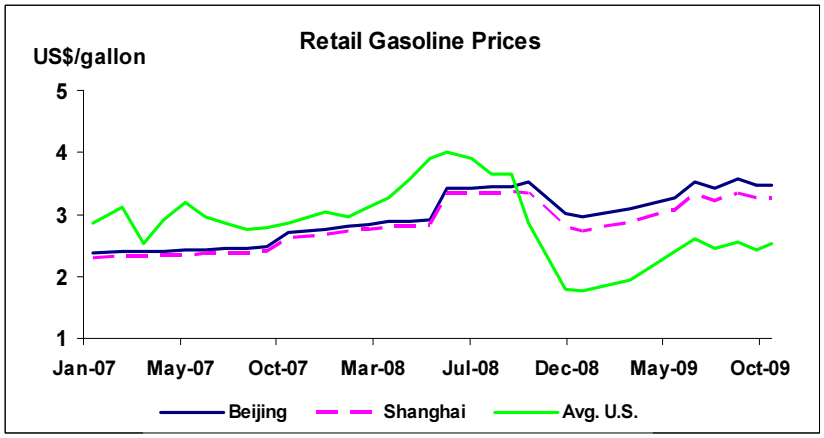

Figure 3
Retail Gas Prices in Representative Cities in China and Average for the U.S.

In addition to the increase of energy prices, current and future regulations have been enforced or proposed for the automobile industry in order to improve vehicle energy efficiency and reduce emissions in China. These regulations include fuel economy standards, emission standards, and vehicle consumption taxes,.

Currently, China does not impose fuel economy standards on each automotive manufacturer's fleet of vehicles, such as the Corporate Average Fuel Economy (CAFE) standard in the U.S. Instead, China has curb weight or gross vehicle weight (GVW) based fuel economy standards for each gasoline and diesel vehicle, requiring each passenger vehicle or commercial vehicle with curb weight or GVW in a certain range to meet a fuel consumption standard. Based on the implementation timeline, the standards are different: stage 1 focuses on new vehicles produced before January 2009; stage 2 regulates new vehicles produced before January 2011; and stage 3 has several implementation phases: in 2012, over 60% of each OEM's volume is required to meet the target; 70% in 2013; 80% in 2014 and 90% in 2015 and beyond. By 2020, China's fuel efficiency standard will match the EU's targeted CO_2 standards (Figure 4).

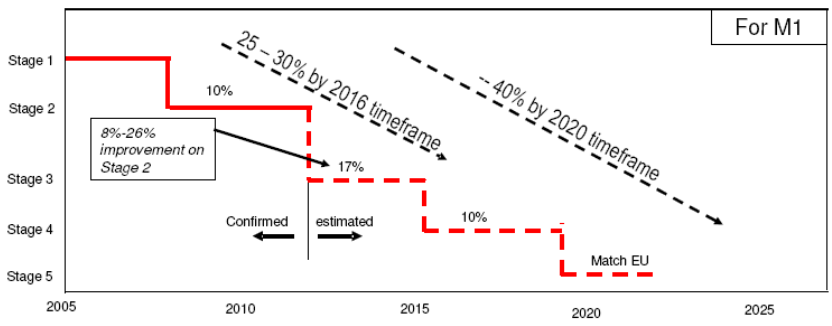

Figure 4
Fuel Economy Regulations by Year for Stages 1 to 5 in China

For example, in stage 1, each commercial vehicle with a gross weight of less than 3.5 ton has to meet a fuel consumption standard based on the range of GVW

and the engine displacement. So, if its GVW $\in$ (2000 KG, 2500 KG) and the engine size L $\in$ (1.5 < L ≤ 2.0), then the fuel consumption of gasoline and diesel vehicles would have to be below 10 liter/100km and 8.4liter/100km, respectively. China's fuel economy standard is stricter for diesel vehicles than for the same type of gasoline vehicle, even if their weight and engine size are the same. A "no-comply no-sale policy" has been applied to domestic vehicles, but not yet implemented for imports in stage 1 and 2. This policy encourages powertrain technology improvements more than weight reduction: this is different from CAFE or CO_2 standards in the U.S.

In addition to fuel economy standards, there are also standards in different cities on other emissions, such as sulfur, NOx, and particulate matter, but not on CO_2. Beijing has implemented Euro IV equivalent emission standards; however, Shanghai and other cities still use Euro III equivalent emission standards. If these standards cannot be met, the vehicles can not be sold in China.

Beyond industry regulations, China has implemented taxation and provided subsidies for vehicle buyers to encourage them to purchase "green" vehicles. For example, purchasers of cars with engines above 4-liter capacity have to pay a consumption tax of 40% of the vehicle price. Additionally, taxes have risen from 15% to 25% on vehicles with 3 to 4 liter engines since September 2008; in contrast, taxes have dropped on automobiles with engines less than 1-liter capacity from 3% to 1% from 2006 to 2008 (Table 2). On the other hand, taxi fleets and local government agencies in 13 Chinese cities have been offered subsidies of up to $8,800 for each hybrid or all-electric vehicle they purchase: this is regardless of the fact that China gets three-fourths of its electricity from coal, which may produce more greenhouse gases than other fuels. This subsidy for the acquisition of electrical vehicles by state agencies is called "13 Cities, 1,000 Vehicles," with the aim of placing 1,000 electric vehicles in each of the 13 cities.

Engine Displacement (Liter)	Before April 1, 2006			April 1, 2006 -- August 31, 2008		Sept. 1, 2008	
	Passenger Car	SUV	Mini Bus <22 seat	Passenger Vehicle	Light/Mid Comm Vehicle 10<Seat>23	Passenger Vehicle	Commercial Vehicle
≤1.0L	3%	3%	3%	3%	5%	1%	5%
1.0 < L ≤ 1.5	5%					3%	
1.5 < L ≤ 2.0				5%		5%	
2.0 < L ≤ 2.2			5%	9%		9%	
2.2 < L ≤ 2.4	8%	5%					
2.4 < L ≤ 2.5							
2.5 < L ≤ 3.0				12%		12%	
3.0 < L ≤ 4.0				15%		25%	
> 4.0L				20%		40%	

Table 2
Vehicle Consumption Taxes in China

To support 13 Cities, 1,000 Vehicles, the state electricity grid has been ordered to set up electric car charging stations in Beijing, Shanghai, and Tianjin. Furthermore, the government provides research subsidies for electric car designs, and the National R&D fund encourages new local technology growth by allocating $150 million to automotive manufacturers for new energy vehicle research. China wants to raise its annual production capacity to 500,000 hybrids or all-electric cars and buses by the end of 2011, according to an article in the April, 2009 issue of the *New York Times*.

In conjunction with the national policies, some major cities have implemented additional restrictions. Beijing bans light duty diesel vehicles in the city, and Shanghai restricts vehicles with a non-Shanghai registered license plate driving on lifted-high ways during rush hours. One major policy issue is the mismatch between intended high emission standards and the existence of low fuel quality. In addition, multiple government agencies like the National Development and Reform Commission, the Ministry of Industry and Information, the Ministry of Environmental protection, and even local governments, sometimes enact uncoordinated or conflicting policies.

Response from the Automobile Industry

China estimates that vehicles may consume 300 million tons of fuel by 2020 and plans to cut vehicle fuel consumption 30% by that timeframe. This includes 60 million tons of savings by deploying new energy vehicles, such as EVs, and 30-40 million tons of savings by deploying alternative fuel vehicles, such as natural gas vehicles.

Up until 2009, most vehicles sold in China were still small sized, fuel-efficient vehicles. 36.8% of consumers purchased their vehicles in the C segment in 2008, increasing to 41.2% in 2009. Between 2008 and 2009, the market shares in the B, sub-B, and small SUV segments also grew (Figure 5). In the future, with the disposable income growth of Chinese consumers, the market shares of fuel-inefficient vehicles may increase, adding more pressure to the demand for fuel.

Because of China's diesel fuel shortage, China does not encourage diesel vehicle development.

Trucks, farm tractors, and military vehicles consume 20-25% of China's diesel fuel. Polk forecasted that China may plan to have 20% of car sales be diesel by 2020. China also plans to develop compressed natural gas (CNG) vehicles in certain regions where the natural gas supply is rich, including the southwest, northwest and northeast. China has E10 vehicles available in nine provinces, but it does not appear to favor developing corn-based E85 vehicles because of potential competition with the production of corn for food. China currently also produces micro and mild hybrid vehicles, which are 5-10% and 10-20% more fuel efficient, respectively, than conventional vehicles. China plans to leapfrog full hybrid vehicles and directly develop plug-in and battery electric vehicles in the 2015—2020 timeframe. By some estimates, converting public fleets to CNG and hybrid electric vehicles could reduce China's energy use by up to 1.6 quadrillion British Thermal Units (BTUs) by 2025, which equals to almost 2% of China's current annual energy use.

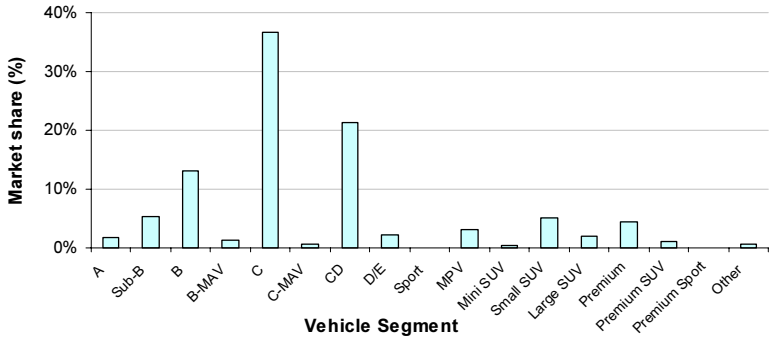

Figure 5
2008 Passenger Vehicle Segment Shares in China

State Grid Corporation of China (SGCC), the largest electric power transmission and distribution company in the world, is speeding up construction of electric car charging stations in Shanghai, Beijing, Tianjin, and other large cities in the country: these will serve electric buses and passenger vehicles in a trial run. Nationwide coverage of the charging station network will be launched immediately if the pilot project (the "13 cities, 1,000 NEVs" national pilot program) operates well and gets approved by the nation's top economic regulator. A recent circulation posted by Ministry of Finance and Ministry of Science and Technology also requested local governments to support facility construction and maintenance, but no details have been revealed yet.

	HEV, PHEV, & BEV Brand		
Local Maker	2008	2009	2010
SAIC		Roewe 750	
FAW	Besturn B70	Bus	
Changan	Jiexun	Zhixiang	
Chery	A5	S18	
Geely		EK-1	EK-2
BYD	F3 DM	F6 DM	E6
Greet Wall		Kulla	Peri
Brilliance	Zunchi		
Hafei Motor		Saibao	Coda

Table 3
Some Electric Vehicle Models Produced by Local Automakers

The Chinese government wants to raise its annual production capacity of hybrid or all-electric cars and buses from 2,100 in 2008 to 500,000 by the end of 2011. So far, most large and growing Chinese OEMs, such as SAIC, FAW, Changan, and BYD, have announced HEV, BEV or PHEV production plans because of financial advantages (government subsidies) and practical advantages (infrequent intercity driving, short commute distance, and frequent low speeds). Some such vehicle models have already been sold in the Chinese market, such as Jiexun by Changan, and Besturn B70 by FAW.

Because of energy shortages and government support, OEMs in China are starting to offer a broad range of EVs (HEV, PHEV, and BEV) and further develop EV technology, even though EVs may not significantly reduce the production of greenhouse gases from light-duty vehicles in China, since most of the electricity is generated from coal. These extensive development activities could make China a major driving force for EV adoption in the world, since the economies of scale will reduce battery technology costs substantially. Automotive players in the U.S. and Europe need to act quickly in the field of EVs in order to seize future potential opportunities for increasing market shares of EVs and developing related technology for improving energy efficiency and satisfying consumers' needs.

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