中国石油集团经济技术研究院
Research Institute of Economics and Technology CNPC

The 7th China-Japan Joint Symposium on Asian Oil & Gas

Energy Substitution and Supply-Demand Trends of Petroleum in China

December 12, 2013

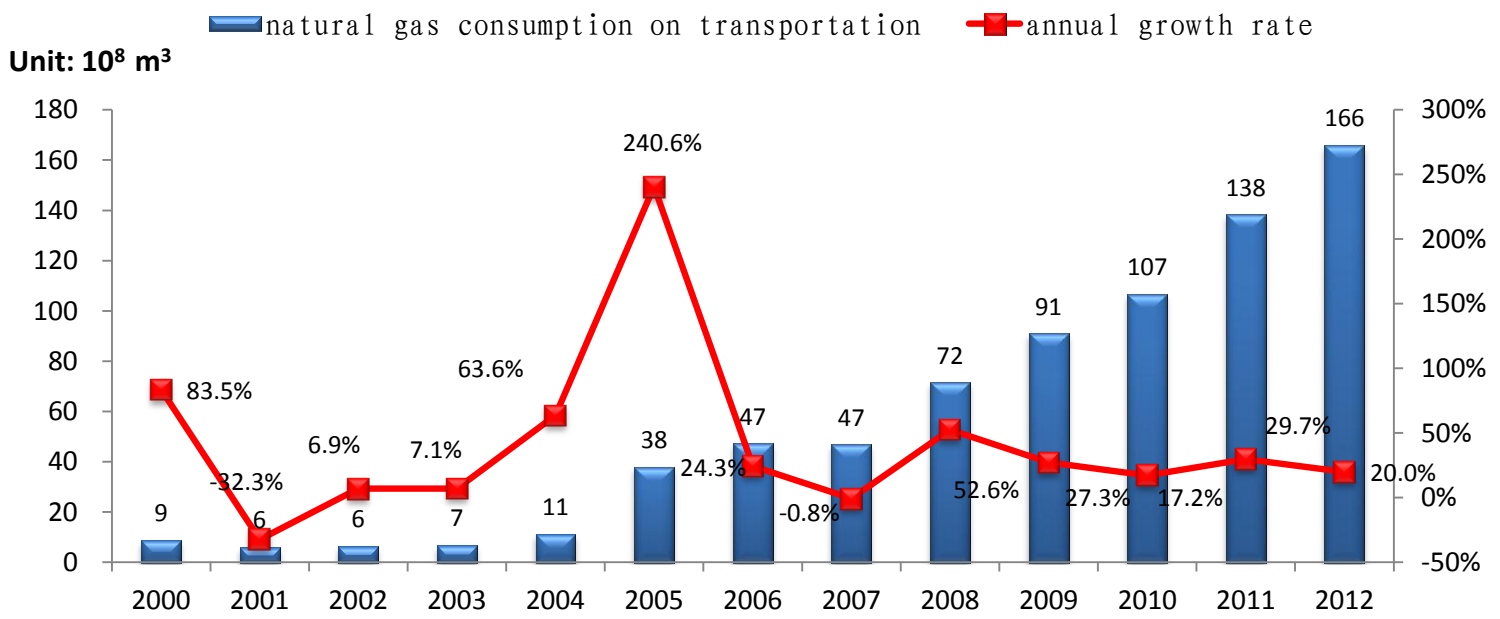
Beijing, China

Contents

1. Accelerated development of large-scale substitution of natural gas for petroleum in China

- Between 2000 and 2012, the average annual growth rate of natural gas consumption on transportation in China is 28%. By 2012 the amount of natural gas consumption on transportation is 16.6 billion cubic meters from 0.9 billion cubic meters in 2000. Ratio transport gas to total natural gas rose to 11% from 4%, and average annual growth rate of total natural gas is 16% from 2000 to 2012.
- Between 2000 and 2012, natural gas on transportation take place of the amount of refined oil (including gasoline, kerosene and diesel) rose to 13 million tons from 0.7 million tons.

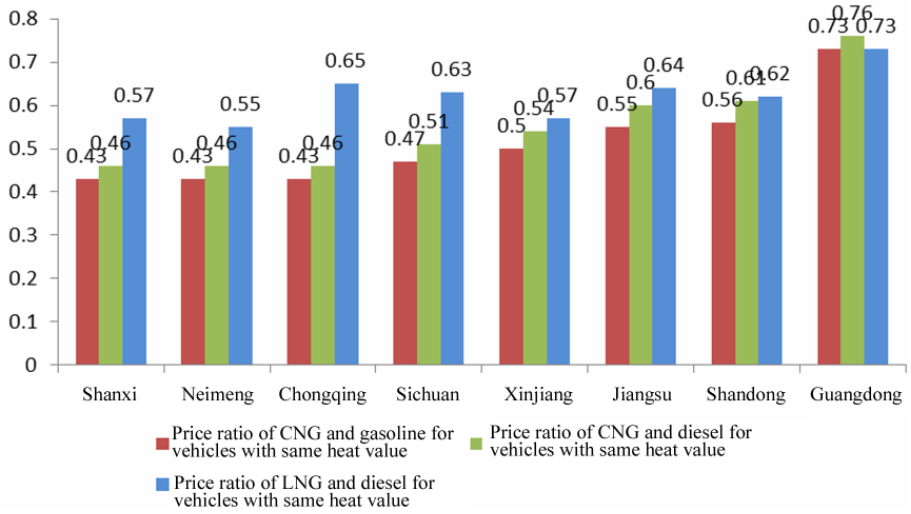
Natural gas consumption on transportation from 2000 to 2012



2. The advantages in price and environmental protection are main reasons for rapid growth of natural gas consumption in transportation

- In China, according to estimates, (under conditions of equal heat value) the average price ratio of natural gas compared to gasoline and diesel for vehicles is about 0.5. Therefore, compared with the price of gasoline and diesel, the price of natural gas is significantly cheaper.
- Compared with traditional automobiles fueled by diesel, automobiles fueled by natural gas emit about 96% less discharge of PM2.5 particulate matters. Therefore, using automobiles fueled by natural gas will help alleviate the current serious air pollution problem in China– and reduce the haze weather in large cities.

Price ratios of natural gas, gasoline and diesel for vehicles in key areas (November, 2013)



Figures on environmental friendliness of automobiles fueled by LNG compared to automobiles fueled by oils

	Main Pollutants						Green House Gas
Main Emissions	CO	CH	NO	SO_2	PB	PM2.5	CO_2
Emission Reduction Ratio (%)	93	73	39	90	95	96	28

3. But the advantages will diminish in the future

- As the continuous price reform of energy, the price of natural gas will increase in the future. Estimated on the basis of integrated price, the price of natural gas in China will increased by 77%, and its price advantage in comparison to gasoline and diesel will thus be reduced by approximately 30%. At this point, the price advantages of natural gas will be significantly reduced.
- By the end of 2017, China will launch the use of gasoline and diesel meeting the national V standard. At that time, the pollution emitted by petroleum products will be lowered considerably, and the environmental advantages of natural gas (compared to gasoline and diesel) will be reduced.

Comparison of Average Sales Price of Natural Gas in China

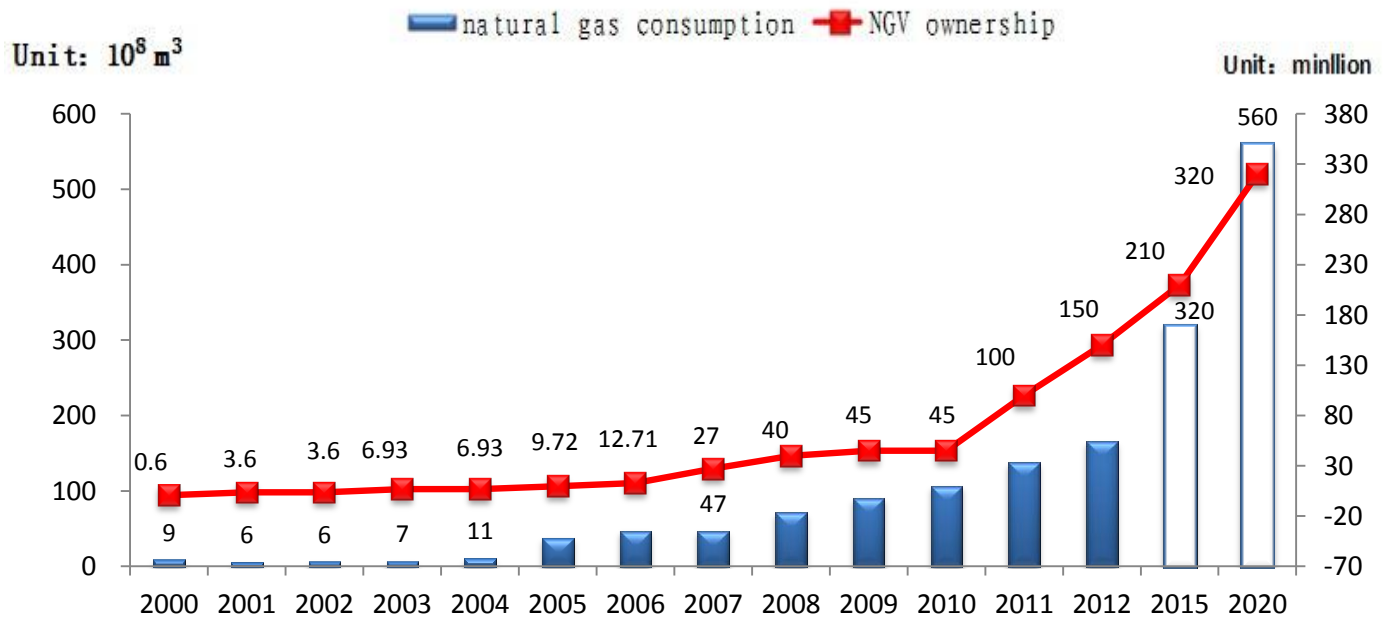
Unit: RMB/Kilo Coal

	Natural Gas	Compared with Gasoline	Compared with Diesel
Current Price	3. 71	-2. 55	-3. 51
Integrated Price	4. 96	-1. 30	-2. 26

4.Natural gas automobiles have great potential, and the substitution for petroleum products will continue to grow

● With energy price reform gradually launched in China, the price advantage of natural gas on comparison with petroleum products would be narrowed gradually. However, from the viewpoint of cleanness and environmental friendliness, Chinese government will advance booming development of natural gas in transportation. The consumption of natural gas in transportation in China will reach 32 billion tons oil equivalent by 2015 and exceed 56 million tons by 2020.

Natural gas car ownership in china from 2000 to 2020



5. Development of coal-to-olefin will accelerate

- At present, coal-based polyolefin is mainly produced in China by enterprises such as Shenhua Baotou, Shenhua Ningxia Coal and Datang Duolun. Production capacity is 1.5 million tons/year (this includes 3×10^4 t/y of polythene, and 1.26 million tons/year of polypropylene). This accounts for 6.9% of total polyolefin production capacity in the country.
- In 2012, the National Development and Reform Commission released *The "Twelfth Five-year Coal Deep Processing Demonstration Project Plan"*, which outlines 15 projects in the coal chemical industry. It is predicted that the modern coal chemical industry (represented by coal-to-olefin and coal-based natural gas) will see a golden age, in which it transitions from demonstration to commercialization.

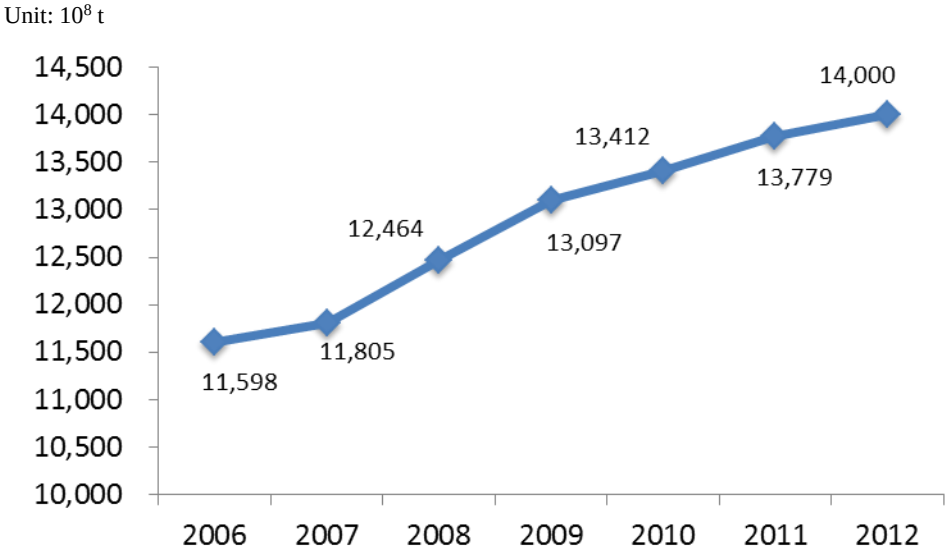
Construction of Coal-to-olefin Devices (May 2013)

Enterprise	Productivity (in 10^4t/y)	Location
Shenhua Coal Oil Chemical Co., Ltd.	108	Erdos
Shanxi Luan coal based synthetic oil company	21	Luan
Yitai Coal Oil Co., Ltd	16	Erdos
Shenhua company	18	Ningxia
Shanxi Coal Group days Creek coal oil branch	10	Jincheng
Total	173	

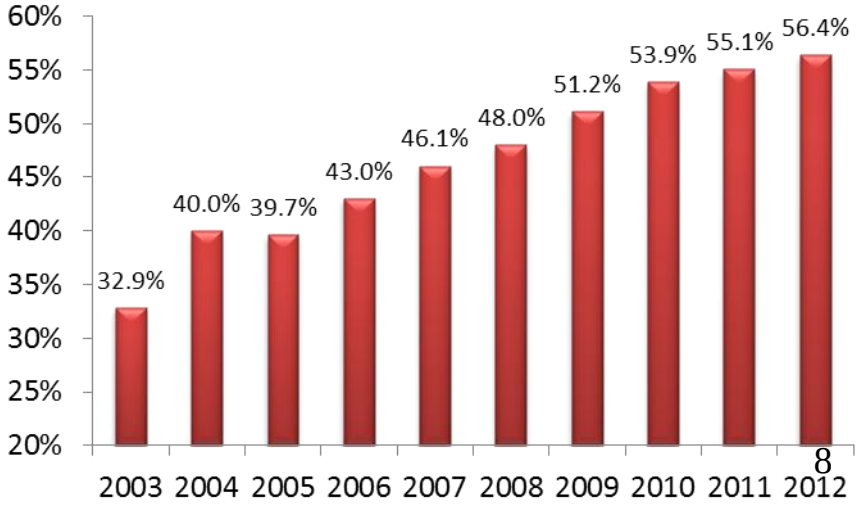
6. Development of coal-to-olefin spurred mainly by " advantages in coal resources" and "security issues of petroleum energy"

- China has some of the richest coal resources in the world, with total ascertained reserves of coal at 1.4×10^{12} t. (China ranks third in the world for coal reserves.) Whereas China is endowed with resources " rich in coal, but suffers from an absence of oil and a shortage of gas", the development of the coal-to-olefin industry could allow China to fully leverage its rich coal resources.
- In 2012, China's net petroleum import volume reached 2.84×10^{8} t– and the percentage of petroleum dependant upon foreign-trade reached to 58%. Thus, China's petroleum energy security is confronted with severe challenges… appropriate development of coal-to-olefin projects in which coal is substituted for petroleum "is an important method for diversifying energy and ensuring national energy security".

Estimated Reserves of Coal in China



China's Dependence on Imported Crude Oil

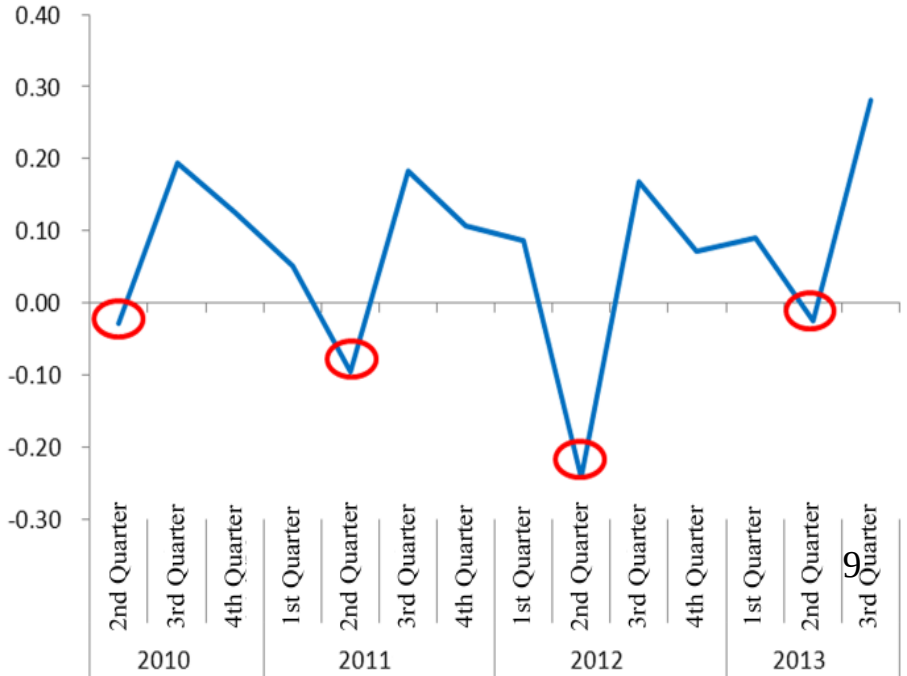


7. The rapid development of China's high-speed rail to jet fuel to form a direct replacement

- As of September 2013, the total distance covered by high-speed trains in China had reached 10000 km. In accordance with the plan in 2020 high-speed rail will reach 2020 kilometers, high-speed rail rapid development is expected to average annual alternative fuel of about 2 million tons.
- It is estimated that during the slack season of passenger transport every year (during the 2nd quarter), a 1% growth in the turnover of railroad passenger transport will cause the turnover of civil aviation passenger transport to drop by 1.7%-- and in turn lead to a 0.5% reduction in the growth of the consumption of coal by the aviation industry that same year.

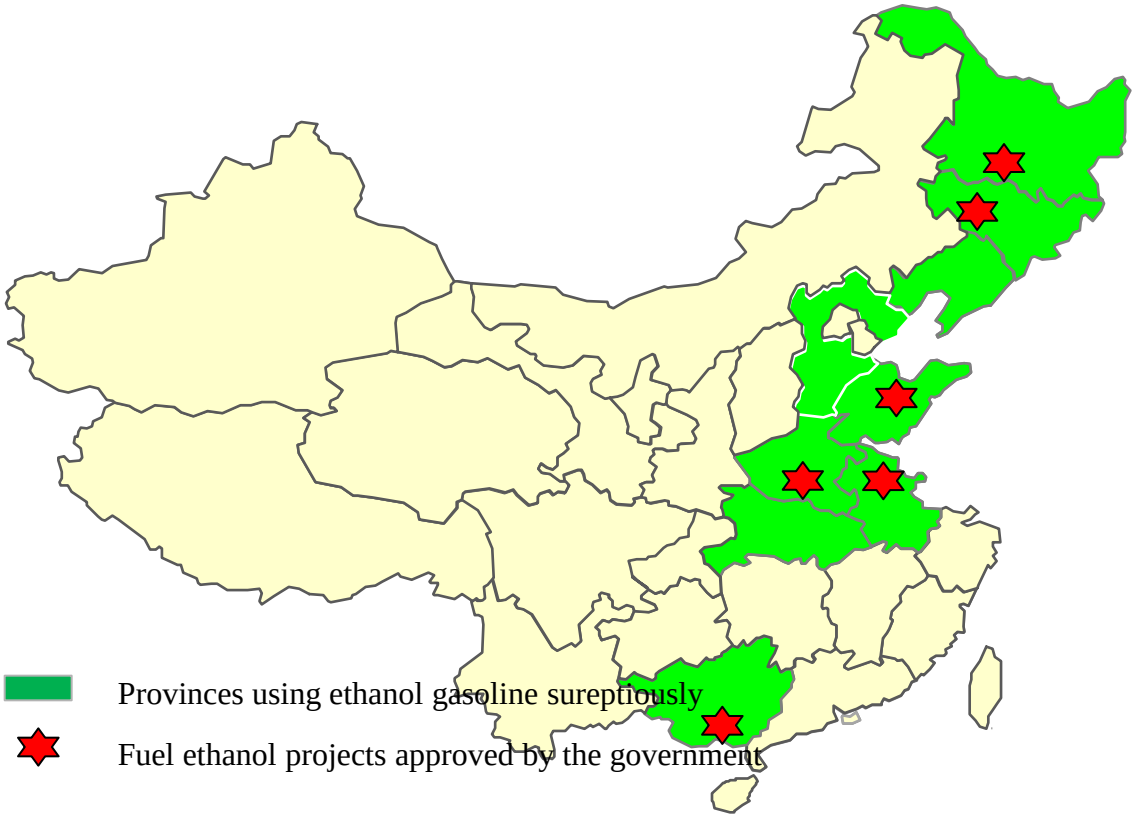
Map for Planned
High-speed Train Network

Relationship Between
Civil Aviation-Railway Passenger Turnover



8. With the gradual elimination of governmental subsidy, the outlook of fuel ethanol is gloomy

- Currently, sales of fuel ethanol and ethanol gasoline (in ten test provinces such as Heilongjiang and Shandong) have exceeded 20% of total gasoline consumption nationwide. The 6 enterprises that manufacture fuel ethanol produce more than 1.6 million tons.
- The national subsidy for fuel gasoline will be eliminated in 2015. Disadvantages of ethanol gasoline such as the current high cost of up-to-date technology and production, low profits and intense competition have become increasingly obvious. There are worries that a full-scale dissemination of fuel ethanol will be abandoned.



9. Pilot work of methanol-fueled automobiles is in progress, and policy support is still needed

- In 2012, the consumption of methanol in China was approximately 36.22 million tons, accounting for 43% of global productivity. This methanol was mainly used in traditional downstream capacities… such as methanal, acetic acid and dimethyl ether (methanol gasoline accounts for less than 10% of use).
- Local governments have launched experimental fuel methanol projects one after another. Currently, there are more than 20 provinces in which fuel methanol is used to differing degrees. Shanxi, a province with systematic experimentation and demonstration, boasts the fastest promotion and application-- it has the biggest in the methanol fuel industry in the country, with 1,000 methanol gasoline filling stations and annual sales of methanol gasoline standing at nearly 4×10^4 tons.

- In February of 2012, the Ministry of Industry and Information Technology issued *The Notice of the Launch of Pilot Work on Methanol-fueled Automobiles*. In Shanxi, Shaanxi and Shanghai, pilot projects of methanol-fueled automobiles have been implemented, with the direction of their development controlled by the government. However, the technical direction of methanol used for vehicles has yet to be determined, it is still uncertain whether or not methanol will be developed at a high or low ratio.

10. The electric car development is not as good as expected, and it depends on policy support and technological breakthroughs

- In 2012 china published the 《energy saving and new energy automobile industry planning (2012-2020)》, which is put forward that in 2020 electric cars cumulative volume has more than 5 million vehicles. But in 2012, the electric car sales is only 11000 cars, and government did not accomplish their aims. It is estimated that electric car will substitutes for gasoline 3 million tons.
- The electric car is the development trend of the future, but power always restricts its application. The current power technology is still in its early stages of development, demonstration, Development is still dependent on policy support on the short-term, and depend on technical breakthrough on the long-term.

11. In the future, petroleum substitute energy will be an important supplement to petroleum consumption

- It is predicted that by 2020, ratio of alternative energy to refined oil (oil (including gasoline, kerosene and diesel)) rose to about 17%.

Influence of Petroleum Substitute Energy on Petroleum Demand in 2020

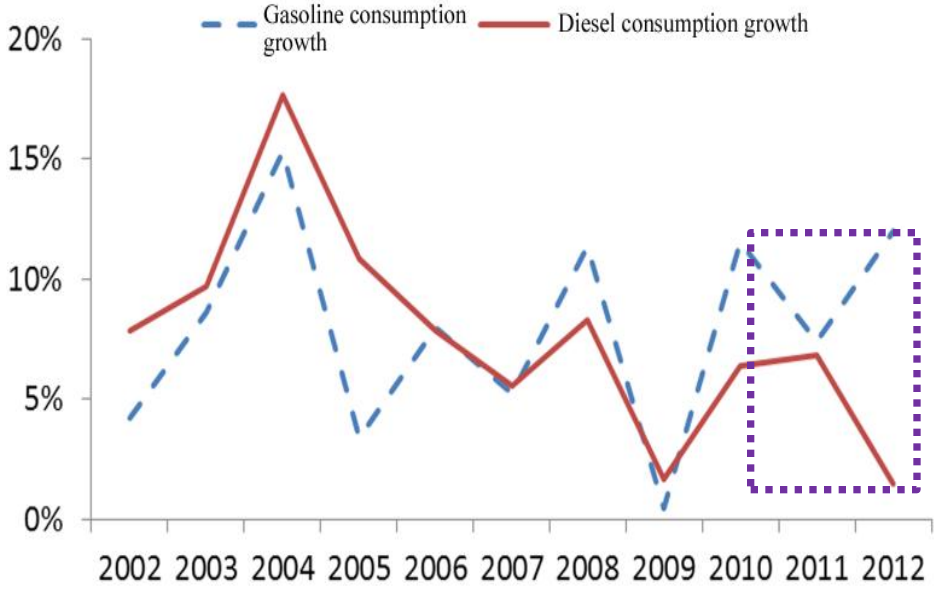
	Petroleum Substitute Energy	Main Influences	Reduction of petroleum demand	Proportion
1	Natural gas	Vehicles fueled by natural gas, etc…	46 million tons/year	70%
2	Coal	Coal quality olefin, etc…	10 million tons/year	15%
3	Ethanol	Ethanol gasoline, etc…	2.5 million tons/year	4%
4	Methanol	Methanol gasoline, etc…	2 million tons/year	3%
5	High-speed Trains and Other	Aviation kerosene, etc…	2 million tons/year	3%
6	Electromobile	Gasoline	3 million tons/year	5%
Total	-	-	6550 million tons/year	100%

Contents

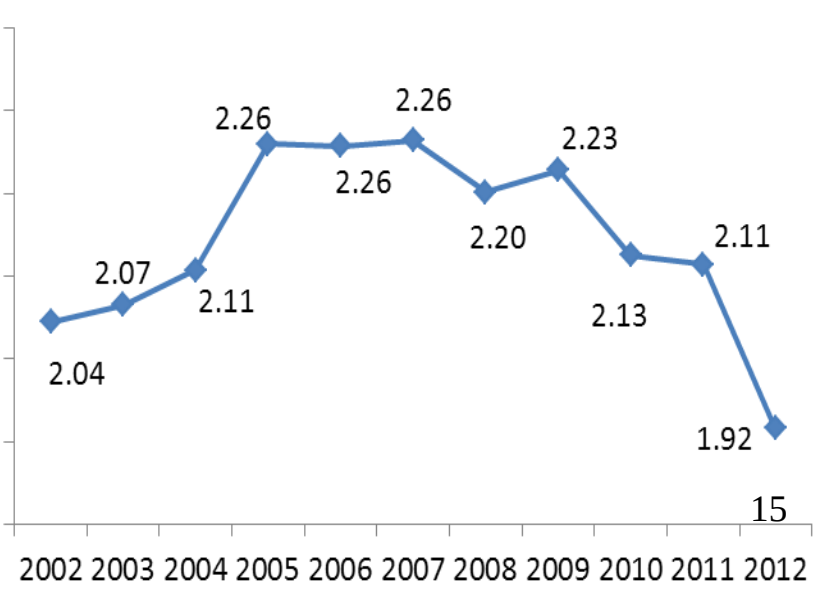
1. Diesel-gasoline consumption decrease sharply in the last two

- Predictions indicate the ratio of diesel-gasoline consumption in 2013 will drop to 1.80-- lower 0.12 than in 2012. This is the fourth year of consecutive decrease following the financial crisis of 2008.
- The main reason for the current slump in the diesel-gasoline consumption ratio in China is the decreased growth of diesel-gasoline consumption caused by economic twitches in China in the wake of the financial crisis, which is a short-term phenomena rather than a long-term trend.

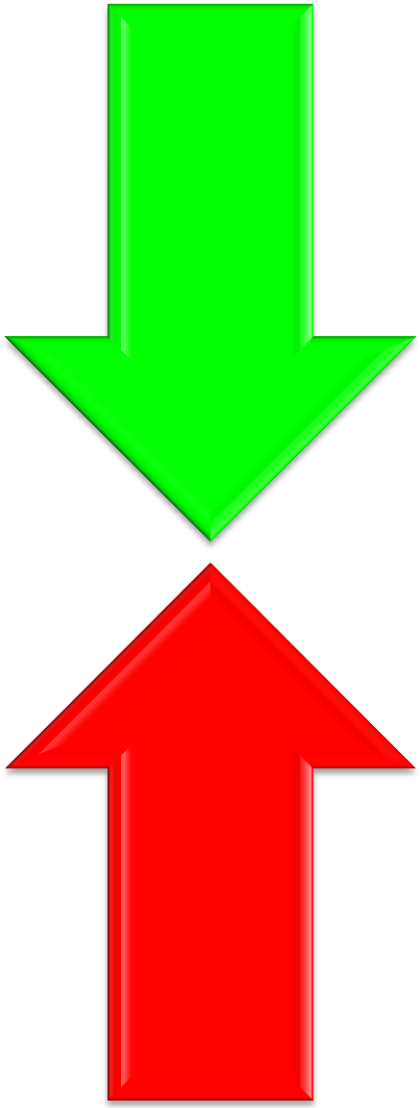
Growth of Gasoline and Diesel Consumption



Change in Ratio of Diesel-gasoline Consumption



2. The ratio of diesel-gasoline consumption will " decrease before stabilize" with a L-shaped trend



Main factors causing lowering of diesel-gasoline consumption in China

- Economic growth in China is gradually shifting from " high-speed" to "middle-speed".
- The influence of tertiary industry on GDP is growing gradually-- and the influence of secondary industry on GDP is declining gradually.
- It promotes the gasoline consumption that blend oil decreases.

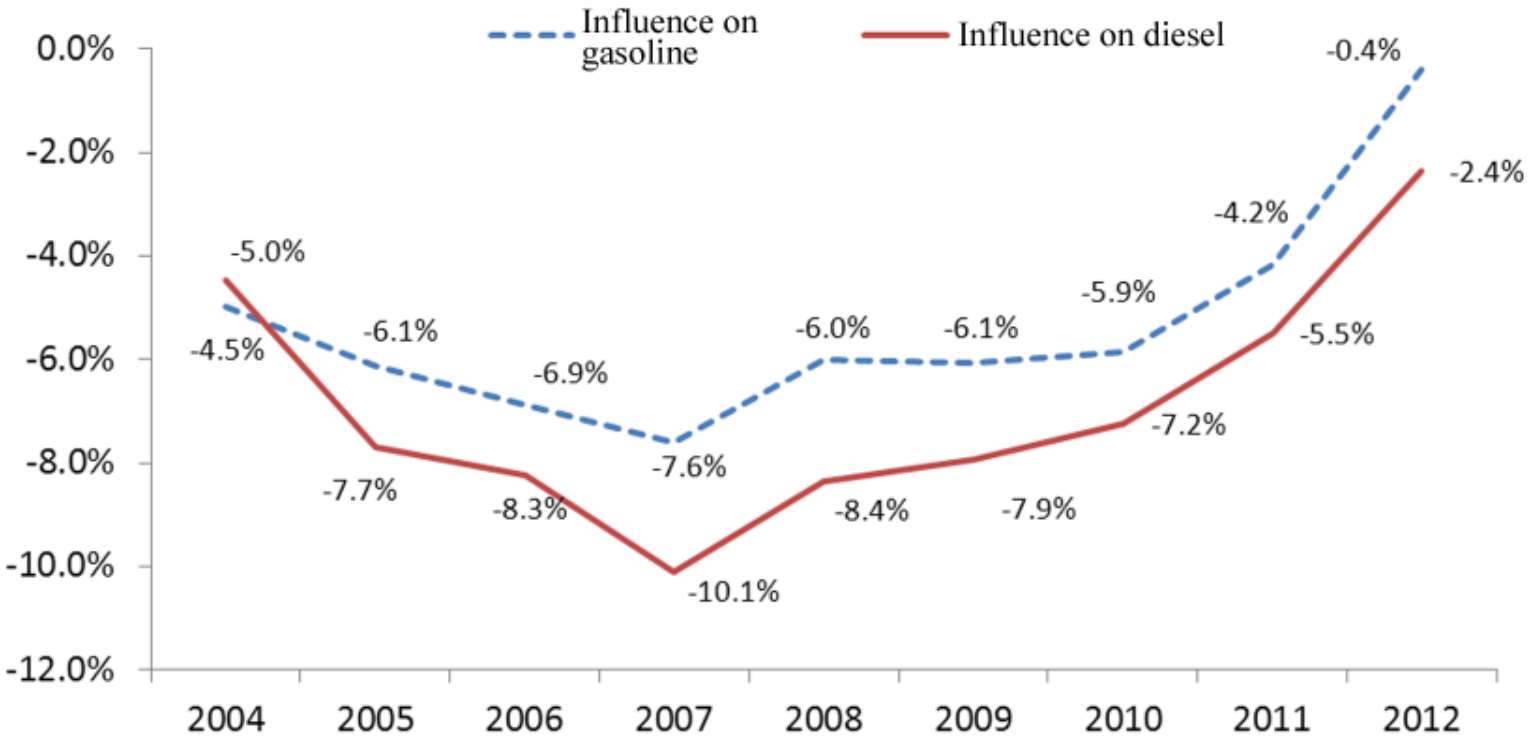
Main factors affecting growth of ratio of diesel-gasoline consumption

- In 2020, growth of automobile inventory in China will reach a turning point, as growth of automobile inventory will slow noticeably between 2020 and 2030.
- The development of petroleum substitute energy includes automobiles fueled by natural gas, fuel methanol, fuel ethanol, as well as electromobiles, etc...

3. Slowing growth of Chinese economy has more direct influence on diesel demand than gasoline demand

Compared with the change in gasoline demand, the change in diesel demand has a closer relationship to economic growth. It is estimated that the growth of gasoline demand and diesel demand will drop by an average of 4.8% and 6.2% respectively every time GDP in China is lowered by 1%. The decline of growth in demand for diesel is 1.3 times higher than that of gasoline. Therefore, the slowing growth of the Chinese economy will help lower the ratio of diesel-gasoline consumption.

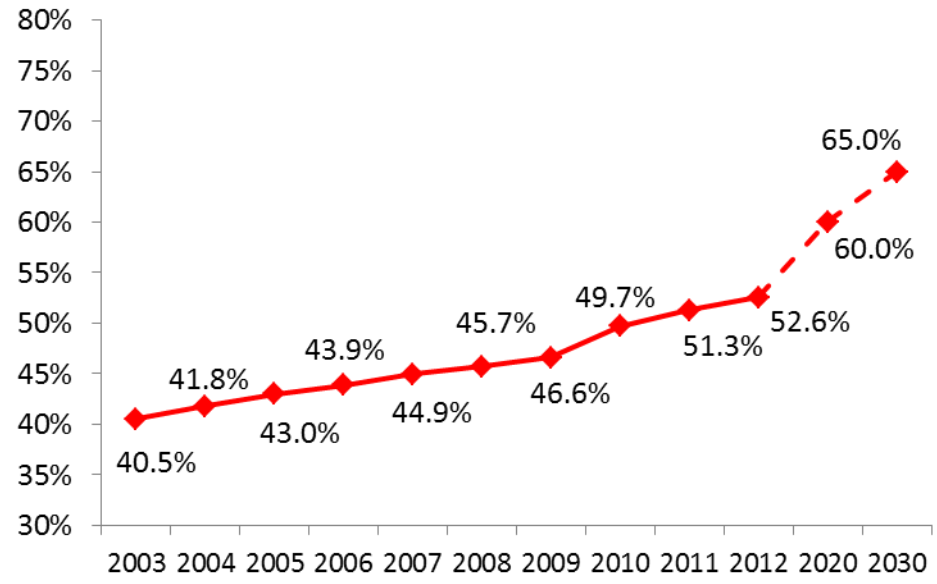
Impact of a 1% Decline in Chinese Economy on Gasoline and Diesel Demand



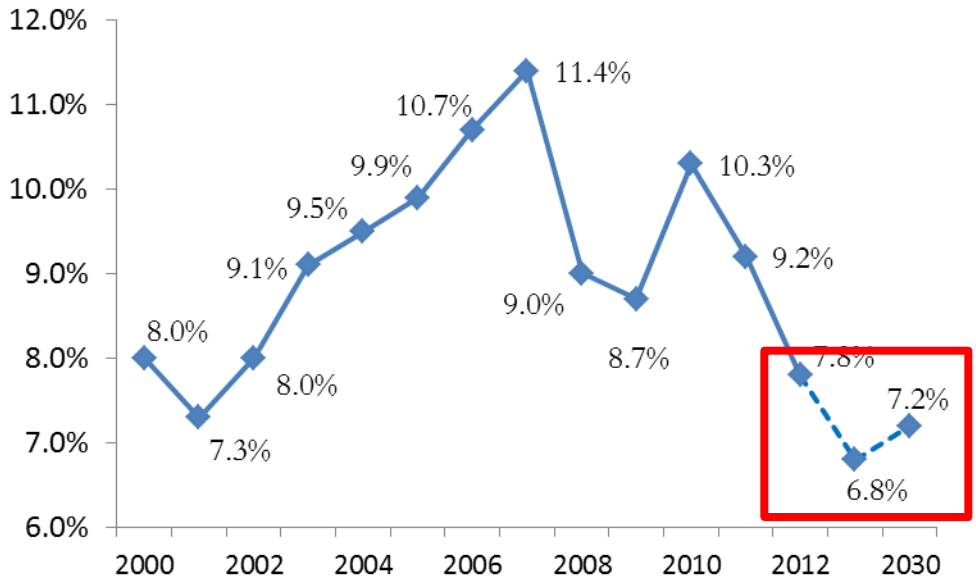
4. China will reach key turning point for economic and social reform in next 10 years

- The communiqué of the Third Plenary Session of the 18th Central Committee of the CPC indicates that the target of comprehensive & deep reform is "improvement and development of the socialist system with Chinese characteristics" and advancement of " modernization of the state's system of governance and governance capability".
- Following a comprehensive, systematic and deepening advancement of reform of the economic system and political system in China, over the next 10 years economic development in China will show an "L"-shaped trend, and economic growth intervals will decline. Compared with economic booms and slumps of the past, the intervals of economic fluctuation will be more subtle in the future, and an intermediate speed of about 7% will become the norm.

urbanization rate in China



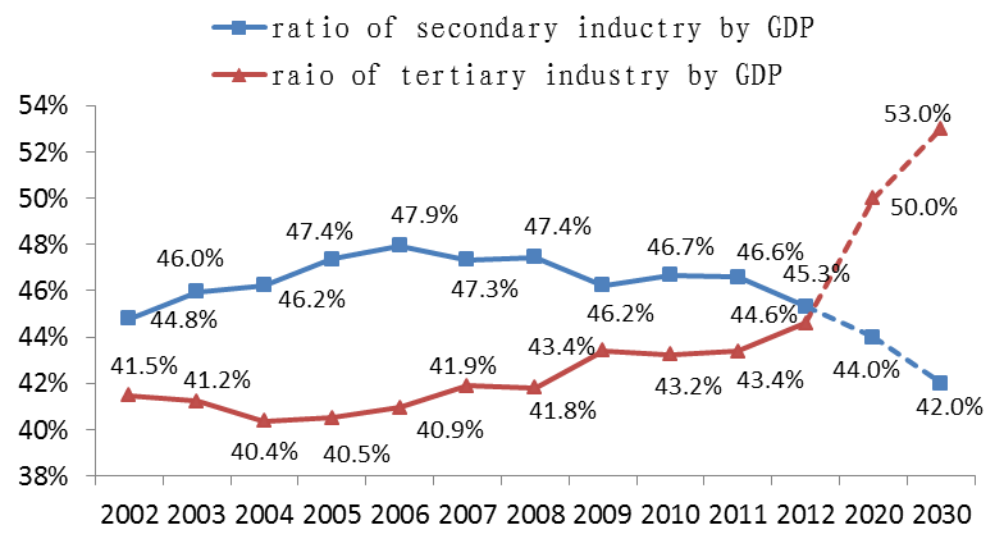
Growth Rate of GDP in China



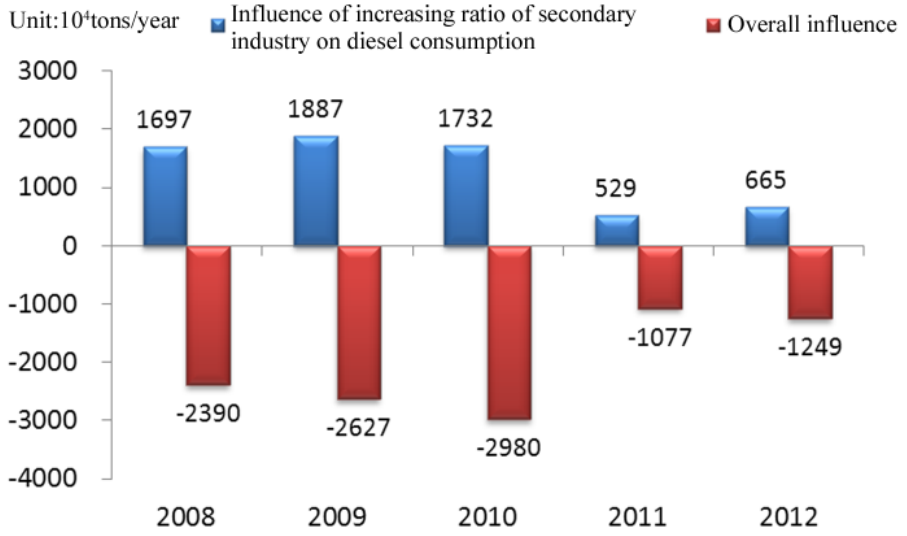
5. Industrial restructuring in China will inhibit growth of diesel consumption

- In 2012, the growth of the tertiary industry in China " caught up" with that of the secondary industry for the first time-- following growth for 4 years. By 2030, the ratio of the tertiary industry in China to GDP is expected to reach 50%. Whether growth or ratio of output by GDP, The third industry will be more than the second industry in an all-round way.
- Economic restructuring in China will have an obvious inhibiting effect on the growth of diesel consumption. It is estimated that when the ratio of the secondary industry to GDP drops 1% and at the same time the ratio of the tertiary industry to GDP increases by 1%, diesel consumption will be reduced by about 9.5 million tons/year on average.

Ratio of Secondary and Tertiary Industry to GDP



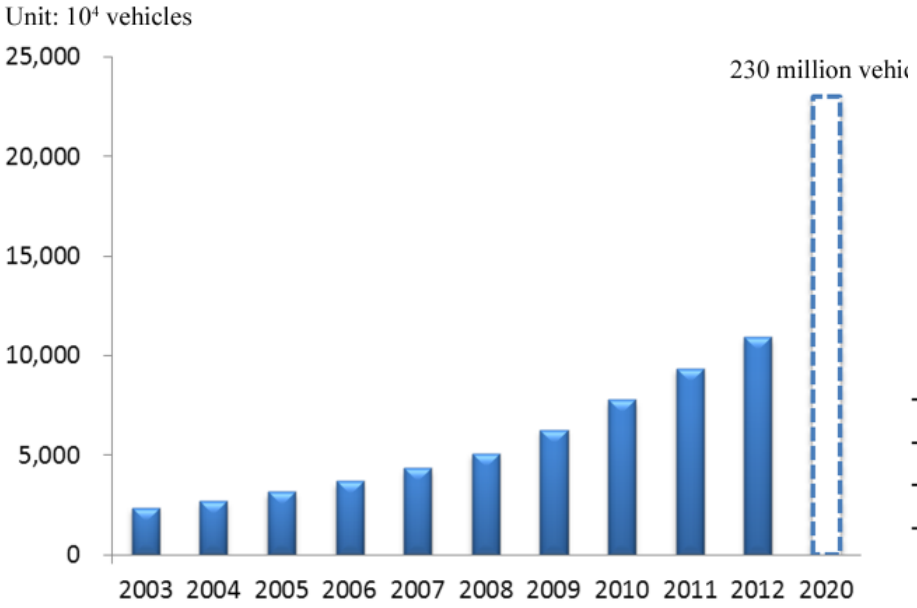
Influence of Industrial Structure Change on Diesel Consumption



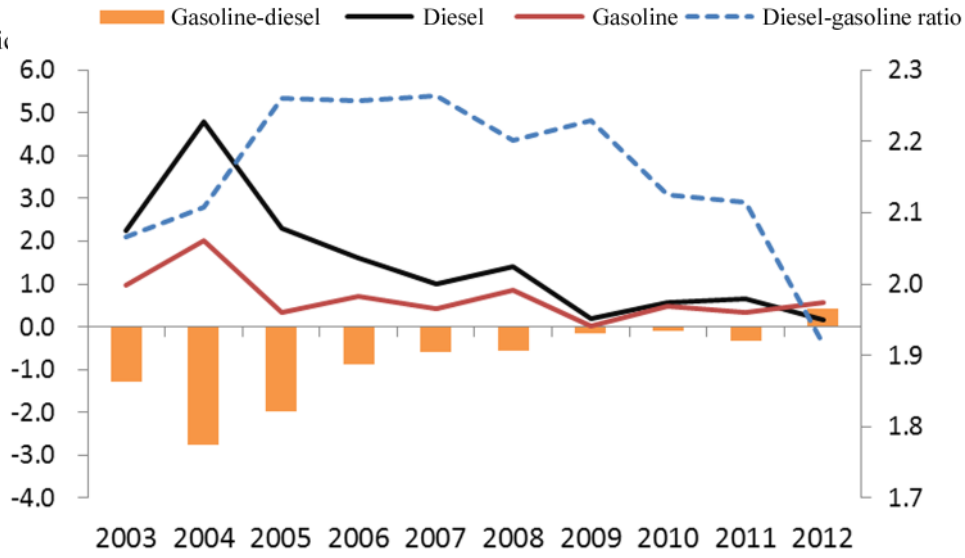
6. Booming automobile market contributes to the rapid growth of gasoline

- Before 2020 the average annual growth of automobile production and sales in China will maintain high 10%-15% growth, and automobile inventory will exceed 230 million vehicles by 2020.
- It is estimated that as automobile inventory increases 1 million units, the consumption of gasoline and diesel increases by 0.64% and 0.40% respectively. This explains why an increase in automobile inventory has a noticeable impact on the acceleration of gasoline consumption.

Automobile Inventory in China



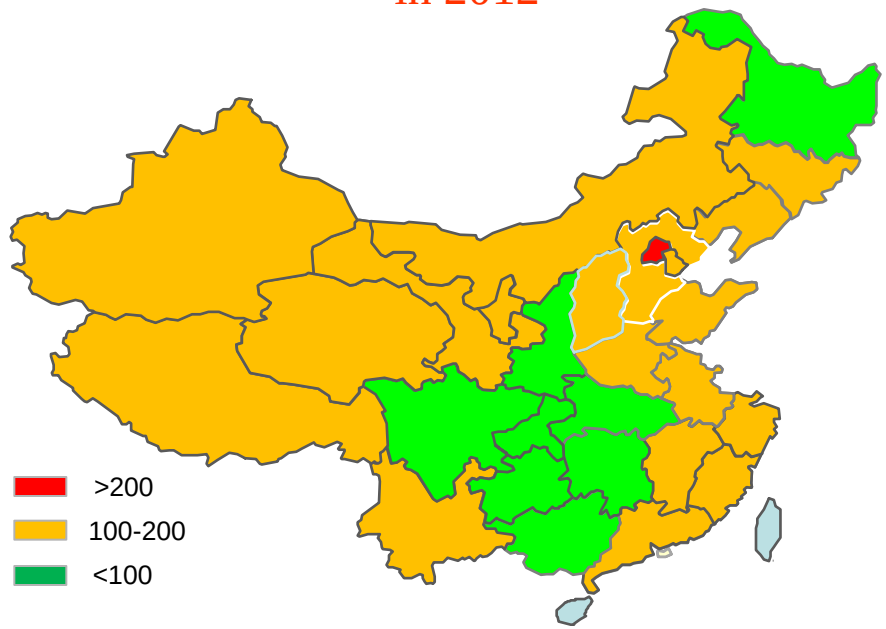
Consumption of Gasoline and Diesel in Relation to Automobile Inventory



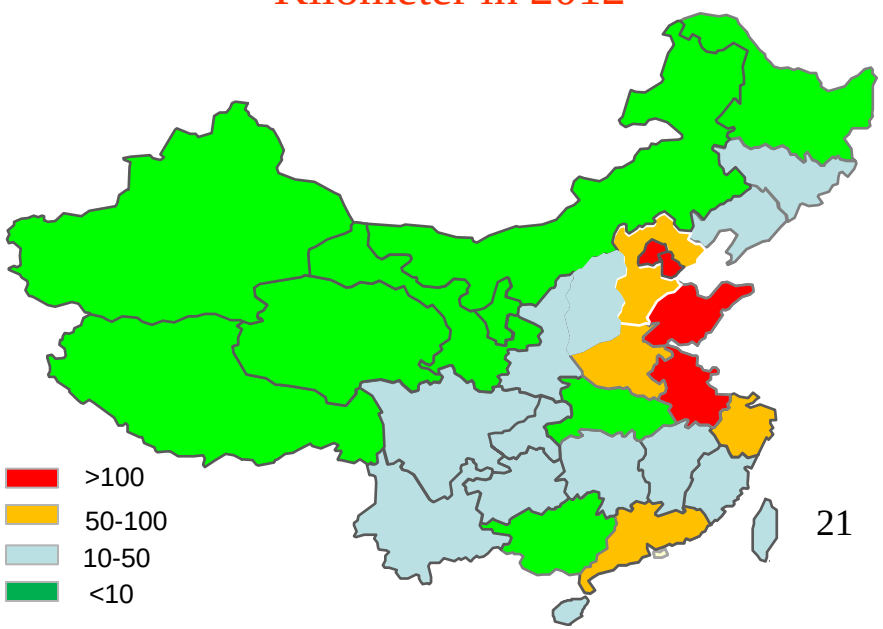
7. After 2020 car ownership will enter a slow growth period in China

- Based on 200 vehicles per every 1,000 persons in the working-age population (15-64 years old) in megacity, automobile inventory in China will reach a peak of 230 million by 2020. At that point, China will adopt policies to restrict vehicle development, and growth of automobile production and sales will slow considerably-- the ratio of diesel to gasoline consumption will converge.
- Based on 81 vehicles per square kilometer in eastern China in 2012, by 2030 automobile inventory in China will reach a peak of 290 million and the growth of gasoline consumption will enter a period of low growth.

Vehicle Inventory per 1000 Working-age People in 2012



Vehicle Inventory Per Square Kilometer in 2012



8. Development of petroleum substitute energy will increase diesel-gasoline consumption ratio

1 Natural gas to substitute for gasoline is greater than the diesel

- It is estimated that natural gas will substitutes for gasoline 26 million tons and diesel 20 million tons by 2020.

2 fuel methanol mainly substitutes for gasoline

- It is estimated that fuel methanol will substitutes for gasoline 2 million tons by 2020.

3 fuel ethanol mainly substitutes for gasoline

- It is estimated that fuel ethanol will substitutes for gasoline 2.5 million tons by 2020.

4 Coal–to–liquids mainly substitutes for diesel

- It is estimated that Coal-to-liquids will substitutes for gasoline 1 million tons and diesel 8 million tons by 2020.

5 Electromobile mainly substitutes for gasoline

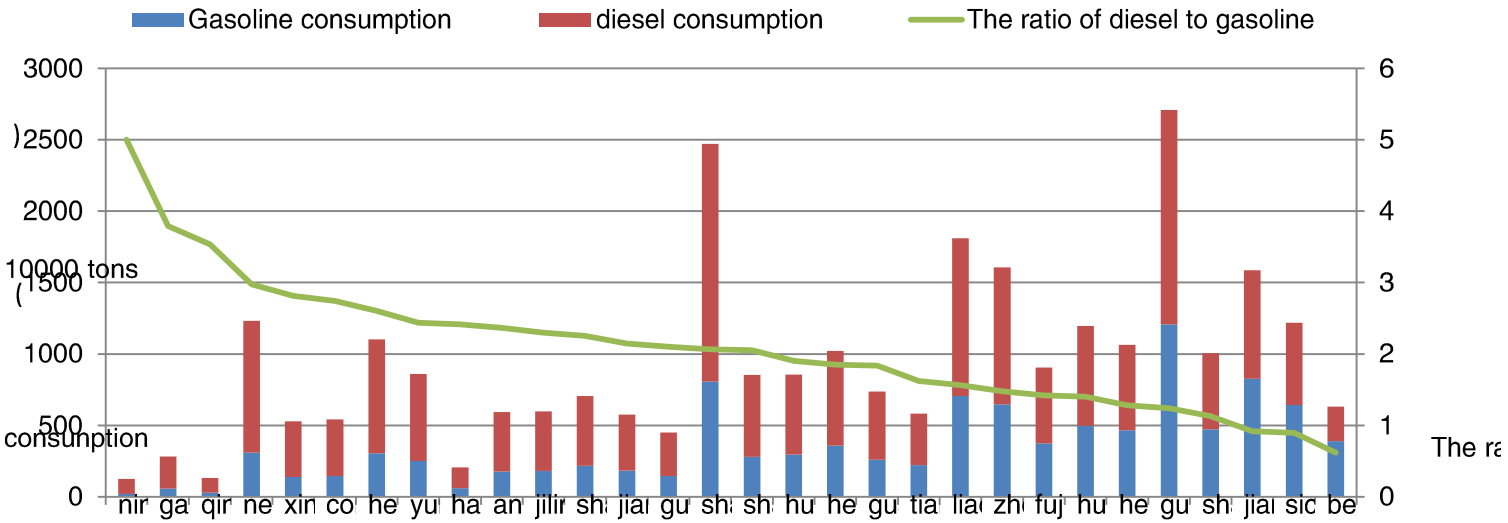
- It is estimated that fuel ethanol will substitutes for gasoline 3 million tons by 2020.

China's alternative energy to substitute for gasoline is greater than the diesel In the next 10 years. It is estimated that alternative energy will substitutes for gasoline 34.5 million tons and diesel 28 million tons by 2020. It will help improve diesel–gasoline consumption ratio.

9. Regional differences make diesel-gasoline consumption ratio to remain a high level

- The consumption of oil products and the economic growth are closely related. Eastern region contributed to 56.4% of gasoline consumption ,70.9% of coal consumption and 49.1% of diesel consumption in China in 2012.
- The level of economic development in eastern region is relatively high, and the diesel-gasoline consumption ratio there is less than 1.5. The middle and western region are less developed and the diesel-gasoline consumption ratio there is relatively high. The ratio is about 5 in Ningxia , and is more than 3.5 in Gansu and Qinghai.

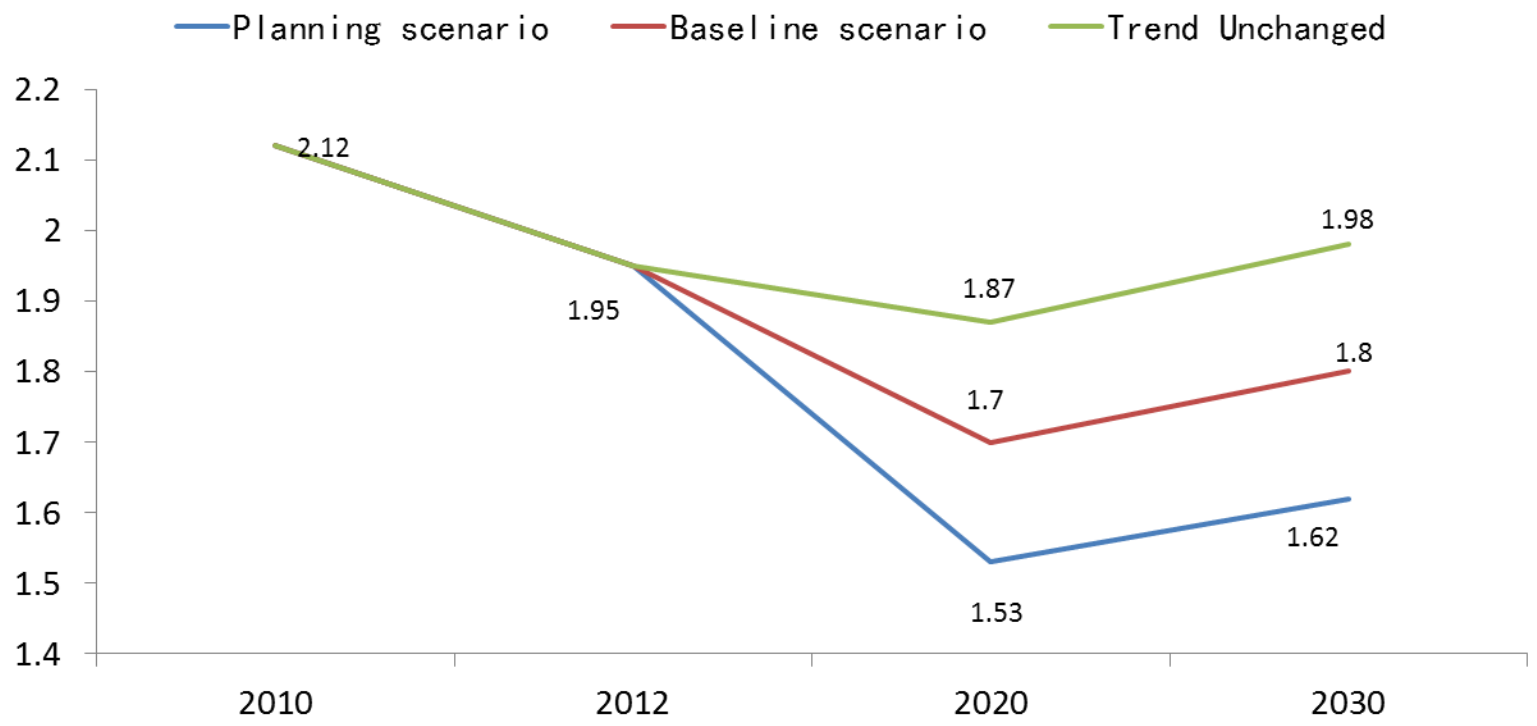
Diesel-gasoline consumption ratio in different provinces in 2012



10. Diesel-gasoline consumption ratio will adjust slightly, returning to 1.8 by 2030

- According to China's economic development in the future forecast, we divided Diesel-gasoline consumption ratio into "Planning scenario", "Baseline scenario" and "trend unchanged".
- In a standard scenario, the diesel-gasoline consumption ratio will drop from 2.12 in 2010 to 1.70 in 2020, then climb up to 1.80 in 2030.

Forecast for Diesel-gasoline Consumption Ratio

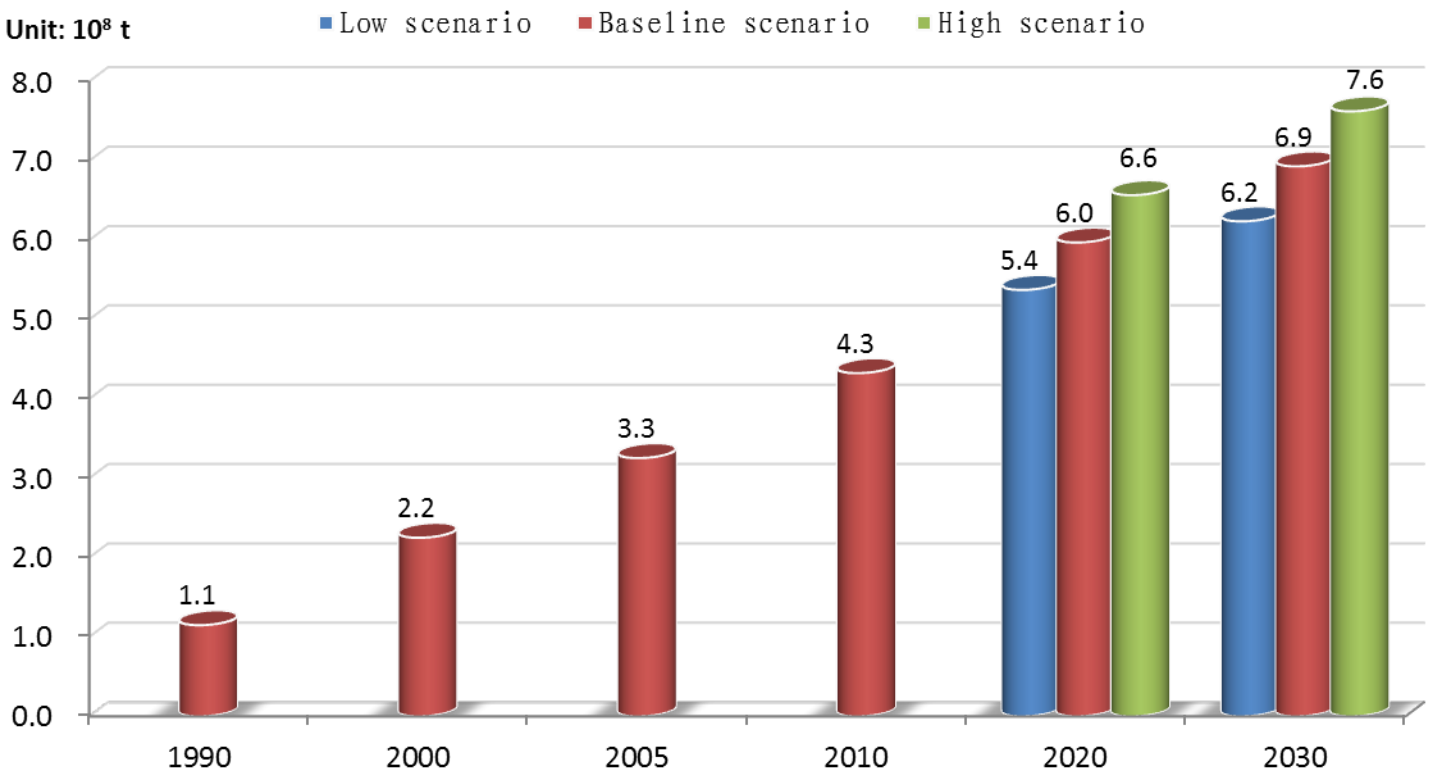


Contents

1. Petroleum consumption will continue to grow over next 20 years, but the speed will slow down

- Based on forecasts of future economic trends in China, petroleum consumption will be 597 million tons in 2020, displaying an average growth of 2.5% annually from 2013 to 2020. The average growth of petroleum consumption from 2020 to 2030 will decline to 1.5%. Petroleum consumption will hit 690 million tons in 2030.

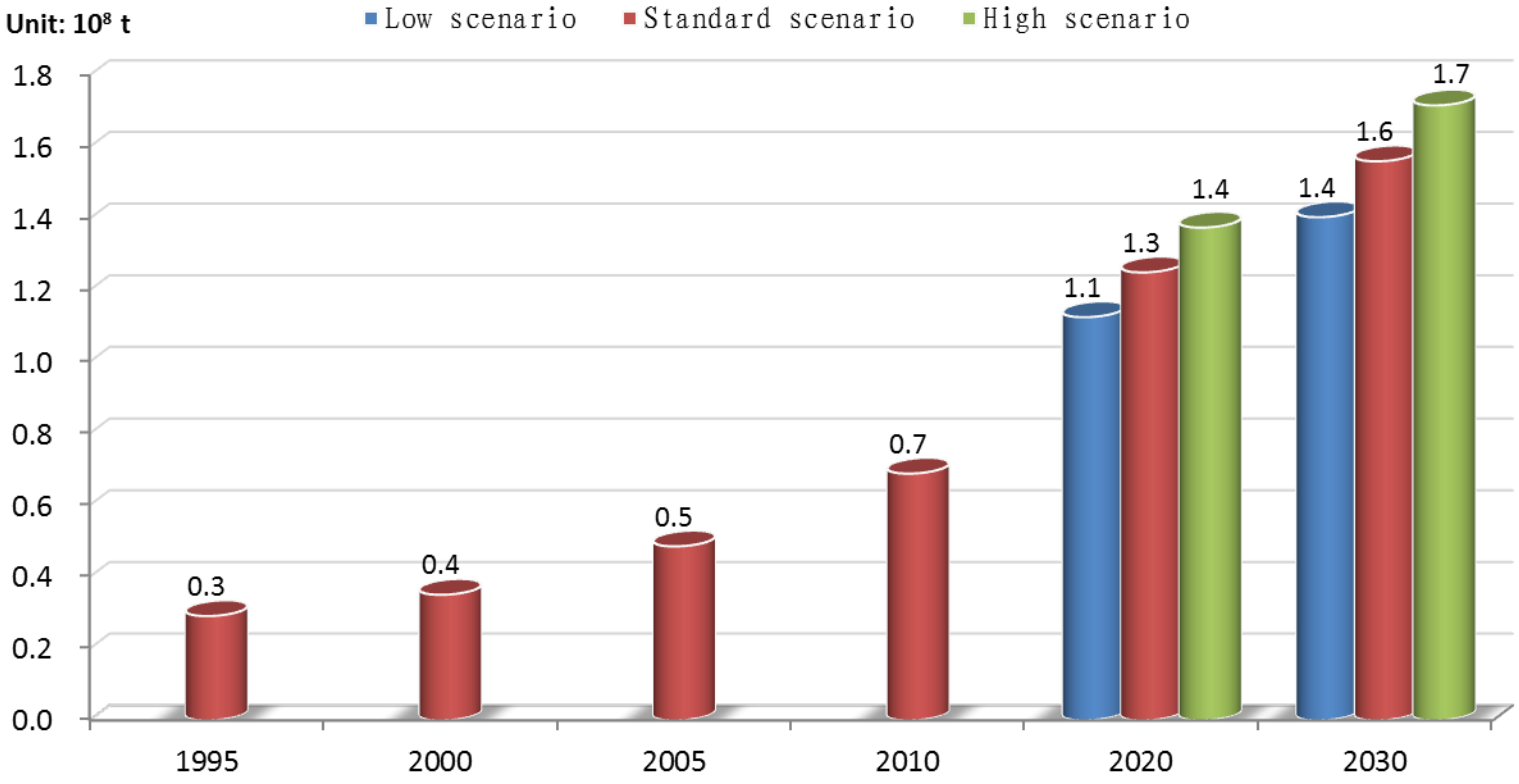
Forecast of Petroleum Consumption



2. Gasoline consumption in China will grow at a moderate speed over the next 20 years

- Gasoline consumption in China will be 128 million tons in 2020, with an average annual growth of 5.0% from 2013 to 2020. The average annual growth of gasoline consumption from 2020 to 2030 in China will further decline to 2.0%. Gasoline consumption will hit 156 million tons by 2030.

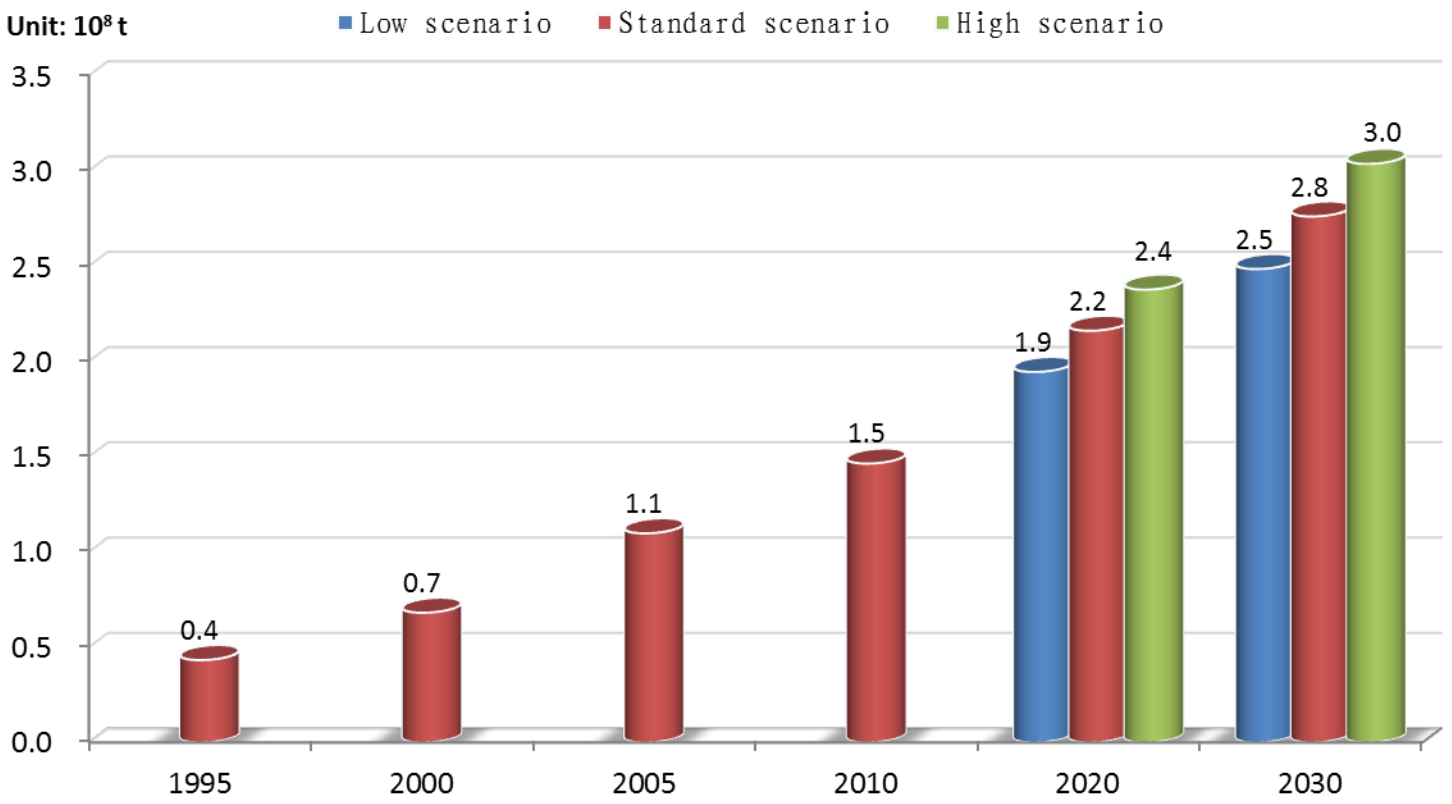
Forecast of Gasoline Consumption



3. Diesel consumption in China will grow slowly over the next 20 years

- Diesel consumption in China will reach 216 million tons by 2020, with an average annual rate growth of 3.0% from 2013 to 2020. Average annual growth of diesel consumption from 2020 to 2030 in China will further declined to 2.5%. Diesel consumption will hit 276 million tons by 2030.

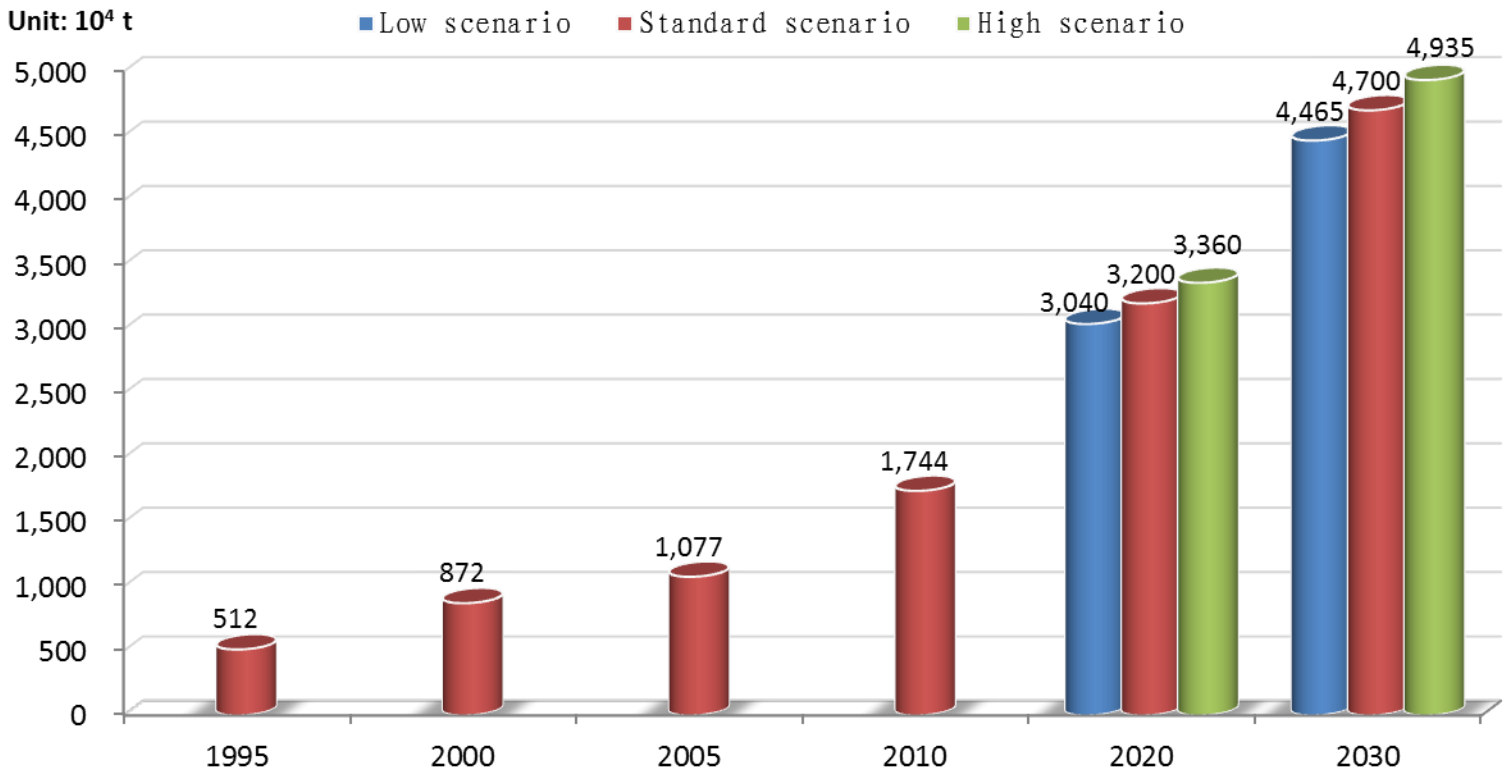
Forecast of Diesel Consumption



4. Kerosene consumption in China will keep a rapid growth over the next 20 years

- Kerosene consumption in China will be 32 million tons in 2020 (an average annual growth of 6.0% from 2013 to 2020). Average annual growth of kerosene consumption from 2020 to 2030 in China will further declined to 4.0% by 2030, Kerosene consumption will hit 47 million tons by 2030.

Kerosene Consumption



5. Petroleum refinery capacity will keep a rapid growth over the next 10 years

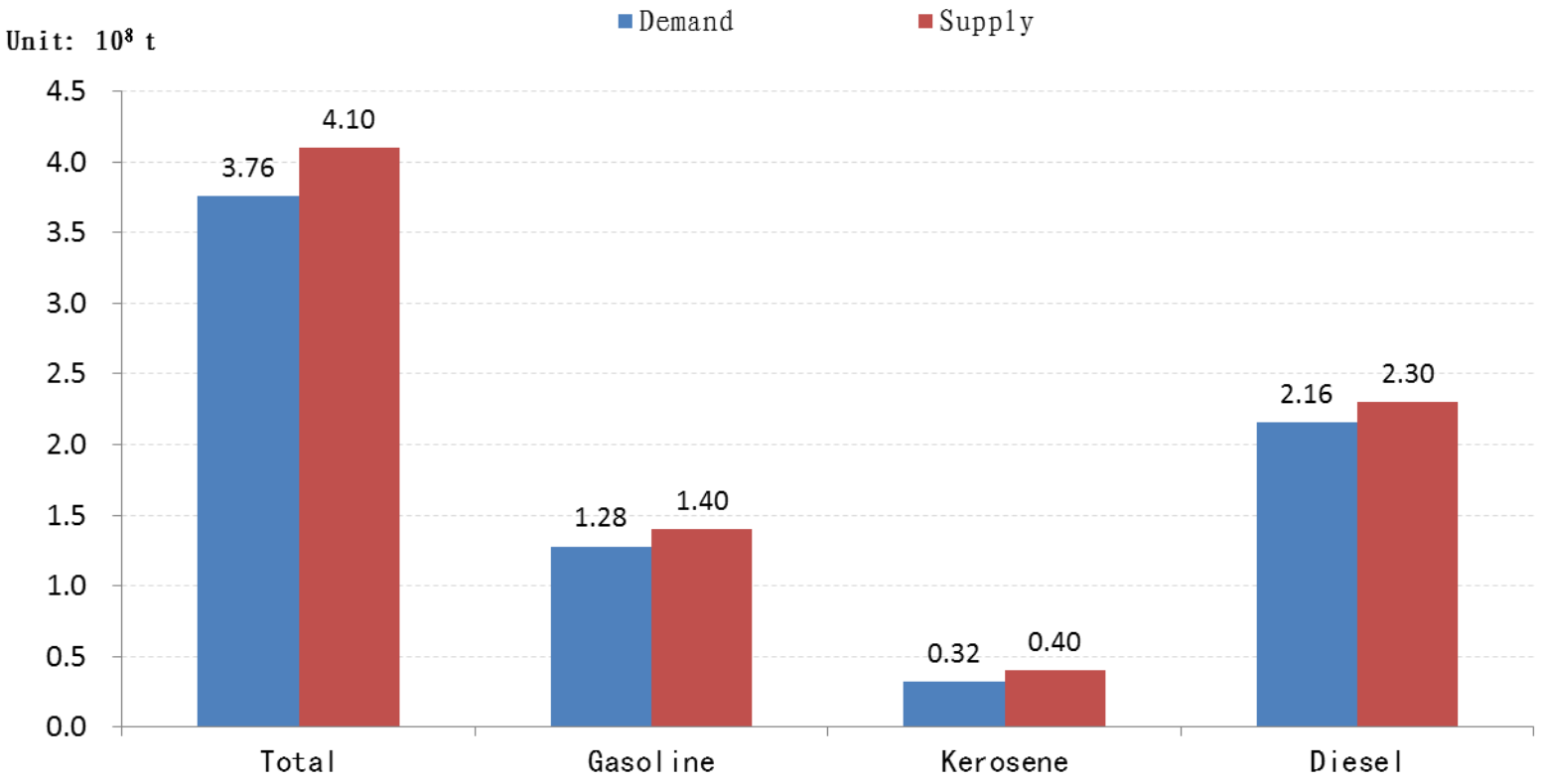
	Region	Enterprise	Growth Capacity	Start Date	Notes
CNPC	Southwest China	Sichuan Sinopec	1000	2013	New
		Kunming Refinery	1000	2015	New
		Chongqing Sinopec	1000	To be determined	New
	South China	Dongfang Refinery	1300	After 2015	New
		Jieyang Refinery	2000	After 2017	New
	North China	North China Sinopec	500	After 2015	New
Sinopec	North China	Qilu Sinopec	400	2015	New
		Caofeidian Sinopec	1000	To be determined	New
		Shijiazhuang Sinopec	500	2014	Expansion
	East China	Yangzi Sinopec	800	2015	Expansion
		Zhenhai Refinery	1200	After 2015	Expansion
		Lianyungang Sinopec	1200	2016	New
		Shanghai Sinopec	400	After 2015	Expansion
	South China	Zhanjiang Dongxing	300	After 2015	Expansion
		KPC Refinery	1500	After 2015	New
		Fujian Refinery II	1000	To be determined	Expansion
	Central China	Jiujiang Sinopec	350	2014	Expansion
		Jingmen Sinopec	500	To be determined	New
CNOOC	Guangdong	Huizhou Refinery II	1000	After 2015	Expansion
	Shandong	CNOOC Dongying	1000	After 2015	New
	Hebei	Zhongjie Petrochemical	800	To be determined	Expansion
SinoChem	Fujian	Quanzhou Fefinery	1200	2014	New
	Zhejiang	Zhoushan Petrochemical	1000	To be determined	New
Total			20950		

- Based on projects under construction, planned for construction and in the planning phase, the refining capacity of new enterprises will reach 210 million tons. By around 2020, total capacity will increase to 800 million tons/year.
- Outlook on petroleum refining of market players in 2020: the refining capacity of CNPC in China will increase to 250 million tons. The refining capacity of Sinopec will increased to approximately 360 million tons. The refining capacity of CNOOC in China will increase to 50 million tons. Total refining capacity of the three enterprises will account for 83% of total refining capacity in China.

6. Supply and demand for petroleum products will be almost balanced, with a slight surplus by 2020

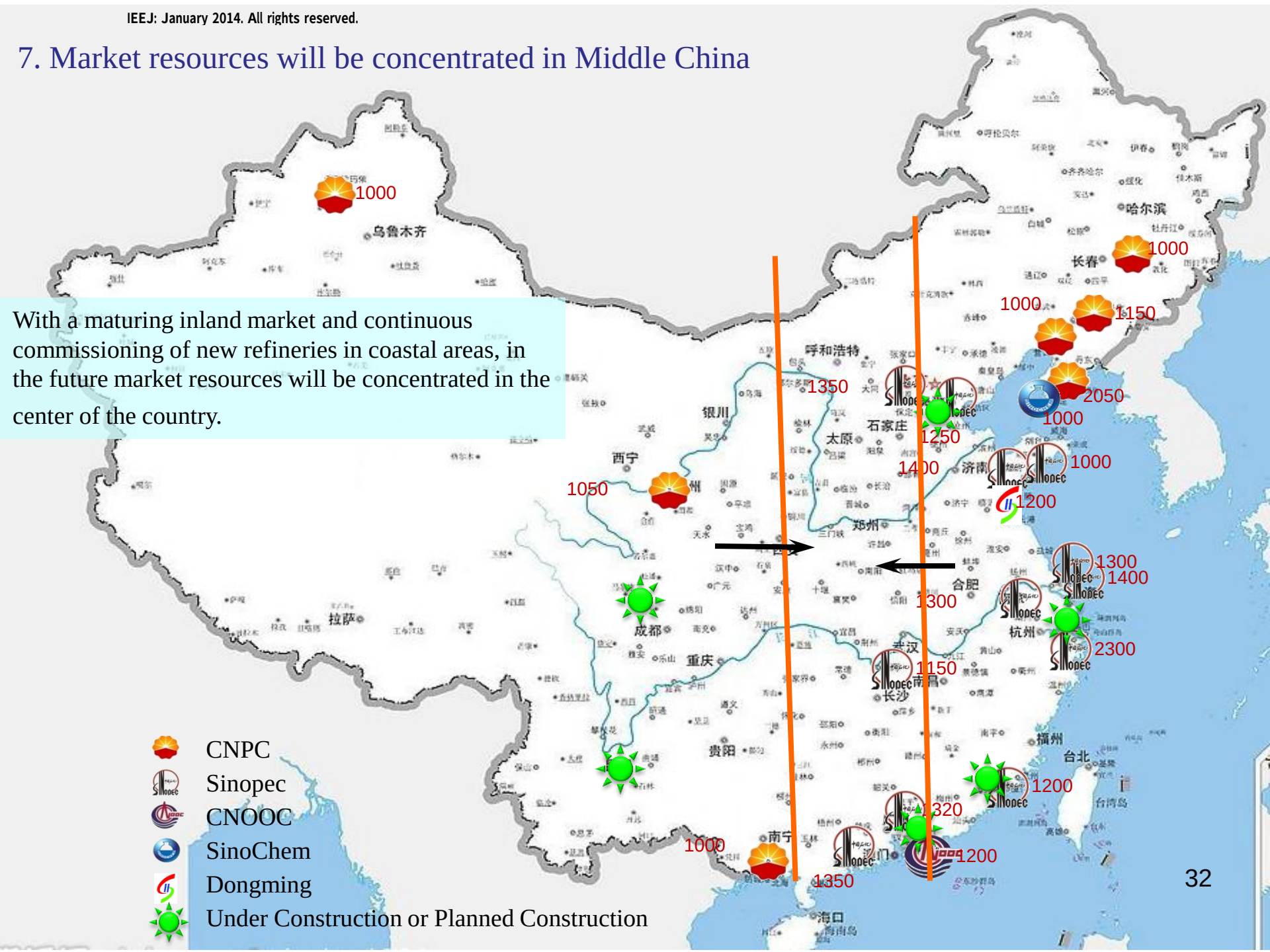
- By 2020, the supply of petroleum products on the market in China will exceed demand, with a surplus of about 34 million tons/year– including 12 million tons/year of surplus gasoline, 14million tons/year of surplus diesel and 8 million tons/year of surplus kerosene.

Supply and Demand for Petroleum Products



7. Market resources will be concentrated in Middle China

With a maturing inland market and continuous commissioning of new refineries in coastal areas, in the future market resources will be concentrated in the center of the country.



Conclusions

Substitute Energy

Petroleum substitute energy in China has good development prospects. Natural gas in particular will have booming growth, but strong support from the government is still required in terms of pricing, taxation and policy.

Petroleum Demand

Petroleum demand in China is still increasing, and petroleum demand will hit 690 million tons by 2030. Diesel-gasoline consumption ratio will be “ lower before stabilizing” in an L-shaped trend.

Petroleum Supply

The growth of China's refining capacity may be lower than expected, but the overall supply is still slightly bigger than the demand. It is an important task to speed up the refinery upgrade and meet the requirements of national product upgrade.

Thank you!

Contact: report@tky.ieej.or.jp