

# Updates on the Chinese Energy Sector

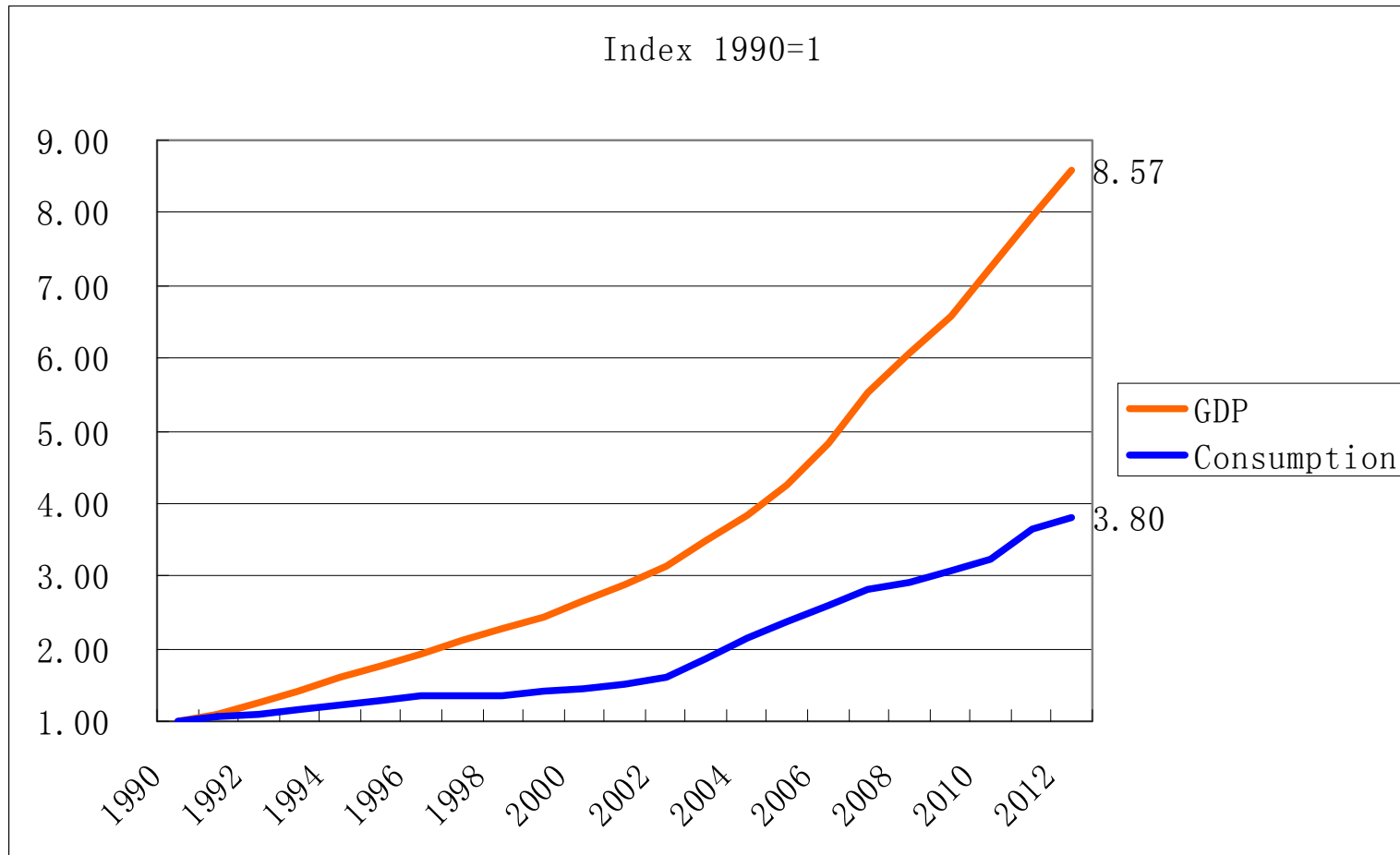
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Tsinghua University, China

28<sup>th</sup> May 2013, Beijing

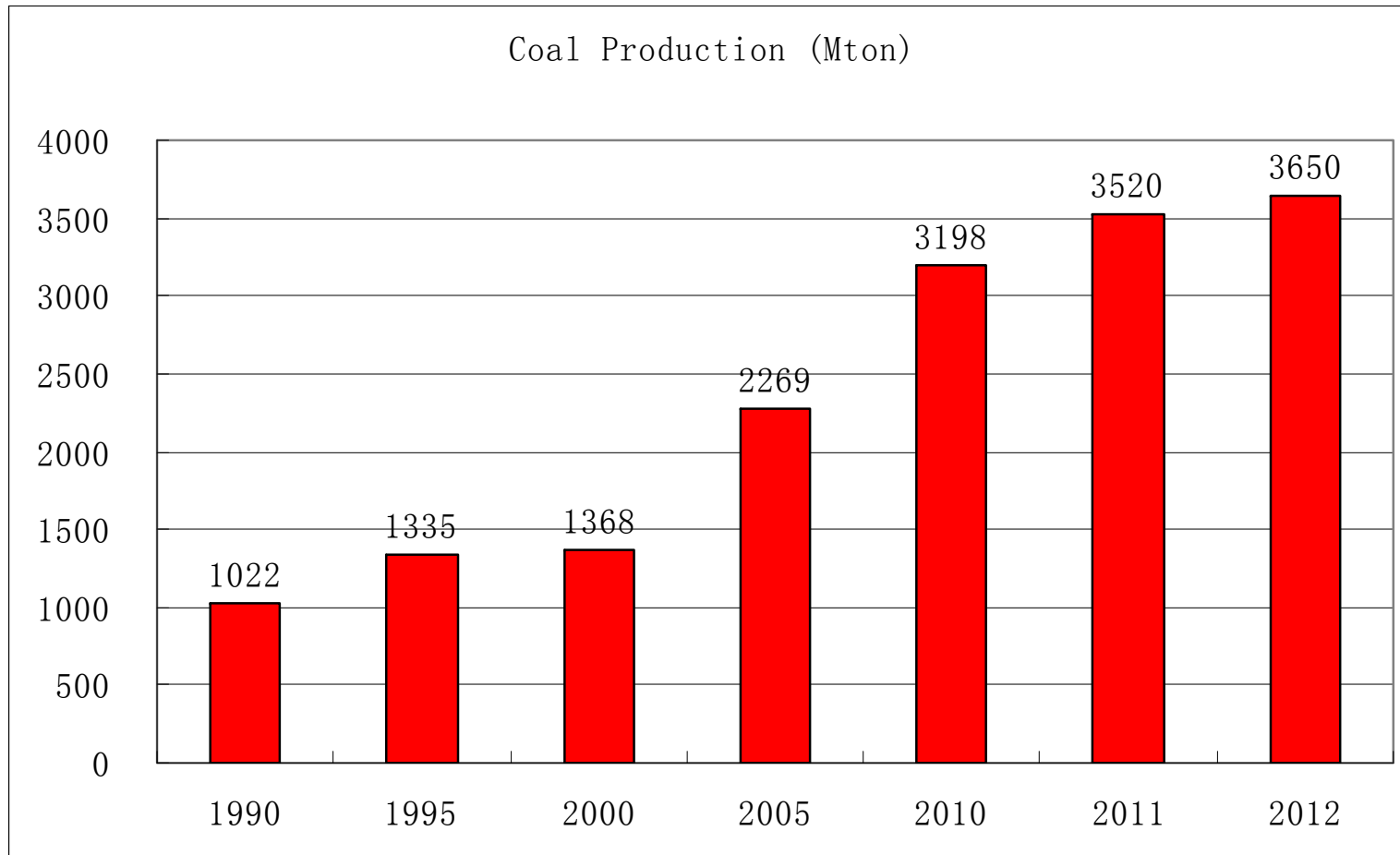
# Outlines

- History of the Chinese energy sector and economy
- Recent development
- Policy changes in 2012-2013

# Economic Development with Energy Consumption Growth



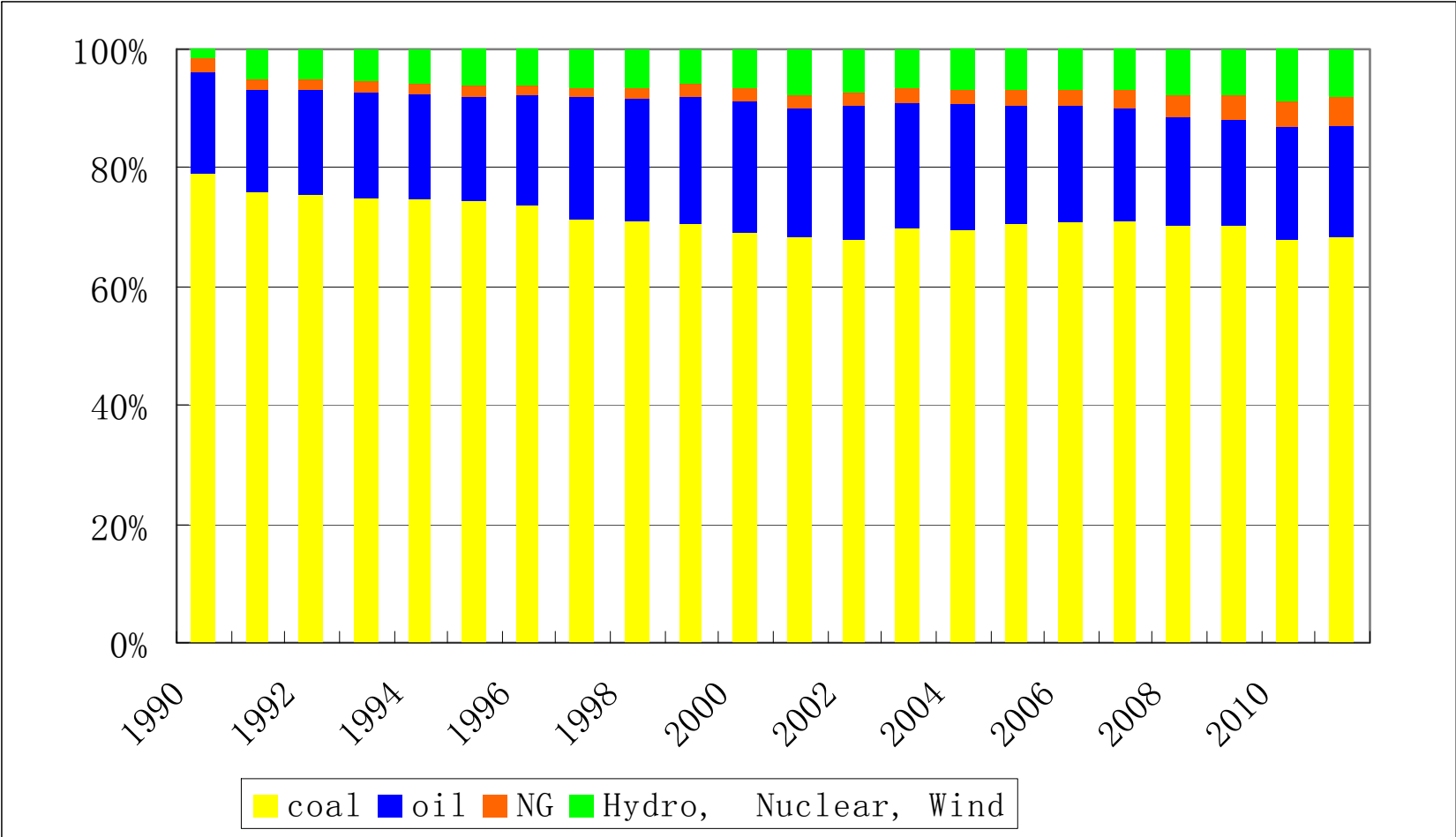
# Focus on domestic resources to secure energy supply



Source: China Energy Statistical Yearbook 2011, Statistical Communiqué of PRC on the 2012 National Economic and Social Development, Statistical Communiqué of PRC on the 2011 National Economic and Social Development,

# Making a high carbon content energy system

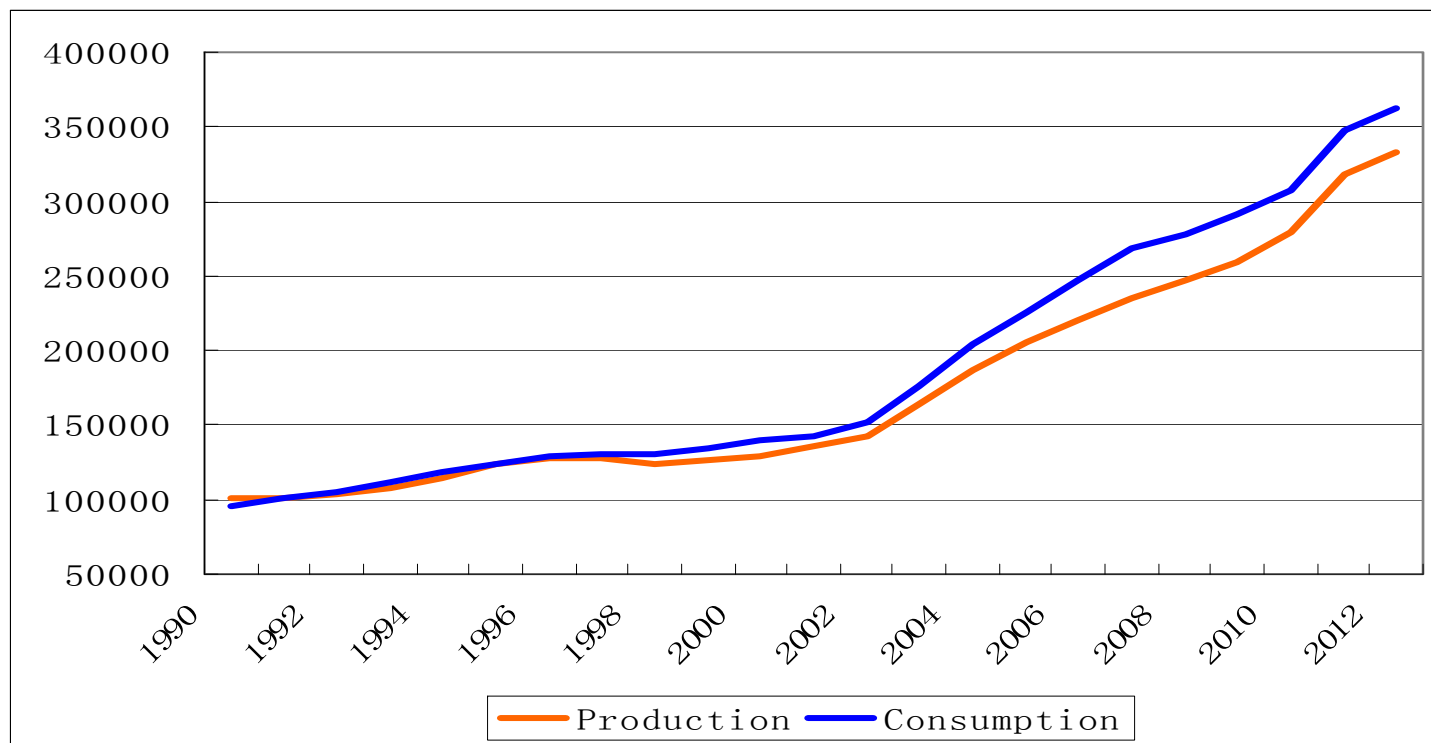
Consumption Mix % ((coal equivalent calculation))



Source: China Statistical Yearbook 2012

# Domestic production can't meet the demand

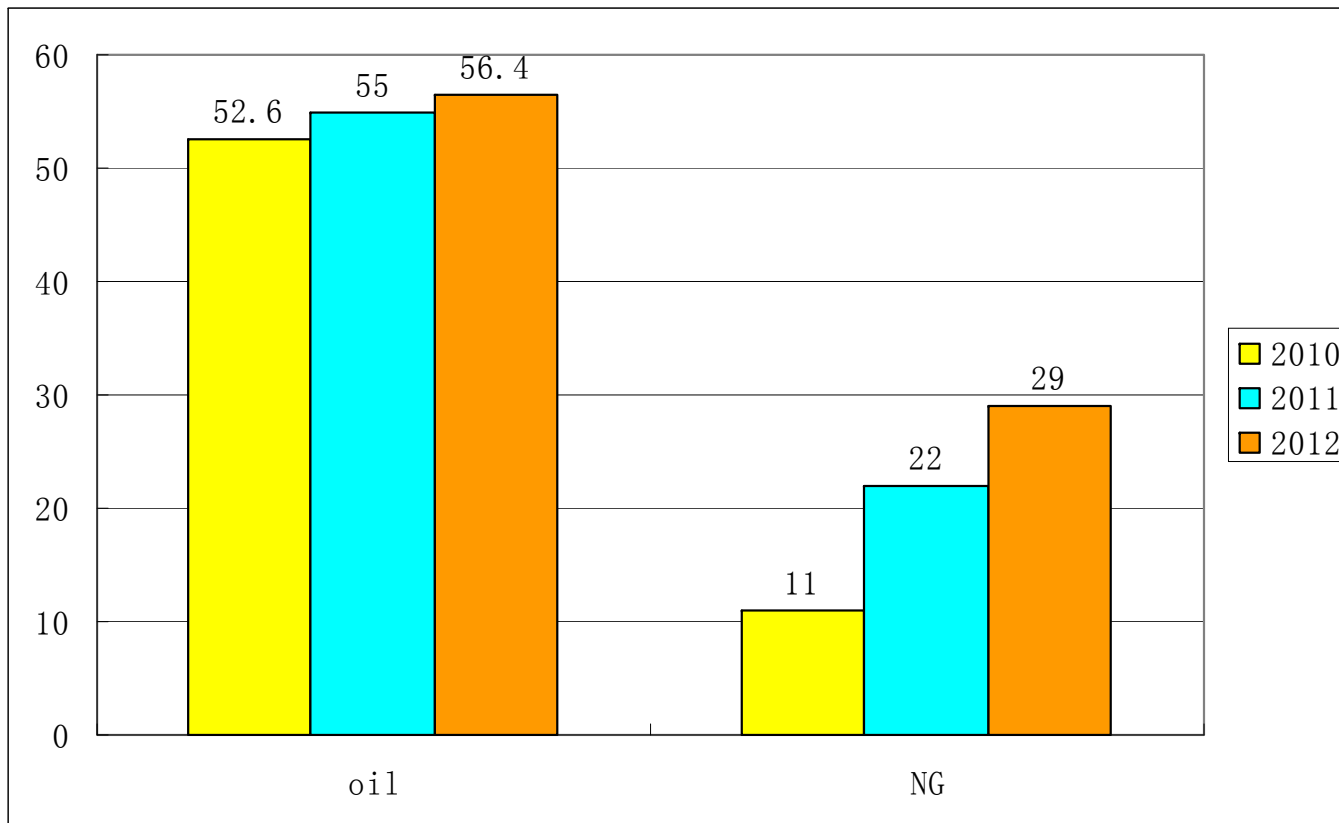
Production increased 3.3 times while consumption increased 3.8 times from 1990 to 2012 (coal equivalent calculation 10k tce)



Source: China Statistical Yearbook 2012, Statistical Communiqué of PRC on the 2012 National Economic and Social Development

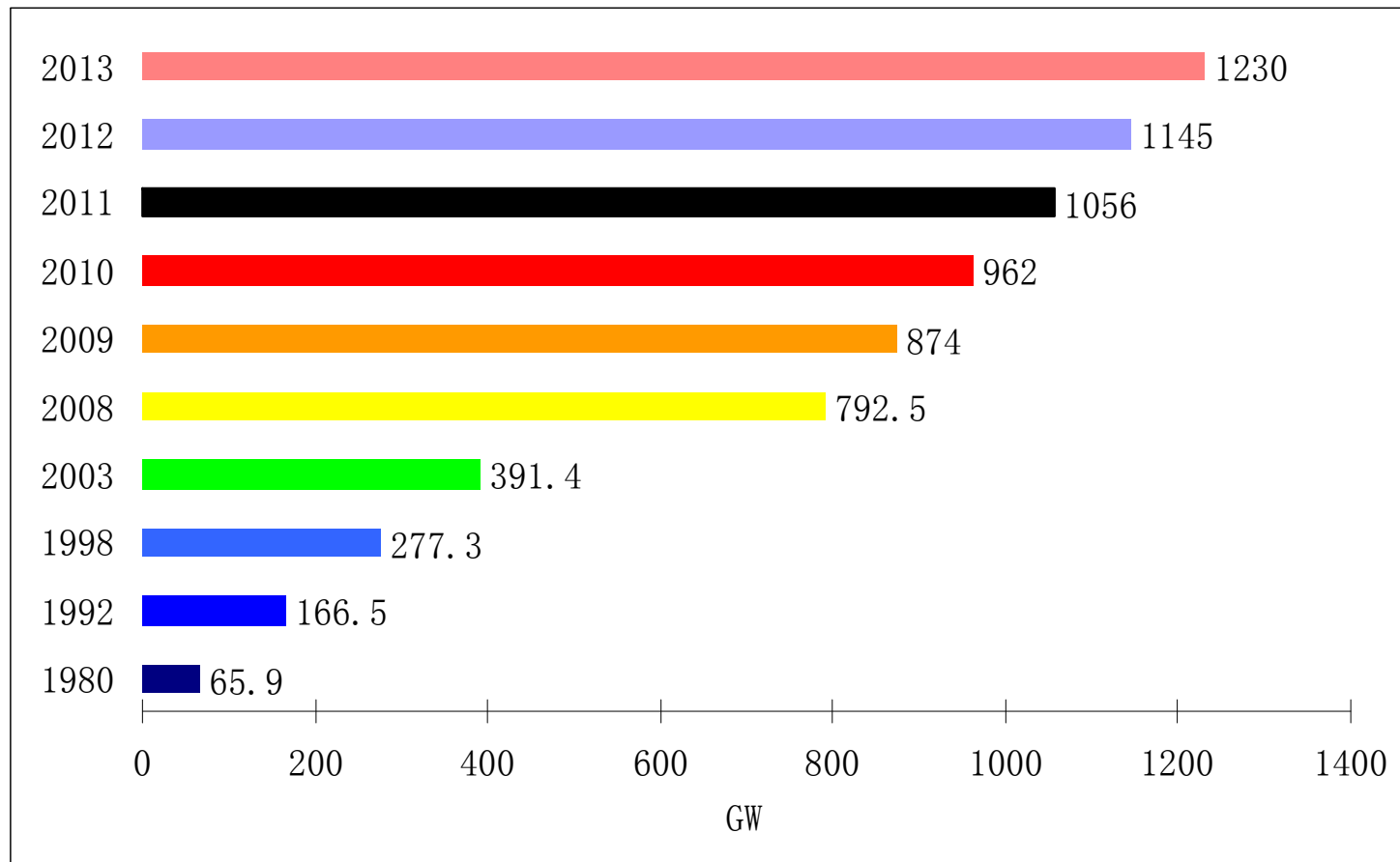
# Import Dependency Increased Continuously

Import dependency=1-Consumption/Production



# Installed capacity of power generation over 1TW since 2011

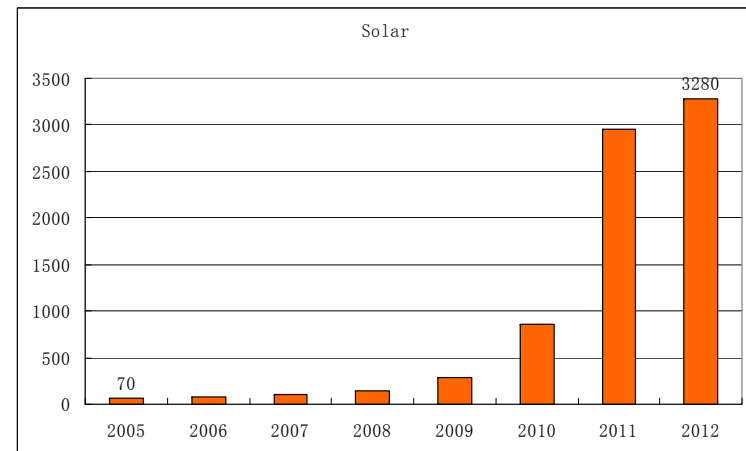
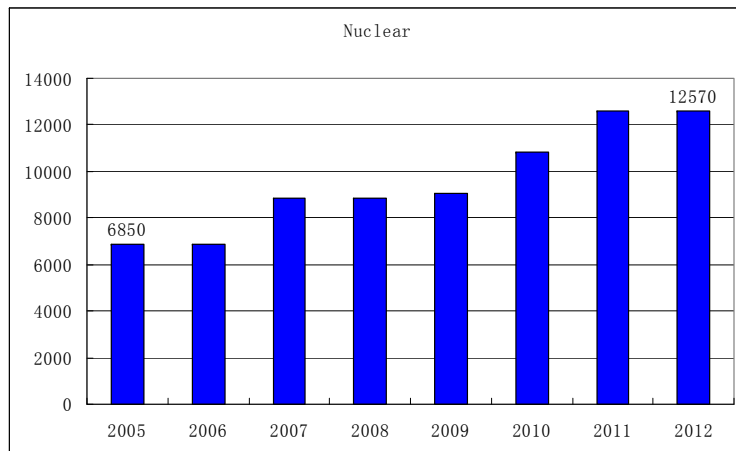
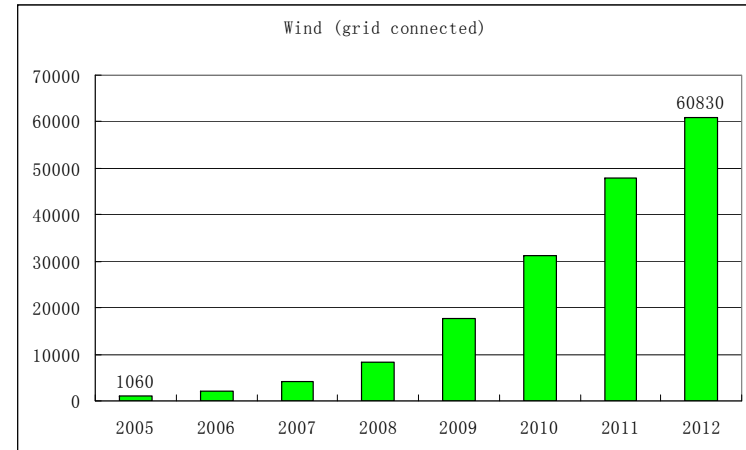
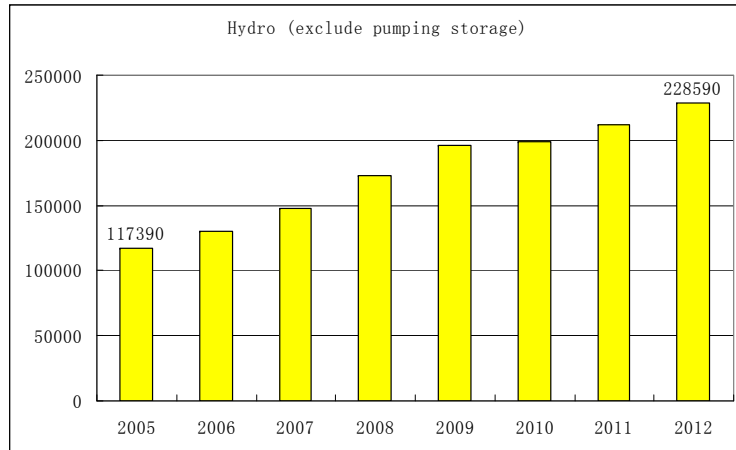
China Electricity Council estimated the installed capacity would reach 1230GW by the end of 2013.



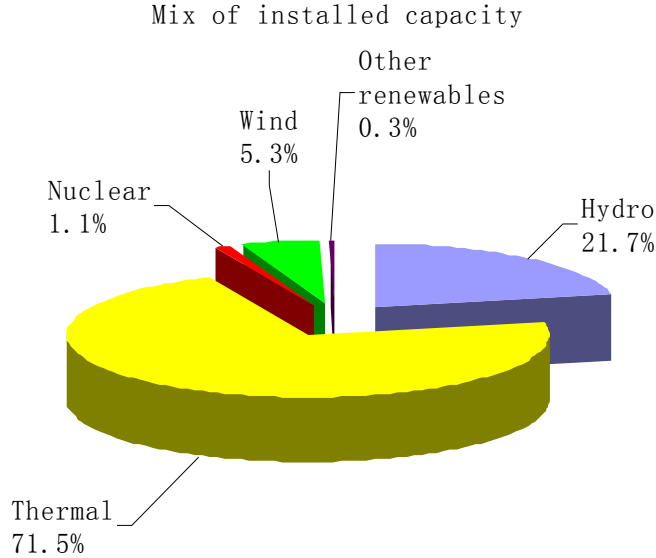
Source: China Electric Power Yearbook (series year)



# Fast Growth in Non-fossil Power Generation Capacity (MW)

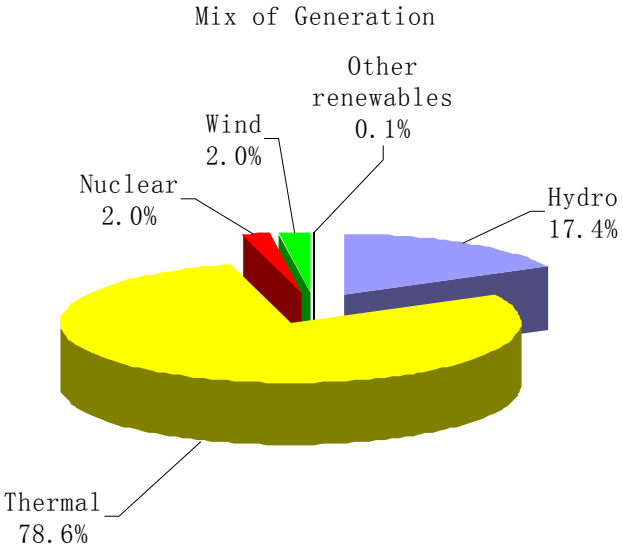


# Thermal power still dominated (2012)



Installed capacity: 1145GW

Generation: 4977.4TWh



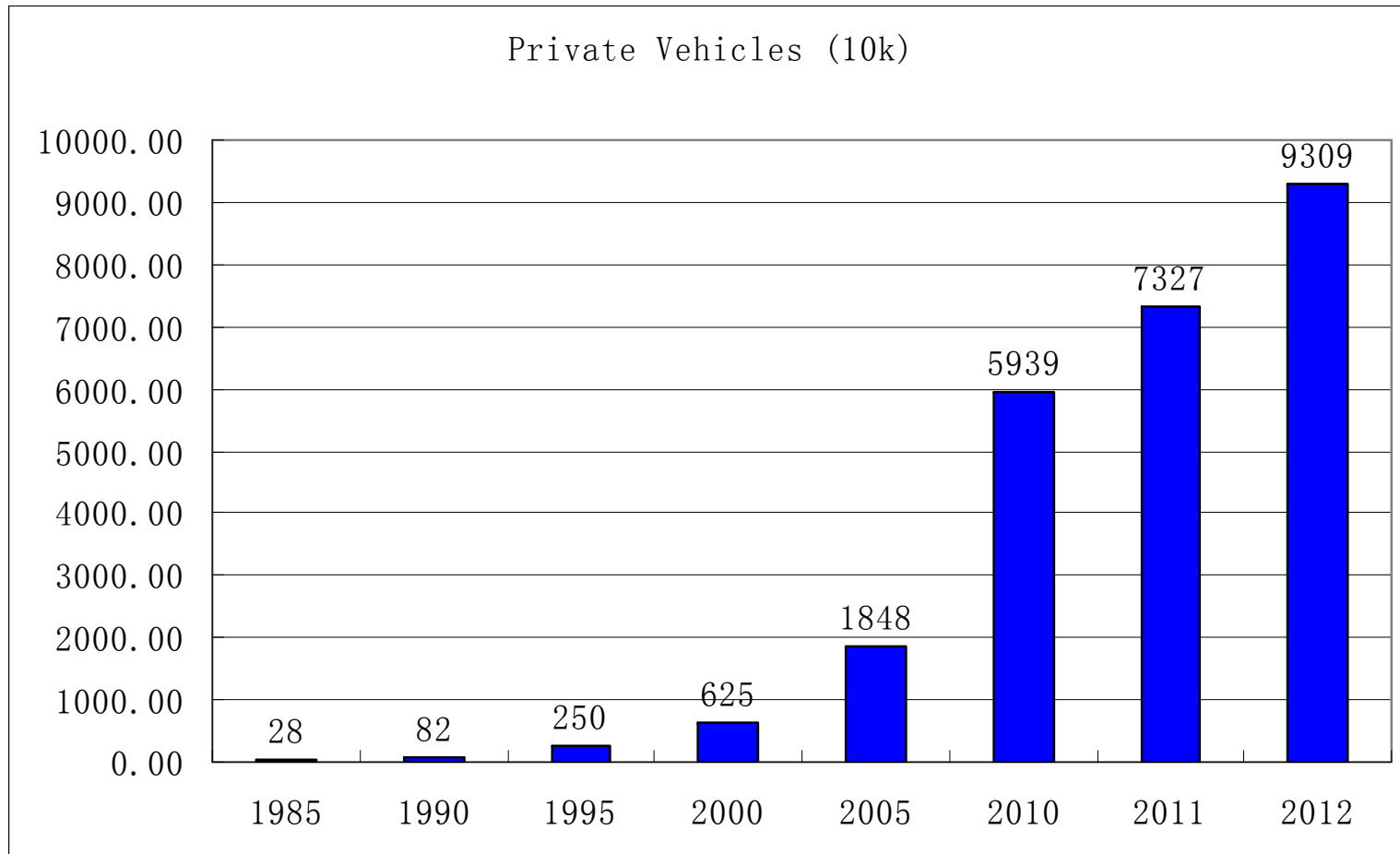
# Key drivers of energy sector trends

- Industrialization
- Urbanization
- Mobilization
- Pollution

# Outputs of main industrial products increased continuously

10k ton	Ethylene	Fertilizer	Cement	Steel	Vehicles
1990	157.20	1879.70	20971.00	6635.00	51.40
2000	470.00	3186.00	59700.00	12850.00	207.00
2010	1421.34	6337.86	188191.17	63722.99	1826.53
2011	1527.50	6213.13	209925.86	68528.31	1841.64
2012	1486.8	7296	221000	71716	1927.7
2012/1990 (times)	9.5	3.9	10.5	10.8	37.5
2012/2000 (times)	3.2	2.3	3.7	5.6	9.3

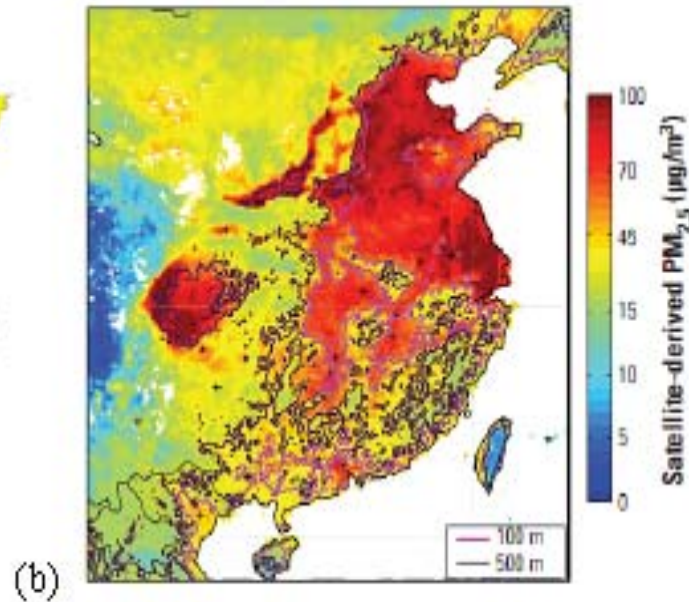
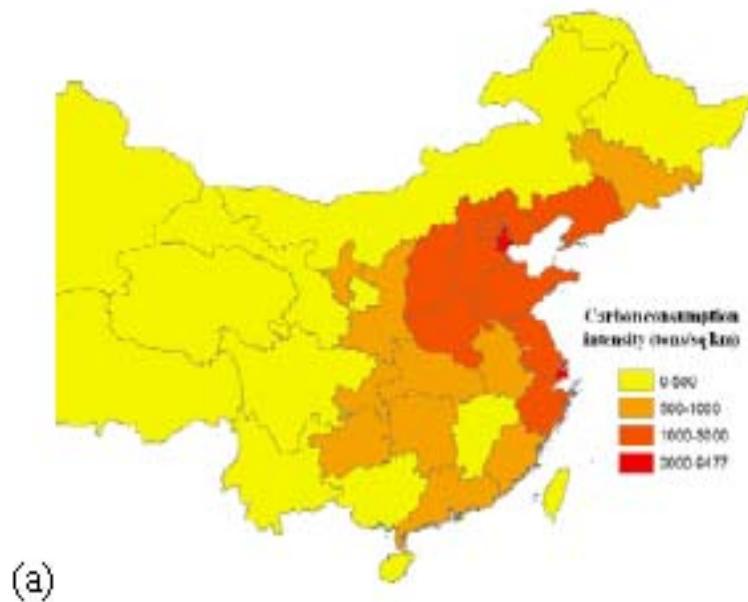
# Population of private vehicles increased 330+ times from 1985 to 2012



# Air pollution in cities



PM<sub>2.5</sub> pollution in eastern region is more serious that consistent with the spatial distribution of coal consumption intensity

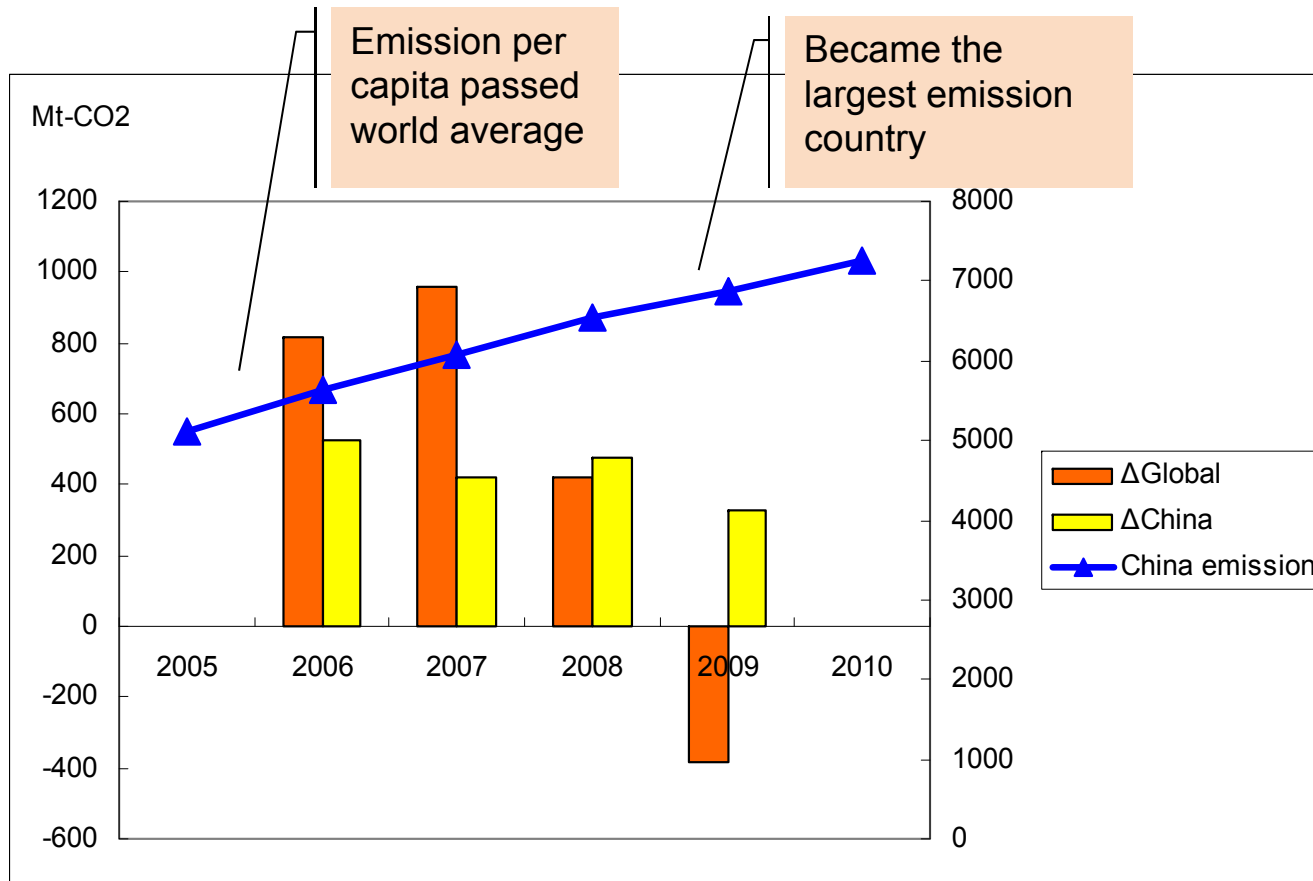


Carbon consumption (ton/sq.km)

PM<sub>2.5</sub> concentration (mg/cb.m)

Source: CCICED. Regional Air Quality Integrated Control System Research

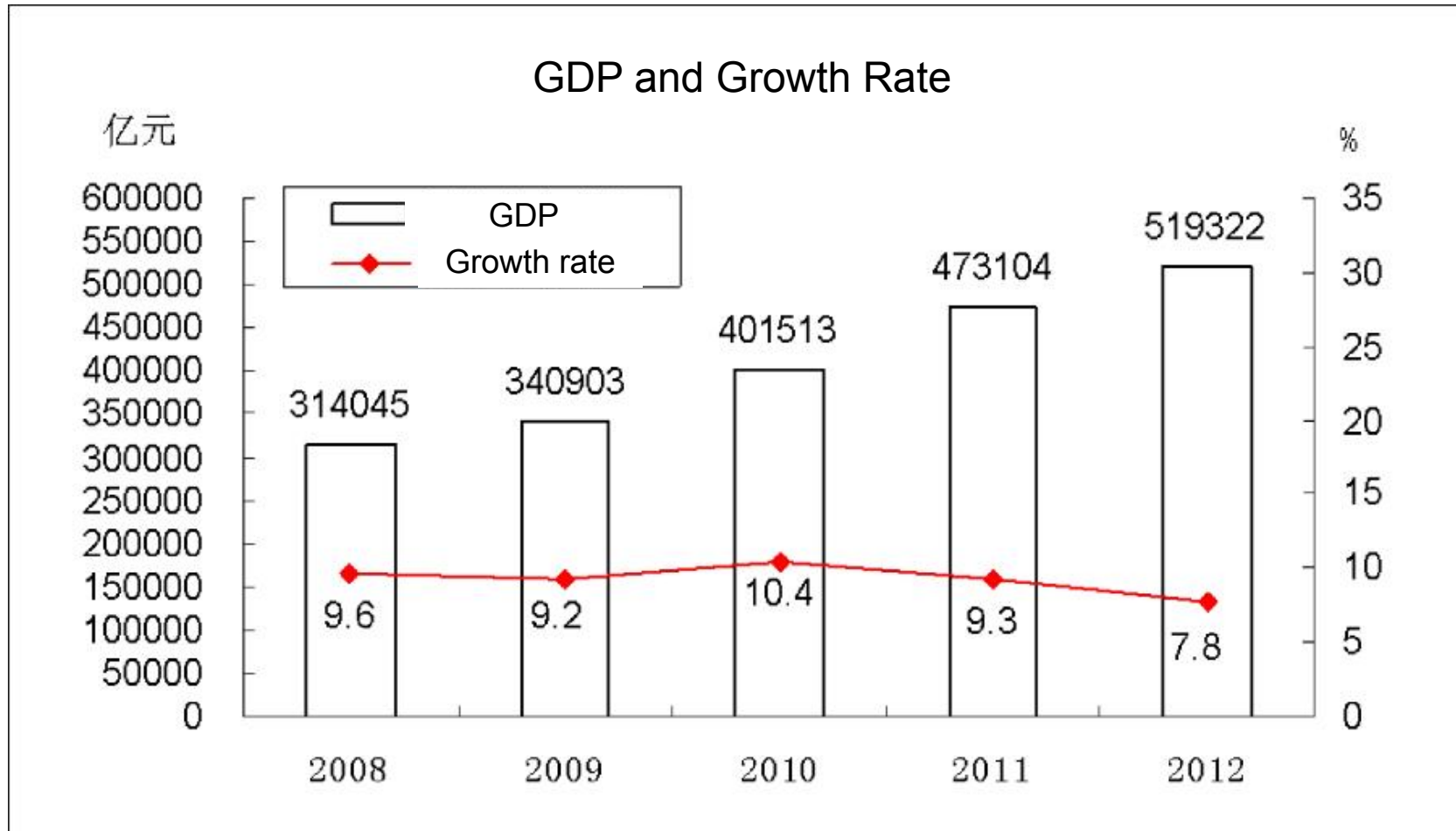
# CO2 emissions of China increased 41% from 2005 to 2010. More than 50% of increased emissions from China



Source: IEA

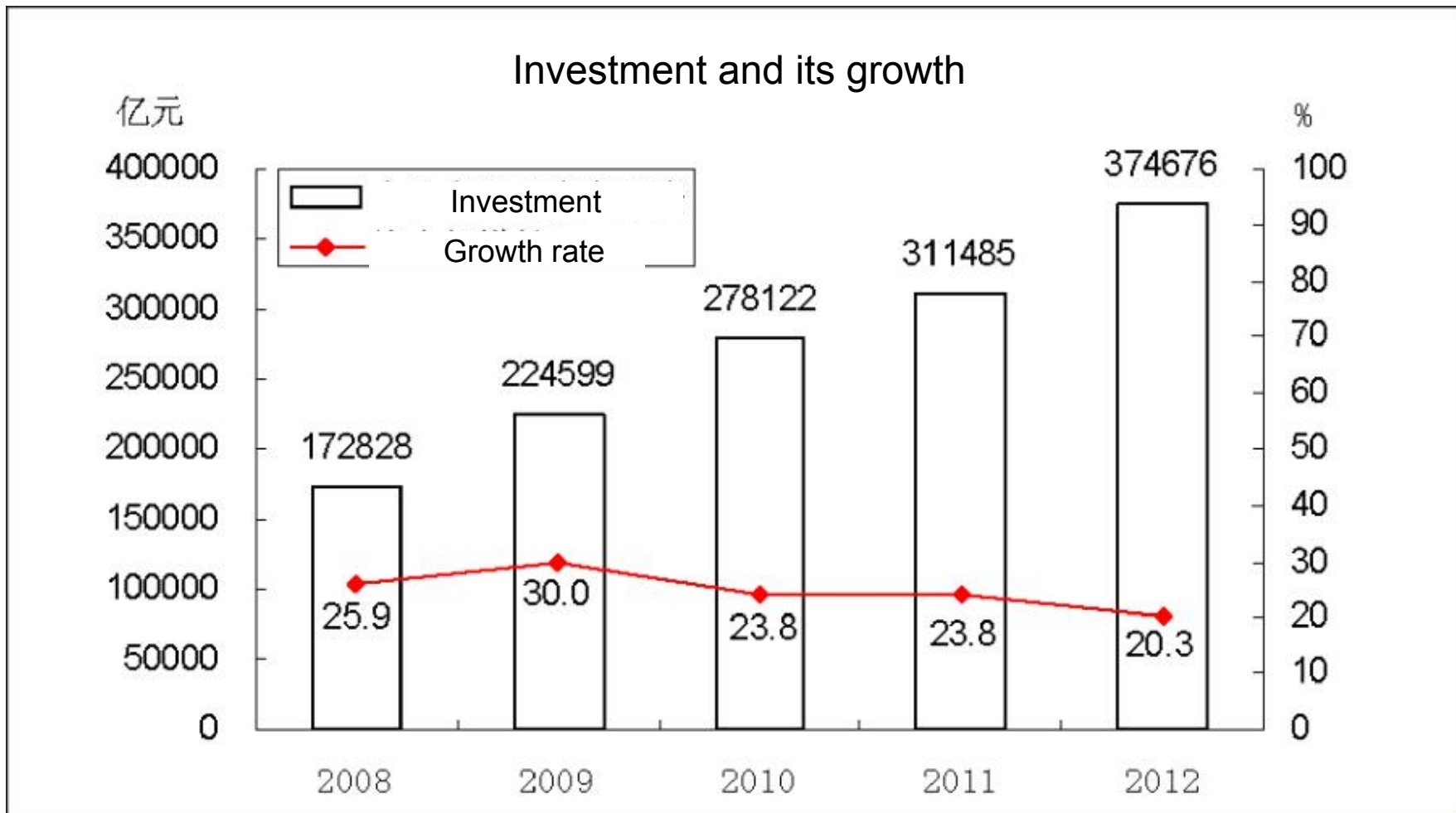


# Economic growth slow down since 2010



Source: [Statistical Communiqué of PRC on the 2012 National Economic and Social Development](#)

# Investment growth slow down since 2009

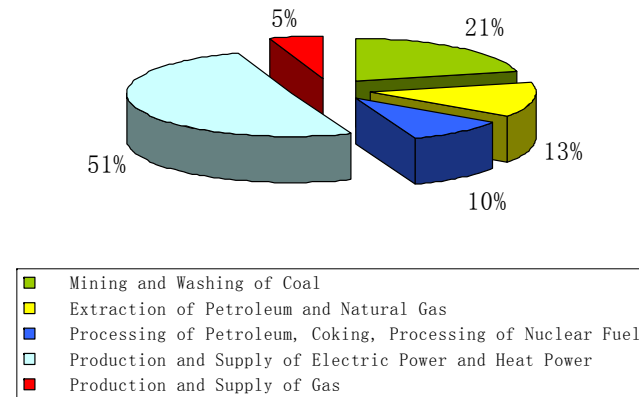


Source: [Statistical Communiqué of PRC on the 2012 National Economic and Social Development](#)

# Energy investment

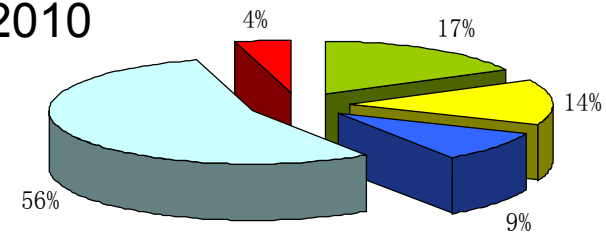
	2010	2011	Growth (%)
Investment in Fixed Assets in Urban Area(100 million yuan)	241430.9	302396.1	25.3
Investment in Energy Sector(100 million yuan)	21627.1	23045.6	6.6
Share of energy investment in total (%)	9.0	7.6	

2011



- Slow down investing energy sectors;
- Power sector takes larger share but shrinks;
- Growth in coal sector.

2010



Source: China Statistical Yearbook 2011, 2012

# Continue to support nuclear power development

- 17 units commissioned
- 29 units under construction
- Resumed all projects that were suspended after Fukushima accident
- The National Nuclear Safety Administration set a regular safety checking system to reassess NPPs by the latest nuclear safety regulations and standards every 10-year, to identify weaknesses and make improvement accordingly
- Existing plants adopt more safety measures through retrofitting: passive containment hydrogen elimination system; auxiliary feed-water systems with two electric pumps and two pneumatic pumps or the two electric pumps and two diesel generator powered pumps;...

## 2012-2013: Policies for 12th FYP and beyond

After Review 11th FYP implementation in 2011, many policies for 12th FYP (2011-2015) were issued in 2012.

- Industrial Energy Efficiency 12th FYP Planning (Feb. 2012)
- Shell Gas Development Planning(2011-2015) (Mar. 2012)
- Coal Industry Development 12th FYP Planning (Mar. 2012)
- Renewable Energy 12th FYP Planning (Aug. 2012)
- China's Energy Policies 2012 (Oct. 2012)
- The 12th Five-Year Plan and Long-Term Goals for 2020 for Nuclear Safety and Radioactive Pollution Prevention and Control (Oct. 2012)
- Energy Development 12th FYP Planning (Jan. 2013)

New administration was formed by the end of 2012.

# Target of 2015 (related to nuclear)

Total installed capacity: 1490GW

Nuclear power: 40GW (2.68%)

Nuclear power under construction: 18GW

For NPPs built during the 12th Five-Year Plan period:

- core damage frequency (CDF)  $< 10^{-5}$  /reactor/year
- large release frequency (LRF)  $< 10^{-6}$  /reactor/year

For the design of NPPs to be built during the 13th FYP period, the possibility of large radioactive materials release should be eliminated.

# Part B:China LEAP Modeling Efforts

GU Alun, WANG Yanjia

May 2013

Beijing

# Basic Assumptions

- Base year: 2000 ->2005
- Target year: 2030
- Dataset: AES2010 Draft
- LEAP2012.0.0.47
- Three scenarios: BAU (considering regional cooperation), Maximum Nuclear Path(MaNS), Minimum Nuclear Path(MiNS)
- Data source



# Population and GDP assumptions

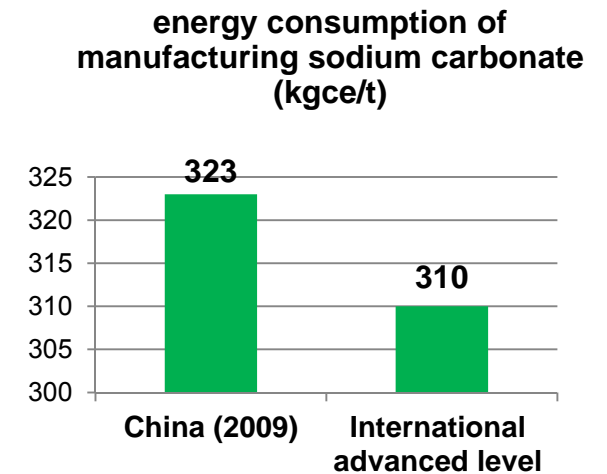
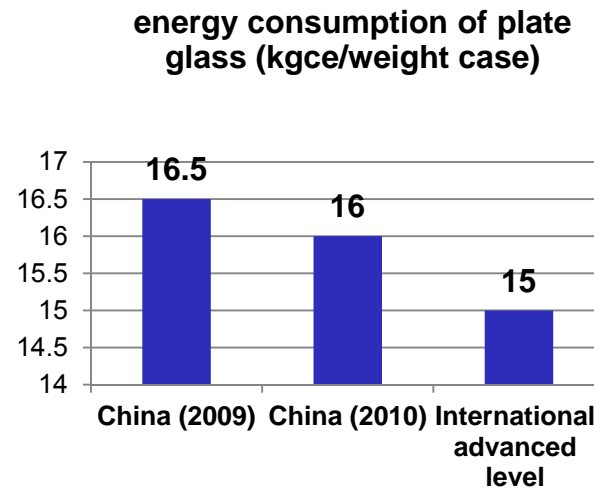
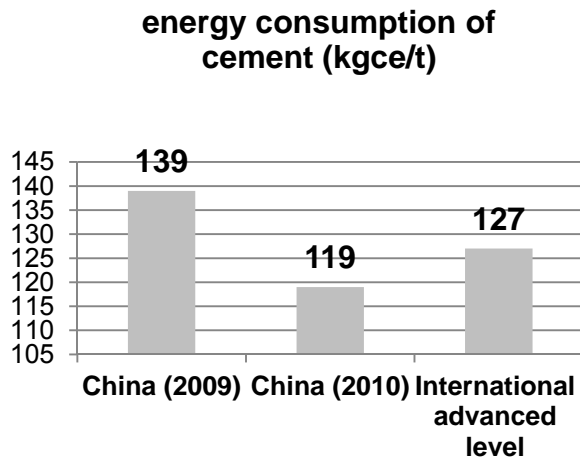
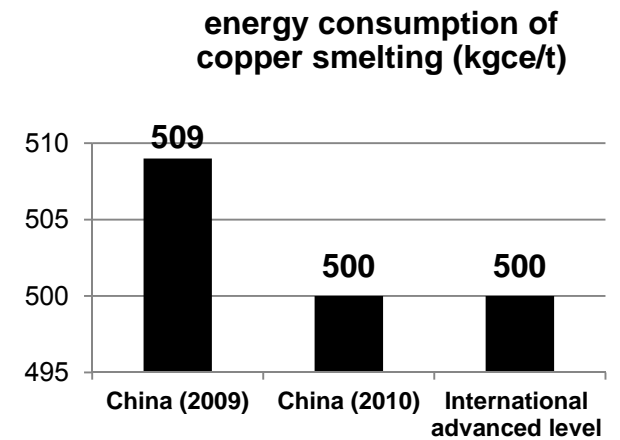
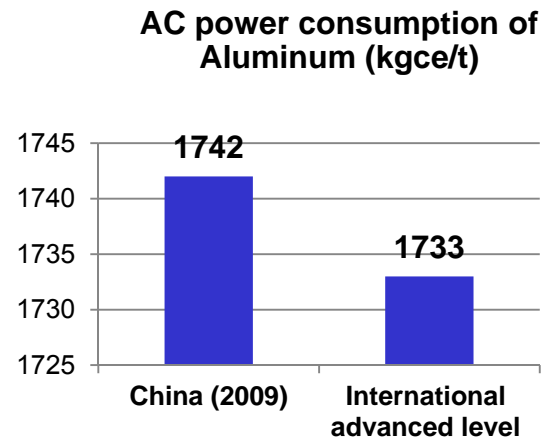
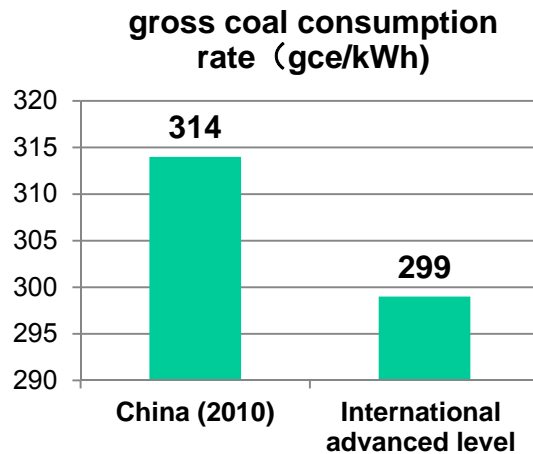
- The BAU scenario reflects a 20-year economic development path that yields average annual GDP growth rates of 8.38% between 2010 and 2020 and 7.11% between 2020 and 2030.
- China's population forecast in the model, adopting national population plans and projections, shows the peak of total population arriving between 2030 and 2040, at 1.47 billion people, with continued and pronounced movement of population from rural to urban area.

<b>Year</b>	<b>Population (million persons)</b>	<b>Urban HH (million)</b>	<b>Rural HH (million)</b>	<b>GDP (10<sup>8</sup> yuan RMB)</b>
<b>2005</b>	1308	190	183	183132
<b>2010</b>	1360	222	190	290505
<b>2020</b>	1440	288	181	649852
<b>2030</b>	1470	337	160	1291047

# Industry assumptions

- Based on China's government policy, growth in the most energy-intensive industrial sectors will be controlled and mainly used to fulfill domestic needs, and energy efficiency measures will be implemented in those sectors to enhance energy savings.
- In the steel, cement, and pulp and paper sectors, for example, physical output is projected to rise through 2020, but then fall slightly (steel), remain unchanged (cement), or rise only slightly (pulp and paper) through 2030.
- At the same time, the energy intensities per unit physical product in these industries is projected, in the BAU path, to fall by 1.0 to 1.8% annually, varying by industry and time period (China Low Carbon Scenario, 2009).

# Comparison about product energy consumption of key industry



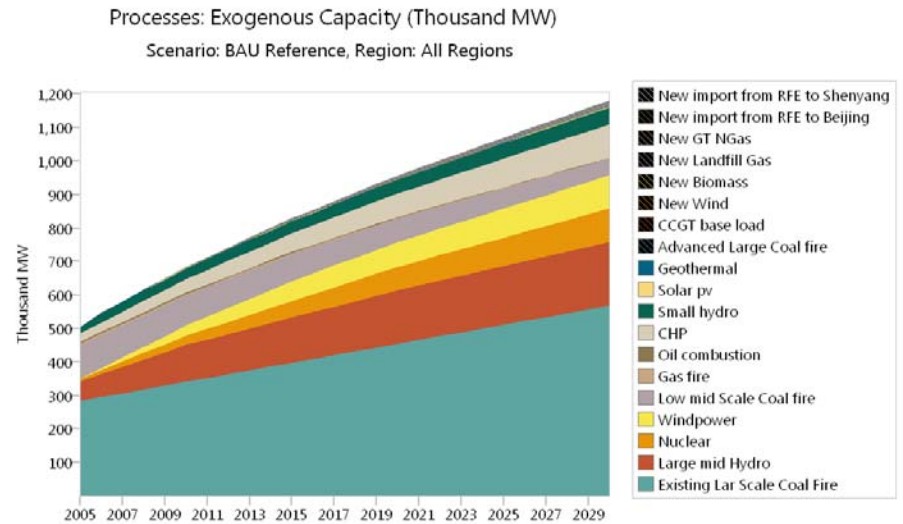
Note: The international advanced level data is statistics by 2007

# Industry assumptions

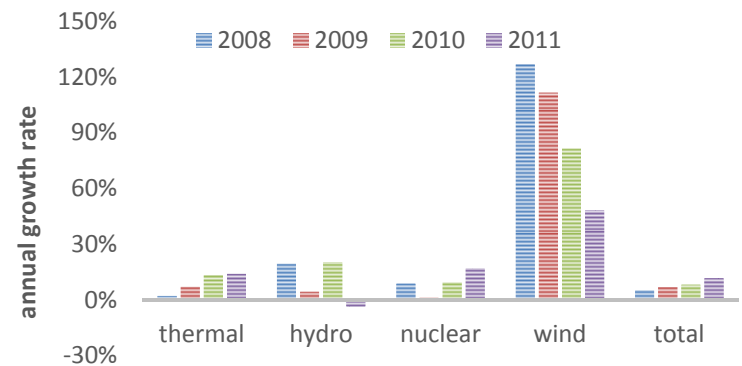
	Production			Intensity		
	Unit	2005年	2020年	Unit	2005年	2020年
Steel	亿吨	3.55	6.1	Kgce/t	760	650
Cement	亿吨	10.6	20	Kgce/t	132	101
Glass	亿重量箱	3.99	6.5	Kgce/重量箱	24	18
Copper	万吨	260	700	Kgce/t	1273	1063
Aluminium	万吨	851	1600	kWh/t	15000	12870
Paper	万吨	6205	11000	Kgce/t	1047	840

# Power sector

- Installed capacity: 966 GW (2010)
- Electricity generation: 42.27 Trillion kWh(2010)
- Wind increased fastest
- Nuclear increase at the same time



Total (MW)	517185	622000	713290	792731	874097	966413
net increase (MW)	73898	104815	91290	79441	81366	91240
Increase compared with last year (%)	16.67	20.27	14.68	11.14	10.26	10.56
Electricity generation (10 <sup>8</sup> kWh)	24747	28344	32559	34510	36812	42278
Increase compared with last year (%)	12.80	14.54	14.44	5.99	6.67	14.85



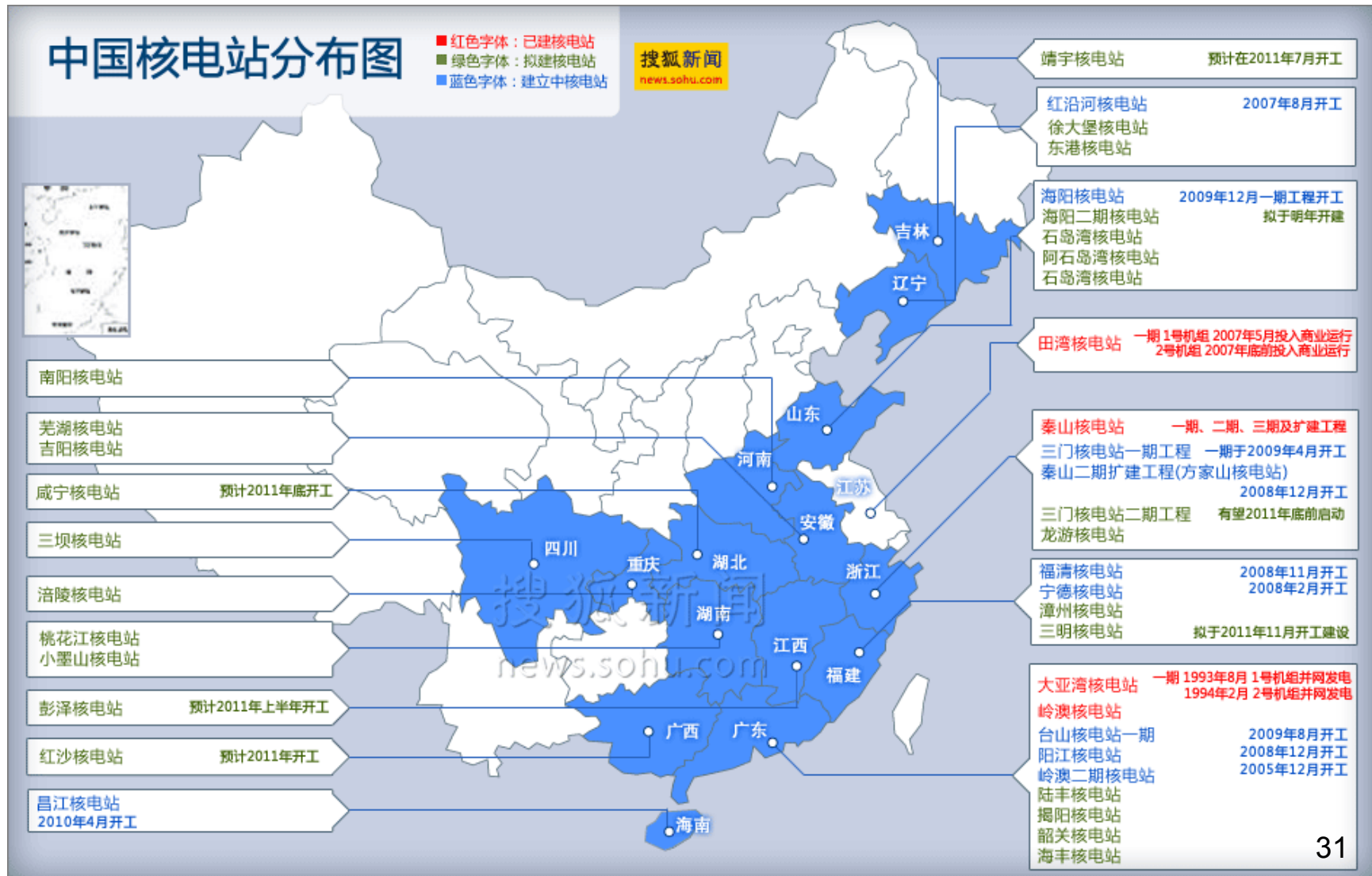
# Nuclear power scenarios changes

AES2007	2005		2010		2020	
	Installed capacity (GW)	share	Installed capacity (GW)	share	Installed capacity (GW)	share
Maximum Nuclear Path	8.7	1.60%	25	3.5%	80	8%
BAU	8.7	1.60%	15	2.1%	40	4%
Minimum Nuclear Path	8.7	1.60%	12	1.7%	20	2%

AES2010	2005		2010		2020		2030	
	Installed capacity (GW)	share	Installed capacity (GW)	share	Installed capacity (GW)	share	Installed capacity (GW)	share
Maximum Nuclear Path	8.7	1.60%	25	3.5%	80	8%	134	8%
BAU	8.7	1.60%	15	2.1%	70	7%	100	4%
Minimum Nuclear Path	8.7	1.60%	12	1.7%	60	6%	80	2%

AES2013	2005		2010		2020		2030	
	Installed capacity (GW)	share	Installed capacity (GW)	share	Installed capacity (GW)	share	Installed capacity (GW)	share
Maximum Nuclear Path	8.7	1.60%	25	3.50%	80	8%	150	8%
BAU	8.7	1.60%	15	2.10%	70	7%	100	4%
Minimum Nuclear Path	8.7	1.60%	12	1.70%	60	6%	80	2%

# Current nuclear power in China



# Current nuclear power in China

		Unit	MW	sub total MW	机组类型
田湾	Jiangsu	2	1060	2120	
秦山	Zhejiang	1	300	300	压水堆 (PWR)
		2	650	1300	压水堆 (PWR)
		2	720	1440	重水堆 (CANDU-6)
				3040	
大亚湾	Guangdong	2	984	1968	压水堆 (PWR)
岭澳		2	990	1980	压水堆 (PWR)
				3948	
			total	<b>9108</b>	



# Under construction

		Unit	MW	sub total MW	机组类型
红河沿	Liaoning	4	1000	4000	压水堆 (CPR1000)
海阳	Shandong	2	1250	2500	压水堆 (AP1000)
秦山二期	Zhejiang	2	650	1300	压水堆 (CNP600)
三门核电		2	1250	2500	压水堆 (AP1000)
福建宁德	Fujian	2	1000	2000	压水堆 (CPR1000)
岭澳二期	Guangdong	2	1000	2000	压水堆 (CPR1000)
台山		2	1000	2000	压水堆 (CPR1000)
阳江		4	1000	4000	压水堆 (CPR1000)
			total	<b>20300</b>	

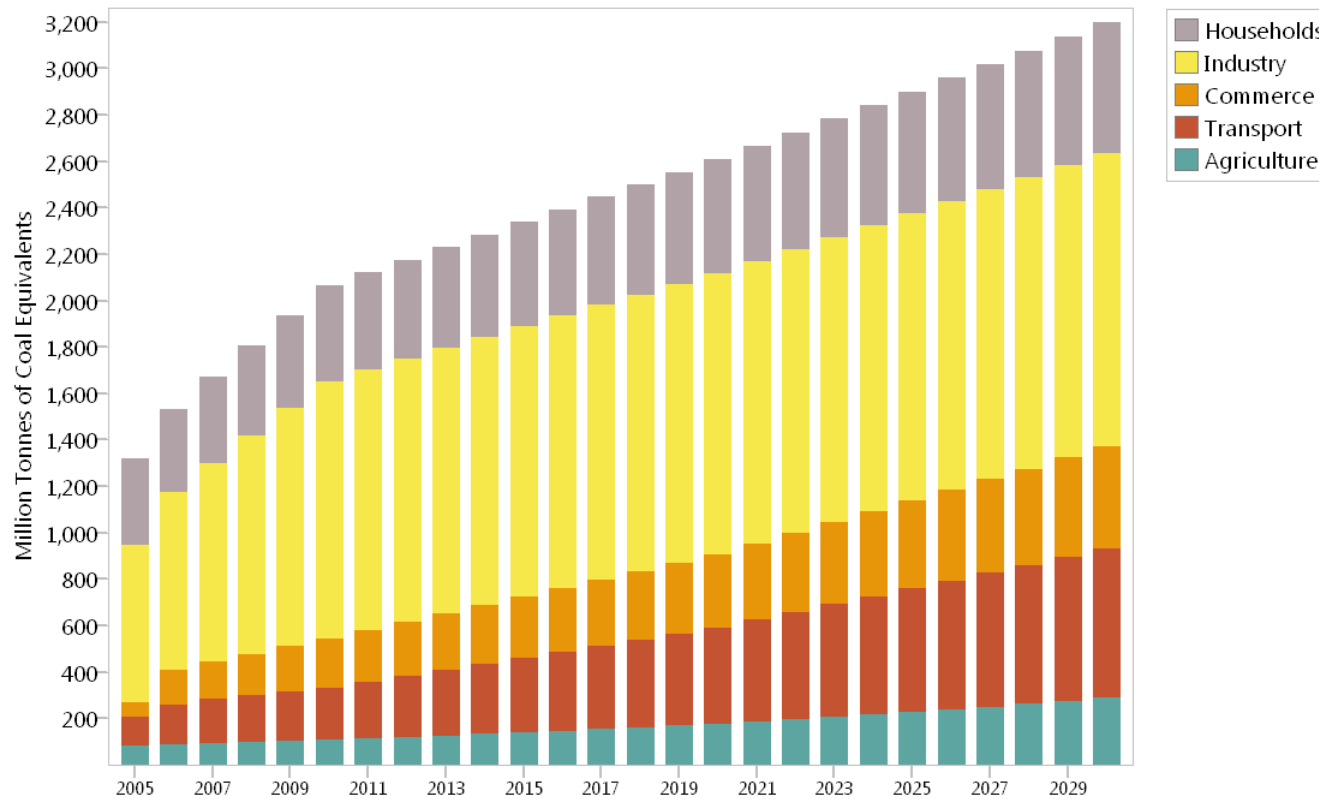
# Future nuclear power in China

The total investment is about 450 billion RMB.

吉林省	4000	
辽宁省		
辽宁省	4000	
山东省		
山东省	6000	
江苏省	4000	
安徽省	2000	压水堆 (CPR1000)
安徽省	2000	压水堆
浙江省	2000	
福建省	6000	压水堆
福建省		
福建省		
广东省		
广东省	4000	压水堆
广东省		
广东省		
广东省		
江西省	4000	
海南省	2600	
广西省	4000	
广西省	2000	
湖南省	4000	
湖南省	6000	
湖南省		
湖南省	4000	
四川省	2000	
重庆市	4000	
湖北省	4000	
	70600	

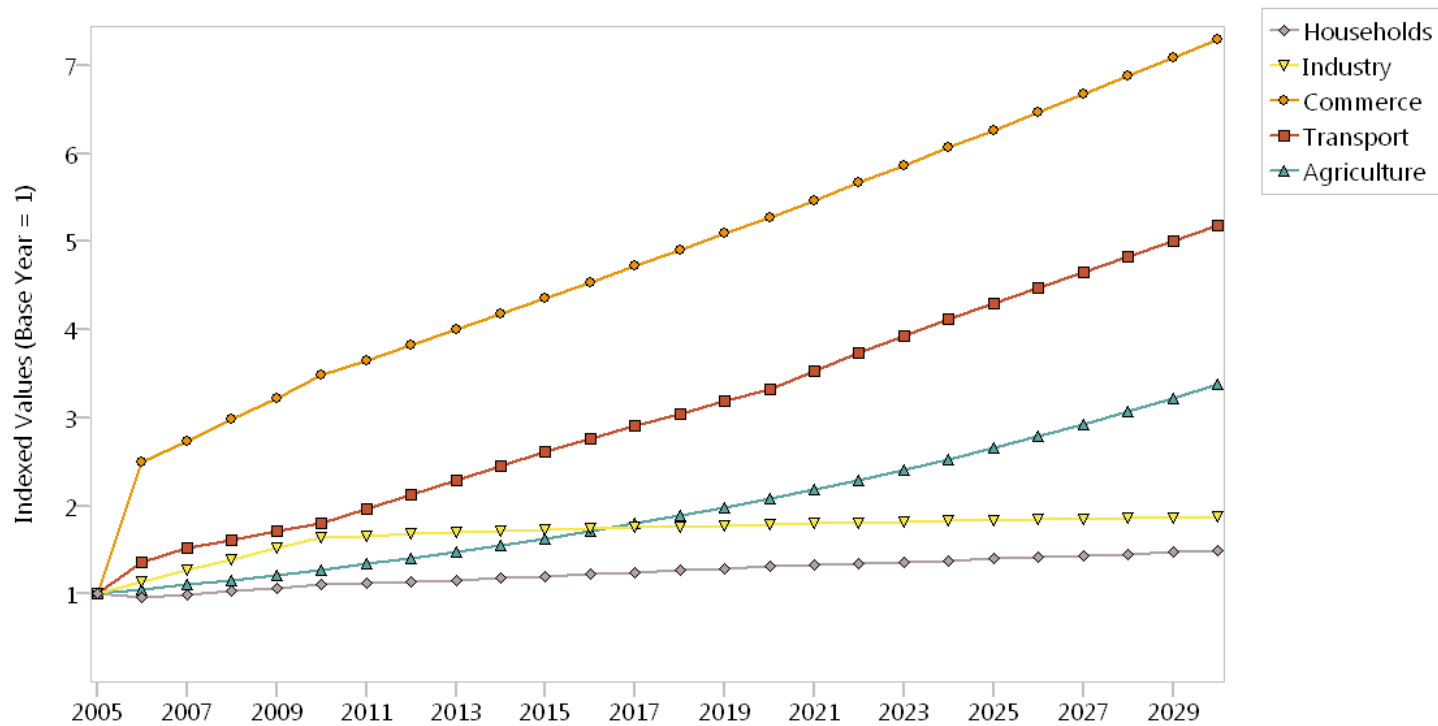
# Results for BAU Scenario

- BAU Scenario Energy Demand by Sector, 2005-2030, annual growth rate 3.6%



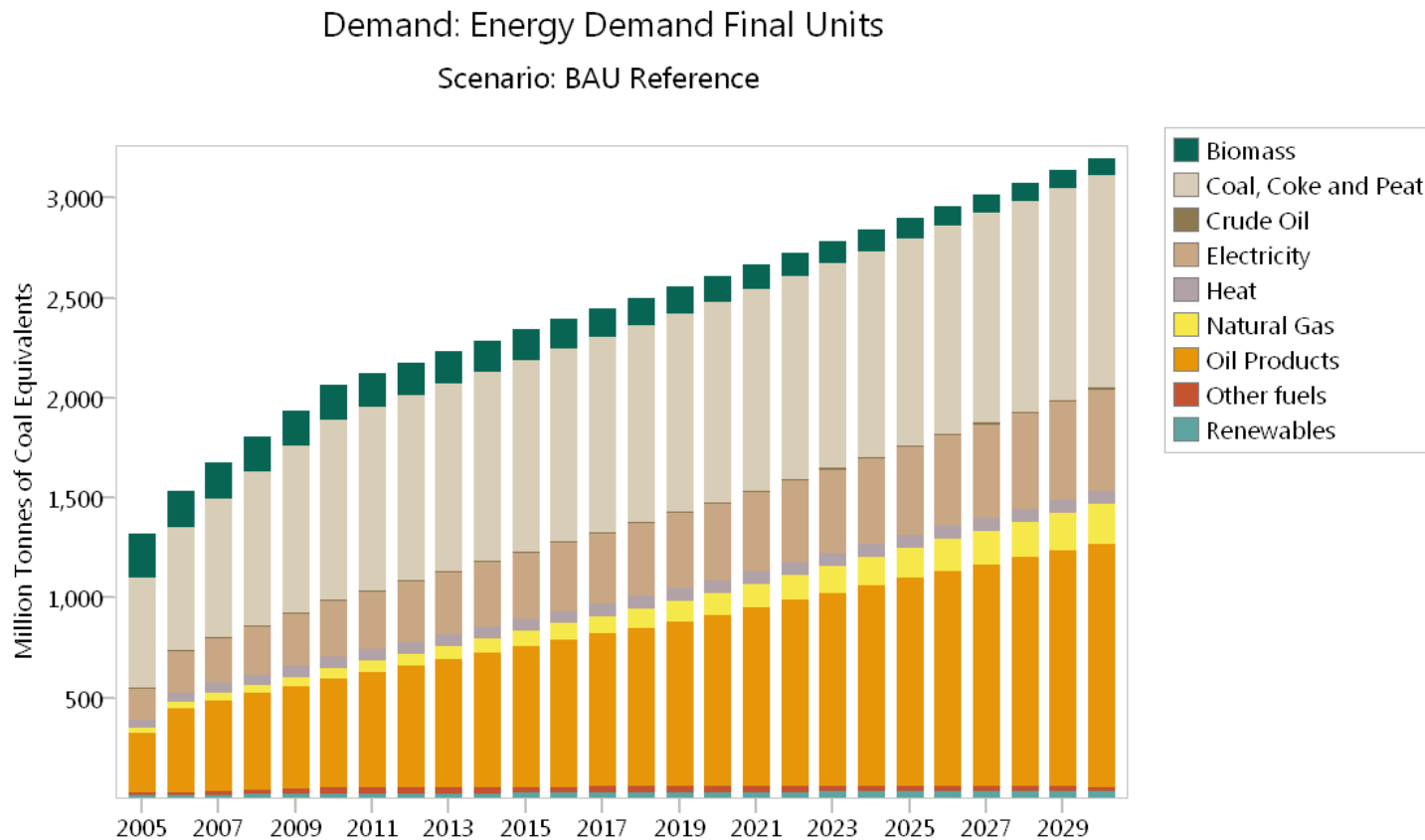
# Results for BAU Scenario

Demand: Energy Demand Final Units  
Scenario: BAU Reference, Fuel: All Fuels



# Results for BAU Scenario

- BAU Scenario Final Energy Demand by Fuel, 2005-2030

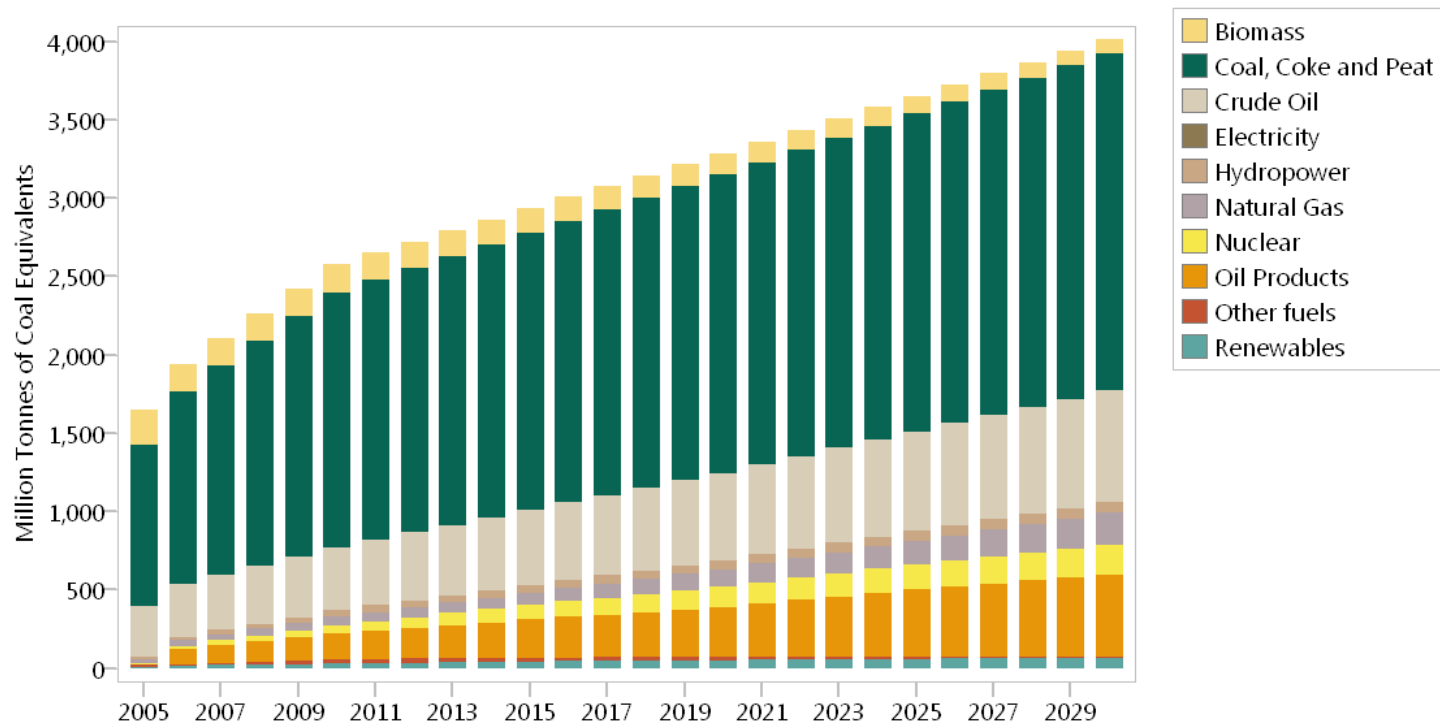


# Results for BAU Scenario

- BAU Energy Supply Outputs by Fuel, 2005-2030

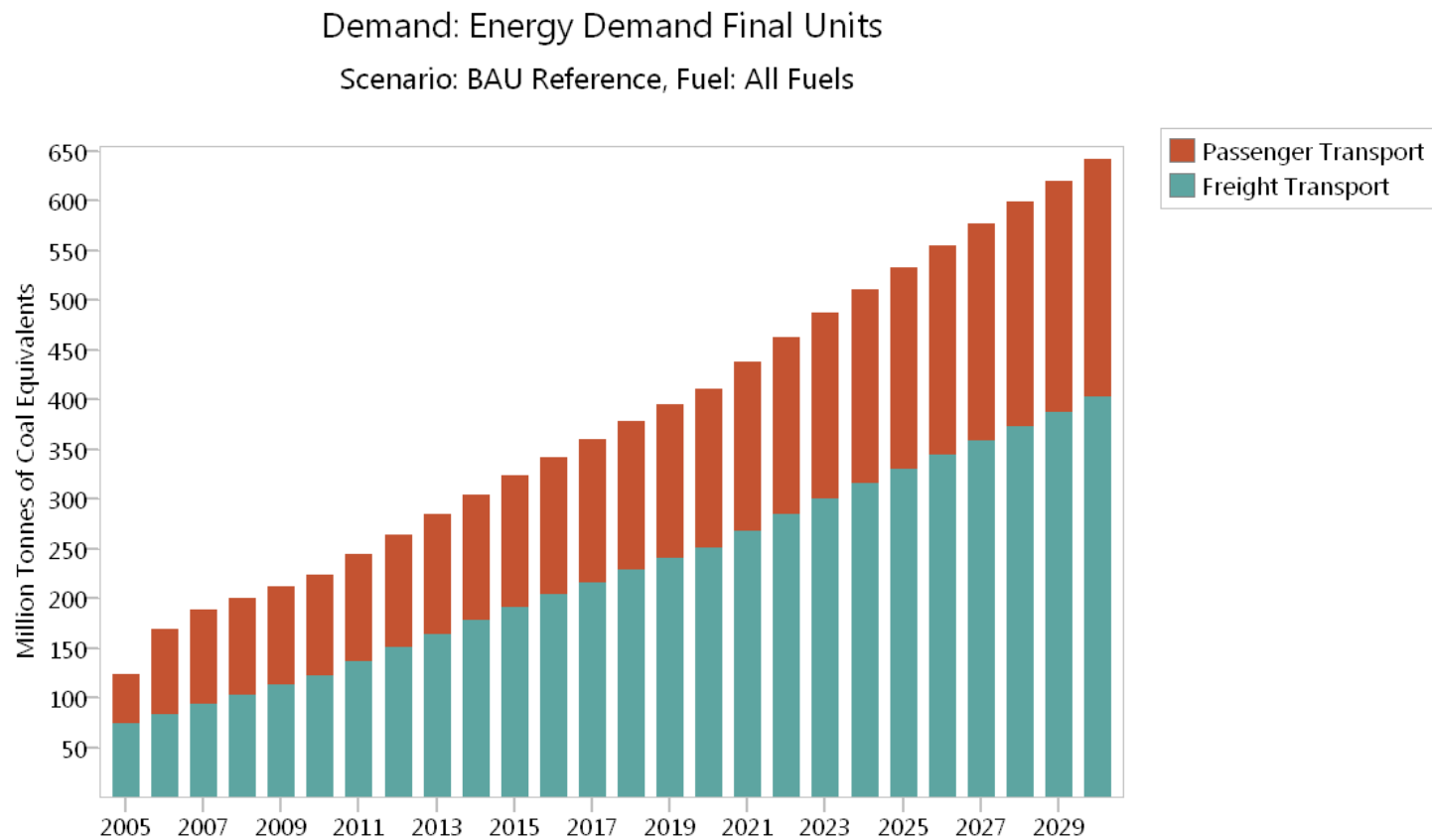
Resources: Primary Requirements

Scenario: BAU Reference



# Results for BAU Scenario

- BAU scenarios transport energy demand, 2005-2030

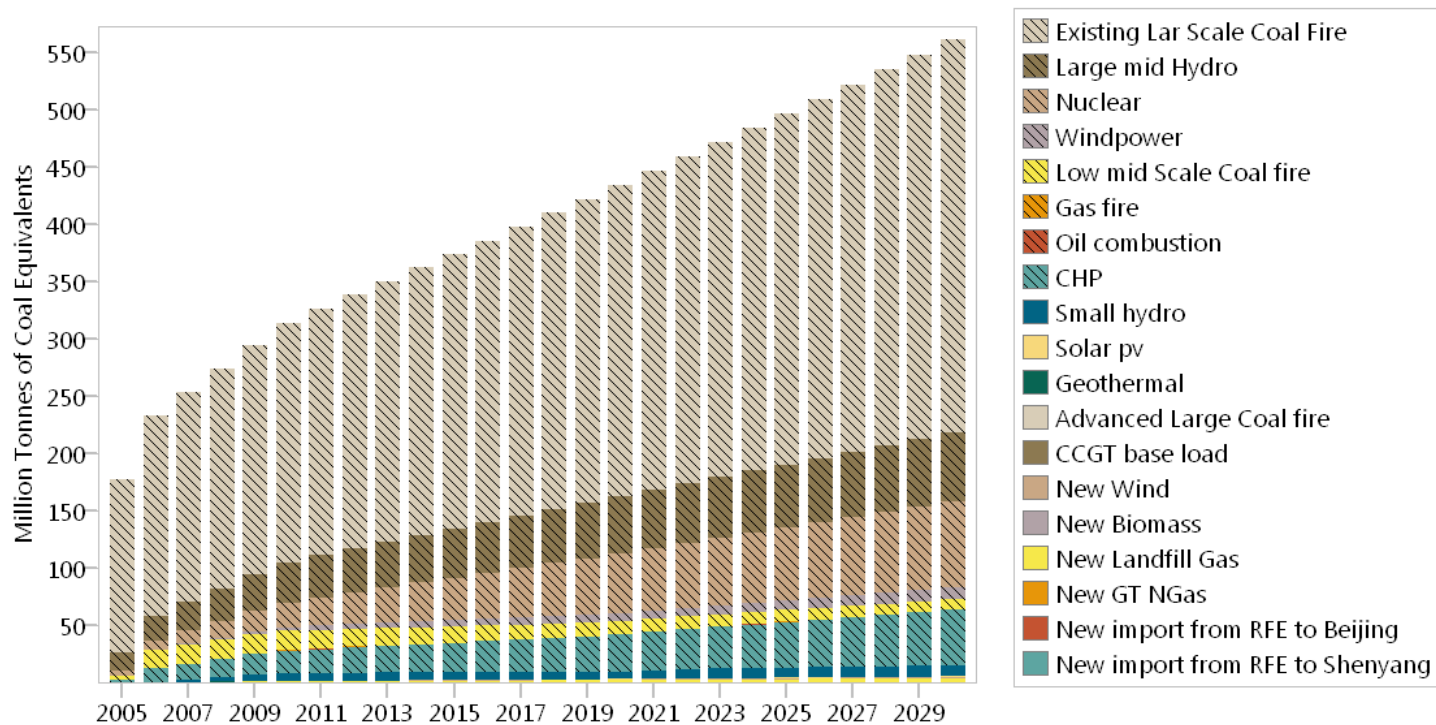


# Results for BAU Scenario

- Electricity generation

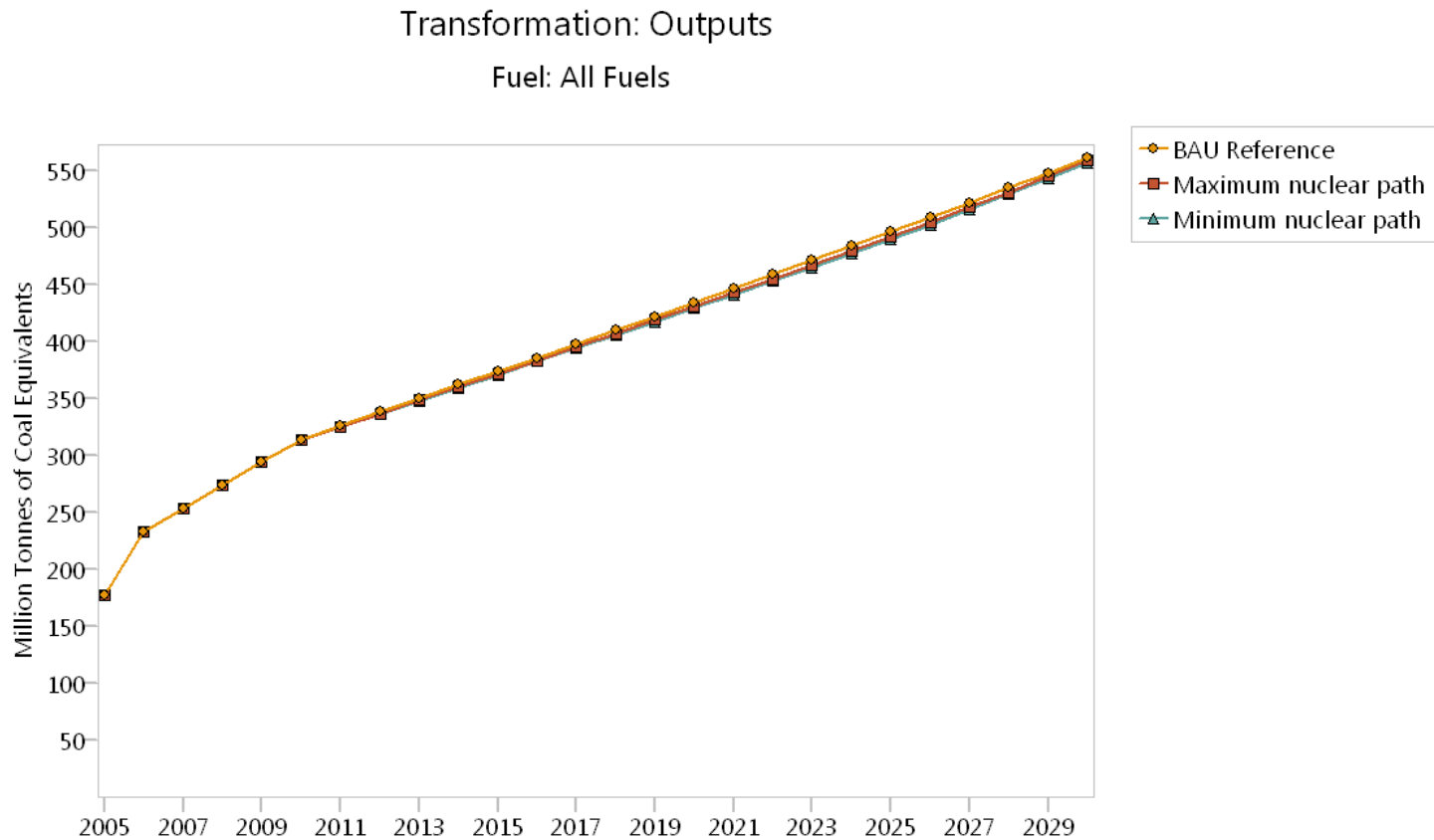
Transformation: Outputs

Scenario: BAU Reference, Fuel: All Fuels





# Scenario comparison for electricity generation



# Conclusions

- China has experienced rapid growth in energy consumption in the recent years. Large amounts of investment have been provided for the power industry and for oil stockpile facility construction to secure energy supplies to support rapid economic growth.
- To realize China's sustainable development, the national energy development strategy includes an energy conservation priority policy, and at the same time is vigorously developing renewable energy and new energy in China. A cleaner energy system and energy development strategy are needed, and should be established through government involvement leading to changes in all production processes and lifestyles through the applications of laws, regulations and fiscal policies.
- Vehicle emission problems in particular require special attention, especially those associated with increases in freight and passenger transport energy consumption.

# Thanks

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