Development strategy for energy technology of China

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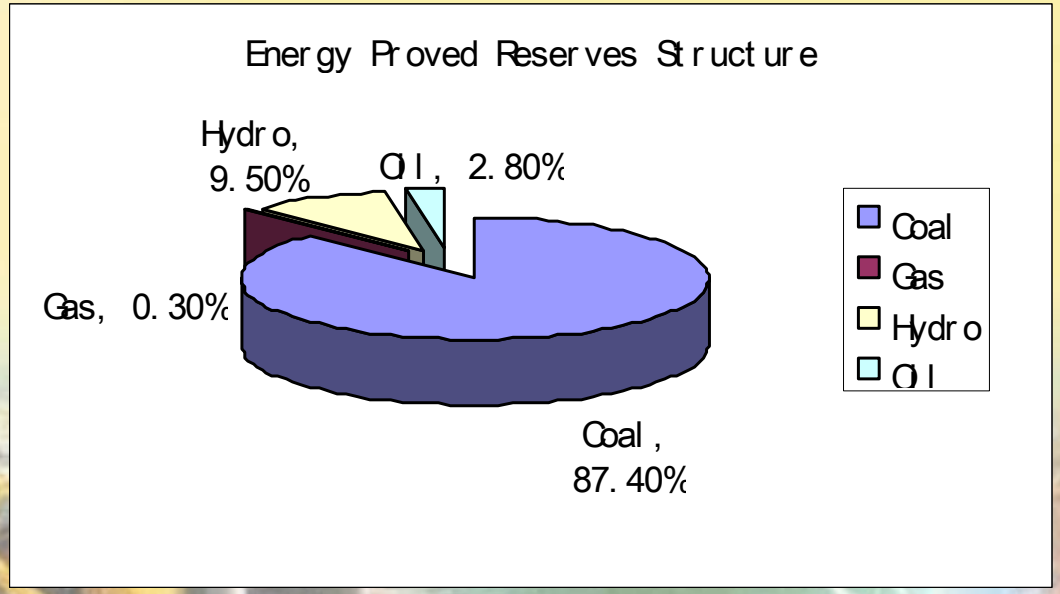
Outline

- Current status of China’s energy and resources
- Energy development strategy
- Energy science and technology development strategy
- Main focuses of advanced energy technology
- Co-operation and prospects

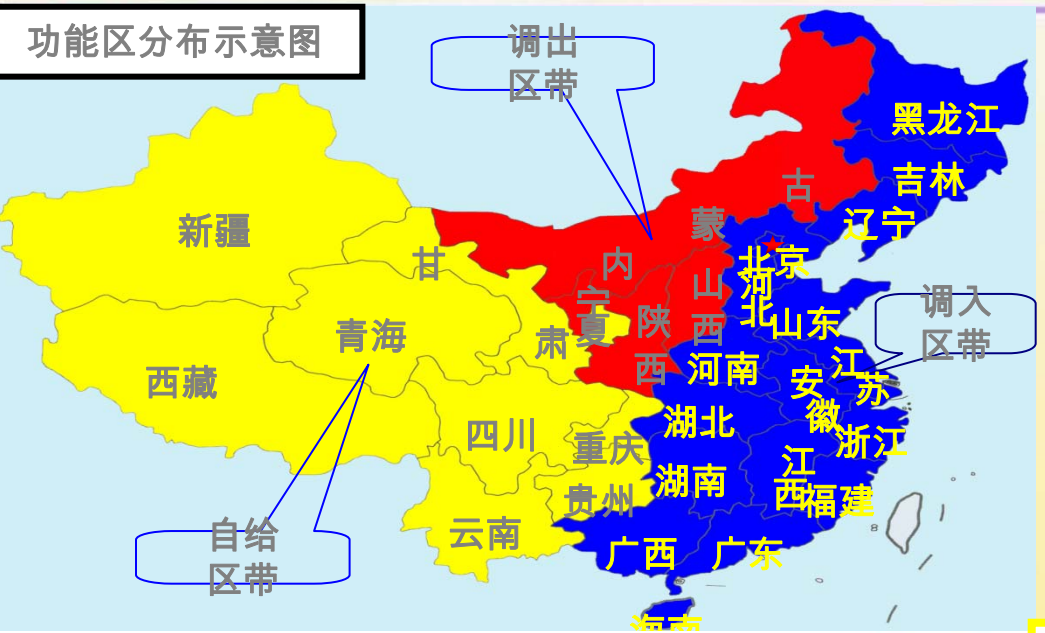
1. Current status of China’s energy and resources

Overview of china's energy resources: coal is the dominant primary energy

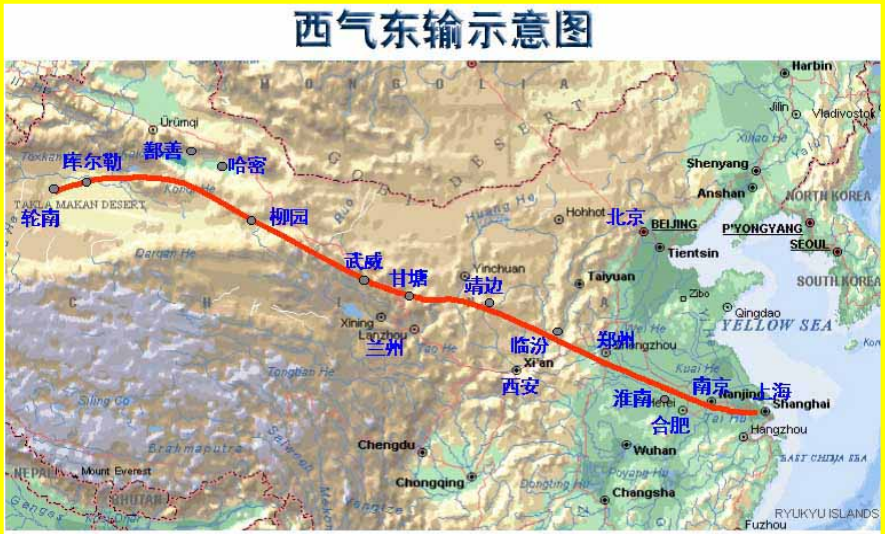
- Ascertained amounts of conventional energy resources are more than 820 billion tce
- The retained coal resources amount to 10,345 billion ton; while China's remained ascertained coal reserves takes 13% of the whole world, the third in the world.
- Ascertained oil and natural gas resources reserves are relatively low.



Unbalanced distribution of energy resources



- North to south coal transmission
- West to east power transmission
- West to east gas transmission



西气东输工程管线以新疆塔里木轮南油田为起点，经库尔勒、库米什、南湖戈壁，甘肃、柳园、张掖、武威，宁夏甘塘、中卫，陕西靖边，山西临汾，河南郑州，安徽定远，江苏南京，最后抵达上海，管线全长约 4000 公里，首期每年输气 120 亿立方米，投资规模 1200 亿元。已于 2001 年分段开工，预计 2004 年完工。

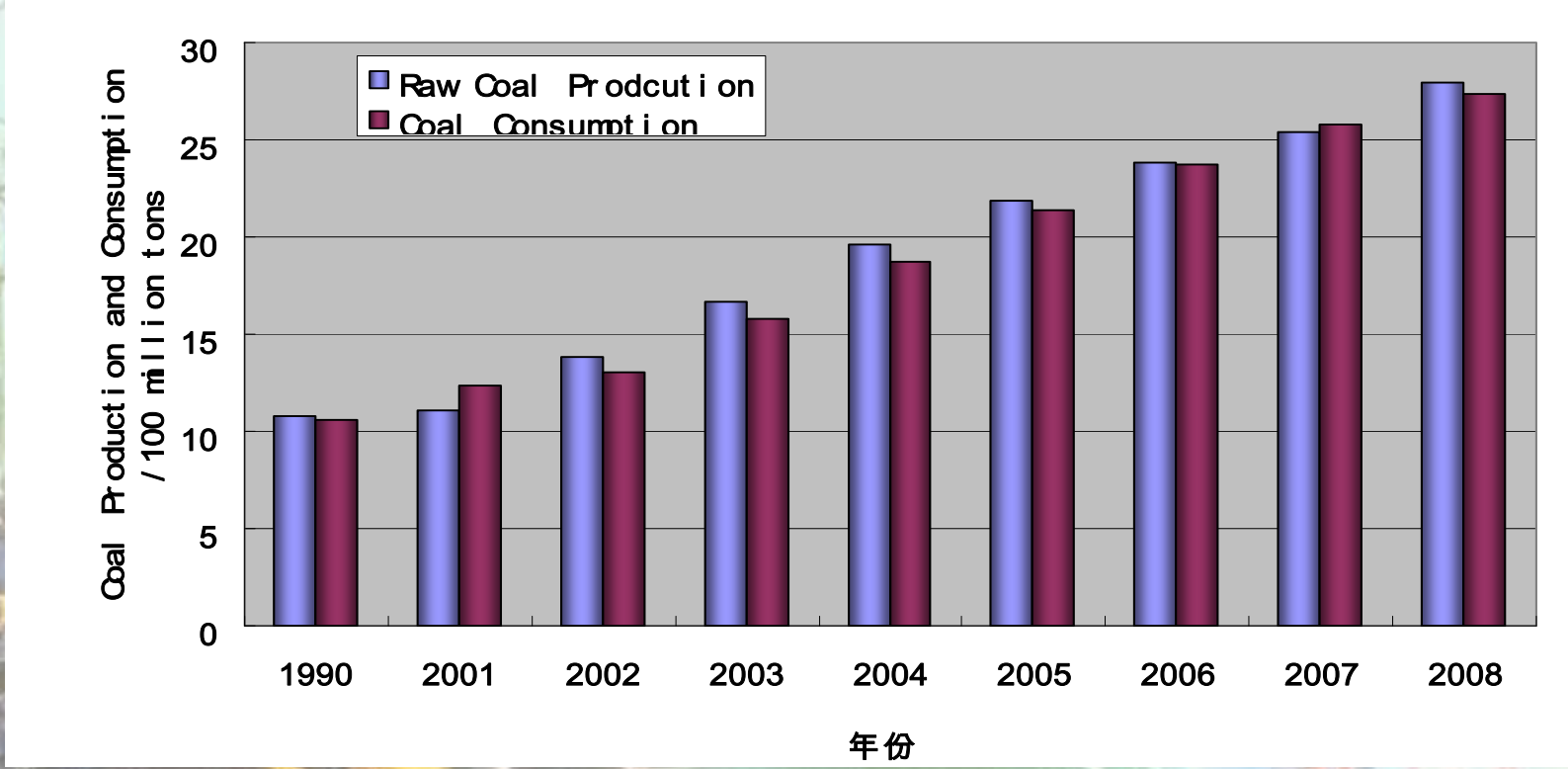
China- the world's second largest producer and consumer

In 2007, the world's total primary energy consumption was 11 billion toe, of which fossil energy took about 88%.

In 2008, China's total primary energy consumption was 2.85 billion tce, about 17% of the world's.

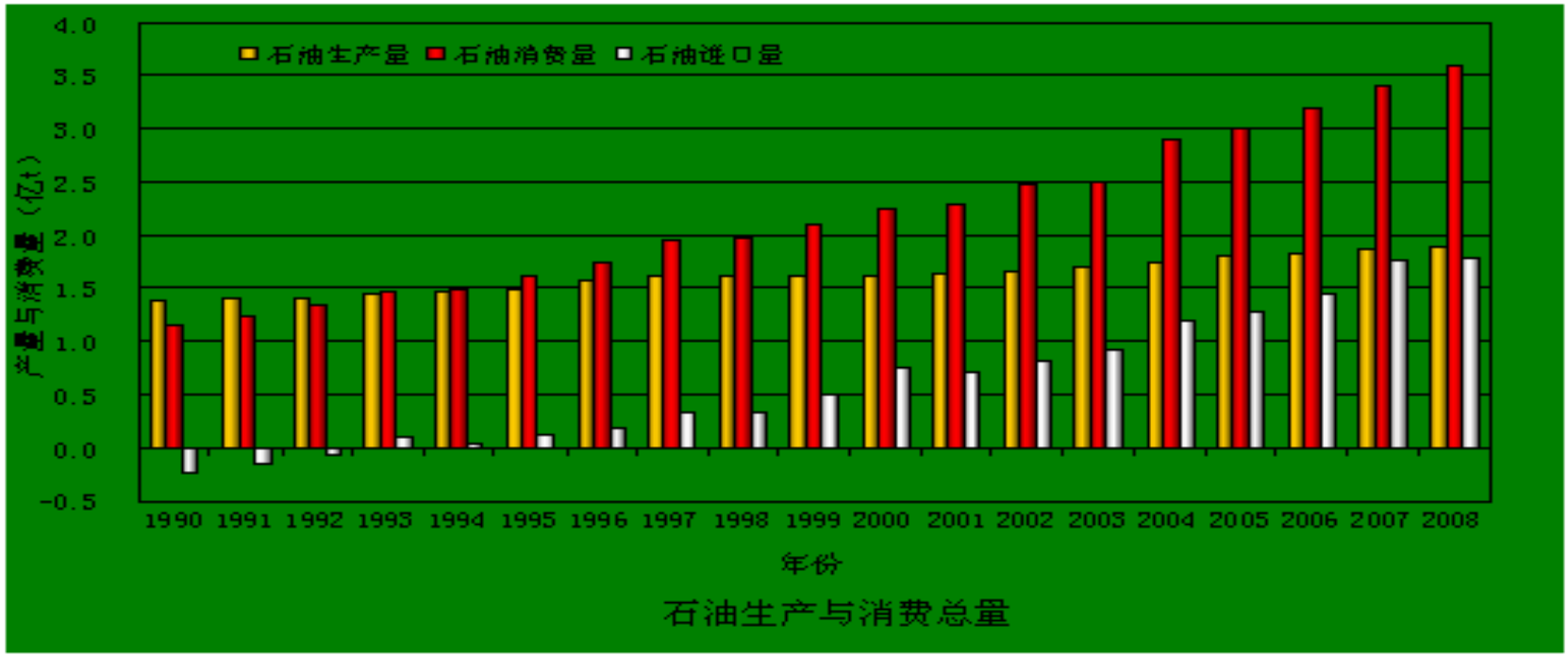
Coal met the energy demand of the rapid economic growth

- Coal consumption has been in a rapid growth since 2000
- In 2008, raw coal production was 2.793 billion ton, 4.1% increase than last year, 76.4% of the total energy production. Coal consumption was 2.74 billion ton, 3.0% increase than the last year, 69.5% of the total energy consumption
- In 2008, China's coal consumption took 38% of the world's .



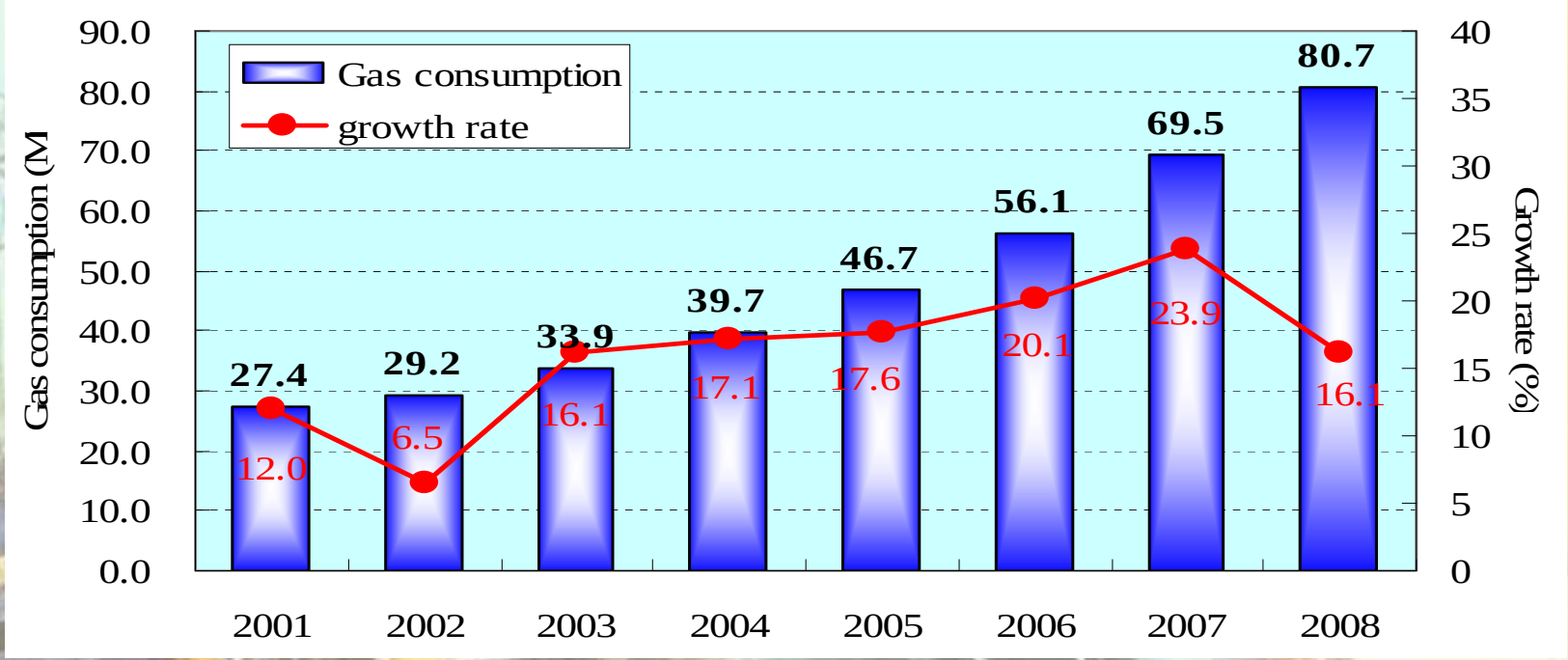
Continuous increase in oil consumption with the rapid economic growth

- In 2008, China consumed 0.36 billion tons of oil, 5.1% increase than last year; Oil import was 0.18 billion tons, 9.6% increase than last year; 50% of china's oil supply relys on import;
- China is now the second largest oil consumer and the third largest oil importer in the world;
- It is a practical choice for china to substitute oil, by making fully use of China's own energy resources—coal.



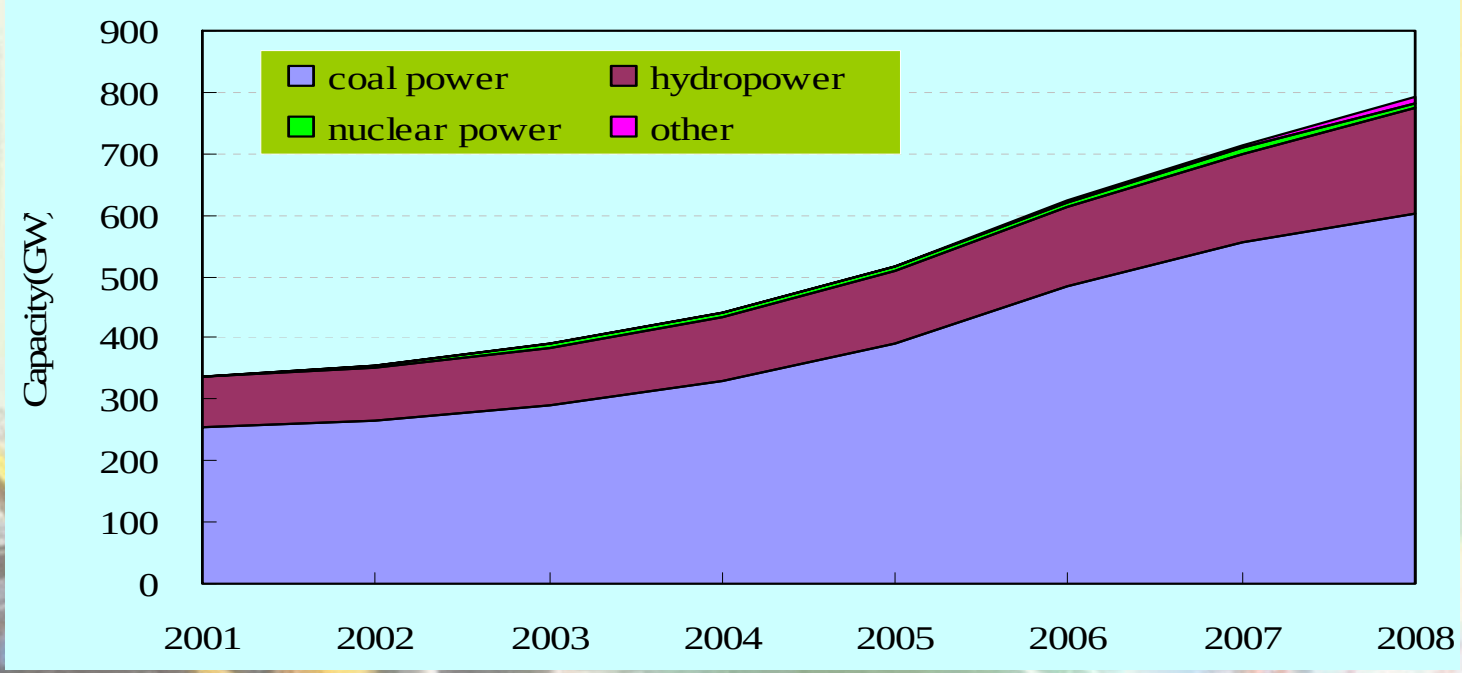
Continuous growth in natural gas consumption

- The domestic natural gas supply has increased to 76.1BCM in 2008, annual growth rate of 12.3%. The import amount of LNG was 3.34 Mt, annual growth rate of 14.5%.
- Proportion of natural gas in total energy consumption is very low



The Rapid Growth in Power Capacity

- China's total installed capacity was 792 GW, the second in the world
- Installed hydropower capacity was 170 GW, the largest in the world
- 14 sets of GW sized nuclear power plants are approved for construction recently, with a total installed capacity of 9.1 GW.



Utilization of renewable energy - at the initial stage

Ratio of the total consumption amount of renewable energy to primary energy 2.83:100

Categories/类型	Physical volume/实物量	Mtce /标准煤量
Large and medium-sized hydropower/大中型水电	78.86GW,208.1TW•h	96.07
Biomass (traditional Use)/生物质能传统利用	295.6Mtce	295.6
Renewable energy		62.80
Micro, small hydropower/微、小水电	38.74GW,121.28TW•h	41.60
Biomass		9.32
Marsh gas/户用、大中型沼气池	706 Billion m^3	6.70
Gasification/秸秆气化集中供气	0.2 Billion m^3	0.03
Power/生物质发电	2GW,4800GW•h	1.67
Ethanol/生物质制乙醇	1Mt	0.92
Solar energy/太阳能	PV cell/光伏电池70MW,78GW•h	10.69
Geothermal energy/地热能	Power/发电28MW,140GW•h	0.65
Wind energy/风能	On grid wind generator/并网风机 1266MW	0.54
Total/总计		454.47

2. Energy development strategy

Mid and long term strategies for China's energy development

- **Energy conservation is a priority**
- **Base on dome resources and market**
- **Promote multi-component development**
- **Rely on technolo**
- **Protect the environment**
- **Promote mutua cooperation and benefit each other**

China's energy industry development should be based on domestic resources and market, and insist the principle of equality, mutual-beneficial and win-win principle. China will enhance cooperation with other countries in energy sector with a frank and practical attitude, improve the cooperation mechanism, broaden the fields for cooperation, and ensure the security and stability of international energy market.

preparation on energy for future development

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Directions for energy substitution strategy

- Low quality energy → Superior energy
- Traditional energy → New energy
- Dirty energy → Clean energy
- High carbon energy → Low/carbon-free energy

Established national overall objectives for energy conservation and emission reduction

- By 2010, reduce energy consumption per 10,000 RMB GDP from 1.22 tce in 2005 to 1 tce, with a decrease of 20%; reduce water consumption per unit industrial added value by 30%.
- During the 11th Five-Year Plan period, reduce the total emission of major pollutants by 10%.
- By 2010, reduce SO_2 emission from 25.94 million tons in 2005 to 22.95 million tons; reduce the chemical oxygen demand (COD) from 14.14 million tons in 2005 to 12.73 million tons; ensure the ratio for urban waste water treatment is no lower than 70%; ensure the ratio of comprehensive utilization of industrial solid waste is higher than 60%.

3. Energy science and technology development strategy

The background and basis for energy S&T strategies

- In February, 2006, “Mid and Long Term Outline for China’s technologies Development Plan”
- In June, 2006, “Mid and Long Term Outline for China’s Energy Industry Development Plan (2004~2020)” (Development strategies for China’s Energy Industry in Mid and Long Term)
- In September, 2007, Mid and Long Term Outline for China’s Renewable Energy Development
- In May, 2007, “Notification by Chinese State Council on the Comprehensive Work Plan for Energy Conservation and Emission Reduction”
- Publication of “the Mid and Long Term Special Plan for Energy conservation”

The background and basis for energy S&T strategies

Policies and actions by Chinese government to cope with global climate change

- In 1992, Chinese government signed “the UN Framework Convention on Climate Change”.
- In 1998, Chinese government signed “the Kyoto Protocol”, which was ratified in 2002.
- Chinese government has set up a National Coordinated Group for Coping with Climate Change, which is composed of 17 national departments
- China has published “Management Methods for the Operation of CDM Projects”
- In June, 2004, MOST published “China’s Scientific and Technological Actions On Climate Change ”
- In December, 2006, MOST and other national departments published “China’s National Assessment Report on Climate Change”
- In May, 2007, Chinese State Council published “China’s National Climate Change Programme ”

Medium and long term S&T development program: Prioritized fields in energy sector

- Energy-saving and efficiency technologies of industry
- Clean coal technologies
- Utilization of renewable energy with low cost and large scale
- Advanced power transmission & distribution system with high reliability

Medium and long term S&T development program: Frontier technologies in energy sector

- Hydrogen energy and fuel cell
- Distributed energy supply technologies
- Fast neutron reactor technologies
- Nuclear fusion with magnetic restriction

Medium and long term S&T development program: Important national S&T projects

China has set up two important national science and technology specific projects in energy sector.

1. Exploitation of large oil/gas fields and coal bed methane
2. Large advanced pressurized water reactor and high-temperature air-cooled reactor plants

4. Main focuses of advanced energy technology

Overall guideline for advanced energy technology

- Take developing advanced technology to meet and support China's energy development as the starting point, take energy saving and GHG emission reduction, cope with climate change as substance, take medium and long-term science and technology program as a basis.
- Aim at directions such as clean coal technology, renewable energy, new energy technology, energy saving and major energy equipments, perform research and development on the key technologies.
- Pay attention to the combination with industry demonstrations, carry out R&D on the advanced energy system.
- Obtain a series of landmark results in the strategic, forward-looking and cutting-edge field of advanced energy technologies.

Overall arrangement of advanced energy technology

- Set-up different types of science and technology programs：
  - The National Basic Research Program (973 Program)
  - The National High Technology Research and Development Program (863Program)
  - The National Key Technology Program
- Set-up different levels of science and technology projects
  - Major project
  - Key project
  - Goal-oriented research themes
  - Exploration-oriented research themes

Major themes of advanced energy technology

- **Fossil energy technology**

  Clean coal technology, heavy-oil refine processing technology.

- **Renewable energy technology**

  Solar energy, wind, biomass energy, ocean energy, geothermal energy, hydro power.

- **New energy technology**

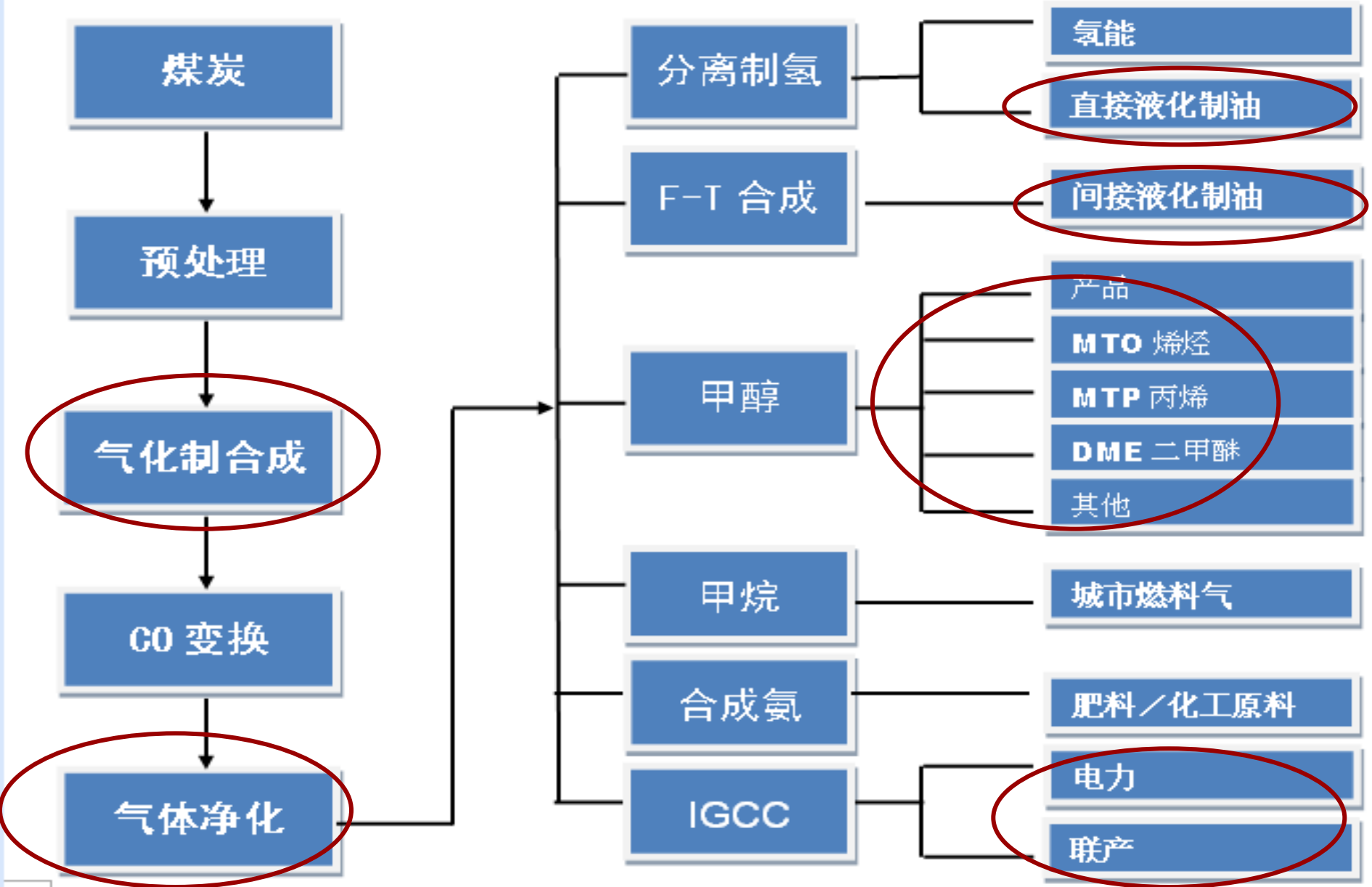
  Hydrogen and fuel cells; nuclear energy technology .

- **Industry energy-saving and the power transmission technology**
- **Major energy equipment technology**

CCT-play an important role in fossil energy utilizations

- Clean coal technology of power generation and heating supply
  - IGCC and co-production demonstration
  - Steam coal optimization technology, and high-efficiency coal-fired boiler technology
  - Supercritical circulating fluidized bed boiler
- Clean coal conversion technologies
  - High temperature F-T technology
  - Direct coal liquefaction technology
  - Advanced coal gasification technology

Support multiple Clean Coal Technologies



Goals for Coal Gasification-based IGCC & Co-production Technologies

Carry out R&D of key technologies and Demonstration of Coal Gasification-based co-production power, clean fuel, chemicals and heating

- **2005, Demonstrations of Power and chemicals Co-production;**
  - **60MWe IGCC, 240 thousand t/a methanol, system integration**
- **2010, Demonstrations of Power, clean fuel, chemicals**
  - **200MWe IGCC, 1 Million oil t/a**
- **2015, Demonstrations of Power, clean fuel, chemicals**
  - **400MWe IGCC, >1 Million oil t/a**

Clean coal conversion technologies

Development Goals- Coal-liquefaction technologies

Deployment and complete sets of technologies on coal to oil (CTL)

- **Oil synthesis and modification processes, catalyst, reactor, control technologies**
- **Clean fuel，oil cost:30～35$/Barrel of crude oil**
- **By 2010, demonstration of 1M t/a direct liquefaction** and **0.2 million ton/a indirect liquefaction**
- **By 2020, industrialization of Coal to clean fuel**

Clean coal conversion technologies

Development Goals- Coal gasification technologies

R&D and Demonstration of a variety of coal gasification technologies

- **New coal-water slurry gasification technology, 2000t/d**
- **Dry pulverized coal pressurized gasification technology, 2000t/d**
- **Fuel flexible gasification technology，600t/d**
- **New gasification technology for High ash melting point coal**

Renewable

- Demonstration of 10MW biomass power generation technology
- Demonstration of 0.1million ton/a biomass to liquid fuel and conversion system
- RD&D of Wind turbine-generator （ >2MW ）
- Developing the technology of power generation from solar thermal power generation and build a 1MW demonstration system
- 1MW on-grid photovoltaic power plant systems
- RD&D of renewable energy and building integrated technology

New energy - Hydrogen and fuel cell

- Aim for application of hydrogen and fuel cell
- Hydrogen production ,transportation and storage technologies
- R&D on the key technologies of high capacity, high reliability, long life, low cost hydrogen fuel cells
- System integration technologies
- Application and demonstration of hydrogen technology , Formation of technical standards
- R&D of power products
- Accomplish RD&D of key technologies, then enter the stage of market intervention

New energy - Energy efficient and new energy vehicles

Most initiated the major project "Fuel Efficient and New Fuel Vehicle Project" under the National 863 Program in the eleventh Five-Year Plan period(2006-2010), input 1.1 billion Yuan of science and technology funding.

- **Developing the key technologies of fuel cell, hybrid, electric, gas and other vehicles;**
- **Developing the key components and assemblies of fuel cell, power battery, power motor, gas engine and others;**
- **Researching and establishing the policy, standard and test abilities related to new fuel vehicles;**
- **Introducing more new fuel vehicles to the market through large-sclace demonstrative and application operations.**

New energy - Energy efficient and new energy vehicles

During the 2008 Beijing Olympic Games and Paralympics, organized by MOST and Gov. of Beijing City, the Beijing Olympic Games Organizing Committee etc., about 600 environmental automobiles such as Electric vehicle, hybrid vehicle , fuel cell vehicle put into use for the transportation of the the Games of the XXIX Olympiad.

A total of 3.71 million kilometers run，tansport 4.41 million passenger trips，970 car trips of official duties。

Use of scientific and technological achievements and practical action to honor the Olympic Center Area Traffic "zero emissions"，in the central region of the surrounding areas and the Olympic transport priority routes "low emissions" commitments.

New energy - Energy efficient and new energy vehicles

The large-scale application and demonstration work of new energy vehicles are currently under way. MOST and the Ministry of Finance (MOF) have established standards and detection platforms, and have jointly issued papers on delivering subsidies in 13 pilot cities includes。 Beijing, Shanghai, Chongqing etc. The operation subsidy for a vehicle ranges from some 10,000 Yuan to some 600,000 Yuan.

Expected by 2012, promote the application of energy efficient and new energy vehicle about 60000, nearly 20 billion Yuan to expand sales。

十米以上城市公交客车示范推广补助标准（单位：万元/辆）

节能与新能源汽车类型	节油率	使用铅酸电池的混合动力系统	使用镍氢电池、锂离子电池/超级电容器的混合动力系统	
			最大电功率比 20%-50%	最大电功率比 50%以上
混合动力汽车	10%-20%	5	20	——
	20%-30%	7	25	30
	30%-40%	8	30	36
	40%以上	——	35	42
纯电动汽车	100%	——	——	50
燃料电池汽车	100%	——	——	60

公共服务用乘用车和轻型商用车示范推广补助标准（单位：万元/辆）

节能与新能源汽车类型	节油率	最大电功率比			
		BSG 车型	10%-20%	20%-30%	30%-100%
混合动力汽车	5%-10%	0.4	——	——	——
	10%-20%		2.8	3.2	——
	20%-30%	——	3.2	3.6	4.2
	30%-40%	——	——	4.2	4.5
	40%以上	——	——	——	5.0
纯电动汽车	100%	——	——	——	6.0
燃料电池汽车	100%	——	——	——	25.0

New energy - Nuclear

- Introducing 3rd generation nuclear power plant technology and make preparations to develop 4th generation advanced nuclear technology
- R&D key technologies on high temperature air cooled reactor, pressurized-water-reactor, fast neutron reactor, fusion, nuclear safety and fuel recycle utilization etc.
- Installed power capacity reaches 40 GW by 2020
- Industrial application of the 4th generation nuclear system by 2030

Energy equipment technology - Heavy and light duty gas turbine

- Heavy duty gas turbine

  - R0110 gas turbine integrated system design, commissioning and operation

- Micro gas turbine and energy supply system

  - 100kW gas turbine key technologies

  - Operation of combined cooling, heating & power (CCHP) demonstration unit

Power Transmission and energy saving technology

- Power transmission and distribution technologies
  - RD&D of ultra-high voltage power transmission system
  - Flexible power transmission system
- Energy saving technologies
  - Large scale air cooling technology
  - Evaporative cooling technology for power generator
  - Demonstration of energy saving technology for in service coal-fired power plant
  - Demonstration of ultra supercritical unit which is suitable to Chinese coal
  - Coal-fired power plant flue gas and solid waste highly efficient treatment and utilization

Carbon capture and storage (CCS)

- **National Key Technology Program**
  - During the 10th five-year period, supported strategic studies on CCS, emphasis is placed on the applicability of CCS in China, and its impact on energy system and GHGs emission reductions.
- **National Basic Research Program (973 Program)**
  - 4 major projects are developed
    - Research on enhancing oil recovery, use as resource and storage of GHG
    - Basic Research of Polygeneration System with syngas co-produced from coal gas and coke oven gas
    - Basic research of high efficient catalytic conversion in reforming reaction of natural gas and syngas
    - Research of thermal-to-power conversion processes in gas turbine
  - In the following years during 11th Five-Year Plan period, the 973 Program will emphasize on the basic theory of CO_2 long term storage, high efficiency and cost effective separation, new theory and method of transportation, etc.
- **The National High Tech Program(863 Program)**
  - 863 Program will also support the development of CCS technology.
  - Project is under design now and will be implemented in the 11th Five-Year Plan period.

Carbon capture and storage (CCS)

- CCS, with significant potential for GHG reduction, is a strategic high technology in the long run. R&D should be continually strengthened to promote and improve CCS technology .
- Given the high cost and energy penalty of the large-scale deployment, the main effectiveness of CCS is mitigating GHG reduction. Now, CCS can NOT become the priority area in developing countries.
- Positive efforts have been made by international society concerning development of CCS technology. In the future, further enhancement of international collaboration on CCS should be strengthened, especially the establishment and improvement of the financial mechanism in promoting the development of CCS technology, so as to jointly promote technology transfer and the development of CCS technology.

Major achievements of advance energy technologies in the eleventh Five-Year Plan period(2006-2010)

Fossil Energy：

- 200MWe IGCC demonstration plant
- 0.1～1 million tons demonstration system of gasification-based co-production system of CTL and power
- 2000t/d scale demonstrations on new type of entrained bed coal gasification technologies
- Several low-cost, high-efficiency coal burning pollutants control technologies and equipments

Renewable Energy

- volume production of 1~2 MW wind generators
- design and production of 2~3 MW offshore wind generators
- 1MW tower solar thermal test/demo. power station
- complete production line of annual product 5MW copper indium selenide, cadmium telluride film cell equipments
- 500 kW dye-sensitized nano film solar cell pilot production line

Nuclear

- prototype of fast neutron reactor design & construction standard, construction, debugging and reaching critical state

5、 Co-operation and prospects

Co-operation and prospects

- Similar to China, above 50 percent of electricity are from coal and oil heavily relies on import in the United States. It is our responsibility and obligation to do our contribution to the energy , economy and environment development of the world.
- Energy industry is technology-intensive, capital-intensive, industry-intensive and talent-intensive, which involves a number of technology fields. The orderly development of energy S&T and industries is a issue the world is facing today. MOST of China expects and is willing to communicate and cooperate with international colleagues extensively and deeply.

Co-operation and prospects

- China and US have established a good cooperation foundation on several fields including clean coal power, coal to liquid, energy environment and economy, CCS, etc., based on the China-US Cooperation Agreement on Fossil Energy. The two countries should keep and deepen their cooperation in energy sector.
- We only have one earth, so that we should firm our input and attitude to cooperate on coping global climate change. Chinese companies are actively working on practical issues based on the technical experiences from US. The S&T cooperation between the two countries should be more specific.

Thanks !