

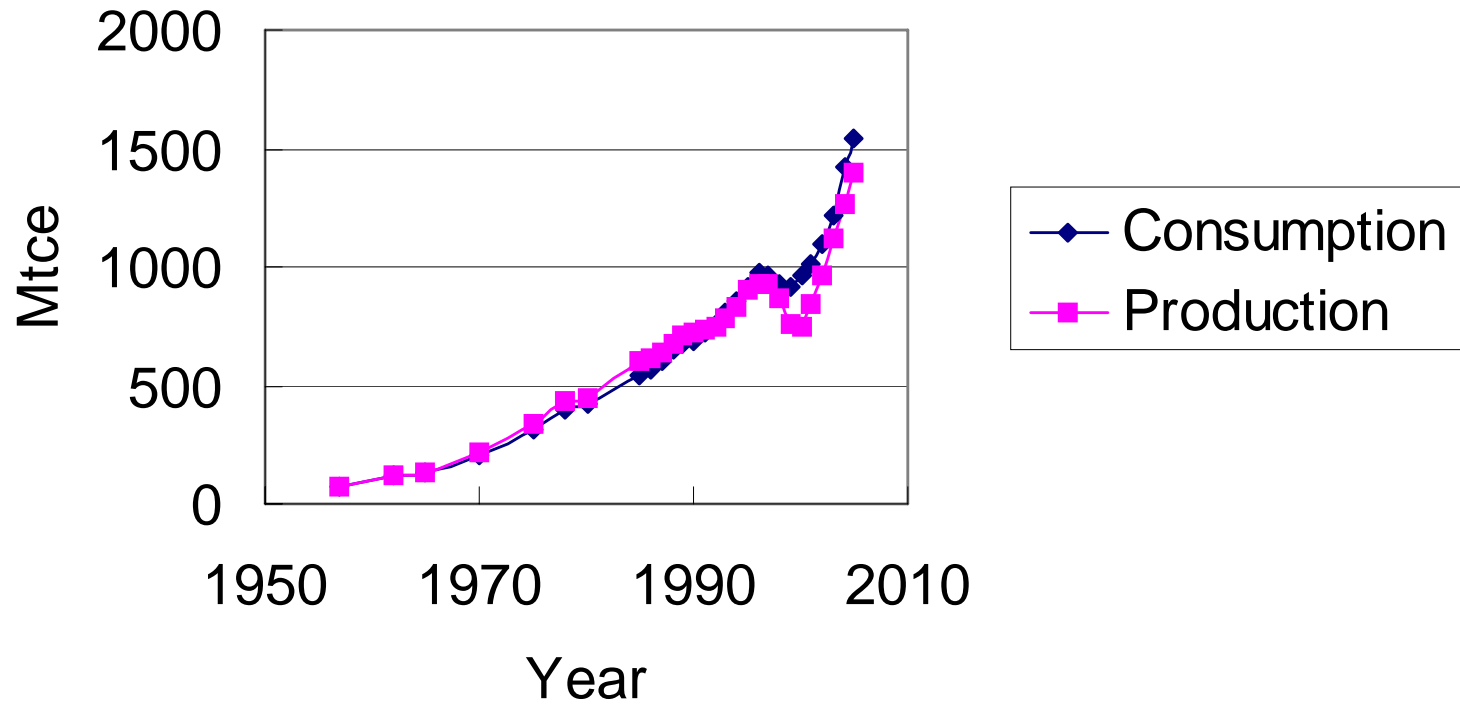
Sustainable Development and Clean Coal: Case Study from China

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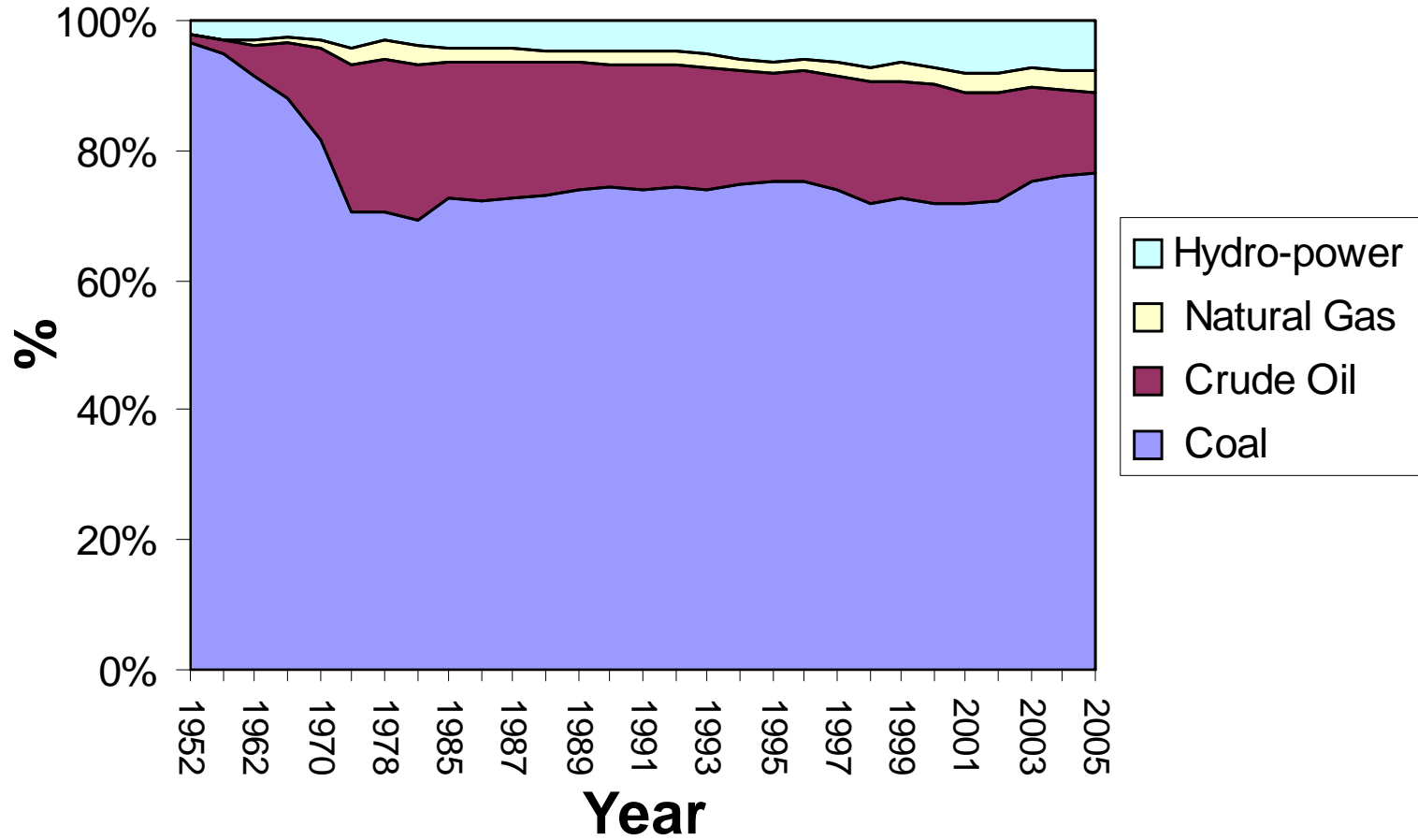
Energy Research Institute, China

**The Workshop on Balance Energy, Development and Climate
Priorities, Guohong Hotel, Beijing, 18 December 2006**

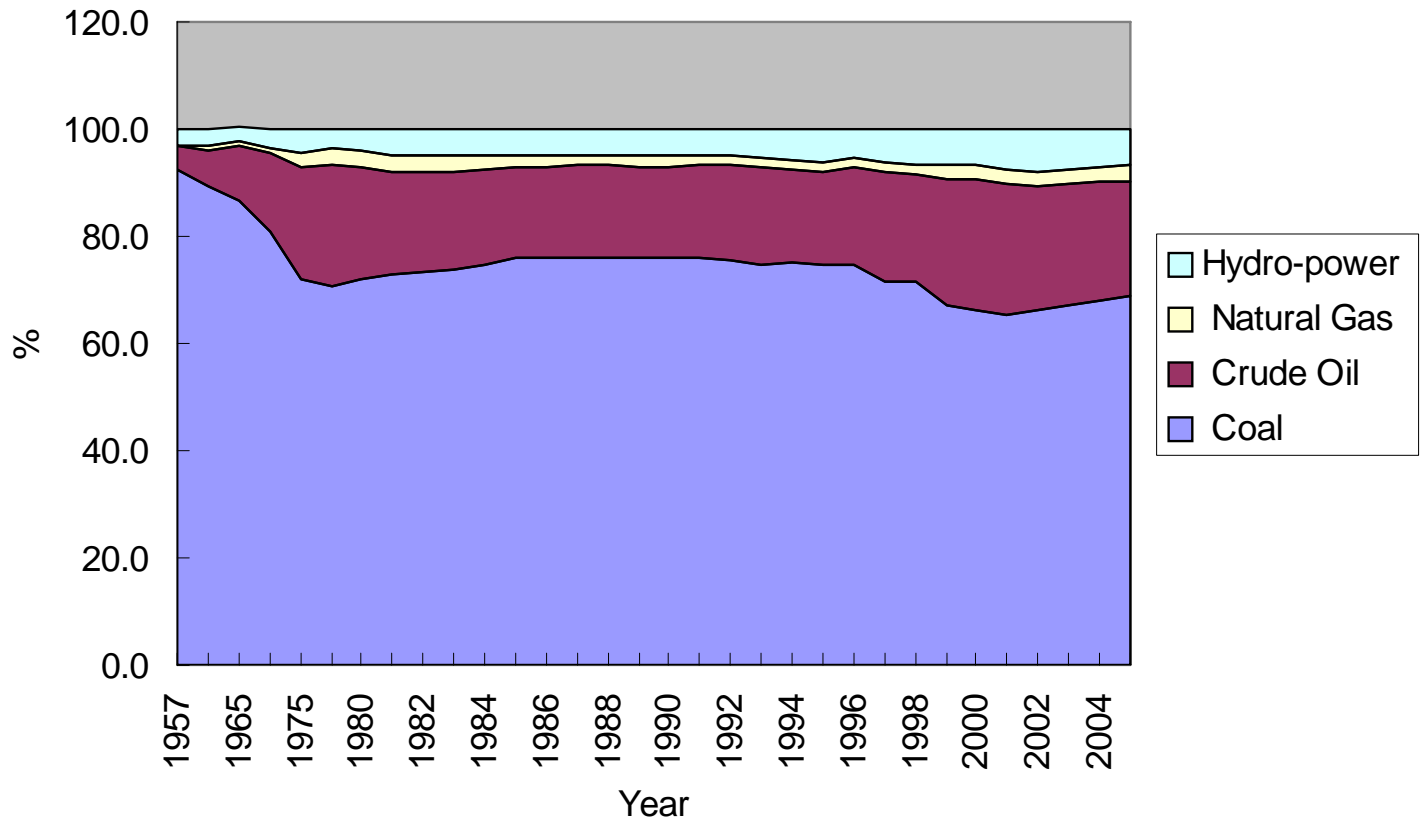
Energy Production and Consumption in China 1957-2005



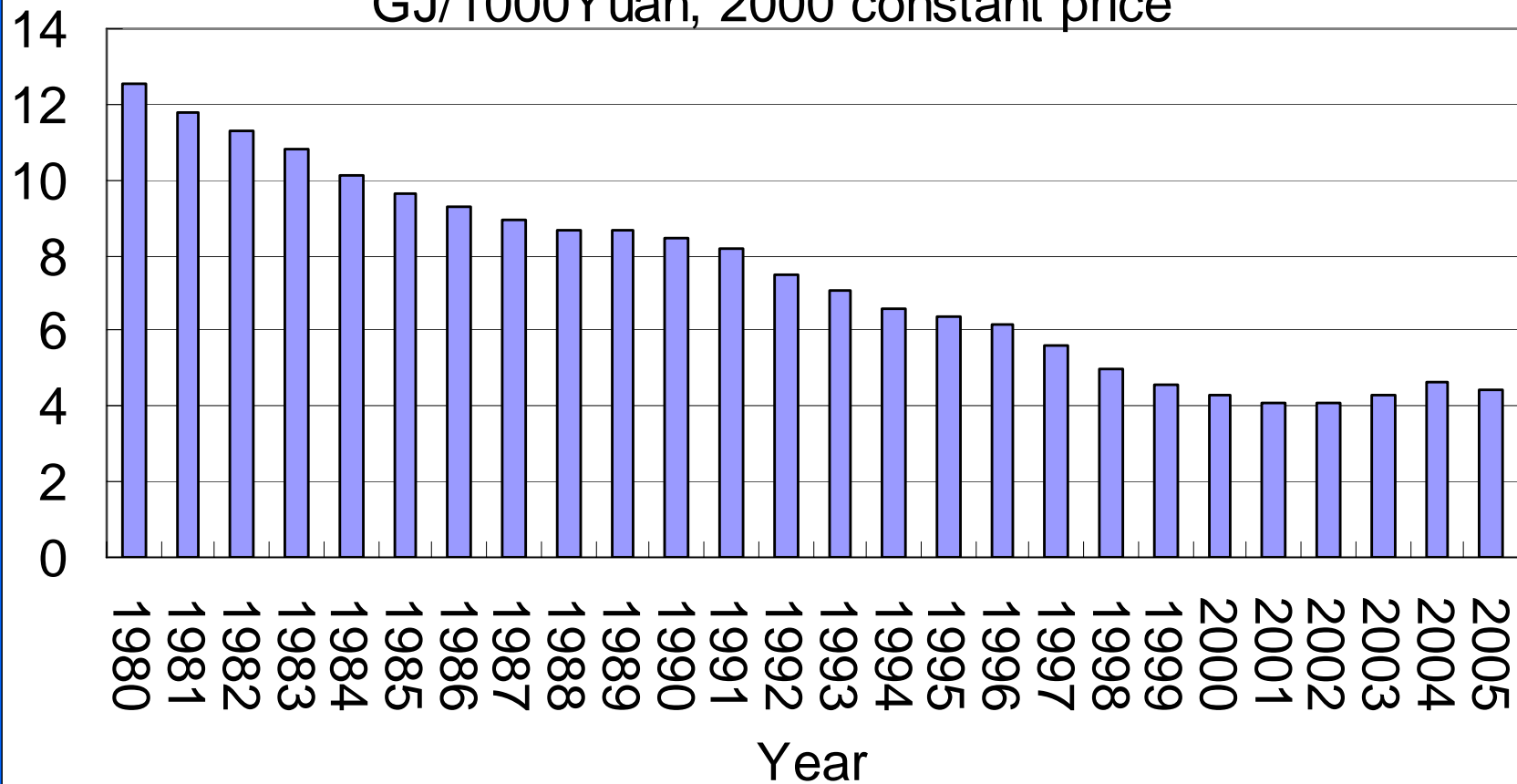
Energy Production Mix in China



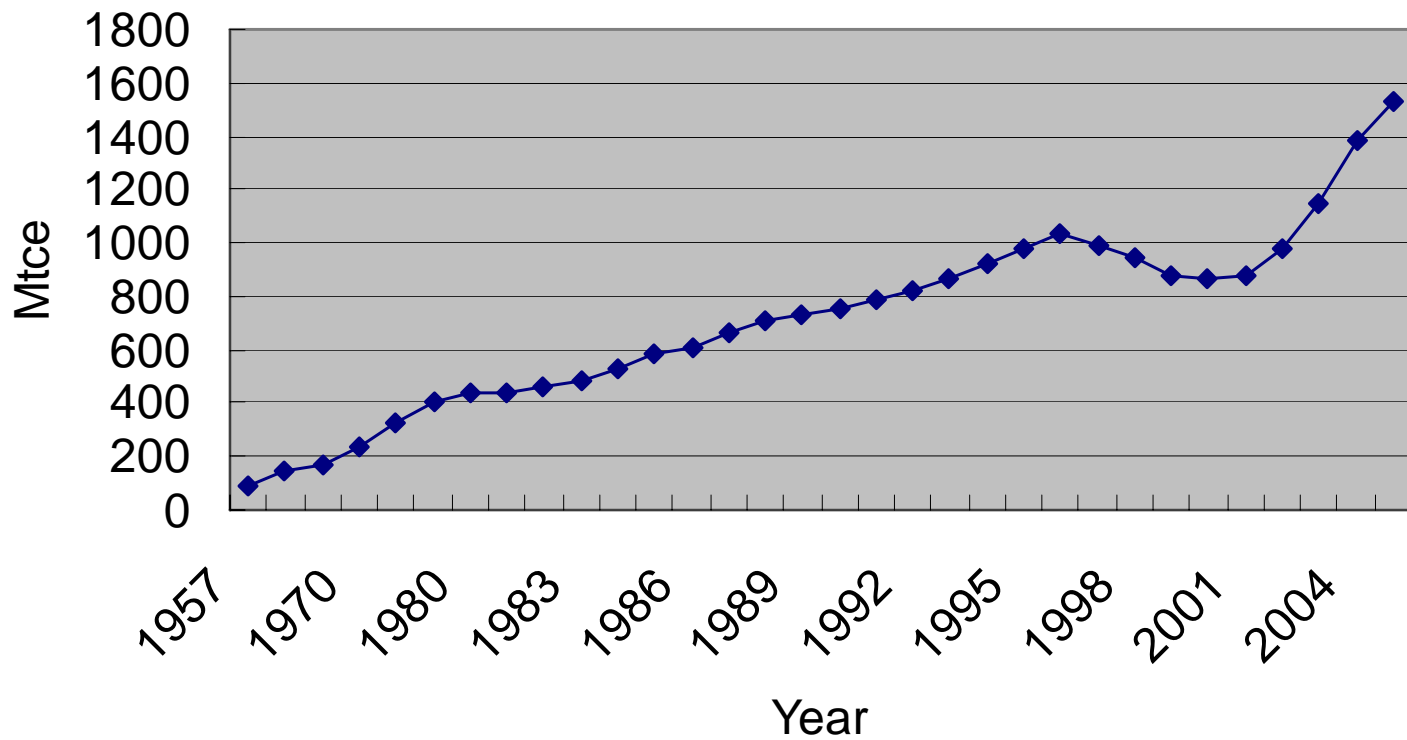
Energy Consumption Mix in China, 1957-2005



Energy Consumption per unit of GDP GJ/1000Yuan, 2000 constant price



Coal Consumption in China



Energy Policies: After 2003

Energy issue is becoming crucial concerning of government, because:

- Sustainable development is an important voice in recent years; circular economy is widely accepted
- Widely spread energy shortage: power shortage in 24 provinces in 2004; Gasoline shortage in Guang Dong province in 2005
- Environment target was not reached in 10th Five Year Plan, energy is key driving force
- Accident in coal mine is widely known by public, and major concerning of government on improving life and working standard of rural employees
- Energy price increase is getting much more attention on energy

Energy Policies: After 2003

National laws and plan

- Long- and Medium-term Energy Conservation Plan, with much more concrete content, 2004
- Renewable energy law: renewable energy target by 2020, 2005
- 11th Five Year Energy Plan: National energy intensity target(20% energy intensity reduction in 2010 compared with that in 2005)

Standard and regulation

- Vehicle fuel efficiency standard
- Strictly implementation of building energy standard in many provinces and cities
- Implementation of energy label of electric appliances
- Release control on coal price for all users
- Higher consumption tax for larger engine vehicles

Energy Policies: After 2003

Administration

- Establish energy leading group
- and office for the leading group was formed, similar size with energy bureau, to take over energy strategy and policy in China

Energy Policies: After 2003

What's going on:

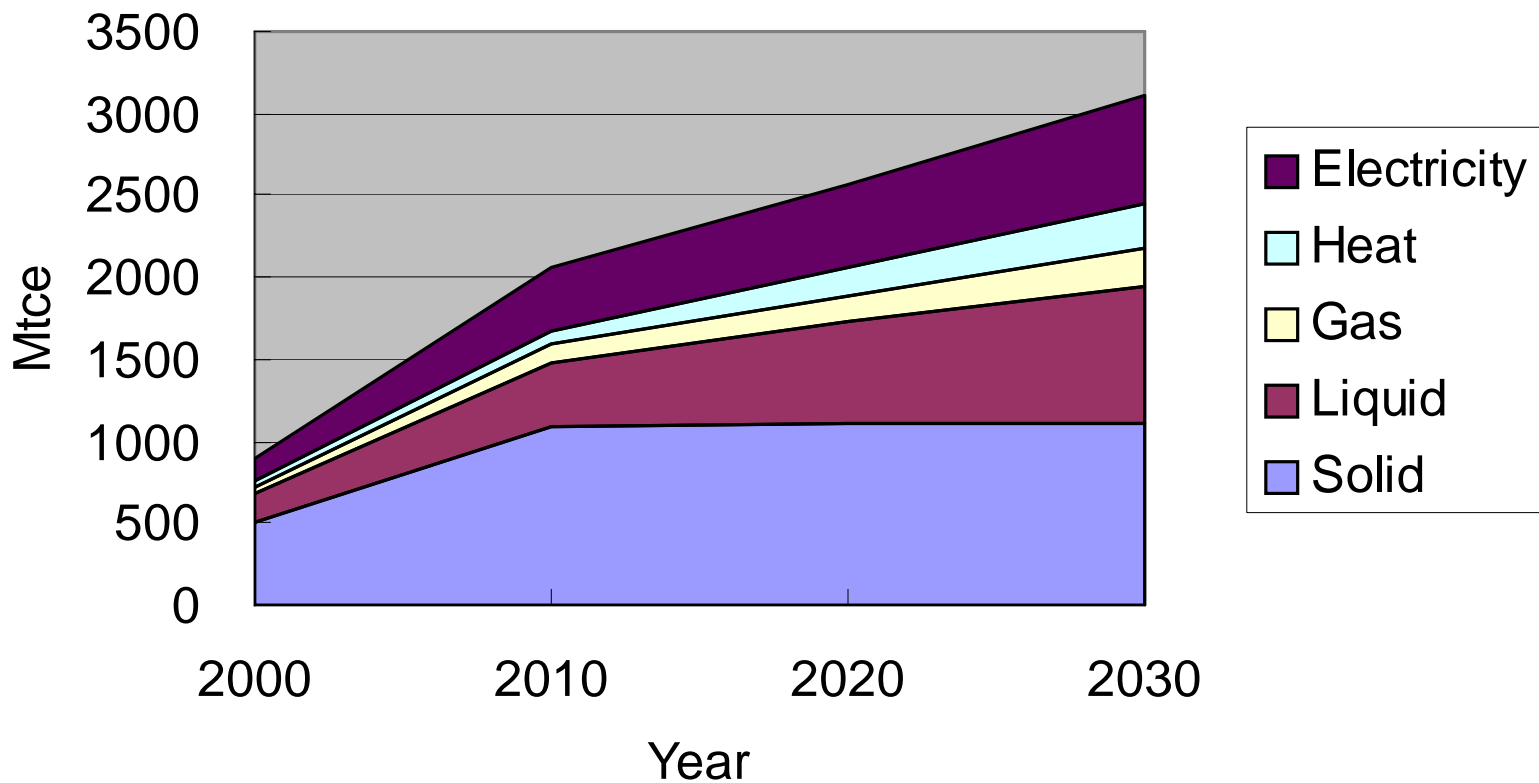
- Draft Energy Law
- Revise Energy Conservation Law
- Draft Oil and Natural Gas Law
- Renewable energy development plan up to 2020

- Implement fuel tax
- Second vehicle fuel efficiency standard
- Renewable energy

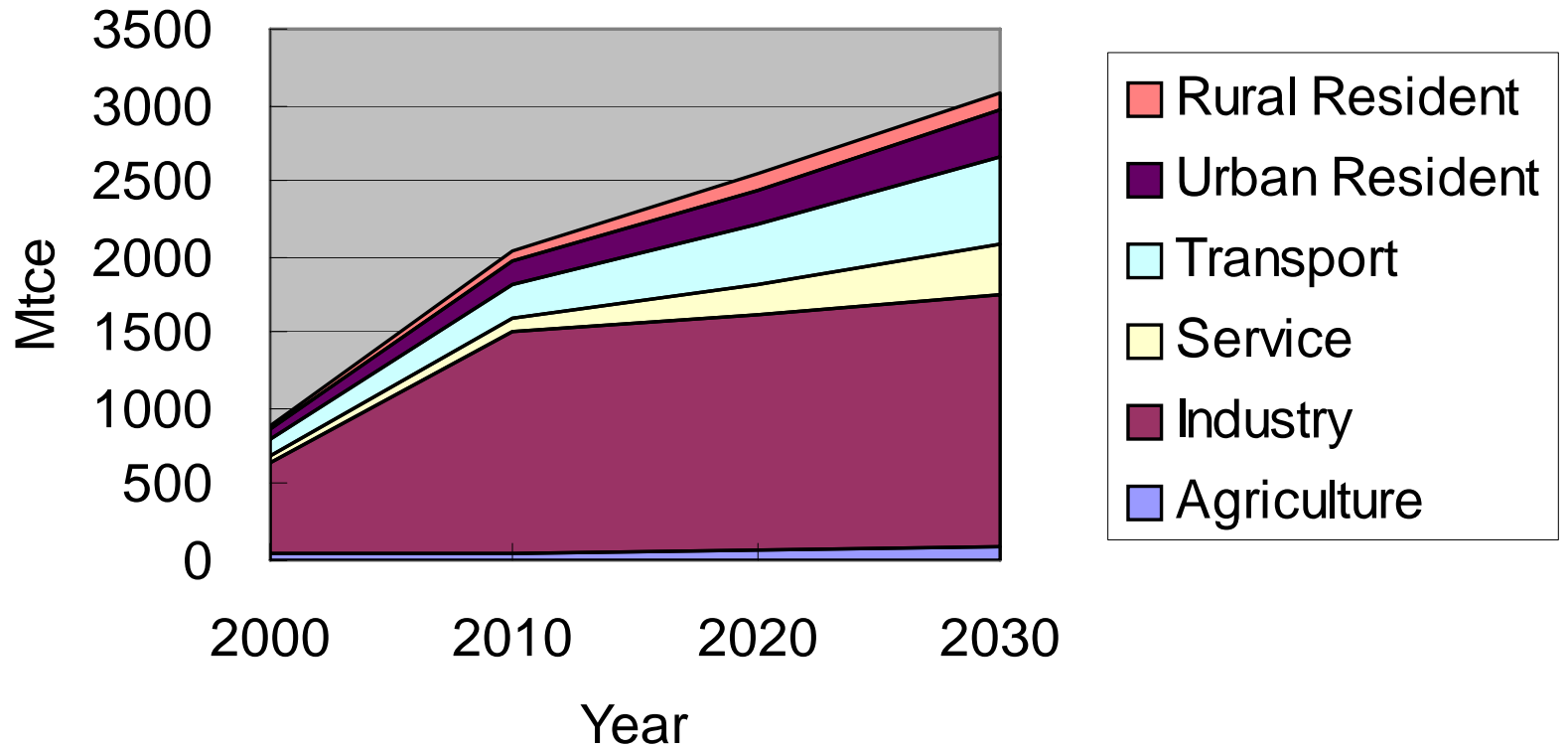
- Energy reporting by government officials
- Energy monitoring for 1000 large energy users

- More than 500 energy conservation projects, in 11th five year plan

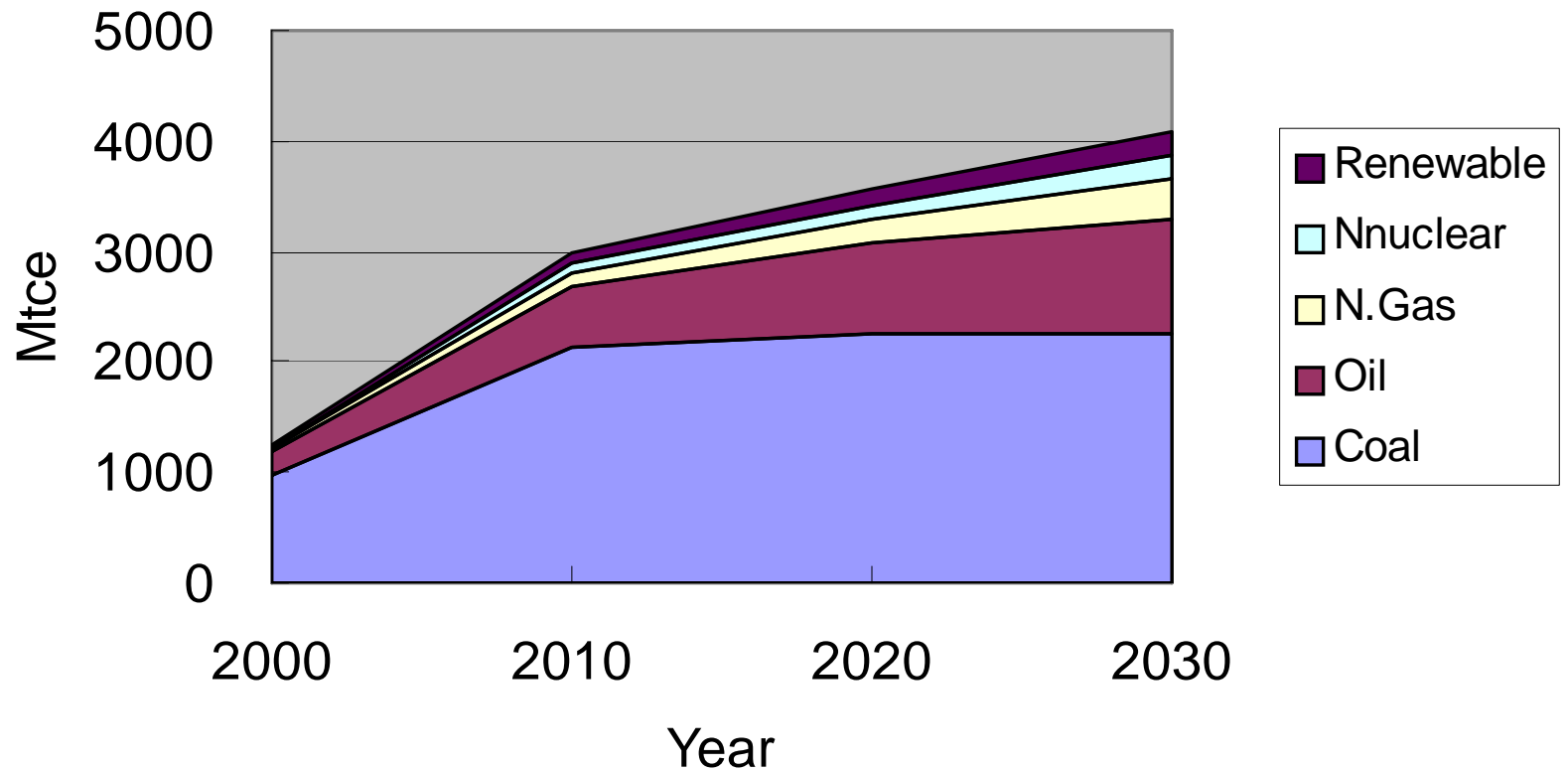
Final Energy Demand



Final Energy Use by Sectors



Primary Energy Demand in China: Baseline



Clean Coal Technology: Global Progress

- ✓ In 2000, Version 21 program in United States
- ✓ Early Entrance Co-production Plant(EECP), 2007
- ✓ Pilot phase plants on LPMEOH and LPDME, which are the technologies to produce methanol, Dimethyl Ether, and co-generation. These plants were constructed in 1997
- ✓ Coal integrated generation system by Some famous international companies including BP, GE, Air Products and Chemicals, Shell
- ✓ Investment for clean coal technology R&D is decreasing in Europe due to less use of coal, even in United States

Clean Coal Technology: Progress in China

- ✓ Coal washing: in 2003, coal washing rate is only 24%, remain very low washing rate
- ✓ Coal-Water mixture: There are huge development of coal-water mixture in China. In 1999 the production capacity was less than 900 thousand ton. The production capacity increased to be nearly 7 million ton in 2003
- ✓ Industry briquette: because of high price, progress of industry briquette is slow. Recently air pollution issues raised the possibility to use more industry briquette
- ✓ Ultra-super critical unit: 1GW unit is under construction in Yuantian Power Plant, which started construction in 2004 and will be in operation in 2007. This is one component of National 863 Project

Clean Coal Technology: Progress in China(conti.)

- ✓ IGCC: Project feasibility study was done for Beijing IGCC project and Yantai IGCC project during 1995 to 2000. And now four IGCC project is planned and will start construction soon.
- ✓ Underground coal gasification: Shan Dong Lineng Group made plan for a pilot phase project on underground coal gasification. This project includes four gasification furnace with total capacity 3million m³ per day
- ✓ Poly-Generation: in 973 Program, a preliminary analysis was conducted. 4 to 5 projects are under construction and will start production in 2007 to 2009

Clean Coal Technology: Progress in China(conti.)

- ✓ **Direct Coal Liquefaction:** In 2002, shenhua Direct Coal Liquefaction project was approved by State Council and started construction. This project is expected to start production in 2007. Fundamental research for direct coal liquefaction is taken by research institutes such as China Coal Research Academy
- ✓ **Desulphurisation:** with recent rapid increase of coal fired power plants, newly construct coal fired power plant with sulphur content higher than 1% equipped with desulphurisation technology. And due to air pollution in cities, some existing coal fired power plants near cities also started to equip with desulphurisation equipments
- ✓ **Low Nox Combustion technology:** still in research process. One pilot project is under construction. As research project, more then ten units equipped with low Nox combustor

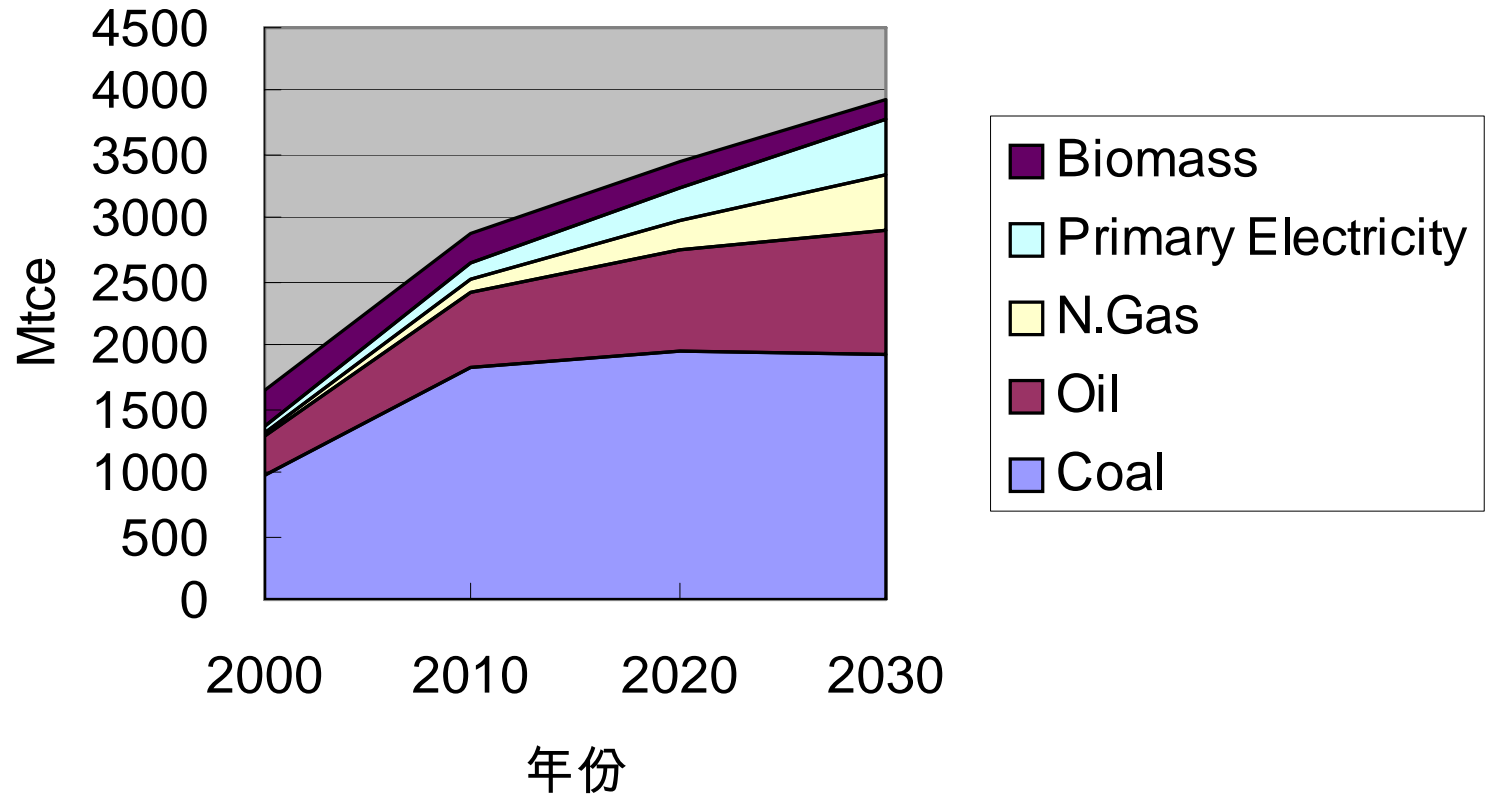
Clean coal technologies in baseline scenario

Sector	Technology	Share in 2030
Power generation	Super Critical	25%
	IGCC	4%
Industry/Boiler	Advanced boiler	45%
Industry/Kiln	Advanced kiln	38%
Coal processing	Coal liquefaction	2% of total coal
Desulfurization in power plants		58% of total coal fired power plants

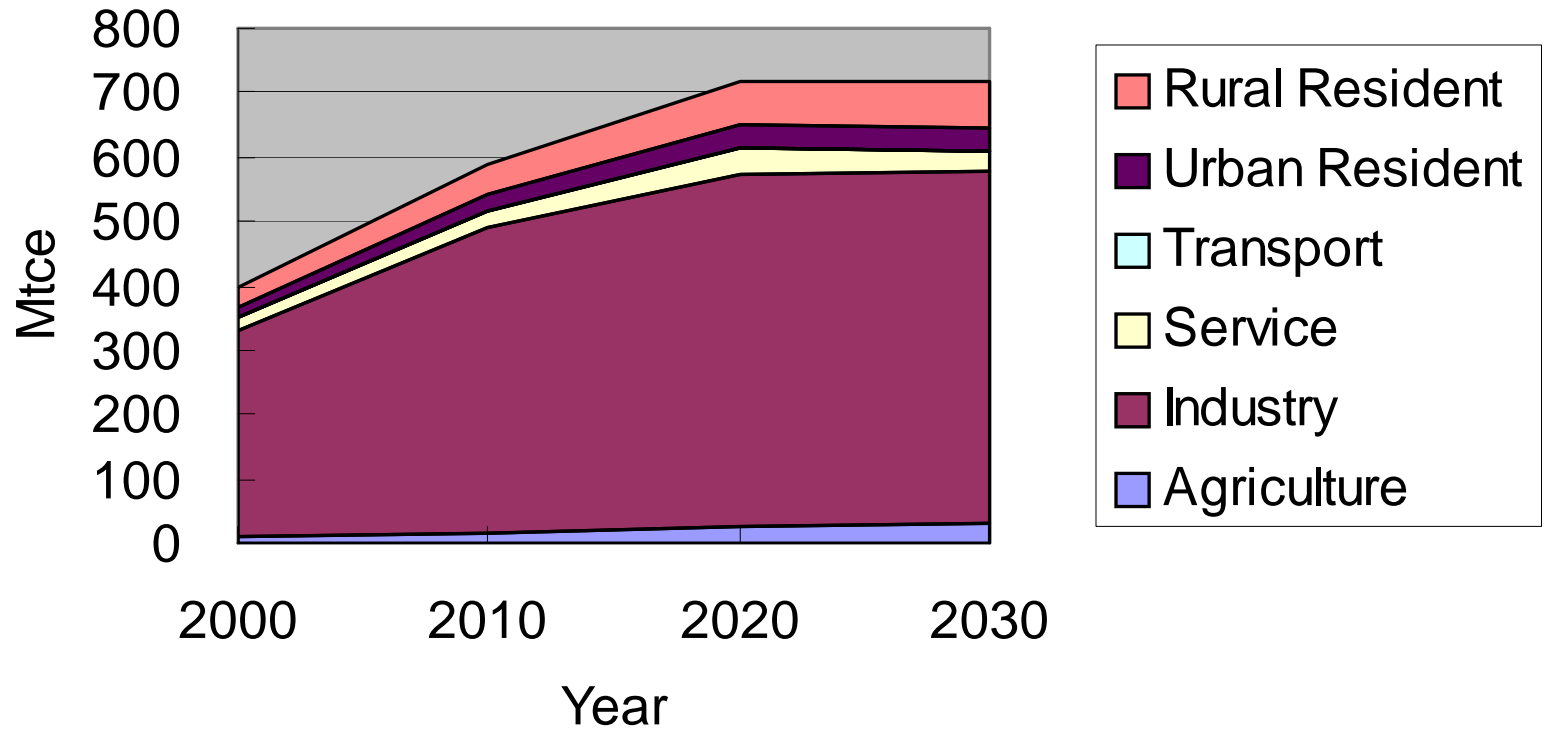
clean coal technology in policy scenario

Sector/Process	Technology	Share in 2030
Power generation	Super Critical	25%
	IGCC	30%
Industry/Boiler	Advanced boiler	75%
Industry/Kiln	Advanced kiln	70%
Coal processing	Coal liquefaction	10% of total coal
Desulphurisation in power plants		80% of total coal fired power plants

Primary Energy Demand, Policy Scenario



Coal Use by Sectors, Policy Scenario



Profit to develop clean coal technologies

- Increase energy security: self-supply of energy 93% in 2005. In 2030, self supply will be 76% in 2030 in baseline scenario, 77% in policy scenario, with smaller import.
- Fundamental industry in China with large employment: 7.6 million employees in 2004, 7.8million in 2030. Important thing is this is good for low income people to fine opportunity
- Extend economy activities. Taking lead for clean coal technology in the world will bring economy benefit. Three power equipment companies in China is becoming among top manufactures in the world in 2005(largest power capacity suppliers for coal fired power plants), and started to export advanced coal fired power plants.

Profit to develop clean coal technologies(Conti.)

- Very good environment effects. SO₂, NO_x, PM emission, water pollution will be significantly reduced by using clean coal technologies, also very important for GHG emission reduction. Clean coal technology development will be crucial for government environment target in 11th Five Year Plan
- Contribution to global climate change collaboration. Asia-Pacific Partnership on Clean Development and Climate, China-EU Partnership on Climate Change have component of clean coal technology collaboration

Factors for coal related activities

		2005	2010	2020	2030
Total Primary energy demand	Million toe		2040	2450	2960
Coal use	Million	2165	2791	2896	3102
Production	Million	2204	2840	2880	3010
Output value	Billion Yuan	645	867	945	1073
Value added in coal mining and	Billion Yuan	314	422	460	523
Share of GDP	%	1.70%	1.50%	0.80%	0.50%
Employee in coal mining and	Million	7.8	7.7	6.3	5.2
Death of worker in coal mine	Person/M-t	2.8	2.6	2	1.1
Value added of Coal fired power manufacture	Billion Yuan	21.6	29.8	37	43
Coal fired power manufacture output	MW	5819	6320	6900	6900
Employees in coal fired power	Person	236400	250000	240000	210000

Technology is moving fast: coal fired power plants

- Super-Critical Generator is major power generation technology in China for new power plants
- There are more than 10 ultra-super critical units under construction
- Four IGCC under planning and start construction next year

