Trends of China's Comprehensive Energy and Environment Package and Japan-China Cooperation

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1. Trends of Economy, Energy and Environment

★ Views on Economic Growth

Annual economic growth averaged 9.9% for 1980-2007 and remained above 10% for five years from 2003

●Growth target under 11th 5-year plan: 7.5% for 2006-2010 Expectation

☆Higher growth For example, ERI projects growth at 8.5%

Li's projection (2004-2030): 6.5% (9.7% for 200-2010, 6.1% for 2010-2020, 5% for 2020-2030) in reference scenario, 7.6% in higher growth scenario, 5.4% in lower growth scenario

★ Energy Supply/Demand Trends

●Fast-expanding demand: 1.5 billion toe in 2005 ⇒ **3.3 billion toe in 2030**

●Production will be limited under constraints concerning resources, transportation capacity, the environment, water, food, etc.

⇒☆**Stable energy supply and energy security problems will grow more serious**

See appendix for details

★ Trends of Environmental Problems

●A rapid shift away from fossil energy including coal will be difficult

⇒**Air pollution, acid rain and rapid CO2 emission growth are emerging**

2. Present Situation and Challenges for Comprehensive Measures

2.1 Economic Development Strategy Shift

- **Strategy shift**: From economic growth supremacy to overall harmony and sustainable development
- **Introduction of binding targets for which the government is responsible:** In energy conservation, environmental problems, social security and other areas where it is difficult for the market mechanism alone to achieve targets.
- **Improvement of plans' feasibility:** Preparation of sector-by-sector plans and implementation of specific plans are faster and more consistent than ever. Achievement of energy conservation and environmental targets has been designated as a decisive factor in assessment of responsible officials' performances. ("veto on one count" (yipiaofoujue) system).

2.2 Energy Measures

2.2.1 Features of Energy Measures (should be rated high)

- **China aggressively introduces any measures that are demonstrated as effective in industrial countries.**

  Energy conservation, renewable energy development, oil security system development, quality improvement

- **From a long-term perspective, China courageously tackles development of technologies that are not comparatively advantageous for China.**

  Coal liquefaction, vehicle fuels such as ethanol and DME, fuel cell vehicles

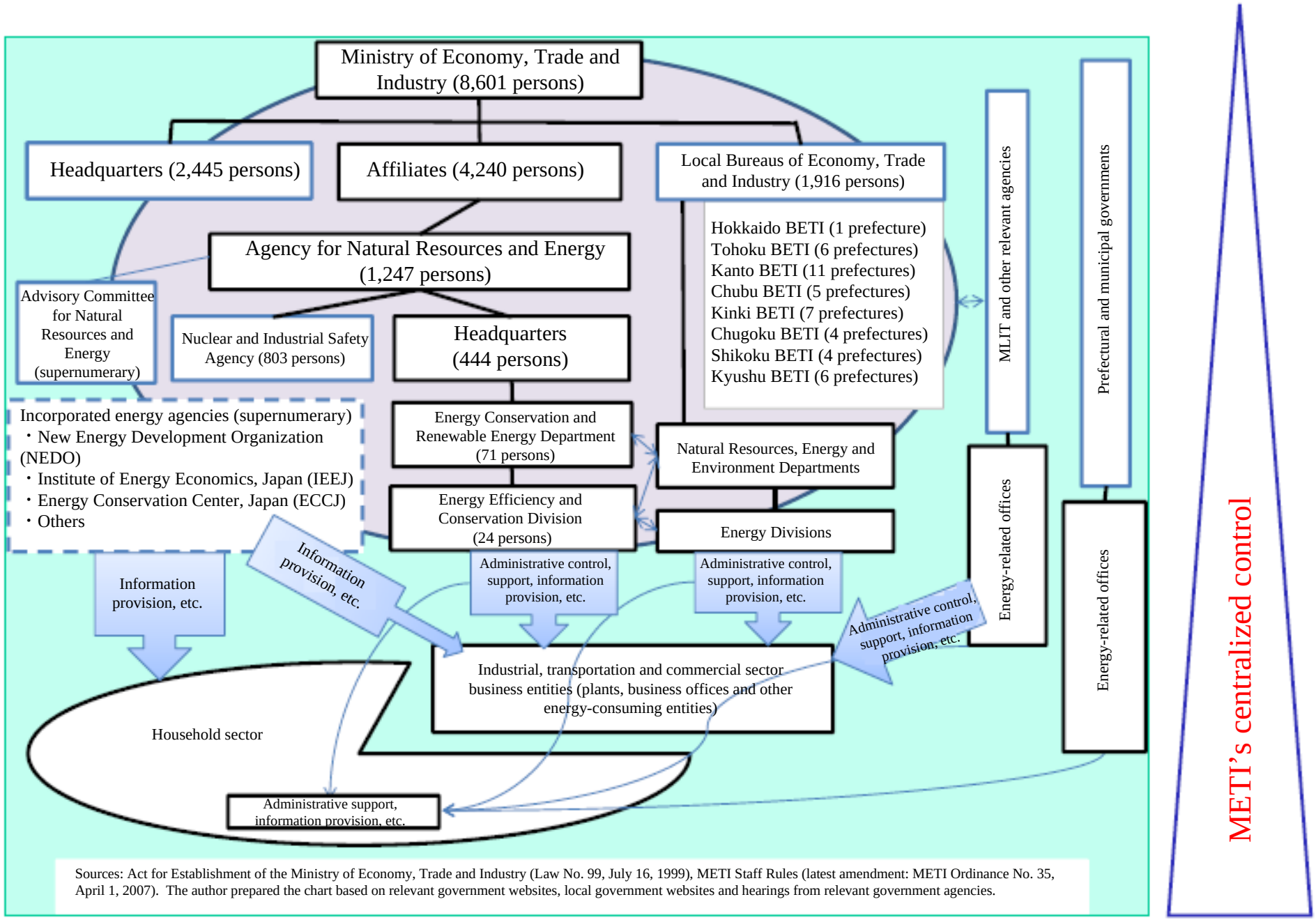
- **China positively attempts measures that meet the realities and characteristics of China.**

  Farming villages should be provided with biogas and electricity generated by distributed wind power and photovoltaics

2.2.2 Problems with Energy Measures

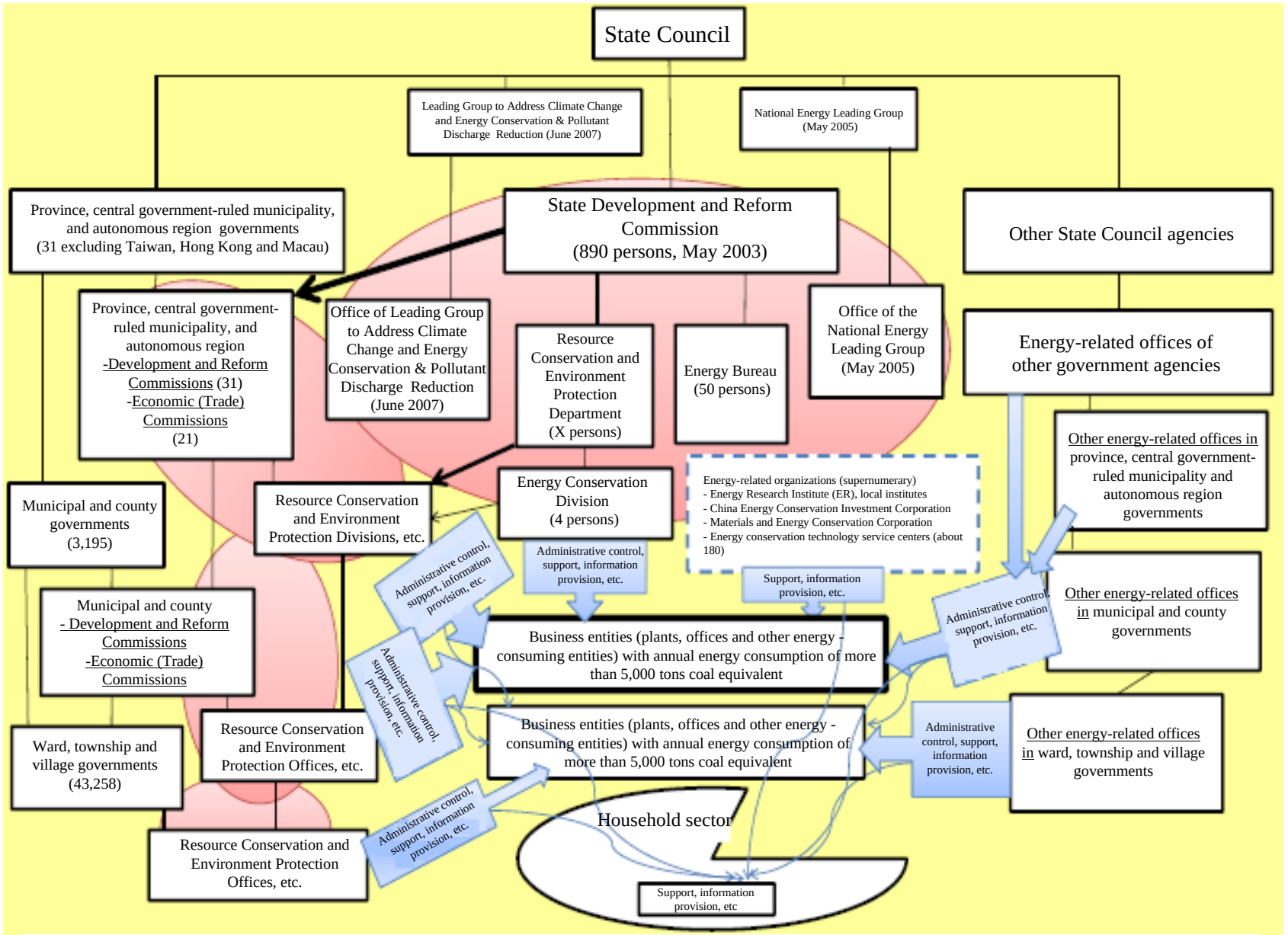
- **<Universality> Deficient legal systems, absence of economic incentives, price control, belated technologies**
- **<Characteristics> Problems with administrative management arrangements**: Although the State Council established the National Energy Leading Group in 2005 and the National Leading Group to Address Climate Change and Energy Conservation & Pollutant Discharge Reduction in 2007, no comprehensive energy agency exists in China. (The State Development Reform Commission has 890 officials.)

<Example>: Administrative Organization (administrative control system) --Japan



Sources: Act for Establishment of the Ministry of Economy, Trade and Industry (Law No. 99, July 16, 1999), METI Staff Rules (latest amendment: METI Ordinance No. 35, April 1, 2007). The author prepared the chart based on relevant government websites, local government websites and hearings from relevant government agencies.

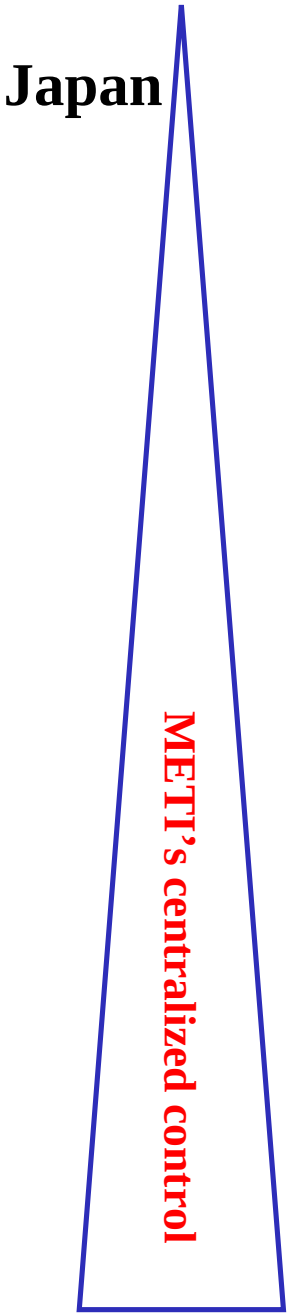
<Example>: Administrative Organization (administrative control system) --China



Sources: Major Duties, Organization and Staff Rules for the State Development and Reform Commission, (State Council Order No. 27, 2003); Energy Conservation Law (established on November 1, 1997, amended on October 28, 2007); Local People's Congress and Government Organization Law (latest or 4th amendment on October 27, 2004); Ordinance on Establishment, Organization and Control of Local People's Governments (State Council Ordinance No. 486, 2007). The author prepared the chart based on websites of relevant government agencies and local governments and on hearings from relevant agencies.

Hierarchical decentralized control under State Development and Reform Commission

<Example> Administrative Organization (administrative control system) –Japan-China comparison



Japan	China	
	Until March 31, 2008	From April 1, 2008
METI's centralized control	Hierarchical decentralized control under a main relevant organization	Hierarchical decentralized control under a main relevant organization
Minister of Economy, Trade and Industry (or Director-General of the Agency for Natural Resources and Energy, or Director-General of the Economic and Industrial Policy Bureau): Overall energy administration	State Council, and people's governments of provinces, autonomous regions and central government-ruled municipalities (Promotion of energy-saving economic development)	State Council, and people's governments of provinces, autonomous regions and central government-ruled municipalities (*Preparation and implementation of annual and medium to long-term energy conservation plans*)
	State Council agencies in charge of energy conservation (nationwide control and administration regarding energy conservation)	State Council agencies in charge of energy conservation (nationwide *and other government agencies'* control and administration regarding energy conservation)
Minister of Land, Infrastructure, Transport and Tourism: Energy administration regarding part of transportation industry, part of buildings, and vehicle performances	Relevant State Council agencies (nationwide control and administration regarding energy conservation in relevant sectors)	Relevant State Council agencies (nationwide control and administration regarding energy conservation in relevant sectors)
	County-level and higher-level local people's government agencies in charge of energy conservation (control and administration regarding energy conservation under their jurisdictions)	County-level and higher-level local people's government agencies in charge of energy conservation (control and administration regarding energy conservation under their jurisdictions)
Prefectural and other local government heads: Energy administration regarding owners of non-residential buildings	County-level and higher-level local people's government agencies related to energy conservation (control and administration regarding energy conservation in sectors and regions under their jurisdictions)	County-level and higher-level local people's government agencies related to energy conservation (control and administration regarding energy conservation in sectors and regions under their jurisdictions)
		An energy conservation target responsibility system and an energy conservation assessment and evaluation system have been introduced for local governments and their officials in charge of energy conservation.
	Note: Major Duties, Organization and Staff Rules for the State Development and Reform Commission, (State Council Order No. 27, 2003) provides resource conservation as a duty of the State Development and Reform Commission.	

Source: The author prepared the table based on energy conservation laws and relevant ordinances, government ordinances, organization laws, relevant websites, literature and hearings in Japan and China.

2.2.3 Energy Strategy Concept

Problem: Lack of comprehensive package system ← Absence of any energy agency……

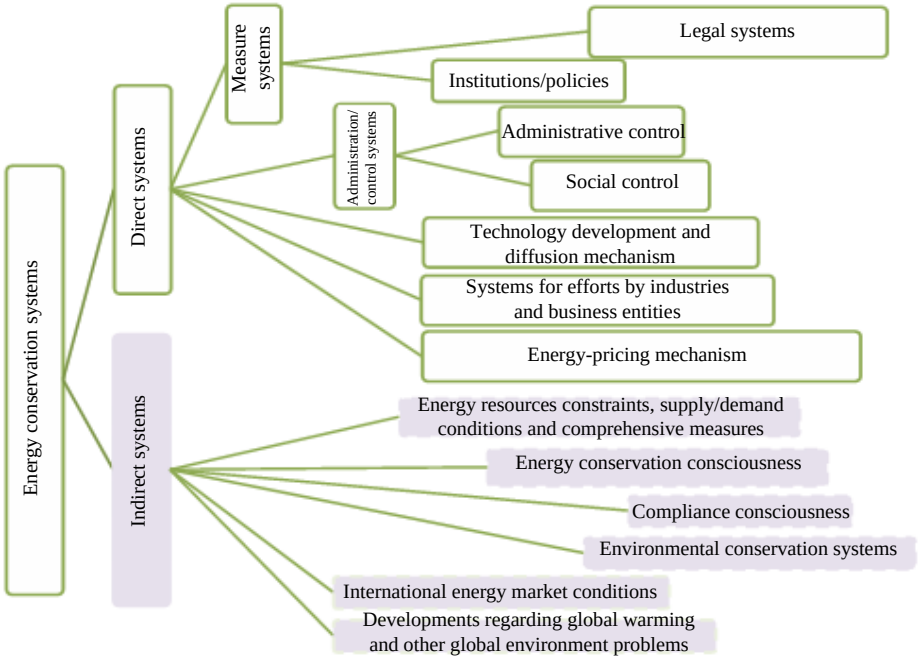
(The State Council Energy Leading Group was created in 2005, and the National Leading Group to Address Climate Change and Energy Conservation & Pollutant Discharge Reduction was established in 2007.)

Solution: ① Creation of a comprehensive energy agency

② Development of a comprehensive system to simultaneously achieve "stable energy supply, environmental conservation and economic efficiency"

Simulated effects of policy measures

	Promoting energy conservation	Enhancing non-fossil fuel	Expanding gas-fired power generation	Adjusting transportation structure	Introducing environment tax
Energy consumption reductions, SO2 and CO2 emission cuts	Very effective	Very effective	Very effective	Effective	Very effective
Energy import reductions, energy security	Very effective	?	-?	Very effective	-?



＜Energy Strategy Concept＞

Promoting energy conservation as national policy：

Technology development, industrial structure adjustments,
promotion of public transportation, price adjustments,
utilization of economic measures, legal system development, etc.

Rebuilding energy conservation systems

Enhancing energy structure adjustments：

Promoting development and utilization of renewable energies, hydrogen fuel cells, etc.

Building energy security arrangements:

Introducing diverse oil security measures simultaneously

Food-based fuel alcohol: A cautious approach is required
Coal liquefaction: A cautious approach is required
Environment tax: A cautious approach is required. If the tax is introduced, part of relevant revenues may be earmarked for financing energy security measures

Promoting utilization of internationally commercialized clean coal technologies: processing, desulfurization, power generation

Note：Technologies that cannot be commercialized should be subjected to technology reserves for enhanced research and development.

★Designing Oil Security Measures: “Diversification” and “joint security” are the key

Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Stage 6
Self Strength: Supply-side Security Measures	Domestic resources	Enhance exploration	Resources preservation	∗ Limited stockpiling facilities in oil-rich countries. Reserves are equivalent to consumption for 57 days in Britain, 74 days in the U.S. and 163 days in Japan.	
			Production management	∗ Price competition and social costs	
	Overseas resources	Development & import	Crude oil	∗ Procuring crude oil from overseas for domestic refining. Development and import projects' share of crude oil imports: 77% for France, 35% for Italy, 22% for Germany, 15% for Japan	
			Petroleum products		
		Trade & import	Crude oil	Long-term contracts	∗ Securing stability
				Spot market procurement	
			Petroleum products	Long-term contracts	∗ Domestic refining secures economic and social effects
				Spot market procurement	
	Strategic reserves	Resources preservation			
		Stockpiling facilities	National reserves	Crude oil	∗ 85 days in Japan
				Petroleum products	
			Industrial reserves	Crude oil	∗ 37 days in Japan
				Petroleum products	∗ 41 days in Japan
Self Strength: Demand-side Security Measures	Oil conservation	Technological	Oil conservation during crude oil development, transportation and refining Oil conservation through improvement of energy conversion rates in power generation and heat supply Oil conservation through improvement of energy efficiency in the transportation sector Oil conservation in industrial and consumer sectors		
		Structural adjustments	Reduce oil-intensive industries		
			Adjust transportation structure	Developing public transportation systems	
				Adjusting oil-vehicle structure	by fuel
					by engine displacement
				Promoting green cars	Hybrid car
					Electric car
					Gas car
					Fuel cell car
		Tax, pricing			
		Lifestyle			
	Oil substitutes	Liquefied energy	Coal	* Technological,economic, environmental and water shortage factors	
			Natural gas	* Technological, economic and resources factors	
			Biomass	Non-food	* Technological and economic factors
				Food	* Technological, economic and food shortage factors
		Others	Coal	* Environmental factors	
			Natural gas	* Resources factors	
			Renewable	* Technological and economic factors	
			Hydrogen	Fossil fuels	* Technological, economic, environmental and resources factors
				Renewable energy	* Technological and economic factors
Alliance Measures	Establishing Asia Energy and Environmental Agency, enhancing cooperation with IEA and its members Cooperation with Northeast Asian countries: (1) cooperation in oil development, spot market procurement and infrastructure development (2) establishment of joint oil stockpiling arrangements				
Oil security promotion measures	Cooperation to oil-exporting countries including those subject to oil development and import projects. Securing oil transportation sea lanes, developing oil transportation infrastructure Shift to post-oil society				
Active participation in formation of international oil security arrangements				Promotion of stability in oil-rich countries and regions	

Water shortages and security

Notes: The special important measures are emphasized in bold strokes.
* shows the main factors that influence the measures.

Example: Framework for Oil Security Measures: diverse supply-side options

Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Stage 6
Self Strength: Supply-side Security Measures	Domestic resources	Enhance exploration	Resources preservation	∗ Limited stockpiling facilities in oil-rich countries. Reserves are equivalent to consumption for 57 days in Britain, 74 days in the U.S. and 163 days in Japan.	
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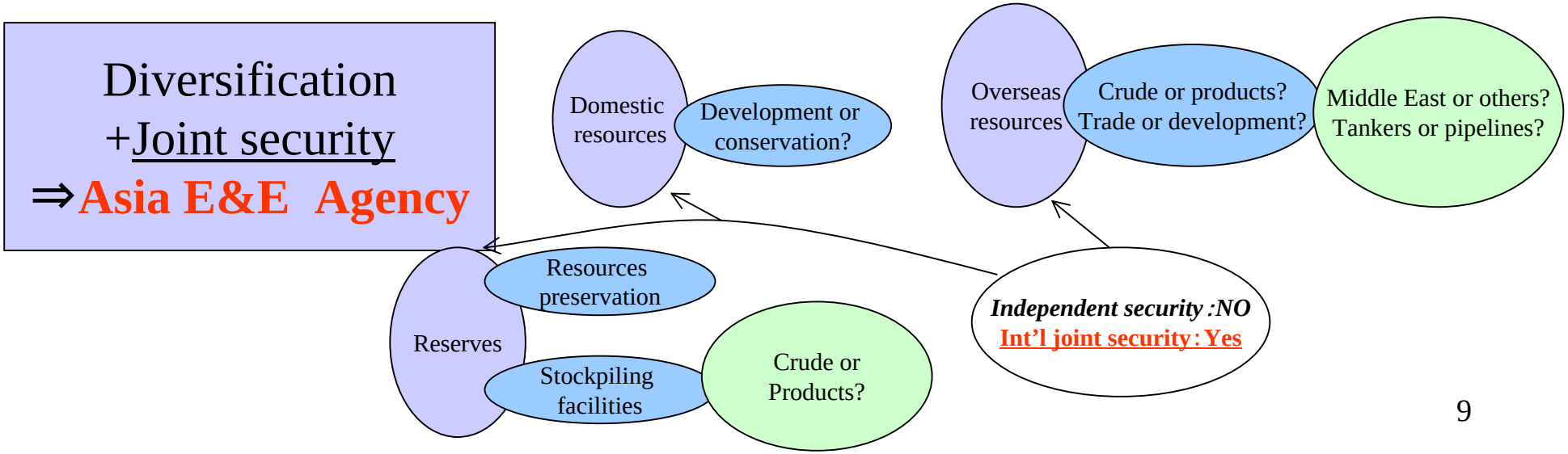


Example: Comprehensive Energy and Environment Strategy for Transportation Sector

・Expanding public transportation systems ・Improving fuel efficiency ・Structural adjustments
・Road development and traffic control enhancement ・Fuel quality improvement ・Green car strategy

☆China's Green Car Strategy (giving considerations to energy, environment and economic development)

Relevant official documents: Economic and Social Development Plan, Science and Technology Development Plan, Auto Industry Plan, Energy Plan, Pollution Prevention Technology Policy for Vehicle Emissions (1999), Pollution Prevention Policy for Diesel Vehicle Emissions (2003), Auto Industry Policy (1994, 2004), National 863 Plan project for electric vehicles (including hybrid and fuel cell cars) (2001), etc.

<Key Points> **① Oil-fueled vehicles will remain the mainstay over a short to medium term.**
② Clean vehicles fueled by oil substitutes will be used wherever appropriate.
③ Fuel cell vehicles will be main over a medium to long term. Purely electric and hybrid vehicles will be used wherever appropriate.

<Viewpoints> Characteristics of vehicles, China's location, strategic objectives, strategic goals, strategic means

☆Will China make another success story like a manned spacecraft flight? Can China leapfrog?

Fuel cell vehicle "Chaoyue 1" (August 2003)
Tare weight: 1.6-1.7 tons Fuel cell: 40kW Acceleration: to 80km/h in 14 seconds
Maximum speed: 110km/h Continuous driving distance: 210km

Fuel cell vehicle (Shanghai) "Chaoyue-Rongwei" (December 13, 2006)

Acceleration: to 100km/h in 15 seconds
Maximum speed: 150km/h Continuous driving distance: 300km

☆Fuel cell unit cost: 10,000 RMB (¥150,000)/kW
Total cost for 50kW passenger car : 700,000-800,000 RMB (¥10 million)
⇒ Unit cost falling to 4,000 RMB (¥60,000)/kW by 2010

2.3 Environmental Measures
2.3.1 Why does China fail to prevent environmental deterioration?

・"Economy-first theory"
(+) The path followed by industrial countries. Lower-level and local organizations give greater priority to economic growth.
(-) The theory cannot explain China's efforts.

・"High growth theory"
(+) Compressed industrialization, explosive urbanization and a shift to a mass consumption society can easily cause environmental problems.
(-) Such effects as green technology introduction and improved environmental consciousness, interpretation of success stories in Singapore and China's Shenzhen and Dalian

・"Theory of constraints on developing countries"
(+) Technological, financial and other constraints
(-) Environmental deterioration could be justified

★"Environmental protection system theory" Defective environmental protection systems (Li 1999, Chinese Academy of Social Sciences 2001)

Case 1: Problems with implementation systems ⇒ Fine payments are advantageous

・One-third of environmental equipment operates normally, one-third fails to operate, and another one-third operates abnormally (1996)
・Fine revenues are available for pollution treatment technologies, but not for clean technologies.

Case 2: Problems with control systems ⇒・Environmental administration cannot be guaranteed to work as local governments hold budget and personnel management rights. Citizens' participation is limited.

A fund-raising ceiling is equivalent to 1.22% of GNP. Real funds raised are limited to 0.74%, with 0.48% left (1991-94).

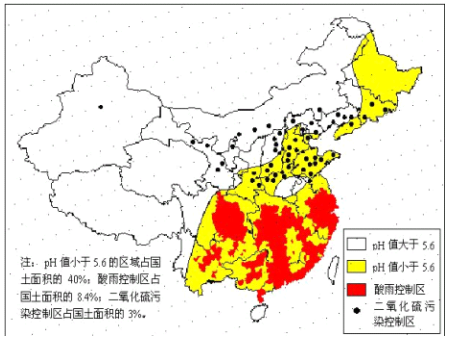
<Example> Japan-China Comparison Regarding Anti-SO2 Measures -See a report by Li & Dai on Energy Economics (March 2000)

	Before← Creation of pollution/environment law →After	
Japan	1960-67	1967-96
Average annual growth of SO2 emissions	8.7%	Δ5.8%
Economic growth	8.1%	4.4%
Emissions' elasticity to GDP	1.07	Δ1.37
China	1971-79	1979-06
Average annual growth of SO2 emissions	6.5%	3.5%
Economic growth	5.9%	9.8%
Emissions' elasticity to GDP	1.09	0.36

Why have such wide gaps emerged between Japan and China?

Japan-China Comparison Regarding Anti-SO2 Measures

	Japan	China
Environmental protection and control systems		
Environmental standards and regulations	Existing	Existing
Concentration regulations	Until 1967	Until 1997
Total emission regulation in specific regions	From 1968,70,74	From 1998
Fuel regulations	From 1971	Specific regions, vague
Fines on emissions	None	Fines exist but are too low
Desulfurizer installation requirement	None	Noncompliance
Administrative and social control capacity	Strong	**Weak**
(**Resultant effectiveness of regulations**)	High	**Low**
Energy-related environment policy		
Energy conservation measures	Law created in 1979	Ordinance created in 1986, law created in 1997 **Unspecified** **Efficiency fell in 2003-2005**
Fossil fuel desulfurization measures	Cabinet decision in 1969	Provided in 1995 Air Law and 1996 Coal Law Unspecified Coal remains mainstay
Fuel shift promotion measures	From 1974	2006 renewable energy law implemented
Energy administration	**Agency for Natural Resources and Energy (1,247 persons)**	**State Development and Reform Commission Energy Bureau (30-50 persons?)**



SO2 emission reduction targets failed to be attained under the 10th five-year development plan

	Results		Results vs. 10th 5-year plan target		Results		Results vs. 11th 5-year plan target	
	2000	2005	2005 target	2005 results/target	2006	2007	2010 target	2007 results/target
	(10,000 tons)	(10,000 tons)	(10,000 tons)	(%)	(10,000 tons)	(10,000 tons)	(10,000 tons)	(%)
SO2 emissions	1,995	2,549	1,800	141.6	2,589	2,468	2,294	112.8
Industrial	1,613	2,168	1,450	149.5				
Nonindustrial	383	381	350	108.8				
Particle emissions	2,257	2,094	2,000	104.7				
Soot dust emissions	1,165	1,183	1,100	107.5				
Industrial	953	949	850	111.6				
Nonindustrial	212	234	250	93.4				
Industrial soot dust	1,092	911	900	101.2				

Source: The author made the table based on the five-year environment plan, annual environmental conditions reports and statistical almanacs, etc.

SO2 Emissions and Desulfurization Rates in China's Industrial Sector and Thermal Power Generation Sector

	Industrial sector				Thermal power generation sector			
	Output (10,000 tons)	Emissions	Desulfurization	Desulfurization rate (%)	Production (10,000 tons)	Emissions	Desulfurization	Desulfurization rate (%)
2000	2,206.4	1,612.5	593.9	26.9	794.6	720.0	74.6	9.4
2001	1,989.7	1,566.6	423.1	21.3	725.6	654.0	71.6	9.9
2002	2,259.8	1,562.1	697.7	30.9	751.5	666.8	84.7	11.3
2003	2,540.8	1,791.6	749.2	29.5	899.5	802.6	96.9	10.8
2004	2,636.3	1,746.3	890.0	33.8	1,169.3	994.9	174.4	14.9
2005	3,068.3	1,980.5	1,087.8	35.5	1,427.9	1,167.2	260.7	18.3

Sources: Data in and before 2003 are from *China Electricity Production and Environmental Problems* by Hu Xiulian on *China* Problems by Hu Xiulian on China Energy, Vol. 27, No. 11, November 2005. Data in and after 2004 from the China Statistical Yearbook..

Causal analysis through "Desulfurized Coal Thermal Plant Electricity Price and Desulfurized Facility Operation Management Method (trial)" (5/29/2007):

① The desulfurizer installation ratio slips below 50%. ② The normal operation ratio is low. ③ Operation costs cannot be recovered. ④ An excessive price-cutting race in the desulfurizer industry **⇒ Tougher regulations and control, and internalization of environmental costs are indispensable.**

2.3.2 Rebuilding Environmental Protection Systems

- Enhancement of administrative control capacity is a priority challenge.

  Personnel management and budget rights for local environment protection bureaus should be transferred from local governments to the State Environmental Protection Administration.

  Environmental protection should be put under joint control by environment agencies, the State Development and Reform Commission, the Price Bureau and industry organizations.

☆ Regional branch offices of the State Environmental Protection Administration have been set up since 2006

- Implementation of Measure System Reform

  Raising unit fines on pollutants ☆SO2 fine at 0.63 RMB/kg→Doubling by 2010

  Shifting from fine collection at a single pollution source to collection at overall pollution sources.

  Toughening total volume control and introducing emission trading ☆Quotas, the "veto on one count" system

- Promotion of information disclosure and education
- Political system reform⇒Promotion of citizen participation, enhancement of social control
- Economic system reform⇒Enhancement of measure systems centering on economic measures, improvement of environment consciousness, expansion of protection capacity, etc.
- Energy supply/demand policy shift ☆ A bias for supply→Energy conservation, natural energy

★Promotion of international cooperation:

Transferring system-building know-how, human resources development

Development and diffusion of low-cost environmental technologies

3. Japan-China Cooperation 3.1 Reciprocal cooperation is important

Impacts on International Community Including Japan

☆Problem Consciousness 1: Three impacts on international community viewed as threats

① Energy supply shortages⇒Deceleration of domestic economy (including foreign companies) ⇒Impact on world economy

＊ **China is Japan's largest trading partner.**

＊ **China is incorporated as a factory or market in the world economy and leads the world economy.**

② Growing dependence on energy imports and declining coal exports

⇒ a. Tighter supply/demand relationship in world energy markets and price spikes b. Rewriting a geopolitical world energy map

③ Domestic environment, cross-border pollution and global environmental problems accompanying increased energy consumption may grow more serious to weaken the infrastructure of China and the world for sustainable development.

☆⇒**Resolution of China's energy and environmental problems should contribute to Japan's national interests including energy security and stable development.**

☆Problem Consciousness 2: Northeast Asian countries have common problems while details of their problems and their priority orders for solutions are different. "Unilateralism" has reached limits

① Resources security problems emerging from constraints on energy and other mineral resources and massive consumption

② Air pollution, acid rain pollution and solid waste treatment problems

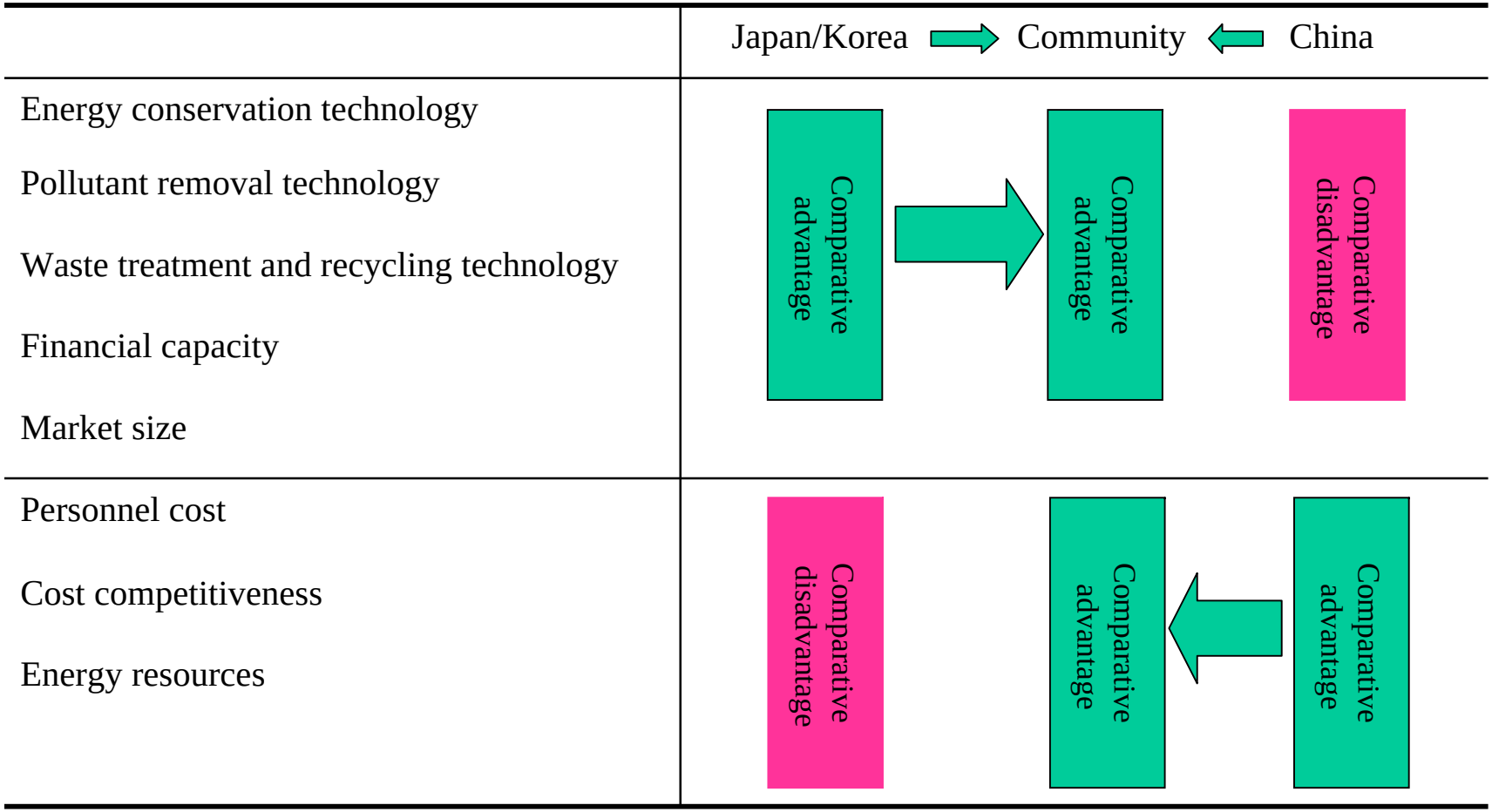
③ How to curb CO2 emissions causing global warming

④ Asia has no economic bloc, failing to link regional advantages to international competitiveness or to counter the EU or NAFTA.

⑤ **"Unilateralism" has difficulties in solving problems and is costly, regarding energy security, CO2 emission reductions, etc.**

☆Problem Consciousness 3: Comparative advantage of solutions exists between Japan/Korea and China

☆Problem Consciousness 4: East Asian regional cooperation including an energy community is required for sustainable development (for example, Japan's National Institute for Research Advancement and the Institute of Japanese Studies at the Chinese Academy of Social Sciences)



Market expansion and cost reduction⇒ Maintaining advancement of Japan's energy conservation and environmental technologies, and relevant technologies

3.2 Moving toward Building "Strategic Reciprocal Relationship"

★Exchange of leaders' visits (Prime Minister Abe's China visit in October 2006, Premier Wen's Japan visit in April 2007, Prime Minister Fukuda's China visit in December 2007), ministerial talks…: Great improvement in the environment for bilateral cooperation

●Japan and China should reaffirm a win-win relationship (eliminate skepticism) and agree on cooperation

Six Japan-China Cooperation Projects as Agreed at Japan-China Energy Cooperation Seminar during Chinese Premier Wen Jiabao's Japan Visit in 2007 (April 2007, Tokyo)

1	Memorandum on long-term cooperation between Nippon Oil Corp. and China National Petroleum Corp.	Nippon Oil Corp. China National Petroleum Corp.
2	Agreement on exchange and cooperation framework between China Power Investment Co. and Electric Power Development Co. of Japan	Electric Power Development Co. China Power Investment Corp.
3	Comprehensive agreement on joint renewable energy development	Kyushu Electric Power Co., Sumitomo Corp. China Datang Carp.
4	Documents on promotion of renovation of existing coal thermal power plants in China	Japan Bank for International Cooperation, Japan Coal Energy Center China Power Investment Corp.
5	Memorandum on Japan-China joint research on energy conservation policies	Institute of Energy Economics, Japan State Development and Reform Commission Energy Research Institute
6	Basic agreement on LNG spot transactions between China National Offshore Oil Corp. and Mitsui & Co.	Mitsui & Co. UK PLC China National Offshore Oil Corp.

Source: The author made the table based on various materials.

10 Cooperation Projects as Agreed at 2nd Forum (September 2007, Beijing)

① Project for energy conservation, environmental diagnosis and technology improvement at coal thermal power plants

(Japan side): Japan Coal Energy Center, Japan Bank for International Cooperation

(China side): China Electricity Council

●The parties will make efficiency and environment improvement proposals based on an environmental diagnosis on existing coal thermal power plants in China and consider financial support including utilization of the Clean Development Mechanism.

② Nine other projects (Japanese participants)

・Improvement of energy conservation at spinning mills (Kyushu Electric Power Co.) ・Effective utilization of sewage sludge, urban garbage and other untapped biomass resources (JGC Corp.) ・Energy conservation and utilization of waste heat and pressure in Yunnan Province's steel and chemical industries (Hitachi Ltd., etc.) ・Research and development of energy conservation equipment networks (Matsushita Electric Industrial Co.) ・Promotion of Japan-China cooperation regarding recycling-oriented cities (Kitakyushu City) ・Creation of a joint venture for waste heat power generation (Kawasaki Plant Systems Ltd.) ・Promotion of energy conservation and environmental improvement under financial schemes (Mizuho Bank, etc.) ・Cooperation using the Japanese chemical industry's energy conservation and environmental technologies (Japan Chemical Industry Association) ・Promotion of energy conservation support services (Japan Association of Energy Service Companies)

Source: The author made the table based on materials for the "Second Japan-China Energy Conservation and Environmental Protection Forum."

A Security Cooperation: strategic reserves, domestic and overseas resources development, import negotiations

B Technological Cooperation: joint development of energy conservation, new energy, environmental conservation and cutting-edge technologies

● China has greatly benefited from Japan's traditional government green aid and present private-sector cooperation. Gratitude.

C Technical cooperation in control systems, know-how and human resources development

● Japan boasts the world's highest energy conservation efficiency, improving its domestic environment rapidly.

⇒Systematic research (development of theories on Japan's experiences) is necessary.

★ Tackling this research as an urgent challenge!★

3.3 Great Room for Further Promotion of Cooperation

★Examples for Technological Cooperation

Agreements have been made primarily on improvement of existing equipment using mature Japanese technologies and know-how

● **Japan's Concern: Japan could lose its technological advantage as its technologies are transferred and imitated**

⇒China is urgently required to enhance protection of intellectual property rights.

● **China's Belief: Japanese technologies, though with excellent quality, are costly. Management and human resources development after introduction of these technologies are insufficient**

⇒ China should conduct a survey on willingness to pay

⇒ Japan should consider joint development of suitable technologies for China, cost reduction, production in China and local contents in China.

? ? A vague suspicion that "Japanese technology transfers would benefit China and lead China to defeat Japan"

⇒**☆Beneficial to both** **<<Consider disadvantages>>**

☆Europe and the U.S. are competitors ⇒ Japanese firms' hesitation to sell could lead them to lose markets

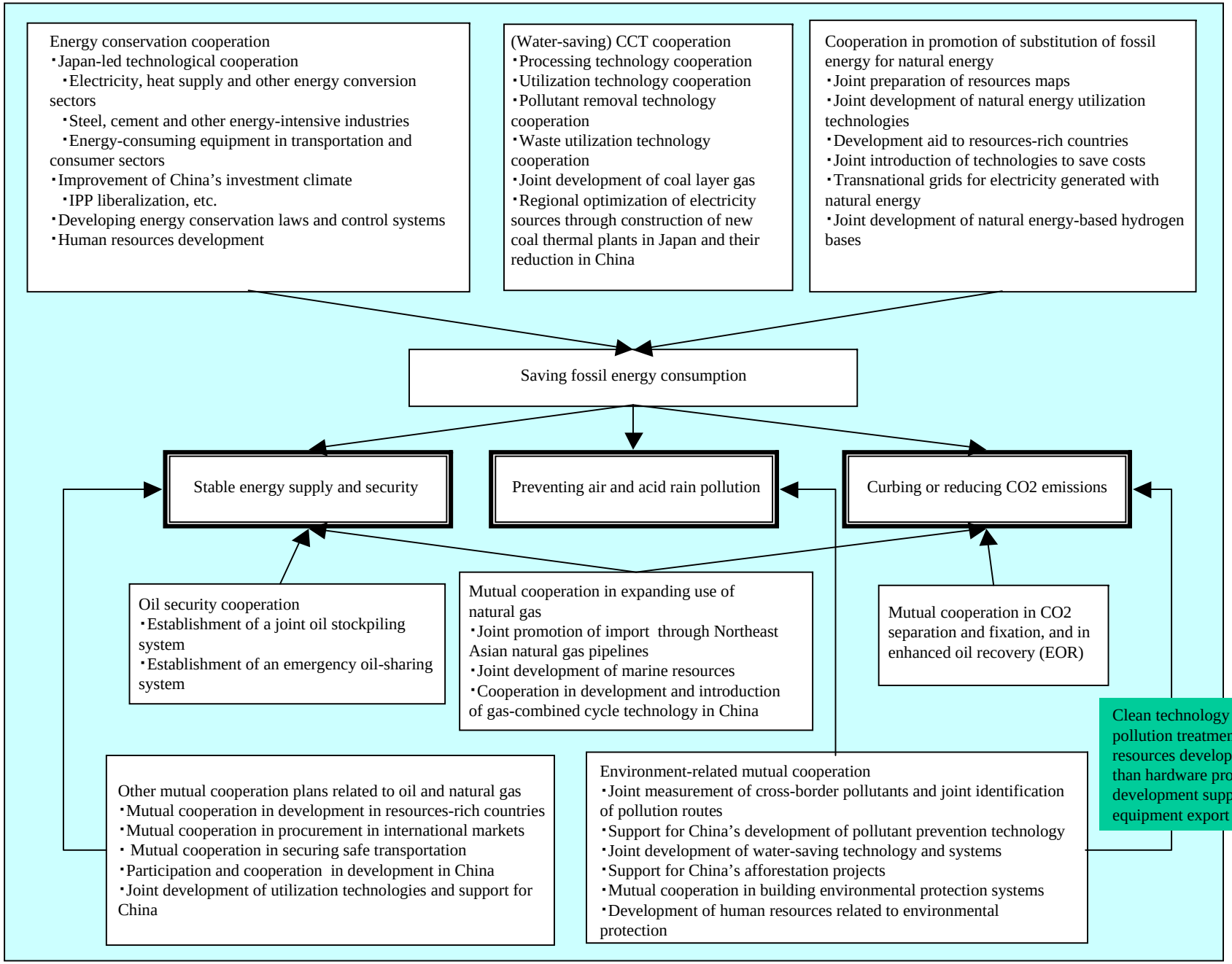
☆Japan-China technology gaps are narrowing ⇒ Don't underestimate China's technology advancement

☆Salability and markets are preconditions for prevention of industrial decline and technological advantages (resources for Japan)

⇒ Japan should positively think that technology transfers would not only contribute to the international community and to prevention of global warming but also work to create markets accepting Japanese technologies and contribute to Japan's industrial promotion and its maintenance of technological advantages.

★★★Hopes on President Hu Jintao's Japan Visit in April: ◎Deals could be cut promptly for major cooperation plans for China's introduction of advanced energy conservation and environmental protection technologies including the IGCC (integrated gasification combined cycle) power generation system (test operations started in Japan in September 2007 and are expected to start in China in 2010). ◎ Joint development of cutting-edge technologies (including fuel cell vehicles) ・・・

3.4 Areas Where Mutual Cooperation Is Required: Business Chances and Risks



Example: Business chances and risks for development of alternative energy to oil

Government policy: Careful promotion of development

China's energy strategy draft in 11th five-year (2006-2010) development plan (October 2005, March 2006)

Objective: Creating a stable, economical and clean energy supply system

Strategy 1 <demand side>: **Giving top priority to energy conservation**

Strategy 2 <supply-side>: Diversifying the energy structure based on domestic coal resources

- Coal: construction of large bases, utilization of coal-layer gas, joint management of mines and power plants close to mines
- Oil and natural gas: Enhancement of domestic exploration and development, expansion of overseas development, reinforcement of strategic oil reserves capacity, development of alternative energy to oil.
- Electricity: Optimum development of large-capacity and efficient coal thermal power plants, hydropower development giving considerations to protection of ecosystems, positive development of nuclear power plants, enhancement of power grid construction, expansion of electricity transmission from the west to the east.
- Renewable energy: Accelerating development of wind power, solar energy and biomass energy

Key points

① Establishing standards for alternative energy to oil to positively develop such energy

② Orderly promotion of coal chemical industry development, coal-based liquid fuel development and coal liquefaction model projects to expedite deep processing of coal and increase value added to coal

③ Expanding fuel ethanol production capacity

④ Expanding biodiesel production capacity

<Example> Check points for risks involving development of coal-based alternatives to oil

① Technological risks

Whether costs can be reduced, whether coal conversion efficiency can be raised, whether water consumption can be saved, whether pollutants can be treated, etc.

②Market risks

Whether the relevant product can compete with others in quality and price, whether an environment (standards, infrastructure and equipment) can be development for utilization of coal-based alternatives to oil, etc.

③Materials risks

Whether stable coal supply (sufficient volume and reasonable and stable prices) can be secured

* China's coal resources are abundant, but limited!
* Coal prices are linked to oil prices
* China's domestic coal prices are rising on internalization of environmental costs, personnel cost growth and depletion of resources.

④Water resources risks

Water resources protection during coal-mining operations, water supply for processing of coal, rising water service prices

⑤Environmental risks

Water resources destruction, ecosystem protection, treatment of pollutants

⑥Institutional and policy risks

⇒Business chance (large) = f{risk(small)} Reduction function !

★Risk management is important

3.5 Cooperation in Prevention of Global Warming: Designing Post-Kyoto Framework

●Principle of "common but different responsibilities" in the 1992 UN Framework Convention on Climate Change
●Responsibilities were specified in a manner to impose emissions reduction obligations on developed countries under the 1997 Kyoto Protocol

⇒Common responsibilities have been questioned as emissions have increased rapidly in China, India and other developing countries

⇒ Developed countries include the EU offering to cut emissions 20% by 2020, the U.S. and Australia quitting the Kyoto Protocol, and those failing to meet obligations

⇒ The post-Kyoto framework calls for all countries' participation in reduction of emissions through harmonization of differences and commonness of responsibilities

×The Kyoto Protocol approach is difficult, having no specific reasons
A flexible framework for all countries' participation may include adoption of diverse indicators such as the U.S.-proposed emissions per GDP unit and developing countries' actions plans endorsed by the U.N. But their fairness and global warming prevention effects are doubtful.

⇒★Framework based on per capita emissions as standard. This indicator can reflect economic development levels, energy consumption structure and efficiency, differences in responsibilities for global warming, fairness of responsibilities for the prevention most comprehensively and clearly.

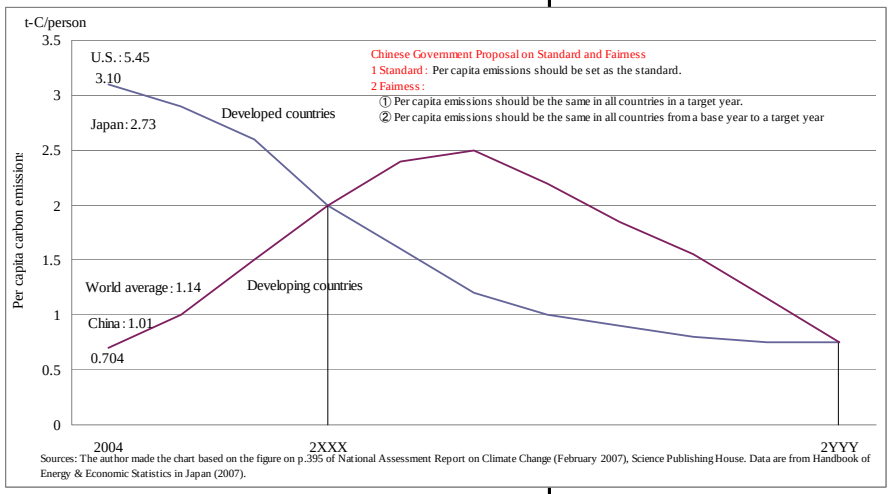
◎ Specifying priority for human rights ◎ The framework gives developing countries incentives to increase sales by reducing emissions ◎ Technology transfers and payments for emission credits from countries that have difficulties in achieving emission reduction targets will allow developing countries to voluntarily promote their sustainable development.

Japan's advantages:**★Japan could sell the world's most advanced energy conservation technologies to other countries, maintain its technological advantage and raise funds for trading in emission credits. ★Japan could secure its leadership ★Japan could achieve a government-advocated global warming prevention strategy to halve global emissions by 2050.**

⇒ In April 2007, the Japanese and Chinese leaders agreed to positively participate in developing an effective framework after 2012. ⇒ Will this agreement lead to a joint proposal?

China's Approach on Framework for Post-Kyoto Protocol (Li's personal view)

	Kyoto Protocol	Post-Kyoto Protocol	
	2008-2012	2013-2017	From 2018
EU	Observing protocol	Protocol formula	
Japan	Unlikely to meet goal		
U.S.	Quitting protocol		
Russia and other transitional countries	Observing protocol		
China, India and other developing countries	No obligation		
China	Energy conervation and other indirect voluntary regulations as domestic plans	Energy conervation and other indirect voluntary regulations as domestic plans (15%)	U.N.-authorized per unit GDP carbon emission cut (30%)
		U.N.-authorized per unit GDP carbon emission cut (60%)	Setting targets based on standards and fairness (10%)
		Setting targets based on standards and fairness (5%)	Setting targets based on per capita annual emission equivalent standards (55%)
		Setting targets based on per capita annual emission equivalent standards (15%)	Setting targets based on other standards (5%)
		Setting targets based on other standards (5%)	
Features of U.N. global warming prevention framework	Kyoto Protocol	Flexible framework	Common framework
	Limited participation	Almost all members' participation	All members' participation

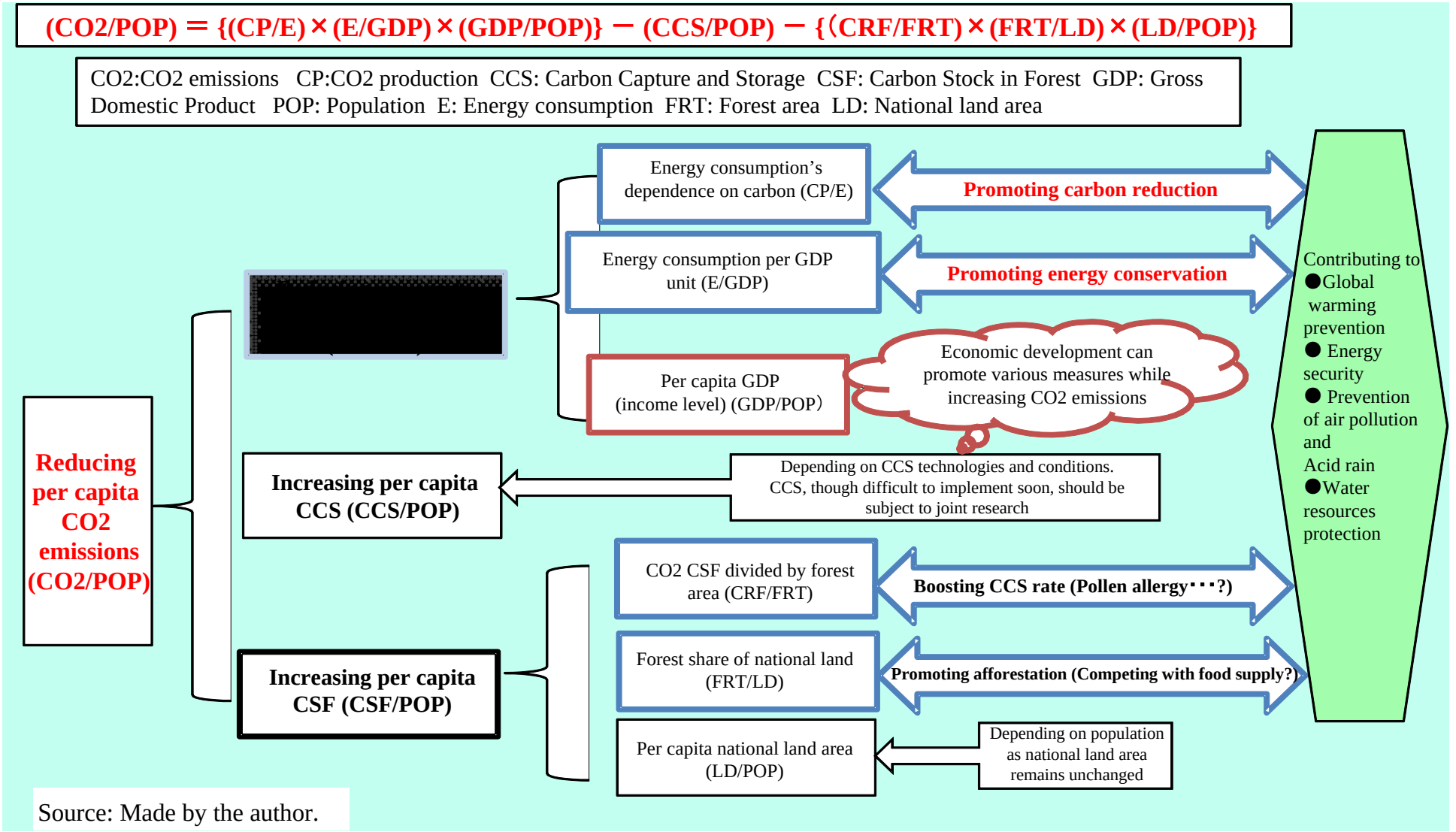


Source: The author prepared the table based on various materials.

Note: Percentages in parentheses indicate possibilities.

★IPCC Chairman Rajendra K. Pachauri and German Chancellor Angela Merkel stated that the concept of per capita emissions should be given priority. (For example, *Nikkei Shimbun* 10/22/2007; *Asahi Shimbun*, 10/22/2007)

3.6 "Asia Energy & Environment Agency（AEEA)" Is Necessary



Source: Made by the author.

★Proposal: Japan and China should take leadership in creating the Asia Energy & Environment Agency. This could pave the way for the Asian community.

Appendix：Trends of Economy, Energy and Environment

★ Economic growth

Economic growth averaged 9.9% between 1980 and 2007 before staying above 10% for five years from 2003.

●"11th 5-Year Plan" target: 7.5% between 2006 and 2010 Expected growth

☆Higher growth. Energy Bureau projects growth at 8.5%.

Li's outlook (2004-2030): Reference 6.5%（**2004-2010：9.7%,** 2010-2020:6.1%, 2020-2030:5%）

Higher growth at 7.6%, lower growth at 5.4%

★ Energy Supply/demand Trends

●Demand increasing fast: 1.5 billion TOE in 2005 ⇒ **3.3 billion TOE in 2030**

●Production will be limited due to constraints concerning resources, transportation capacity, the environment, water resources and food.

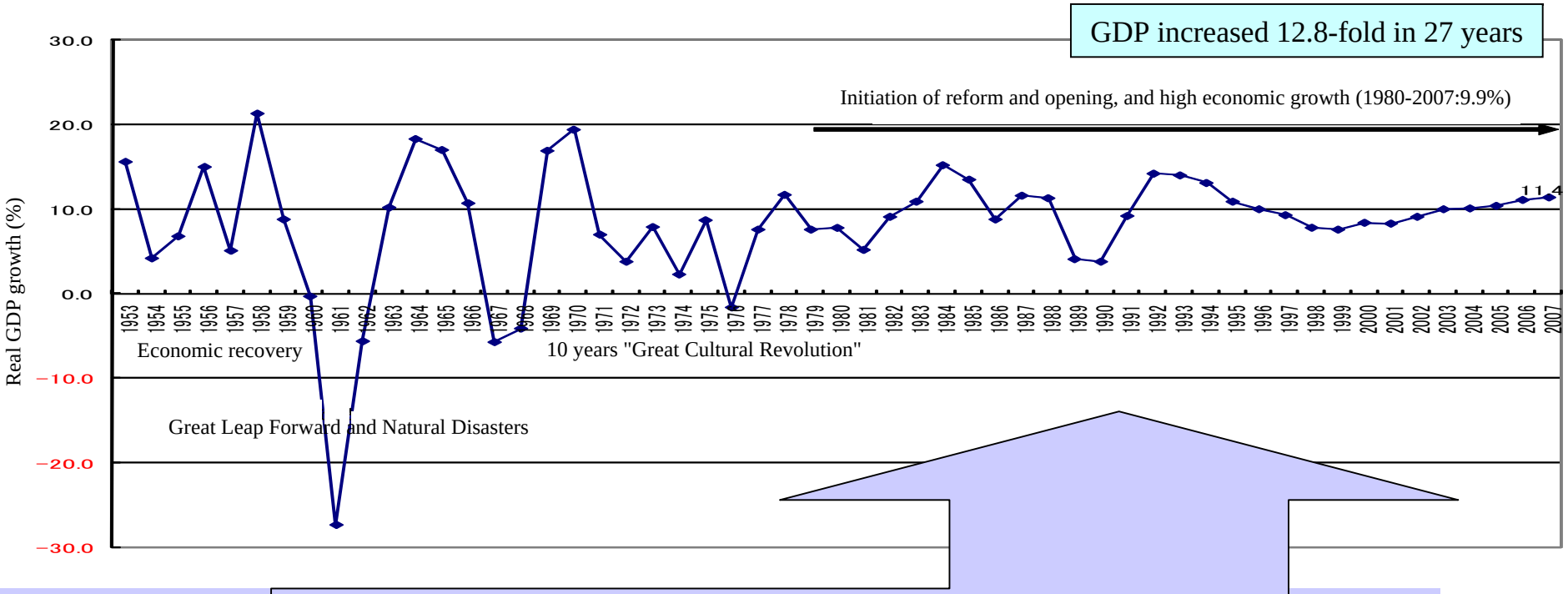
⇒☆Stable energy and security problems will grow more serious

★ Environmental Problems

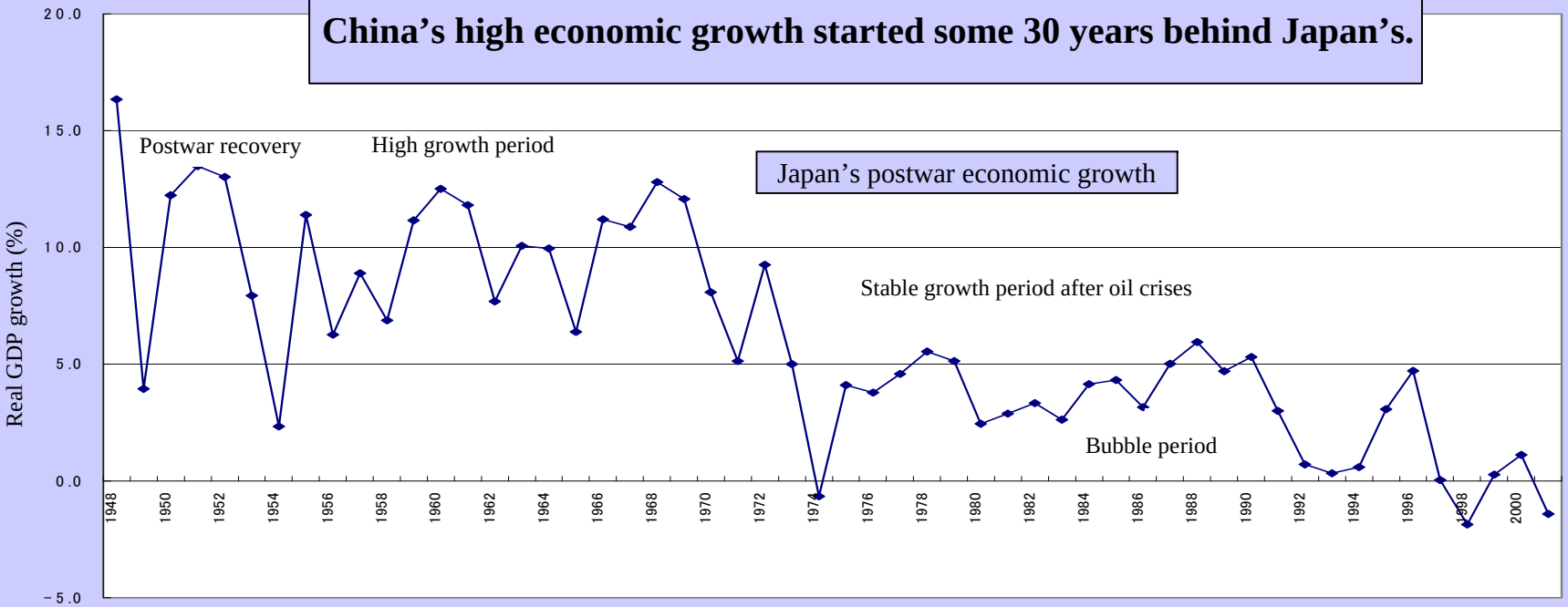
●It is difficult for China to make a fast shift away from fossil energy centering on coal.

⇒ Emerging will be air pollution, acid rain pollution and a fast increase in CO2 emissions.

1.1 Macroeconomic Situation: Amidst high economic growth

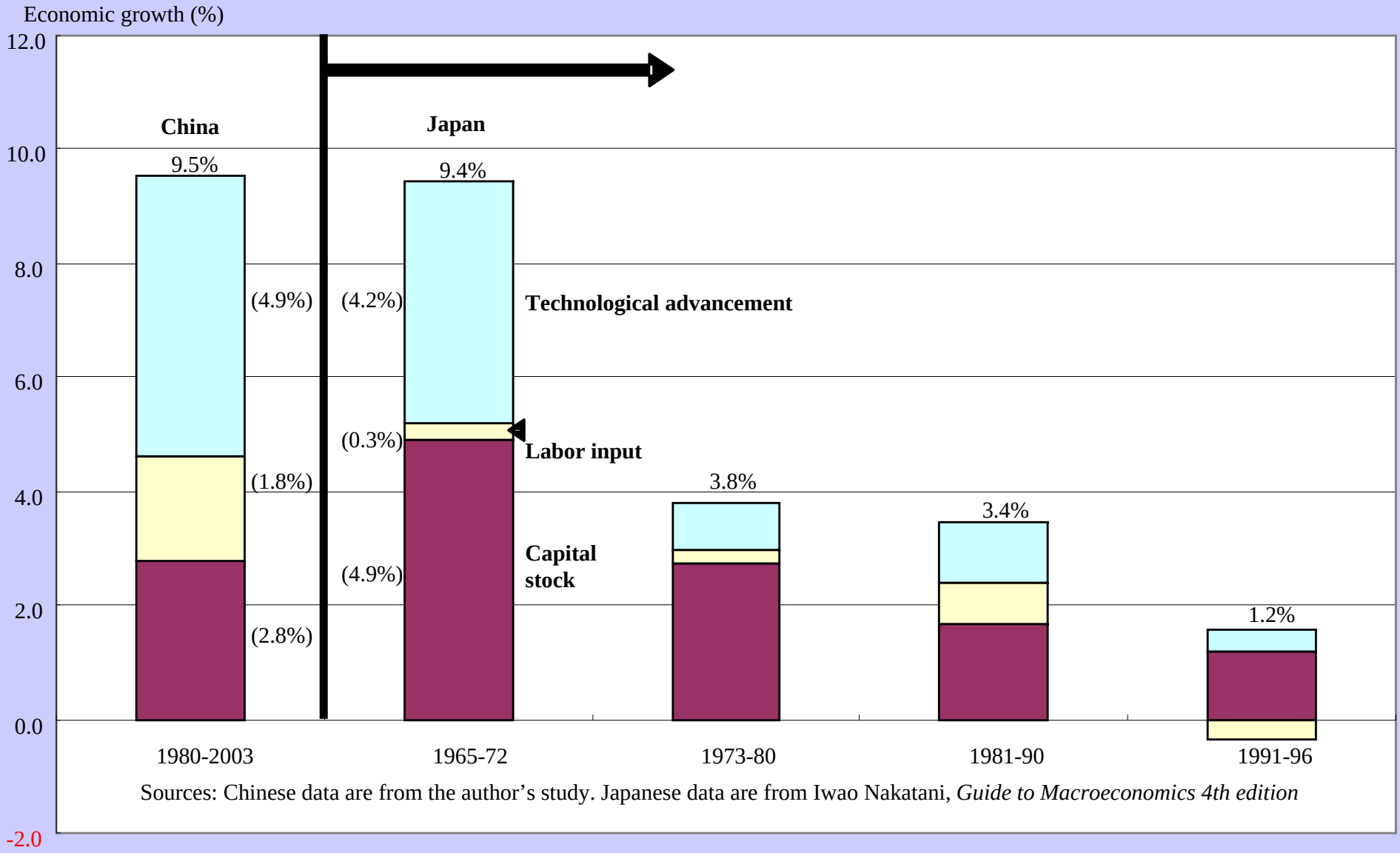


China's high economic growth started some 30 years behind Japan's.



Technological advancement made the greatest contribution to economic growth

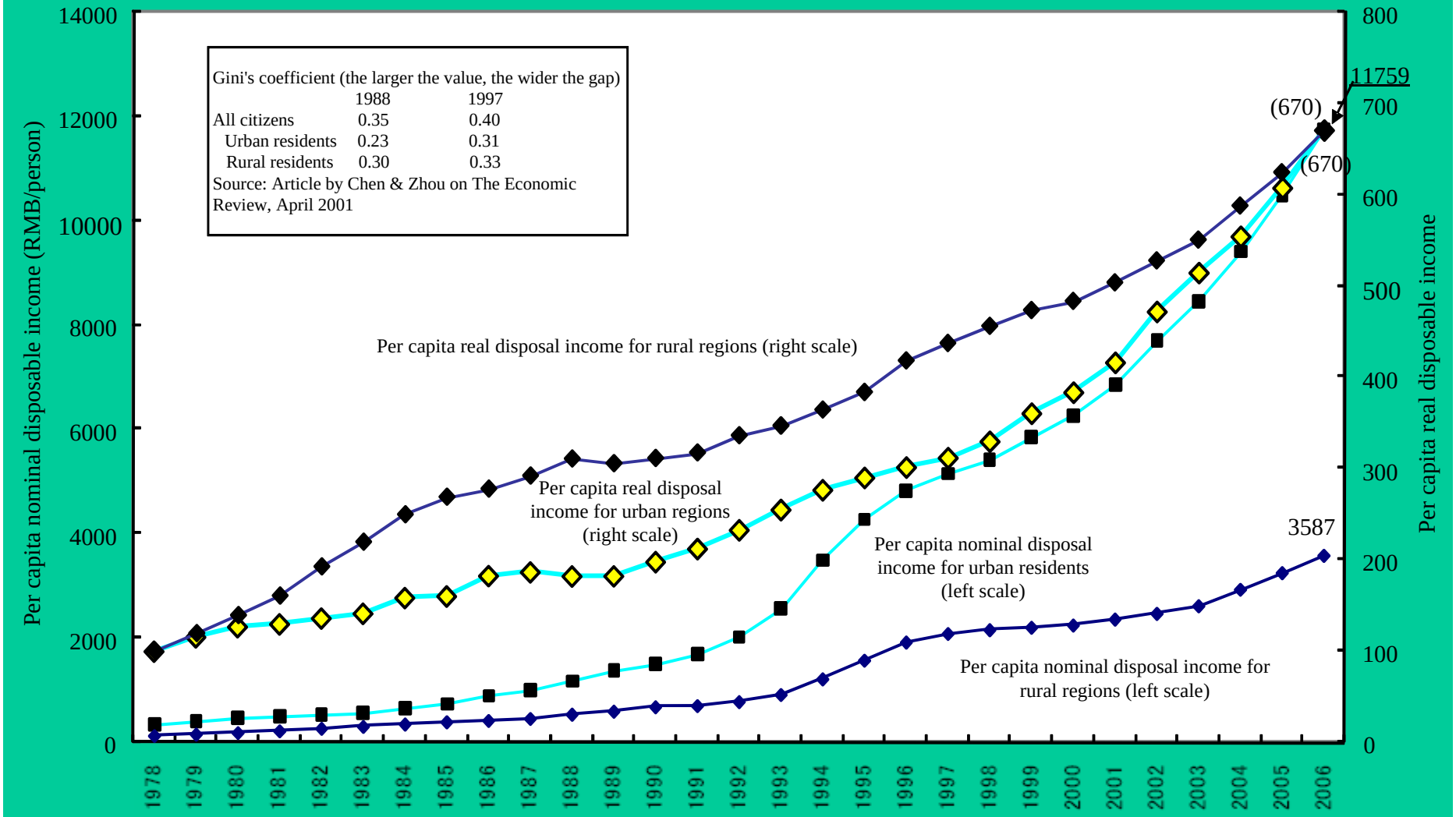
Comparison of Japanese and Chinese economic growth factors



Sources: Chinese data are from the author's study. Japanese data are from Iwao Nakatani, *Guide to Macroeconomics 4th edition*

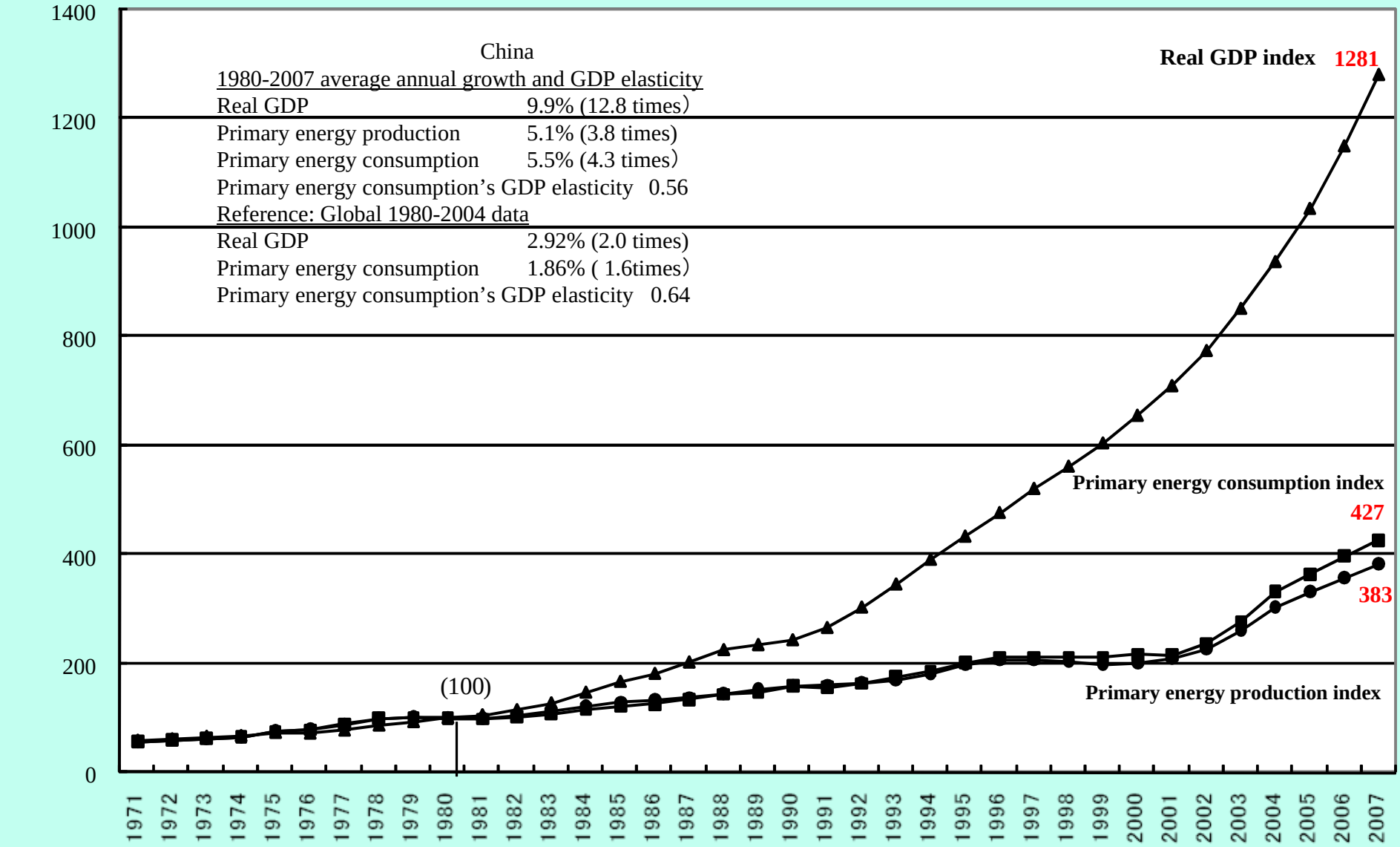
Income gap problem: While gaps have expanded, each group's bottom has been raised!

Problem of income gap between urban and rural residents in China



Sources: The author developed the chart based on China Statistical Yearbook , The Economic Review, Statistics Bulletin, etc.

1.2 Present Energy Supply/demand: Fast consumption expansion and emergence of stable supply problem



Sources: The author developed the chart based on IEA statistics, China Statistical Yearbook, China National Economic and Social Development Statistics Bulletin, Handbook of Energy & Economic Statistics in Japan, etc. Data for 2007 are preliminary or estimated data.

・Giant Energy Consumer and Supplier Ranked 2nd in Consumption and Production ・Net Energy Importer

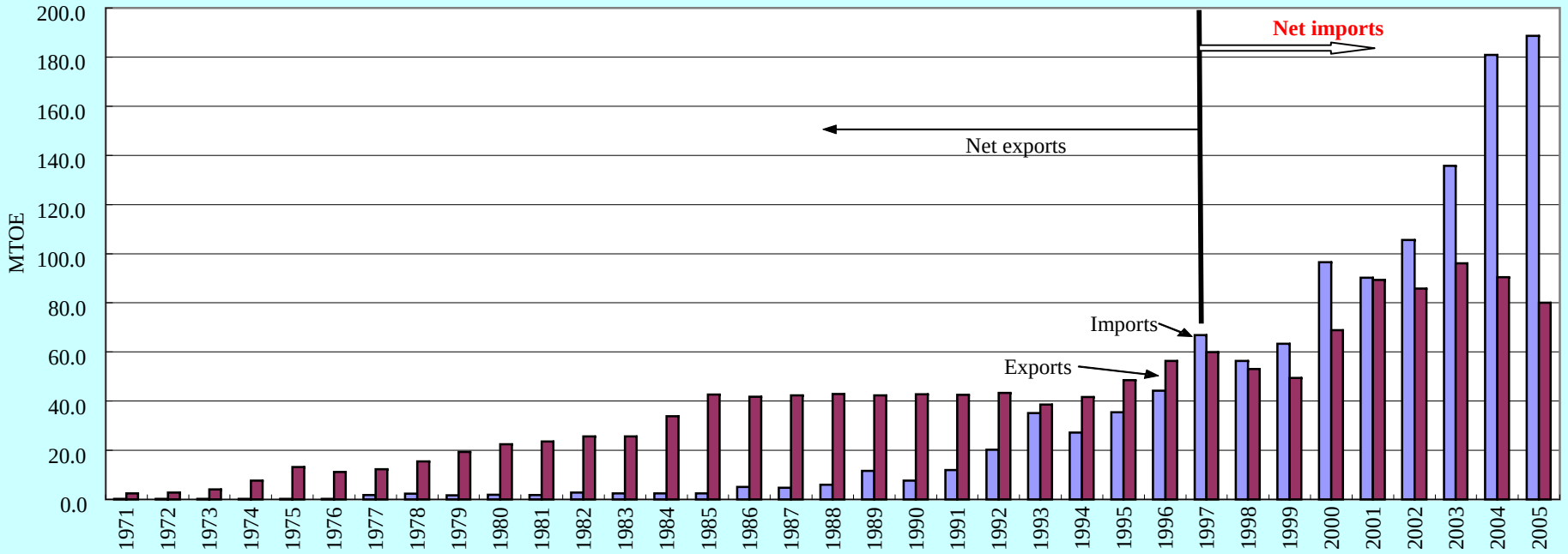
Six Largest Energy Consuming Countries' Supply/demand Characteristics (2005)

Consumption Ranking	Country	Primary energy consumption		Primary energy production		Self-sufficiency rate	Energy supply/demand characteristics
		(MTOE)	(%)	(MTOE)	(%)	(%)	
①	U.S.	2,340.3	23.0	1,630.7	16.0	69.7	Giant consumer/supplier, giant net importer
②	China	1,511.6	14.8	1,417.4	13.9	93.8	Giant consumer/supplier, net importer
③	Russia	639.8	6.3	1,177.9	11.6	184.1	Giant consumer/supplier, giant net exporter
④	Japan	530.5	5.2	99.8	1.0	18.8	Giant consumer, giant net importer
⑤	India	379.2	3.7	260.9	2.6	68.8	Giant consumer, giant net importer
⑥	Germany	344.8	3.4	134.5	1.3	39.0	Giant consumer, giant net importer
World		10,183.5	100.0	10,176.0	100.0	99.9	

(Note) ①Excluding non-OECD combustible and renewable energy ②Self-sufficiency rate=Domestic production/domestic consumption

Source: *IEA Statistics 2007*

China's Primary Energy Supply/Demand (Imports/Exports) Trends



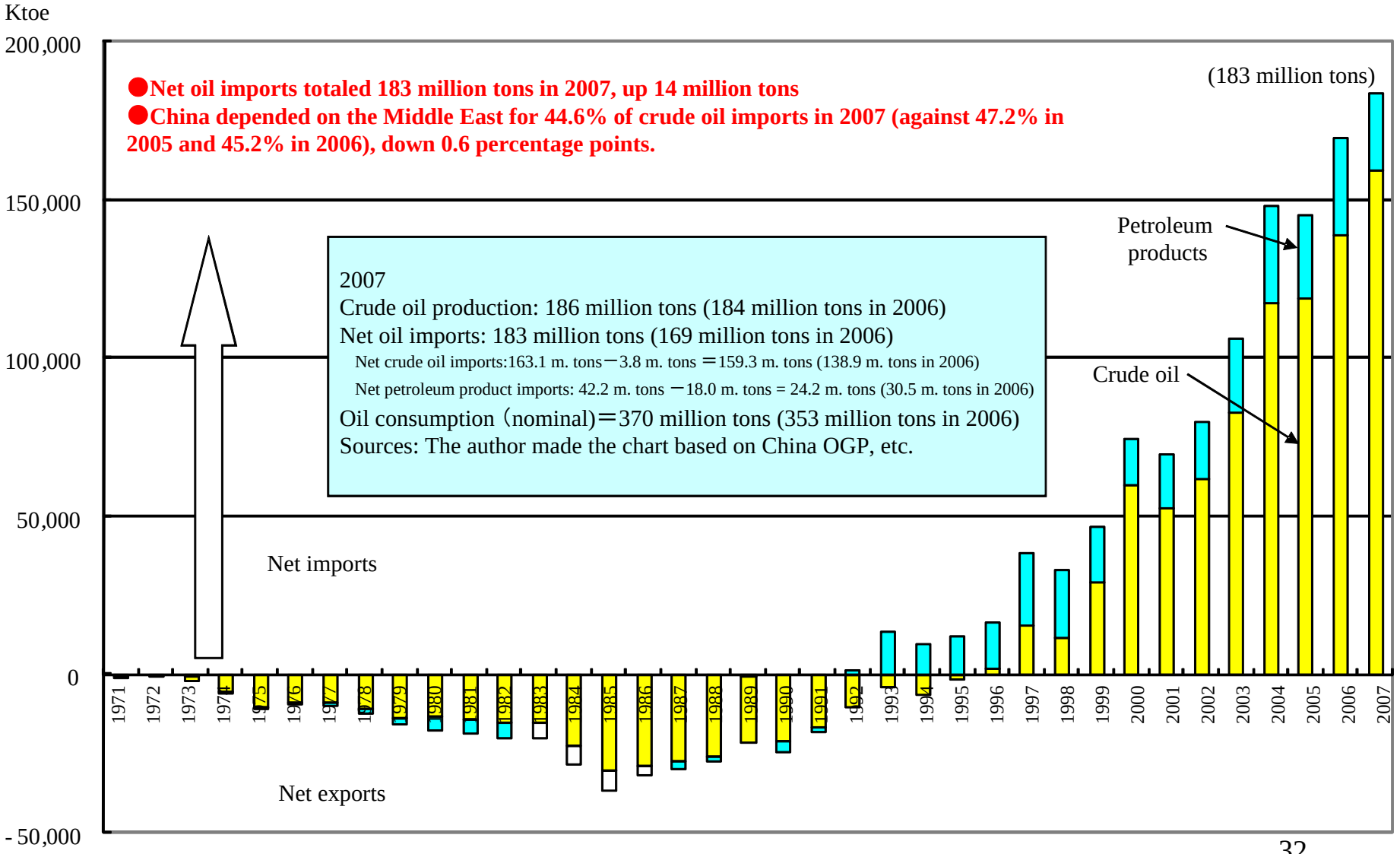
Sources: The author made the chart based on *IEA Statistics 2006* and *China Statistical Yearbook 2006.*

・Self-sufficient in coal (net exports at 2.15 million tons in 2007) ・Limited Natural Gas Imports

☆Net Oil Imports emerged in 1993, totaling 183 million tons in 2007

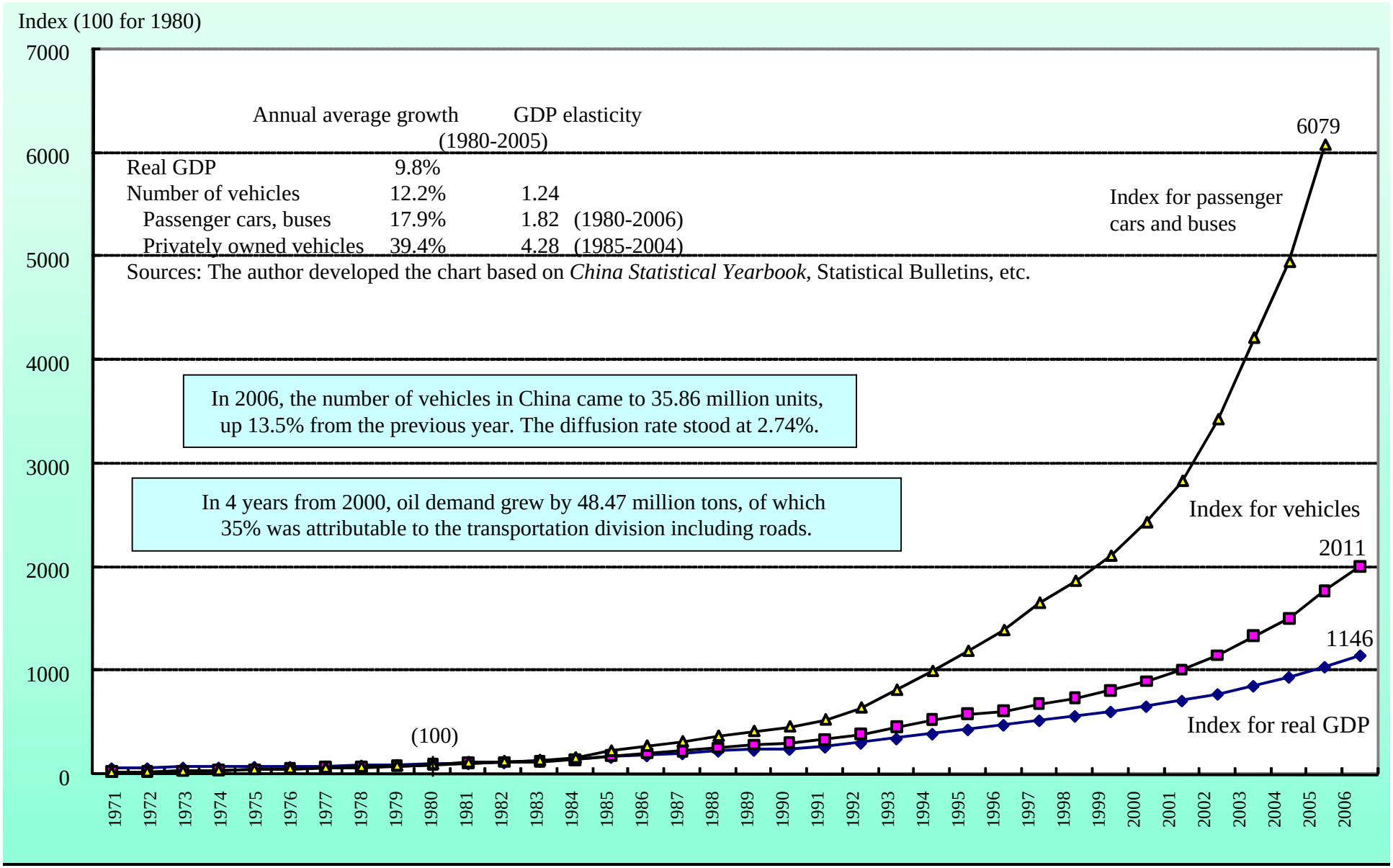
In 7 years from 2000, production increased by 23 million tons (an annual average of 3.3 million tons)

Demand expanded by 148 million tons (an annual average of 21.2 million tons) ⇒ Fast growth in net imports



Sources: The author developed the chart based on IEA, *Energy Balances of Non-OECD Countries, 1971-2004*; *CHINA OGP, etc.*

Diffusion of Vehicles Is A Key Factor behind Expansion of Oil Demand or Net Imports



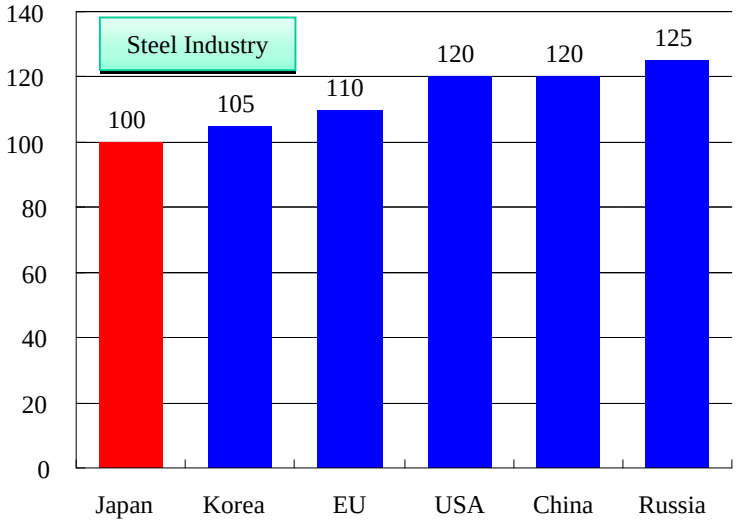
★Energy conservation potential is great: Energy efficiency at 70-80% of levels in developed countries

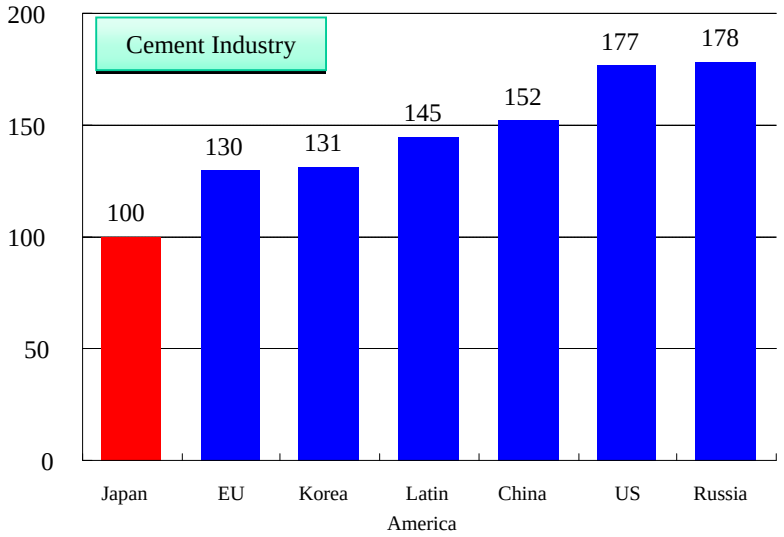
	Specific energy consumption as quantitative indicator			China/industrial world	
	China		Industrial world	Specific consumption comparison	Efficiency comparison
Energy consumption per GDP unit (TOE/1,000PPP dollars)	0.185	(2003)	0.145 (Japan, 2003)	127.4%	74.8%
(TOE/1,000 dollars, exchange rate conversion)	0.840	(2003)	0.120 (Japan, 2003)	698.6%	14.1%
Thermal power plant generating end heat efficiency（gce/kWh) ①	349	(2004)	299 (Japan, 2004)	116.6%	85.8%
Specific energy consumption for steel (kgce/t) ②	705	(2004)	610 (Japan, 2004)	115.6%	86.5%
Specific energy consumption for cement (kgce/t) ③	157	(2004)	127 (Japan, 2004)	123.6%	80.9%
Specific energy consumption for sheet glass (kgce/box)	23.5	(2004)	15 (2004)	156.7%	63.8%
Specific energy consumption for ammonia (kgce/t) ④	1314	(2004)	970 (U.S., 2004)	135.5%	73.8%
Specific energy consumption for ethylene (kgce/t)	1004	(2004)	629 (2004)	159.6%	62.6%
Overall specific energy consumption for crude oil processing (kgce/t)	112	(2004)	73 (2004)	153.4%	65.2%
Specific energy consumption for paper-pulp (kgce/t)	1.57	(1997)	0.70 (1997)	224.3%	44.6%
Gasoline truck fuel efficiency (liter/100km)	7.55	(1997)	3.40 (1997)	222.1%	45.0%
Specific energy consumption for home heating (gce/(square meter year))	25.3	(2000)	13.51 (N. Europe, 2000)	187.3%	53.4%

Note：①6MW or larger thermal power plants for China. Nine electric utilities' thermal plants for Japan. ②Medium and large firms for China. All firms for Japan.
③Medium and large firms for China. All firms for Japan. ④ Large firms using natural gas as raw materials

Sources: The author developed the table based on *China Energy 50 years; Energy Policy Research,* January 2002; *China Energy* May, 2005, *International Oil Economy* February 2006; etc.

- **Energy Consumption per Output**





Japanese and other advanced technologies and systems could save energy consumption by 20-30% or 300-450 TOE!

In addition:

- ***Coal remains a mainstay energy source in supply and demand: Coal accounts for 70% of energy supply/demand***
- ***China has lagged behind in developing and diffusing clean coal technologies***
- **China has lagged behind in developing and utilizing natural gas or renewable energy**
- **Lagging modernization of final energy consumption**
- **Energy-caused environmental problems:** air pollution, acid rain pollution, cross-border pollution, fast-increasing CO2 emissions, water resources destruction, etc.

Challenges

- **Promotion of energy conservation, development of renewable energy**
- **Energy security including oil security**
- **Stable electricity and coal supply, clean coal utilization**

1-3 Present Situation of Environmental Problems (including energy-caused problems)

(1) Government recognition of environmental conditions: **No general improvement has been seen**

- 1979: The environmental protection law (trial) was established to tackle environmental protection.
- -1996: **Environmental deterioration continued**
  "Environmental pollution mainly in China's urban regions has been continuing. At the same time, environmental pollution has become rampant in rural regions. Ecosystem destruction has still been expanding."
- 1997: "**Improvements in some regions** are seen"
- 1999: "**Deterioration of nationwide environmental pollution has generally been put under control for the first time ever**. But **the environmental situation is still severe."**
- 2002: "China's **environmental quality has basically maintained the previous year's level. In some cities, air pollution has been improved to some extent.** But **no optimism can be warranted on the ecological environment."**
- 2004: "China's environmental quality has basically been stable… Acid rain pollution has been growing more serious."

☆ 2001-2005 Review: **"Environmental pollution has accelerated and the ecological environment has deteriorated. China has failed to achieve target reductions in pollutant emissions under the five-year development plan."** (Summary of 11th 5-year national economy and society development plan, March 2006. A similar view was in the 11th 5-year national environment protection plan, November 2007)

1-3 Present Situation of Environmental Problems (including energy-caused problems)

(2) Air Pollution

Sulfur dioxide, dust and suspended particle matter emissions have remained at high levels. Sulfur dioxide emissions total some 20 million tons (19.27 million tons in 2002, 21.59 million tons in 2003, 22.55 million tons in 2004, 25.49 million tons in 2005, 25.94 million tons in 2006), the most in the world and more than 20 times as much as in Japan.

In 2006, 62.4% of urban regions cleared the national environmental standard (the second class – suitable for living). Of urban population, 37.6% (about 220 million people) have been exposed to air pollution.

In urban regions, pollution through auto waste gas emissions has grown more obvious.

Air pollution in farming villages has become rampant on industrialization (township and village enterprises) and transfers of urban pollution sources.

(3) Acid Rain and Cross-border Pollution

Acid rain-polluted area（Zhan Kunmin, et al, 1996; National Environment Protection Agency, 1996; annual environmental condition bulletins)

	1985	1993	2nd half of 1990s
Area (10,000 square kilometers)	175	280	380
Share of national land	18%	29%	40%

Cross-border acid rain pollution: affecting the Korean Peninsula and Japan

Effects on the Sea of Japan coast (including Kyushu and Niigata) have been identified.

*Ichikawa et al, 1994, 1995; Ikeda et al, 1997 a,b,c; Sato et al, 1997; National Institute for Environmental Studies group on acid rain, 1997; many others

*Third acid rain survey (1993-97) by a panel on measures against acid rain at the Ministry of the Environment, released in 1999

* Courtesy call on Premier Zhu during the second Japan-China-Korea environment ministers meeting (2000, website for the Japanese Ministry of the Environment)

(4) Other Environmental Problems

- **Fast-increasing CO2 emissions:** 18.1% of total emissions (2004), the second largest share following 22.1% for the U.S. (EDMC Handbook of Energy & Economic Statistics in Japan, 2007)
- **Water pollution:** Seriously polluted (Category IV or lower) are 58.4% of the seven major river systems and 74% of the 27 key lakes and dams. Drinking water resources have been polluted in 22 of the 47 priority cities (2004).
- **Water shortage:** More than 400 of 657 cities saw drought, including 110 cities hit by serious drought (2007).

Water resources (t. tons = $t.m^3$)＝2.8124=(surface water)2.7115＋(underground water)0.8288－(overlap)0.7279

Northern Region: Accounting for 2/5 of population, 3/5 of farmland, more than 90% of coal resources, and 1/5 of water resources

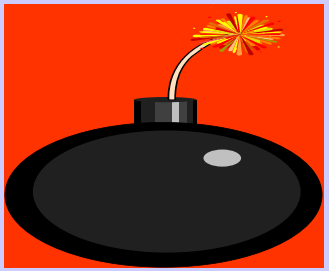
Maximum available water resources (100 m. tons = 100 m. m^3)＝ Water resources×35-40%＝7984～9125＝8555(average, 37.5%)

Nationwide water resources utilization (China Water Resources Bulletin)

	1980	1997	2001
Total water requirement（100 million m^3)	4437	5566	5567
Requirement's share of maximum available water resources	52%	65%	65%

- **Waste:** Garbage surrounds cities.
- **Farmland:** Chinese farmland accounts for 9.5% of the world, declining with soil deteriorating.
- **Desertification:** Chinese deserts total 1.74 million square kilometers (2004), accounting for 18% of national land. Of these deserts, 63% have emerged in and after the 20th century. Of the new deserts, 94% have emerged from human activities.
  - ☆ The total desert area in China expanded by an annual average of 3,436 square kilometers in the second half of the 1990s and declined by an annual average of 1,283 square kilometers in the 2000-2004 period.
- **Cross-border pollution through blizzard:**

  China＋Mongolia＋Central Asia⇒Korean Peninsula, Japan



⇒China's environmental problems have already been in critical condition

1.4 Medium to Long-term Economic Outlook ☆Economic growth ⇒☆Optimistic projections are abundant

	Results	Medium to long-term plan or outlook			
	1980-2006	2000-2010	2010-2020	2020-2030	2030-2050
Average growth	9.8	5.1-7.0-8.9	4.0-6.0-8.0	3.9-5.1-6.3	3.2-3.4-4.8
Energy Strategy Task Group (November 1996)		8.0-8.2-8.6	5.9-6.0-6.4	4.4-4.6-4.8	3.2-3.4-3.6
Chinese Academy of Engineering (May 1997)		8.0-8.3	5.9-6.1		3.3-3.5
China Energy Research Institute (February 1999, p.289)		7.3	6.6	6.3	
China Energy Research Institute (2000)		7.2	6.2		
State Council Development Research Center (November 2003)		7.2	7.2		
State Information Center (December 2003)		7.5	7.3	5.5	5.0→4.5
Government projection (March 2003) By 2020, GDP should be quadrupled from 2000.		7.2	7.2		
11th 5-year plan (March 2006)		(2005-2010) 7.5			
IEA(1998)		5.8	4.5		
IEA(2002)		5.7	4.7	3.9	
IEA(2004)		(2002-2010) 6.4		(2010-2030) 4.4	
IEA(2006)		(2004-2015) 7.3		(2015-2030) 4.3	
EIA/DOE/USA(2001)		(1997-2010) 5.1-7.4-8.9		4.0-6.5-8.0	
EIA/DOE/USA(2003)		4.5-7.0-8.0		3.5-6.0-7.0	(2020-2025) 2.8-5.3-6.3
Li (March 2004)		6.2-7.8-9.0	5.0-6.6-7.7	4.0-5.5-6.5	
Li (July 2007)		(2004-2010)	(2010-2015)	(2015-2020)	(2020-2030)
		9.2-9.7-10.3	5.5-6.6-7.6	4.3-5.6-6.9	3.7-5.0-6.3

Note: The Energy Strategy Task Group means the China Energy Strategy Study Group's "China Energy Strategy Study 2000-2050," published by China Electric Power Press in November 1996.
The China Energy Research Institute (February 1999) means "China Medium to Long-tem Energy Strategy" by Zhou Fengqi & Zhou Dadi. The China Energy Research Institute (2000) means the ERI "Natural Gas Report."
The Chinese Academy of Engineering (May 1997) means "China's Sustainable Development and Energy Strategy Study Report - 1st draft" by the academy, May 1997.
The State Council Development Research Center (November 2003) means "Basic Concept of National Energy Strategy" given at the State Council Development Research Center's China Development Forum (by Feng Fei, Zhao Fengqi, Wang Qingyi) on November 17, 2003.
The State Information Center (December 2003) means Liang Youcai's "Chinese Economic Development Review and Outlook" given on December 7, 2003.
IEA, World Energy Outlook 1998,2002,2004,2006; EIA/DOE/USA, International Energy Outlook, 2001,2003.
Li's study indicates results of simulation analyses using China's 3E-Model Ver. 2004 and Ver. July 2007.

Li's 3E-Model (July 2007), including latest data and the 11th 5-year development plan, and simulation

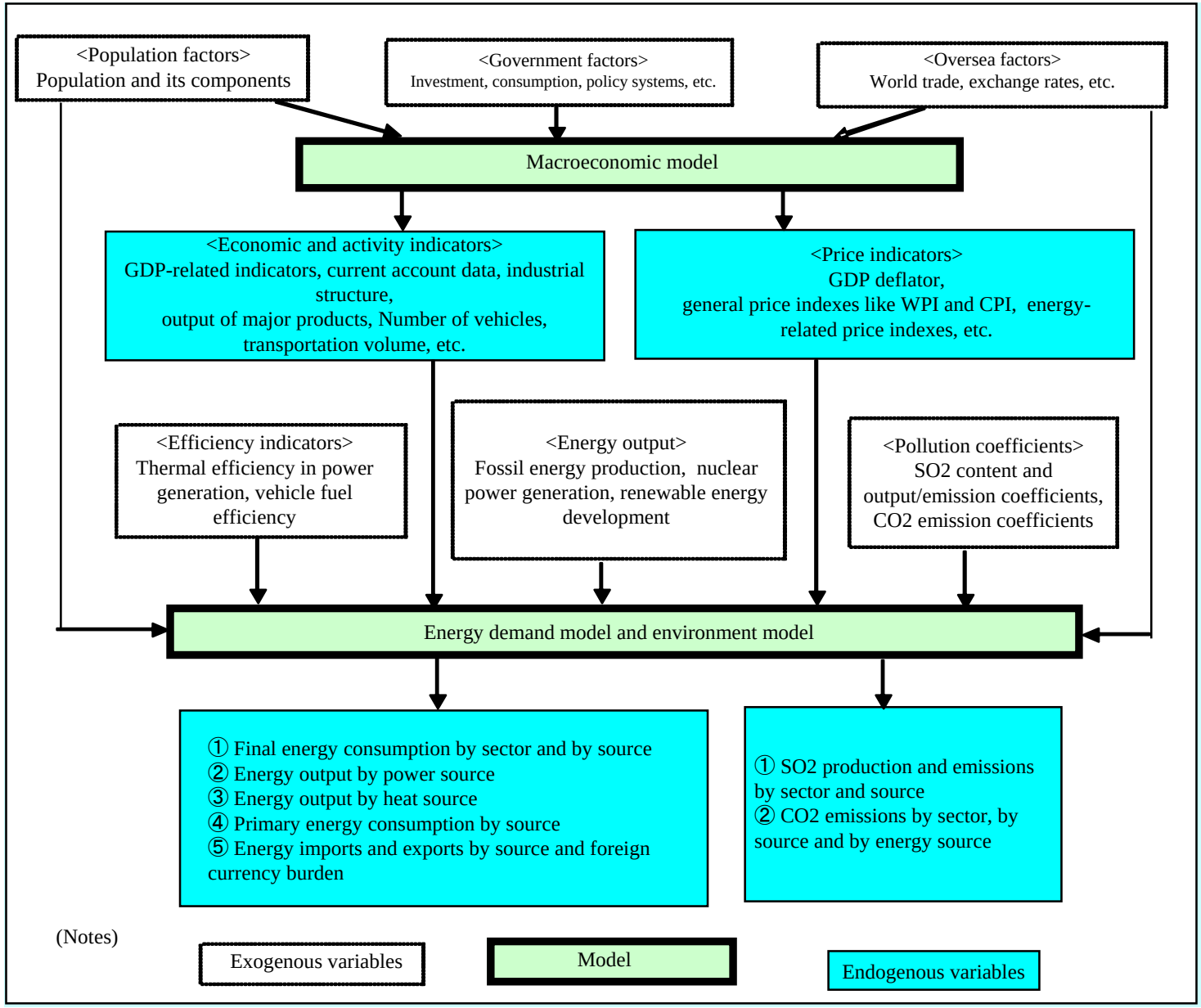
Scenario-by-scenario economic growth (2004-30): 6.5% for reference, 7.6% for higher growth, 5.4% for lower growth

Scenario-by-scenario probability: 60% for reference, 30% for higher growth, 10% for lower growth

11th 5-year plan projection: 7.5% Expectations ☆ Higher growth is possible. For example, the Energy Bureau predicts growth at 8.5%.

★ Economy, Energy and Environment Analysis Based on Integrated Model

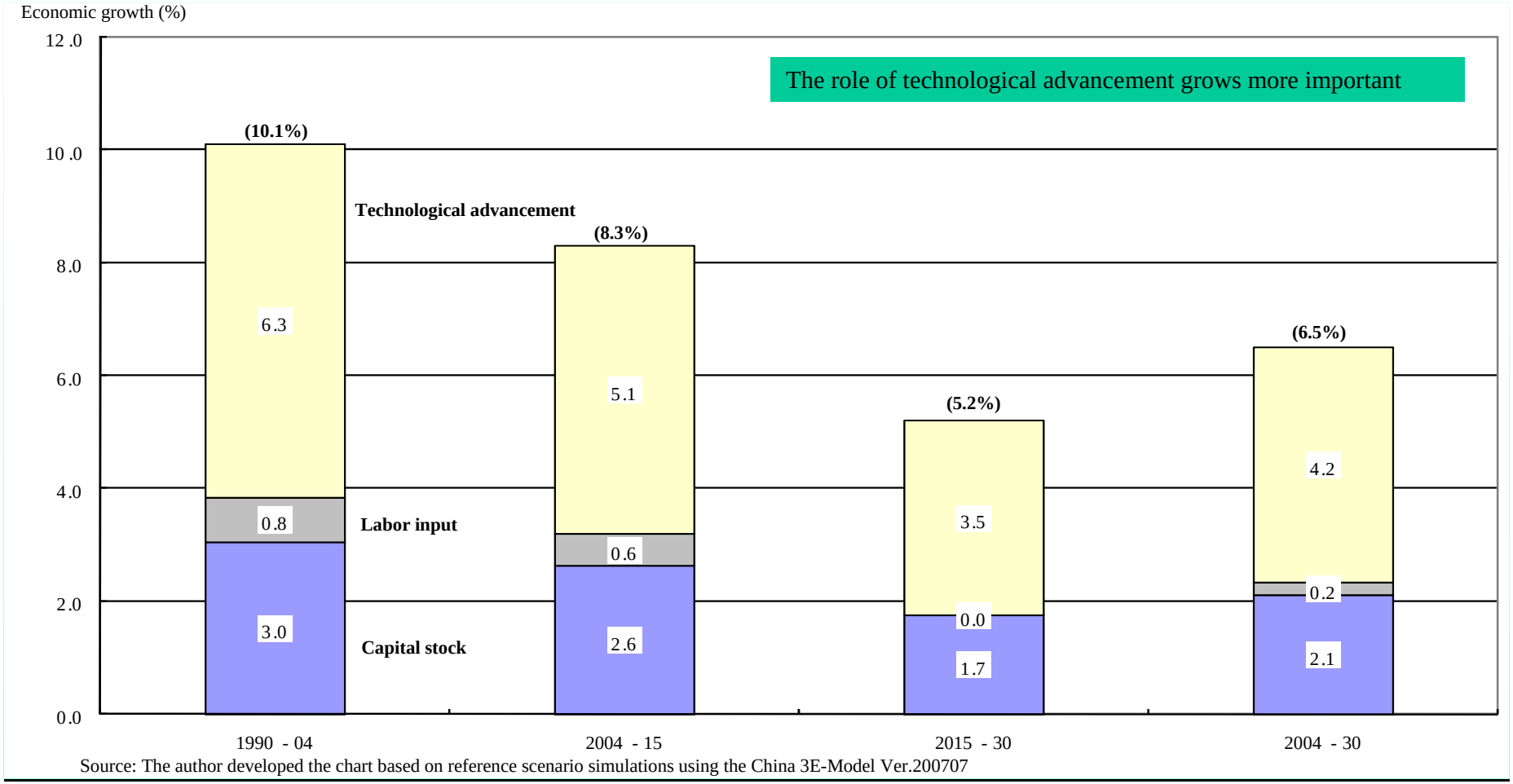
3E-Model—Econometric model, data: 1952-2005 (2006) for economy, 1971-2004 (2006) for energy and environment



113

Total at 761

648

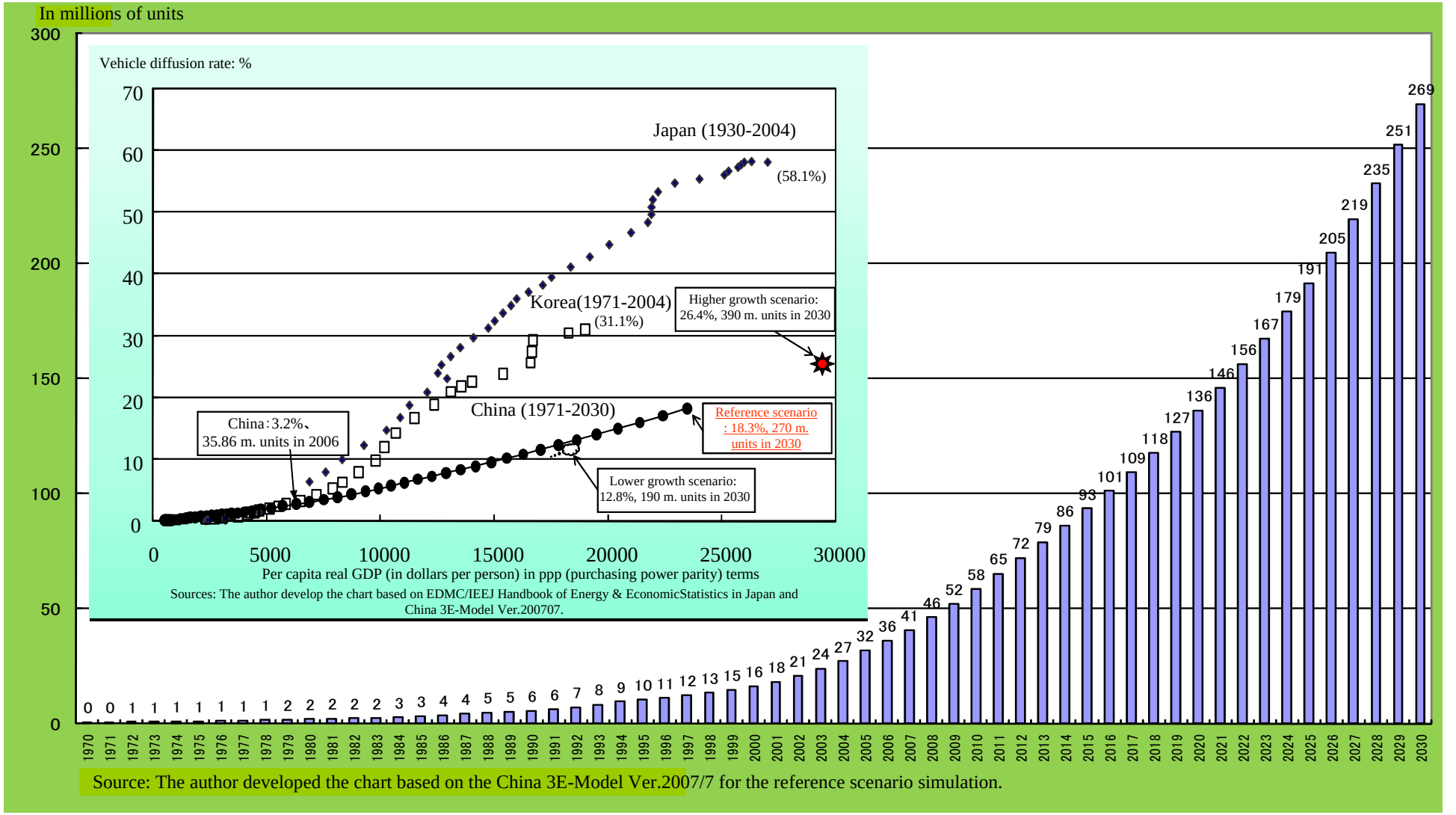


Source: The author developed the chart based on reference scenario simulations using the China 3E-Model Ver.200707

Comparison of High Economic Growth Periods			
Country or region	High economic growth period	Consecutive years of growth	Average annual growth
Japan	1947-1973	26 years	9.7%
Republic of Korea	1962-1996	34 years	8.0%
Taiwan	1962-1997	35 years	8.3%
China	1980-2004: Results	24 years	9.8%
	2004-2010: Projected	6 years	9.7%
	2010-2015: Projected	5 years	6.6%
	1980-2015	35 years	9.3%

Sources: Economic Planning Agency Economic Research Institute, *21st Century Scenario for China;* EDMC/IEEJ, *Handbook of Energy & Economic Statistics in Japan; This study.*

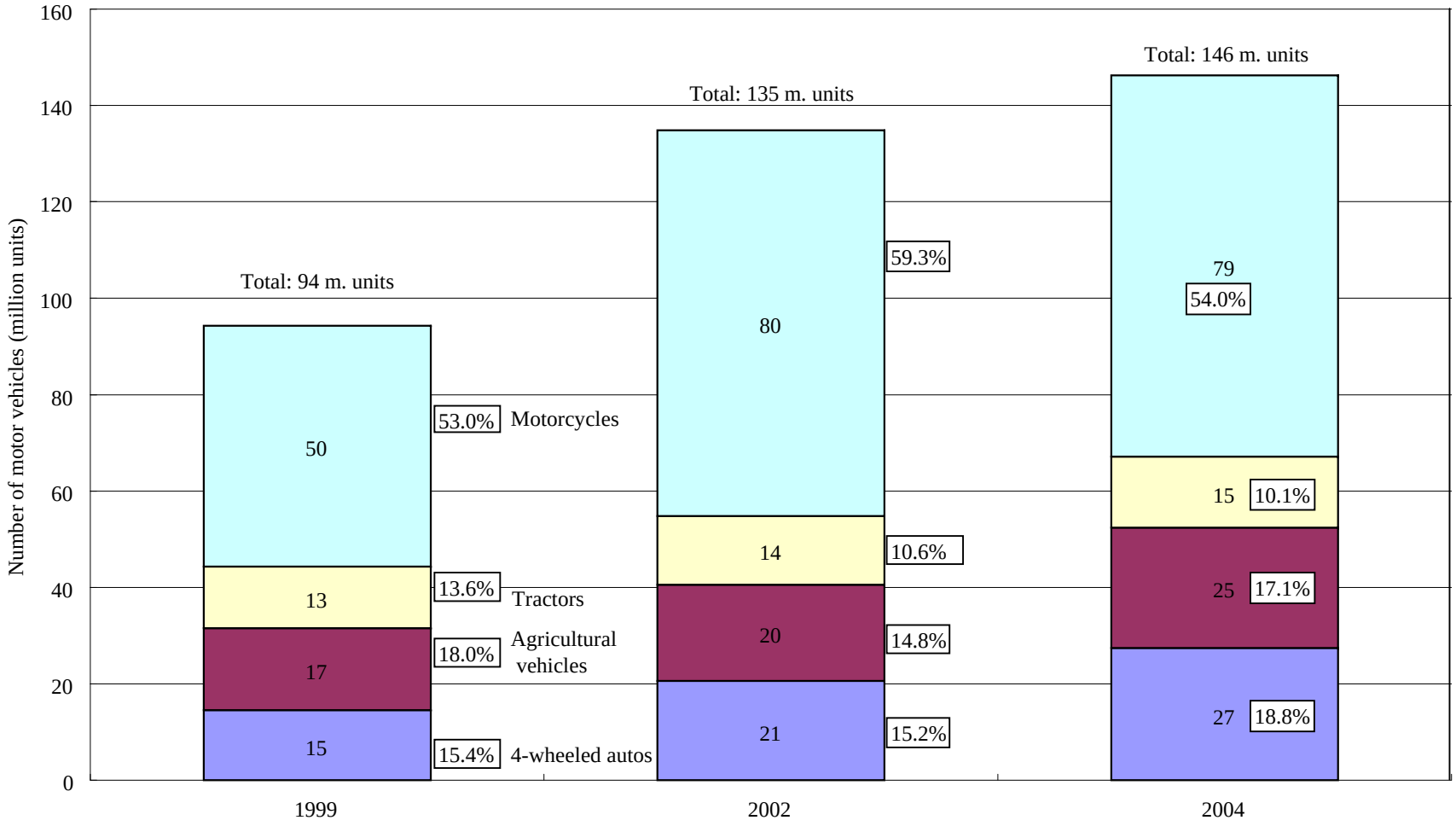
- **Modernization of industrial structure:** Primary industry, 13%(2004)→5%(2030); secondary industry, 46%⇒51%; tertiary industry, 41%→45%
- **Fast-increasing energy intensive products:** Cement, 970 m. tons ⇒1,250 m. tons; ethylene, 6.3 m. tons ⇒26.8 m. tons; steel, 300 m. tons
- **Income in 2030 would reach $20,000 PPP, a level for medium-developed countries**
- **Vehicle diffusion:** In the reference scenario, the number of vehicles would rise to 132.6 million units with the diffusion rate at 9.5% in 2020 and to 269 million units with the diffusion rate at 18.3% in 2030.



Source: The author developed the chart based on the China 3E-Model Ver.2007/7 for the reference scenario simulation.

The number of motor vehicles reached 150 million in 2004, including agricultural vehicles, transportation tractors and motorcycles. Four-wheeled automobiles' share, though increasing, is limited to 19%.

Chinese citizens would promptly shift from motorcycles to passenger cars and from agriculture vehicles and transportation tractors to trucks.



Note: The author developed the chart based on *China Statistical Yearbook*, Duan Liren (December 2003), and *2004 Environment Bulletin*.

1.5 Energy and Environment Outlook <Reference Scenario>

Primary energy consumption would reach **3.3 billion TOE in 2030,** **exceeding a combined 3.1 billion TOE for North America and Japan in 2004.** The GDP elasticity would fall from 0.53 for 1990-2004 to 0.51 for 2004-2030. The energy-saving rate would drop from 4.3% to **2.9%**

	Level						Growth, elasticity			
	Results		Outlook				Result	Outlook		
	1990	2004	2010	2015	2020	2030	1990-2004	2004-2015	2015-2030	2004-2030
Outlook under this study: Reference scenario										
Primary energy consumption (Mtoe)	666.1	1,388.9	1,873.6	2,175.9	2,511.0	3,264.1	5.4	4.2	2.7	3.3
Real GDP (in trillions of RMB, in 1995 prices)	3.4	13.2	22.9	31.5	41.4	67.3	10.1	8.3	5.2	6.5
Primary energy consumption per GDP unit (toe/million RMB)	195.4	105.6	81.8	69.2	60.7	48.5	-4.3	-3.8	-2.3	-2.9
Primary energy consumption's GDP elasticity							0.53	0.51	0.52	0.51
Information: IEA(2006a)										
Primary energy consumption (Mtoe)	666.1	1,388.9		2,286.0		3,157.0	5.4	4.6	2.2	3.2
Real GDP growth (%)							10.1	7.3	4.3	5.5
Primary energy consumption's GDP elasticity							0.53	0.63	0.51	0.58
Information: Li (2005)	(1980)	(2000)	(2010)		(2020)	(2030)	(2000-2010)	(2010-2020)	(2020-2030)	(2000-2030)
Primary energy consumption (Mtoe)	412.9	929.3	1,405.7		2,062.8	2,974.0	4.2	3.9	3.7	4.0
Real GDP (in trillions of RMB, in 1995 prices)	1.4	8.7	18.4		34.9	59.5	7.8	6.6	5.5	6.6
Primary energy consumption per GDP unit (toe/million RMB)	302.2	106.8	76.5		59.0	50.0	-3.3	-2.6	-1.6	-2.5
Primary energy consumption's GDP elasticity							0.54	0.59	0.68	0.60
Information: IEA (2004)	(1980)	(2000)	(2010)		(2020)	(2030)	(2000-2010)	(2010-2020)	(2020-2030)	(2000-2030)
Primary energy consumption (Mtoe)	412.9	929.3	1,395.0		1,836.0	2,303.0	4.1	2.8	2.3	3.1
Real GDP growth (%)							6.7	4.9	4.0	5.2
Primary energy consumption's GDP elasticity							0.62	0.57	0.57	0.59
Information: State Council Development Research Center (2003)		(2000)	(2010)		(2020)	(2030)		(2000-2020)		
Real GDP growth (common to all scenarios, %)								7.2		
Primary energy consumption (Mtoe): Reference scenario		910.4	1,510.7		2,342.7			4.8		
Policy adjustment scenario			1,462.3		2,078.7			4.2		
Policy enhancement scenario			1,324.0		1,786.3			3.4		
Primary energy consumption's GDP elasticity: Reference scenario								0.67		
Policy adjustment scenario								0.59		
Policy enhancement scenario								0.48		

Sources: The author developed this table based on This Study (3E-Model Ver.200707), IEA (2006a), Li (2005), IEA(2004), State Council Development Research Center (Feng, Zhou, Wang, 2003).

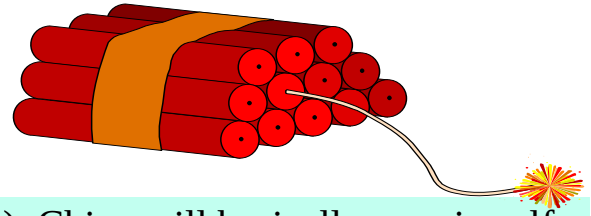
Note: Data for conversion of electricity into primary energy for State Council Development Research Center (2003) have been adjusted to the IEA standards and are different from original data.

☆This scenario is almost identical to a scenario of the State Council Development Research Center ⇒ Effects of the 3E Project (reports, seminars, etc.)

☆Primary energy consumption in the reference scenario is far more than projected by IEA (2004) and slightly more than predicted by IEA (2006). IEA projects economic growth at 5.5% against 6.5% in the reference scenario.

☆IEA (2007) projects economic growth at 6.0%, primary energy consumption at 3.79 b. TOE for 2030 in the reference scenario and at 3.2 b. TOE in the policy-implemented scenario.

<Reference Scenario>: 2030 Supply/Demand Balance and Security Problem



☆While demand will increase for coal mainly for power generation (50%→60%), China will basically remain self-sufficient in coal.

⇒Expansion of production, ensuring of transportation capacity and diffusion of clean coal utilization are future challenges. **☆China will lose capacity to export coal in the long run.**

☆ Demand for oil mainly for automobiles (22%→37%) will expand from 350 million tons in 2006 to 930 million tons in 2030. As domestic production is limited to 230 million tons (including 46.5 million tons in oil substitutes), net oil imports will increase rapidly to 710 million tons. China will thus depend on imports for 76% of its oil supply.

⇒Resources security problem: How could China curb its dependence on the Middle East? ⇒ Growing importance of neighboring oil-producing countries

⇒Transportation safety problem: Is transportation through the Straits of Malacca safe? How much can China secure imports through pipelines?

⇒Foreign currency burden

☆ While natural gas demand in China will increase rapidly mainly in the consumer sector (29%→53%) and the power generation sector (5%→28%), domestic supply growth will fail to catch up with the demand expansion. China's net natural gas imports are projected at 160 billion cubic meters for 2030, indicating China would depend on imports for 52% of its natural gas supply.

⇒Securing supply through LNG and pipeline gas imports and safety of transportation

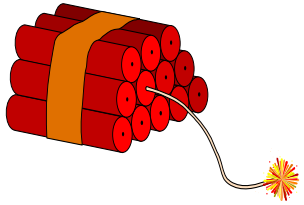
⇒Foreign currency burden

☆Foreign currency burden for energy imports

5.3% (2004) → 8.2% (2030) in export value, 6.4% → 10% in import value

<Reference Scenario> Outlook for Environmental Problems

<Reference Scenario> Fast-increasing CO2 emissions



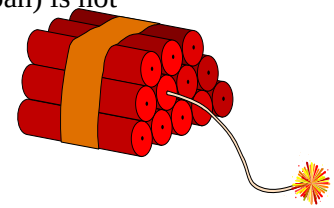
Emission doubling to 2.6 billion T-C in 2030 with per capita emissions at 1.8 T-C → Pressure will grow further on China to curb or reduce emissions

	China		International levels for 2004			
	2004	2030	U.S.	Japan	OECD	World
Per capita CO_2 emissions (t-c/person)	1.0	1.8	5.5	2.7	3.1	1.1
Ratio of Chinese level in 2030 to international levels in 2004			32%	65%	57%	155%
Chinese government efforts: ① The 10th 5-year development plan called for favorable measures for curbing emissions. ② The 11th 5-year plan called for obtaining effects of emission curbs. ③China does not have emission reduction targets but has energy conservation targets and is promoting development of renewable energy and afforestation.						

Sources: International levels are from IEEJ/EDMC Handbook of Energy & Economic Statistics in Japan. Chinese levels are from the 3E-Model Ver.200707 reference scenario.

<Reference Scenario> Growing pressure on China to protect air

SO2 emissions are projected to rise from 34.67 million tons in 2004 to 67.7 million tons in 2030. The overall desulfurization rate should be raised to at least 73% to keep SO2 emissions within the environmental capacity (18 million tons). The rate (against 85% in Japan) is not impossible but difficult to achieve.



<Reference Scenario> Water shortages, food crises, etc.

・As water demand increases close to the estimated maximum capacity of 800 billion tons, water shortages will grow more serious in the northern region, particularly big cities.

・Progress of desertification ・Decreasing farmland and deteriorating soil quality ・Declining and deteriorating grassland

⇒ Food safety (food shortage ?) problems could emerge.

・Domestic production capacity：Past peak output at 512 million tons (1998). Decreasing farmland, deteriorating soil quality, limits on production per unit area

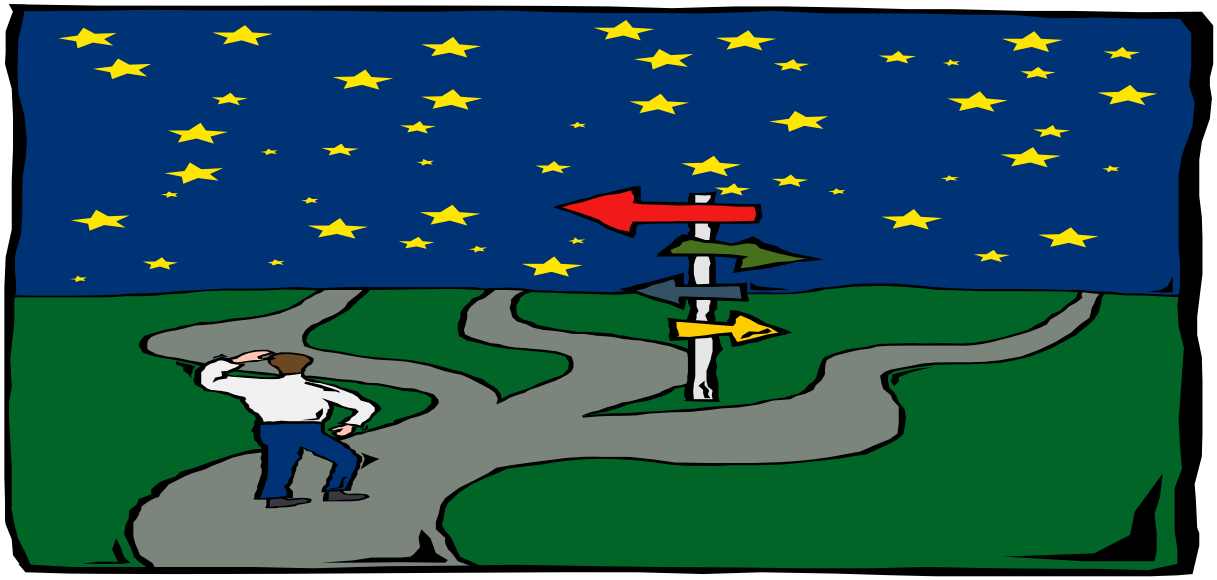
・Demand: Population growth and eating habit changes could boost food demand to more than 600 million tons in 2020.

・Balance: Annual net food imports are projected at 10 million tons (according to Chinese views) to 300 million tons (according to the Lester Plan)

Tentative Conclusion on Reference Scenario

Under the traditional development model (existing trends of changes and present policies), development foundations are vulnerable and development is likely to become unsustainable.

⇒ <u>Questing for a new development model</u>



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I here would like to thank them for helping me. However, I am responsible for this report and relevant materials.

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