

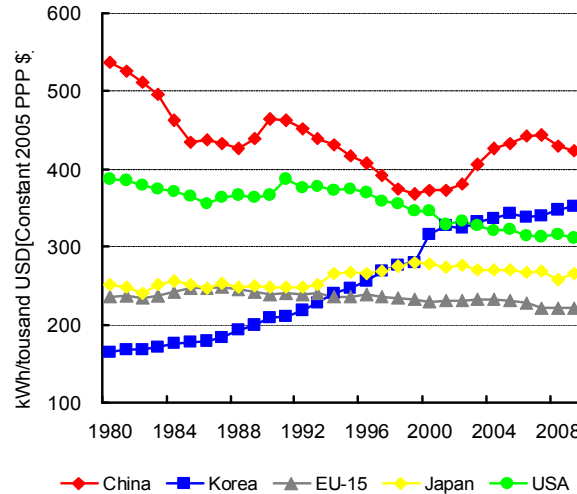
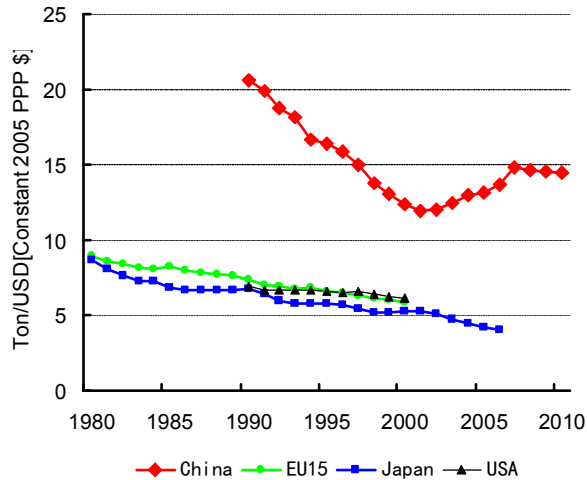
Comparative Study on Green Growth Strategy in China and Korea

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2014.1.14

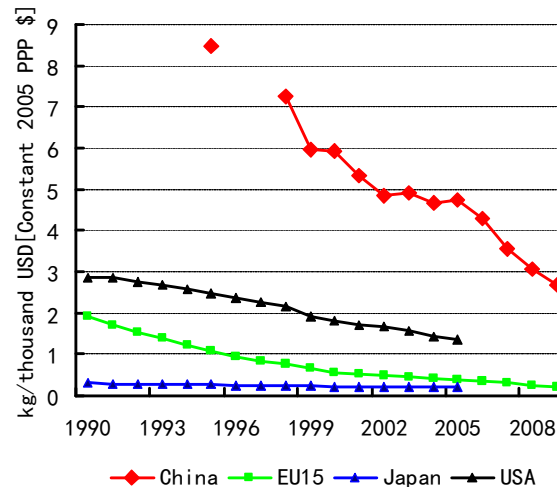
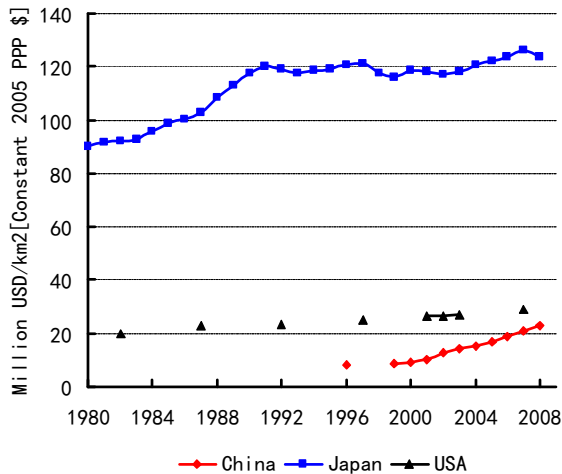
Part 1: Why a Green Development Strategy is So Important for China?

1. The Traditional Mode of Economy Growth Is No Longer Feasible



- In 2010, the amount of direct material input (DMI) per unit of GDP was 14.5 tons in China, while this indicator was only 5.9 tons in 2000 in EU-15 and 4 tons in 2006 in Japan.
- In 2009, electricity consumption per unit of GDP was 0.424 kWh in China, and it was 1.6 times of that of Japan and 1.9 times of that of EU-15.

Direct material input per unit of GDP Electricity consumption per unit of GDP



- In 2007, GDP per square kilometer of construction land was 21.1 million dollars in China, and it was 72.2% of that of USA and 16.7% of that of Japan.
- In 2009, SO₂ emissions per unit of GDP of GDP was 22.68 g,

GDP per square kilometer of construction land SO2 emissions per unit of GDP

1. The Traditional Mode of Economy Growth Is No Longer Feasible



Environmental and natural resource degradation and depletion in 2008

At China's current level of development, the environmental degradation and resource depletion in the country is valued at approximately 9 percent of gross national income (GNI), more than 10 times higher than corresponding levels in Korea and Japan, of which air pollution accounts for 6.5 percent, water pollution 2.1 percent, and soil degradation 1.1 percent.

2. The Traditional Mode of Industrialization Is No Longer Feasible

- Overall, China's industrial growth continues to show deterioration in technical efficiency trend. Although the technical efficiency of the Eastern Region during the past 25 years has improved, it is still difficult to offset the impact of the deterioration of the technical efficiency of the Central Region, the Western Region and the Northeast Region.

Table Technical Efficiency Deterioration of Industrialization in China from 1985-2009

Time period	The Nation	The Eastern Region	The Central Region	The Western Region	The Northeast Region
1985-1990	0.413	0.256	0.494	0.483	0.488
1991-1997	0.44	0.194	0.536	0.57	0.549
1998-2003	0.492	0.218	0.608	0.651	0.586
2004-2009	0.502	0.213	0.621	0.669	0.621

(Source: Pang Ruizhi, Li Peng. Regional Disparity and Dynamic Evolution about China's New Industrialization Growth Performance, 2011.)

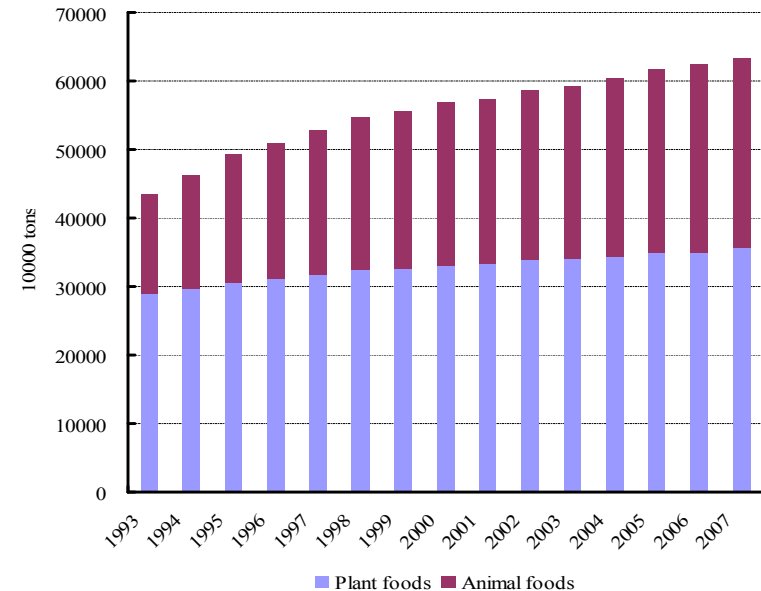
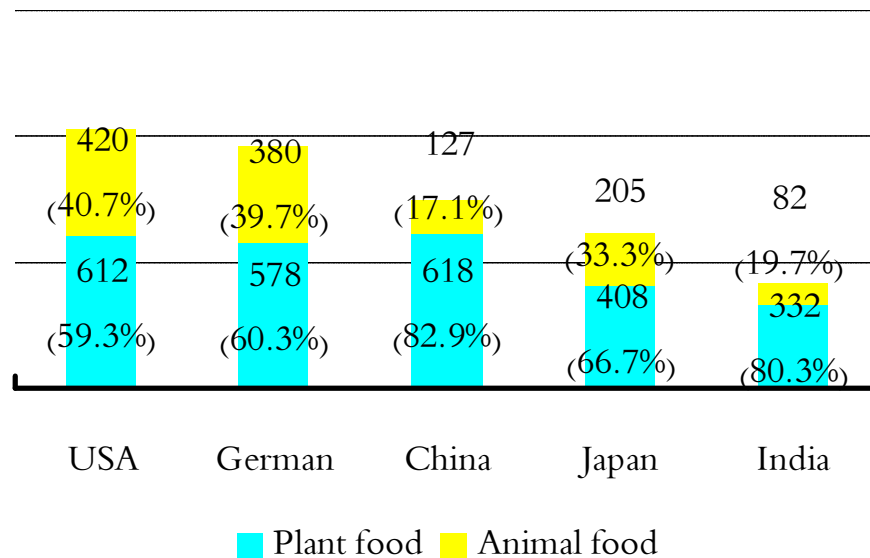
2. The Traditional Mode of Industrialization Is No Longer Feasible

- During the transitional period of imitation and independent R&D from 1993 to 2009, the share of the contribution of technological progress to economic growth was only 20.7% and the elasticity coefficient was only 0.13 in China. This suggests that many technological achievements do not have the economic benefits. And it was still the improvement in technical efficiency rather than technological progress dominating the Nation's industrial restructuring. Technological innovation has not yet become the main way of technological development.
- From the investment point of view of independent innovation, the R&D expenditure of high-tech industries in China as a percentage proportion of industrial added value level (6%) was far behind that of the United States (36.8%) , Japan (28.9%) and other developed countries .
- This directly caused the extension of excess capacity in the traditional industries such as cement, steel, nonferrous metal to the new and high-tech industries such as vehicle manufacturing,

3.The Traditional Mode of Urbanization Is No Longer Feasible

- From 1978 to 2011, the proportion of urban population increased from 17.92% to 51.3% in China. The average annual urbanization rate increased 1.2 percent per year. 1991-2010, China's urban built-up area expanded 2.12 times, while the urban population grew by only 0.89 times. The rate of land expansion was 2.38 times of the rate of urban population growth.
- From 1996 to 2010, with the growth of every percentage in the urbanization rate, an additional 49.4 million tons of standard coal, 6.45 million tons of steel and 21.9 million tons of cement increased in average.
- The average annual growth rate of urbanization was 3.12% from 2001 to 2010, far below the average annual growth rate of built-up area (5.84%) and the growth rate of urban electric power consumption (12.62%). It was also lower than the growth rate of urban solid waste generation (5.64%) and the growth rate of urban sewage emissions (5.72%) in China.

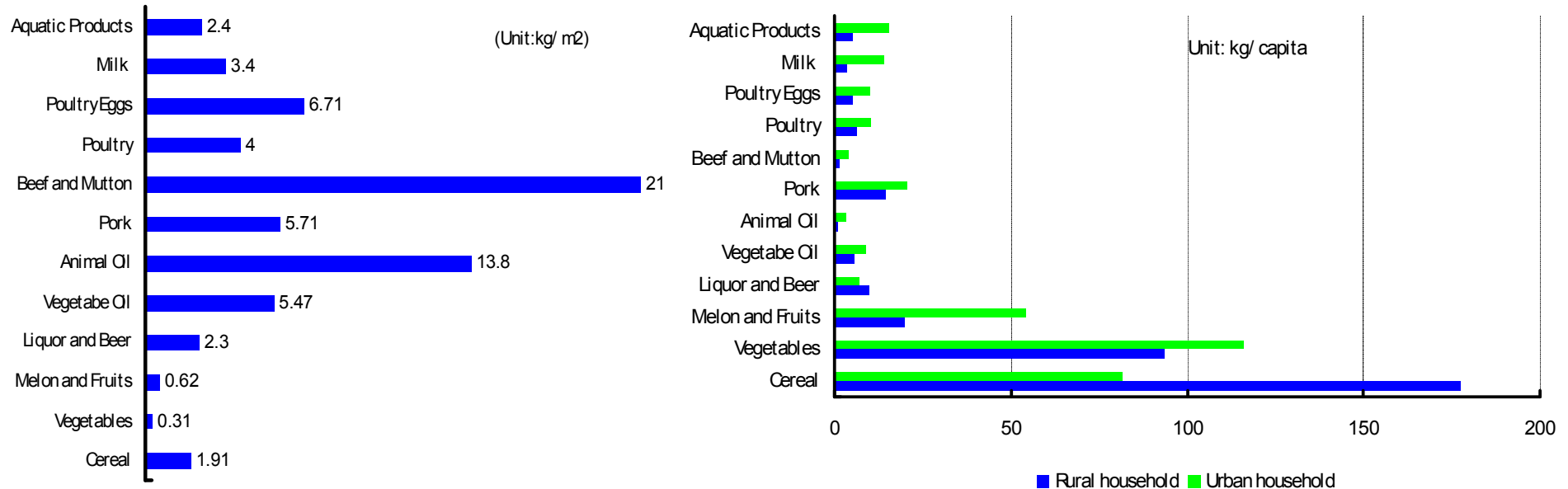
4. The Traditional Mode of Urban Household Consumption Is No Longer Feasible



Food consumption structure in different countries. The trend of food consumption in China

- Food consumption:** The proportion of plant food consumption per capita in all food consumption per capita is 82.9% in China in 2007, which was still much higher than that of U.S. (59.3%), Germany (60.3%), and other developed countries. With the advance of urbanization and the improvement of rural household's living standard, it can be expected that the proportion of plant food consumption per capita will decrease, while the proportion of animal

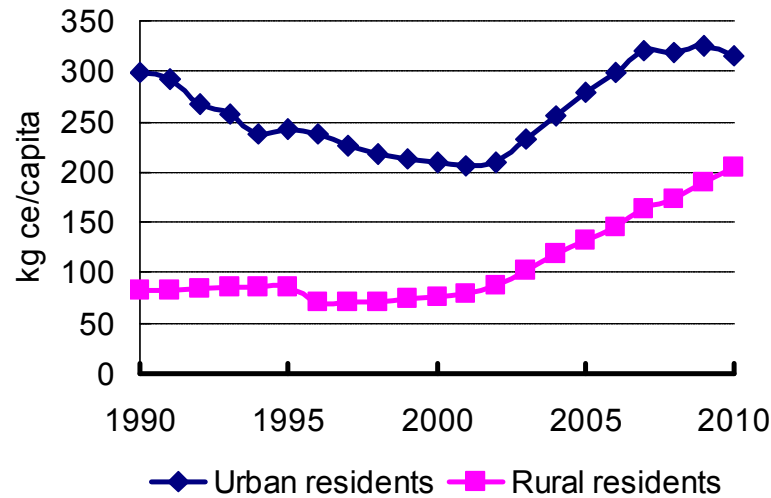
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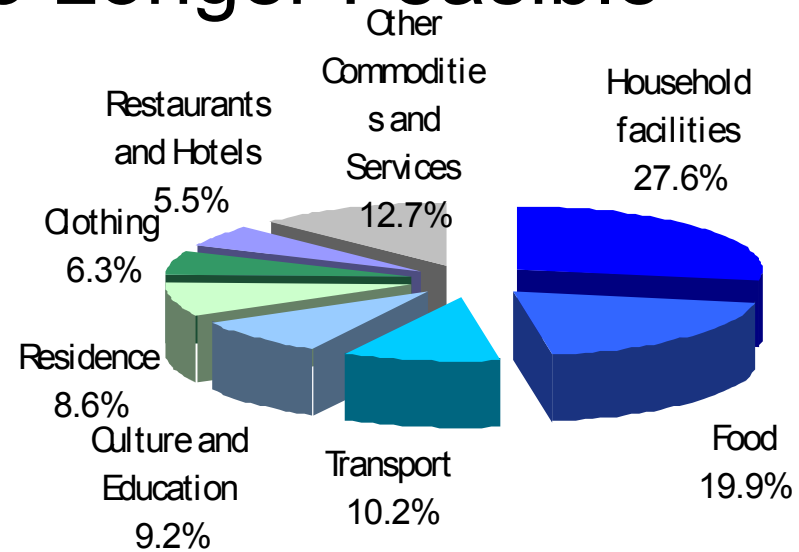
Land requirement per unit food Food consumption by rural household and urban household

- Because the virtual water content, land use and pollutant emissions per unit mass animal food are much higher than those of plant food, the steady increase of animal food consumption will increase the pressure on the environment and nature resource such as water and arable land. According to our estimation, from 2013 to 2030, 16800 square kilometers of extra land resources should be supplied to meet the food demand from plant food to animal food of 0.2 billion farmers moving from rural area to cities and towns

4. The Traditional Mode of Urban Household Consumption Is No Longer Feasible



Energy consumption by urban and rural residents

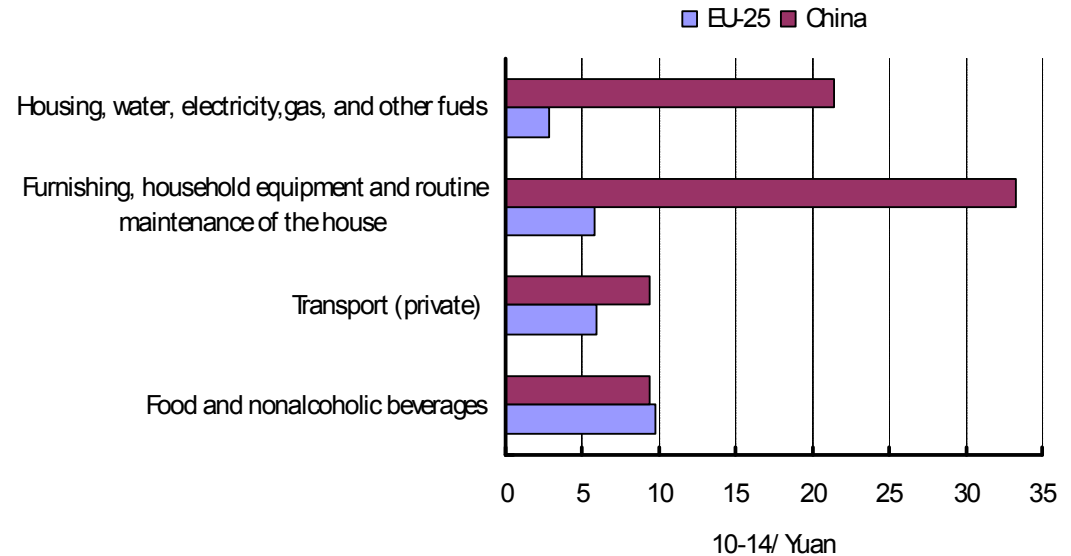


The structure of aggregate environmental impact caused by different consumption domains

- Consumer durables consumption:** Chinese society transitioned from an era of necessities into an era of consumer durables over the past two decades. The rapid growth of PC and private car ownership led the energy used by urban household in China to increase from 207 kg of standard coal per capita in 2001 to 315 kg of standard coal per capita in 2010. Among all consumption domains of the urban household expenditure in China in 2007, the top 4 highest domains in aggregate environmental impact were *Household equipment and services (27.6%)*, *Food and nonalcoholic*

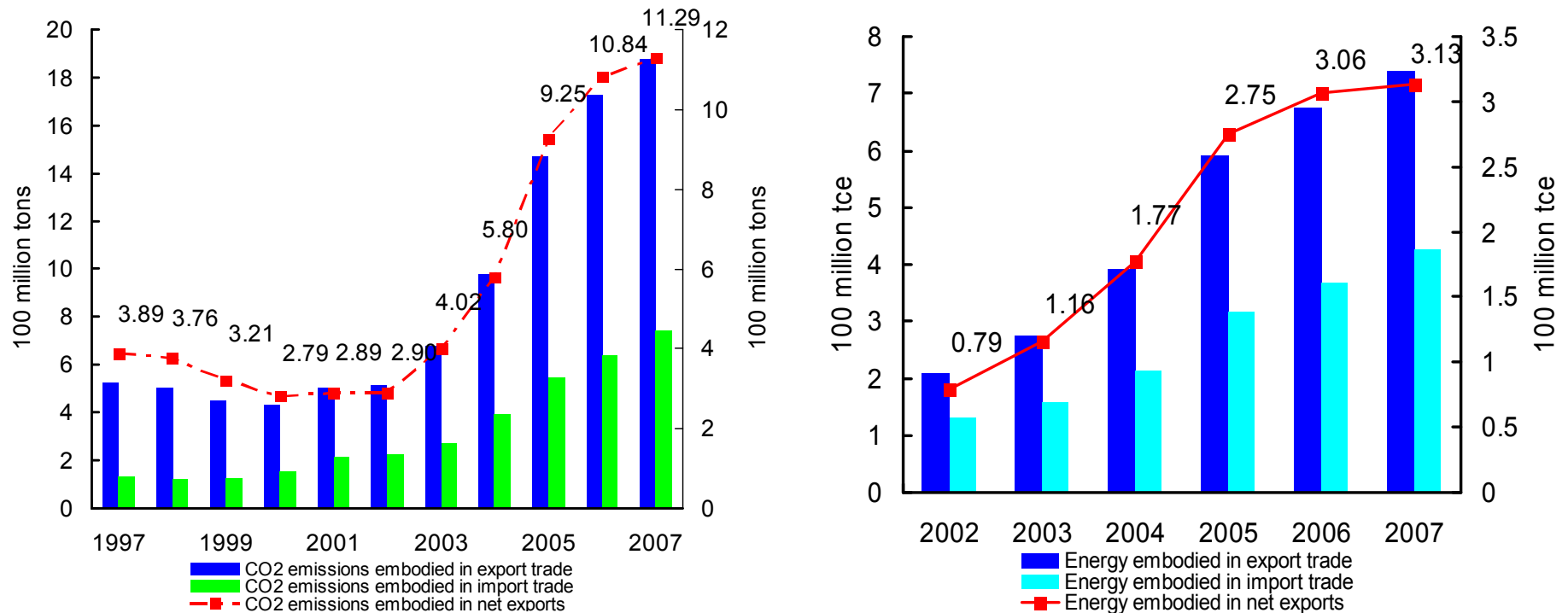
4. The Traditional Mode of Urban Household Consumption Is No Longer Feasible

The aggregate environmental impacts per unit household consumption expenditure in Housing, Household equipment and service, Transport (private) were 7.40, 5.75, 1.59 times higher than those of EU-25



- In 2007, the expenditure in *Household equipment and services* accounted for 6.02 percent of urban household expenditure in China, but the cumulative environmental impact accounted for 27.6% of the total impacts. While in 2005 the expenditure in *Furnishing, household equipment and routine maintenance of the house* accounted for 12% of urban household expenditure in EU-25, the cumulative environmental impact was only 13.9% of the total.

5. The Traditional Pattern of Foreign Trade Is No Longer Feasible



- In 2007, CO₂ emissions embodied in net exports of China reached 1.129 billion tons, accounting for 20.3% of total domestic CO₂ emissions. And energy embodied in net export trade reached 313 million tons of standard coal. 33.8%, 26.3% and 56.1% of China's total CO₂ emissions, energy consumption and SO₂ emissions were caused by exports, respectively.

Part 2: Experience of South Korea: Revelation to China

1. Foster Green Sources of Growth

Green Transformation of Traditional Sectors

Table Energy Productivity of China and Korea

(Unit: US\$ per ktoe)

	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011
China	1.45	2.13	3.08	3.16	3.26	3.52	3.57	3.61	3.71	3.82
Korea	5.02	4.72	4.68	5.22	5.40	5.46	5.47	5.43	5.29	5.32
USA	4.20	4.49	4.93	5.44	5.64	5.65	5.78	5.87	5.90	6.04
Japan	7.45	7.08	7.07	7.47	7.61	7.84	8.07	8.00	7.94	8.55

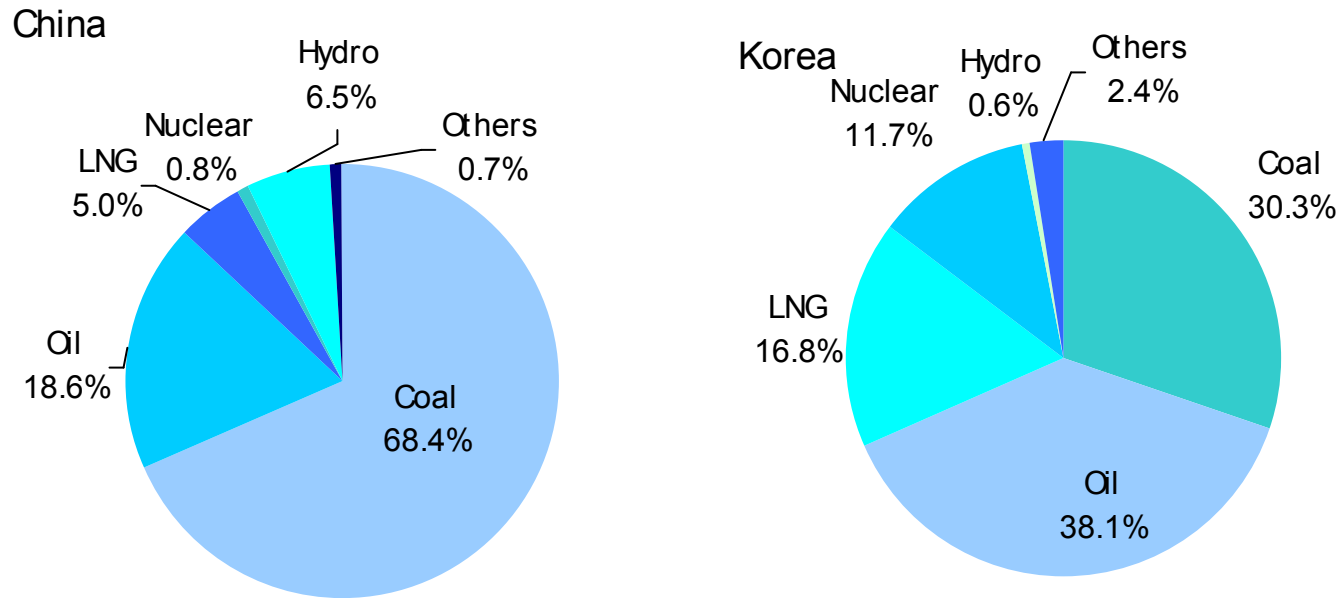
(Source: OECD-Statistic Database.)

Korea's energy efficiency objective is to reduce energy intensity by 46 percent between 2007 and 2030. The overall energy savings goal for 2030 is nearly 38 Mtoe, 44 percent of which should be achieved in industry (17 Mtoe), 32 percent in the residential and commercial sector (12 Mtoe), 19 percent in the transport sector (7 Mtoe), and 5 percent in the public sector (1.9 Mtoe).

1. Foster Green Sources of Growth

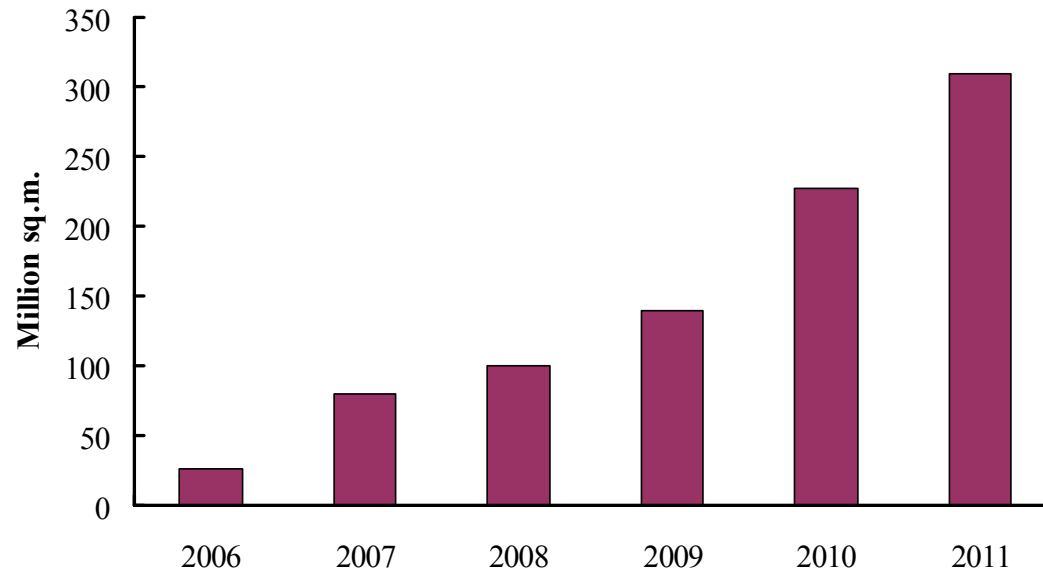
- Green Transformation of Traditional Sectors
- Despite the unprecedented progress China has made in reducing the energy intensity of its economy over the past three decades, a large gap between China and the high-income countries remains in energy productivity. During the “ Eleventh Five Year” period, new green technologies have been implemented to improve the energy efficiency in traditional sectors in China.
- Take the ten major energy conservation projects as an example. From 2006 to 2010, the central budget for investment and the special funds for energy conservation of central government arranged 30.5 billion Yuan to implement 5100 projects contained in the ten major energy conservation projects, which formed an energy-saving capacity of 160 million tons standard coal. Over the past five years, China's steel industry promoted the use of complementary energy such as blast furnace gas, coke oven gas and converter gas. self-generating capacity increased from 6.8 million kilowatts in 2005 to 16.8 million kilowatts in 2009.

1. Foster Green Sources of Growth



- Expansion of Emerging Green Industries
- Emerging industries are green if they emit low levels of pollution and greenhouse gases. The most concrete example of emerging green industries is new and renewable energy industry. The proportions of new and renewable energy consumption in China and Korea were 8.0% and 14.7%, respectively. The targets of the proportion of new and renewable energy consumption in 2015 and 2020 in China are 11.4% and 15%. And the targets of the proportion of new and renewable energy (except nuclear energy) consumption in Korea are 4.3% and 6.1% in 2015 and 2020.

1.Foster Green Sources of Growth



GSHP (Ground Source Heat Pump)
Cumulative Application Area in China

- Since 2005, implementation of green growth strategy fostered new and huge green markets in China. Take the market of energy-saving equipment as an example. In 2010, the market size of ground source heat pump was about 2.5 billion Yuan, an increase of about 31%, the largest increase in recent years. In 2011, the market size reached 3.1 billion Yuan. Starting in 2011, the Ministry of Finance, the Ministry of Housing and Urban-Rural Development launched a public building energy-saving demonstration of key cities.

1.Foster Green Sources of Growth

- The first batch, including Shenzhen, Tianjin and Chongqing, received a total of 240 million central financial subsidy funds. At least 12 million square meters will be completed in public buildings energy saving in these three cities. By 2015, public building energy consumption per unit area of key cities should be reduced by more than 20%, of which large public buildings energy consumption per unit area should be reduced by 30%.
- In August 2013, the State Council of China issued a document named “Views About Accelerating the Development of Energy-saving and Environmental Protection Industry“. This document put forward the goal to promote the faster development of energy-saving and environmental protection industry from 2013 to 2015: in 2015, the gross output value of this industry will reach 4.5 trillion Yuan, And it will become a new pillar industry of the national economy.

1. Foster Green Sources of Growth

- Expansion of the Service Sector
- The green transformation will impact the service sector in two ways. First, it will give birth to new green service industries, such as ecosystem services, carbon asset management services, carbon trading, and contract energy management. Second, it will support the country's intended economic rebalancing away from heavy manufacturing and toward a larger service sector. Meanwhile, One of the benefits of developing the service sector would be to reduce energy-intensity.

Table . The Share of Service Sector in Total Value Added in China and Korea

	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011
China	31.5	32.9	39.0	40.5	40.9	41.9	41.8	43.4	43.2	43.3
Korea	49.5	51.8	57.3	59.0	59.7	60.0	60.8	60.4	58.5	58.1
Japan	60.4	65.4	67.4	70.7	70.8	70.7	71.4	72.9	71.5	
USA	70.1	72.1	75.4	76.6	76.7	76.9	77.6	79.3	78.8	
Germany	61.2	66.6	68.2	69.7	69.1	68.6	69.4	72.4	71.2	
OECD	65.1	68.3	70.8	72.7	72.7	72.9	73.5	75.4	74.4	

1. Foster Green Sources of Growth

- Expansion of the Service Sector
- In contrast to the high share of energy-intensive industry in GDP, the share of the service sector in Korea is one of the lowest at 60% of value added. And energy intensity in services in Korea is less than one third of that of manufacturing.
- Compared with Korea, the share of services in total value added was much lower in China, But the emerging green service sector is already important. During “Eleventh Five-Year” period, the gross output value of energy service industry increased from 4.73 billion Yuan to 83.629 billion Yuan, with an annual growth rate above 40%. By the end of 2011, the gross output value of China’s energy service industry reached 125 billion Yuan, of which the gross output value of Energy Performance Contracting (EPC) accounted for 41.2 billion Yuan, almost one-third of the total energy service industry.
- And according to estimates by the DRC, the energy intensity of output (value added) by services was one-fifth of secondary industries in 2009. Every percentage point increase in the share of services in GDP is associated with a decline in energy consumption of 1.4 percentage points in China.

2. Promote environmental tax

Revenue from environmental taxes in Korea increased from 2.16% of GDP in 1995 to 2.86% in 2007, then it decreased to 2.42% in 2011. In China, the ratio of revenue from environmental taxes to GDP is 1.36% in 2011. However, the growth rate of this ratio increased fast since 2000.

Table . The Ratio of Revenue from Environmental Taxes to GDP in

	1995	2000	2005	2006	2007	2008	2009	2010	2011
China	0.00	0.39	0.76	0.77	0.78	0.76	1.27	1.42	1.36
Korea	2.16	2.79	2.72	2.68	2.86	2.75	2.45	2.78	2.42
Japan	1.69	1.73	1.75	1.72	1.68	1.61	1.68	1.60	1.59
USA	1.12	1.00	0.89	0.88	0.84	0.81	0.82	0.80	0.46
Germany	2.35	2.36	2.49	2.42	2.24	2.21	2.29	2.18	2.24
OECD	1.93	1.80	1.78	1.72	1.71	1.62	1.68	1.65	1.43

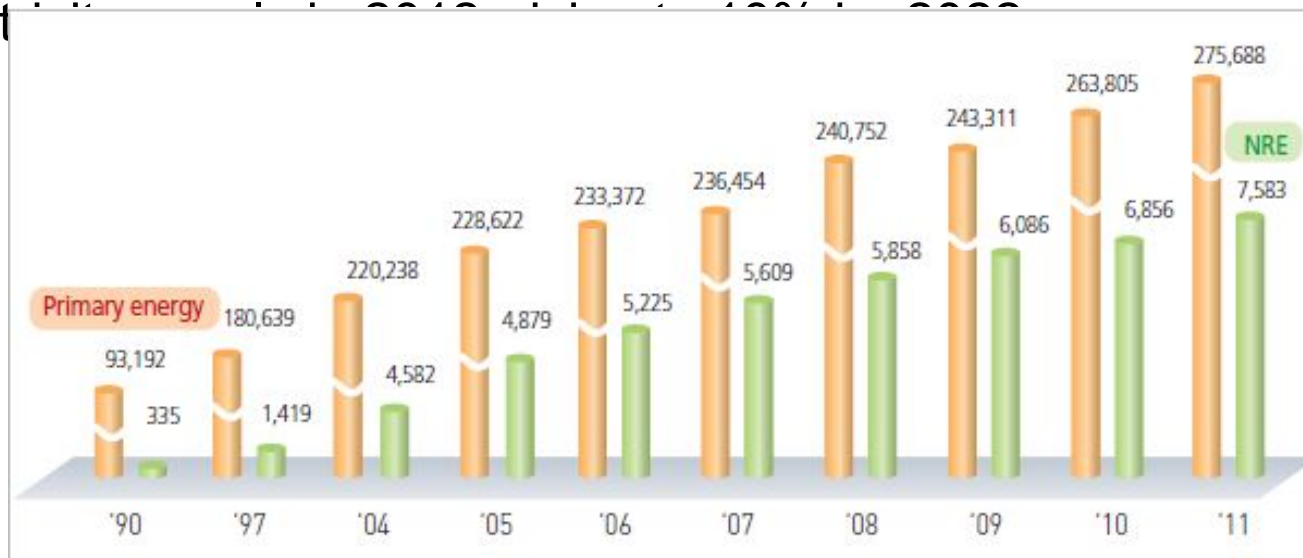
At present, China mainly takes measures such as administrative penalties and pollution charge to control environmental pollution. Because the level of penalty fees is less than the cost to reduce pollution by enterprises, enterprises lack the motivation to cut the emissions and tend to accept the punishment. So the effect of the implementation of the policy is not obvious.

2. Promote environmental tax

- In 2013, the scheme to levy environmental tax has been submitted to the State Council of Chinese government. It is estimated, based on the tax base of 2006, the gross national environmental tax revenue would reach 233 billion Yuan, which makes up 6.0% of the total government fiscal revenue and 6.7% of the tax revenue respectively.

3. Make Subsidies More Greener

- How to subsidy Renewable Energy industry
- In 2002, a Feed-In-Tariff (FIT) system has been established in Korea. With the promotion of FIT system, the share of renewable energy in total primary energy supply (TPES) increased from 1.4% to 2.75% in 2011.
- In 2012, the government replaced the FIT with Renewable Portfolio Standard (RPS). The RPS target for renewables is 2% of total elect



(Source : Korea Energy Management Corporation, New and renewable energy

3. Make Subsidies More Greener

- An important reason for shifting from a price-based instrument to a quantity-based instrument is that it can reduce the financial burden on the government as it no longer has to provide subsidies.
- And this is just the problem the Chinese government meets with. Renewable energy tariff standard increased from 0.1 cent/kWh to 0.8 cent/kWh at the end of 2011. According to the published plan, China's subsidies for electricity from renewable sources are no less than 100 billion Yuan in 2015. According to the estimation at the current level of 0.8 cents per kWh, even if all due taxes, about 48 billion yuan may be levied for funding renewable energy tariff subsidies in 2015. But there are still over 500 million funding gap. Until then, the government will face a dilemma, either to default subsidies, or to rise electricity price.
- At present, since the downward pressure on China's economy is increasing, the rise in electricity price will greatly affect the competitiveness of enterprises and offset the bonus from structural tax cuts and other measures to them

3. Make Subsidies More Greener

- Meanwhile, disadvantages of government subsidies continue to appear in 2013. The “Gold Sun” demonstration project, which gives 50% to 70% of the construction end subsidies to the solar roof project included in the list, started from 2009. A total of more than 900 projects have been included in the list of subsidies, for which the central government subsidies amounted to more than 200 billion Yuan. However, a number of companies and units defrauded the central government’s subsidies of about 260 million Yuan by fabricating false application materials, etc.
- Relevant departments in China have begun to realize that subsidies are not a permanent solution. It can cope with a relatively low price of wind power. But once the scale of photovoltaic power generation with higher price grows as quickly as that of wind power, subsidies will not work. Tradable certificate systems tend to be more effective in promoting renewable energy if they use long-term contracts, thus reducing the risk associated with the short-run volatility of certificate prices. It provides an alternative choice for the Chinese government

4. R&D in Green Technologies

- To avoid government failure, policies to promote green industries should be as neutral as possible, focusing on basic and long-term R&D in technologies that are still too far from commercial viability to attract private investment.
- Compared to the total national R&D investment increase from USD 10.26 to USD 11.37 billion (10.8%) over the same period, the increase in green technology R&D (40.0% for overall green technology and 35.1% for 27 core green technologies) confirms the remarkable change in policy priorities since the launch of Korean Green Growth Initiative.
- In 2011, the government assessed progress in these technologies, based on patent data and appraisal by experts. It found that Korea's overall level of technology had increased from about one-half of the most advanced countries in 2009 to around two-thirds in 2011. In six technologies, including CO₂ capture and storage, smart grid and green cars, the gap had been reduced by more than 20 percentage points.

4. R&D in Green Technologies

- In China, the most serious problems to develop strategic emerging industry are the lack of R&D capabilities and core technology and also inadequate control of intellectual property. Although in recent years, China's manufacturing industry is developing at an alarming rate, it is still in the low-end position in the global industry value chain, which is mainly due to the lack of advanced technology.
- In 2010, the ratio of R&D investment to GDP reached 1.76% in China, but there were still some gaps with the average level of 2.5% in developed countries. Although R&D investment by enterprises increased gradually since 2000 and has now reached 73% of total R&D investment, the ratio of enterprises with R&D activities accounted for only about 10% of all enterprises in 2010. And the R&D activities were unstable in 49.25% of enterprises with R&D activities.

5. Provide Strong Market Stimuli

- Channel Funds to Green Business
- In Korea, the government is using various channels to supply money to green businesses. Because of the high risk of green finance and its long investment horizon, credit guarantees are used to activate green lending.
- The ceiling on the amount guaranteed is higher for green loans at 7 billion won (\$6.2 million), compared to 3 billion won for non-green loans, and the fee for the guarantees is lower.
- To reduce the risk of green finance, a well-functioning certification system to determine which firms are truly green was established by the Green Certification Committee. By October 2011, 456 technologies and 12 projects had been certified.

5. Provide Strong Market Stimuli

- Channel Funds to Green Business
- In China, commercial banks adopted a "list-style" management approach, as well as differentiated pricing of risk, adjustment of economic capital coefficient, special allowance and other methods to control the credit to the "two high and one left" industry. This drastically reduced lending to thermal power generation, coke and other industries.

Table . The Change of Loan for energy-saving and environment-friendly projects in China

Year	2004	2005	2006	2007	2008	2009	2010	2011
Loan balance of energy saving and environmental protection	90	130	200	340	370	860	1010	1265

In 2010, commercial bank loans to steel, cement, plate glass, coal, chemical, electric power, petrochemical and shipbuilding industries with excess capacity declined by 0.37 percent, compared to 2009. Meanwhile, the size of commercial bank's green loans in energy saving and low-carbon economy is growing rapidly from 2008 to 2011

5. Provide Strong Market Stimuli

- Still, "China Green Credit Development Report 2011" overall evaluation showed that the green credit of China's banking industry was at low level. And the banking industry was in a dilemma between economic efficiency and environmental protection and social responsibility.
- In China, loans to the projects of "two high and one left" is still in a high proportion, which is reflected especially in the city commercial banks. The total loans to green credit projects or energy saving project is increasing, but is still in a low proportion.
- A well-functioning certification system is still lacked in China's green credit. Because the projects of new energy and energy efficiency technology are mainly in the development stage, of which market maturity is not high. Banks face a potential high risk to grant loans to these projects. So an authoritative certification system is important to guide the bank's loans to reduce the potential risk.

5. Provide Strong Market Stimuli

- Improve Air Quality with Market Mechanism
- In Korea, an emission cap-and-trade programme was introduced in 2008 covering NO_x, SO_x and Total Suspended Particles (TSP) in the capital region. The system was extended in 2010 to mid-size emitters, covering a total of around 300 factories in the capital region.
- In China, compared to developed countries, emissions tradings carried out in the past were not exactly market transactions, which were mostly done with the coordination of government departments.
- According to statistics, from 2008, when the Ministry of Finance approved the pilot, to April 2012, there were more than 12,000 transactions happened in the 10 pilot provinces, and the trading volume was over 1.8 billion Yuan.
- However, most of these transactions happened in the way of auctioning emission allowances between the government and enterprises. The real active secondary market is far from mature.

5. Provide Strong Market Stimuli

- Improve Air Quality with Market Mechanism
- Currently, the objects of pollutant emissions trading are sulfur dioxide and chemical oxygen demand.
- After energy conservation target responsibility system has been established, local governments faced with stringent pressure to reduce pollutant emissions. Therefore, the total amount available for trading in emission rights is not the sum of the emission rights owned by existing polluters, but the remaining part after the emissions reduction requirements by region have been fulfilled.
- This has resulted in a cutback in the tradeable number of emission rights during each cycle of emissions reduction.

5. Provide Strong Market Stimuli

- Flourish the Market for Carbon Emissions Trading
- In Korea, since 2005, the government has been operating a voluntary carbon market called Korea Certified Emissions Reductions (KCERs), which is open to firms that have reduced CO₂ emissions by more than 500 tonnes a year through improved energy efficiency and production processes and investment in renewable energy development. As of the end of 2009, 287 projects had generated 5.6 million KCERs, out of which 4.7 million had been purchased by the government for 23 billion won (\$20 million).
- In May 2012, the National Assembly approved legislation to create a cap-and-trade ETS in 2015 covering six types of GHGs. The first step is the creation of a “Target Management System” (TMS), which requires firms emitting more than 15 thousand tonnes annually to set targets with the government beginning in 2012. Firms emitting over 25 thousand tonnes, a threshold that included 497 firms in 2011 accounting for around 60% of total emissions, will join the ETS in 2015.

5. Provide Strong Market Stimuli

- Flourish the Market for Carbon Emissions Trading
- Although China has the largest carbon resource in the world and is the largest carbon CERs supplier in the international carbon trading market, it has not formed a unified national carbon trading market. So it lacks the pricing power and is only a passive participant in international carbon trading market, which led to massive carbon CERs sold cheaply to developed countries.
- In 2013, the carbon trading markets in Shenzhen, Shanghai, and Beijing were launched, followed by those of the other four pilot provinces and cities, which are also expected to start this year.
- Some provinces confirmed pilot enterprises with an annual amount of more than 5,000 tons of carbon dioxide emissions. The rests can apply to join the carbon emission quotas distributed system by themselves. Beijing municipal government announced that the units in the administrative areas of Beijing with emissions from fixed facilities and more than 10,000 tons of direct and indirect carbon

Part 3: Conclusion

Enhance cooperation in the field of green industries between China and Korea

- At present, China and Korea are cultivating their own strategic emerging industries. And the measures taken by the two governments such as subsidies, tax breaks, emissions trading market building also have some similarities.
- From a point of view of long-term cooperation, China and Korea should avoid homogeneous competition on developing strategic emerging industries. In this way, products and technologies of Korea's strategic emerging industries will be able to adapt and meet the needs of a range of new green markets in China during the green transformation period. This has important implications for the expansion of cooperation and trade between China and Korea.
- In the field of new energy industries, along with structural changes in energy demand and strong government support, China began to accelerate the development of clean energy industries and some industries have entered into growth stage and mature stage. China is close to or even exceeds the level of Korean technology and market share in the photovoltaic cell manufacturing solar water heaters

Enhance cooperation in the field of green industries between China and Korea

- In fact, compared to a good endowment condition for new energy of China, Korea's land and climate conditions are not conducive for the development and popularity of renewable energy. Inadequate level of production scale also makes clean energy (except nuclear power) lack cost competitiveness compared with traditional fossil fuels. And nuclear technology output to China by Korea will be hindered under the condition that the development prospect of nuclear power is not clear.
- So much more investment and R&D efforts of Korea should be focused on the fields of new energy vehicles, green building products, smart appliances and other equipment, which gain more comparative advantages in technical aspects, as well as mature segments such as power generation from waste incineration. Meanwhile, it is worth for companies of Korea to investment in emerging green service industries in China such as energy performance contracting, contract for environmental services and operation services for smart cities, which shows great prospects for

Thank you!