

Woodrow Wilson Centre

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Approaches to and measures for *Low Carbon Development*

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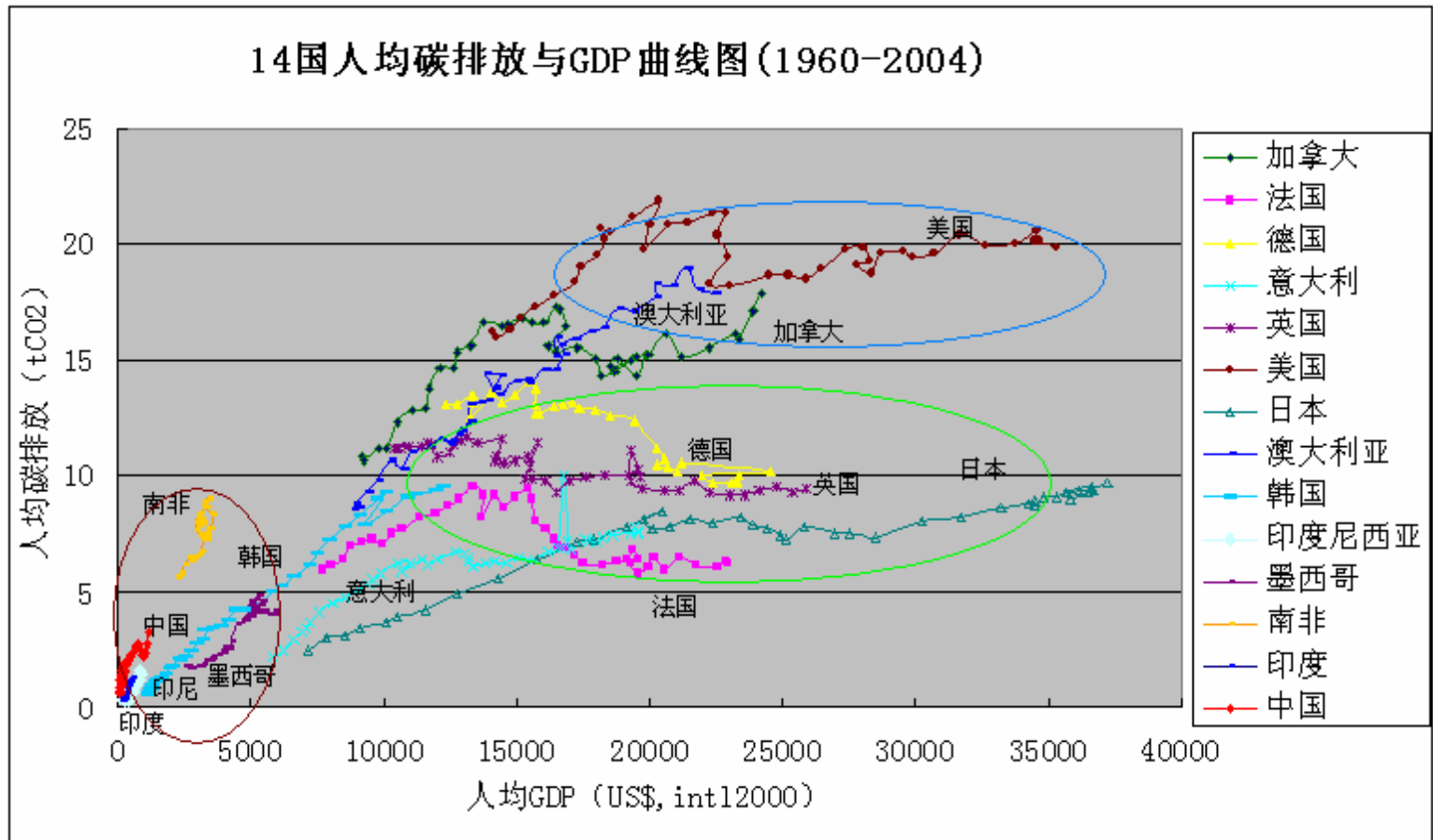
- The meaning of Low Carbon Development
- Measurement and comparison of low carbon development
- Regional variations of low carbon development in China
- Challenges for low carbon development in China
- Successful stories of low carbon efforts



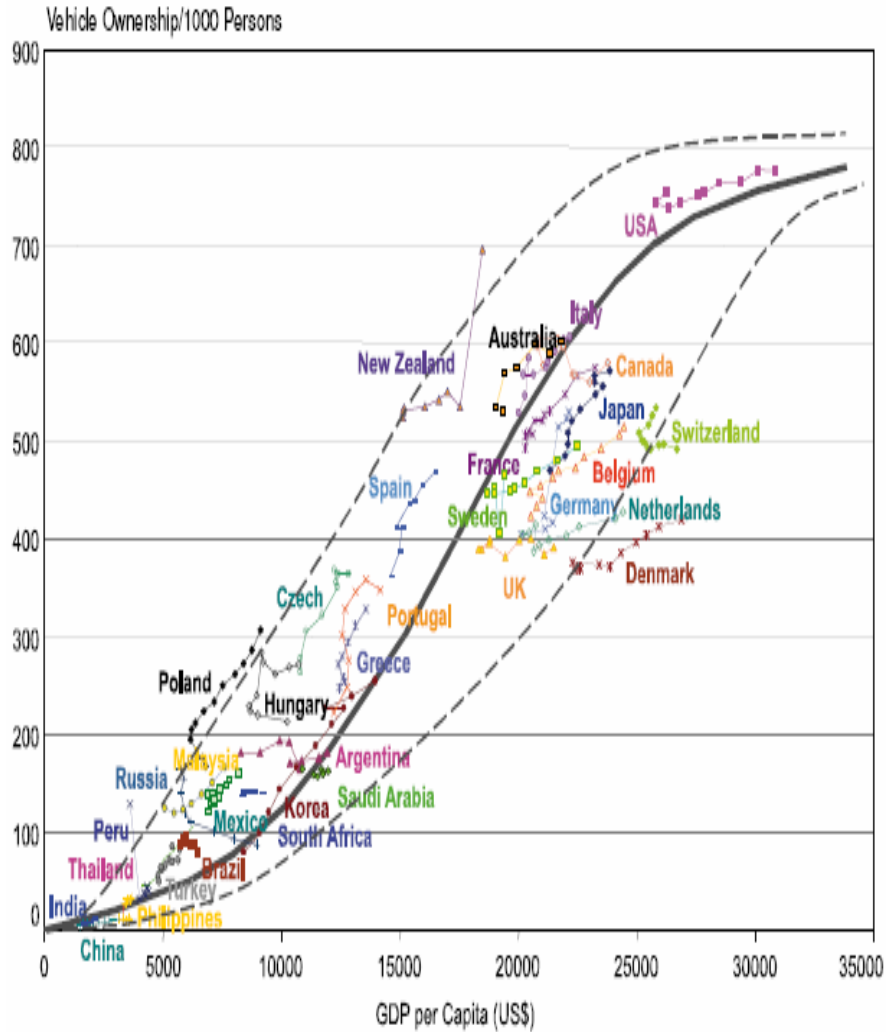
The meaning of Low Carbon Development

- LCD is a process along which both carbon productivity and human development are enhanced to a desired level, with high levels of both carbon productivity and human development.
 - Not: least developed with low carbon
 - Not: recession for low carbon
- this process is highly dependent upon *development stage, endowment of resources, consumer behavior* and *technology*.

Development vs carbon emissions: historical process for selected countries, 1960 - 2004



Consumption vs carbon emissions: consumer behavior does matter



Countries	Final consumption of total GDP (%) (2005, WB)	CO2 Emissions per capita (t CO2) (2004, WB)	CO2 emissions per capita by consumption (t CO2)
China	50.6	3.86	2.15
USA	86.5	20.58	18.08
UK	86.5	9.81	12.49
Germany	77.7	9.79	6.17
Japan	75.2	9.84	7.46
Korea	67.6	9.68	6.76
Mexico	79.7	4.12	3.45
India	68.3	1.24	0.91
World (average)	81.2%	4.31	-



Measuring Low Carbon Development

- **Low Carbon Development Index (LCDI) :**

LCDI is a comprehensive measurement to judge the development of an economy/region/city for achieving a low carbon economy, if achievable or achieved.

- **LCDI: A SMART measurement for LCD:**

SMART: Specific, Measurable, Achievable, Realistic and Timely.

- **Data availability:** from *Human development*

Report: 2007/2008, UNDP; World Development Indicators-2007, World Bank.

- **Comparable:** for different countries/cities in one same year; or for a same country/city in different period.

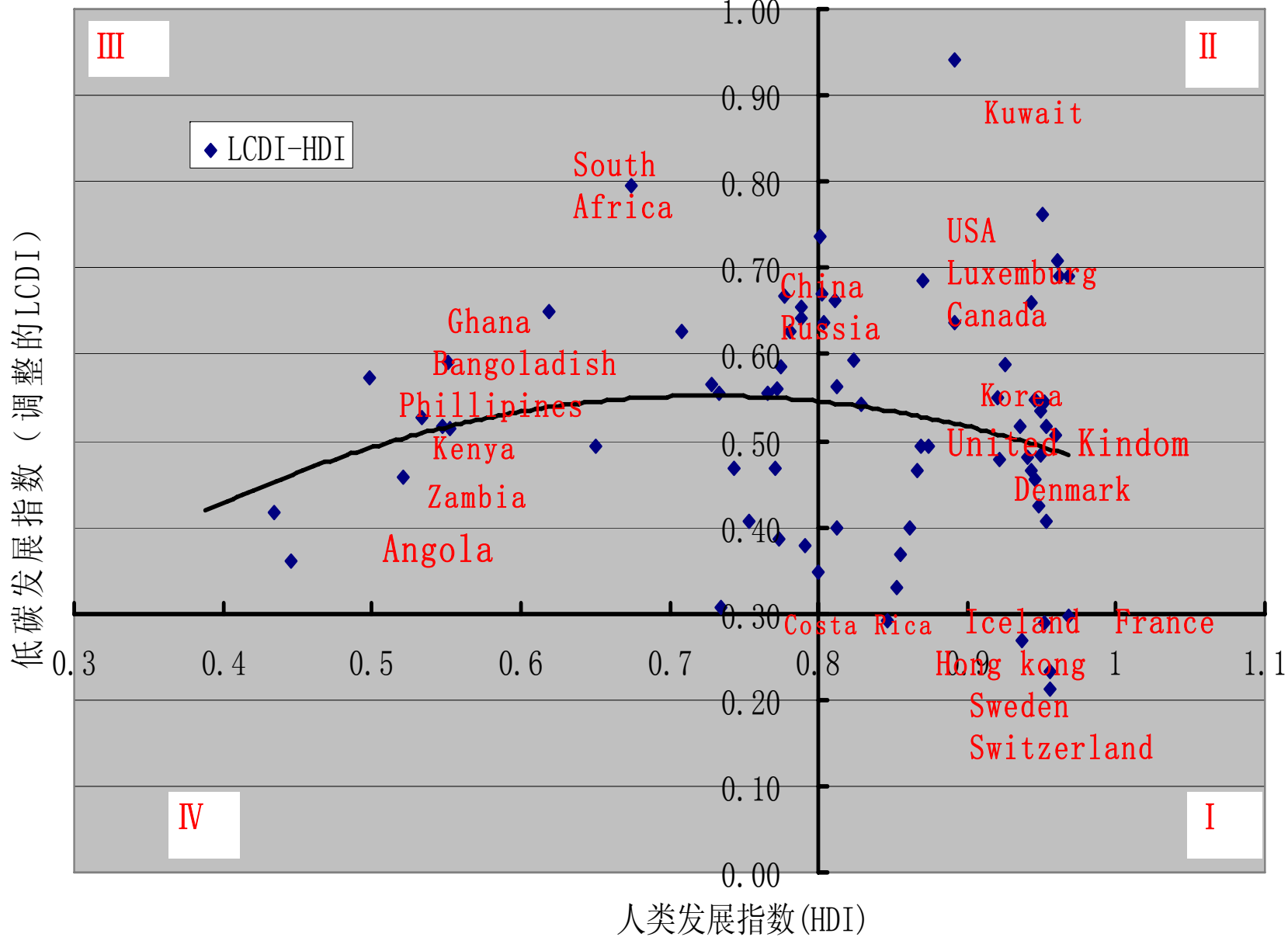
Key indicators & Low Carbon Development Index

- Development: **HDI** → → *Human Development Index*
- Energy mix: **carbon intensity** in energy → → *Carbon Energy Index*
- Technology → → **carbon productivity** → → Carbon Productivity Index → → *Carbon Output Index*
- Consumption → → **carbon consumption per capita** → → *Carbon Consumption Index*

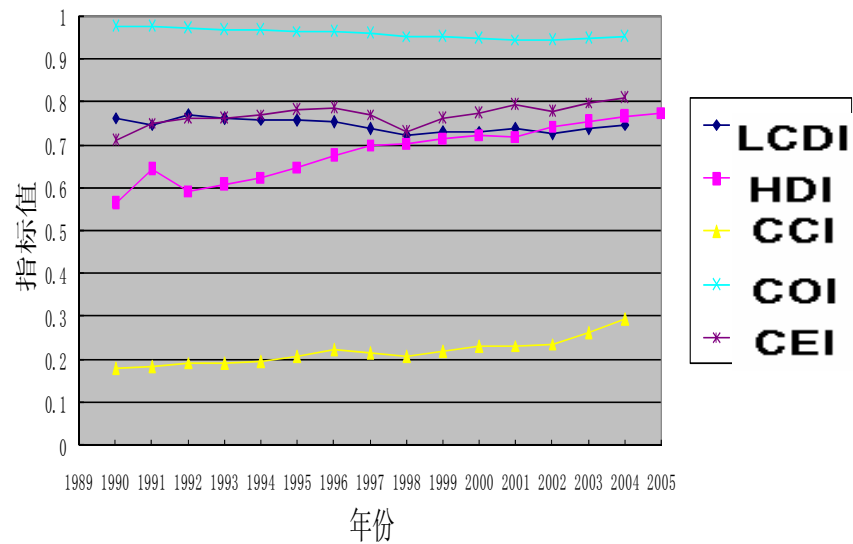
$$LCDI = f \left\{ \begin{array}{l} \textit{Carbon Consumption Index (CCI)} = f \{ \textit{co2 emissions by} \\ \textit{govnt consumption; co2 emsiions by household} \} \\ \textit{Carbon Output Index (COI)} = f \{ \textit{energy consumption on} \\ \textit{sectors, sectoral GDP, carbon productivity} \} \\ \textit{Carbon Energy Index (CEI)} = f \{ \textit{energy consumption by} \\ \textit{fuels, carbon emission factor} \} \\ \textit{Human Development Index (HDI)} = f \{ \textit{education, health,} \\ \textit{GDP per capita} \} \end{array} \right.$$

LCDI-HDI CORRELATION (2005)

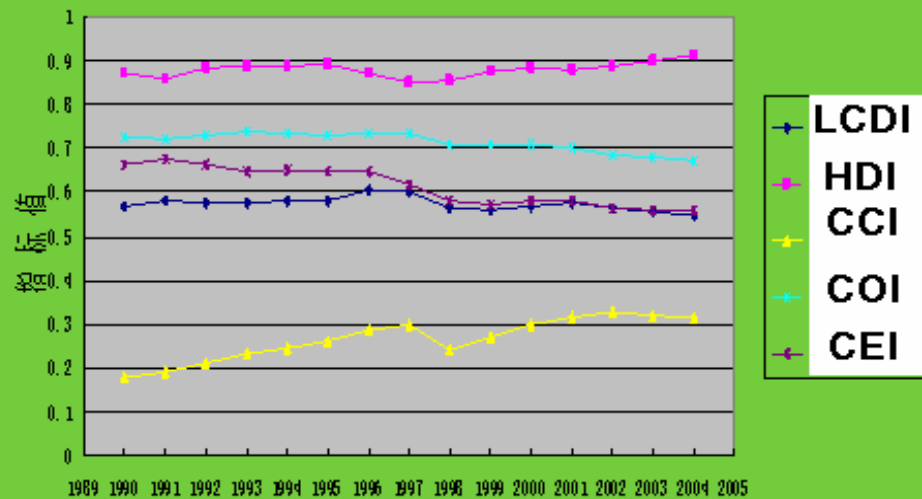
- LCDI adjusted by power of HDI



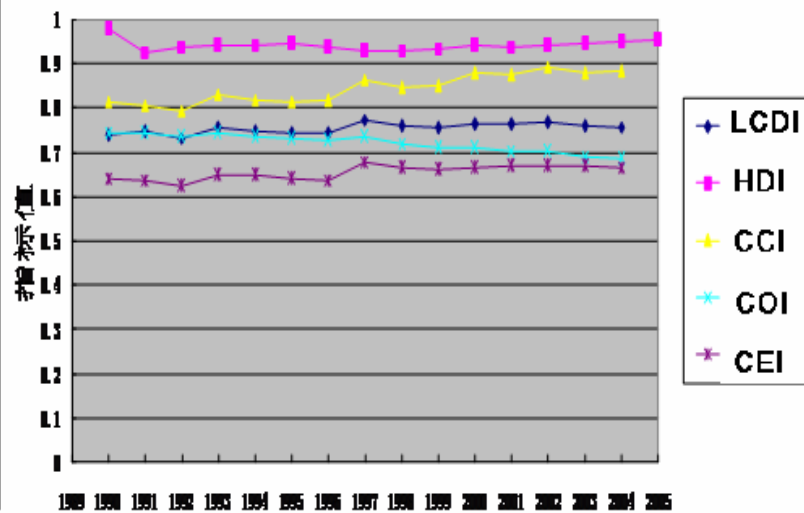
China(1990-2004):LCDI



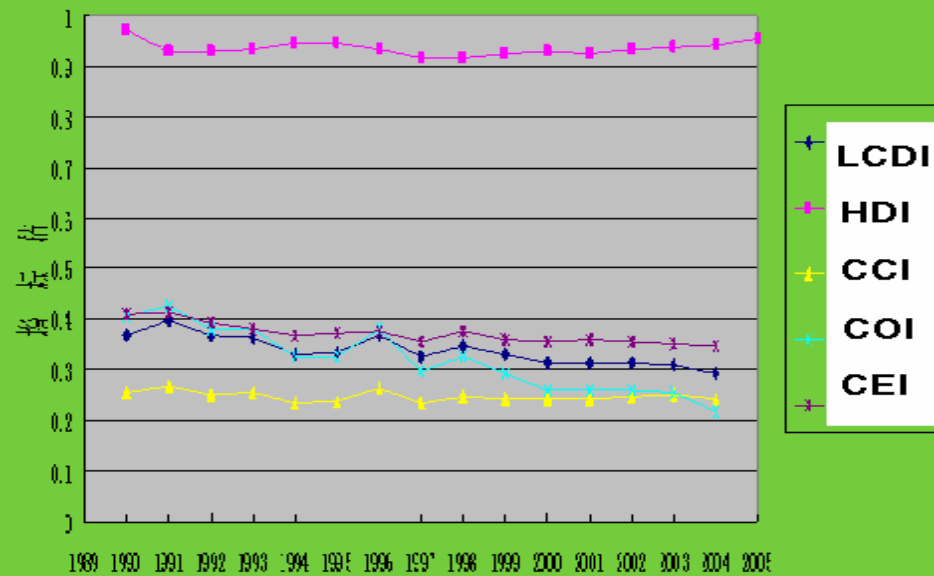
Korea(1990-2004)



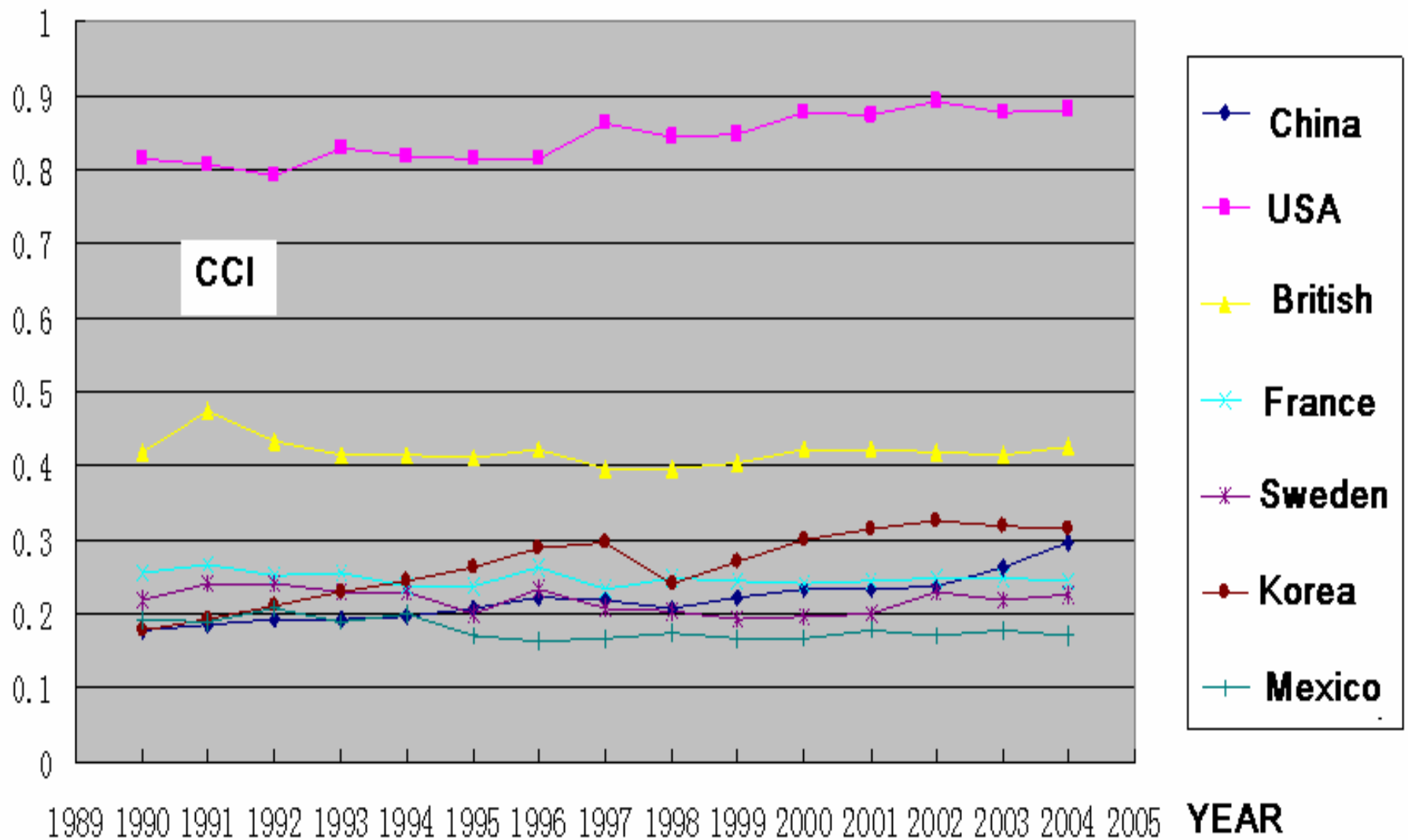
USA(1990-2004):LCDI



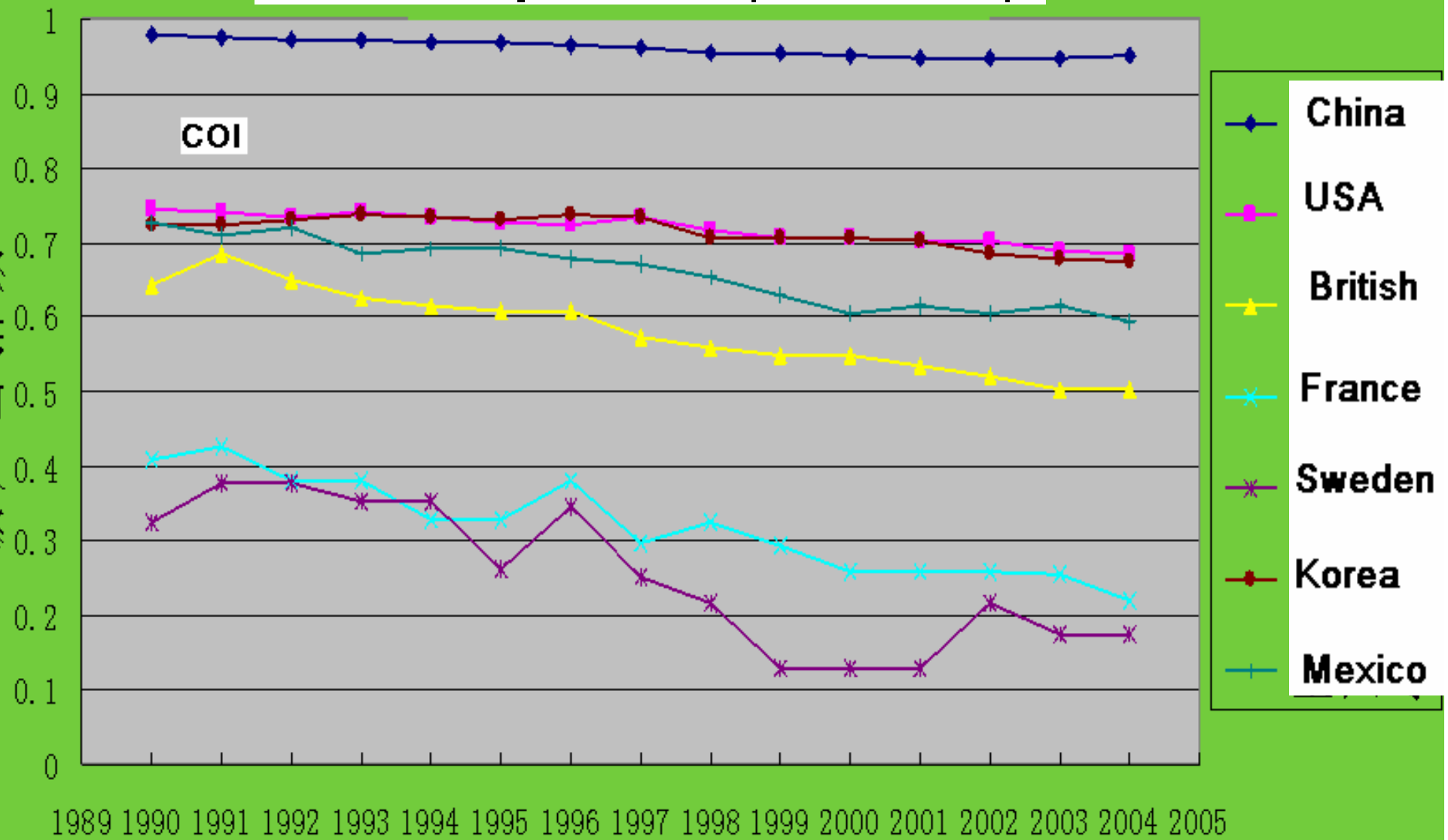
France



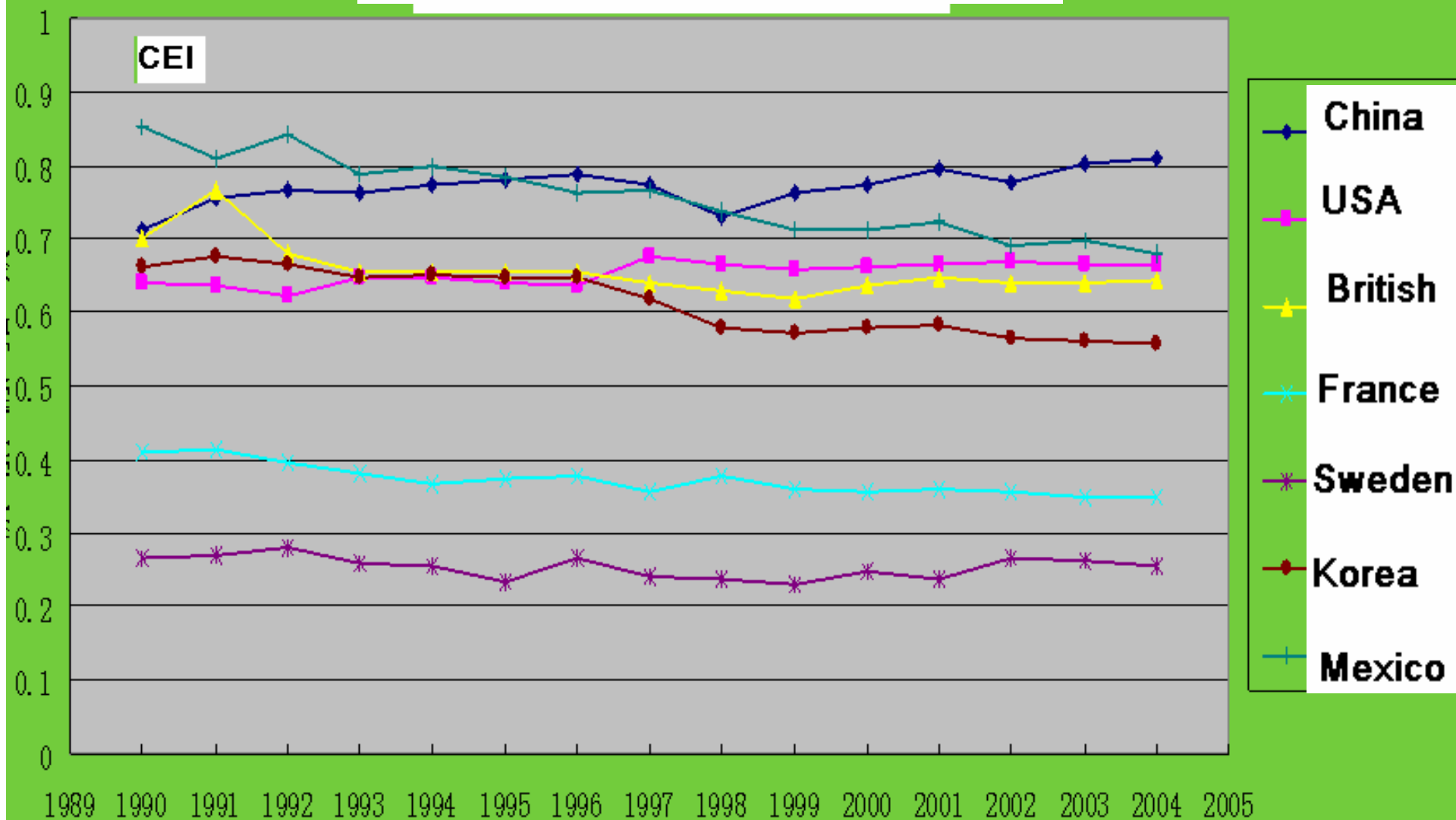
1990-2004 carbon consumption index



Carbon Output Index (1990-2004)



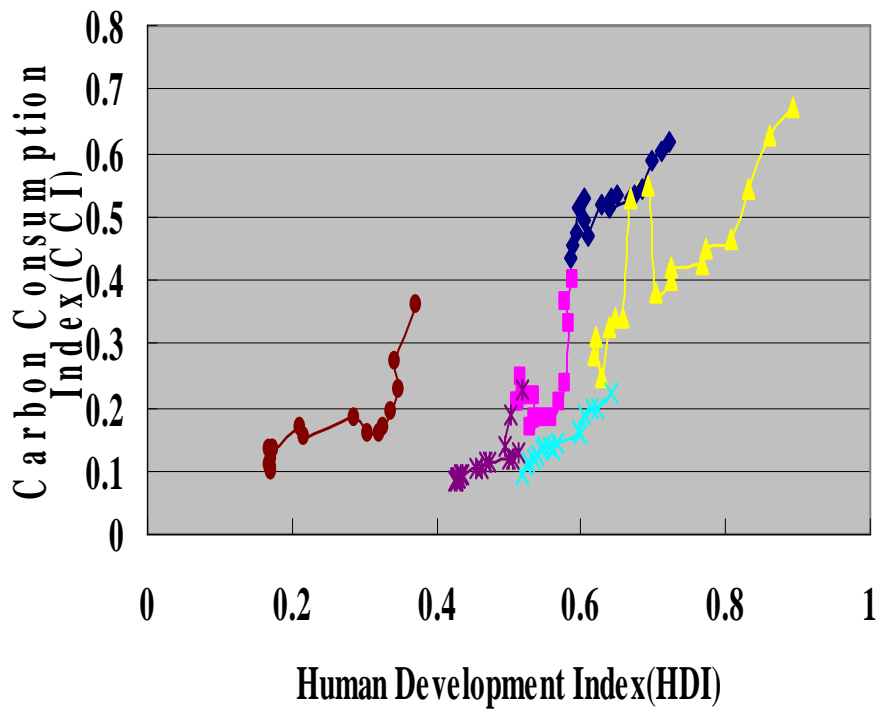
Carbon Energy Index(1990-2004)



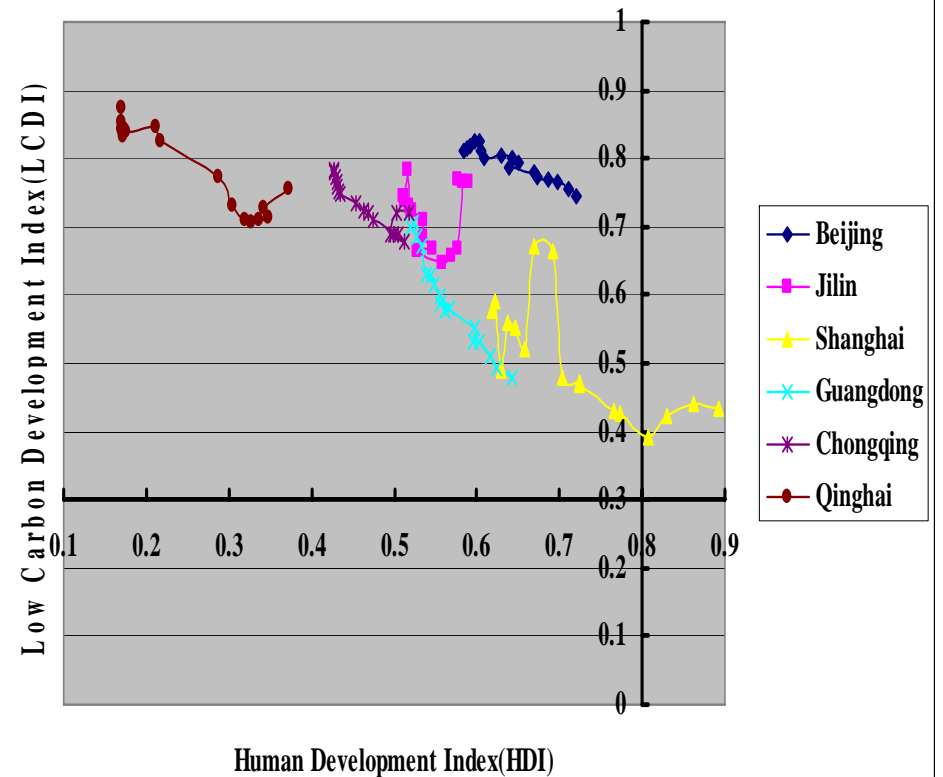
◇ Regional cases of low carbon development status



Fig. 1 Location of the Case Regions



Human Development Index (HDI)-Carbon Consumption Index (CCI) Correlation of 6 regions in China (1990~2006)



Human Development Index (HDI)-Low Carbon Development Index (LCDI) Correlation of 6 regions in China (1990~2006)



Three key areas for a lower carbon development

- *Consumer behavior: A reduction of per capita CO2 emissions on consumption* → → Carbon Consumption Index ↓
- *Technology innovation: To improve carbon productivity through higher energy/carbon efficiency* → → Carbon Productivity Index ↑ → → Carbon Output Index ↓
- *Lower carbon in the energy mix: To reduce carbon intensity through reduction of carbon rich fuels and increase in zero emission fuels* → → Carbon Energy Index ↓

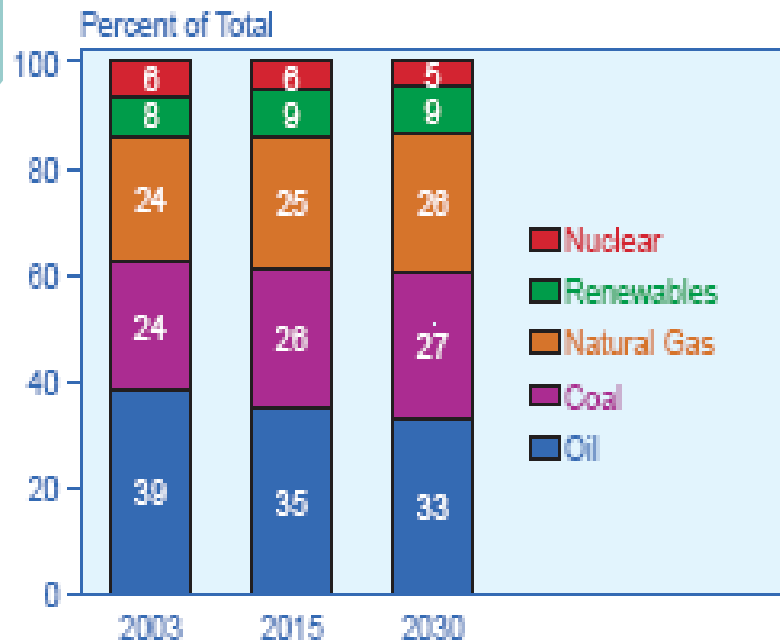


Lower carbon development: **Key challenges for China**

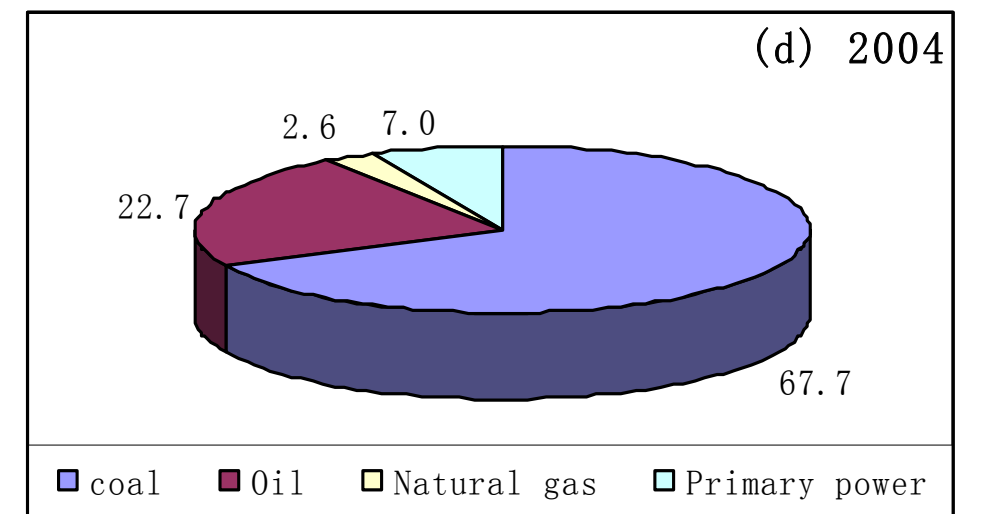
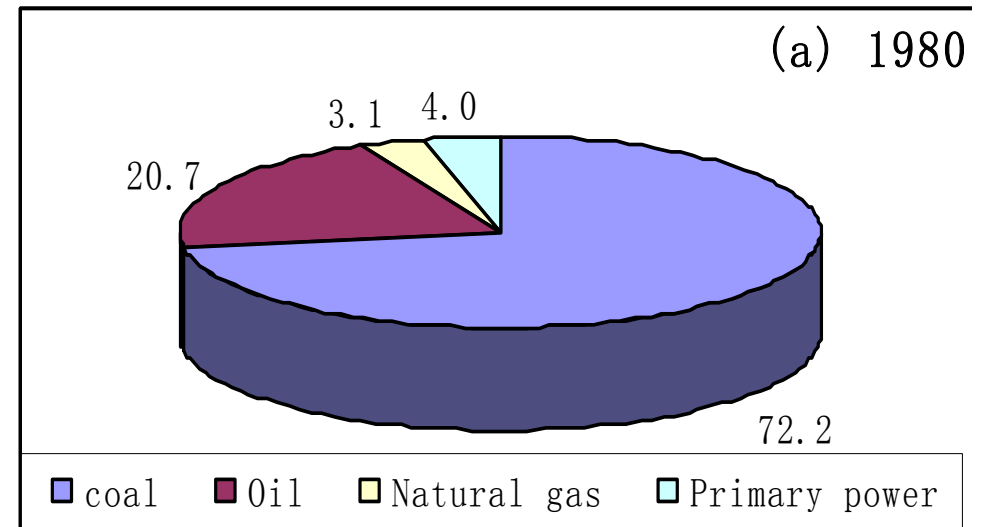
- **Structure of the economy: low share of service and high value added manufacturing sector; energy intensive dominated manufacturing sector**
- **Demographic and behavior changes**
 - **Population: Total numbers; Growth rate; Geographical distribution**
 - **Family sizes: Extended family; Nuclear family; Single**
 - **urbanization**
 - **Energy intensive way of living: cars, buildings**

Decarbonizing energy supply? the challenge for China

Share of renewables in the Energy Mix World: 2003-2030; China: 1980-2004



Sources: 2003: Energy Information Administration (EIA), *International Energy Annual 2003* (May-July 2005), web site www.eia.doe.gov/iea/. 2015 and 2030: EIA, *System for the Analysis of Global Energy Markets* (2008).



Lower carbon in Rural areas

- ❑ An 8 m³ **bio-digester** for a household with 3-5 people
- ❑ Emission reductions
1.2-1.5tCO₂/y
- ❑ Construction costs
Total RMB 2500
- ❑ CER revenue
84-105 RMB@10\$/tCO₂



Lower carbon in urban areas

- A 2 m² solar water heater for a households with 3-5 people

- Emission reductions
0.6-1.0 CO₂/y

- Costs/heater
RMB 2000-2500

- CER revenue
42-70 RMB@10\$/tCO₂





Low Carbon City – solar city in Baoding



The power sector: carbon reduction 2007

**Shut-down of small power generators:
14.38GW capacity, totaling 553 units, per
unit capacity at 26MW;**

- **Coal saving: 600MW super critical power generator works at 299gce/kWh, as compared 450gce/kWh under 50MW. Saving over 50%**
- **National level improvement: each kWh electricity, 10gce reduction in 2007 as compared to 2006 (though still at 357gce/kWh level) : coal saving: 27 million tce in the power sector**



谢谢!

Thank you!