Low Carbon Scenario up to 2050 for China
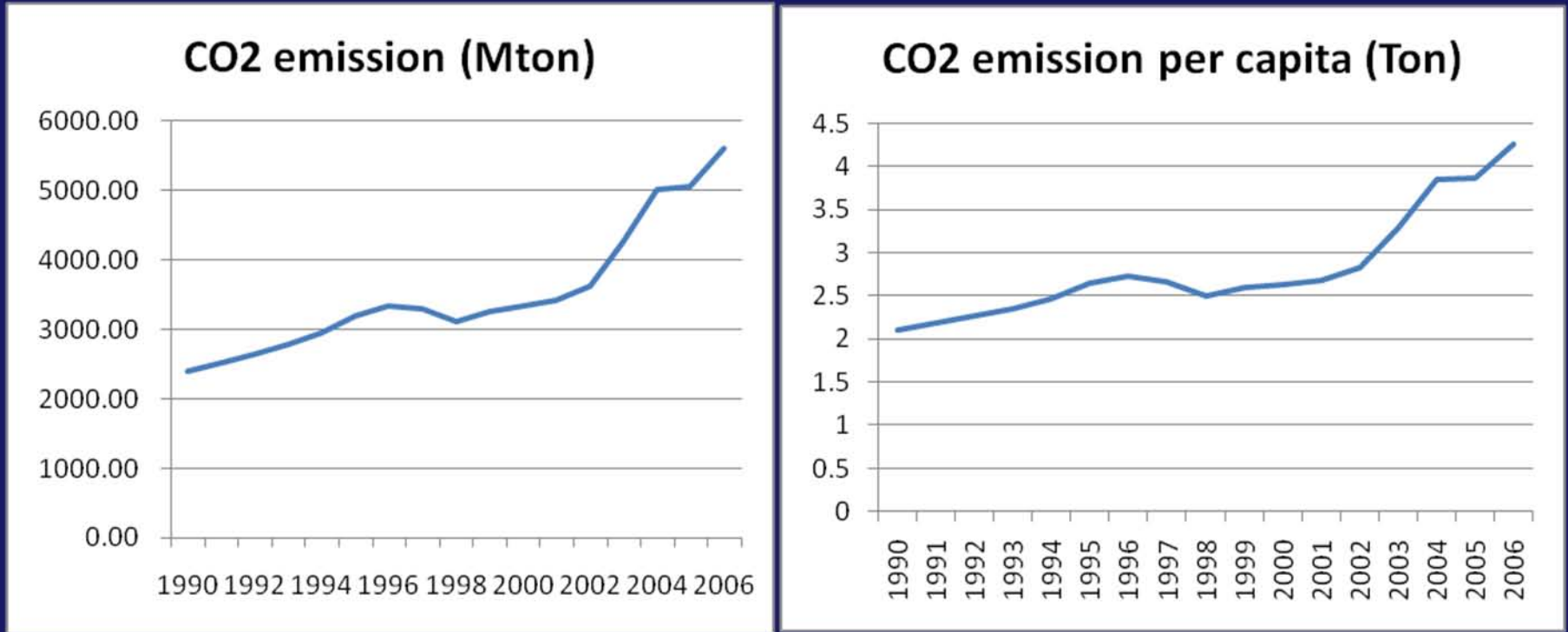
Liu Qiang, Jiang Kejun

Energy Research Institute

Eighteenth Asia-Pacific Seminar on Climate Change
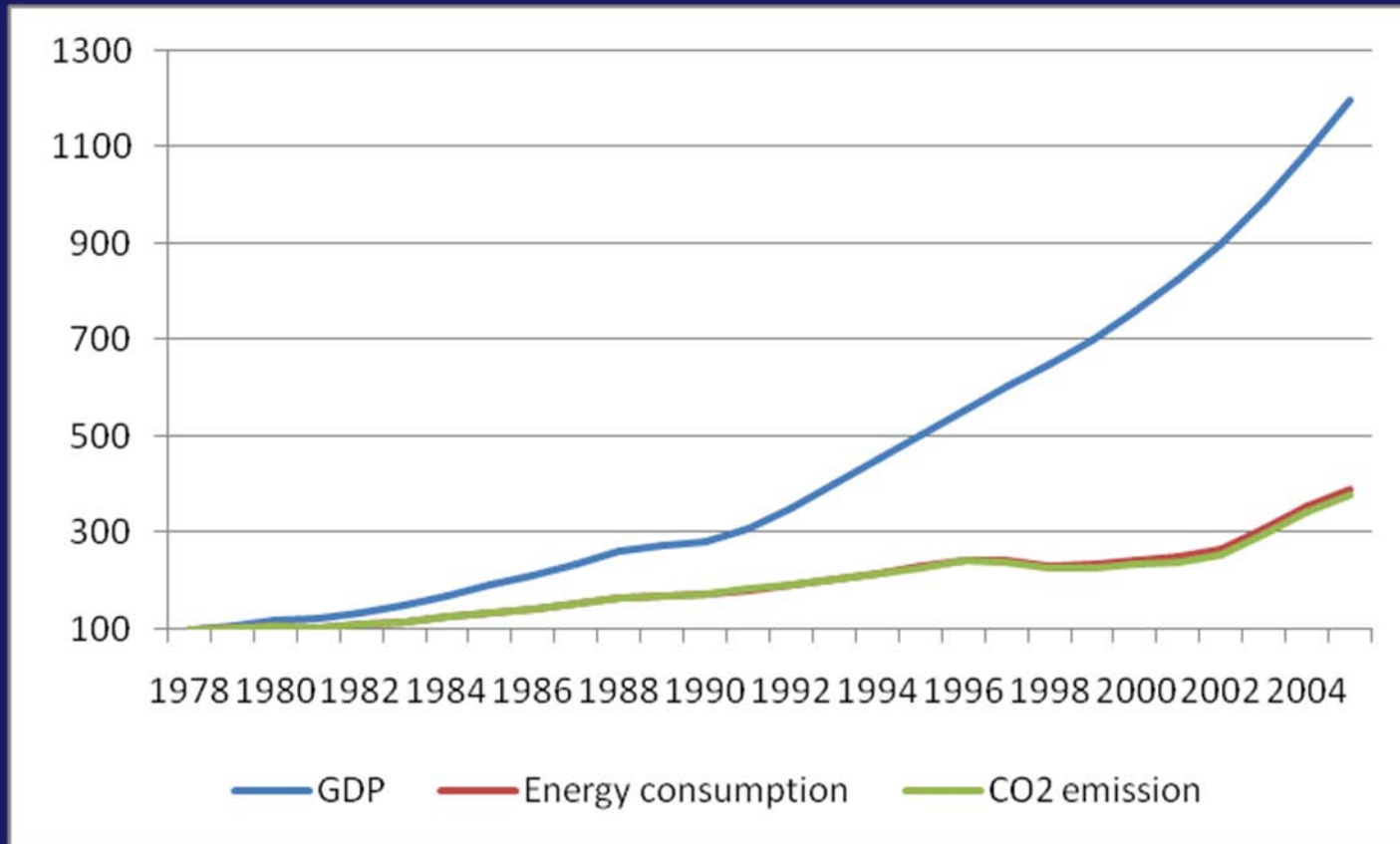2-3 March 2009, Hanoi, Vietnam

Contents

- Background information

- Methodology framework

- Main consideration

- Results

- Findings and conclusion

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Background information

Source: CO2 from fuel combustion, UN Statistics Division

Background information

Background information

The Chinese government attaches a high attention on climate change issues.

- 2006, National Climate Change Leading Group
- 2008, Climate Change Department of NDRC
- 2006, "Climate Change Strategy of China"
- 2006, "National Programs on Climate Change"
- 2008, "China White Book on Policies and Actions to Address Climate Change"

# *Related Policies and Measures: After 2003*

National laws and plans

- Long- and Medium-term Energy Conservation Plan, with much more concrete content
- Renewable energy law
- Renewable energy development plan up to 2020
- 11th-five-year Energy Plan: National energy intensity target

Standards, regulations and measures

- Vehicle fuel efficiency standard
- Strictly implementation of building energy standards
- Fuel tax
- Releasing the control on coal price for all users
- Higher consumption tax for larger engine vehicles
- Energy monitoring for 1000 large energy users

Background information

Major Products Energy Consumption Index change from 1985 to 2003
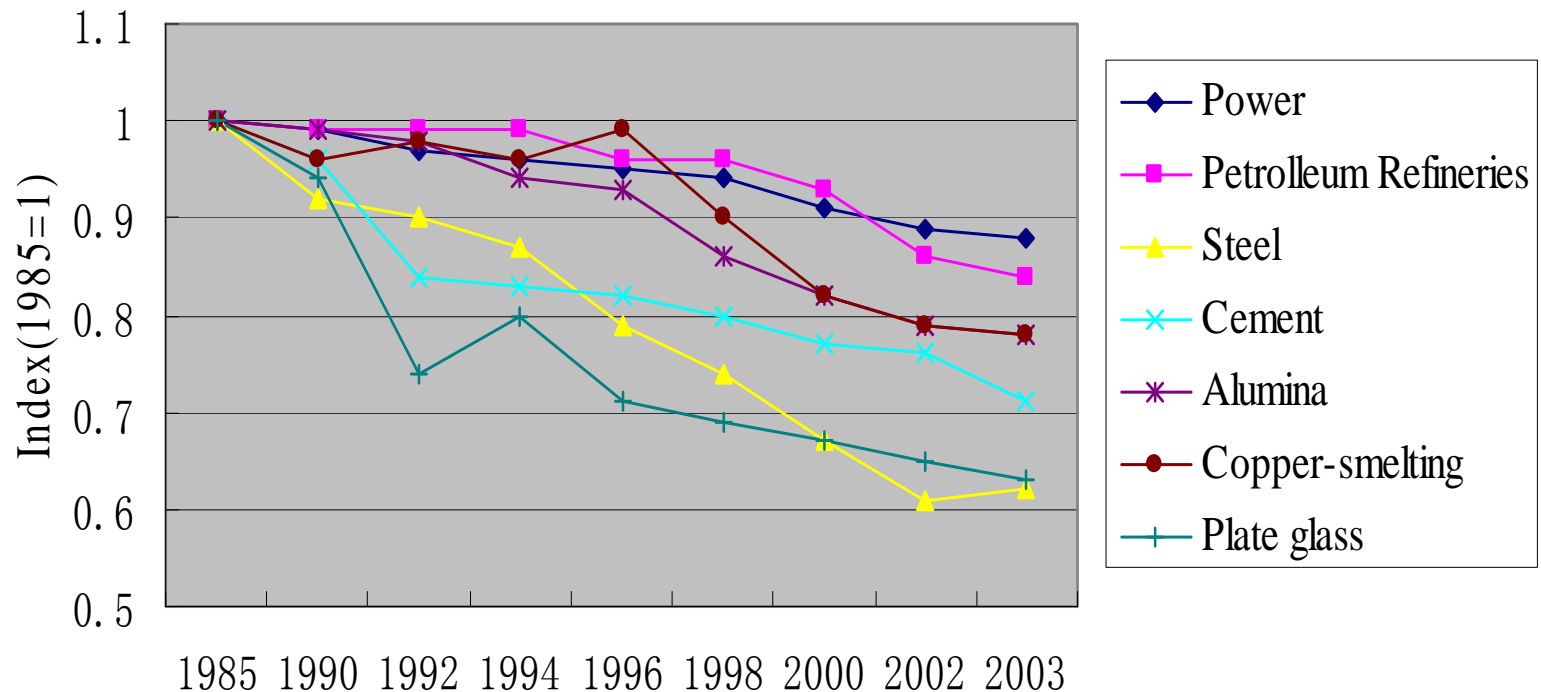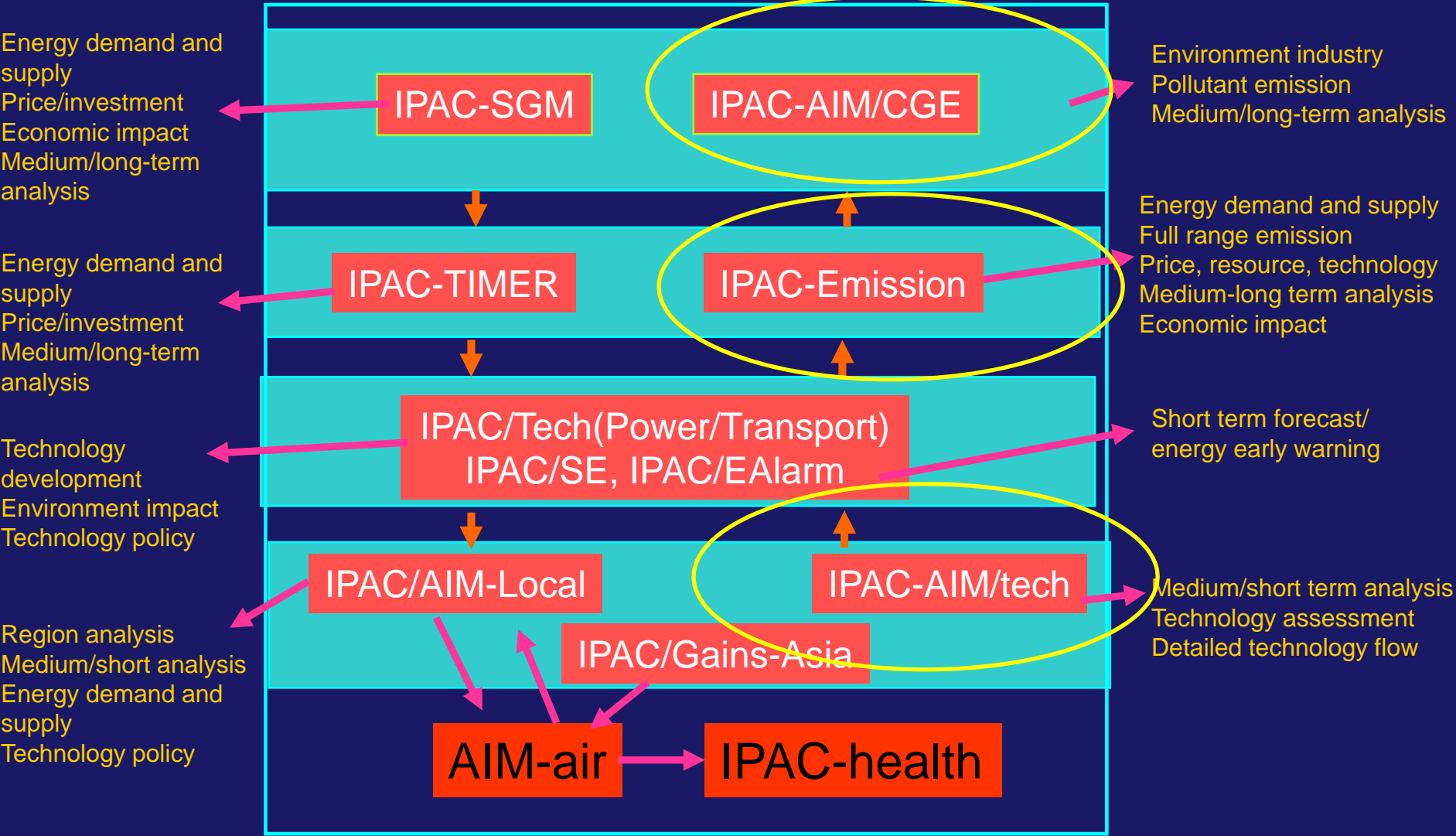
Future views on climate change

- China's GDP will maintain a gradual growth and the energy demand will increase very fast from the relatively low energy-service level, which will drive the growth of GHG emission in the future

- China's effort on energy saving, renewable energy development and environmental protection will have apparent positive effect on GHG mitigation, which will control the growth speed of GHG by large degree

- China face many choices in future development pathway. It is very key and important to identify the main forces to drive China toward a low carbon direction

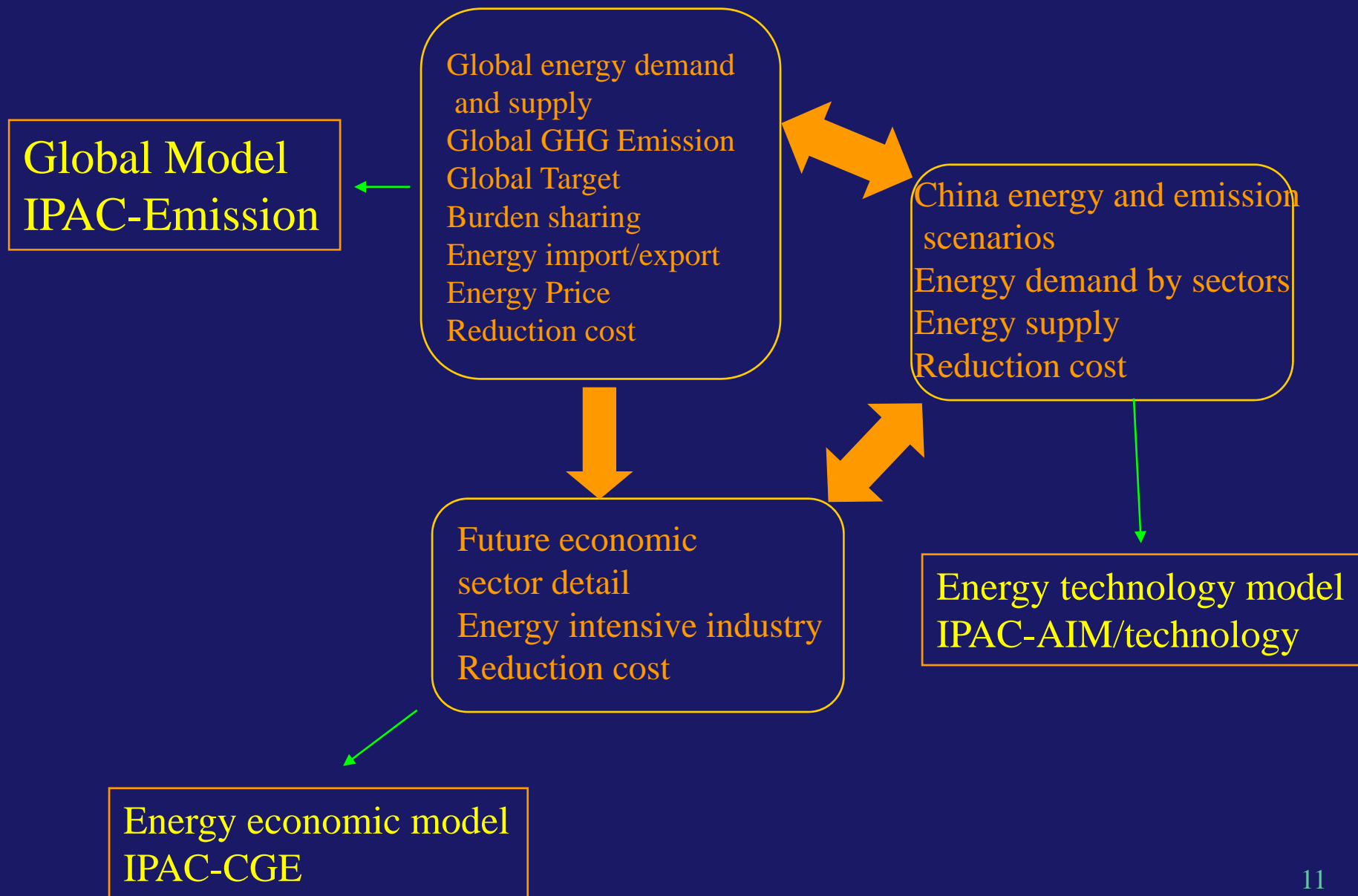# *Research on low carbon scenarios*

- Low carbon: *slow down the growth of carbon emission*
- Focus: *Main contributors for low carbon*
- Research oriented: *Forecasting and Backcasting*
- Methodology: Integrated model framework
  Integrated Policy Assessment for China (IPAC)

Methodology: Model framework
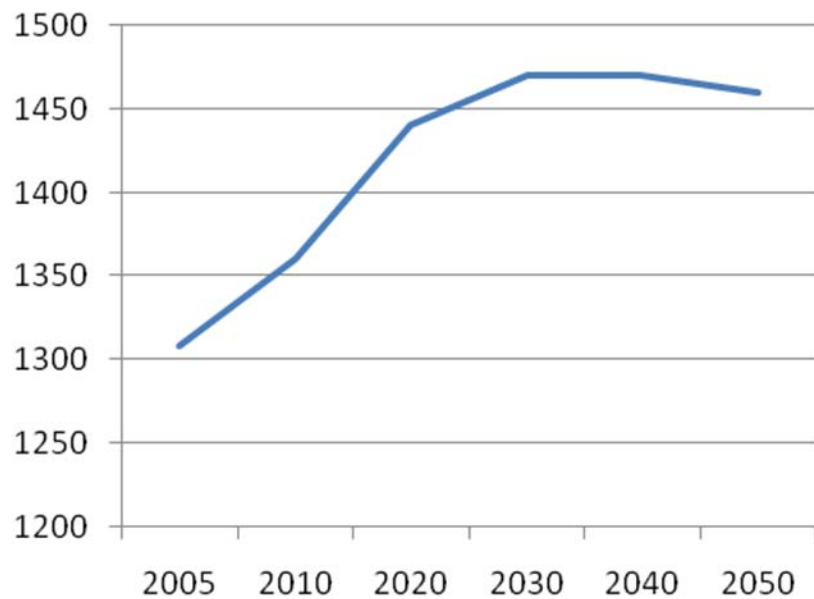## Integrated Policy Model for China (IPAC)

Energy demand and supply
Price/investment
Economic impact
Medium/long-term analysis

IPAC-SGM

IPAC-AIM/CGE

Environment industry
Pollutant emission
Medium/long-term analysis

Energy demand and supply
Price/investment
Medium/long-term analysis

IPAC-TIMER

IPAC-Emission

Energy demand and supply
Full range emission
Price, resource, technology
Medium-long term analysis
Economic impact

Technology development
Environment impact
Technology policy

IPAC/Tech(Power/Transport)
IPAC/SE, IPAC/EAlarm

Short term forecast/
energy early warning

IPAC/AIM-Local

IPAC-AIM/tech

Medium/short term analysis
Technology assessment
Detailed technology flow

Region analysis
Medium/short analysis
Energy demand and supply
Technology policy

IPAC/Gains-Asia

AIM-air

IPAC-health

Climate Model

10

ERI, China

Methodology: Analysis framework

Global Model
IPAC-Emission

Global energy demand
and supply
Global GHG Emission
Global Target
Burden sharing
Energy import/export
Energy Price
Reduction cost

China energy and emission
scenarios
Energy demand by sectors
Energy supply
Reduction cost

Future economic
sector detail
Energy intensive industry
Reduction cost

Energy technology model
IPAC-AIM/technology

Energy economic model
IPAC-CGE

Two Scenarios

- BAU scenario:
  - Economy is the main driving force;
  - High consumption pattern, concern on environmental protection, technology progress
- Low carbon scenario:
  - Low carbon approach:
  - More driven by domestic forces and measures
  - Combined measures: new energy technology adoption, energy saving, enhanced technology innovation and development, considering energy security and economic competitiveness
  - Cost reduction of low carbon technologies;
  - Investment on low carbon economy
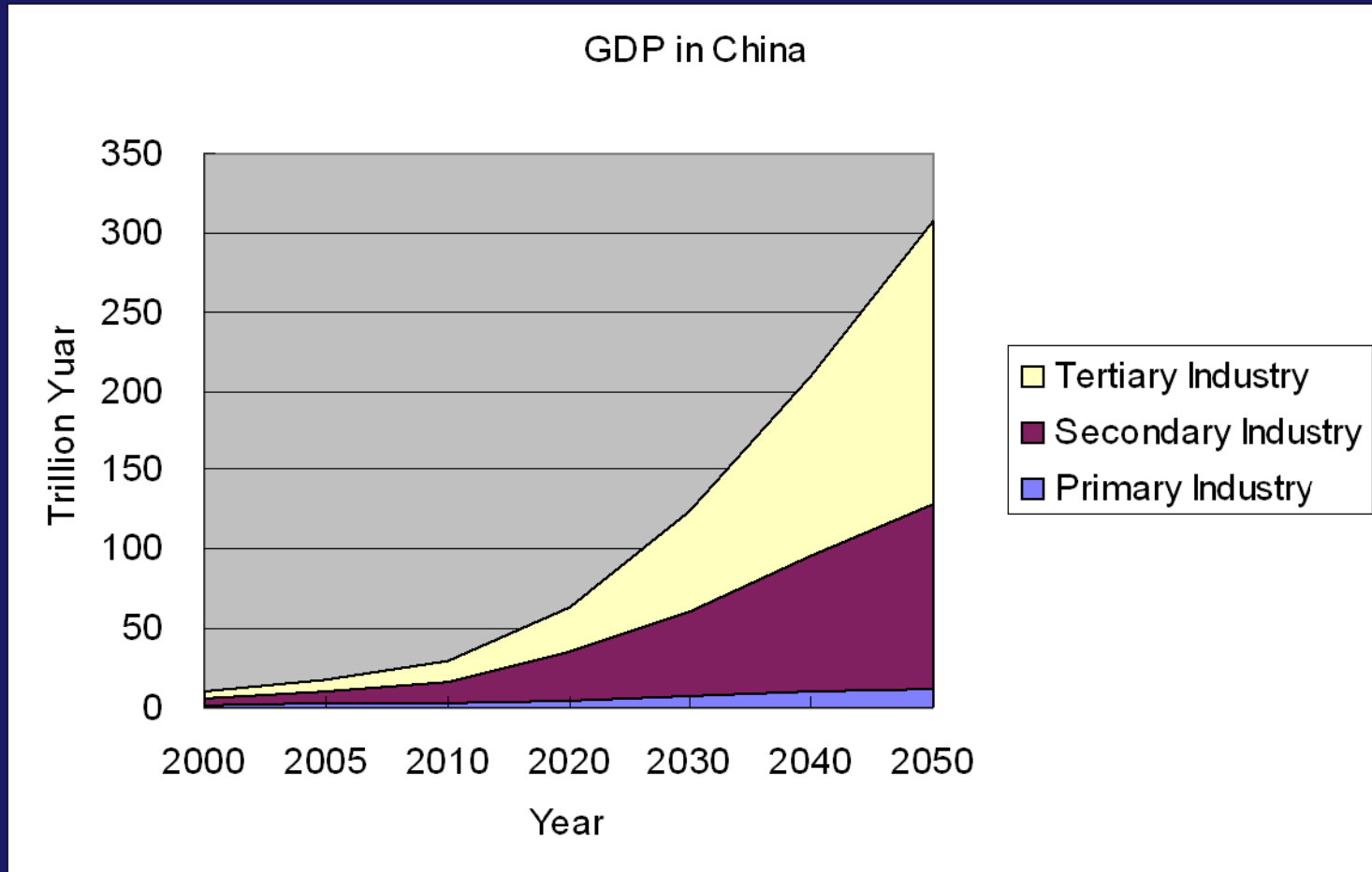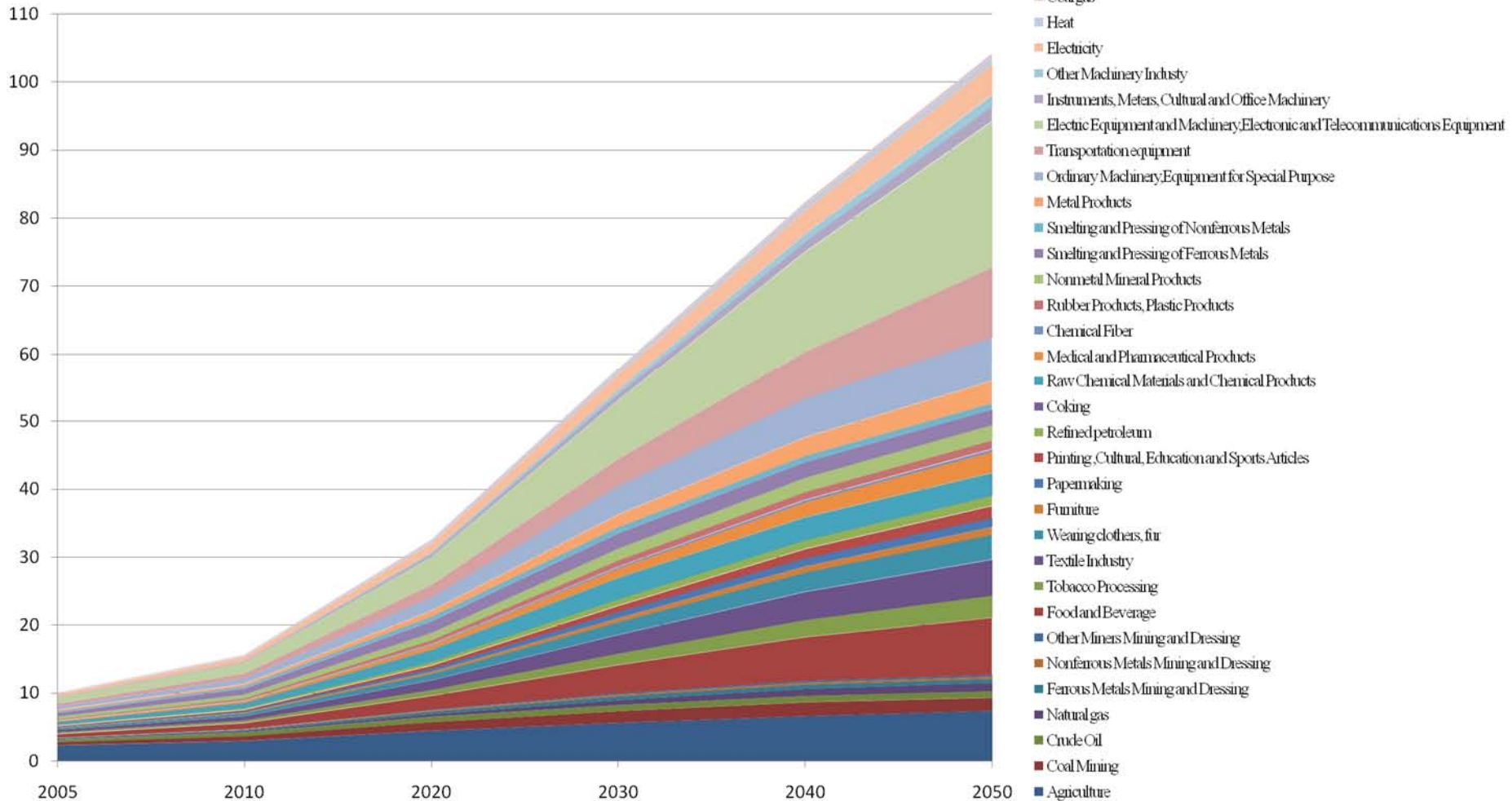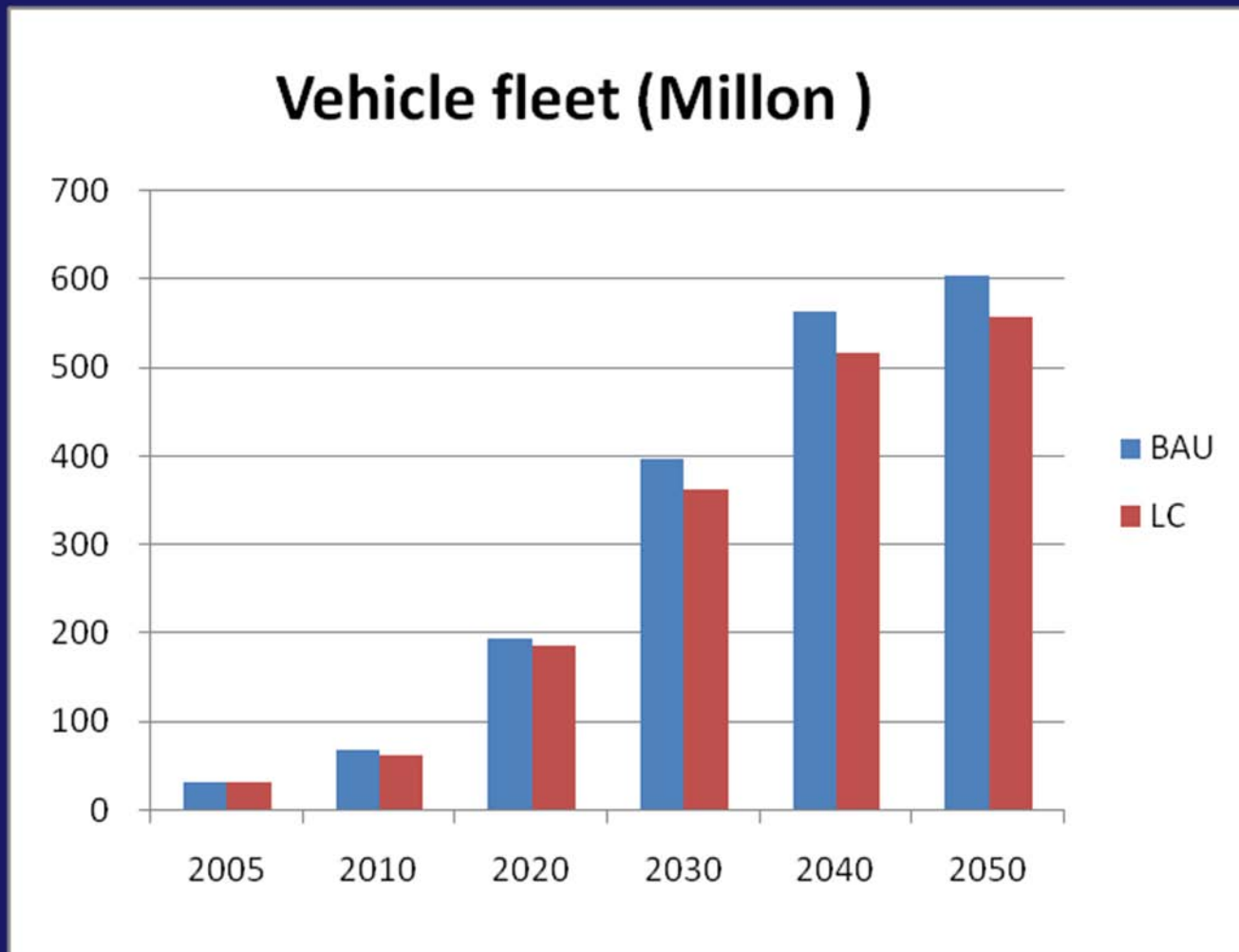
Population and urbanization

GDP growth trend

ERI, China
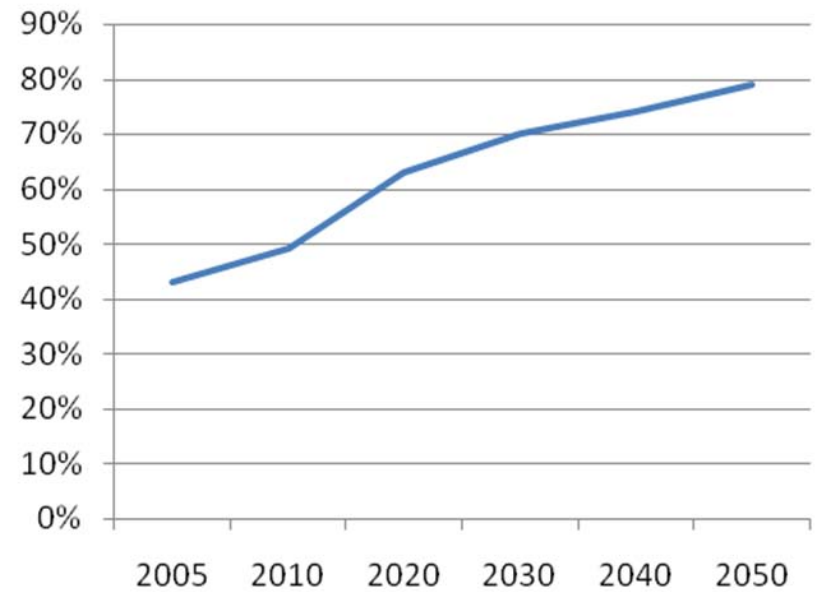
GDP by sectors

Trillion Yuan

Legend:
- Coal gas
- Heat
- Electricity
- Other Machinery Industy
- Instruments, Meters, Cultural and Office Machinery
- Electric Equipment and Machinery, Electronic and Telecommunications Equipment
- Transportation equipment
- Ordinary Machinery, Equipment for Special Purpose
- Metal Products
- Smelting and Pressing of Nonferrous Metals
- Smelting and Pressing of Ferrous Metals
- Nonmetal Mineral Products
- Rubber Products, Plastic Products
- Chemical Fiber
- Medical and Pharmaceutical Products
- Raw Chemical Materials and Chemical Products
- Coking
- Refined petroleum
- Printing, Cultural, Education and Sports Articles
- Papermaking
- Furniture
- Wearing clothers, fur
- Textile Industry
- Tobacco Processing
- Food and Beverage
- Other Miners Mining and Dressing
- Nonferrous Metals Mining and Dressing
- Ferrous Metals Mining and Dressing
- Natural gas
- Crude Oil
- Coal Mining
- Agriculture

ERI, China

Transportation sector

Vehicle fleet (Millon)
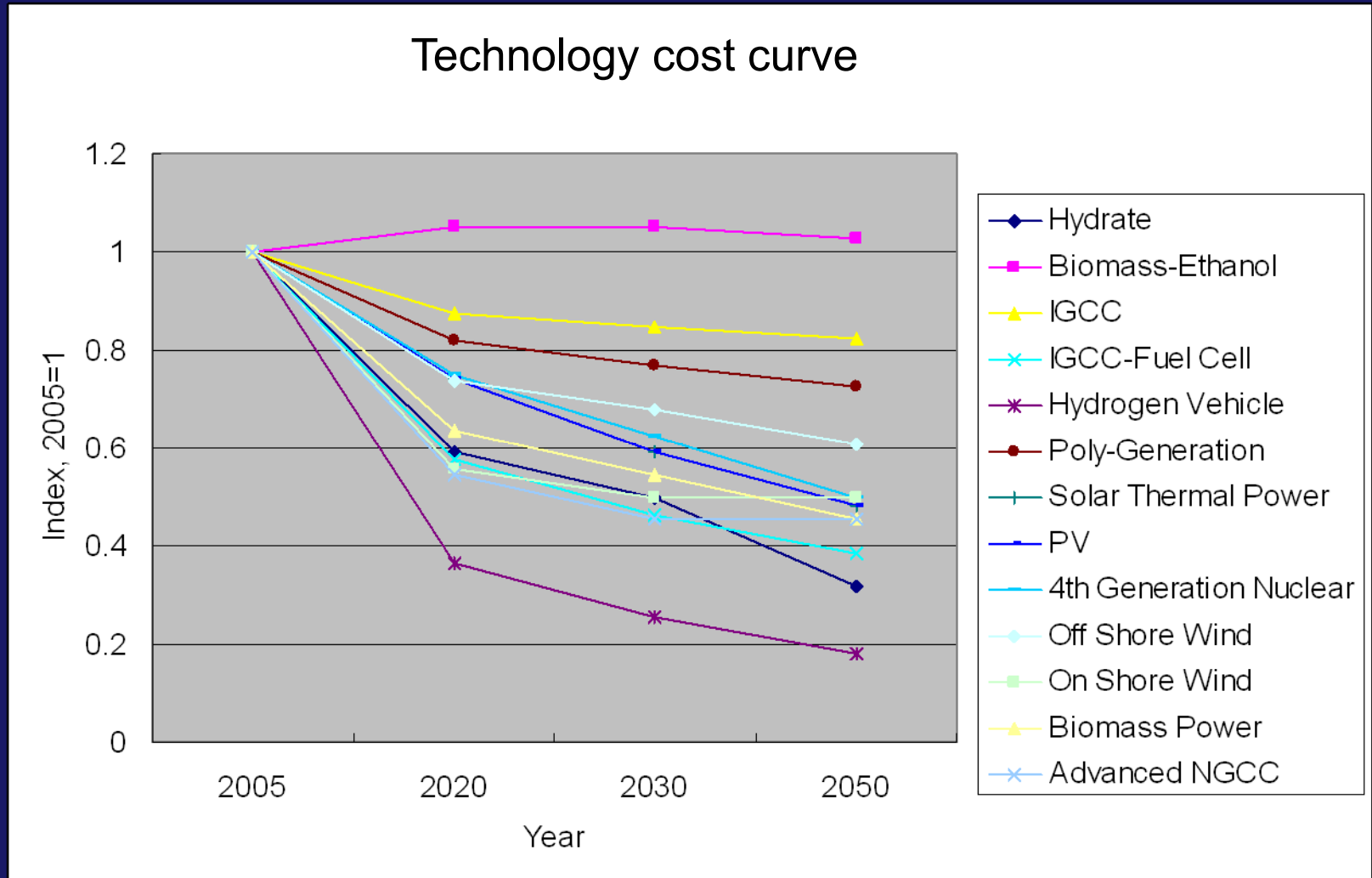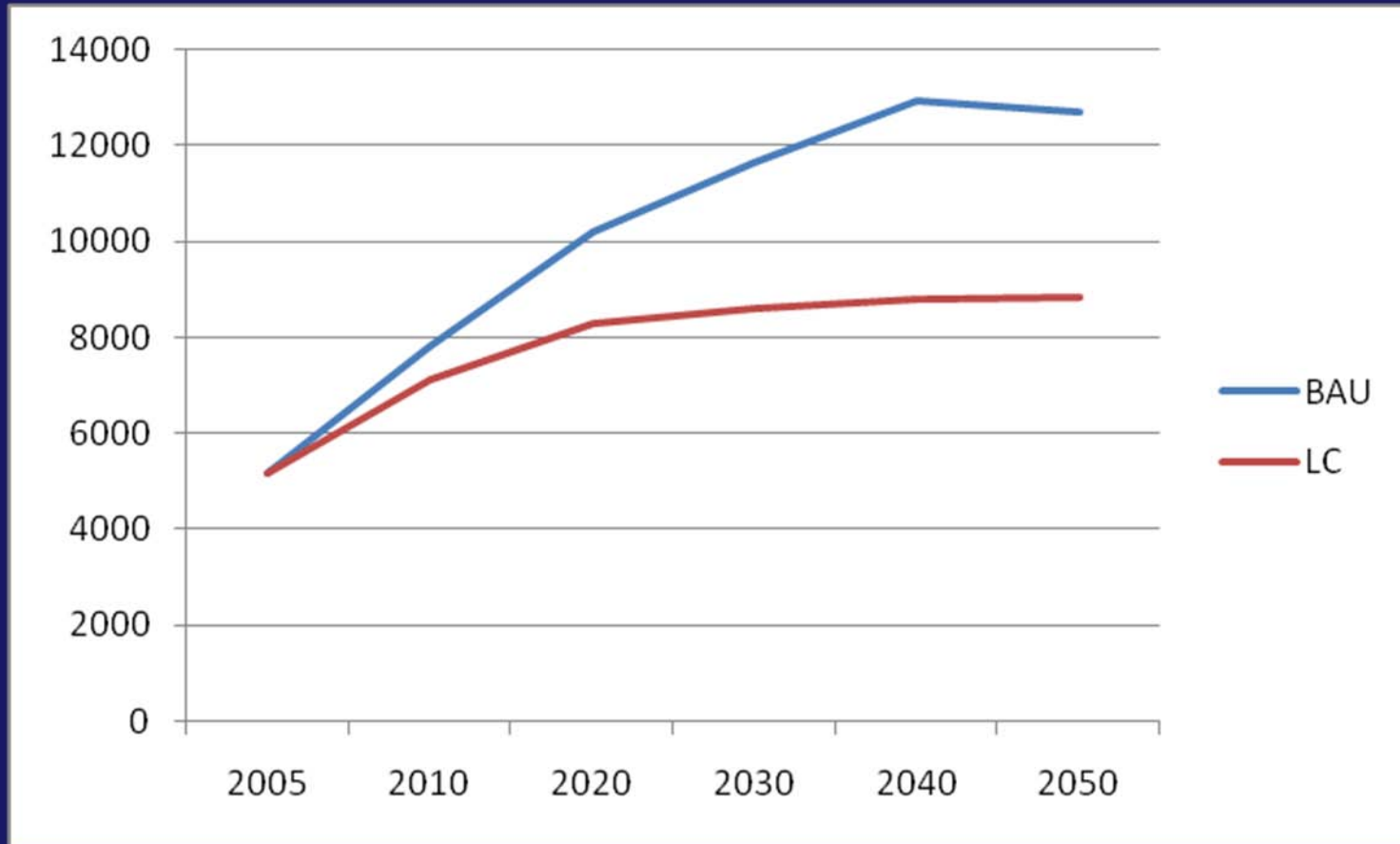
Energy efficiency improvement for main industry products
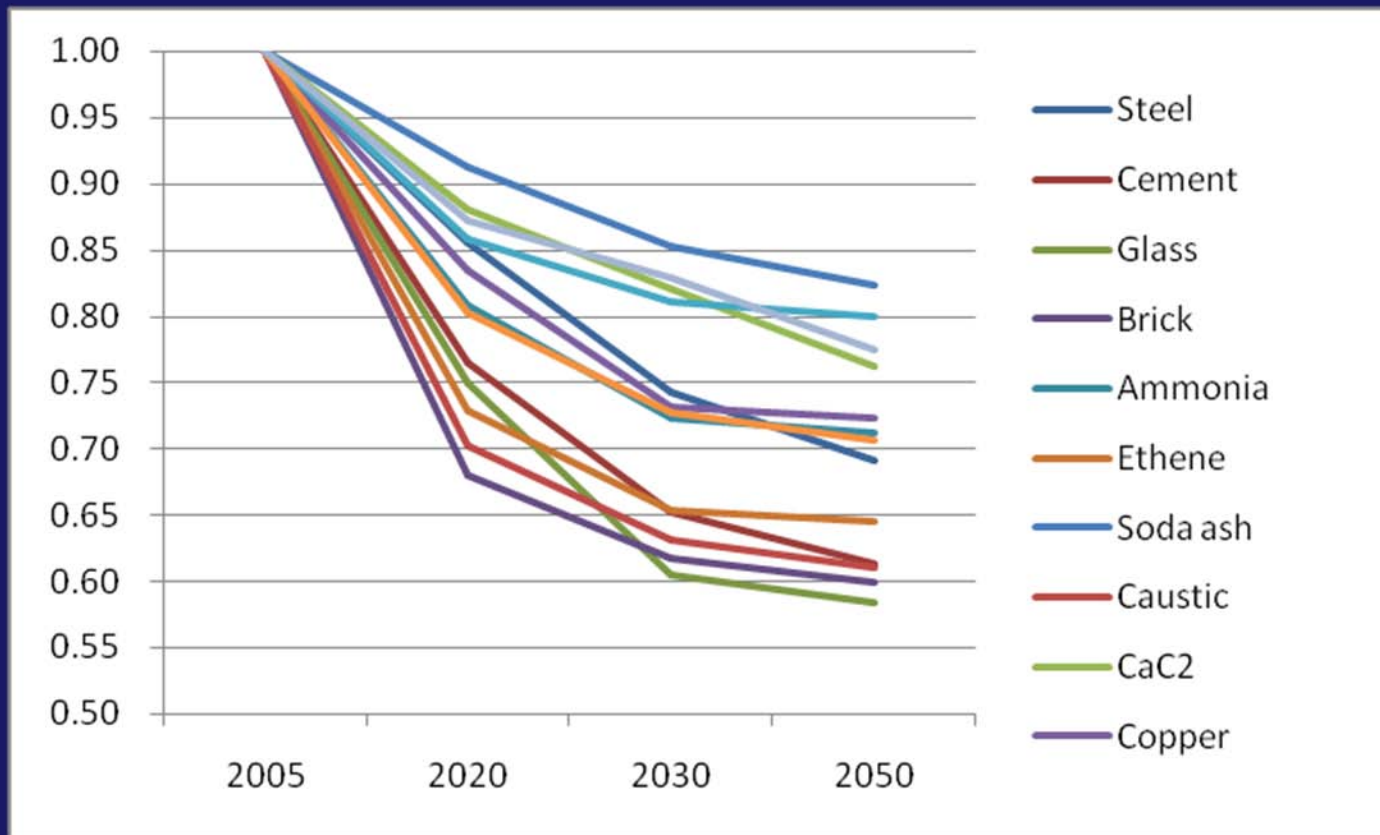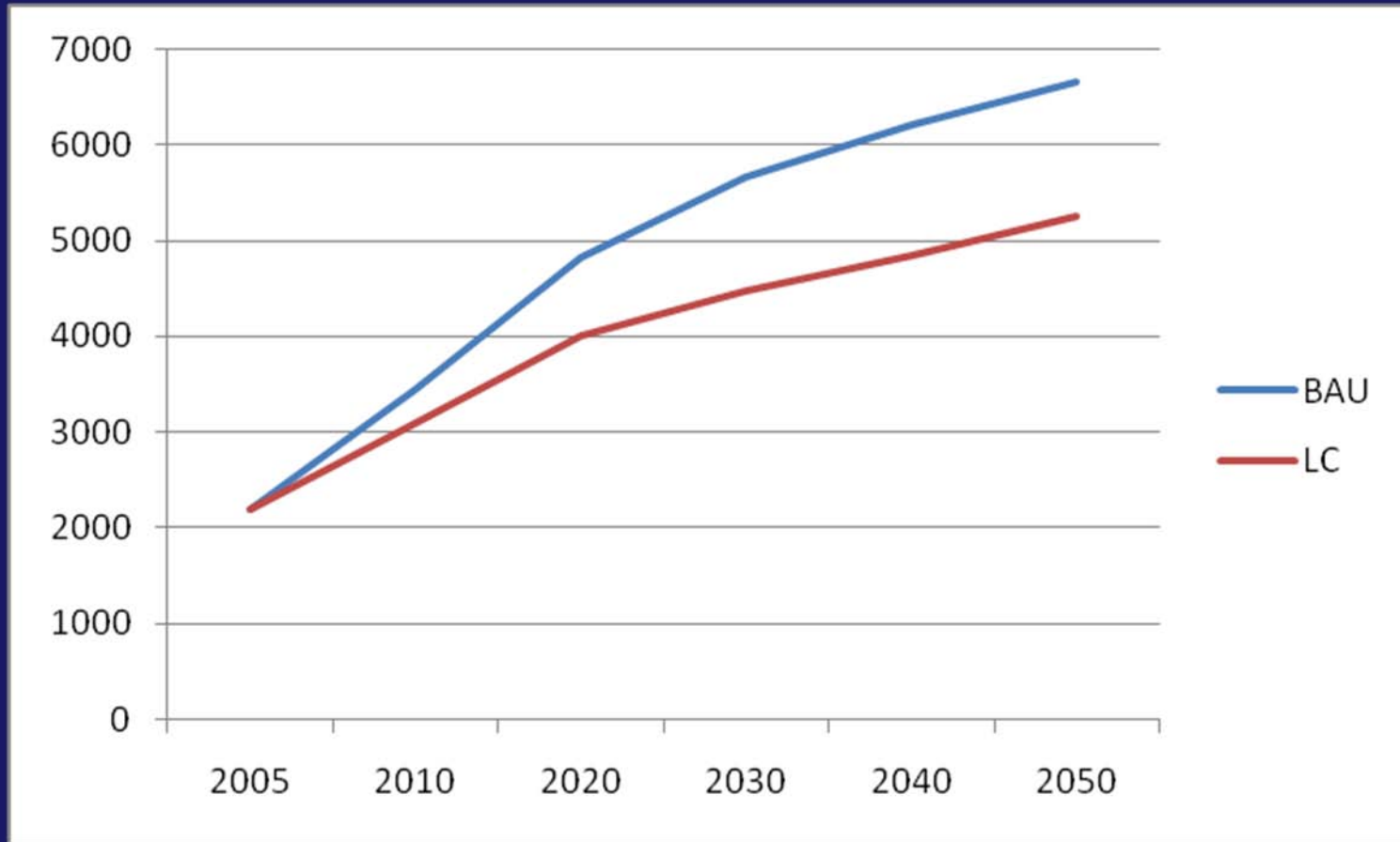
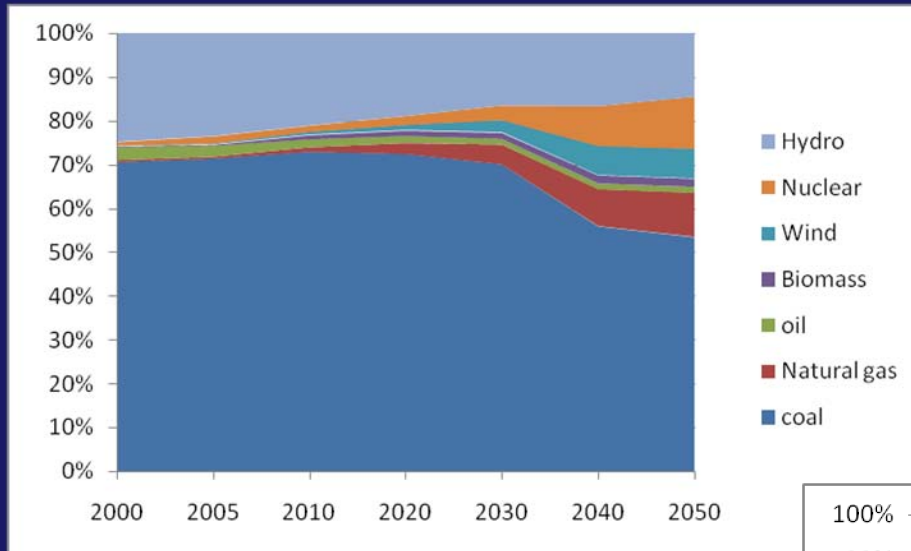# Technology development: *Cost curves of main technologies*

Result --- *Carbon emission (Mton)*

ERI, China

Result --- *Primary energy demand (Mtce)*

ERI, China

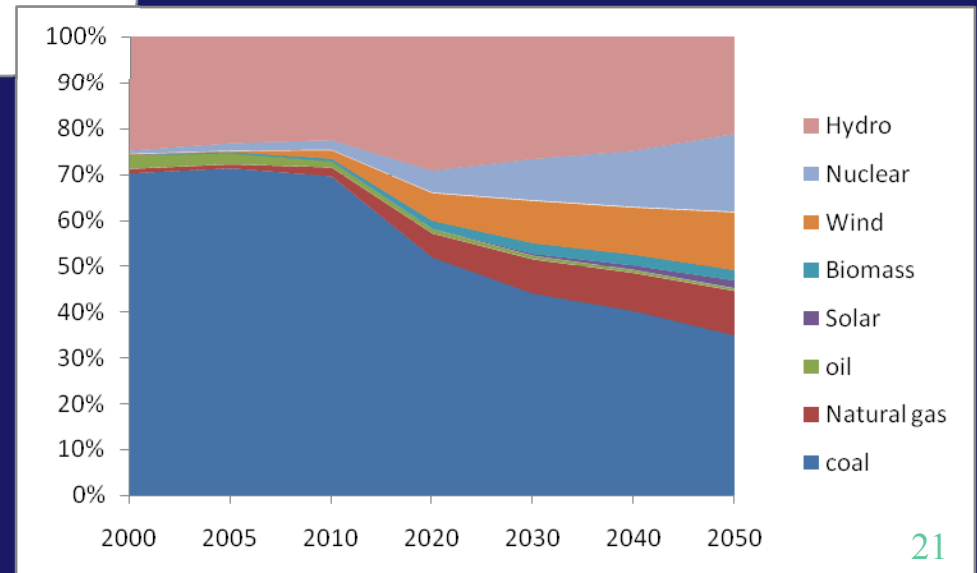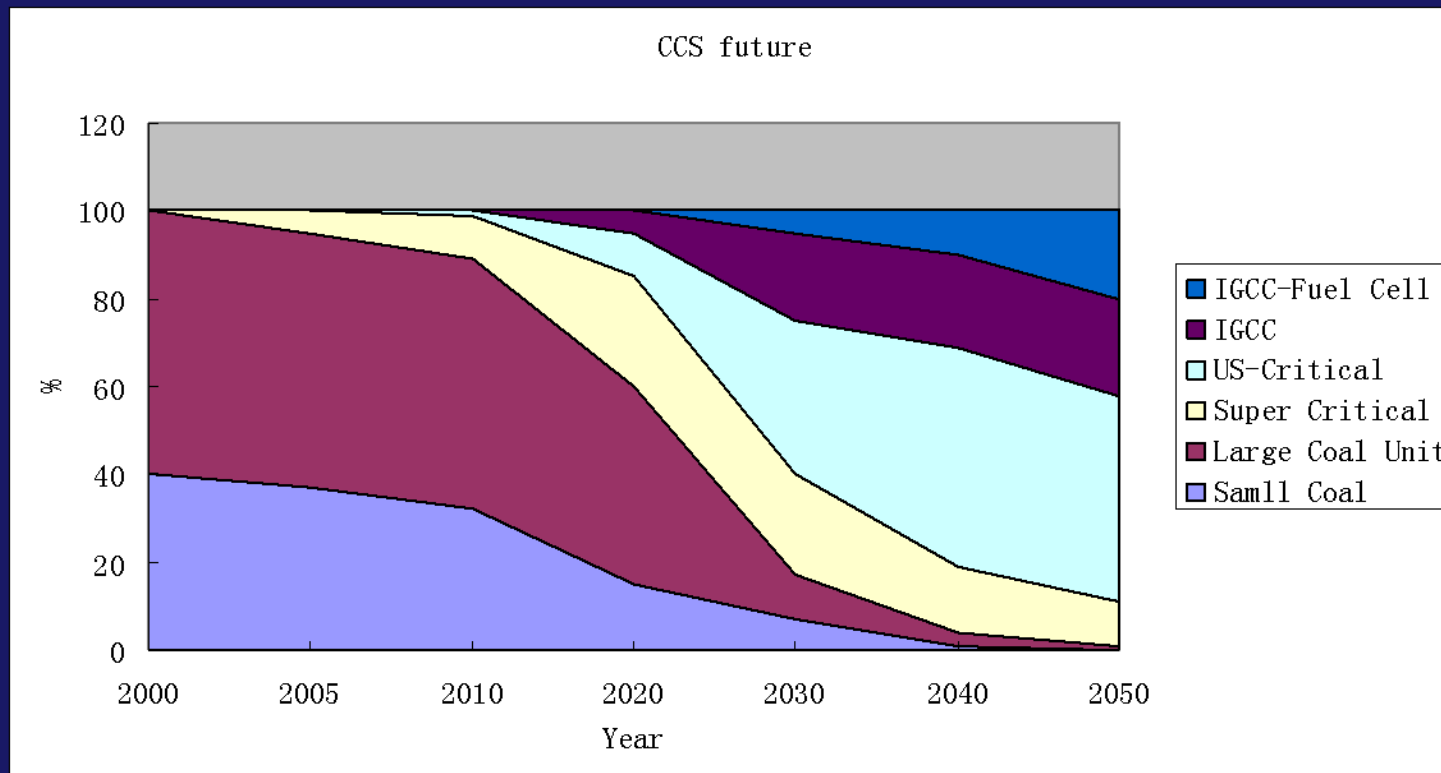# Result --- *Power capacity mix*

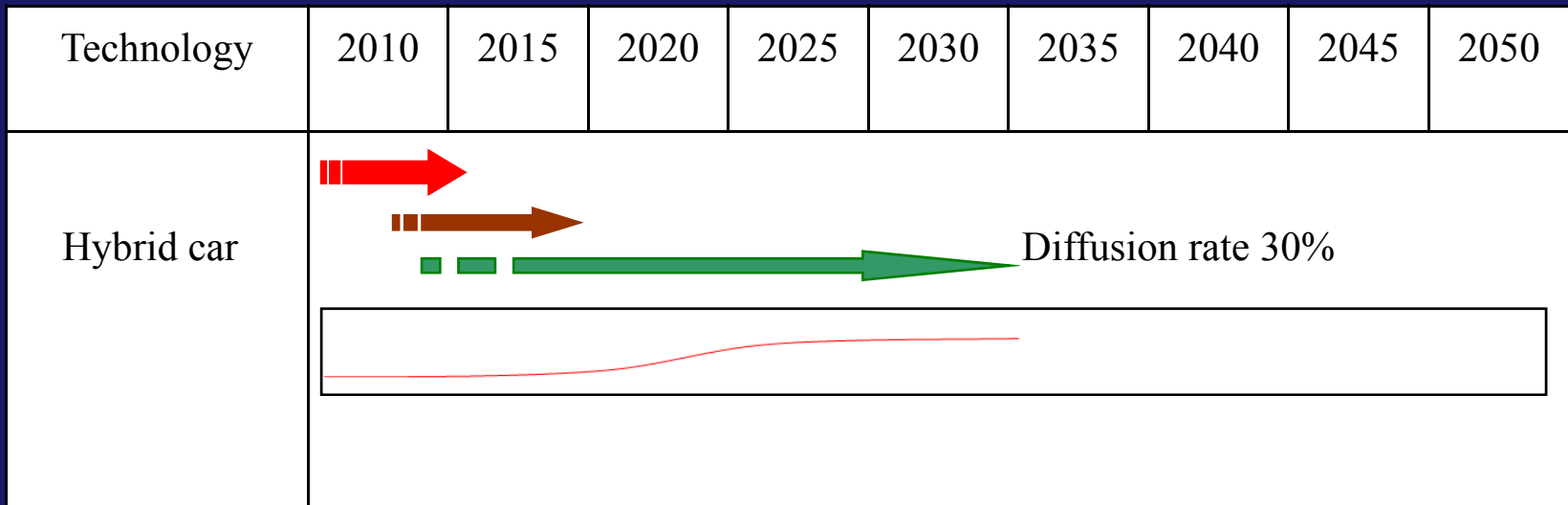

BAU

LC

Result --- *new technology penetration, CCS in power sector*

CCS future

Legend:
- IGCC-Fuel Cell
- IGCC
- US-Critical
- Super Critical
- Large Coal Unit
- Samll Coal

ERI, China

Result --- *Identified efficient technologies (fully used by 2020)*

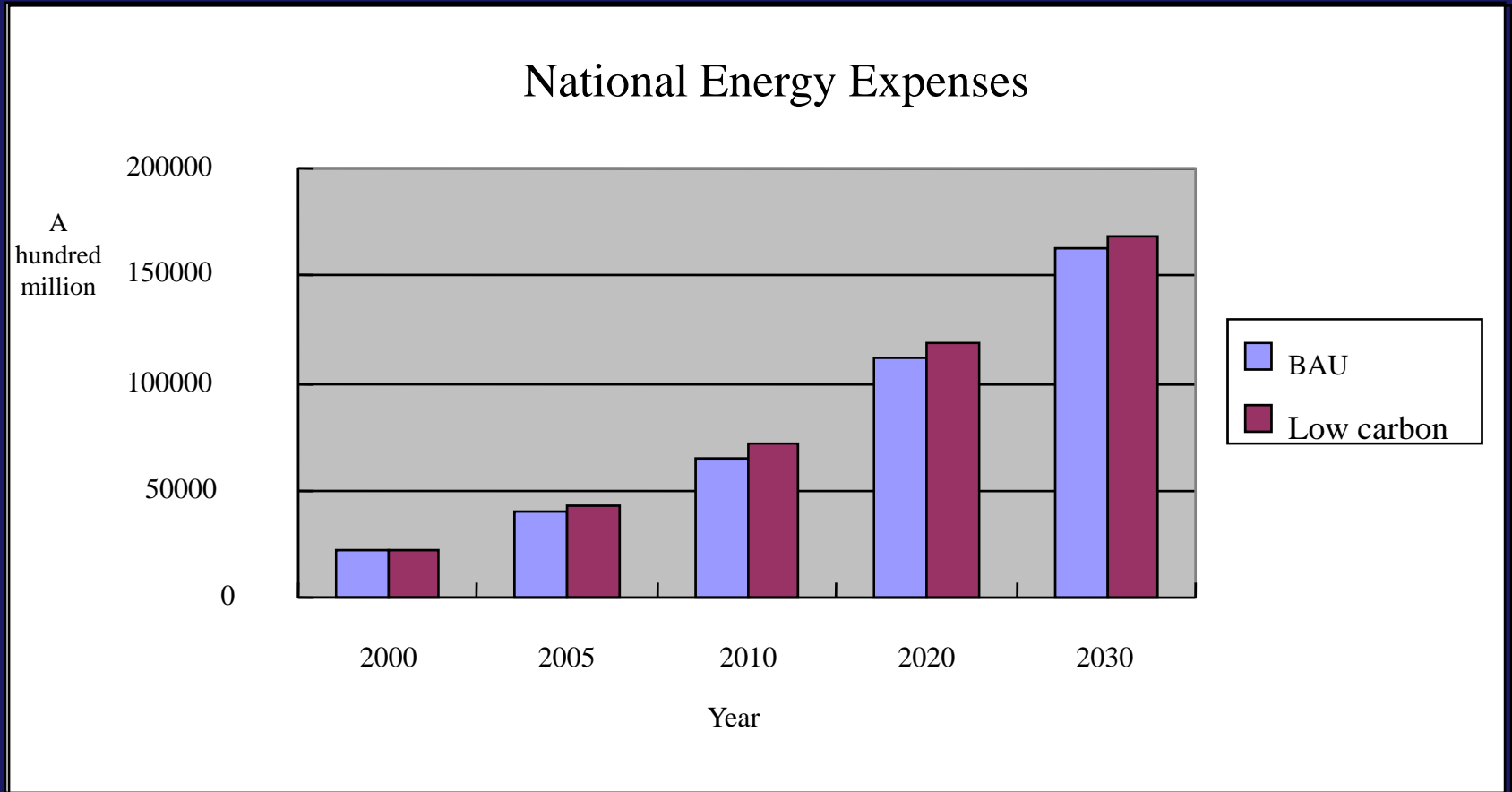| Sector	Technologies
Steel Industry	Large size equipment (Coke Oven, Blast furnace, Basic oxygen furnace ,etc.), Equipment of coke dry quenching, Continuous casting machine, TRT Continuous rolling machine, Equipment of coke oven gas, OH gas and BOF gas recovery , DC-electric arc furnace
Chemical Industry	Large size equipment for Chemical Production, Waste Heat Recover System, Ion membrane technology, Existing Technology Improving
Paper Making	Co-generation System, facilities of residue heat utilization, Black liquor recovery system, Continuous distillation system
Textile	Co-generation System, Shuttleless loom, High Speed Printing and Dyeing
Non-ferrous metal	Reverberator furnace, Waste Heat Recover System, QSL for lead and zinc production
Building Materials	dry process rotary kiln with pre-calciner, Electric power generator with residue heat, Colburn process, Hoffman kiln, Tunnel kiln
Machinery	High speed cutting, Electric-hydraulic hammer, Heat Preservation Furnace
Residential	Cooking by gas, Centralized Space Heating System, Energy Saving Electric Appliance, High Efficient Lighting
Service	Centralized Space Heating System, Centralized Cooling Heating System, Co-generation System, Energy Saving Electric Appliance, High Efficient Lighting
Transport	Diesel truck, Low Energy Use Car, Electric Car, Natural Gas Car, Electric Railway Locomotives
Common Use Technology	High Efficiency Boiler, FCB Technology, High Efficiency Electric Motor Speed Adjustable Motor, Centrifugal Electric Fun, Energy Saving Lighting

Technology road map: *Hybrid car*

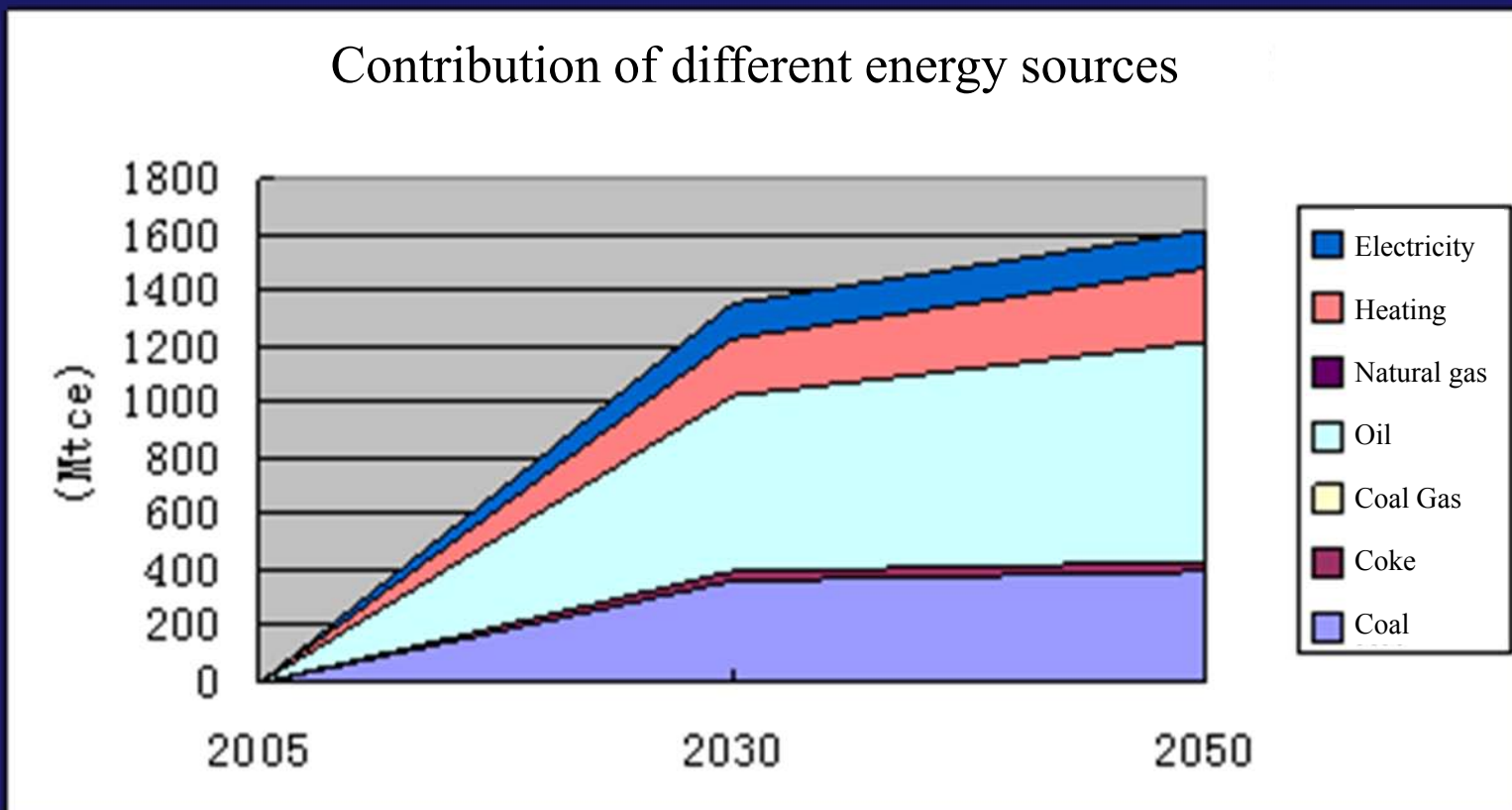
R&D

Demonstration and initiation in the market

Maturation and diffusion

Technology	2010	2015	2020	2025	2030	2035	2040	2045	2050
Hybrid car					Diffusion rate 30%				

Cost: *National Energy Expense*

National Energy Expenses

Contribution to energy saving

Contribution of different energy sources

Legend:
- Electricity
- Heating
- Natural gas
- Oil
- Coal Gas
- Coke
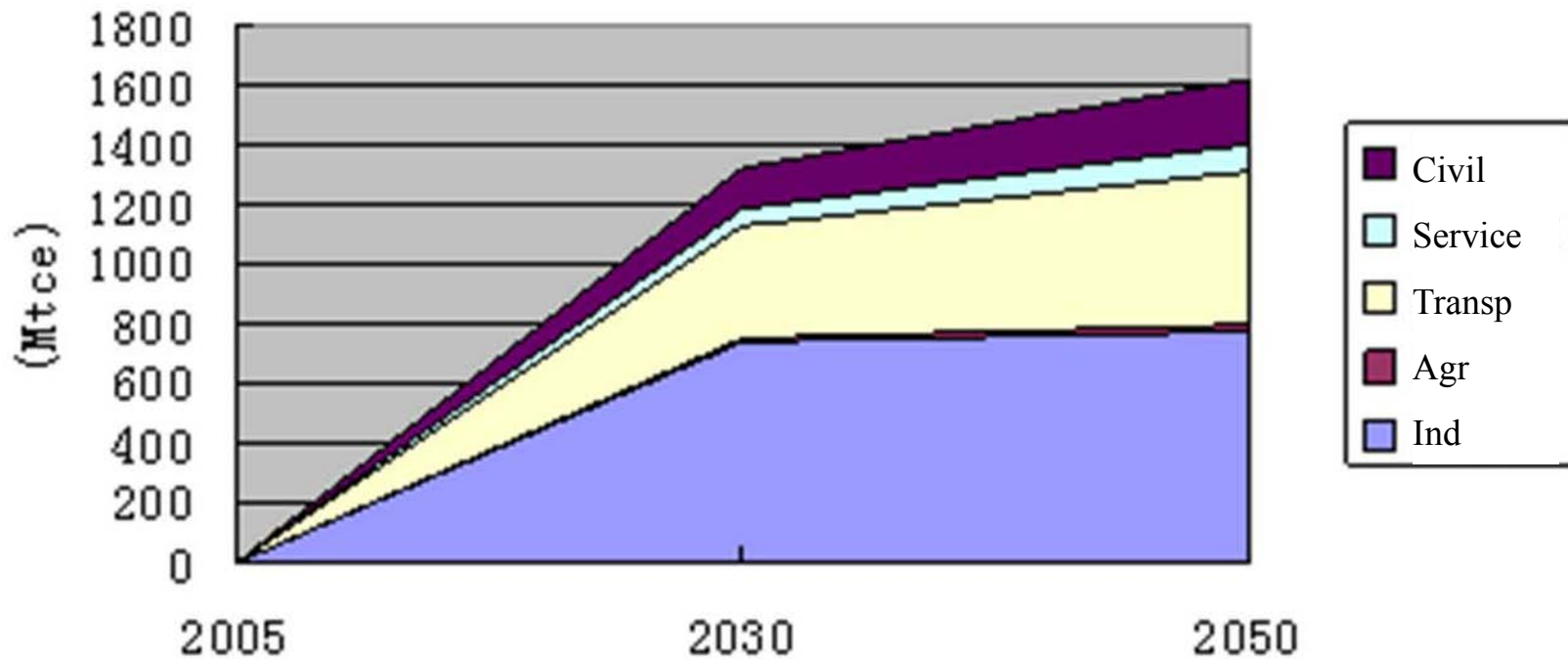- Coal

Contribution to energy saving

Contribution of different sectors

General findings

LC via BAU scenario:

- CO_2 emission is reduced by 44%

- Primary energy is reduced by 26.8%

- Energy structure is optimized: share of coal is reduced from 44% to 37.4%, oil from 27.6% to 20.2%, nuclear 9% to 14.2%, RE from 9.4% to 13.8%

Mainly finding:

- Industry and transportation contribute much to energy saving

- Application of new and low carbon techs is crucial

- A challenge: demand of oil and gas increase very fast

- Cost and benefit: certain amount of cost should not be avoided but opportunities exist

Primary conclusion

In order to develop toward a low carbon scenario, appropriate policies and measures are needed to promote:

- Optimization of economic structure:

  Energy saving, competitiveness, international cooperation

- Popularization of low carbon technologies:

  Industry, buildings, building energy use, transportation

- Low-carbon living pattern:

  Behavior change, awareness raising, new LC and ES equipments

- Cycling economy and sustainable development

  Standards and R&D, achievement of cobenefit

Current researches

Research topics and areas:

➤ Low carbon scenarios for China up to 2050:

Together with other research team in China

➤ Low carbon zones & cities: actions

E.g. Beijing, Shanghai, Ji Lin, Baoding

➤ Low carbon technologies: Technology roadmap

RE&EE technologies, CCS (IGCC), Solar, FC

➤ Policies and measures:

E.g. energy taxes, trading system, sectoral approaches

➤ Short term via long term

E.g. Economy recession, 12th-five-year plan, sustainable development

Thank you!

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