MOST and IEA Joint Workshop on CCS in Industry
Beijing
16 October ,2012

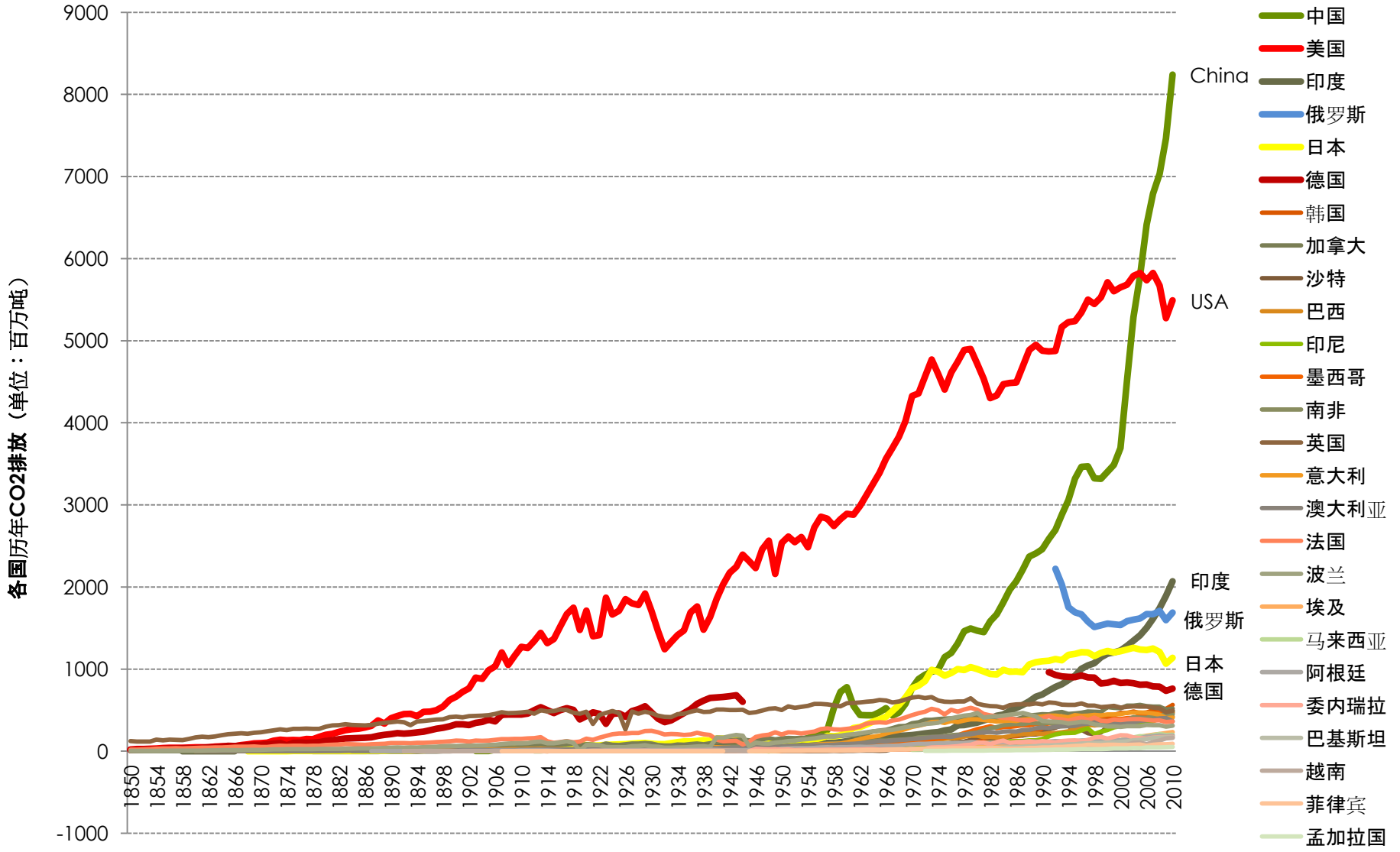
# *Key Sectors and Key Technology Priorities* for China's Low Carbon Future: Role of CCS

WANG Ke

Programme of Energy and Climate Economics (PECE)

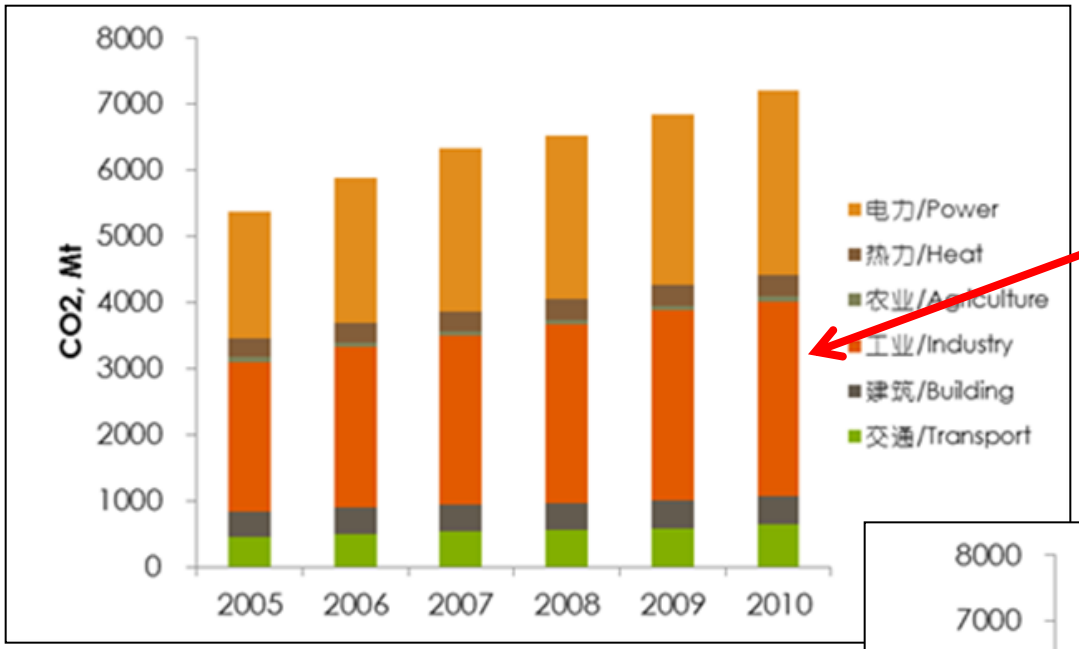
RENMIN UNIVERSITY OF CHINA

# $CO_2$ emissions of major countries（1850-2010）



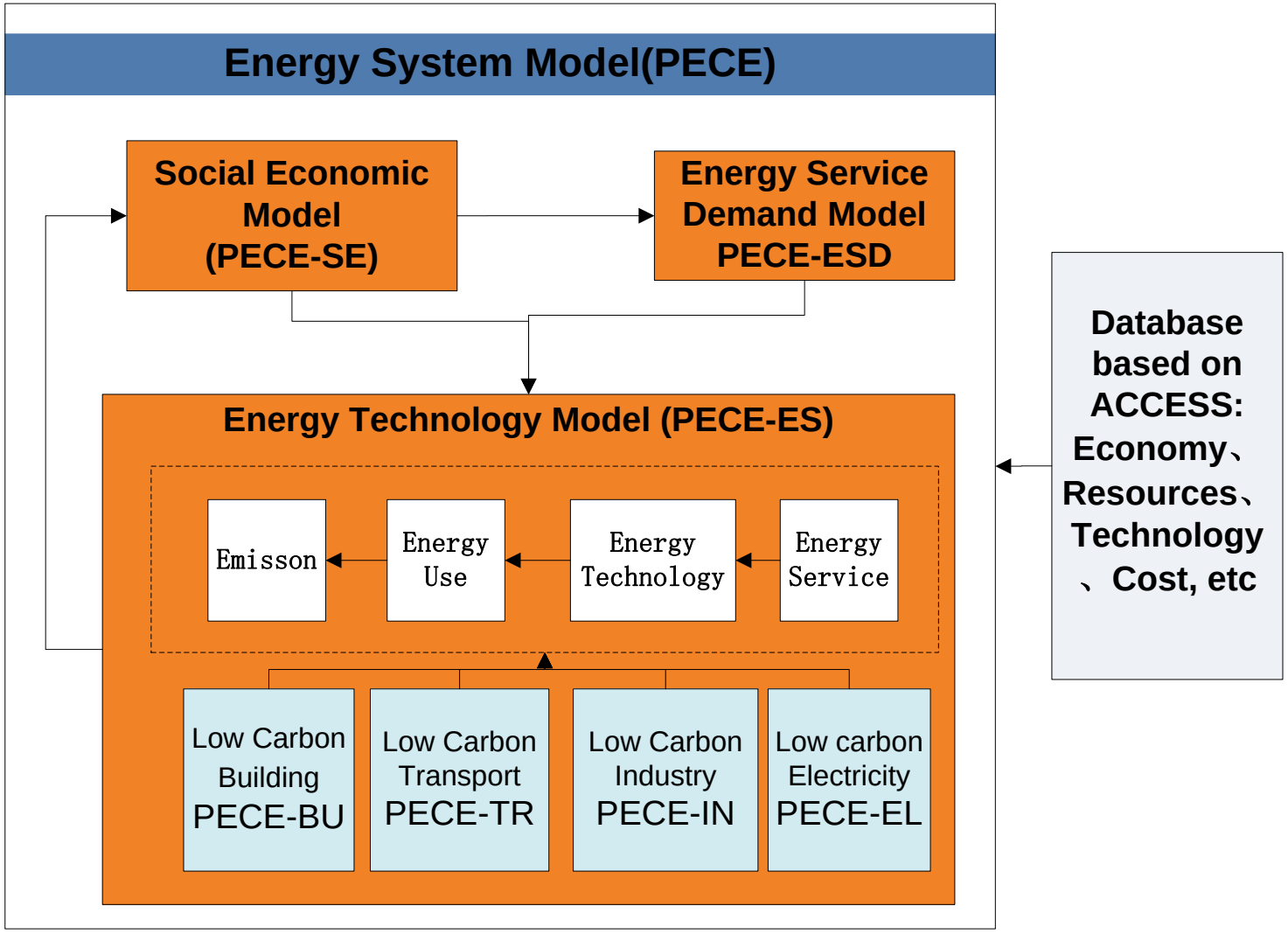

Data Sources： CDIAC(Carbon Dioxide Information Analysis Center) , Oak Ridge National Laboratory, 2011

# Sectoral Structure of China's CO2 Emissions




Industry

# Scenarios Analysis and Technology Needs Assessment: PECE model



# Description of three original scenarios

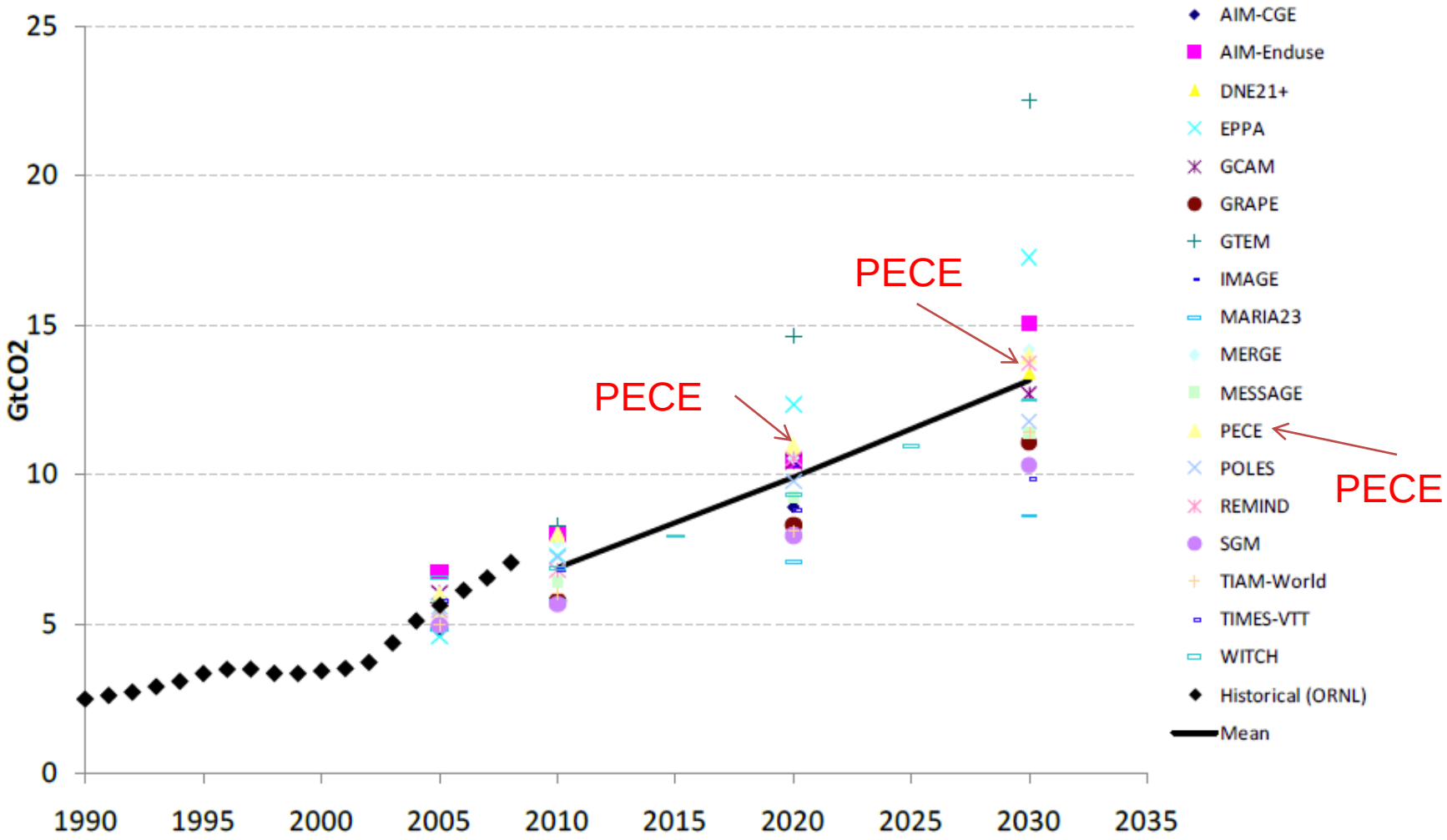
| Scenarios | For short | Scenario description |
|---|---|---|
| Reference scenario | **BAU** | This scenario takes full account of China's domestic development needs. During this scenario period, the Chinese Government has imposed a limited number of additional policies (such as the phasing out of outdated productivity and the adjustment of industrial structures), and has assumedly avoided countermeasures such as carbon taxes or subsidies. Planning polices, such as the four measures aimed at emissions reduction presented by President Hu Jintao on 22 September 2009, are not included in this scenario. Most current mainstream technologies (such as SC and USC) will continue to play core roles. The scenario would provide a series of comparative reference points for China's future policy options. |
| Emission control scenario | **EC** | Under this scenario, china has made great efforts to respond to climate change. It has adopted a variety of efforts to reduce energy consumption, and achieve a structural transformation of industrial and energy systems. This scenario is aimed at reaching a higher potential for emissions reduction while minimizing socioeconomic impacts. Under this scenario, China will adopt a series of advanced measures, including a large-scale deployment of renewable energies, and achieve substantial emissions reduction results. These measures will not include a large-scale application of carbon capture and sequestration, or renewable energy sources such as solar power. It will provide a range of focus for China's future negotiating positions and policy options. |
| Emission abatement scenario | **EA** | Under this scenario, China's CO2 emission would reach peak in 2030, and would reach "maximized" potential of emission reduction with even more significant incremental cost, and widely deployment of low carbon technologies in 2050. |

# Description of Three CO2 Price Path

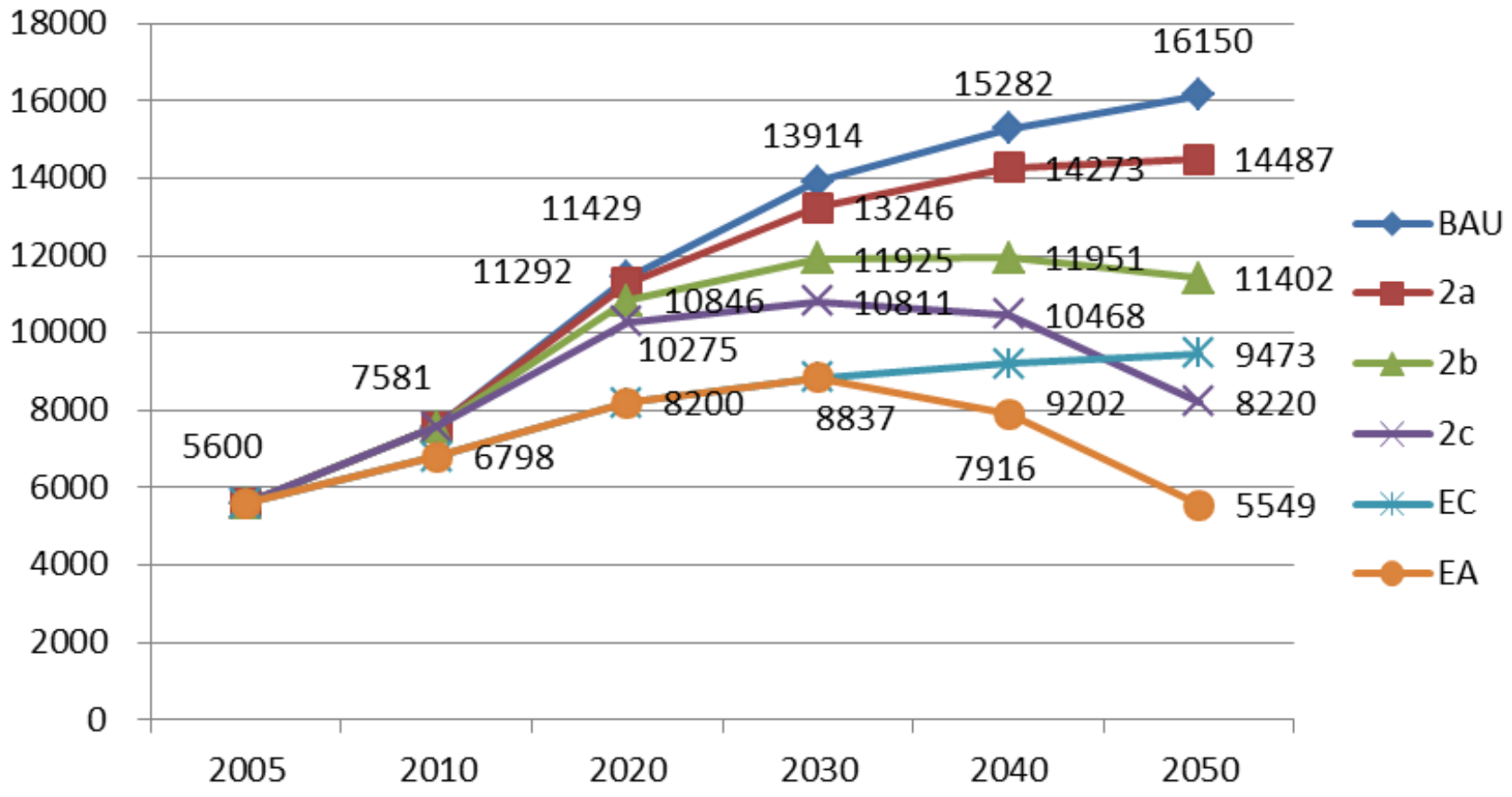
Scenarios Definition in International Model Forum:
AME (Asian Modelling Exercise ) and CPO (Climate Policy Outreach )

| Scenario | Price Units | 2020 | 2030 | 2040 | 2050 |
|---|---|---|---|---|---|
| 2a | $/tonne CO2, (2005 U.S. $) | 10 | 16 | 27 | 43 |
| 2b | $/tonne CO2, (2005 U.S. $) | 30 | 49 | 80 | 130 |
| 2c | $/tonne CO2, (2005 U.S. $) | 50 | 81 | 133 | 216 |

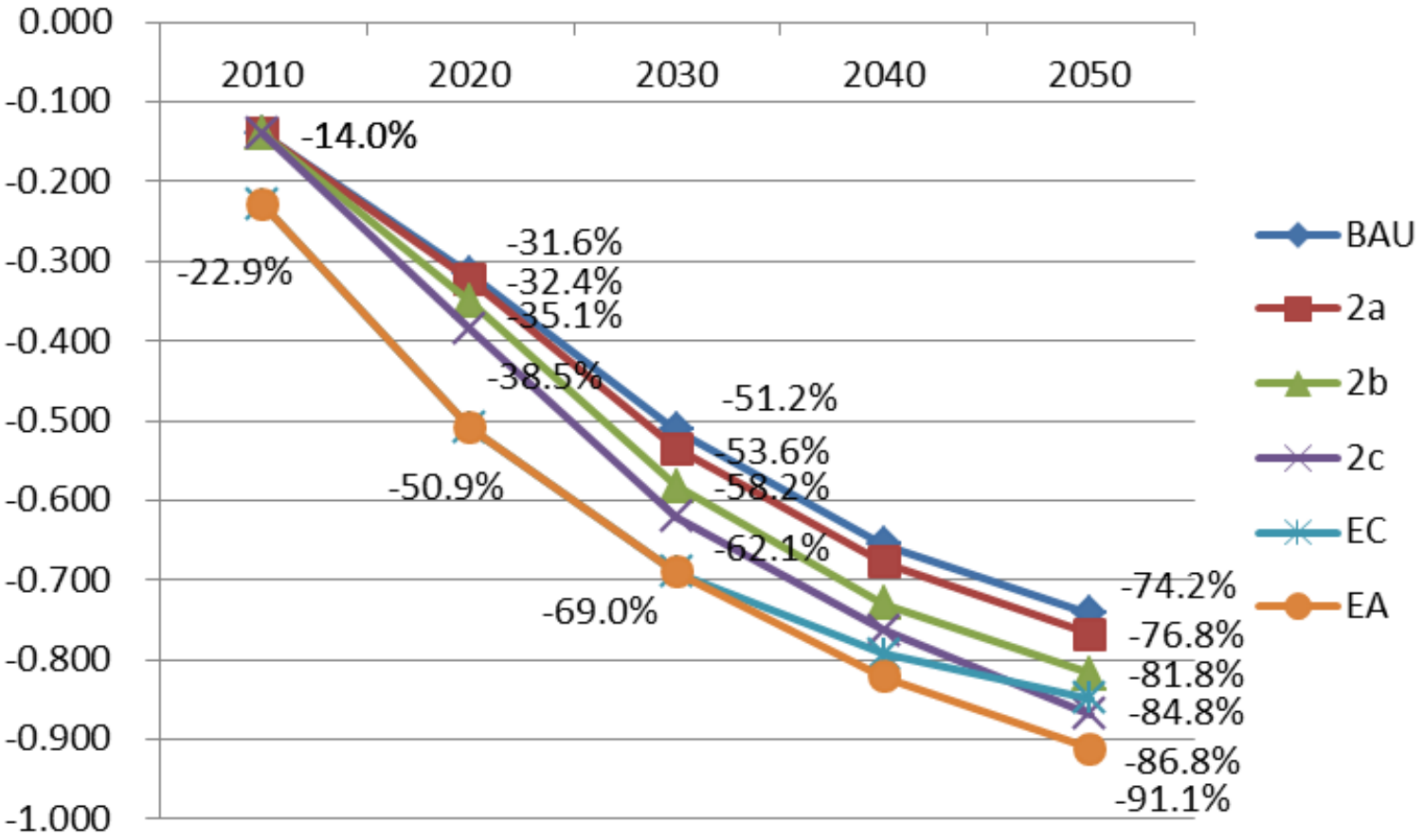
# Baseline scenarios



# CO2 Scenario



# CO2 Intensity of GDP

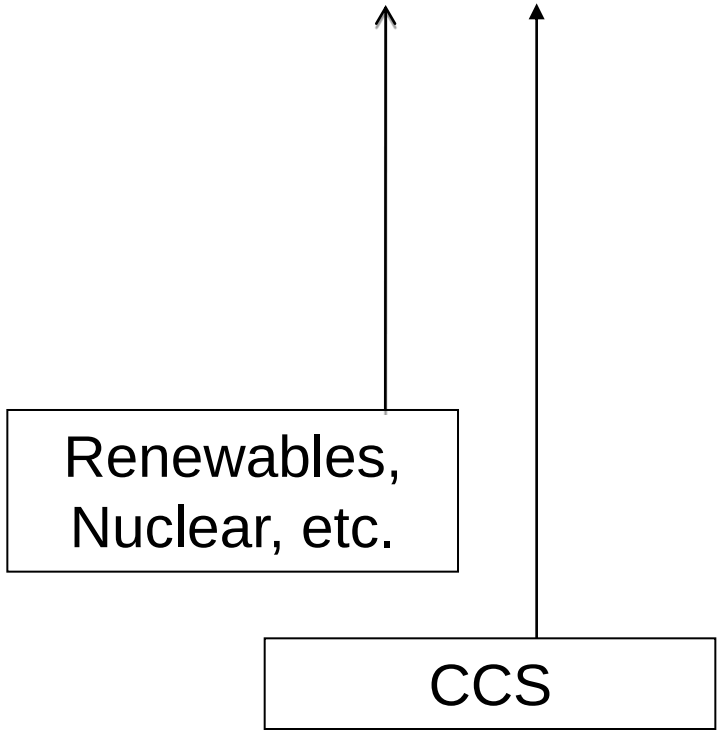


# Importance of technology transfer in addressing climate change

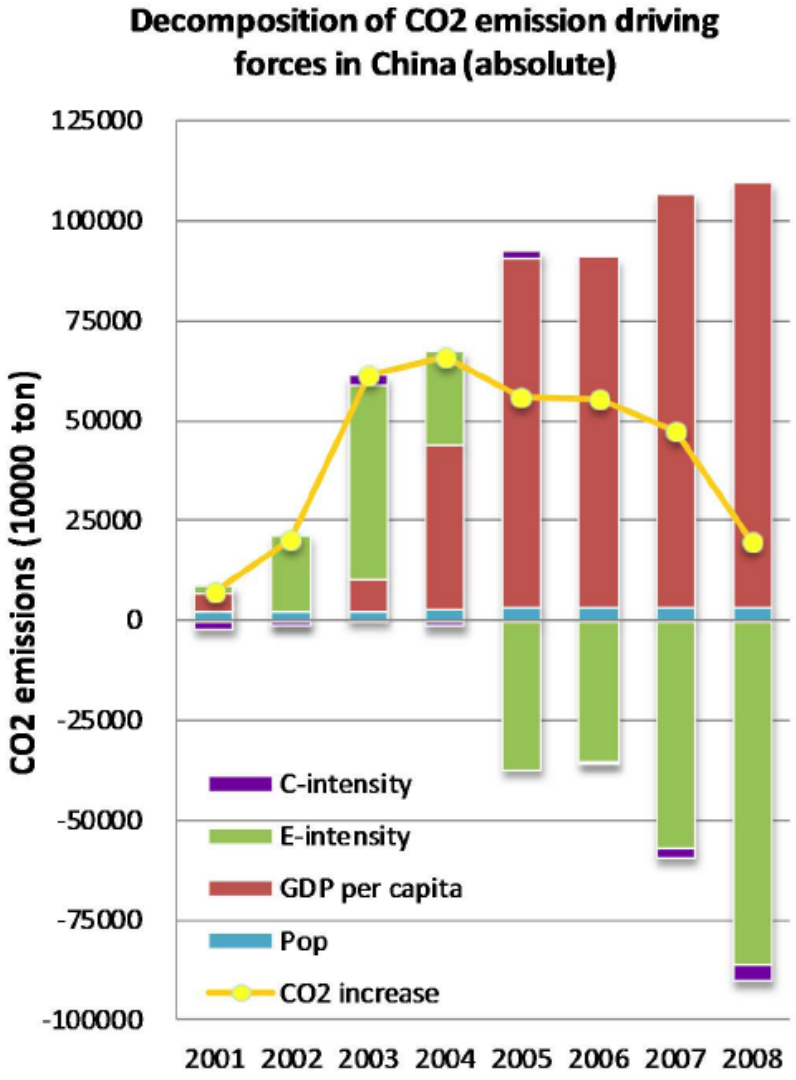
- The innovation and diffusion of environmentally sound technologies (ESTs) is critical to meet the challenges of climate change (IPCC AR4, 2007)

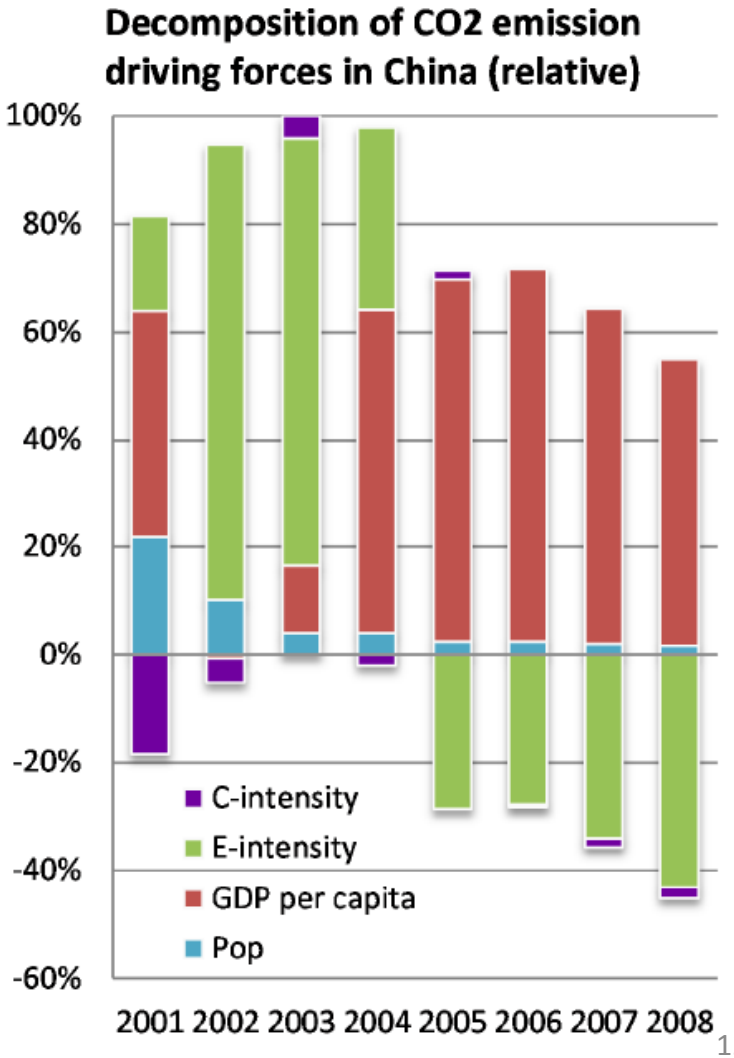
# Solutions

$$CO2 = Population \times \frac{GDP}{Population} \times \frac{Energy}{GDP} \times \frac{CO2}{Energy}$$

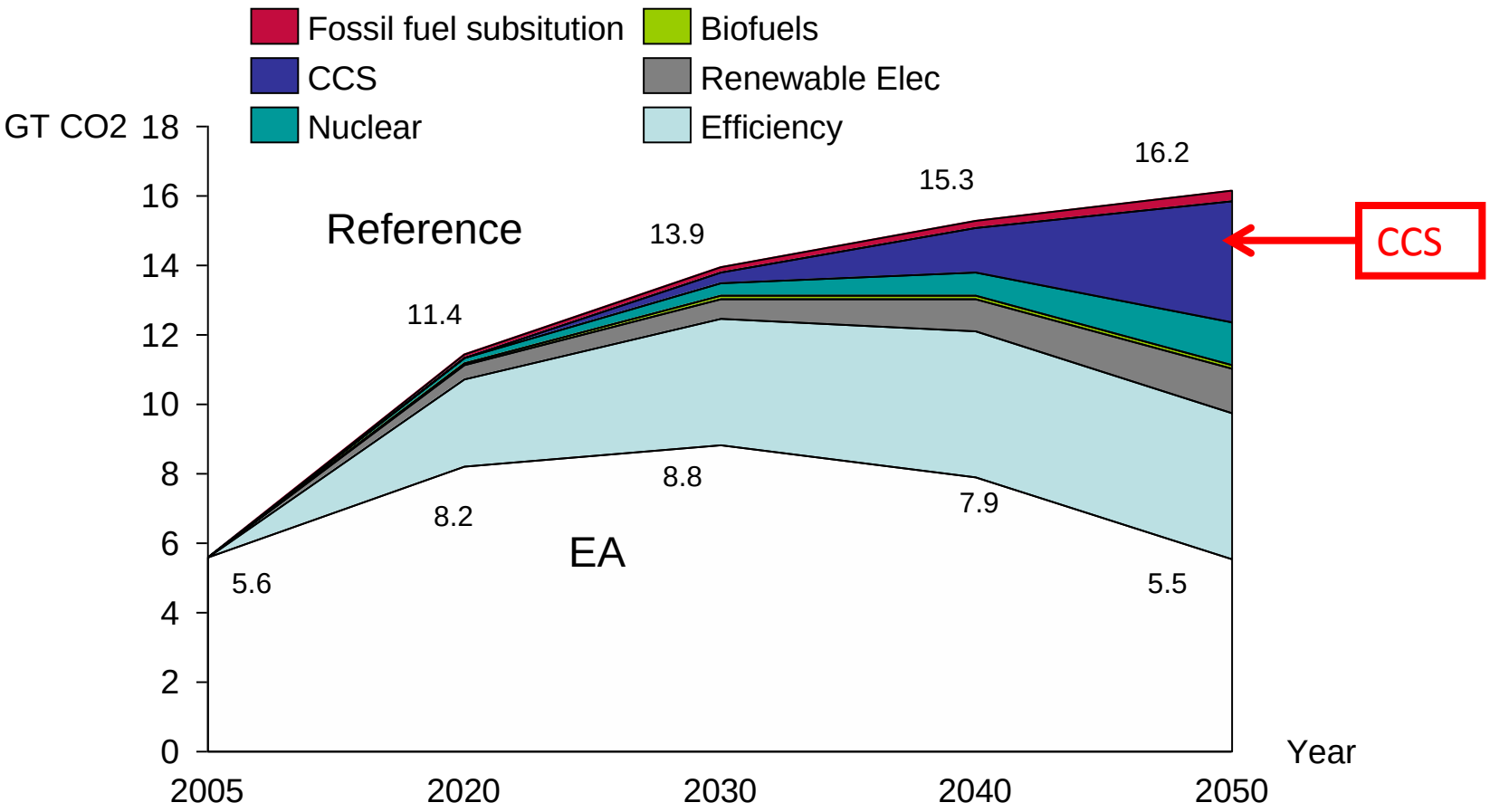


# Decomposition of CO2 emission driving forces in China (2001-2008)



# Sector-wise Potential



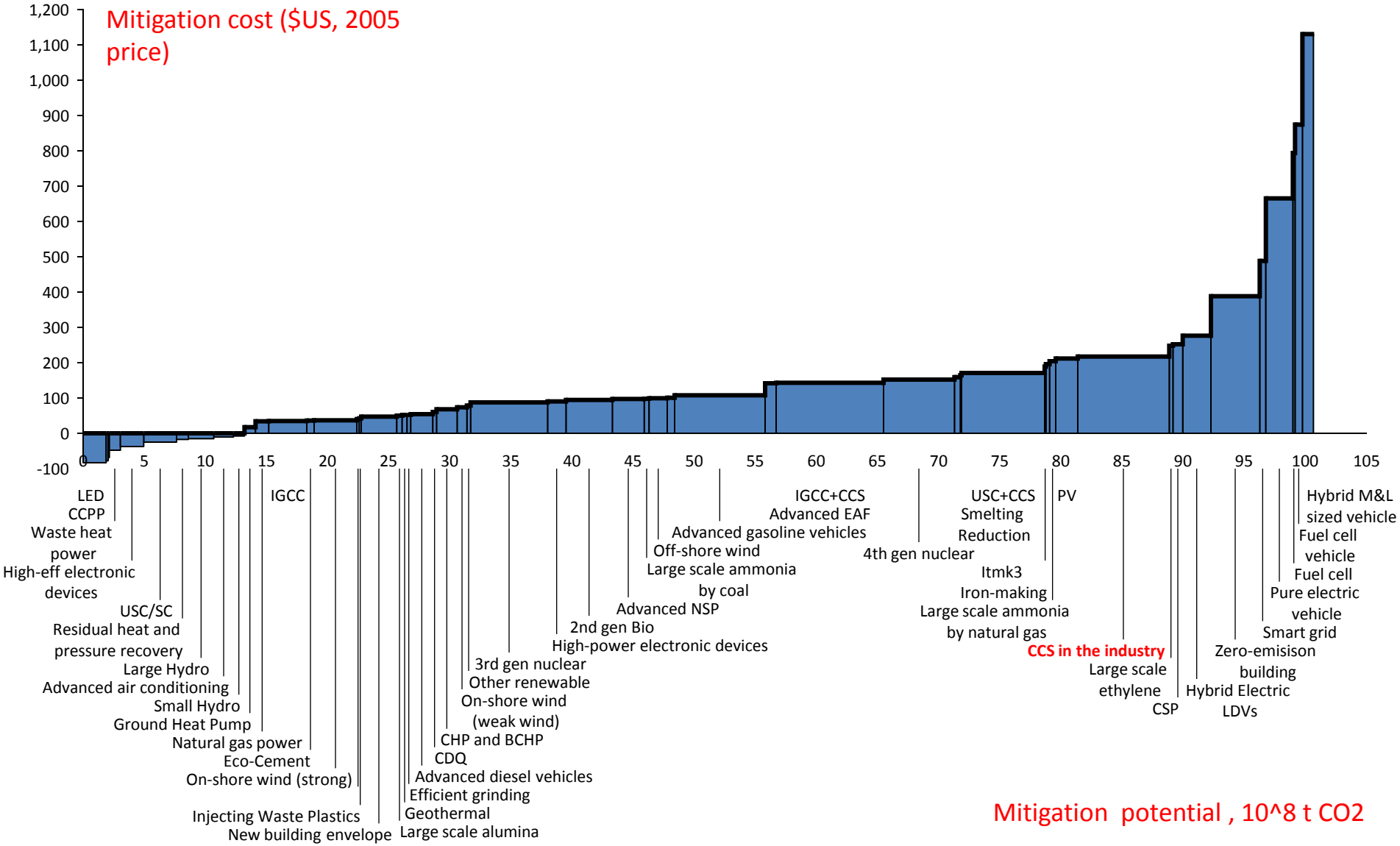
# Technology needs

- The currently available technologies can only make limited contribution to emission reduction, but still need some financial resources;
- R&D for future technologies, e.g. **CCS, are necessary and should be made at once, assuming 10 yrs for demonstration, another 10 yrs for dissemination, and full employment after 2030;**
- Some clean technologies like renewables and nuclear may encounter sorts of technological constraints which limit further deployment;
- Learning curves for most of the technologies go down over time with assumed rates; and
- Key technologies are selected with considerations of emission abatement potential and costs.

# Key Technology Needs

| | Deployment &Diffusion (Near term) | Demonstration (Mid-term) | R&D (long term) |
|---|---|---|---|
| Power | USC;<br>On-shore Wind power technology;<br>3rd generation large-scale Advanced pressurized water reactor;<br>Geothermal- Conventional;<br>High-efficiency natural gas fired power generation; | Coal Integrated Gasification Combined Cycle (IGCC);<br>Off shore wind power;<br>Solar Photovoltaic;<br>Geothermal–Enhanced;<br>2nd Biomass; | Low cost CO2 capture and storage;<br>Nuclear fusion;<br>CSP; Power storage; Smart grid;<br>4th nuclear generation;<br>Solar nanotechnology photovoltaic;<br>Hydrogen production, storage and distribution;<br>Fuel Cell |
| Steel | CDQ; CCPP; CMC;<br>Power, heat and fuel recovery;<br>Coal Injection of Blast Furnace;<br>Energy management center; | COREX; FINEX;<br>Advance EF;<br>Smelting reduction technology;<br>Waste Plastic Injection; | Direct Casting;<br>CO2 capture and storage; |
| Transport | Enhance fuel economy of vehicles by improved engine/ transmission/ matching technology;<br>Develop advanced diesel vehicles;<br>Improve railway electrification;<br>Aviate fuel economy management; | Hybrid vehicles;<br>Enhance fuel economy of transport system by information & intelligent systems<br>Improved road network; | Fuel cell vehicles;<br>Electric-motor vehicles;<br>Optimizing the construction and integration of transport capacity; |
| Cement | NSP cement kiln technology, especially the automatic control device and the overall operation level;<br>Low-temperature cogeneration technology; | Eco-cement<br>Alternative fuels and cement clinkers; | CCS; |
| Chemical | New type catalyst;<br>Large-scaled Synthetic Ammonia equipment; Optimize structure of raw material for Ethylene; | Alternative fuels and raw materials; | CCS; |
| Buildings | Green Lighting;<br>Technologies and materials of heat-insulation of external walls and roofs; Advanced efficiency electric devices ; | District energy system;<br>Heat pump system; supervising and Monitoring of building energy consumption technologies; Heat-electricity-coal gas triple co-supply system | Energy storage technology ;<br>Zero-emission buildings<br>Building integrated photovoltaic solar power system;<br>Advanced city plan; |

# MACs in 2050 (EA scenario)



| Sector | Technology | Development stage | Abatement potential (100 million tons of $CO_2$, under the EA scenario in 2050) | Incremental investment (US$100 million, under the EA scenario in 2050 ) |
|---|---|---|---|---|
| Power | CCS technology (including pre-combustion Carbon capture technology and post-combustion carbon capture technology, and carbon storage technology) | R&D | 20.1 | 13849 |
| Iron and Steel | CCS technology | R&D | 2.6 | 2955 |
| Cement | CCS technology | R&D | 1.3 | 1574 |



17

# Future work: further thinking about the role of CCS in China

- “Research on China’s low carbon technology strategy” under Key Program on China’s Low Carbon Macro Strategy by NDRC
- China Technology Needs Assessment Project (GEF Project and implemented by World Bank)

Thank you for your attention!

Contact:
Dr. WANG Ke
wangkert@ruc.edu.cn