# China's Climate Change Mitigation: Assessment of Policies and Roadmap

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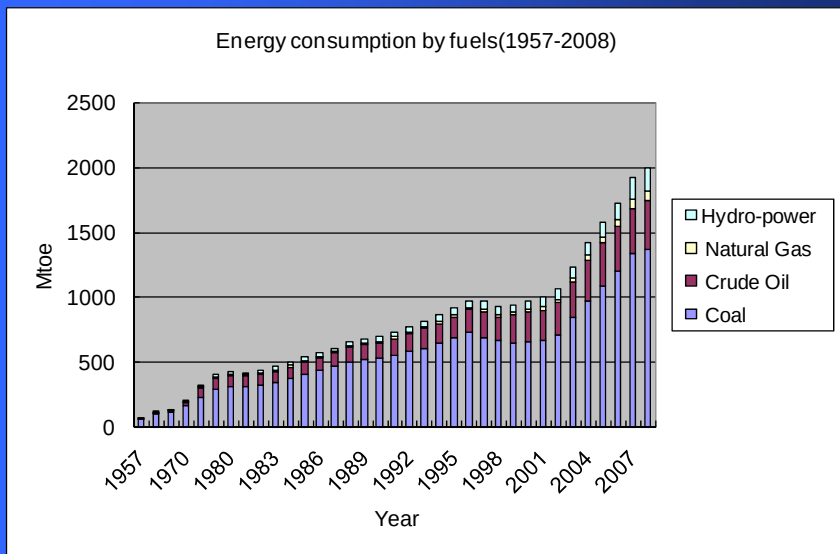
ERI, China

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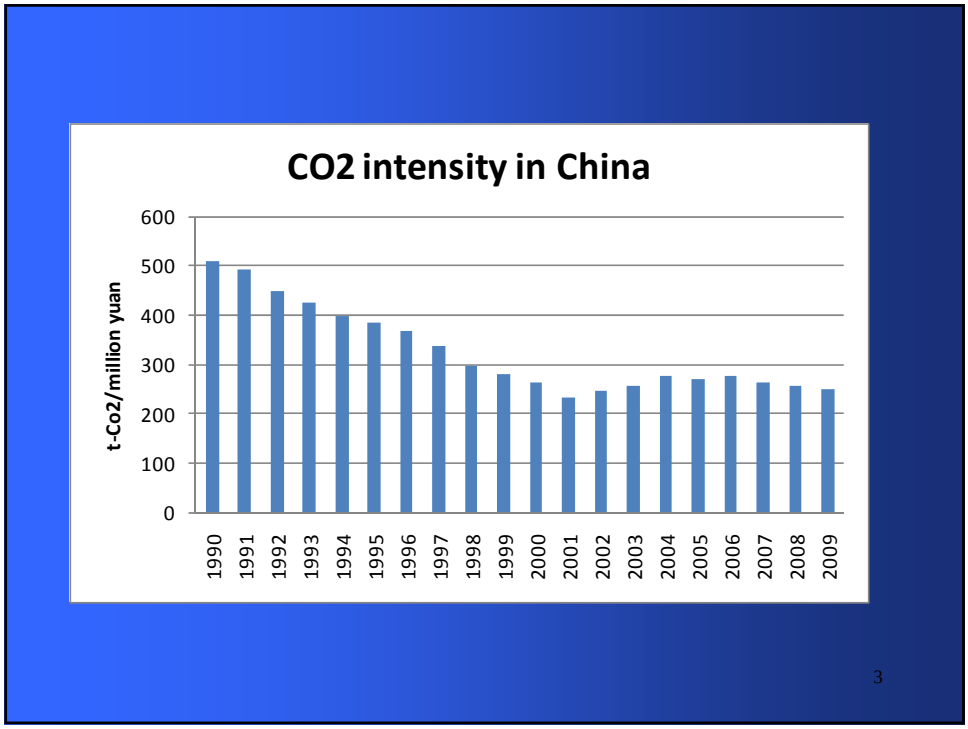
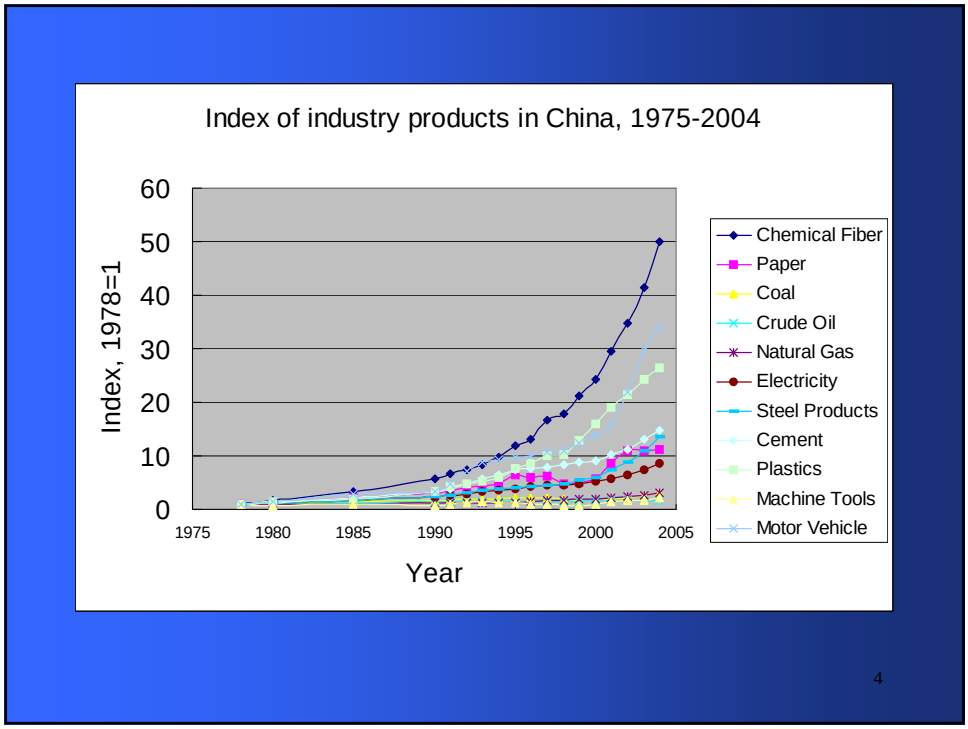
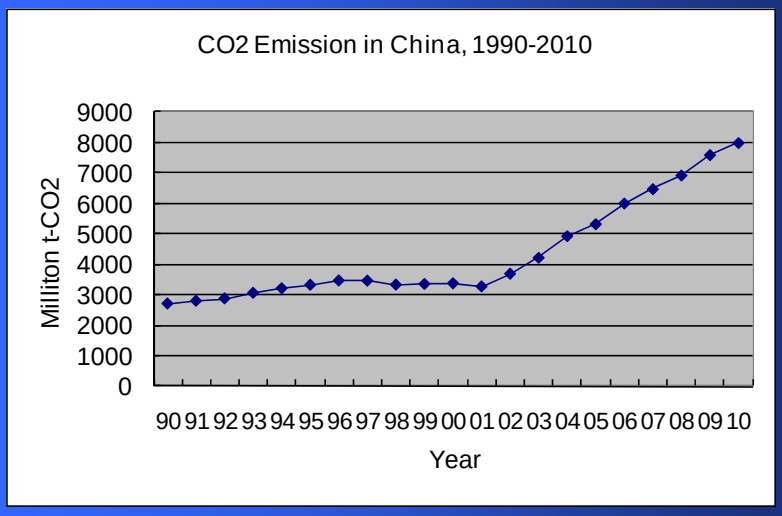

CO2 intensity in China
t-Co2/million yuan
600
500
400
300
200
100
0
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
3


Index of industry products in China, 1975-2004
Index, 1978=1
60
50
40
30
20
10
0
1975
1980
1985
1990
1995
2000
2005
Year
Chemical Fiber
Paper
Coal
Crude Oil
Natural Gas
Electricity
Steel Products
Cement
Plastics
Machine Tools
Motor Vehicle
4

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## *Energy Policies: Before 2003*

National Laws and Planning

- Energy Conservation Law, 1997
- Five Year Energy Planning, every five year
- Long-term Energy Planning, 1996
- Renewable Energy Development Framework, 1996
- Electricity Law, 1995
- Coal Law, 1996

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## *Energy Policies: Before 2003*

Energy Standard/regulation

- Energy Efficiency Standard for many industry products
- Subsidy for wind power, 0.7yuan/kWh
- Limitation of small size energy plants/energy intensive production factory

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## *Energy Policies: Before 2003*

Energy Reforming

- Energy Price: changing from government price to market price, nearly finished now(by 2006)
- Power generation sector (separate from government control to be business activities, separate distribution and generation)
- Oil and Natural Gas industry: established three big oil company, no more government agency (Oil Ministry)

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## *Energy Policies: After 2003*

Energy issue is becoming crucial concerning of government, because:

- Sustainable development is an important voice in recent years; circular economy is widely accepted
- Widely spread energy shortage: power shortage in 24 provinces in 2004; Gasoline shortage in Guang Dong province in 2005
- Environment target was not reached in 10th Five Yeay Plan, energy is key driving force
- Accident in coal mine is widely known by public, and major concerning of government on improving life and working standard of rural employees
- Energy price increase is getting much more attention on energy

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## *Energy Policies: After 2003*

National laws and plan

- Long- and Medium-term Energy Conservation Plan, with much more concrete content, 2004
- Renewable energy law: renewable energy target by 2020, 2005
- 11th Five Year Energy Plan: National energy intensity target(20% energy intensity reduction in 2010 compared with that in 2005)

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## *Energy Policies: After 2003*

Standard and regulation

- Vehicle fuel efficiency standard
- Strictly implementation of building energy standard in many provinces and cities
- Implementation of energy label of electric appliances
- Release control on coal price for all users
- Higher consumption tax for larger engine vehicles

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## *Energy Policies: After 2003*

Administration

- Establish energy leading group
- and office for the leading group was formed, similar size with energy bureau, to take over energy strategy and policy in China
- Energy Bureau, 2008

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## *Sustainable Development and Energy Policies*

Renewable energy law: renewable energy target by 2020

| | |
|---|---|
| Wind: | 30GW/150GW |
| Solar Power PV: | 1.8GW/20GW |
| Solar heater: | 300million m2 |
| Biomass Power: | 30GW |
| Biomass Diesel: | 2Mt |
| Biomass | 10Mt |
| Biomass solid fuel: | 50million ton |
| Small Hydro: | 80GW |

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## *Energy Policies: After 2003*

What's going on:

- Draft Energy Law
- Revise Energy Conservation Law
- Draft Oil and Natural Gas Law
- Renewable energy development plan up to 2020

- Implement fuel tax
- Second vehicle fuel efficiency standard
- Renewable energy promotion policies

- Energy reporting by government officials
- Energy monitoring for 1000 large energy users

- More than 500 energy conservation projects, in 11th five year plan

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## *Ten Programs for Energy Efficiency in the plan (NDRC 2004)*

| Program | Potential Annual Energy Savings |
|---|---|
| Coal-fired industrial boilers conversion and energy efficiency improvement | 70 Mtce (conversion)<br>35 Mtce (efficiency) |
| Heat-power co-generation | 5 Mtce |
| Residual heat and pressure usage | 2.66 Mtce (steel industry)<br>3 Mtce (cement industry)<br>1.35 Mtce (coal mining industry) |
| Oil conservation and substitution | 35 Mt less oil consumption |
| Electrical machinery system energy conservation | 20 billion kWh electricity |
| Energy system optimization | strive to achieve international benchmarks of energy efficiency in steel, petrochemical and chemical industries |
| Construction energy conservation | 50 Mtce |
| Green lighting | 29 billion kWh electricity |
| Government organisations' energy conservation | reduce energy consumption per capita and per area of office space by 20% in 2010, compared to 2002 |
| Energy conservation monitoring & technology services system construction. | |

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## *China's National Climate Change Programme*

- Status Quo of Climate Change in China and Efforts to Deal With Climate Change
- Impacts and Challenges of Climate Change on China
- Guidelines, principles and objectives of China to respond to climate change
- China's policies and measures to address climate change
- China's Position on Key Climate Change Issues and Need for International Cooperation

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## *GHG Control target for 2010*

- 20% energy intensity reduction from 2005 to 2010
- Renewable energy will take share of 10% by 2010 in total primary supply
- Limit N2O emission by 2010 to be same level in 2005
- Try to increase forest coverage to 20% by 2010
- Newly increase improved grass land by 24million ha
- Recover degraded, deserted and basified grass land by 52million ha,
- Increase share of natural reserve area to be around 16% of total land
- Retreat hungriness land by 22million ha.

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## *What is happening now on policy*

- Negotiation in COPs, Copenhagen and after that
- 12th Five Year Plan on Energy, Climate change
- Low Carbon Development Planning and Strategy
- National long-term energy plan

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Table 4. Major policies announced recently

| Classification | Policies |
|---|---|
| Administration | Establishing energy conservation and emission reduction steering group chaired by Prime Minister (June 2006); Distributing targets to each province (September 2006) |
| Overall National Policies | Synthesizing Working Program for Energy Conservation and Emission Reduction (June 2007); Revised Energy Conservation Law (October 2007); Integrated Resource Utilization Guidance (January 2007); Guidance for Accelerating Energy Conservation Service Industry (2008); Guidance Catalog for industry structure change (annual) |
| Monitoring | Implementation Program of Energy Intensity Per GDP Statistic Index System (Nov. 2007), Implementation Program of Unit Energy Use Per GDP Exam (Nov. 2007), Implementation Program of Unit Energy Use Per GDP Monitoring (Nov. 2007) |
| Pricing/Financing | Differentiating energy prices for key energy-intensive industries |
| Standardization | Second catalog of energy efficiency labeling for consumer products (Sep. 2006); Third catalog of energy efficiency labeling for consumer products (January 2008) |
| Industry | 1000 large energy users monitoring program by national government (April 2006); extending provincial large energy user monitoring program (April 2006); closure of small-size industry in energy intensive sectors including cement, steel, non-ferrous, chemistry etc. (June 2006); approval for new projects based on energy efficiency standard (January 2007) |
| Transport | Light Vehicle Fuel Efficiency Standard (Sep. 2007) |
| Buildings | 11th Five Year Plan for Energy Conservation in Buildings (February 2006); Building Efficiency Standard Implementation (June 2007) |
| Power generation | Closure of small power plants (January 2007), regulation for newly installed coal-fired power plants to be most advanced power plants |

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## *Chinese targets in Copenhagen*

- Carbon Intensity reduction of 40% to 45% from 2005 to 2020
- Non-Fossil fuel accounts for 15% in TPE in 2020

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## *China's 12th Five Year Plan*

- Energy Intensity reduction: 16%
- Carbon Intensity reduction: 17%

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## *China's 12th Five Year Plan: supporting actions*

- 10000 top energy users program
- Non-Fossil fuel energy: 11.4% by 2015
- Forest area: 12.5million hectares increase by 2015
- COD: 8% reduction
- SO2: 8% reduction
- Nox: 10% reduction

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## *Recent climate change related actions*

- 13 pilot cities and provinces for low carbon development
- 6 pilot cities and provinces for emission trading
- Discussing about carbon tax
- Low carbon technology priority
- Energy consumption cap by 2015

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## *Domestic climate change strategy*

- What is the targets of GHG in China? Short-term and long-term?
- Key policies and countermeasures for low carbon future
- Long-term Energy and emission pathways?
- Economy development pattern?
- Technology R&D strategy? What kind of technologies?
- Near-term action and policies? Cost and benefit of these near-term policies?

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## *Using modeling tools*

- Scenarios: pathways, targets (intensity and absolute)
- Cost analysis: wide range of cost analysis
- Multi-development targets analysis
- Benefit analysis by taking low carbon economy
- Co-benefit analysis (GHGs, local pollutions, water pollutions, and others)
- Integrated analysis

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## *What we are doing*

- Low carbon scenario up to 2050 for China
- Technology roadmap up to 2050
- Policy roadmap for deep cut in 2050
- Political roadmap for Climate change in China and the world
- Low carbon development for cities and provinces (more than 10 cities and provinces)
- Cost and benefit analysis
- Technology solution

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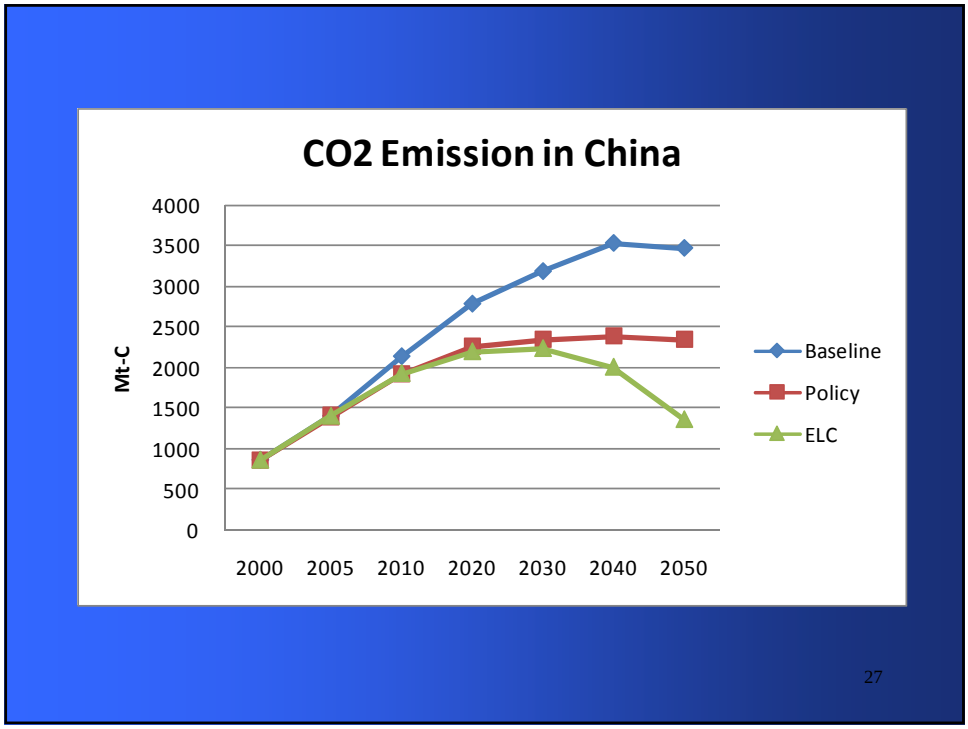
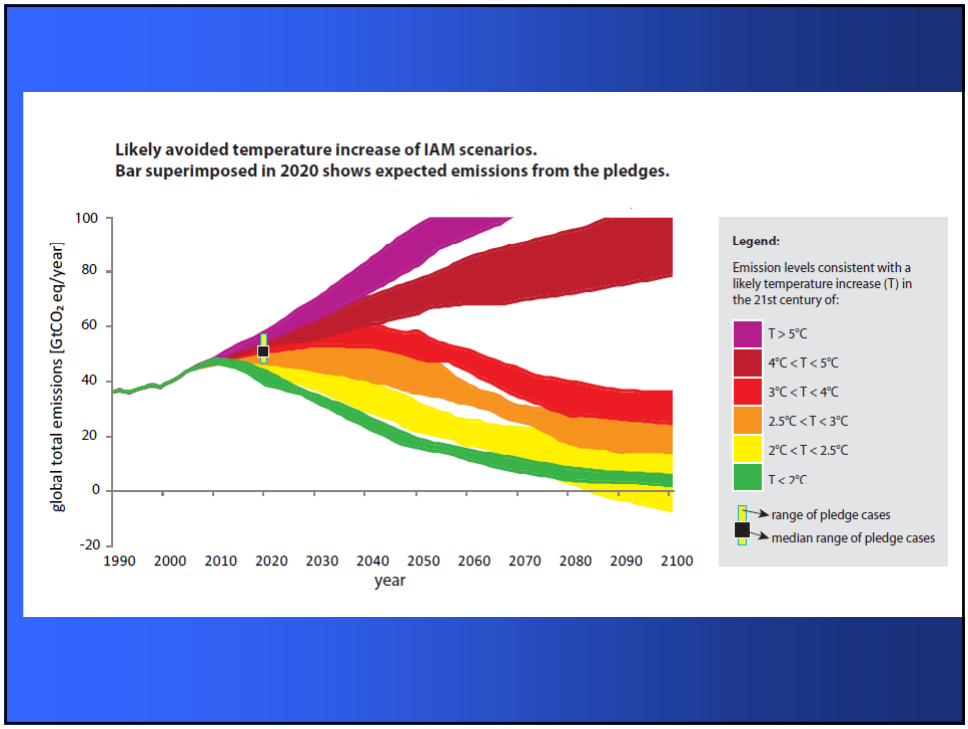
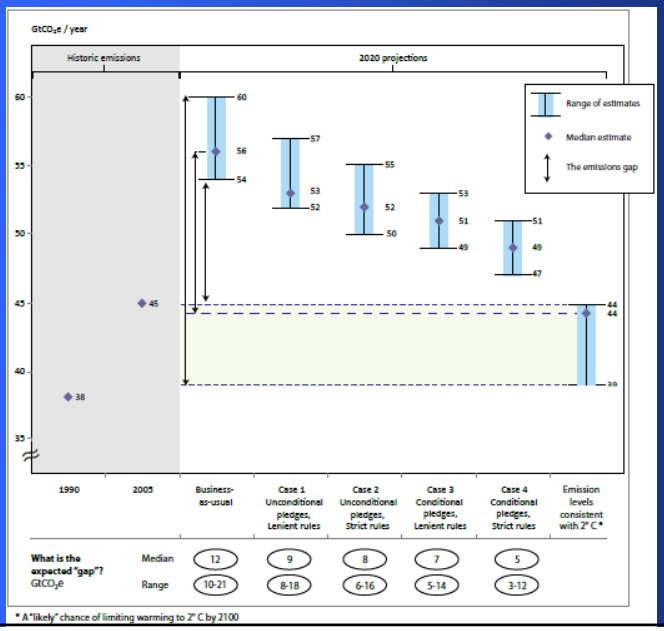
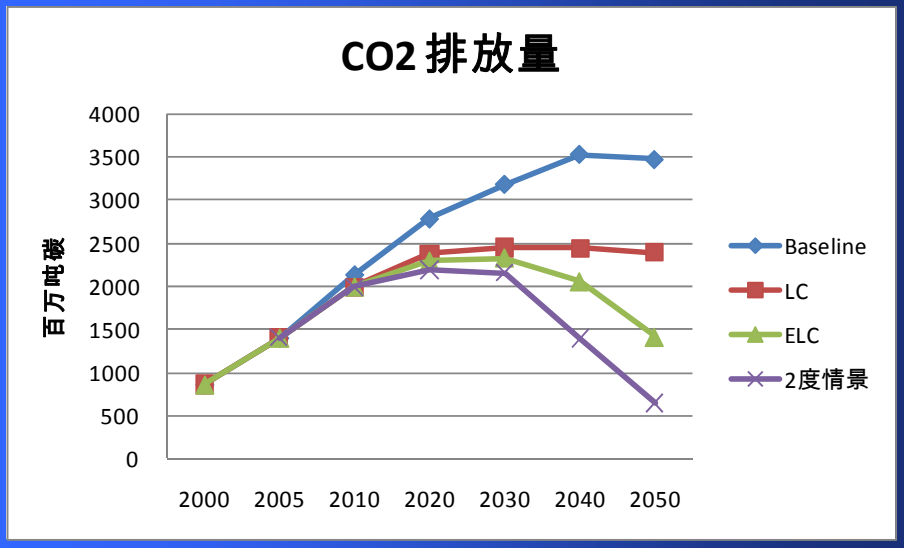

CO2 Emission in China
Mt-C
4000
3500
3000
2500
2000
1500
1000
500
0
2000
2005
2010
2020
2030
2040
2050
Baseline
Policy
ELC
27


Likely avoided temperature increase of IAM scenarios.
Bar superimposed in 2020 shows expected emissions from the pledges.
global total emissions [GtCO2 eq/year]
100
80
60
40
20
0
-20
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100
year
Legend:
Emission levels consistent with a likely temperature increase (T) in the 21st century of:
T > 5°C
4°C < T < 5°C
3°C < T < 4°C
2.5°C < T < 3°C
2°C < T < 2.5°C
T < 2°C
range of pledge cases
median range of pledge cases

## Emission Gap



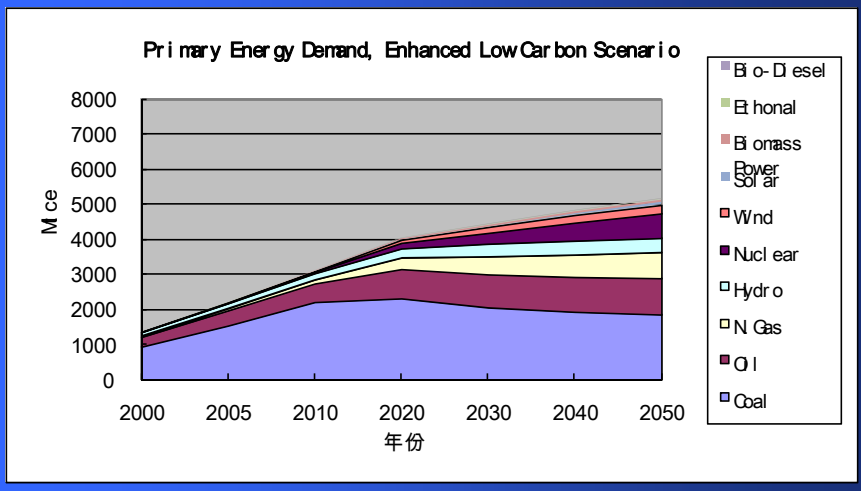



POWER_BOX by Baosteel

2kW wind
10kW Solar PV


## Policy Comparison: take China and US as a case

| Classification/sector | Policy/ Action | China | | | United State | | |
|---|---|---|---|---|---|---|---|
| | | Content of the policy/action | Quantitative Indicator | Verifiable | Content of the policy/action | Quantitative Indicator | Verifiable |
| Emission target | | By 2020, CO2 intensity decrease 40% to 45% in the base of that in 2005<br>Non-fossil fuel will be 15% of TPE by 2020 | 40%-45%<br>15% | Yes<br>Yes | CO2 intensity decrease 18% from 1990 to 2012<br>CO2 emission reduction 17% by 2020 compared with that in 2005, 83% by 2050 | 18% 碳强度下降<br>17%CO2 排放量下降 | Yes<br>Yes |
| National Law | | Renewable energy law<br>Energy conservation law | | Published<br>Published | Clean Energy and Security Act<br>Energy Act 2005<br>National Environment Policy Act<br>Energy Conservation Act | Published<br>Published | Yes |
| National Document | | National Program on Climate Change, 2007 | Target for 2010 | Published | | | |
| Carbon Tax | | | | | | | |
| Energy Tax | | Oil consumption tax<br>Coal consumption tax | 0.8yuan to 1 yuan/Litter | Yes | | | |
| Carbon Trading | | 中国企业参与CDM | | | 自愿碳贸易：2009年市场为8亿多美元<br>2009新法案引入了"总量控制与排放交易"排放权交易机制。根据这一机制，美国发电、炼油 | 交易量 | 可核实 |

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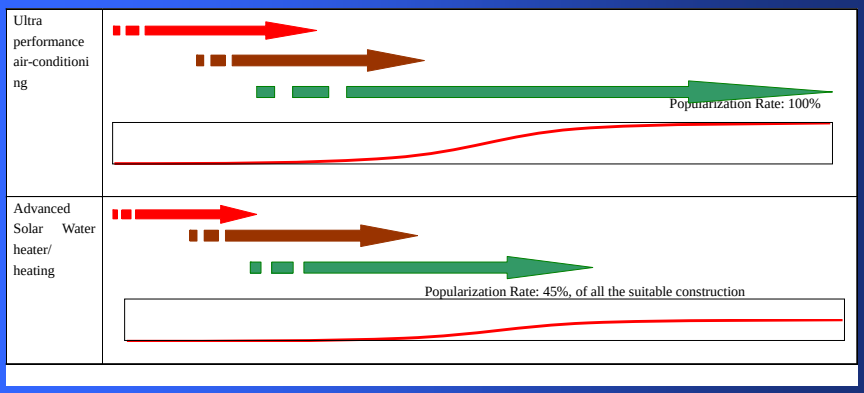
## 28 key technologies in the enhanced low carbon scenario in China

| No. | Sector | Technology | Description | Note |
|---|---|---|---|---|
| 1 | Industry technology | High energy efficiency equipment | High efficiency furnace, kiln, waste heat recovery system, high efficiency process technologies, advanced electric motor | Nearly in market |
| 2 | | New manufacture process technology for cement and steel | | |
| 3 | | CCS | In cement, steel making, refinery, ethylene manufacture | |
| 4 | Transport | Super high efficiency diesel vehicle | Advanced diesel hybrid engine | |
| 5 | | Electric car | | |
| 6 | | Fuel cell car | | |
| 7 | | High efficiency aircraft | 30% higher energy efficiency | |
| 8 | | Bio-fuel aircraft | | |
| 9 | Building | Super high efficiency air-conditioner | With COP>7 | |
| 10 | | LED lighting | | |
| 11 | | In house renewable energy system | Solar PV/Wind/Solar hot water and space heating | |
| 12 | | Heat pumps | | Mature |
| 13 | | High isolation building | | Mature |
| 14 | | High efficiency electric appliance | | Mature before 2030 |
| 15 | Power generation | IGCC/Poly-Generation | With efficiency above 55% | |
| 16 | | IGCC/Fuel cell | With efficiency above 60% | |
| 17 | | On shore Wind | | Mature |
| 18 | | Off shore wind | | Mature before 2020 |
| 19 | | Solar PV | | |
| 20 | | Solar Thermal | | |
| 21 | | 4th Generation Nuclear | | |
| 22 | | Advanced NGCC | With efficiency above 65% | |
| 23 | | Biomass IGCC | | |
| 24 | | CCS in power generation | | |
| 25 | Alternative fuels | Second generation bio-ethanol | | |
| 26 | | Bio-diesel | Vehicles, ships, vessels | |
| 27 | Grid | Smart grid | | |
| 28 | Circulating tecnologies | Recycle, reuse, reducing material use | | |

## Technology Roadmap

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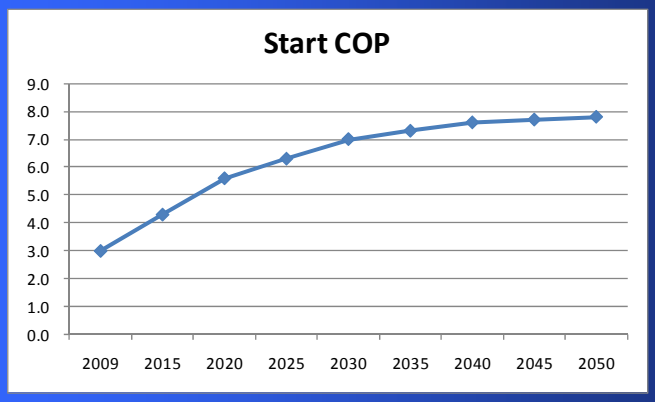
## Policy roadmap: Super high efficiency air conditioner

- Efficiency Standard: COP, MEPS
- Government Planning
- Subsidy

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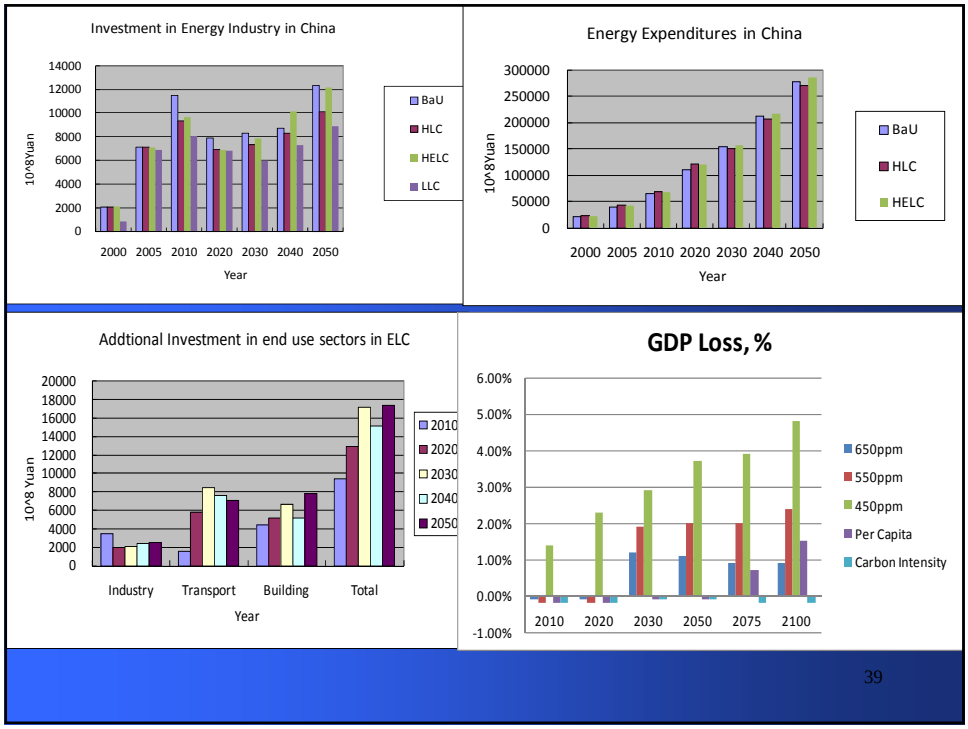
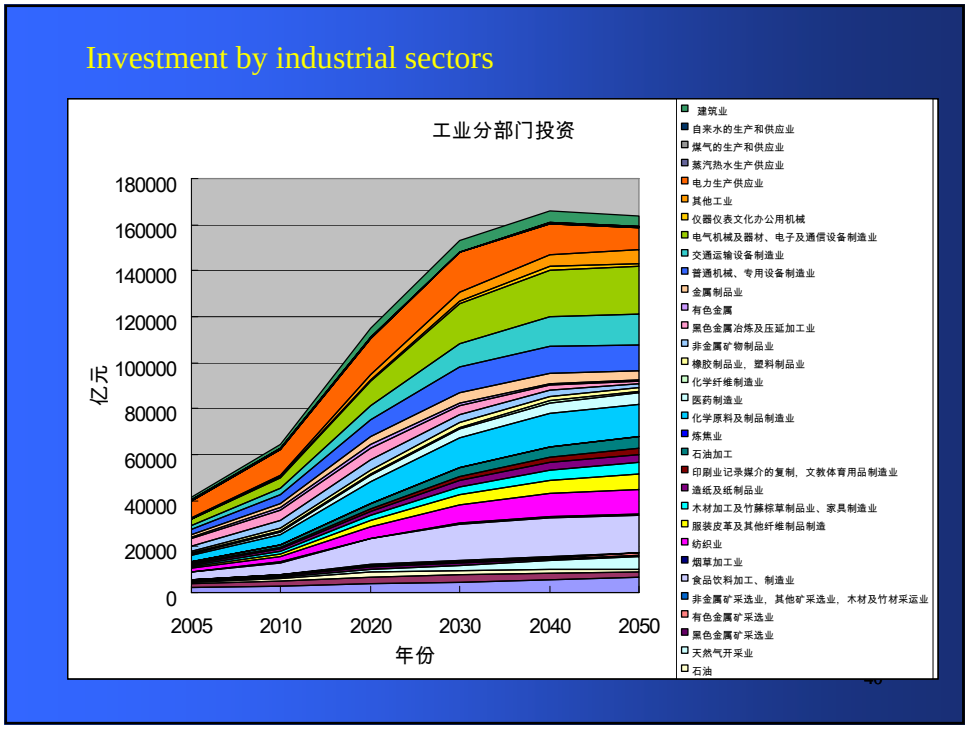
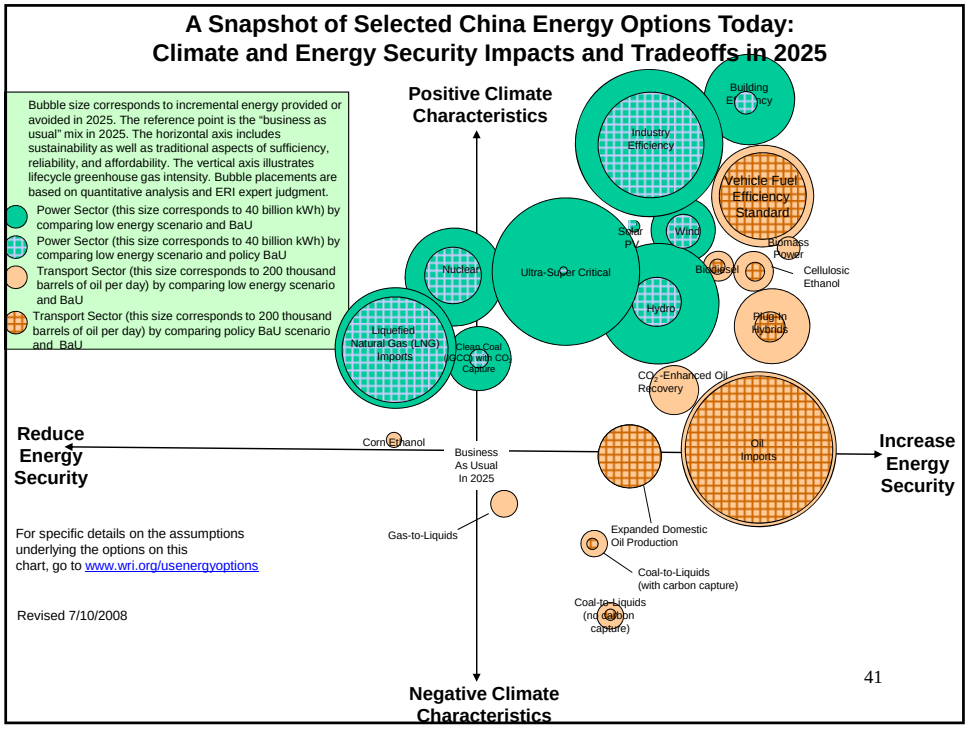
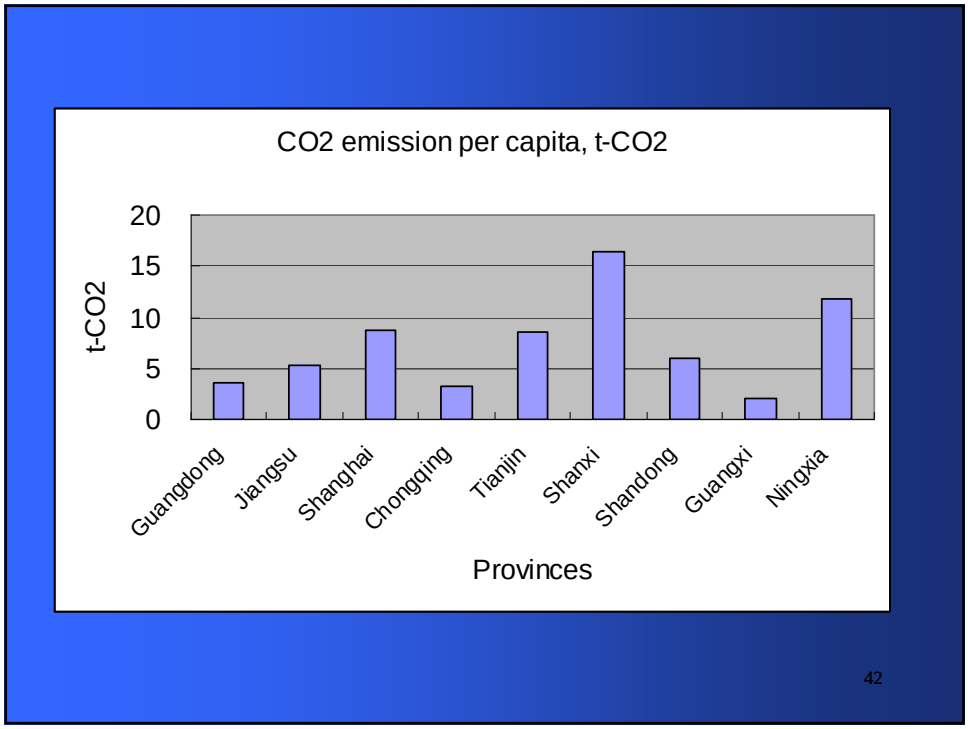
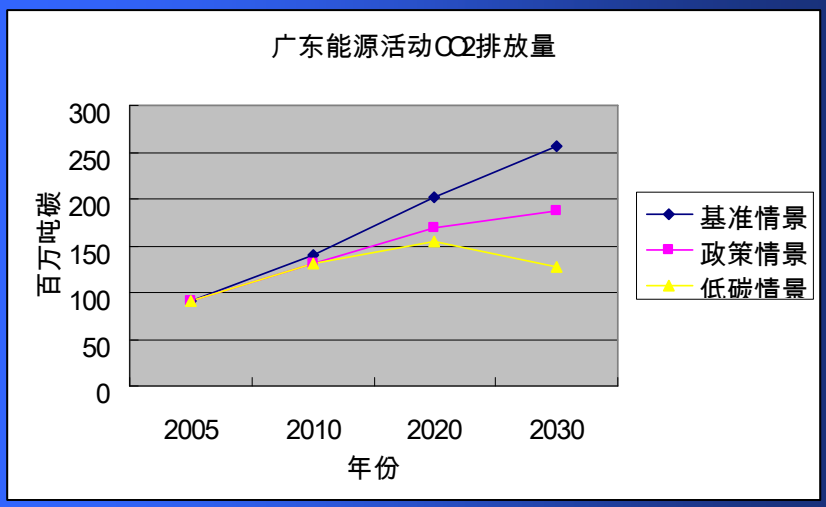

Investment in Energy Industry in China
10^8Yuan
14000
12000
10000
8000
6000
4000
2000
0
2000 2005 2010 2020 2030 2040 2050
Year
BaU
HLC
HELC
LLC
Energy Expenditures in China
10^8Yuan
300000
250000
200000
150000
100000
50000
0
2000 2005 2010 2020 2030 2040 2050
Year
BaU
HLC
HELC
Addtional Investment in end use sectors in ELC
10^8 Yuan
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
Industry
Transport
Building
Total
Year
2010
2020
2030
2040
2050
GDP Loss, %
6.00%
5.00%
4.00%
3.00%
2.00%
1.00%
0.00%
-1.00%
2010
2020
2030
2050
2075
2100
650ppm
550ppm
450ppm
Per Capita
Carbon Intensity
39


Investment by industrial sectors
工业分部门投资
亿元
180000
160000
140000
120000
100000
80000
60000
40000
20000
0
2005
2010
2020
2030
2040
2050
年份
建筑业
自来水的生产和供应业
煤气的生产和供应业
蒸汽热水生产供应业
电力生产供应业
其他工业
仪器仪表文化办公用机械
电气机械及器材、电子及通信设备制造业
交通运输设备制造业
普通机械、专用设备制造业
金属制品业
有色金属
黑色金属冶炼及压延加工业
非金属矿物制品业
橡胶制品业，塑料制品业
化学纤维制造业
医药制造业
化学原料及制品制造业
炼焦业
石油加工
印刷业记录媒介的复制，文教体育用品制造业
造纸及纸制品业
木材加工及竹藤棕草制品业、家具制造业
服装皮革及其他纤维制品制造
纺织业
烟草加工业
食品饮料加工、制造业
非金属矿采选业，其他矿采选业，木材及竹材采运业
有色金属矿采选业
黑色金属矿采选业
天然气开采业
石油


A Snapshot of Selected China Energy Options Today:
Climate and Energy Security Impacts and Tradeoffs in 2025
Bubble size corresponds to incremental energy provided or avoided in 2025. The reference point is the "business as usual" mix in 2025. The horizontal axis includes sustainability as well as traditional aspects of sufficiency, reliability, and affordability. The vertical axis illustrates lifecycle greenhouse gas intensity. Bubble placements are based on quantitative analysis and ERI expert judgment.
Power Sector (this size corresponds to 40 billion kWh) by comparing low energy scenario and BaU
Power Sector (this size corresponds to 40 billion kWh) by comparing low energy scenario and policy BaU
Transport Sector (this size corresponds to 200 thousand barrels of oil per day) by comparing low energy scenario and BaU
Transport Sector (this size corresponds to 200 thousand barrels of oil per day) by comparing policy BaU scenario and BaU
Positive Climate Characteristics
Building Efficiency
Industry Efficiency
Vehicle Fuel Efficiency Standard
Solar PV
Wind
Biomass Power
Biodiesel
Cellulosic Ethanol
Nuclear
Ultra-Super Critical
Hydro
Plug-in Hybrids
Liquefied Natural Gas (LNG) Imports
Clean Coal (IGCC with CO2 Capture
CO2-Enhanced Oil Recovery
Reduce Energy Security
Corn Ethanol
Business As Usual In 2025
Oil Imports
Increase Energy Security
Gas-to-Liquids
Expanded Domestic Oil Production
Coal-to-Liquids (with carbon capture)
Coal-to-Liquids (no carbon capture)
For specific details on the assumptions underlying the options on this chart, go to www.wri.org/usenergyoptions
Revised 7/10/2008
Negative Climate Characteristics
41


CO2 emission per capita, t-CO2
t-CO2
20
15
10
5
0
Guangdong
Jiangsu
Shanghai
Chongqing
Tianjin
Shanxi
Shandong
Guangxi
Ningxia
Provinces
42

CO2 emission from energy activities in Guang Dong, mt-C

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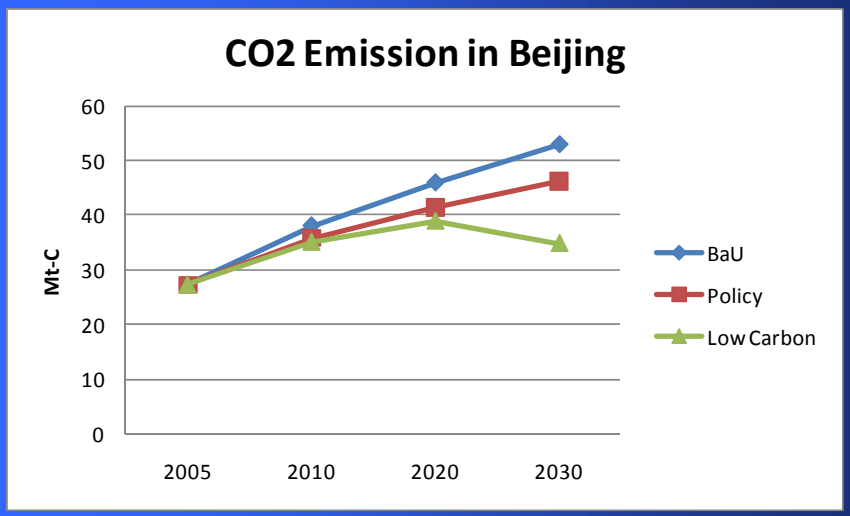


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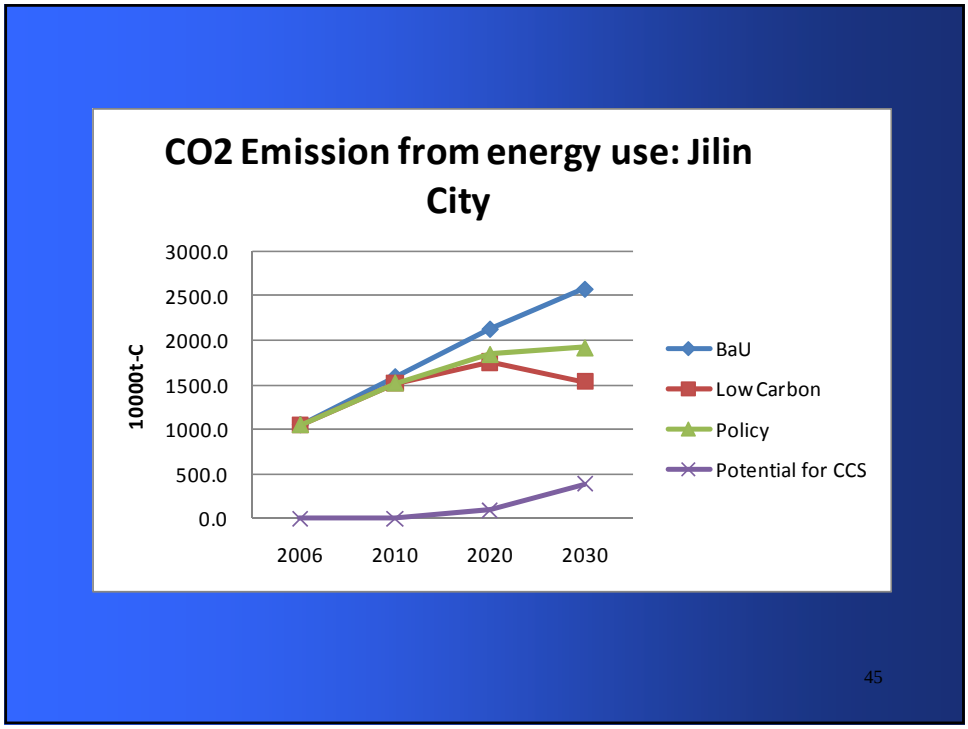
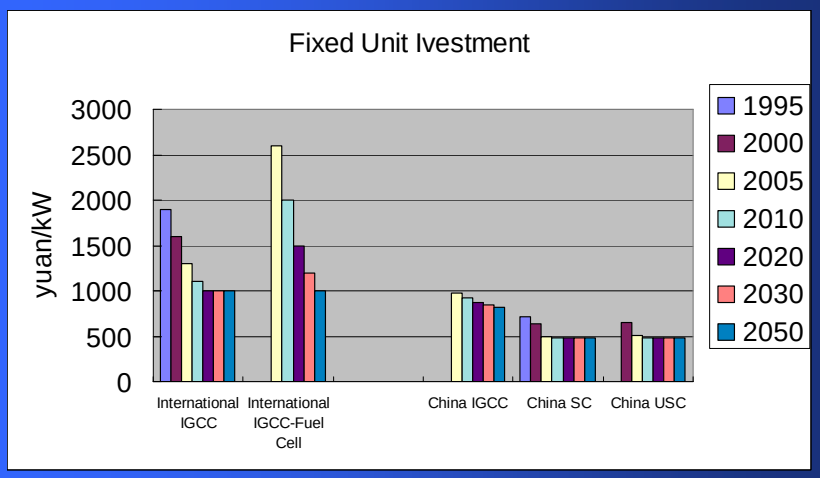

CO2 Emission from energy use: Jilin City
10000t-C
3000.0
2500.0
2000.0
1500.0
1000.0
500.0
0.0
2006
2010
2020
2030
BaU
Low Carbon
Policy
Potential for CCS
45


bjhev.com
46

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## *Post 2012 option road map of China*

| | 2010 | 2020 | 2030 | 2040 | 2050 |
|---|---|---|---|---|---|
| Domestic Energy Saving Target | | | | | |
| APP | | | | | |
| Post Kyoto Mechanism | | | | | |
| Bilateral Cooperation | | | | | |
| Emission Trade | | | | | |
| Non-constraint Emission Reduction Target | | | | | |
| GHG Reduction Target Considering Promises | | | | | |

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