Energy Transition in China in a 2 degree global target

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China’s energy and climate change policies: 11th Five Year plan

- 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.
<table>
<thead>
<tr>
<th>Classification</th>
<th>Policies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Administration</td>
<td>Establishing energy conservation and emission reduction steering group chaired by Prime Minister (June 2006); Distributing targets to each province (September 2006)</td>
</tr>
<tr>
<td>Monitoring</td>
<td>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)</td>
</tr>
<tr>
<td>Pricing/Financing</td>
<td>Differentiating energy prices for key energy-intensive industries</td>
</tr>
<tr>
<td>Standardization</td>
<td>Second catalog of energy efficiency labeling for consumer products (Sep. 2006); Third catalog of energy efficiency labeling for consumer products (January 2008)</td>
</tr>
<tr>
<td>Industry</td>
<td>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)</td>
</tr>
<tr>
<td>Transport</td>
<td>Light Vehicle Fuel Efficiency Standard (Sep. 2007)</td>
</tr>
<tr>
<td>Buildings</td>
<td>11th Five Year Plan for Energy Conservation in Buildings (February 2006); Building Efficiency Standard Implementation (June 2007)</td>
</tr>
<tr>
<td>Power generation</td>
<td>Closure of small power plants (January 2007), regulation for newly installed coal-fired power plants to be most advanced power plants</td>
</tr>
</tbody>
</table>

Note: The table provides a summary of major policies announced recently in China, covering various sectors such as Administration, Overall National Policies, Monitoring, Pricing/Financing, Standardization, Industry, Transport, Buildings, and Power generation. The policies include establishment of steering groups, implementation of working programs, energy efficiency standards, and other regulatory measures to promote energy conservation and emission reduction.
China’s energy and climate change policies: 12th Five Year plan

- 16% energy intensity reduction from 2010 to 2015
- 17% CO2 intensity reduction from 2010 to 2015
- Energy cap: 4Billion tce of total energy demand by 2015
Released in January 2013
Cap on energy consumption to be 4billion tce by 2015
Cap electricity 6150TWh by 2015
Share of non-fossil fuel energy to 11.4%
Share of natural gas to 7.5%
Decrease coal share to be below 65%
### 12th Five Year Plan on Energy Development

<table>
<thead>
<tr>
<th>Category</th>
<th>2010</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy demand</td>
<td>3.25Btce</td>
<td>4Btce</td>
</tr>
<tr>
<td>Share of non-fossil</td>
<td>8.6%</td>
<td>11.4%</td>
</tr>
<tr>
<td>Electricity use</td>
<td>4.2TWh</td>
<td>6.15TWh</td>
</tr>
<tr>
<td>Energy Intensity</td>
<td>81tce/Myuan</td>
<td>68</td>
</tr>
<tr>
<td>Unit energy use for power</td>
<td>333gce/kWh</td>
<td>323</td>
</tr>
<tr>
<td>Grid loss rate</td>
<td>6.5%</td>
<td>6.3%</td>
</tr>
<tr>
<td>Green energy pilot county</td>
<td>108</td>
<td>200</td>
</tr>
<tr>
<td>Population using natural gas</td>
<td>180million</td>
<td>250</td>
</tr>
</tbody>
</table>
12th Five Year Plan on Energy Development: renewable energy

- Wind: 31GW → 100GW
- Solar: 2GW → 21GW
- Biomass power generation: 1.7GW → 13GW
- Landfill power generation: 1.7GW → 3GW
- Hydro: 200GW → 290GW
- Nuclear: 10.8GW → 40GW
Keyword: Transition – mitigation to reach some climate change targets

Category I  
(< 400 ppm CO₂)  

Category II  
(< 400-440 ppm CO₂)  

Category III  
(< 440-485 ppm CO₂)  

Emissions (GtC)

N=19

N=27

N=76

without neg. emissions

with neg. emissions
Transformation: CO2 emission, a rapid change

CO2 Emission in China
What’s the future of China’s low carbon policy: key factors

- Economic structure optimization policies
- Energy efficiency policies
- Renewable energy/nuclear power generation oriented policies
- CCS
- Low carbon consumption/lifestyle
- Land use emission reduction policies: so far relatively poor
- Climate change target: China is key part of that
- Can we pay for it? Cost and benefit
Transformation: Energy System

Primary Energy Demand, Enhanced Low Carbon Scenario

- Bio-Diesel
- Ethonal
- Biomass
- Power Solar
- Wind
- Nuclear
- Hydro
- N.Gas
- Oil
Transformation: CCS
Transformation: Air pollution
Challenges for short term energy system in China

• We are in a rapid change period, energy system need to response right now.
• But it is difficult to make change due to inertia. It could happen in decades in other countries, but maybe 5 to 10 years in China
• Coal peak before 2015? Coal fired power plant peak by 2013?
• Much more natural gas demand
• Energy pricing should be higher, and need public to accept(public education)
• There are still more space for new policies
• It could be a big movement in China’s energy system, all aspects
The expected big changes in energy system in China

• Coal consumption start to decrease, coal industry should be ready for it, and make own long-term strategy: local manufacture, export/import, security, clean coal use.
• Much more natural gas demand, need to work out for the supply
• Much faster progress on renewable energy, both centralized and distributed
• Grid should be reconstructed to support the system
• Energy price increase, to cover energy environment externality.
• Large scale of nuclear in
• Much lower growth rate for energy demand in China
Renewable Energy

• 2009 Energy Bureau: Wind 80WG
• 2010 Energy Planning: Wind 150 GW, Solar 20GW by 2020
• 2013, the 12th Five Year Plan: 20GW of solar PV by 2015, 150GW wind
• February 2013, 35GW PV by 2015

• Now: Wind 200GW to 300GW, Solar 50WG to 120 GW

• Based on the conclusion from Chinese Academy for Engineering, grid in China could adopt these renewable energy power generation in short term.
Transformation: Technologies

By 2020, Wind 200GW to 250GW, Solar 50WG

Price: US$38000
Subsidy: US$15000 (Shanghai), no need to apply number plate (cost US$10000)
US$18000 (Beijing), no need to apply number plate (By Oct. 2012, 1.1 million people apply for 20000 number plates per month),

荣威E50的长/宽/高分别为3569/1551/1540mm，其定位为A00级紧凑型车。
The New Five Year Plan on Air Pollution Control

• From 2013 to 2017

• Target: 30% improvement of air pollution

• A package of policies

• In which: reducing coal use in key areas including Beijing-Tianjin-Hebei region, Yangtze Delta Regions, Pearl River Delta Region

• Clean oil supply for vehicle, upgrade emission standard and oil quality

• Regulation on diffusion on high efficiency cars
US R&D expenditures in 2008
GDP in China, current price

10^8 Yuan

Investment in Energy Industry in China

Energy Expenditures in China

Addtional Investment in end use sectors in ELC

GDP Loss, %
Figure 2. Emission allowances by allocation category for Cat 1, i.e. 425-475 ppmCO₂e, in 2030 relative to 2010 emissions (min, 20th percentile, 80th percentile, max). Number of studies in brackets. GHG emissions (all gases and sectors) in GtCO₂e in 1990 and 2010 were OECD90 13.4, 14.2, EIT 8.4, 5.6, ASIA 10.7, 19.9, MAF 3.0, 6.2, LAM 3.3, 3.8.
Figure 4. Renewable Power Capacities in World, EU-28, BRICS, and Top Six Countries, 2013

Gigawatts

World Total: 560
EU-28: 235
BRICS: 162

China: 118
United States: 93
Germany: 78
Spain: 32
Italy: 31
India: 27

CSP and Ocean Power
Geothermal power
Bio-power
Solar PV
Wind power

Not including hydropower
Figure 11. Hydropower Capacity and Additions, Top Six Countries for Capacity Added, 2013

Additions are net of repowering and retirements.
Figure 13. Solar PV Capacity and Additions, Top 10 Countries, 2013

- Germany: +3.3
- China: +12.9
- Italy: +1.5
- Japan: +6.9
- United States: +4.8
- Spain: +0.2
- France: +0.6
- United Kingdom: +1.5
- Australia: +0.8
- Belgium: +0.2

Gigawatts

Legend:
- Added in 2013
- 2012 total
Figure 16. Solar Water Heating Collectors Global Capacity, Shares of Top 10 Countries, 2012

China 64%

Next 9 countries 23%

Rest of the World 13%

- United States 5.8%
- Germany 4.2%
- Turkey 3.9%
- Brazil 2.1%
- Australia 1.8%
- India 1.6%
- Austria 1.2%
- Japan 1.1%
- Israel 1.0%
Figure 20. Wind Power Capacity and Additions, Top 10 Countries, 2013

Gigawatts

+16.1
+1.1
+3
+0.2
+1.7
+1.9
+0.4
+0.6
+1.6
+0.6

China
United States
Germany
Spain
India
United Kingdom
Italy
France
Canada
Denmark

Added in 2013
2012 total

Additions are net of repowering.
The New China-US Announcement:  keywords

- Considering global 2 degree target
- China: peak by 2030, make effort to peak earlier
- US: 26-28% emission reduction by 2025 compared with that in 2005
- Both Will make more strict target in future
Our Studies Now

• Global emission scenarios by joining international studies: RoSE, EMPERE, LIMIT, IAMC, EMF30
• CO2 Emission scenario for China: focusing on 2 degree scenario
• Local air pollution emission scenario and policy roadmap: focusing on Jing-Jin-Ji area
• Energy and GHG indicators for 13th Five Year Plan
• Carbon tax implementation analysis
• Coal cap scenario analysis
• ETS design modeling for China and pilot phase cities
• Policy design for building on energy and CO2 emission target
• International emission scenario analysis: US, Japan, EU, China
• Up-Grade of Chinese Economy: a Yangtze River Case