Energy demand and supply in China

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Contents

- Energy consumption
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- Energy policies
China's rapid economic growth was accompanied with quick increase of energy consumption.

In 2000-2013, the annual economic growth rate in average is more than 10%.

- Primary energy consumption growth rate is 7.6%.
- Energy production growth rate is 7.4%.
Energy consumption mix

- In 2013, China consumed 3.75 BTce energy, in which coal, oil, gas, nuclear and renewable accounted for 66.1%, 18.6%, 5.6%, and 9.7%, respectively.
- Energy consumption mix was changed little over time
- Coal is still dominating the energy consumption mix
- More than 75% electricity was produced by thermal power
TPES per capita

- The U.S. TPES/population is much higher than the world average, which is around 7 toe/capita in recent years.
- Japan and Korea keep in the second grade, reaching the average level of OECD total of around 4.5 toe/year.
- China’s TPES/population has kept in the last grade, but continued to increase and exceeded to the world average of 1.9 toe/year since 2011.
Energy gaps and energy import

- Energy self-sufficiency rate in China stayed at about 90% level since 2010.
- China has been shifted to a net importer of crude oil in 1996, natural gas in 2007 and coal in 2009.
- In 2013, China imported 282 million tons of crude oil, 53 billion cubic metres of natural gas and 327 million tons of coal.
- In 2013, the oil, natural gas and coal import dependence is 57.39%, 31.6% and 8.13%.

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China has experienced a dramatic decline in energy intensity.

China had achieved a 19% decrease in energy intensity during the period of the 11th Five Year Plan.

China’s government set a mandatory target to cut energy intensity by 16% in the 12th Five-Year Plan.
Energy demand in the future

- Many uncertainties in the outlook of China’s energy demand
Forecast from IEA

- China will account for 31% of world energy demand growth from 2011 to 2035

Primary energy demand and the share of global growth in the new policies scenario (Source: IEA, WEO 2013)
## Energy Demand Forecast

### China Energy Outlook 2035

<table>
<thead>
<tr>
<th>Year</th>
<th>BP Energy outlook 2035 New policies scenario (Mtoe)</th>
<th>IEA World Energy Outlook 2013 450 scenario (Mtoe)</th>
<th>Current policies scenario (Mtoe)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2020</td>
<td>3741.8</td>
<td>3519</td>
<td>3276</td>
</tr>
<tr>
<td>2030</td>
<td>4458.3</td>
<td>3945</td>
<td>3292</td>
</tr>
<tr>
<td>2035</td>
<td>4671.6</td>
<td>4060</td>
<td>3324</td>
</tr>
</tbody>
</table>

## Energy Demand Forecast

### China Energy Demand Forecast

<table>
<thead>
<tr>
<th>Year</th>
<th>New policies scenario (Mtoe)</th>
<th>450 scenario (Mtoe)</th>
<th>Current policies scenario (Mtoe)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2020 2030 2035</td>
<td>2020 2030 2035</td>
<td>2020 2030 2035</td>
</tr>
<tr>
<td>Coal</td>
<td>2118 2166 2135</td>
<td>1882 1423 1246</td>
<td>2302 2579 2645</td>
</tr>
<tr>
<td>Oil</td>
<td>615  702  726</td>
<td>580  558  520</td>
<td>634  775  824</td>
</tr>
<tr>
<td>Gas</td>
<td>257  393  442</td>
<td>261  402  442</td>
<td>255  383  436</td>
</tr>
<tr>
<td>Nuclear</td>
<td>136  222  248</td>
<td>148  336  426</td>
<td>126  204  225</td>
</tr>
<tr>
<td>Hydro</td>
<td>105  118  122</td>
<td>106  121  125</td>
<td>97   110  116</td>
</tr>
<tr>
<td>Bioenergy</td>
<td>213  222  237</td>
<td>219  276  316</td>
<td>211  210  215</td>
</tr>
<tr>
<td>Other renewable</td>
<td>74  122  150</td>
<td>80  176  249</td>
<td>65  99  114</td>
</tr>
</tbody>
</table>
By 2035, China’s oil imports reach 12.2 mb/d, its import dependence increases to 80%.

The natural gas import dependence increases to 40% in 2035.

Source: IEA, WEO 2013
**Forecast from CEEP, CAS**

## Approach
- China’s Dynamic Energy Computable General Equilibrium (CDECGE)

<table>
<thead>
<tr>
<th>Extensive Economic Scenario</th>
<th>Reference Scenario</th>
<th>Enhanced Low-carbon Scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>- The present policies would not be carried out completely; - The government haven’t make or carry out some new effective low-carbon policies. - The development way of China will not transform effectively, and the structure of the economic will still unreasonable.</td>
<td>- The national policy that our country issued will not change and carry out completely. - The carbon emission intensity of China in 2020 will be reduced by 40% compared with the 2005 level - The proportion of non-fossil energy in primary energy demand is about 15% in 2020.</td>
</tr>
</tbody>
</table>
### Specification

**China’s GDP growth by scenario**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Extensive Economic Scenario</td>
<td>11.3%</td>
<td>8.8%</td>
<td>7.3%</td>
<td>6.0%</td>
<td>5.0%</td>
</tr>
<tr>
<td>Reference Scenario</td>
<td>11.3%</td>
<td>7.5%</td>
<td>6.5%</td>
<td>5.9%</td>
<td>5.3%</td>
</tr>
<tr>
<td>Enhanced Low-carbon Scenario</td>
<td>11.3%</td>
<td>7.4%</td>
<td>6.4%</td>
<td>5.9%</td>
<td>5.3%</td>
</tr>
</tbody>
</table>

- In the Reference Scenario, China’s GDP will grow at the economic 7% per annum from 2011 to 2020 and 5.6% per annum from 2021 to 2030.
- In the Extensive Economic Scenario, it will grow faster in the short term with an average rate of 8.8% per annum from 2011 to 2015.
## Forecast results

### China’s primary energy demand and CO2 emissions

<table>
<thead>
<tr>
<th>Primary energy demand (Mtoe)</th>
<th>Extensive Economic Scenario</th>
<th>Reference Scenario</th>
<th>Enhanced Low-carbon Scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal</td>
<td>1142.1</td>
<td>2290.2</td>
<td>2345.3</td>
</tr>
<tr>
<td>Oil</td>
<td>328.2</td>
<td>695.2</td>
<td>817.9</td>
</tr>
<tr>
<td>Gas</td>
<td>42.2</td>
<td>318.4</td>
<td>430.3</td>
</tr>
<tr>
<td>Non-fossil energy*</td>
<td>110.4</td>
<td>399.8</td>
<td>/80.4</td>
</tr>
<tr>
<td>Total</td>
<td>1622.8</td>
<td>3703.6</td>
<td>4373.9</td>
</tr>
<tr>
<td>CO₂ emissions (Mt)</td>
<td>5630</td>
<td>13490</td>
<td>14360</td>
</tr>
<tr>
<td>CO₂ emissions per unit of GDP (t-CO₂/million constant 2000$)</td>
<td>2973.5</td>
<td>1936.6</td>
<td>1208.2</td>
</tr>
<tr>
<td>The share of non-fossil energy (%)</td>
<td>6.8</td>
<td>10.8</td>
<td>17.8</td>
</tr>
</tbody>
</table>

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In China, coal production continues to increase in line with domestic demand. It has a much slower rate than in recent years, with most growth coming before 2020. Production growth saturates before 2030, at a level 390 Mt.
Oil supply

- Our plan: keep production within 180 MT and 200 MT till 2030 or longer
- From BP and IEA:
  - China’s oil production holds steady near 200MT through to 2025, then falls notably to 130 MT in 2035
  - Light tight oil production in China will increase to pass the 200 kb/d level in 2020. China could grow a light tight oil industry, in parallel with its efforts on shale gas.
Natural gas supply

- The production outlook rises triple to almost 320bcm in 2035 from 103bcm in 2011
- It depends on progress with unconventional gas and implementation of reforms in the pricing of wholesale gas

China's natural gas production (Data Source: BP, 2013; IEA, WEO2013)
Renewable energy potential

- China’s renewable energy contributes an increasing share to total primary energy and will reach 28% in 2035.
- New wind installations are concentrated in China, which has the largest share in 2035.
- China’s installed solar PV increases by 150 GW compared with 2012.

Source: IEA, WEO2013
Challenge 1: energy demand uncertainties

- Population growth is a fundamental driver of the amount and type of energy use.
- More and more people transferring to urban regions will result in the development of the urbanization.
- China is at the mid-term of industrialization, economic growth has a direct effect on the energy demand.
- The technological progress can effectively improve energy efficiency, promote energy saving and new energy development.
- Energy and climate policies have significant impacts on the demand increase and the mix of energy use.
Energy consumption and construction ratio

![Graph showing energy consumption and construction ratio across different countries. The x-axis represents人均GDP (千美元/人: 2000年美元不变价), and the y-axis represents energy consumption and construction ratio. Various countries are marked with different symbols and colors, including Australia, Austria, Belgium, Brazil, Canada, China, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Indonesia, Ireland, Italy, Japan, Korea, Netherlands, Poland, Portugal, Romania, South Africa, Spain, Sweden, UK, and USA.](www.ceep.cas.cn)
Challenge 2: energy security

- **Resource restriction**
  - China is developing towards industrialization and urbanization
  - Energy demand will keep increasing in coming 20 years relatively fast
  - Conventional fossil energy potential faces bottlenecks
  - Peak oil theory and resource uncertainty threaten energy supply

- **Uncertain alternative energy development**
  - The share is still low and cost reduction is slowdown
  - Technological breakthroughs is not expected in short term
  - Unclear international cooperation
The key of supply: unconventional gas and oil

- Conventional energy supply will change little
- The reserve of shale gas is roughly estimated to be 25 kbcm with large uncertainty
- Geological conditions are complex: depth between 1800m and 4800m, large population and mountain area, water vulnerability
- BP outlook: Shale gas makes the largest contribution to growth (10 Bcf/d, 43%) of China’s gas supply, with most of it coming on line after 2020
- Coalbed methane is rising less rapidly than planned and will reach 30bcm closer to 2020
## Energy import and import dependence

<table>
<thead>
<tr>
<th>China’s energy import</th>
<th>Reference scenario</th>
<th>Extensive economic scenario</th>
<th>Enhanced low-carbon scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal Import(btce)</td>
<td>0.351</td>
<td>0.384</td>
<td>0.449</td>
</tr>
<tr>
<td><strong>Import dependence(%)</strong></td>
<td>13.68</td>
<td>13.67</td>
<td>14.88</td>
</tr>
<tr>
<td>Oil Import(btce)</td>
<td>0.542</td>
<td>0.689</td>
<td>0.825</td>
</tr>
<tr>
<td><strong>Import dependence(%)</strong></td>
<td>65.48</td>
<td>70.7</td>
<td>74.27</td>
</tr>
<tr>
<td>Natural gas Import(btce)</td>
<td>0.131</td>
<td>0.212</td>
<td>0.819</td>
</tr>
<tr>
<td><strong>Import dependence(%)</strong></td>
<td>45.07</td>
<td>44.39</td>
<td>70.31</td>
</tr>
</tbody>
</table>
Challenge 3: Environment pollution

- Ecological risk caused by energy exploitation and use
  - Fossil energy use bring environmental pollution and water pollution
Almost all of north, east and central China are suffering heavy haze.

Coal provides not only 80% of China's electricity, but also the lion's share of its air pollutants, from soot to sulphur dioxide.

The top sources of PM 2.5 in Beijing are industrial pollution, coal combustion and secondary inorganic aerosol.
Challenge 4: Climate change

- Carbon dioxide emissions was in rapid upward trend
- In 2012, its share of the global CO2 emissions is one fourth
- China has achieved a considerable decrease in CO2 emission intensity
Policy intention

- Targets in the 12th five-year plan:
  - Adjust economic structure, increase the share of value-added in service sector (end-2015) by 4%
  - Increase the share of GDP in R&D spending (end 2015) by 0.4%
  - Reduction in energy intensity of GDP (end-2015) by 16%
  - Reduction in carbon intensity of GDP (end-2015) by 17%
  - Non-fossil fuel in primary energy consumption in 2015 is 11.4%
- The total energy consumption control
  - Energy conservation
  - Energy use standard
  - Resources tax
  - Energy efficiency trade
  - Energy Performance Contracting
  - Tens of thousands of enterprises for energy saving and low carbon action plan
- Economic structure adjustment
  - Limit the share of energy intensive industries
  - Change the growth mode to low carbon
Policy intention

- Renewable energy promotion
  - Feed-in tariff
  - R&D investment
- Resources development
  - Unconventional energy development
  - Nuclear development
  - International cooperation
- Pollution control and climate mitigation
  - Air Pollution Prevention Action Plan
  - 7 Emission Trading Scheme pilots
**Intensive policies for haze control**

- Beijing has signed responsibility commitment for the improvement of air pollution in 2017, which investment will reach 760 billion RMB
- Detailed measures
  - Accelerating the implementation of PM2.5 standards, establishing long-term mechanism for haze prevention
  - Insisting on clean energy development strategy, making progress on smoke pollution control
  - Encouraging green travel, developing and programming public transportation
  - Restricting vehicle emissions, eliminating old cars, lifting oil quality
  - Optimizing the industrial structure, deepening industrial pollution regulation
  - Controlling dust pollution, measuring contingency plans for heavy pollution weather
  - Enhancing energy efficiency, increasing alternative energy R&D, developing green energy and low-carbon economic mode
Energy market reform

Released policies

- Coal-electricity pricing linkage (2004): allowing power companies to float the on-grid electricity rate to cover 70 percent of the coal cost hike
- Oil and gas resources tax reform in Xinjiang (2011): oil and gas resources implement ad valorem taxes and the tax rates are 5%
- Ladder-type electricity price (2012): adjusting the sale price classification structure, implementing ladder ascending price of residential electricity
- New refined oil pricing mechanism (2013): shortening the price adjustment period to 10 working days and cancelling the threshold of 4% change in international crude oil prices
- Non-residents natural gas prices reform (2013): incremental valve station prices are determined by 85% of alternative energy (fuel oil, liquefied petroleum gas) prices
- Carbon emissions trading pilot (2013): 7 provinces launch pilot carbon trading
- Residents gas price ladder system (2014): the first, second and third gear gas prices on the principle of parity 1:1.2:1.5
Sum up

- China is still in the process of industrialization, TPES per capita is still low, energy demand keep an upward trend till 2030
- Energy conservation is the priority with specific target
- Renewable will plan a crucial role in coming decades
- Non-conventional energy has large uncertainty
- Market reform: Ensuring the market will play a decisive role in allocating resources
- Co-benefit from climate mitigation, pollution control and energy security
- International cooperation is important for both China and the world
Thank you!

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