China’s Energy Transition and Development Path

2019

Report series of China energy and petrochemical industry

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Evolution on China's Energy Supply and Demand
Energy production and consumption have maintained growth and energy self-sufficiency has declined.

- Energy consumption grew; Supply stable;
- Self-sufficiency rate: 111.8% (1985) to 98.2% (1992), 93.7% (2000) and 79% (2018).
- Domestic oil and gas production is stable.
- Growth of oil and gas consumption replaces coal.
- 2018, coal consumption dropped to 59%, 10% lower than in 2000.
China Key economic development indexes estimated

**Industrialization**
- 2018: proportion of tertiary industry 51.6%
- 2030: 60.3%

**Population**
- 2018: 1.40 billion
- 2029: 1.44 billion, peak

**Urbanization**
- 2018: 60%
- 2030: 70%

**Economic Growth**
- 2018: GDP growth 6.9%
- 2030: GDP growth 5%
Targets for 2030 within the framework of China's energy revolution

**Total Energy Demand:** 4.2 billion toe

**Greenhouse gas per unit of GDP:** reduces 60%-65% than 2005

**Terminal energy consumption:** electricity increases to 30%

### Energy consumption revolution
- 2020/2030, energy demand: below 5/6 billion tce (3.5/4.2 billion toe).

### Energy supply revolution
- Added energy is mainly from clean energy

### International cooperation
- Overseas cooperation: one belt one road energy corridor

### Technology revolution
- Energy-saving technologies; smart energy technologies

### Energy system revolution
- Effective and competitive energy market system;
- Market-oriented pricing mechanism;
- Energy legal system.

### Energy Mix

<table>
<thead>
<tr>
<th>Fuel</th>
<th>Percentage</th>
<th>Change vs 2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil</td>
<td>17.8%</td>
<td>2.2%</td>
</tr>
<tr>
<td>Gas</td>
<td>13%</td>
<td>7%</td>
</tr>
<tr>
<td>Coal</td>
<td>47%</td>
<td>9%</td>
</tr>
<tr>
<td>Non-fossil</td>
<td>24%</td>
<td>11%</td>
</tr>
</tbody>
</table>
Coal consumption reached its peak on 2013.

Coal consumption, production and imports (100 million tons)

Three stages of China's coal consumption since 1990

- Steady development;
- Production exceeded consumption
- Self-sufficiency
- Consumption increased
- Imports increased
- Energy conservation
- Emission reduction
- Energy structure transition
- Cutting the backward capacity
- Encourage the import of high-quality coal

Since 2005, China's dependence ratio on foreign coal remained between 6% and 7.5%. The external dependence ratio of 2018 is 7.3%.
Coal demand will decline in the future.

**Coal demand target**
- 4.0-4.1 billion tons (2016-2020)
- 3.5-4.0 billion tons (2021-2030)
- 3.0-3.5 billion tons (2031-2050)

**Power generation**
- ✓ progress in RE power storage technology and support system for grid
- ✓ 57% of total coal used for power in 2035 and 45% in 2050.

**Steel**
- ✓ entering stable stage
- ✓ 10% of coal demand in steel in 2030, 7% in 2050.

**Building materials:**
- ✓ Slower development step.
- ✓ 13% of coal used in 2017, and 6% in 2050.

**Chemicals**
- ✓ Modern coal chemical industry develop
- ✓ Increase from 7% in 2017 to 30% in 2050.
Optimization of coal industry is to mainly promote construction of integrated base

Base construction: coal production, chemical conversion, electricity, building materials integrated

International cooperation in science and technology promote base construction

Around 2020, the output of **14 large coal bases** will be **3.7 billion** tons, accounting for more than **95%** of the total coal production.
3 Oil Demand and Development Trend
Domestic production decrease and refining capacity increase led to external dependence ratio rise

China oil demand, supply and foreign dependence ratio
(10 thousand tons)

- **Domestic production decrease**: and refining capacity increase led to external dependence ratio rise.

- **Oil price down**:
  - 2016: 199 million tons
  - 2017: 192 million tons
  - 2018: 190 million tons

- **Refining capacity growth**:
  - Net increase of 18 million tons
  - Refining capacity reached 770 million tons in 2017
  - Net increase of 22 million tons
  - Refining capacity reached 830 million tons in 2018
China has more oil trade partners in the world

- **2000**: 30 importing countries, covering the Middle East, Africa, Europe/former Soviet Union, the Americas and the Asia-Pacific region. The import volume was led by the Middle East, nearly **38 million tons**, far exceeding other regions.

- **2017**: 43 importing countries, 13 of which were added and mainly from Africa, America and Europe. Most of the new imports came from the Middle East and Europe, with Saudi Arabia increase more than **45 million tons**.
The oil demand will reach its peak with over 700 million tons around 2027.

**By 2030:**
- **China's population:** 1.44 billion
- **Energy efficiency:** the world's advanced level
- **Urbanization level:** 70%
- **Number of electric:** 50-80 million; 1/4 of the total

**Data sources:** EDRI

- **Gasoline**: replaced by electrification; a decade of growth
- **Diesel**: replaced by gas in urban buses, and truck transportation.
- **Aviation kerosene**: Driven by annual growth rate of passenger turnover.
Domestic supply: widen E&P fields and EOR technologies

Resource

✓ Rich in petroleum
✓ 35% proven, and has potential

Unconventionals

✓ Shale oil and oil sands are rich.
✓ The State Key Laboratory of Shale Oil has been set up.

Resource Conversion Rate

✓ Resource conversion rate is Low
✓ Improving recovery and conversion rate through technological progress

Output

✓ Diversified investors
✓ Oil production will have space for growth
4 Natural Gas Demand and Development Trend
Natural gas demand is growing rapidly, with the External dependence exceeding 40%.

Medium and long-term energy planning outline: Energetically develop natural gas

First stage (before 2000)
- Utilization around of field
- Industrial gas is dominant

Stable demand (2000-2010)
- Cross-regional utilization
- City gas demand growth

Period of Rapid demand
- Import accelerate
- Channels and domestic pipeline
- Optimization of demand

Source: Operation bureau of national development and reform commission, EDRI
Diversified imports, more gas trade partners, quick LNG import growth

✓ 2006-2007, 85% came from long-term contracts in Australia
✓ The rest from spot contracts in Oman, Algeria and Nigeria.

✓ 2012, mainly from Qatar, Australia, Indonesia, Malaysia, Yemen and Russia.

China has imported LNG from more than 20 countries in 2018.
Medium and long-term gas demand structure will be stable

China's natural gas consumption forecast (bcm)

- **City gas:** 10%
- **Power:** 33%
- **Industrial fuel:** 36%
- **Chemical materials:** 18%

**2018**
- City gas: 408 bcm
- Power: 1608 bcm
- Industrial fuel: 1048 bcm
- Chemical materials: 208 bcm

**2040**
- City gas: 2040 bcm
- Power: 277 bcm
- Industrial fuel: 368 bcm
- Chemical materials: 208 bcm

**2050**
- City gas: 277 bcm
- Power: 189 bcm
- Industrial fuel: 231 bcm
- Chemical materials: 70 bcm

**Source:** EDRI

**POWER:** If gas turbine technology can be mastered, fixed cost of gas power plant will be reduced from 90% to 30%.

**INDUSTRIAL FUEL**
- Emission reduction
- Efficiency improvement
- Promoted to nationwide

**CHEMICAL MATERIALS:**
- Growth will be slower.

**CITY GAS:**
- Rate of gasification: 80%
- Gas in public transportation and freight logistics be promoted.
Key Projects for Natural Gas

**Upstream E&P**
Increase investment to discover more reserves and output.

**Pipeline network interconnection**
Key natural gas infrastructure connectivity projects for 2019 have been launched.

**Gas storage**
Increase working gas storage capacity underground

**LNG Terminals**
Keep quick pace on construction of LNG terminals.
Non-fossil Energy Demand and Development Trend
Technological advancements enhance Non-fossil energy’s competitiveness

✓ From 2017 to 2025, China’s large solar photovoltaic and onshore wind power investment costs will be reduced by about 50% and 30%

✓ LCOE cost of electricity will be reduced by about 35% and 25% respectively.

China’s large Photovoltaic station installed cost and LCOE

China’s onshore wind power station installed cost and LCOE

Note: National average, LCOE: Levelized Cost of Electricity. Data sources: Chinese State Grid Energy Research Institute, IRENA
Non-fossil energy: China’s electricity generation capacity will keep fast growing

China’s non-Fossil energy cumulative installed power capacity will keep fast growing.

- 2018, China’s non-Fossil energy cumulative installed power capacity is 780 GW, 40% of the total installed power capacity, generating 2200 TWh of electricity, 30% of total electricity generation.

- 2050, China’s non-Fossil energy cumulative installed power capacity will be over 2800 GW, generating 7300 TWh of electricity.
6 Energy Demand & International Cooperation Outlook
Outlook on China Medium-Long Term Energy Demand

- **Total energy**: peaking around 2045
  - **4.2 billion toe**

- **Coal**: continues to decline
  - **34%** of total by 2050

- **Oil**: Peaking around 2030
  - **720 million tons**

- **Natural gas**: Peaking around 2050
  - **700 billion m³**

- **Non-fossil**: 1.4 billion toe by 2050, 35% of total
  - Main energy source

**China's energy transition:**
- Coal demand reduction; clean use of coal
- Natural gas demand increase
- Stable oil demand;
- Non-fossil energy keep growth
Chinese companies' overseas business will maintain steady development

**Upstream**
- More than 30 oil and gas companies have overseas business
- More than 200 oil and gas projects in 50 countries

**Refining**
- 12 overseas refining projects
- Total refining capacity of 73.6 million tons/year.

**Chemical**
- 2010-2016,
  Keep growth in overseas investment
- Total overseas investment: 200 billion yuan

**Engineering service**
- Market service in Russia, Central Asia, the Middle East and South Asia

**Trading**
- More oil and gas trade partners
- Trading has become an important link

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China’s booming oil and gas industry is providing opportunities for global enterprises

- International cooperation will enhance energy and chemical industries.
- More foreign enterprises are entering Chinese market.
- Domestic upstream market will be further open
- Cooperation field diversified

**Oil and gas E&P**

- Infrastructure construction accelerating
- The new negative list of foreign investment encourages multiple investment entities to enter

**Pipeline**

**Refining & Chemical**

- China is committed to building high-end, low-energy consumption petrochemical integration base.
- By 2020, build 7 domestic bases.
Q&A