CHINA ENERGY 2020

David Sandalow
September 11, 2014
View of Pudong, Shanghai (1983)
View of Pudong, Shanghai (2010)
China Is World’s Largest Energy Consumer And Producer

U.S. and Chinese Energy Consumption
2000-2010

Total Energy Consumption in China Surpasses U.S.

China Uses HALF of the World’s Coal

Coal consumption (2012)

<table>
<thead>
<tr>
<th>CHINA</th>
<th>WORLD</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.15 bn short tons</td>
<td>8.45 bn short tons</td>
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China Uses HALF of the World’s Coal

China is World’s Leading Oil Importer
China - #1 in New Car Sales

Millions passenger vehicles and trucks

China: 137m in 2013
China -- #1 in Solar Installations

Top 10 countries in amount of solar photovoltaic power installed in 2013 (Megawatts)

<table>
<thead>
<tr>
<th>Countries</th>
<th>Solar PV installed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. China</td>
<td>11300</td>
</tr>
<tr>
<td>2. Japan</td>
<td>6900</td>
</tr>
<tr>
<td>3. United States</td>
<td>4751</td>
</tr>
<tr>
<td>4. Germany</td>
<td>3305</td>
</tr>
<tr>
<td>5. Italy</td>
<td>1461</td>
</tr>
<tr>
<td>6. India</td>
<td>1115</td>
</tr>
<tr>
<td>7. Romania</td>
<td>1100</td>
</tr>
<tr>
<td>8. Greece</td>
<td>1043</td>
</tr>
<tr>
<td>9. United Kingdom</td>
<td>992</td>
</tr>
<tr>
<td>10. Australia</td>
<td>848</td>
</tr>
</tbody>
</table>

Sources: BP Statistical Review of World Energy 2014, Energy Charting Tool; Photo: Wikimedia Commons.
China - #1 in Solar Installations

IHS Figure 2: Share of Global PV Installations in 2014 (in Gigawatts)

- China, 29%
- Japan, 20%
- USA, 14%
- Germany, 6%
- India, 3%
- Italy, 2%
- Australia, 2%
- France, 2%
- Thailand, 2%
- Rest of World, 16%

Source: IHS, April 2014
Today, the United States has around 300 billion square feet of floor space.

China will add about 300 billion square feet in the next 15-20 years.
Energy consumed per unit of GDP in 2010

(in Thousand Btu)

China: 10.51
India: 7.30
US: 6.75
EU: 5.43
Japan: 4.99

Energy Consumption Projections

Figure 13. Energy consumption in the United States, China, and India, 1990-2040 (quadrillion Btu)

China Is Building Half The World’s New Nuclear Plants

UNDER CONSTRUCTION REACTORS

Sources: IAEA Power Reactor Information System
From 2010 to 2014, emissions grow by an average of 2.1% per year and counts for 49% of the total world increase in carbon dioxide emissions. Increase is led by coal-related carbon dioxide emissions, and emissions from natural gas and liquid fuels use.
Wide Variations Within China

Spatial distribution of provincial industrial CO2 intensities (average from 2005 to 2010)

China Natural Gas Use Is Small

Total energy consumption in China by type, 2011

- Coal: 69%
- Oil: 18%
- Natural gas: 4%
- Hydroelectric power: 6%
- Other renewables: 1%
- Nuclear: <1%

Note: Numbers may not add due to rounding.
Chinese Shale Gas Resources Are Vast

Top 10 countries with technically recoverable shale gas resources

Shale gas (trillion cubic feet)

China > Argentina > Algeria > U.S. > Canada > Mexico > Australia > South Africa > Russia > Brazil

Sources: U.S. Energy Information Agency; Ministry of Land and Resources (MLR), National Survey and Assessment of Shale Gas Resource Potential 2013
Drilling furiously: Chinese energy giants turn upbeat on shale gas

Fri, Aug 29 2014

By Charlie Zhu

HONG KONG, Aug 29 (Reuters) - China's energy heavyweights Sinopec Corp and PetroChina have upgraded their outlook on the country's shale gas industry, citing steadily declining costs, but stopped short of predicting a near-term boom.

China, estimated to hold the world's largest technically recoverable shale resources, is hoping to replicate the shale boom that has transformed the energy landscape of the United States. Industry experts caution that it would be much more difficult for China to monetise its shale gas reserves than the U.S. as it faces serious challenges from water shortages to complicated geological structure and a lack of infrastructure.

Natural gas in China
Shale game

China drastically reduces its ambitions to be a big shale-gas producer

Aug 30th 2014 | From the print edition

IN 2012 China’s main planning agency, the National Development and Reform Commission, declared that the country would produce 60 billion-100 billion cubic metres of shale gas a year in 2020. It needed those forecasts to be accurate.

They weren’t. Wu Xinxiang, the director of China’s National Energy Administration, recently predicted that only 30 billion cubic metres a year will come on stream by 2020. That would barely meet 1% of China’s energy needs now, let alone in 2020.
MEETING CHINA’S SHALE GAS GOALS

David Sandalow, Jingchao Wu, Qing Yang, Anders Hove and Junda Lin

SEPTEMBER 2014
WORKING DRAFT FOR PUBLIC RELEASE
US Tight Oil and Shale Gas Production
2000-2014

Sources: EIA derived from state administrative data collected by DrillingInfo Inc. Data are through June 2014 and represent EIA’s official tight oil & shale gas estimates, but are not survey data. State abbreviations indicate primary state(s).
What Led to the US Shale Revolution?

- a large and high-quality shale resource
- a competitive market system
- private property rights
- federal government support for R&D
- federal tax incentives
- publicly available data
- an extensive pipeline network
- an entrepreneurial culture
Findings

- In the next few years, Chinese shale gas production will not be substantial. After that, high growth and low growth scenarios are both plausible.

- Key barriers to growth include high production costs, weak incentives for state-owned enterprises, lack of competition, restrictions on foreign businesses and limited data availability.

- Policies are key
Chinese Shale Gas Policies

- **Annual production targets** of 6.5 bcm in 2015 and 60-100 bcm in 2020.

- **Production subsidy** of 0.4 RMB/cubic meter (roughly $1.83/thousand cubic feet), which expires in 2015.

- **Waivers of price controls and fees**

- **Provincial policies** (including shale gas development plans in Sichuan, Chongqing, and Guizhou)
Findings (cont.)

- **Environmental impacts** could range from very positive to very negative
- **Water supply constraints** could be a factor in medium and long term
- **U.S. and Chinese governments share common goals** with respect to shale gas.
Recommendations

- Accelerate market-based reforms
  - Continue natural gas price reforms
  - Speed pipeline reforms
  - Encourage competition for mineral rights
  - Improve data availability
Recommendations

- Accelerate market-based reforms
- Provide clear roadmap for foreign companies
- Build regulatory capacity
- Invest in innovation
- Coordinate among ministries