The Power Sector in China

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Frederick Weston

睿博能源智库

The Regulatory Assistance Project
北京市朝阳区建国门外大街19号国际大厦2504室
邮编：100004
电话：+86-10-8526-2241
www.raponline.org
Problem

• Generation is unbundled from the wires
• Wholesale contracts are regulated:
  – Thermal units paid prices per MWh, based on technology and vintage, with contractual targets for minimum number of operating hours each year
  – Unit commitment and dispatch scheduled to achieve operating-hours target
    • Surpluses and shortages of hours shared equally among all generators
• Why was the system designed this way? Would you change it and, if so, what would you do?
Context

• The world burns some 8.2 billion short tons of coal annually
• 25% of that goes to produce electricity in China
  – 80% of China’s electricity comes from burning coal
• Another 25% of it goes to industrial processes and heating in China.
• That is, half of the coal that the world burns each year is burnt in China.
• Global CO$_2$ emissions totaled roughly 36 gigatons in 2013—2.5% higher than in 2012 and 61% higher than in 1990.
  – The lion’s share of that jump came from increased energy consumption in Asia—in India and mostly China.
• China is the leading producer of CO$_2$ emissions, at roughly 28% of the world’s annual total. The US is number two at 15%, although we still win when it comes to per capita emissions.
China’s Power Sector

• Two grid companies: State Grid (85%) and China Southern Grid (15%), both state-owned
• Five major state-owned generating companies, which account for about 50% of installed capacity
  – The remainder belongs to provincial and municipal power companies, and to renewables developers (also mostly state-owned)
• Total capacity was 970 GW in 2010 and will top out at nearly 1,500 GW this year, a 53% increase in five years
• Regulatory jurisdiction (both energy and environmental) is split (opaquely) between the provincial and central governments, but the central government has the final say
  – Provinces are given freedom to experiment with reforms, which, if successful, can become national policy
China’s Energy and Environmental Goals

• Carbon intensity reduction by 40-45% from 2005 levels by 2020
  – A 17% reduction by 2015, from 170.69 mtCO₂/RMB 10,000 (2005) in 2010 to 141.76 in 2015

• Energy intensity reduction by 16% from 2010 levels by 2015. That is, a reduction from 0.81 to 0.68 mtce/RMB 10,000.

• By 2020, 15% of its primary energy needs will be served by renewable resources.
  – Wind from 31 GW in 2010 to 100 GW in 2015, 150 in 2017, and 200 by 2020
  – Solar from 0.86 GW in 2010 to over 35 in 2015 and 70 GW by 2017.

• China will reduce coal consumption as a percentage of primary energy to below 65% by 2017
  – As part of this, it has set absolute caps of coal consumption in the three most populated regions of the country: Beijing and environs (Jing-Jin-Ji), Shanghai and the Yangtze River area, and the Pearl River Delta (southern China surrounding Guangdong)
Air Quality

• Over the last three years the country has issued progressively more stringent regulations to deal with local air pollution
  – The regulations specifically allow for investment in renewable energy and end-use energy efficiency as means of avoiding emissions.

• The 12\textsuperscript{th} Five-Year Plan called for reductions in SO\textsubscript{2} emissions of 12.4\% and in NO\textsubscript{X} emissions of 15.1\% between 2010 and 2015.
November 2014: Xi-Obama Agreement

• US to cut greenhouse gas emissions 26-28% below 2005 levels by 2025.
• China to hit a peak in its carbon dioxide emissions by 2030—possibly sooner—and to increase the non-fossil fuel share of energy to around 20% by 2030.
  – Modeling shows that a peak in carbon emissions must be preceded at least five years earlier by a peak in coal consumption
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- State Council-Communist Party joint statement calls for reform, according to five principles:
  - The need for reliability;
  - Increased use of market mechanisms;
  - Protection of residential and agricultural consumers;
  - Energy savings, emissions reductions, and increased use of renewable and distributed generation; and
  - Better governance and regulation, including better planning and strengthened capacity in terms of regulatory agencies and approaches
March 2015: Document #9

- **Grid company reform**: Revenue-caps regulation piloted in Shenzhen to be extended nationally
- **Direct access**: Extension of provincial pilots that allow large users to bypass the grid companies and negotiate prices directly with generators
  - Buyers and sellers screened for efficiency environmental performance
- **Demand-side management**: Increased investment in DSM (demand response and end-use energy efficiency)
- **Improved generator dispatch**: Increased efficiency, lower costs, and reduced curtailment of renewables
- **Renewables integration**: Improved dispatch, new mechanisms for ancillary services, and improved inter-provincial, cross-regional power trading
- **Distributed generation**: Increased investment in DG
  - Removal of market access barriers
- **Power sector planning**: Improved planning
  - Also, "power planning should take full account of environmental carrying capacity"
There are Two Ways to Look at This Graphic

Power Sector Emissions (MtCO₂)

- China
- Rest of U.S.
- California
- New England
In Conclusion

• Continue to reform your markets:
  – Design them to favor desired outcomes and capabilities: e.g., no-carbon and flexibility
  – Integrate environmental policymaking with energy

• Expand investment in end-use efficiency and renewables

• If you have the opportunity, engage with China
  – Fashion solutions that work for China

• Be a threat of a good example
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RAP 帮助中国政策制定者制定和实施相关政策，来促进可持续经济发展、增加能源系统可靠性、改善空气质量和社会公众健康，从而为中国大量和长期地减少温室气体排放作出贡献。

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中文网页：www.raponline.org/cn

rweston@raponline.org