Challenges of China's transition to clean and low-carbon energy

Lin Boqiang

Xiamen University

Key to China's low carbon and clean energy transition is reducing coal

2017 energy structures of major countries (%)

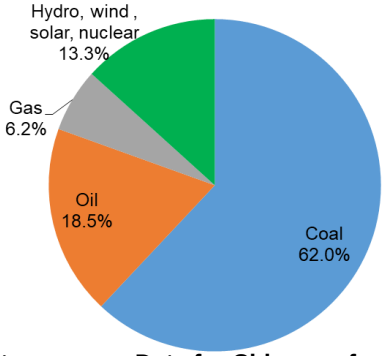
Country	Coal	Oil	Natural Gas	Others
US	14.9	40.9	28.4	15.8
EU	15.1	37.1	23.2	24.6
Japan	26.4	41.3	22.1	10.3
India	56.3	29.5	6.2	8.1
China	59.1	19.5	8.0	13.3

Data sources: Data for China are from National Statistical Bureau, Others from 《BP Energy Statistic 2018》

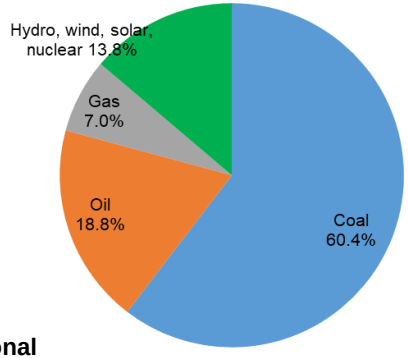
- **China's low carbon and clean energy transition requires not only reducing the share of coal and but also controlling coal consumption**
- **"Clean coal" approach is limited by high cost and CO2 emissions**
- **Transition strategy needs to consider both energy coal and energy security in China. If not, it will be difficult to implement in reality**
- **Because of externalities, energy market reforms is good for clean and low carbon transition, but not sufficient**

Coal substitution in China, recent situation and future expectation

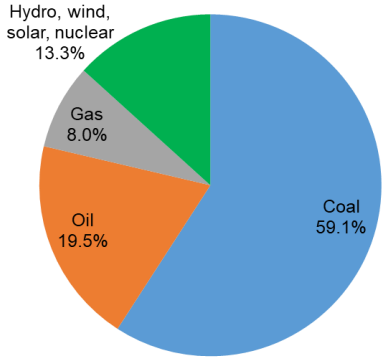
2016 Energy structure



2017 Energy structure



2018 Energy structure（estimated）

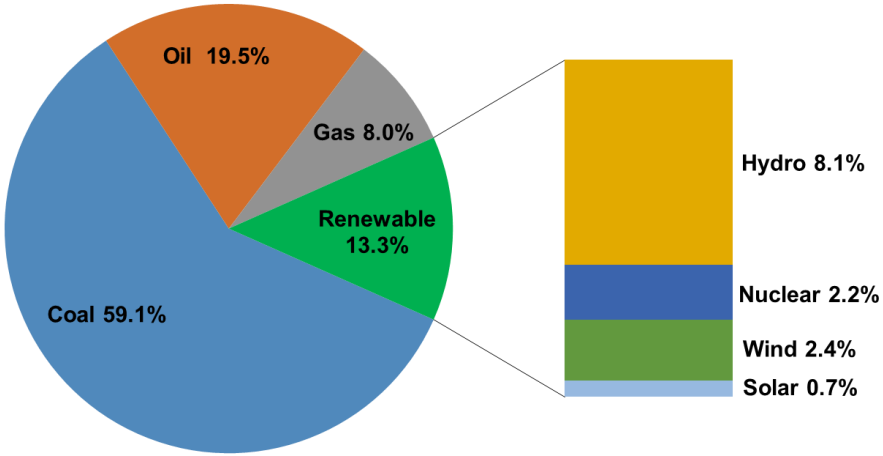


Data sources: Data for China are from National Statistical Bureau，and authors calculation

- **In last two year, coal share reduced by more than 1% each year. The contributions were from gas and oil, not renewables，the “15%”renewable target of the 13 Five Years Plan will not be achieved**
- **Renewable energy costs have dramatically decreased but the energy mix has not significantly shifted**
- **In the short run, coal substitution mainly depends on gas, and in the long run, hopefully solar, wind and nuclear**

Conditions for China's coal substitution

2018 Primary energy structure in China

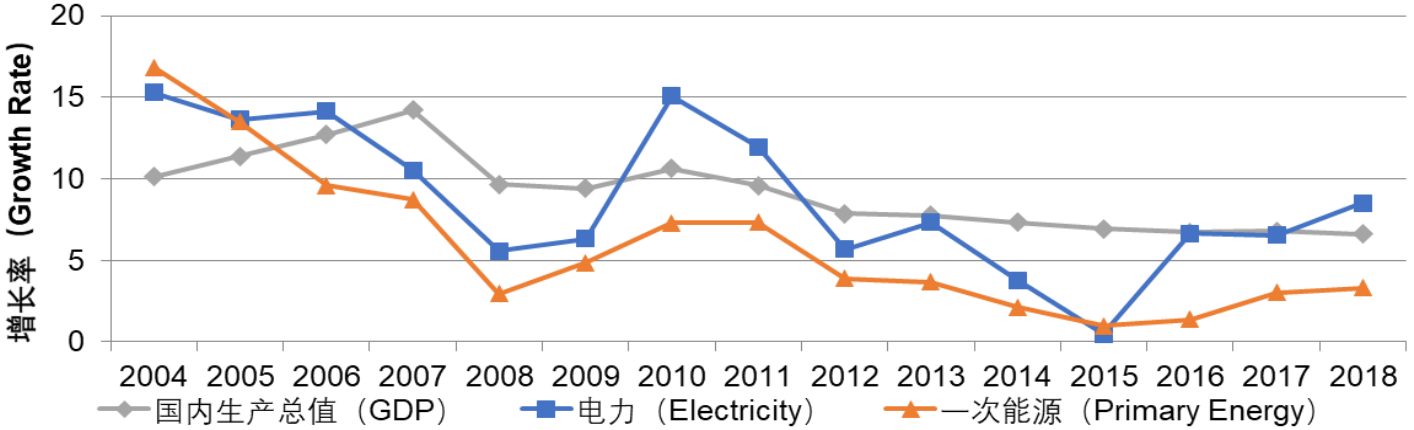


Data sources: Data for China are from National Statistical Bureau，and authors calculation

- The current energy structure demonstrates the reality of China's energy transition
- We are not on track to delivering on the imperative of net-zero emissions by 2050
- Energy conservation and adjustment in energy consumption structure requires more attention
- Supporting faster renewables development. The share of renewable should be large enough to meet energy demand growth at the same time substitute coal
- At present, a rapid coal substitution requires a very low energy demand

Could China grow with a low energy demand?

Growth Rates of China's GDP, Electricity and Energy Consumption between 2003-2018

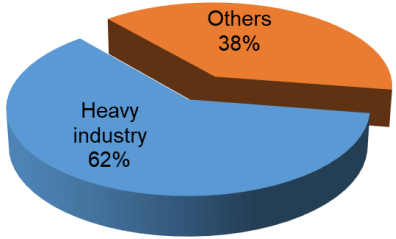


Data sources: Data are from National Statistical Bureau

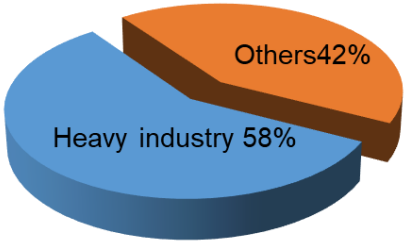
- **In a rapid economic development stage, energy demand fluctuates dramatically, making it unpredictable. "Stand tall and speak high" energy forecast, planning and investment, make shortage and surplus unavoidable**
- **Energy demand relates not only to GDP, but also to country's condition, development stage, industrial structure, and position in international production chain**
- **Under the current condition, China's energy demand will continue with a relative high growth rate**

High concentration in energy consumption could be the main source for unstable energy demand

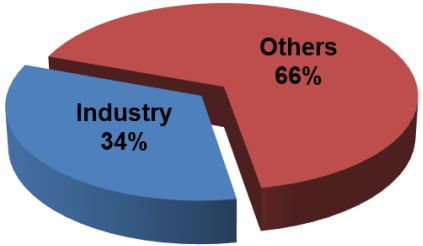
2017 Energy structure



2017 Electricity structure



2017 GDP Structure

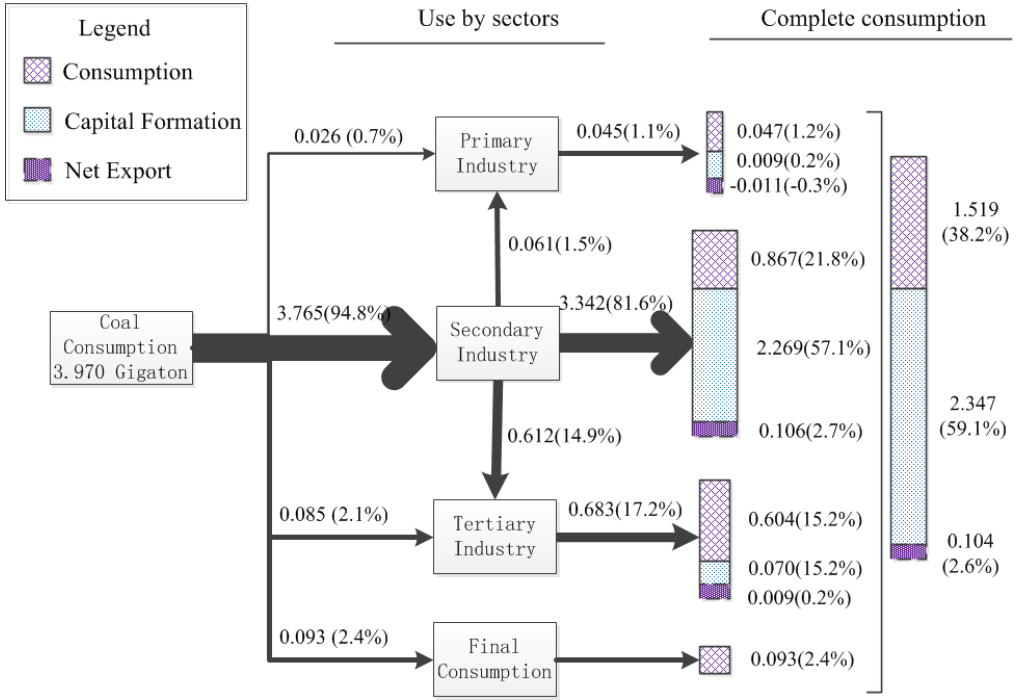


Data sources: Data are from National Statistical Bureau

- **Heavy industry is most sensitive to changes in economic conditions:**
  - **Large fluctuations of energy consumption are unavoidable**
  - **Large deviations between energy consumption and GDP growth is unavoidable**

- **In addition to a stable GDP growth, China's energy demand growth could be stabilized only with smaller consumption share of energy intensive industries**

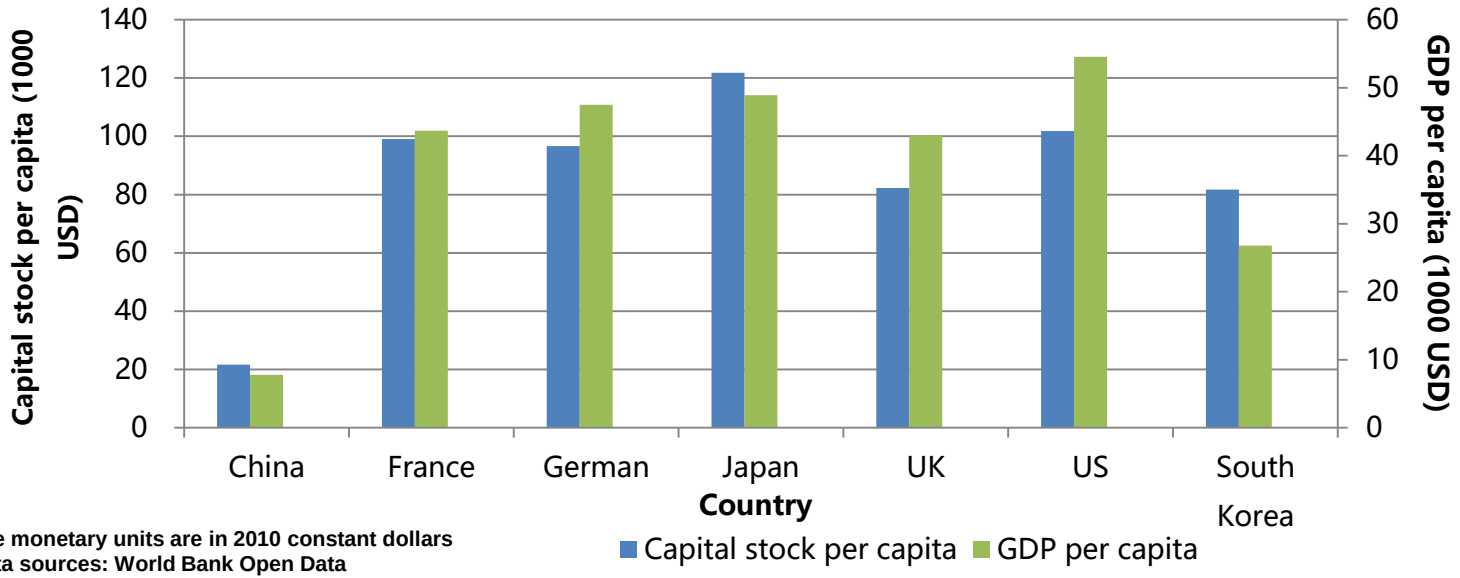
Coal consumption in China: a coal example



- One-third of the final coal consumption is direct consumption and two-thirds in capital formation
- The current energy consumption is still “production-oriented ”, but not “consumption-oriented”
- Example: in 2018,commercial and residential electricity consumption together was about 75% in US, but 30% in China

Data sources: 2015 Input-Output Tables of China

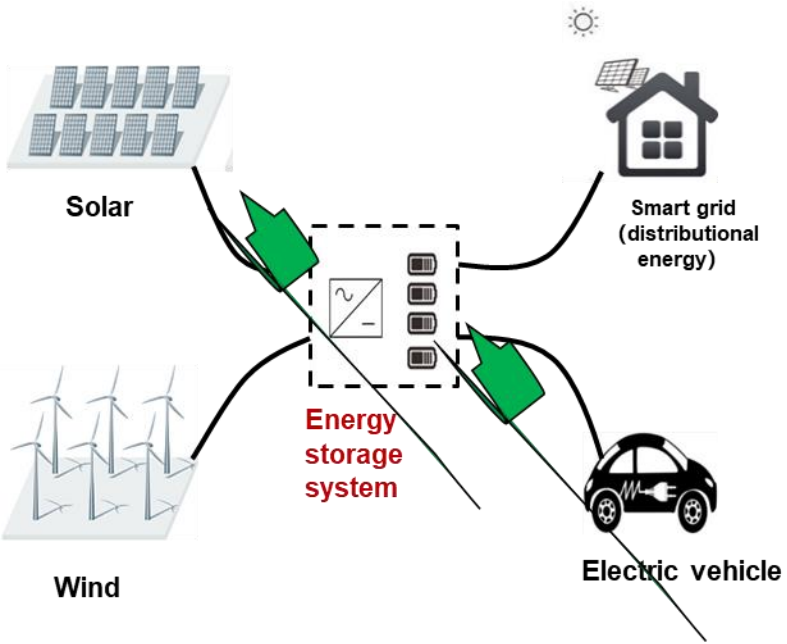
Capital stock per capita in 2018



The monetary units are in 2010 constant dollars
Data sources: World Bank Open Data

- **Very low capital stock per capita indicates that China will continue to have a relatively high energy demand growth**
- **Energy and electricity growth rates also depend on the time span of capital stock accumulation**

How future clean energy system looks like?



- **In a future clean energy system: energy storage system is a vital point**
- **Solar has largest potential in the future clean energy system**
- **Electric vehicle is not only just for oil substitution and pollution reduction, but also an important part of electricity system**
- **The main focus of renewable development has been changed to renewable infrastructure development**
- **The energy transition creates economic and business opportunities, but faces very different political economy realities**
- **Subsidy design and policy support should also be changed accordingly**

Potential impact of US-China trade war on energy transition

- **The key issue of trade war is the impact on the global production chain**
- **A smooth energy transition requires a favorable economic environment: domestic and international**
- **Trade war reduces the spillover benefits of new energy technology**