China’s Energy Transition Under the Pollution Control and Climate Change

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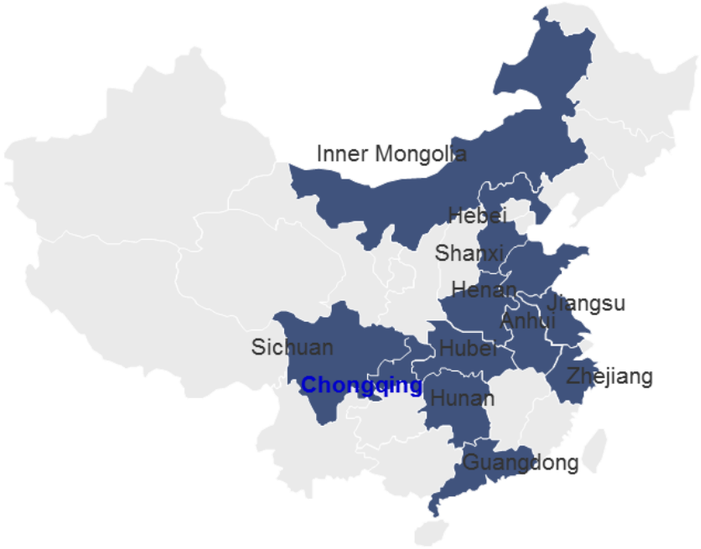
China in the world (2017)

	China	US	EU
Population	**1390 million**	323 million	510 million
GDP	$12.2 trillion	$19.4 trillion	$19.9 trillion
Energy demand	**3132mtoe**	2235mtoe	1970mtoe
Oil imports	**8.95 mb/d**	6.82 mb/d	11.46mb/d
CO2 emissions	**9232 mt**	5038mt	4152 mt

Year 2016		Population (million)	Energy consumption (mtoe)
Chinese provinces	Guangdong	104	218
	Shandong	96	273
	Henan	94	163
	Sichuan	80	141
	Jiangsu	78	218
	Hebei	72	210
	Hunan	65	111
	Anhui	59	89
	Hubei	57	118
	Zhejiang	54	143
EU countries	Germany	82	328
	France	67	238
	Italy	60	156

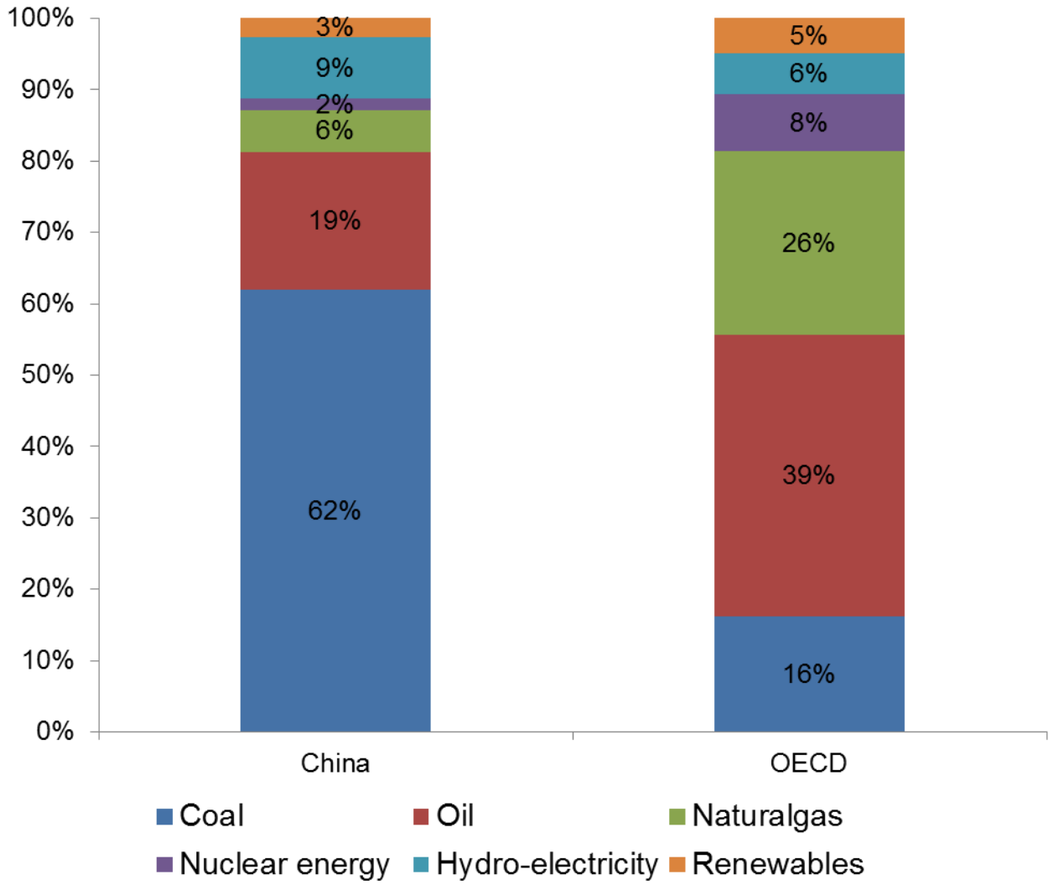


Source: BP Statistical Review of World Energy, 2018

Rapid coal-led demand growth

Primary Energy Consumption (mtoe)

2017 Energy Mix: China and OECD



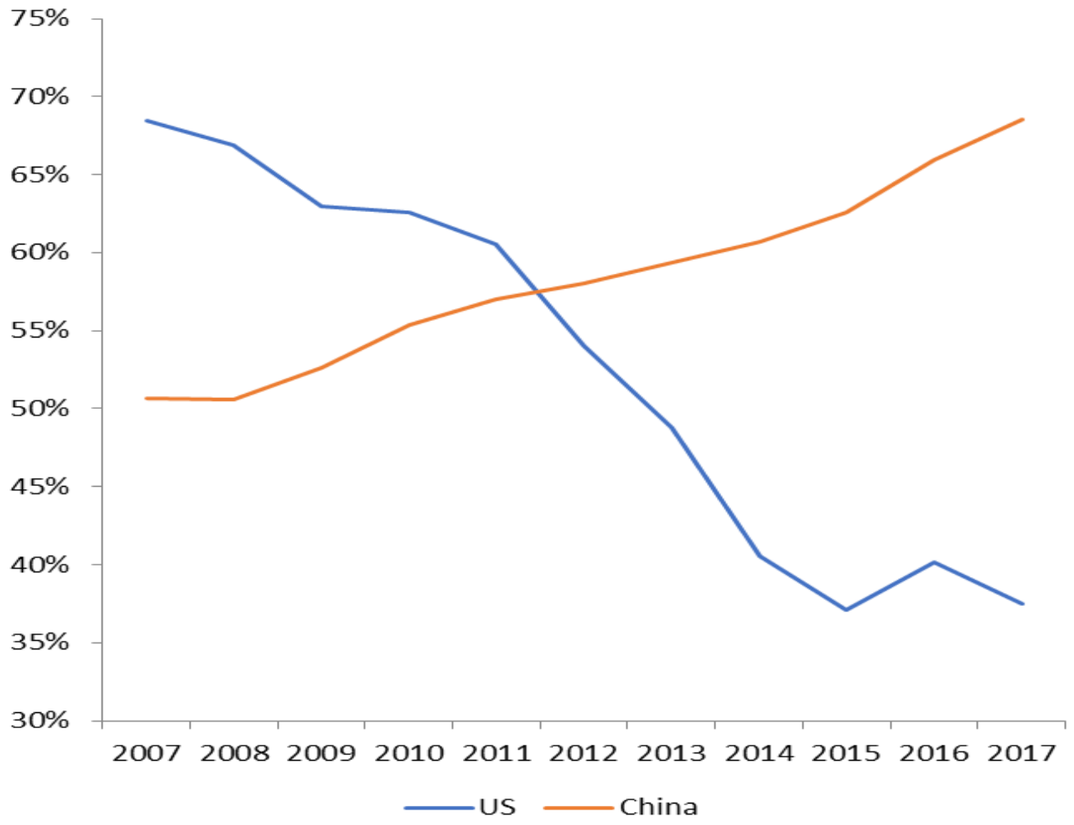
China accounted for

- **23.2% of global energy Consumption in 2017**
- **50.7% of global coal demand in 2017**

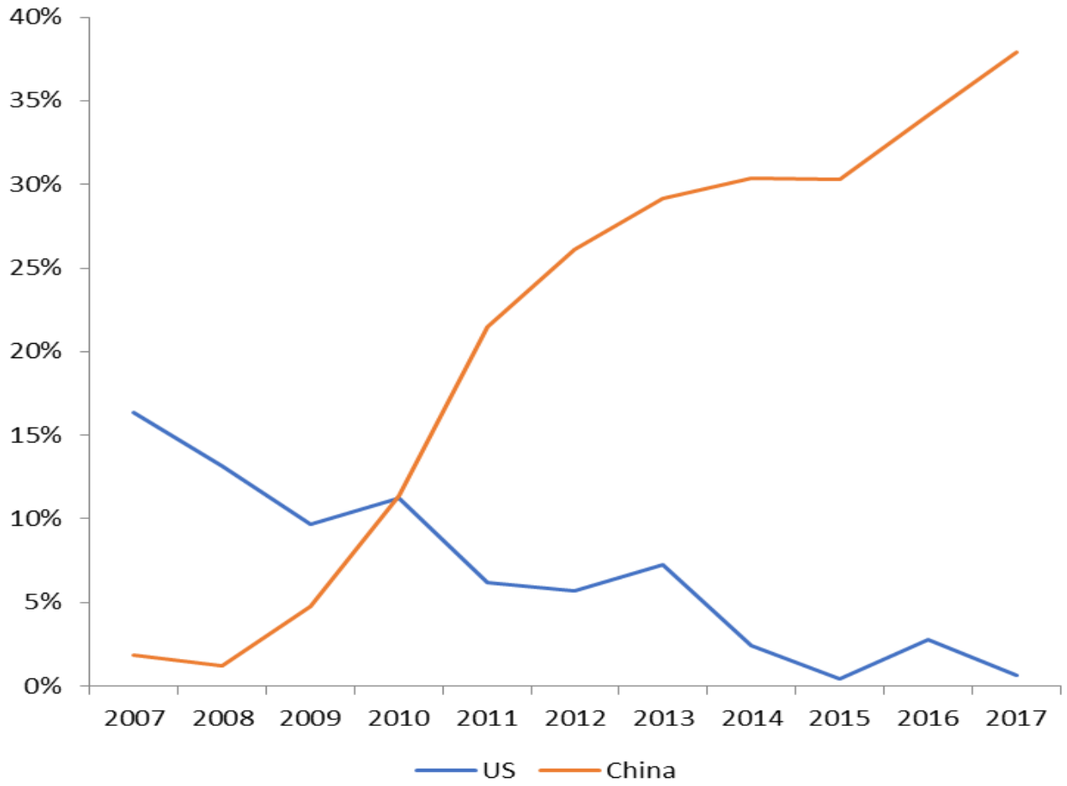
Source: BP Statistical Review of World Energy, 2018

Growing oil and gas import dependency

Oil import dependency



Gas import dependency



Source: BP Statistical Review of World Energy, 2018

Air pollution severely affects life and business

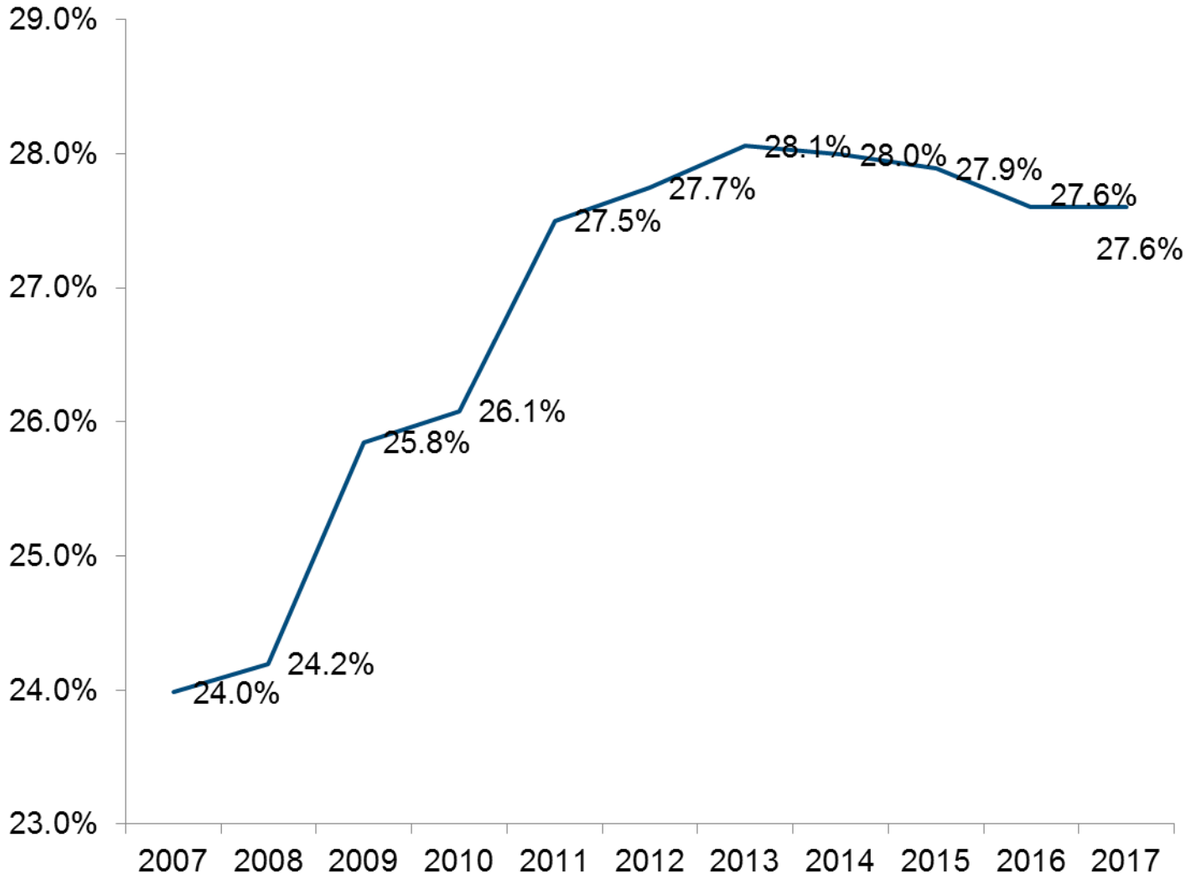
Pollution sources

- Dispersed coal burning
- Coal-fired power plants
- Straw burning
- Automobile tailpipes
- Industrial gases
- Dusts
- Volatile organic contents

Climate change calls for Chinese action

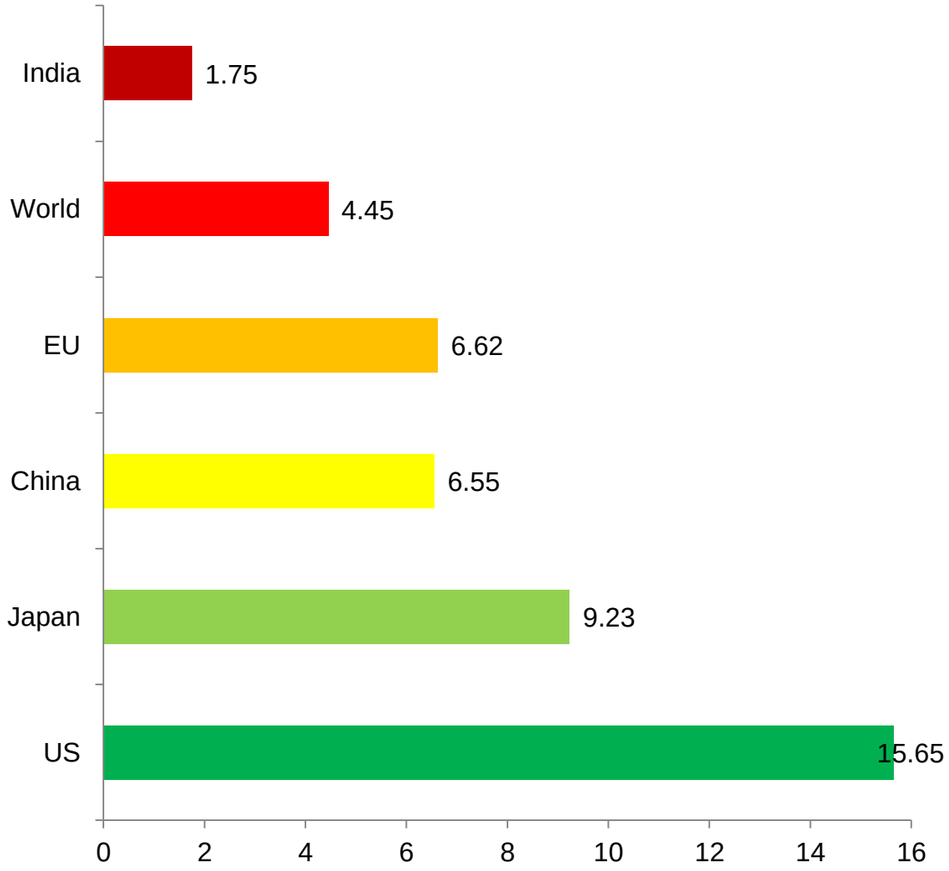
Energy related CO2 emission

(China's share of the world)



CO2 emissions per capita in 2017

(tons per capita)



Source: BP Statistical Review of World Energy, 2018

Shifting energy policy priorities

Supply security → **Environmental security with low emission economy**

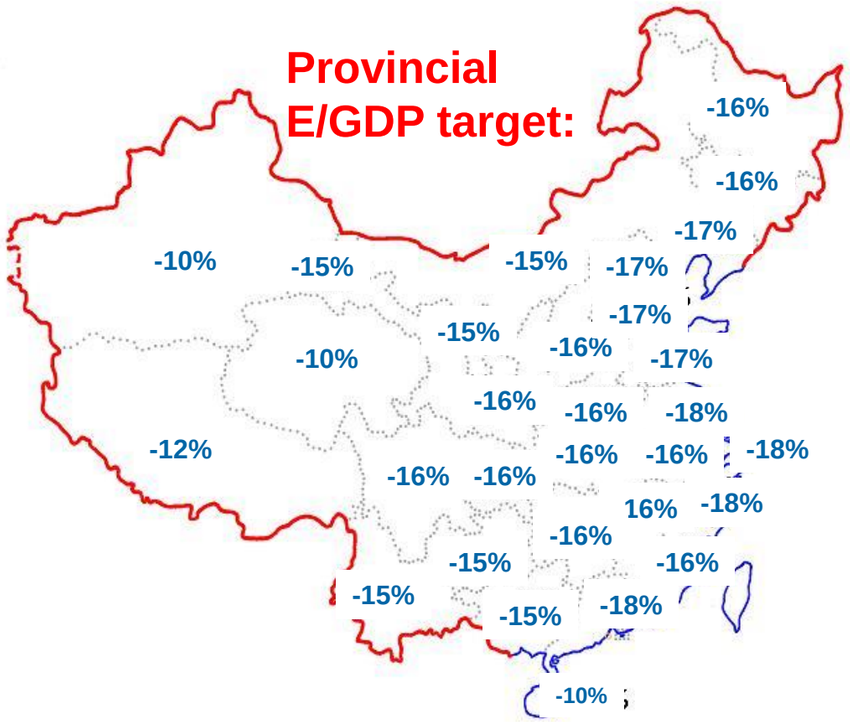
- ✓ **Actions to reduce PM10, PM2.5 COD, SO2, NOx and NH3-N, and CO2**
- ✓ **More efforts on saving energy and controlling coal use;**
- ✓ **More gas: both domestic production and imports;**
- ✓ **More nuclear, hydro and other renewables;**
- ✓ **More interest in global energy governance.**

Getting real on energy efficiency and pollution reduction

Provincial GDP Energy Intensity and Pollution Reduction Targets 2010-2015

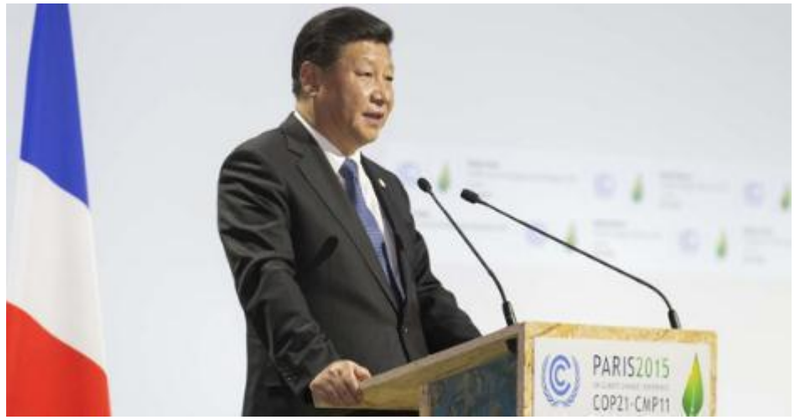
National pollution reduction targets:

- **CO2/GDP: -17%**
- **Chemical Oxide Demand: - 8%**
- **SO2: - 8%**
- **NOx: - 10%**
- **Nitrogen ammoniac: - 10%**



National energy intensity (E/GDP) target: -16%

Chinese Climate Commitment (Intended Nationally Determined Contribution)



- Emission trading pilot in 5 cities and 2 provinces completed;
- National ETS for power sector to start in 2020.

- CO2 emission peaking around 2030 or earlier
- By 2030:
  - Reducing CO2/GDP 60-65% below 2005 level;
  - Increasing non-fossil fuels in energy consumption to around 20%;
  - Increasing forestry stock by 4.5 billion cubic meters above 2005 level.

China’s energy transition

Non-fossil fuels targets:

2020:15%

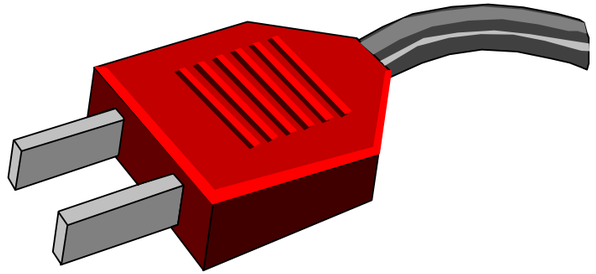
Phase1:
- Reduce coal, increase gas

2030:20%

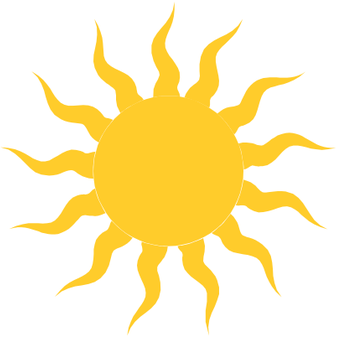
Phase2:
Expand clean energies

2050:50%

Phase3:
Decarbonise energy supply



Power system transition

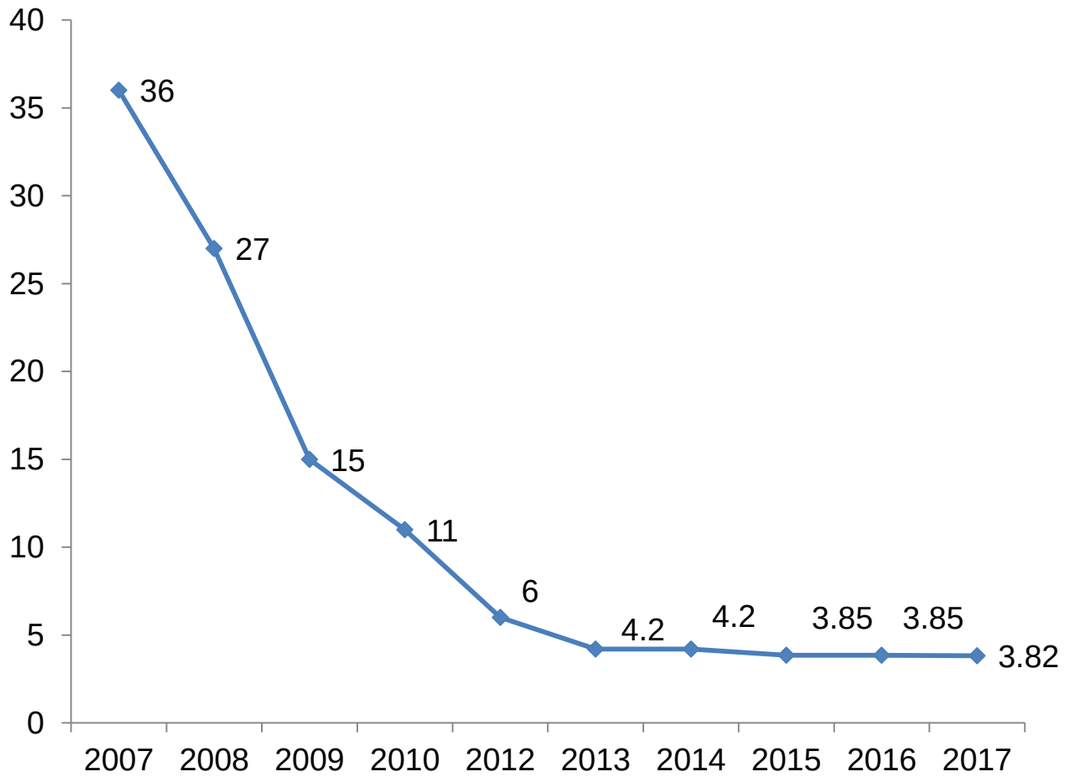


Heating transition

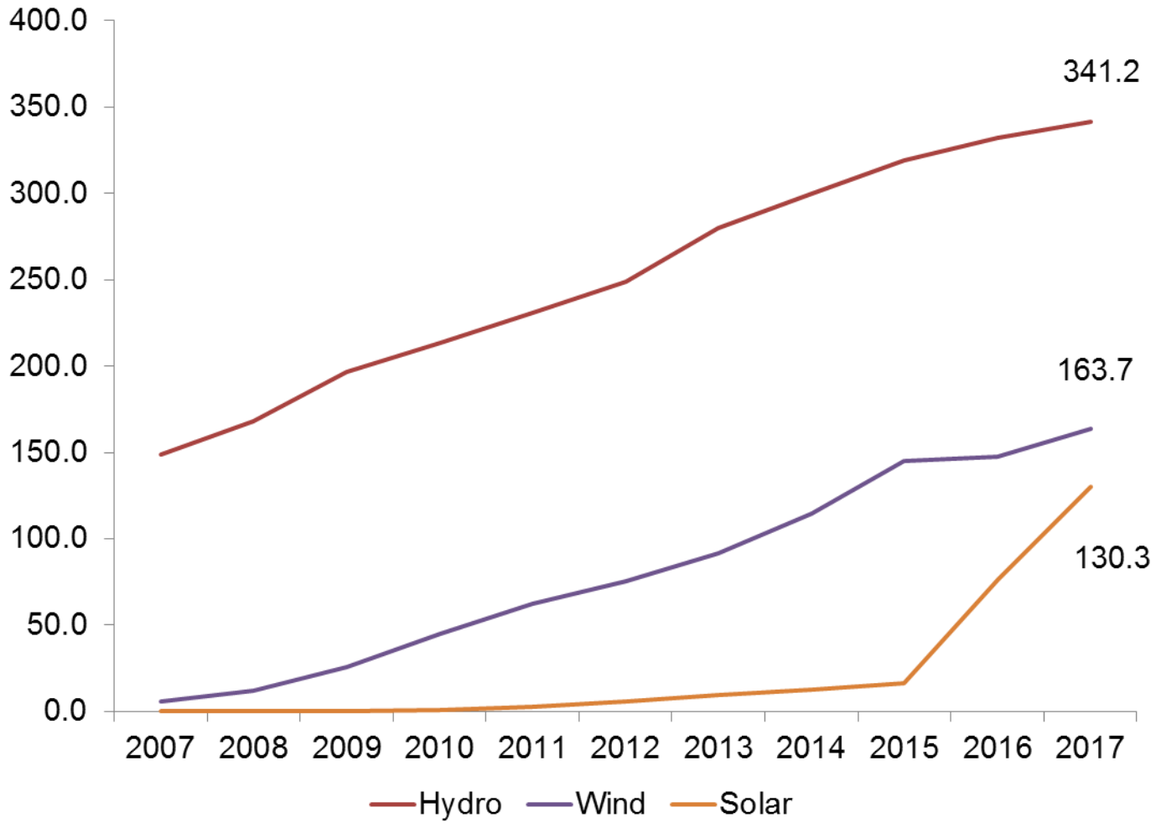
Transition in transportation

China’s non-fossil fuel on-grid generation reached 665GW, 38%of total power capacity in 2017

Solar PV cost reduction
(RMB/W)

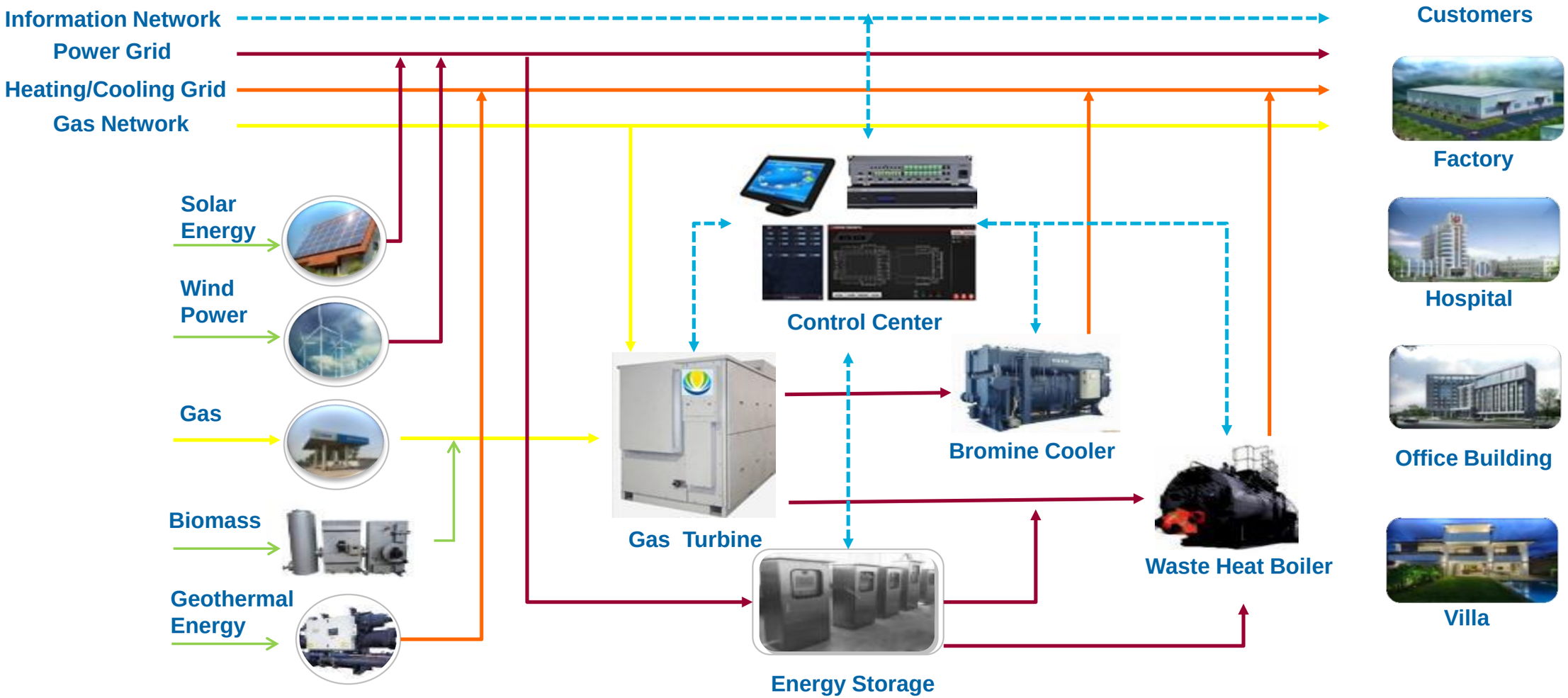


On-grid Generation Capacity
(GW)

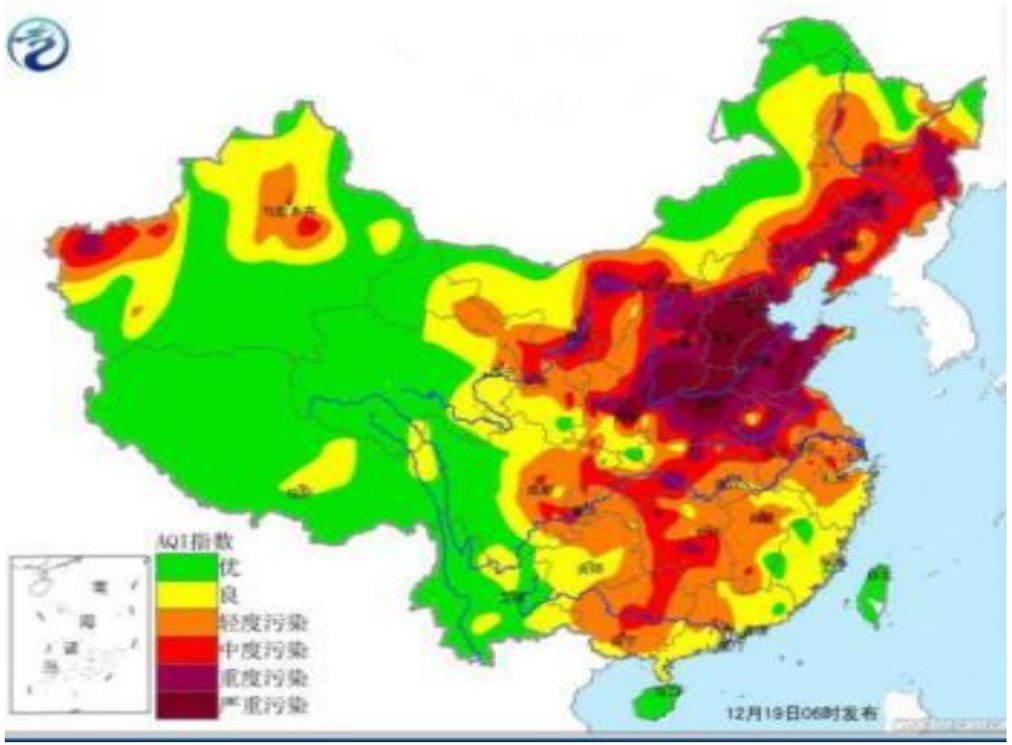


Transition in power generation and distribution

ENN's Ubiquitous Energy or Digitalised Distributed Energy System

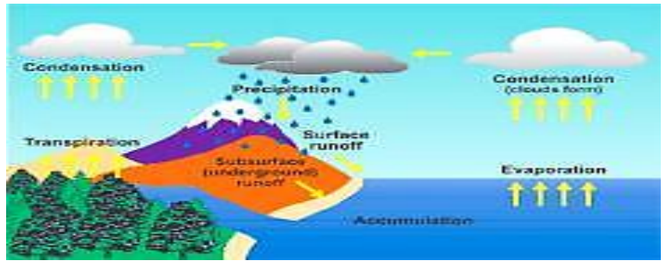


Heating transition - coal to gas/power



20% of China's coal consumption comes from dispersed coal use

Heating transition – water vapor heat pump



Water vapor in the air

Water vapor
heat source tower

Heat pump

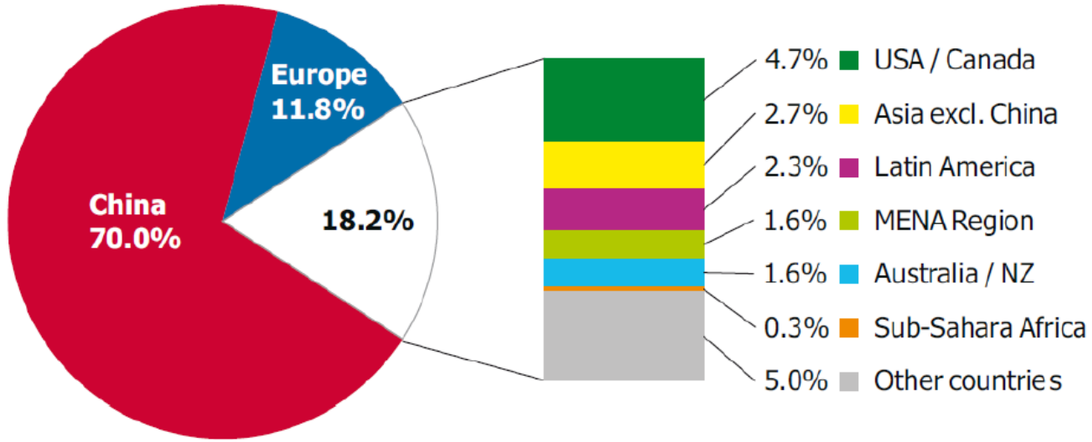
Water vapor energy
utilization system

End users

Make use of the heat released from water phase change, to provide cooling, heating and hot water for buildings.

Heating transition – solar water heater

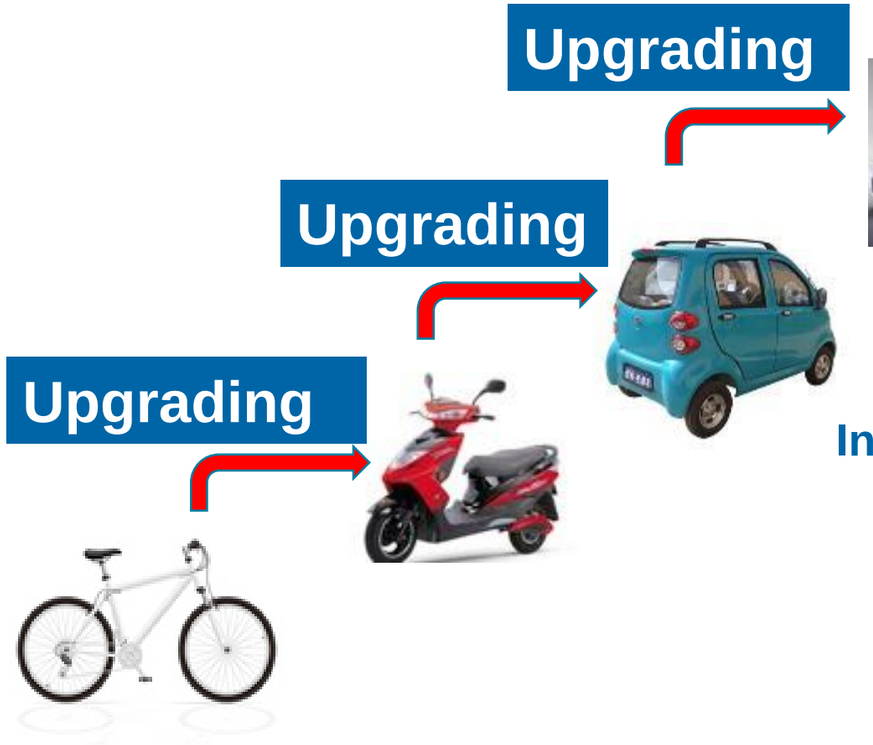
Cumulative capacities of solar heat worldwide by end 2013



Transition in transportation

Shared Bikes

Shared Cars

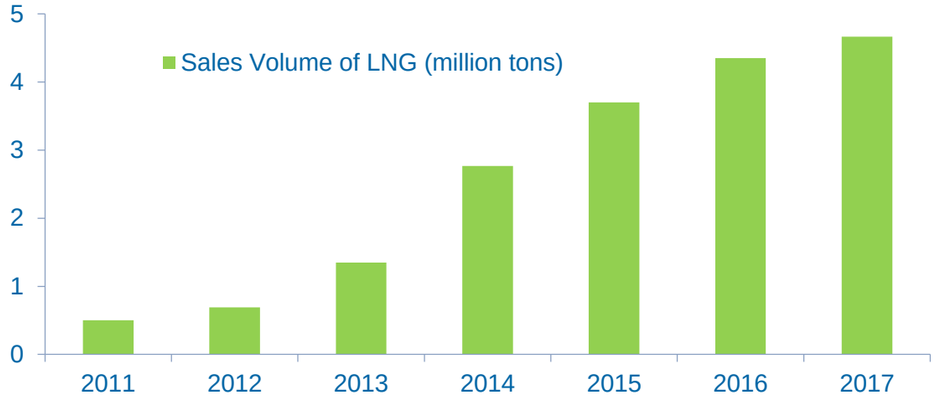


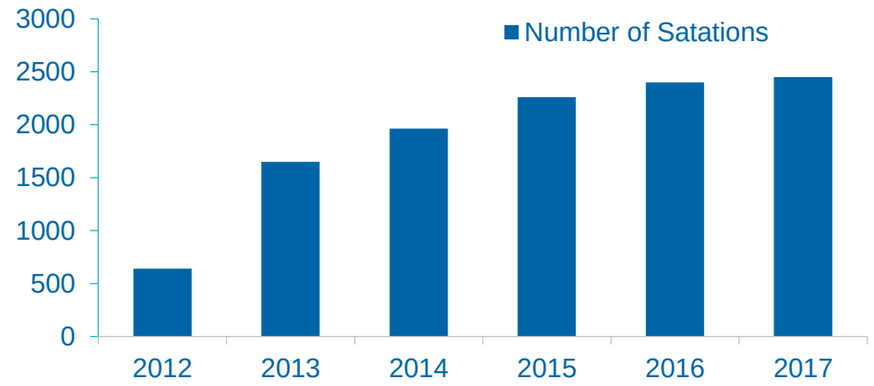
By March 2018, total charging poles reached 621,356

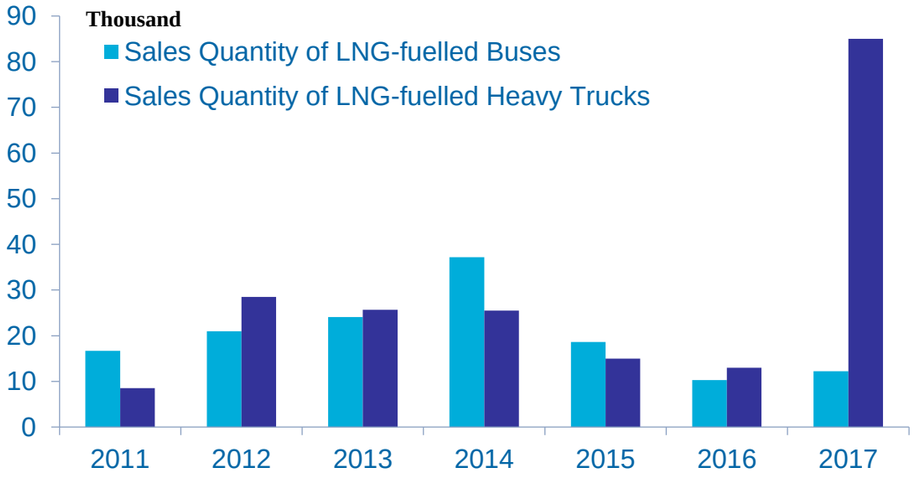
In 2017, China sold 777,000 Evs, reaching the total of 1.7 million units

In 2017, Shandong province alone sold 756,000 low-speed EVs

LNG as a transportation fuel in China







- As LNG can save cost and reduce pollution, China's LNG vehicles grew quickly in recent years, especially LNG heavy trucks and LNG buses.
- 2,450 LNG filling stations have been built, of which 1,830 were in operation by 2017.

Transition and Innovation

Solar PV + :

- All building roofs;
- Railways, highways, roads, parking;
- Agriculture, fishery and animal farms;
- Desert and wetland.

Business and policy innovation:

- EV mobile charging;
- Power storage;
- Demand response;
- Time of day pricing

Solar PV for Poverty Reduction

- **3KW PV, costing 24,000 yuan**
  - 8000 yuan from provincial government
  - 8000 yuan from county level government
  - 4000 yuan borrowed bank and friends
  - 4000 yuan raised by the family
- **Daily generation = 10kWh, so 10 yuan per day, the family gets 3000-3,300 yuan revenue per year.**

Digitalisation facilitates energy transition

China has 57.7% internet access rate with:

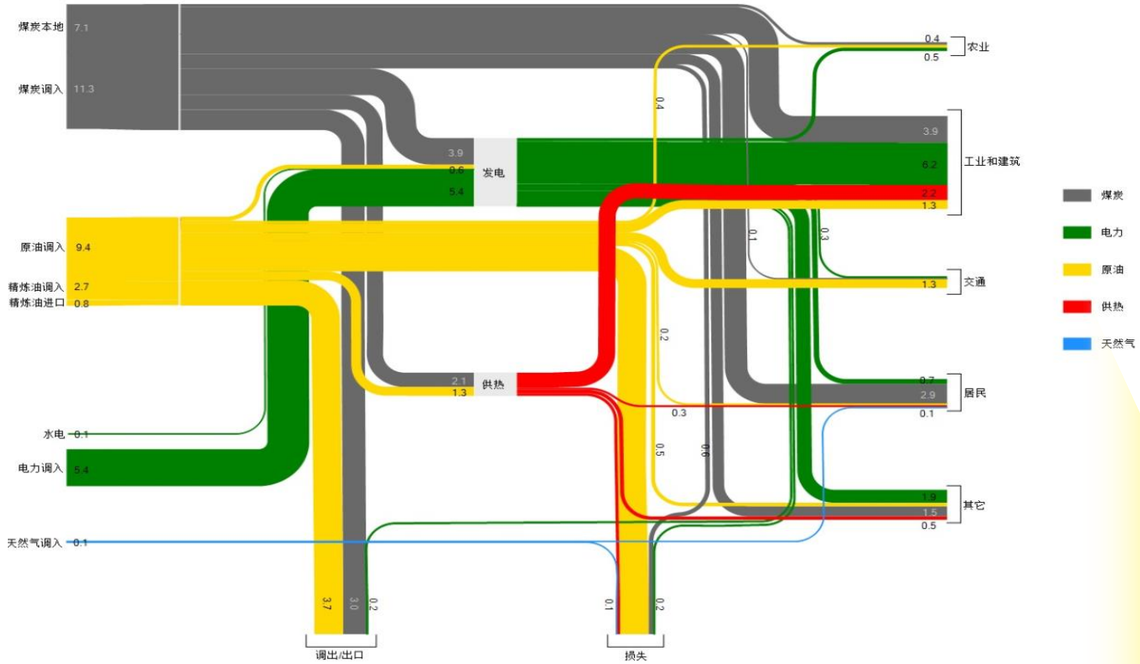
- 802 million internet users;
- 753 million mobile internet users;
- 527 million online shoppers.

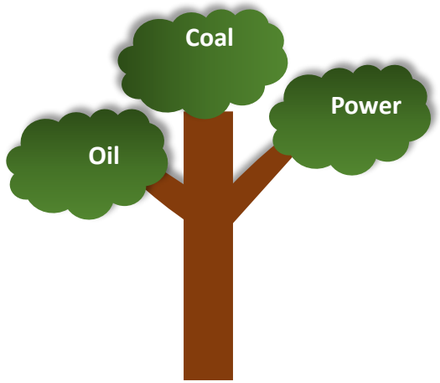
Energy Internet

Smart Grid

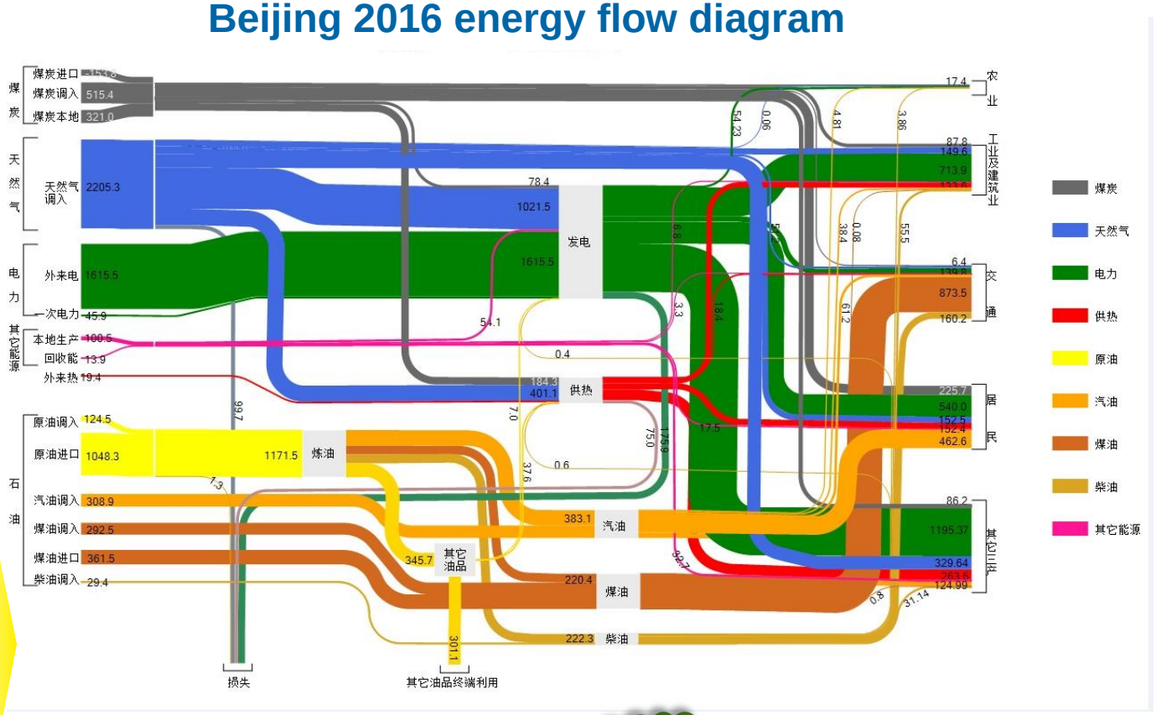
Diversification: example of Beijing's energy supply

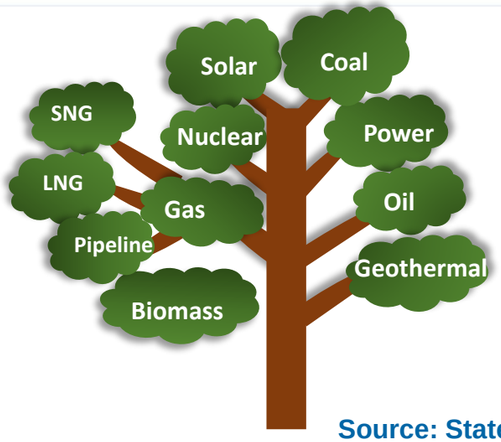
Beijing 1995 energy flow diagram





Beijing 2016 energy flow diagram



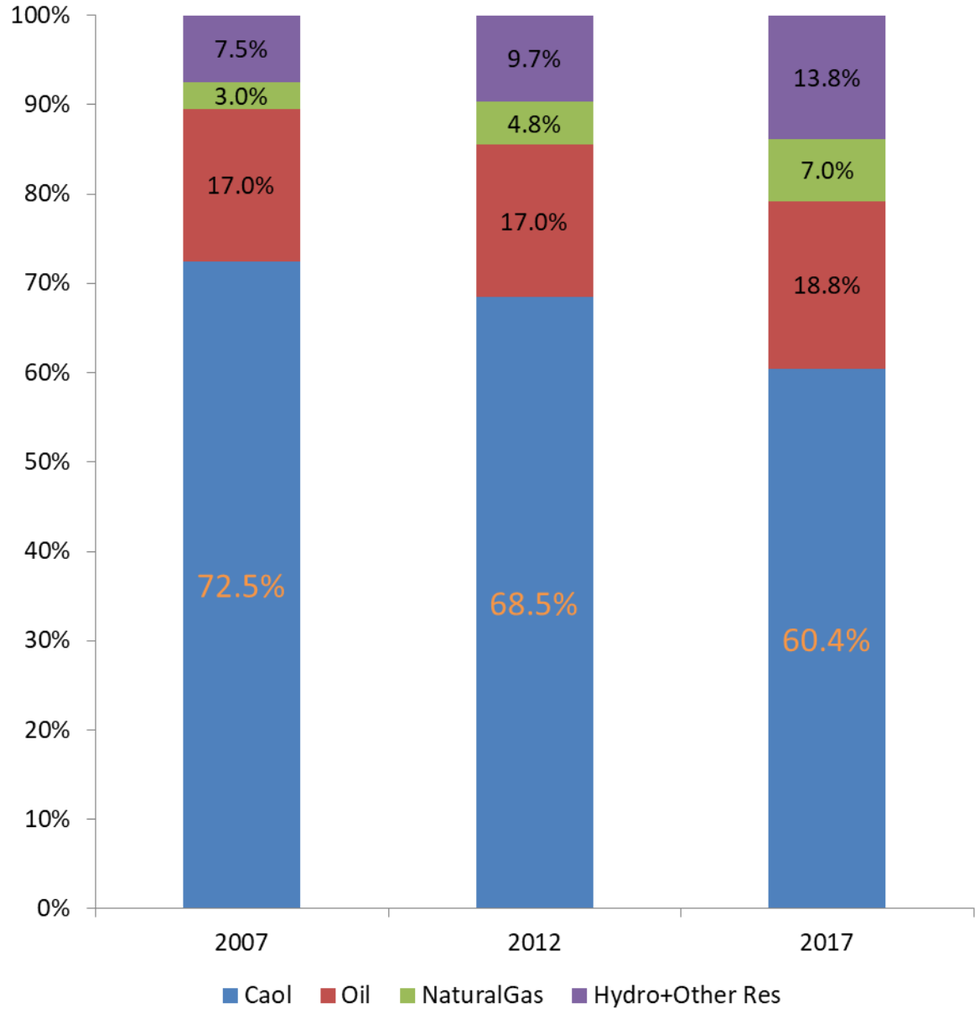


Source: State Grid Energy Research Institute

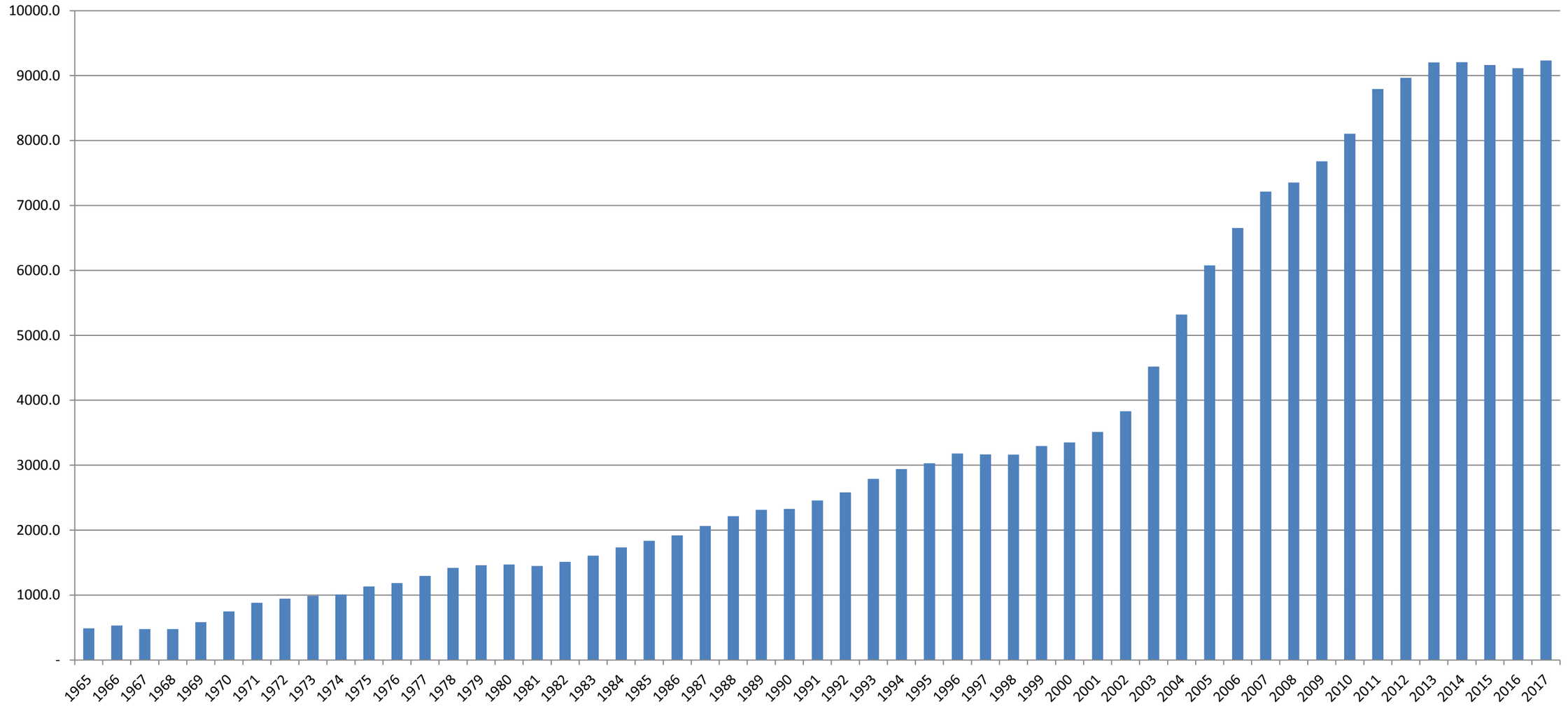
7Ds Driving China's Energy Transition

Results of persistent hard work

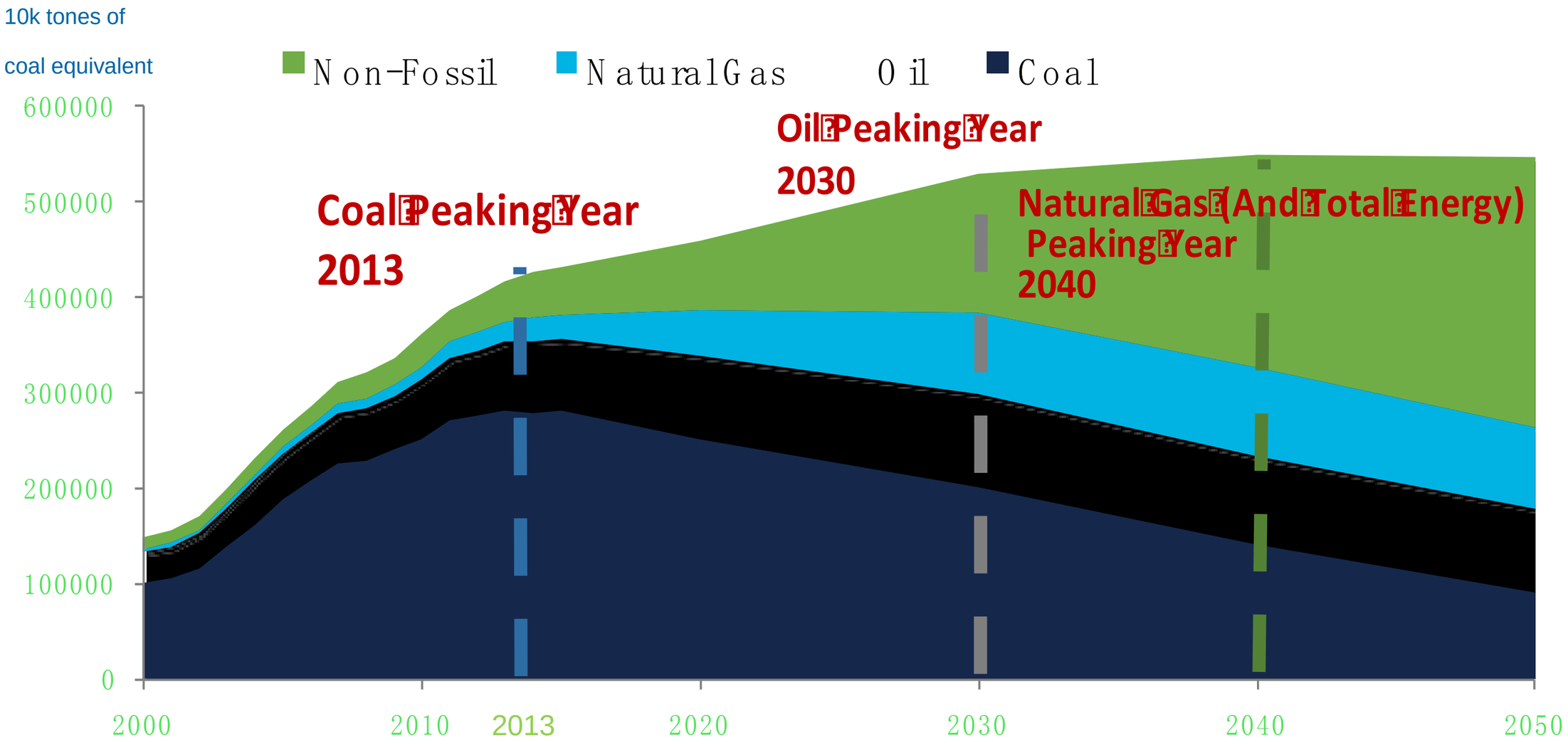
China energy supply structure



CO2 emission Changes in China



Possible future of Chinese energy demand



Source: China Coal Consumption Cap Scenario Analysis Report (2015-2050), China Coal Cap Project, November 2015

Thank You!

Q&A