The Greening of the energy sector in China: Challenges and Opportunities

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Introduction

- Since 2006, China has replaced the US to become the largest greenhouse gas (GHG) emitter in the world
- Largely due to the increase in energy consumption
- Consumer consumption has become an increasingly important factor that drives up demand

Table 1: China's CO_2 emissions ($GtCO_2$), 1990-2007, selected sources[7]

Source	1990	1995	2000	2005	2007
Chinese National Statistics	2.76	3.59	3.16		
MNP data	2.31	3.22	3.33	5.57	6.72
US EIA 2008	2.24			5.32	
IIASA GAINS Baseline08	2.35			6.31	

Source: *A Balancing Act*

What's behind the rising demand

- The accumulative effect of the past 30 years of development
- Individual freedom + prosperity = consumption
- Industrialization + urbanization =

  (new apartment + TV, refrig, A/C, …)*

  600 to 700 million urban population =

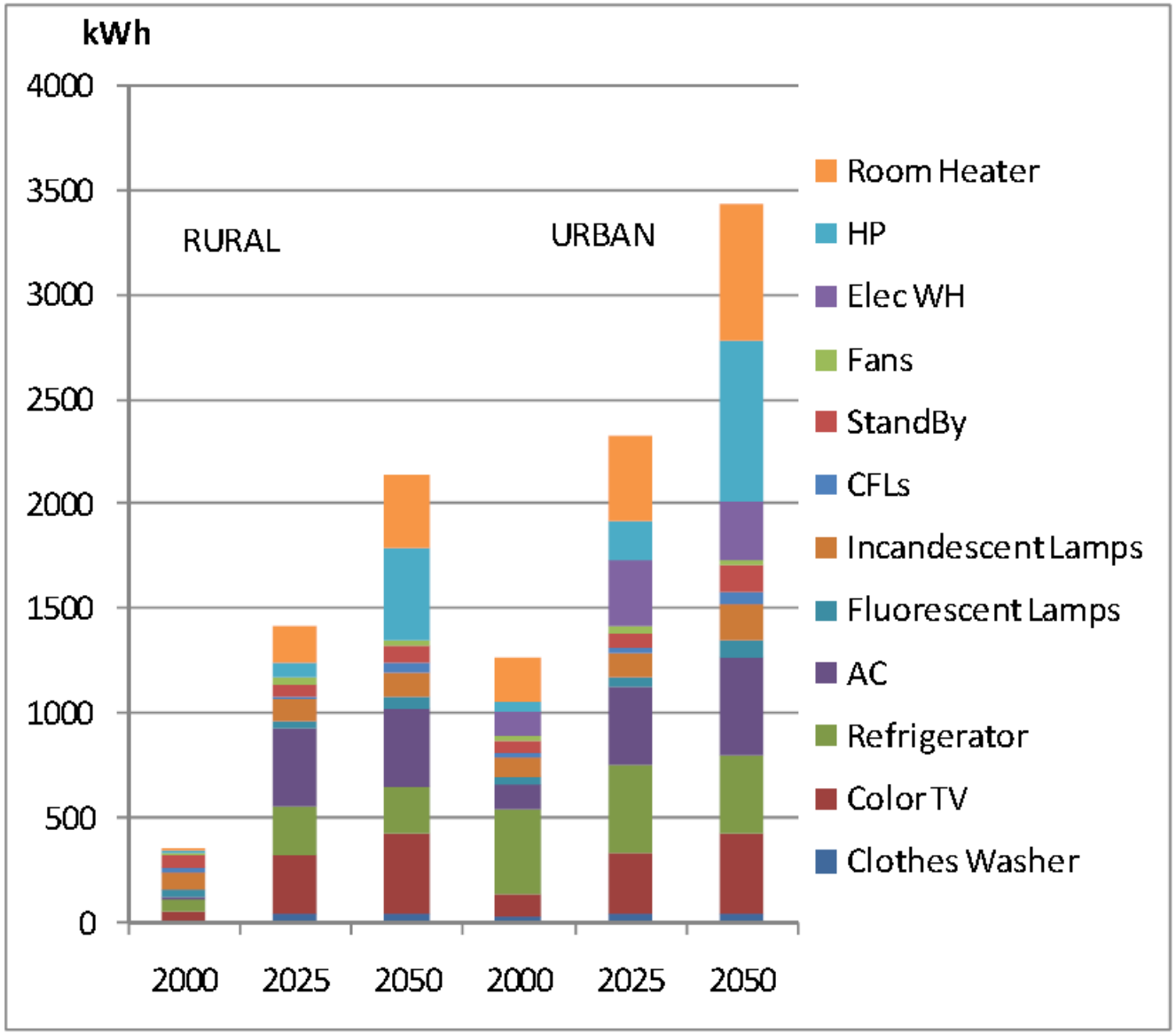
  souring demand in power supply =

  rolling blackout in the early 2000s.

But that's only half of the story

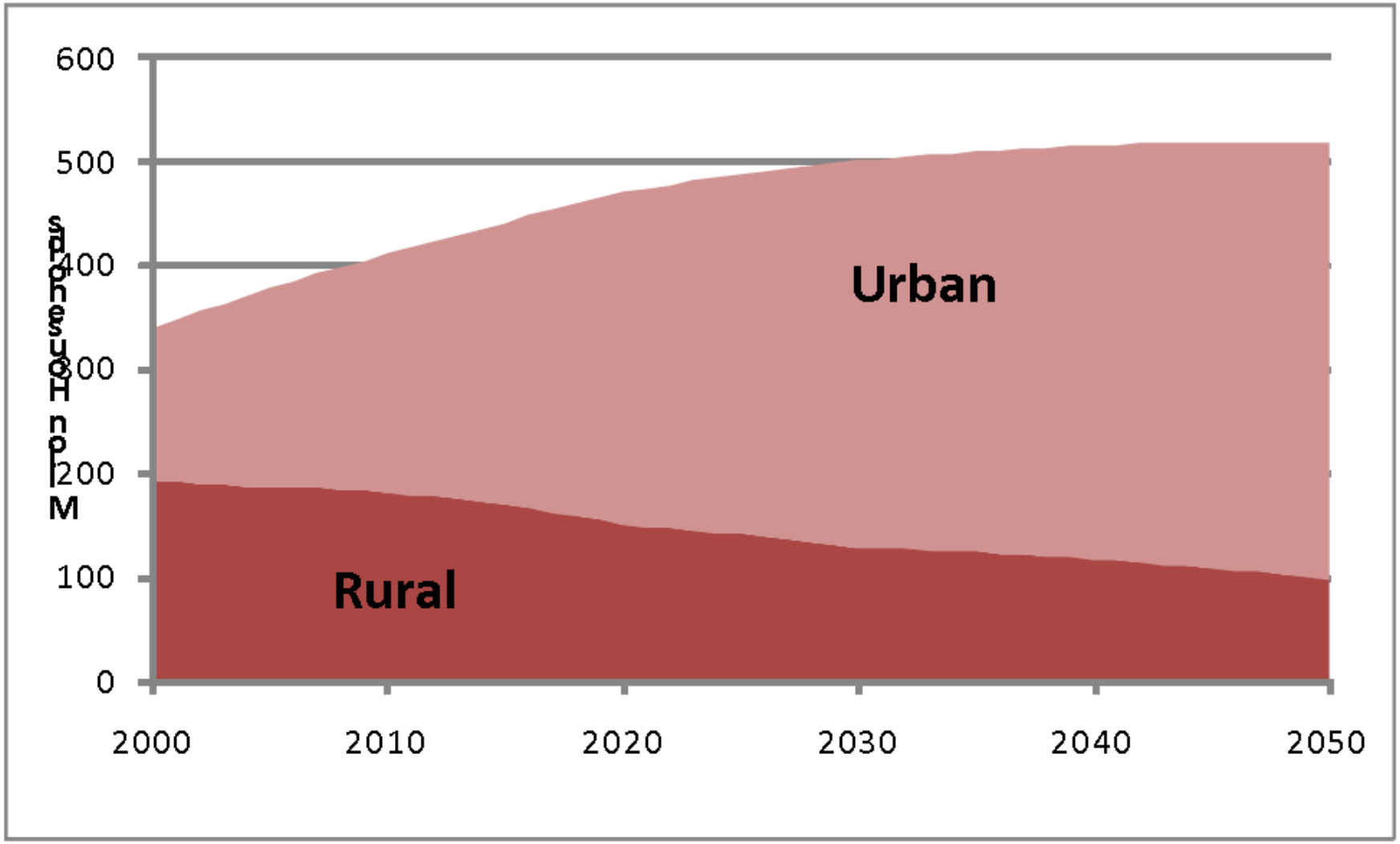
- The other half still lives in rural areas
- Many without basic sanitation, sewage treatment, or waste collection
- Living in close proximity with animals
- Without treated water
- Without electricity or stable supply
- Another 600 to 700 million people

Figure 5 – Modeled Annual per household Consumption



Source:
Letschert 2010

Figure 6 Number of households in urban and rural areas



Source: Letschert 2010

China vs. the US

- The US on average
  - 9000 to 15000 kWh per household per year
- Urban household in China
  - 1100 to 1500 kWh per year
- Rural household in China
  - 500 kWh per year
- If per capita energy consumption as a crude indicator of living standard, China is not even half way close to the West

Projection 1

- Per capita GDP
  - 2000: US$1000
  - 2010: US$2000
  - *Assuming steady annual growth rate at 8%:*
  - 2020: US$4000
  - 2030: US$8000
  - 2040: US$16000
- The magic number:
  - per capita GDP of US$15000

Projection 2

- If energy demand and supply capacity grow at the same rate of GDP, i.e., 8% per year, and doubles every 10 years
  - Installed capacity in 2009: 700 GW
  - 2020: 1400 GW
  - 2030: 2800 GW

The challenges to greening

- How to fill the 2100 GW gap in 20 years?

How many coal fired power plant does it take?

- The biggest coal fired power plant in China today has the capacity of 4GW
- It has four 1GW power generating units
- Using the most advanced ultra supercritical technology
- 44% energy efficient
- US$2.1bln and more than 5 years to build
- 540 million tons of CO_2 reduction annually

To fill the 2100GW gap:

- China need more than 500 such mega plants in the coming 20 years
- At the rate of roughly one new plant every 2 weeks, i.e., 25 new plants per year, it takes 20 years
- Total investment: US$1250bln

To fill half of the 2100GW with coal

- That is to say, the energy mix of newly added capacity will be reduced to only 50% coal
- 250 mega plants
- One new mega plant every month, 12 new plants every year
- It takes 20 years

What about nuclear power

- The biggest nuclear power plant under construction has a maximum capacity of 4.4GW with four 1.1GW units
- Current model CPR1000 has 1GW capacity
- China and Westinghouse will collaborate to develop CAP1400 with 1.4GW per reactor, and possibly 1.7GW later
- China will own the intellectual property rights of the new design

China's nuclear power plan

- Current installed capacity
  - 9.1GW with 11 reactors at 4 sites
- By 2020
  - 30-35 new plants
  - 70GW installed capacity
  - 5% of national total capacity
- By 2030
  - 250GW installed capacity
  - 16% of national total capacity

Promises and problems with nuclear power

- With the new model jointly developed by Chinese companies and Westinghouse, China will have a competitive edge

- China is not rich in uranium reserve
- Facing long-term fuel shortage

Hydropower

- The Three Gorges Project
  - 22.5GW installed capacity
  - US$26bln to build
  - 100 Three Gorges Project to add 2100GW in new capacity
- 2010
  - 190GW installed capacity
  - 17% of national total capacity

The proposed mega hydro plant

- the Yarlung Tsangpo/Brahmaputra river hydro-electric plant
- 38GW in capacity
- Might be controversial
- If the plan goes forward, it will be one of 28 dams on the same river

Smaller and small hydro-electric plants all over the country

- All the rivers in China that have significant potential for power generating have been licensed to various power companies
- Small hydro-electric plants everywhere
  - 250KW generator in a village
  - It takes 100,000 generators of this size to make up one Three Gorges Dam Project
  - China has about 300,000 villages, but many of them are dry

Wind power

- 2006
  - 3GW installed capacity
- 2007
  - 6GW installed capacity
- 2008
  - 12.2GW installed capacity
- 2009
  - 25.1GW installed capacity
- 2010 target: 10GW installed capacity
- 2020 target: 100GW, 7% of national capacity

Solar power

- China produces 30% of the world's photovoltaic panels
- 820MW of solar PV produced in 2007

- 20GW by 2020

The promise of China's clean energy industry

- Government policies
  - Toughened rules for conventional energy projects, especially coal fired power plants
  - Guidelines and investment
- Private enterprises
  - Domestic markets
  - International markets

The challenges

- Government subsidies
  - Capital
  - Land
  - Tax
- US Steel Workers Union recently filed a complaint listing Chinese government's subsidies to the clean energy industry as violations to WTO rules

The climate and trade dilemma

- Subsidies are critical to technology innovation
- Technology innovation is critical to the green transformation

- But subsidies to the export industry is illegal under WTO rules

Way out of the dilemma?

- It's not just Chinese enterprises want access to the world market
- International companies want access to the Chinese clean energy market too
- Do we need new trade rules for clean energy technology and products?
- Should China propose a "climate exemption" clause to the WTO rules?