The Power Sector in China:
What a difference two years can make . . . or not

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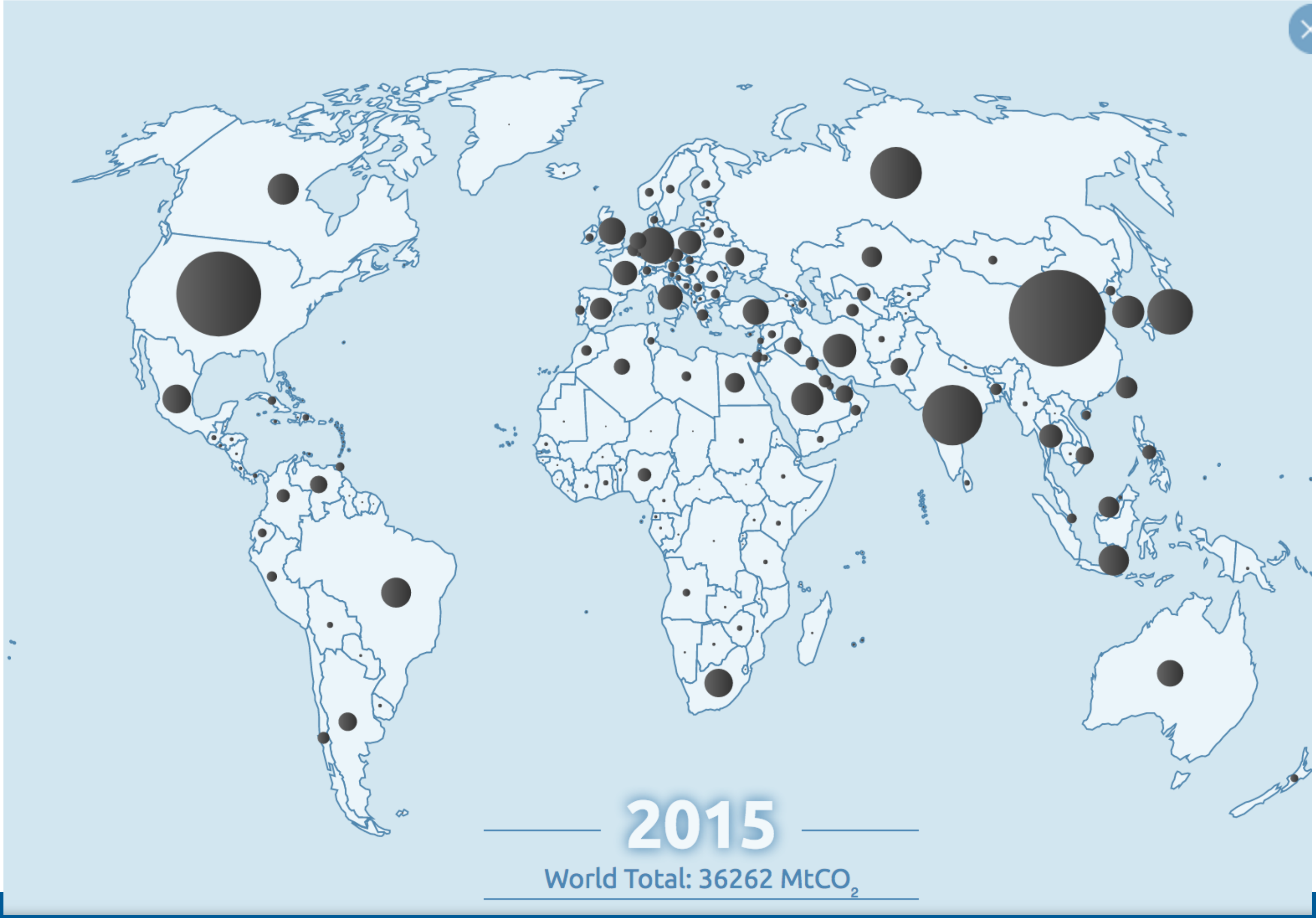
Beijing, 12 October 2007, 2:33 PM

Cocktail Party Fun Facts

- Annual global coal consumption: 8.7 billion short tons
- 50% in China
  - Half for industry and heating
  - The other half for electricity
- Global CO_2 emissions totaled roughly 36.2 billion tonnes in 2015—virtually the same amount as in 2014 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 produces 29% of global CO_2 emissions
- The US is number two at 14%
  - We still win when it comes to per capita emissions

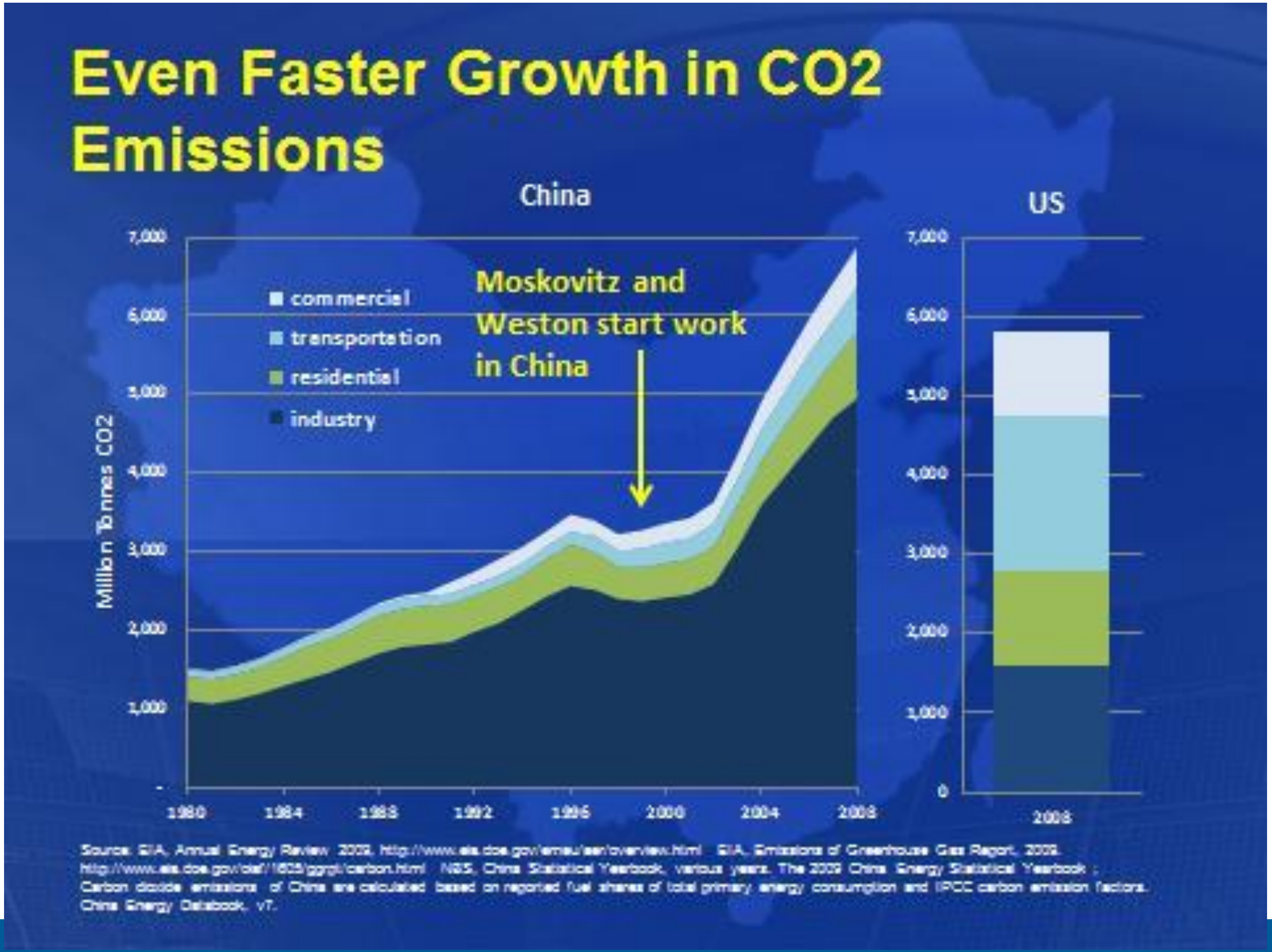
Sources: PBL Netherlands Environmental Assessment Agency and Index Mundi

CO_2 Emissions



Source: Global Carbon Atlas

Post hoc ergo propter hoc

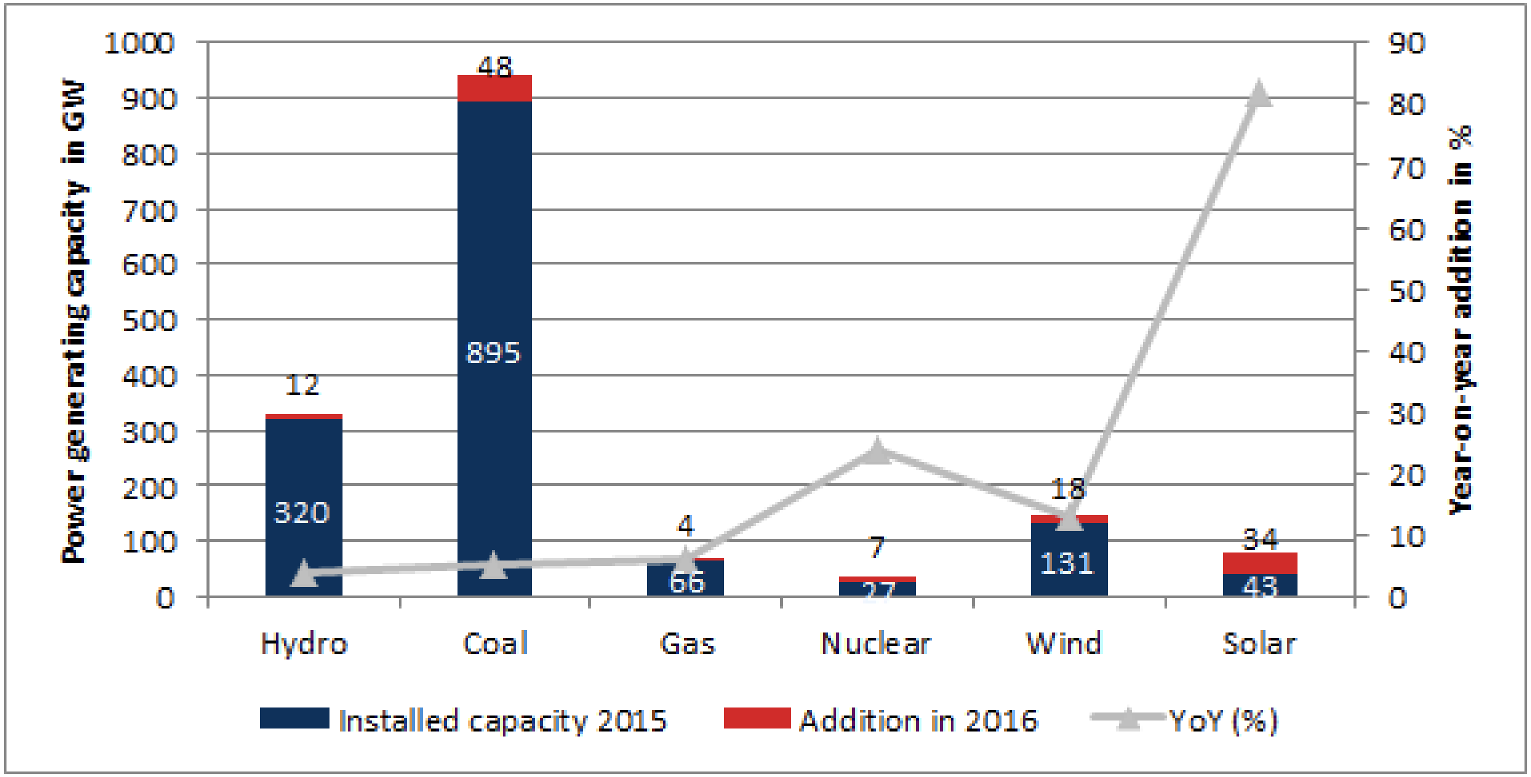


When last we see our heroes (June 2015)

China's Power Sector: Much the same as it was in 2015, only bigger

- Two grid companies: State Grid (85%) and China Southern Grid (15%), both state-owned
- Five major state-owned generators, with 50% of installed capacity
  - The rest belongs to provincial and muni power companies, and to RE developers (also mostly state-owned)
- Total capacity was 970 GW in 2010 and topped out at >1,600 GW at the end of 2016, a 70% increase in six years
  - ~125 GW of new capacity—mostly unneeded—were added in 2016
  - Avg. thermal utilization rates down 200 hours/year, to 4,165 hours/yr
- Total consumption in 2016: 5,920 TWh
  - Industry 70%, households 14%, the rest commercial and agricultural
- 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

2016 Generation Portfolio



March 2015: Document #9
"Deepening Power Sector Reform"

- State Council-Communist Party joint statement:
  - The need for reliability;
  - 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 regulatory capacity

Reform Progress?

- *Regulation:* Revenue-caps piloted in Shenzhen is now national policy
- *Direct access:* Large users bypass gridcos, buy directly from suppliers
  - Buyers & sellers screened for efficiency and environmental performance
  - Monthly & annual contracts give discounts from wholesale tariffs
- *Demand response*
  - Funded by government payments to end-users, not through the market
  - No link to wholesale market prices because there is no economic dispatch or market
- *Dispatch:* “Equal shares dispatch”
  - Unit commitment to assure annual operating hours (e.g., 4,500) and thus capital cost recovery, not to minimize total operating cost
  - No imbalance trading
- *Renewables:* Most investment in solar and wind in the world
  - But very high rates of curtailment (>25%), because of dispatch rules & no interprovincial trading
- *Power sector planning:* No least-cost integrated resource planning

China's Energy & Environmental Goals

- Carbon intensity reduction by 40-45% from 2005 levels by 2020
- By 2020, 15% of China's 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 the end of this year
  - Absolute caps on 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)

November 2014: Xi-Obama Agreement

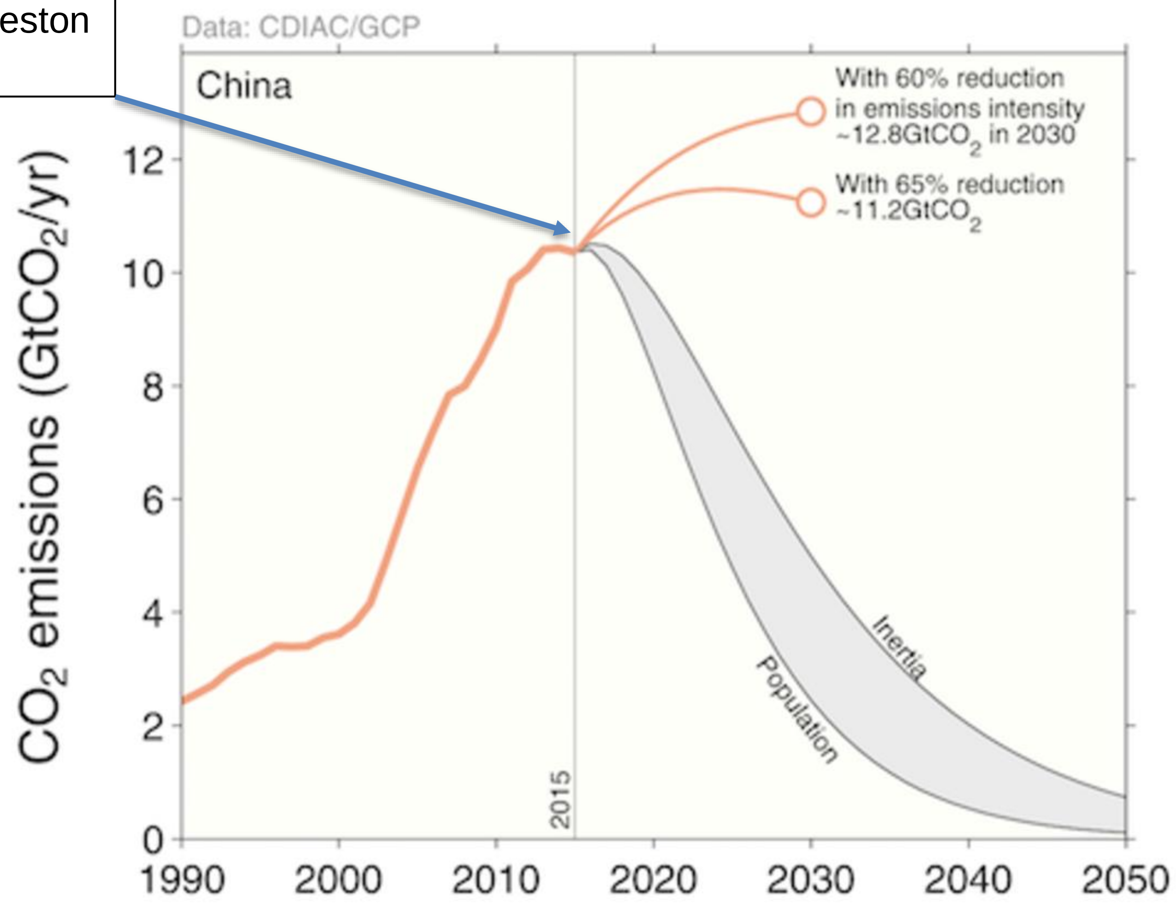
- US to cut greenhouse gas emissions 26-28% below 2005 levels by 2025.
- China to hit a peak in its carbon dioxide emissions by 2030—possibly sooner—and to increase the non-fossil fuel share of energy to around 20% by 2030.
  - Modeling shows that a peak in carbon emissions must be preceded at least five years earlier by a peak in coal consumption

September 2015:
The Second Xi-Obama Agreement

- Reaffirmation of US and Chinese post-2020 commitments to reductions in GHG emissions in lead-up to Paris
- China:
  - National CO_2 emissions trading
  - "Green" dispatch
  - Green buildings
- US:
  - Clean Power Plan

Et Voila! Chinese CO_2 Emissions: Pledges, Peaks, Needs?

Moskovitz and Weston leave China?



Source: Climate Change News

The beginning of a beautiful friendship?

- China and the EU to step into the breach?
- Premier Li Keqiang last Thursday: "Step by step, and very arduously, together with other countries, we will work toward the goals set."
- But on Friday, China and the EU did not release a joint statement on climate change, because of a trade policy dispute.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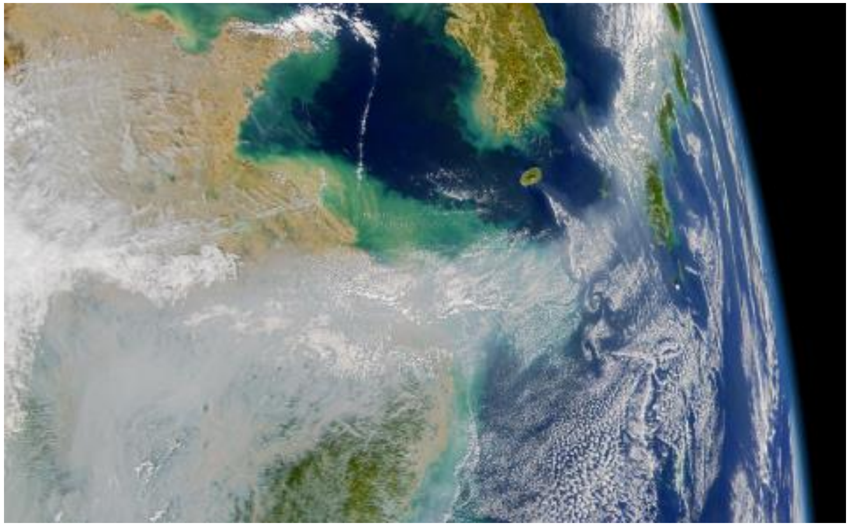
Air Quality

- Since 2011, China has issued progressively more stringent AQ regulations
  - RE and EE recognized as means of avoiding emissions.
- In 2016, revisions to the Air Law went into effect
  - China is now implementing an emissions permitting system modeled in part on the Clean Air Act and in part on European regulations


Beijing, 25 October 2007, 12:30 PM

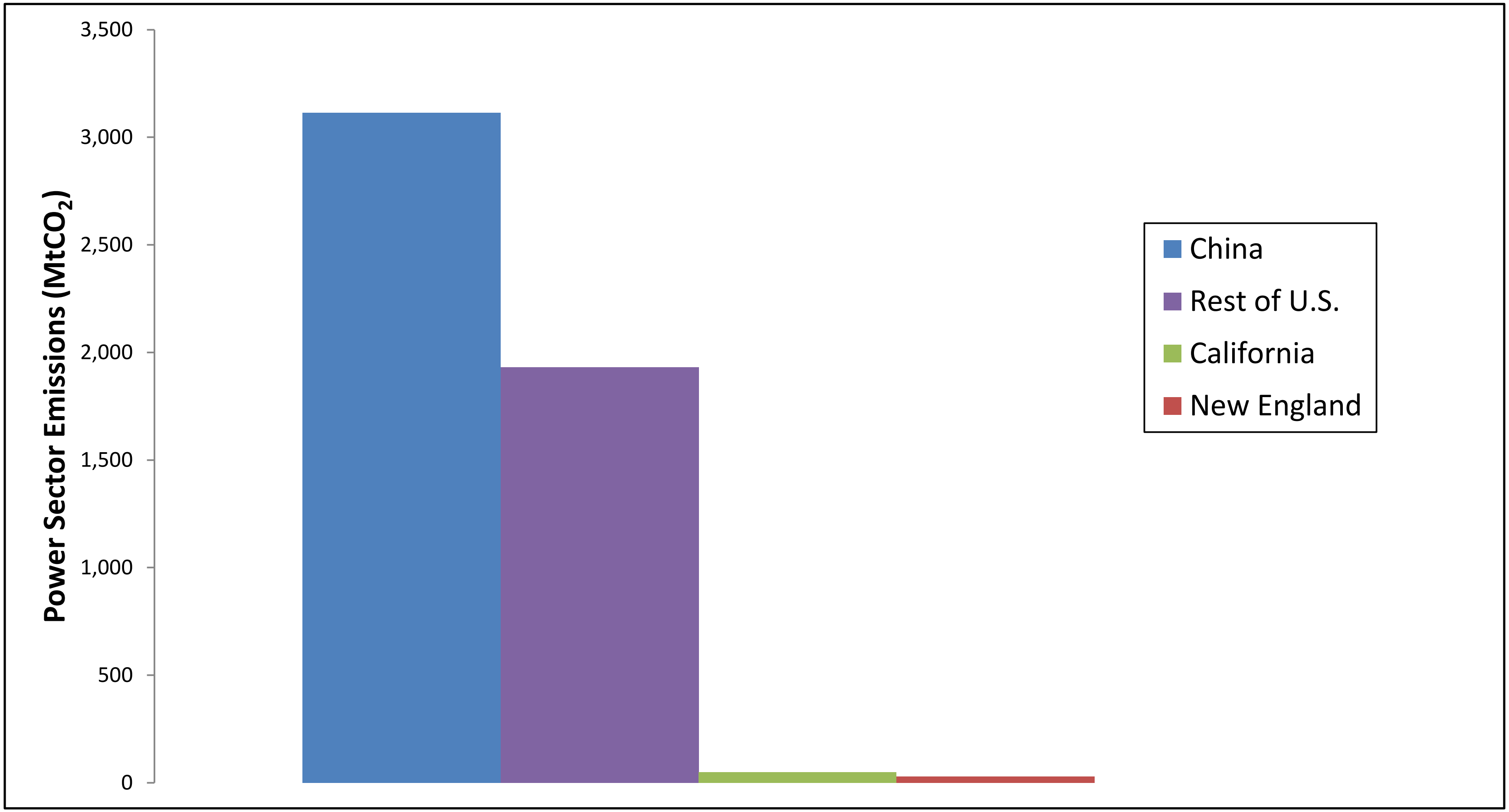
Immigration Policy?



- EPA: downwind air pollution from Asia may erase savings from domestic emissions programs
- Ozone, particulates, and mercury
  - 8-12% of pollutants in the Pacific NW have an Asian signature

Source: Dan Jaffe at UW-College of the Environment

There are two ways to look at this graph



In conclusion: as in 2015, again

- Continue to reform your markets:
  - Design them to favor desired outcomes and capabilities: e.g., no-carbon and flexibility
  - Fully integrate environmental and energy policymaking
- Expand investment in end-use efficiency and renewables
- If you have the opportunity, engage with China
  - Fashion solutions that work for China
  - Help build institutional capacity
  - Remember that learning goes both ways
- Be a threat of a good example


Beijing, 26 October 2007, 9:21 AM

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