

Why China Is Acting on Clean Energy: Successes, Challenges, and Implications



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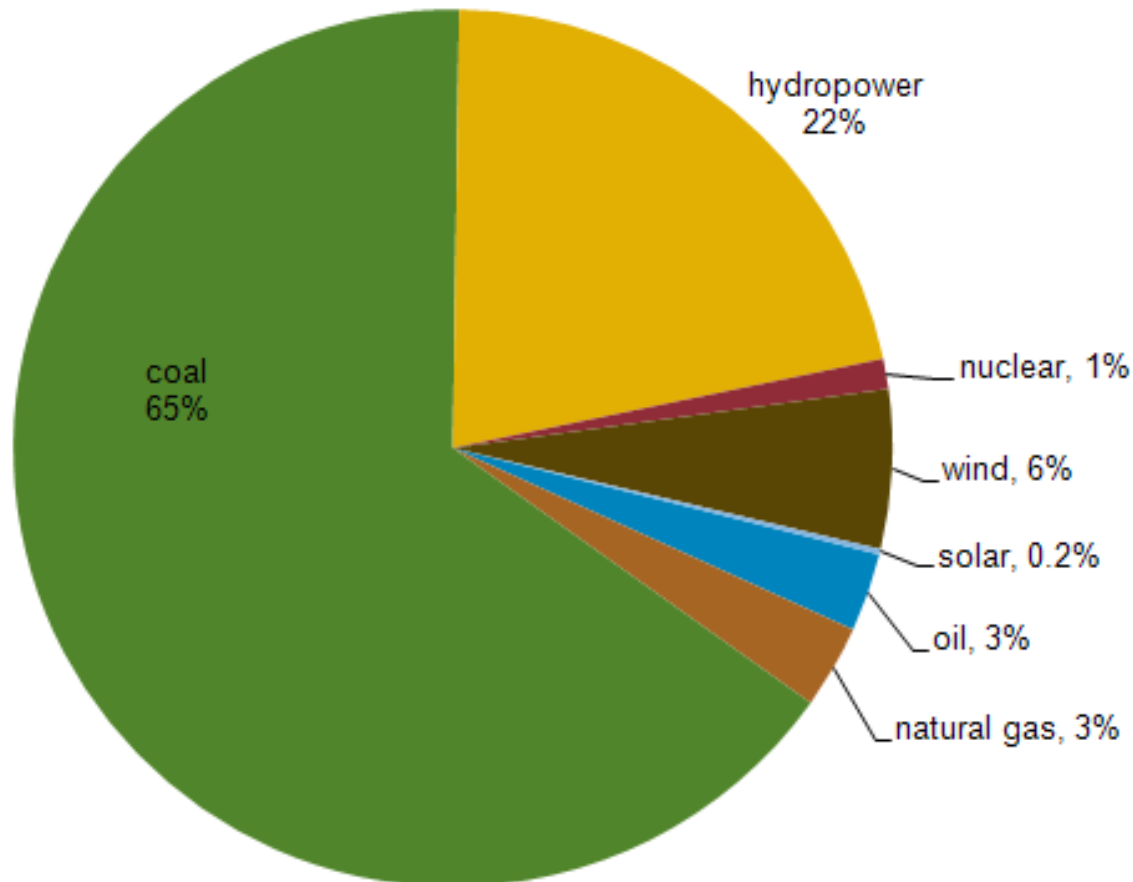
China's Clean Energy Achievements

- Is the leading manufacturer of most renewable energy technologies (small and large wind, solar PV, small and large hydro, solar hot water)
 - Became largest wind market in the world largest user of clean energy overall in 2010
 - Is developing first of its kind government-coordinated gigawatt-scale wind and solar projects
 - Invested \$54.4 billion in clean energy in 2010 – more than any other country
- *Focus today on how this was accomplished, and the outlook for the coming years*

Non-Hydro Renewables Still Small Share of Electricity Capacity

China's installed electricity capacity by fuel, 2011

installed capacity: 1,073 gigawatts



Non-Fossil Energy Targets

	2015	2020
Wind capacity	>100 GW	>200 GW
Wind power	190 bln kWh	>380 bln kWh
Solar capacity	>20 GW	>50 GW
Biomass capacity	13 GW	30 GW
Hydropower capacity	260 GW	
Pumped storage hydro	30 GW	
Geothermal and tidal	110-120 MW	
Ocean power	50 MW	
Nuclear	40-50 GW	60-70 GW

-Target for 15% of its primary energy consumption from non-fossil fuel by 2020

-18 GW of PV in 2010 installed globally (so their 2020 target is more than twice current global installations).

12th FYP: Strategic Industries Redefined

	The <i>old</i> pillar industries	The <i>new</i> strategic and emerging industries
1	National defense	Energy saving and environmental protection
2	Telecom	Next generation information technology
3	Electricity	Biotechnology
4	Oil	High-end manufacturing (e.g. aeronautics, high speed rail)
5	Coal	New energy (nuclear, solar, wind, biomass)
6	Airlines	New materials (special and high performance composites)
7	Marine shipping	Clean energy vehicles (PHEVs and electric cars)

- **“Pillar industries”** – strategically important for national security and public interests (over 70% of SOE assets and profits concentrated in the “old” pillar industries)
- Receive access to dedicated state industrial funds; increased access to private capital
- Supported by national industrial policy (tariffs, preferential loans, R&D funds)

The Renewable Energy Law

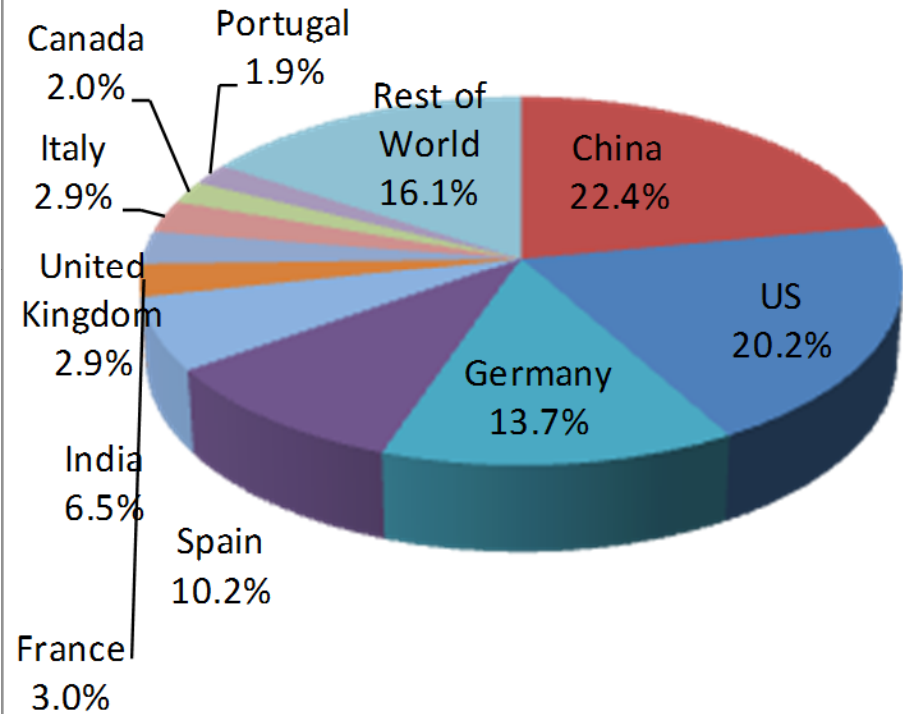
- Sets national renewable energy targets
 - mandates sub-national mid and long term targets
- Creates power purchasing obligation
 - grid operators are required to purchase renewable energy power, including wind, solar, and biomass power
- Authorizes differential tariffs
 - Feed-in tariffs authorized for renewable energy vary in accordance with the regional distribution of renewable energy resources, technology differences, and other related factors
- Creates mechanism for cost sharing
 - Subsidies for renewable energy are shared by domestic electricity consumers through surcharges in the electric utility rates (*Renewable Energy special fund*)

Wind Development in China

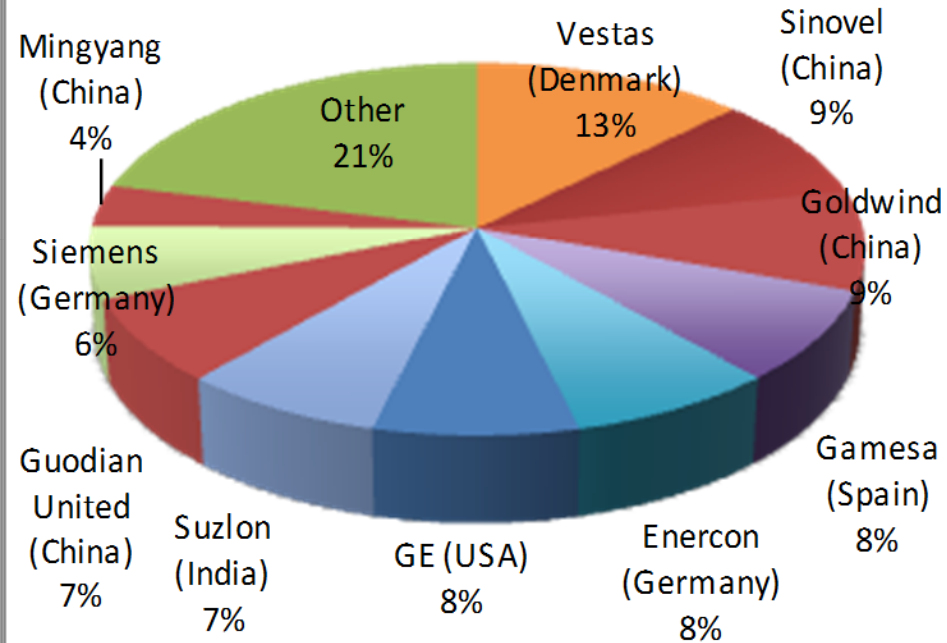


Leading Global Wind Markets

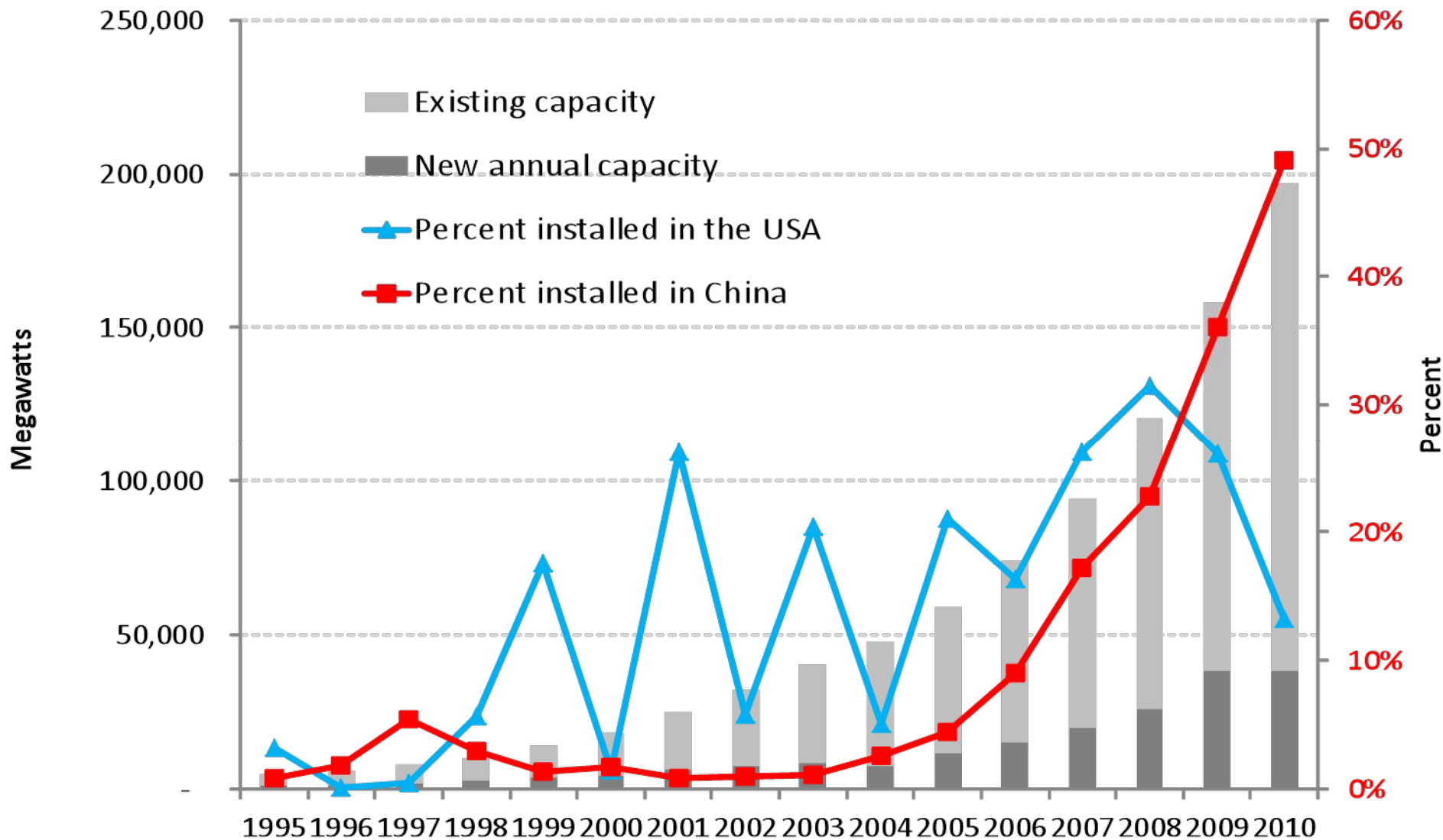
Installed Wind Capacity



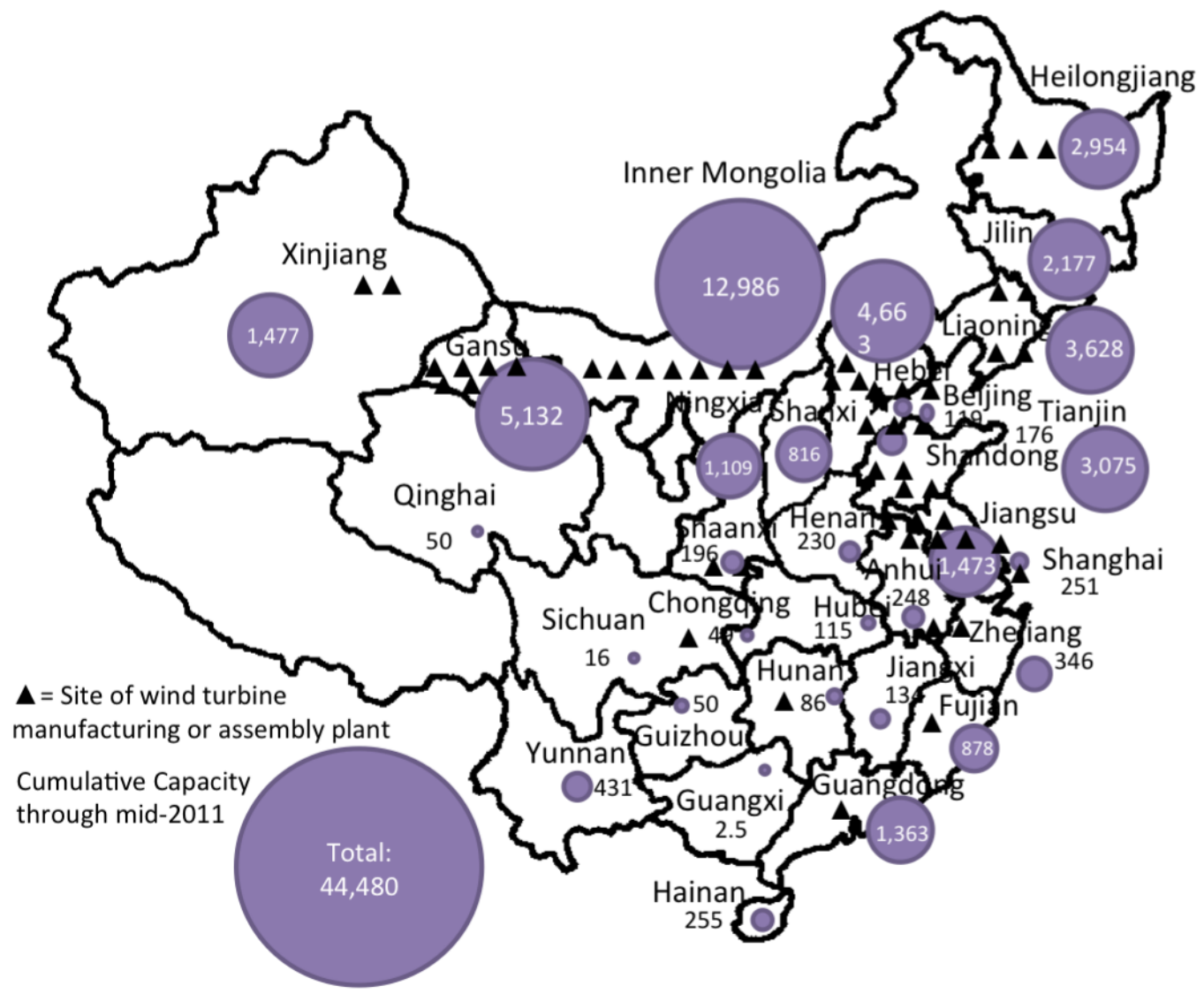
Wind Turbine Production



US & China Shares of Global Wind Installations

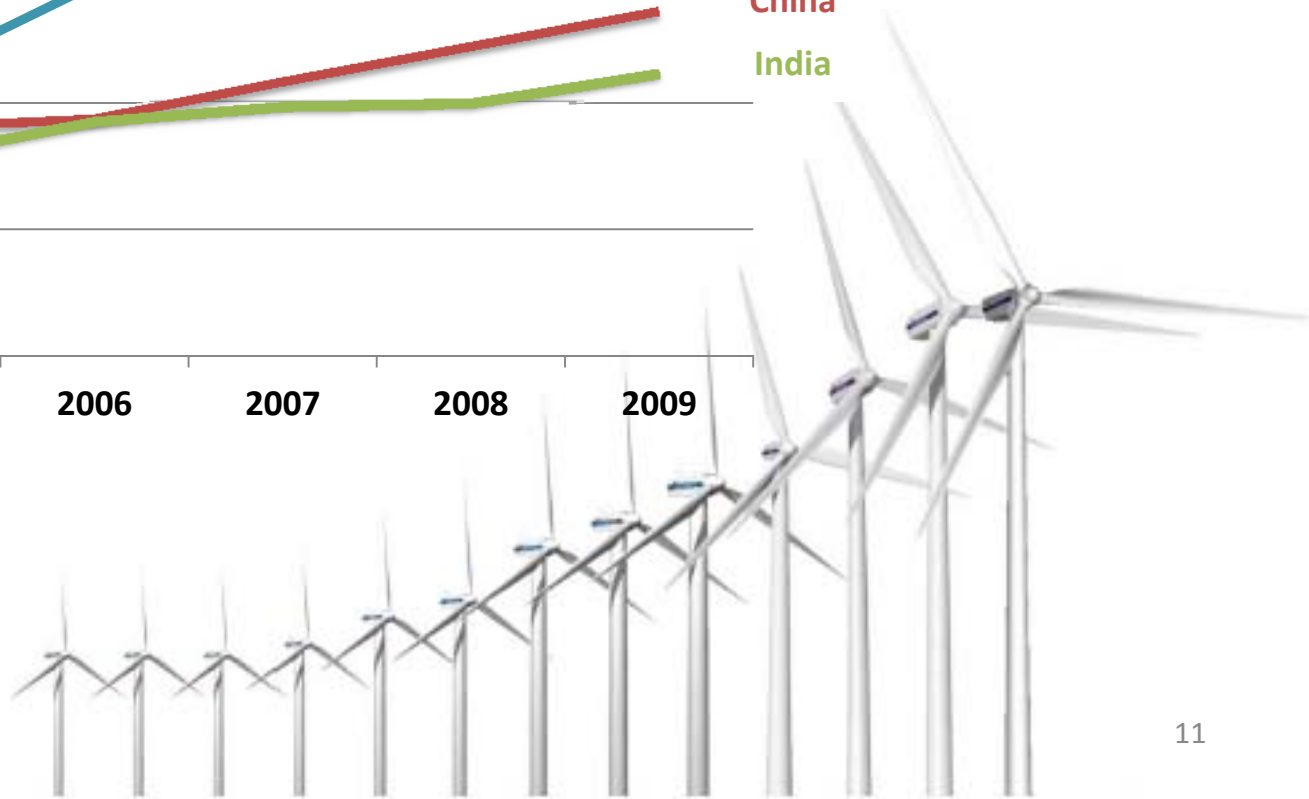
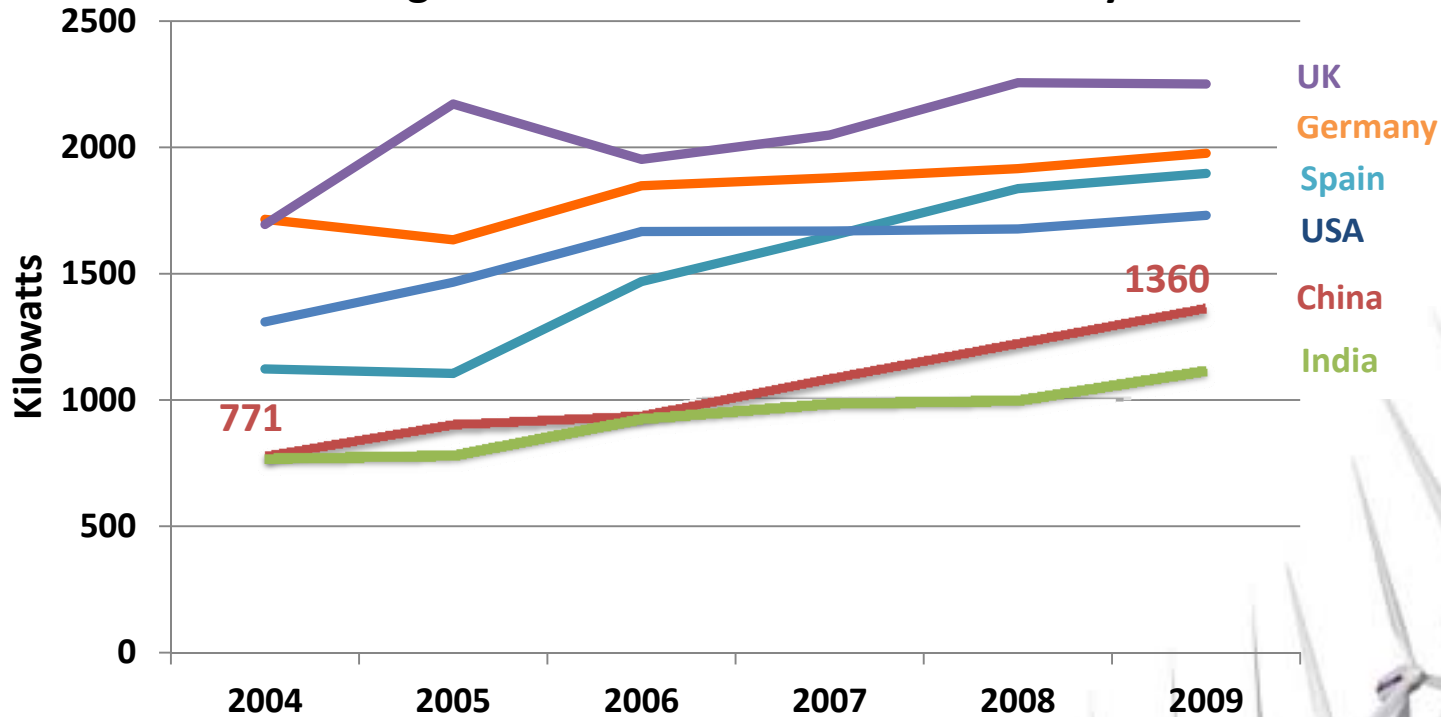


Provinces Becoming Hubs of Manufacturing and Deployment

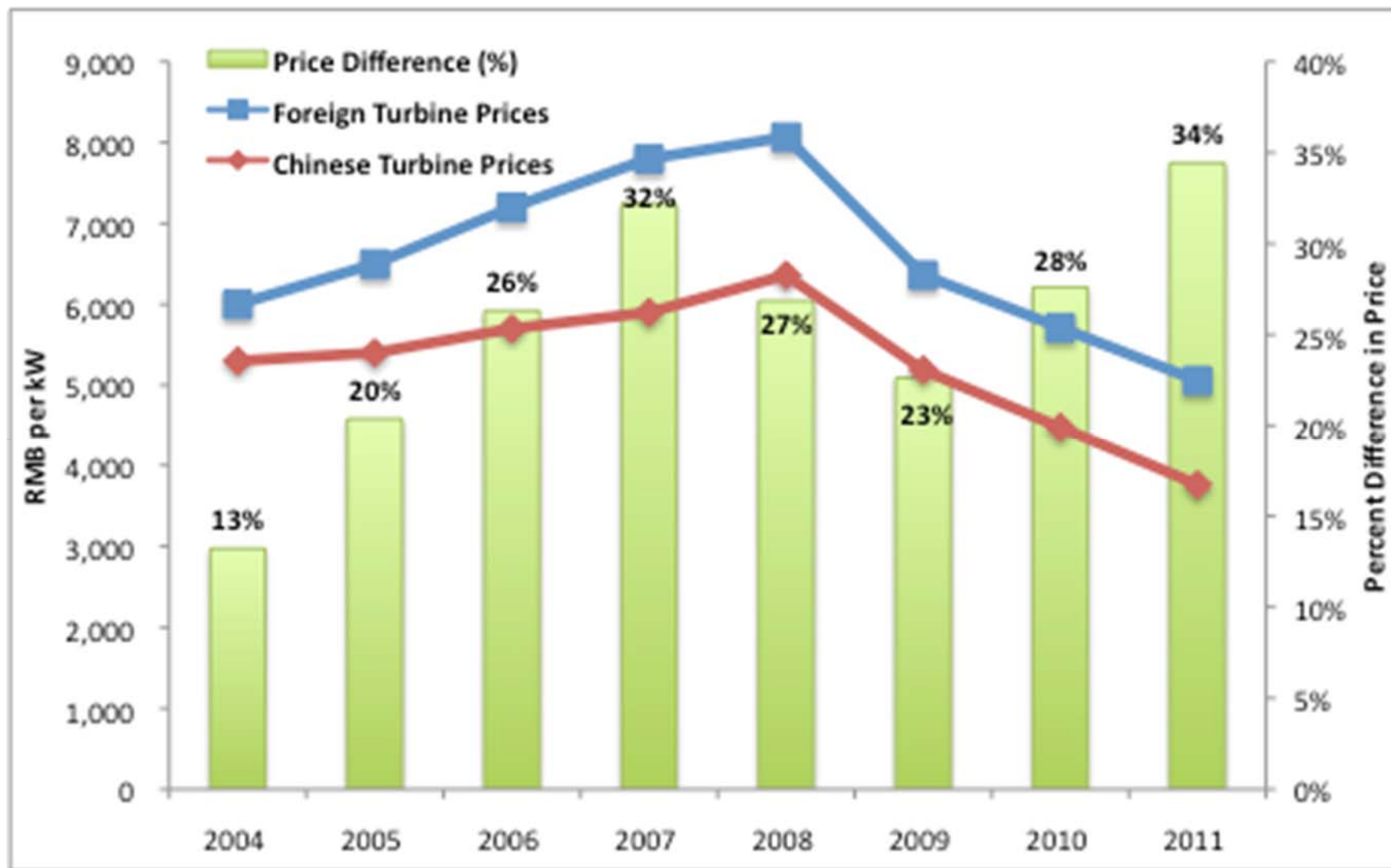


Wind Technology Leaders and Followers

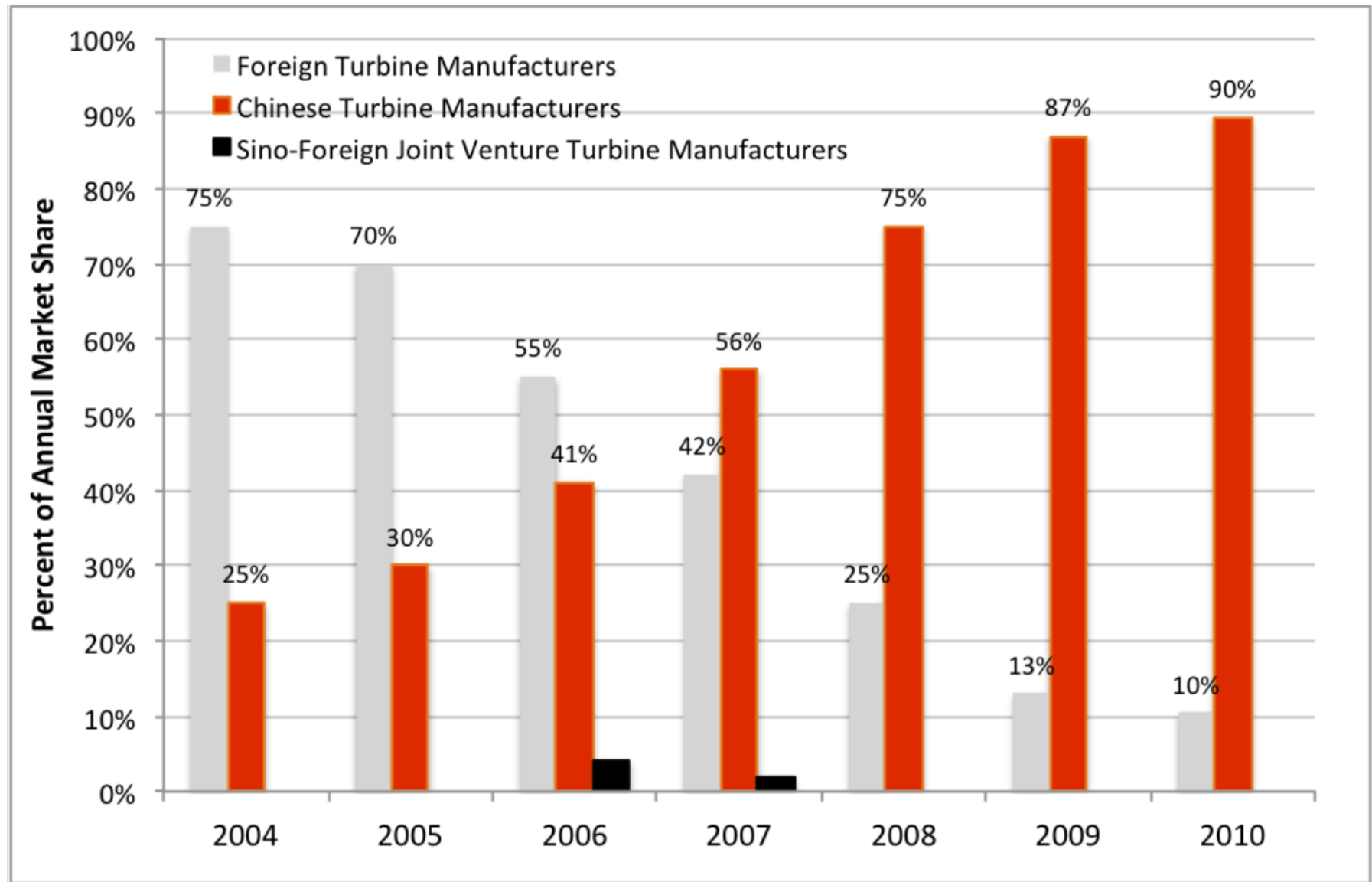
Average size wind turbine installed each year



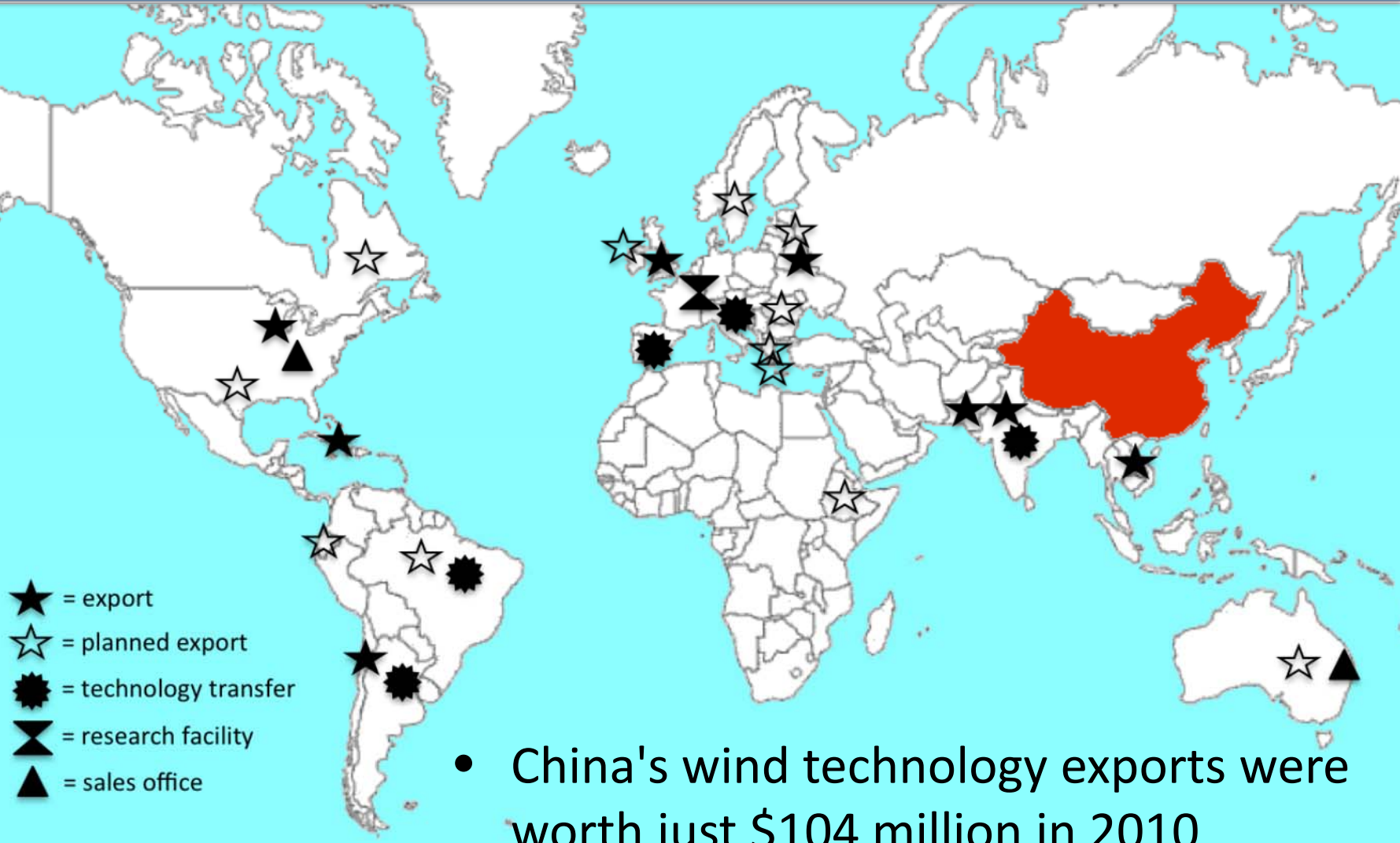
Wind turbine prices as bid in Chinese wind concession projects, 2004-2010



Chinese-Owned Turbine Manufacturers Increasingly Dominate Chinese Market



Very Few Chinese Wind Turbines Have Been Exported Outside of China... Yet



- China's wind technology exports were worth just \$104 million in 2010

Policy Timeline for Wind Development

1994: Provisions for On-Grid Wind Farm Mgt

1996: RE Fund, start of local content requirements

1997: Ride the Wind Program, Double-Increase Program

1999: Low interest loan program for wind farm development

2001: 863 High Tech Program for Wind Energy R&D

2002: VAT reductions on wind electricity

2003: Wind Concession Program begins

2006: National Renewable Energy Law; R&D support for 2-3 MW turbines

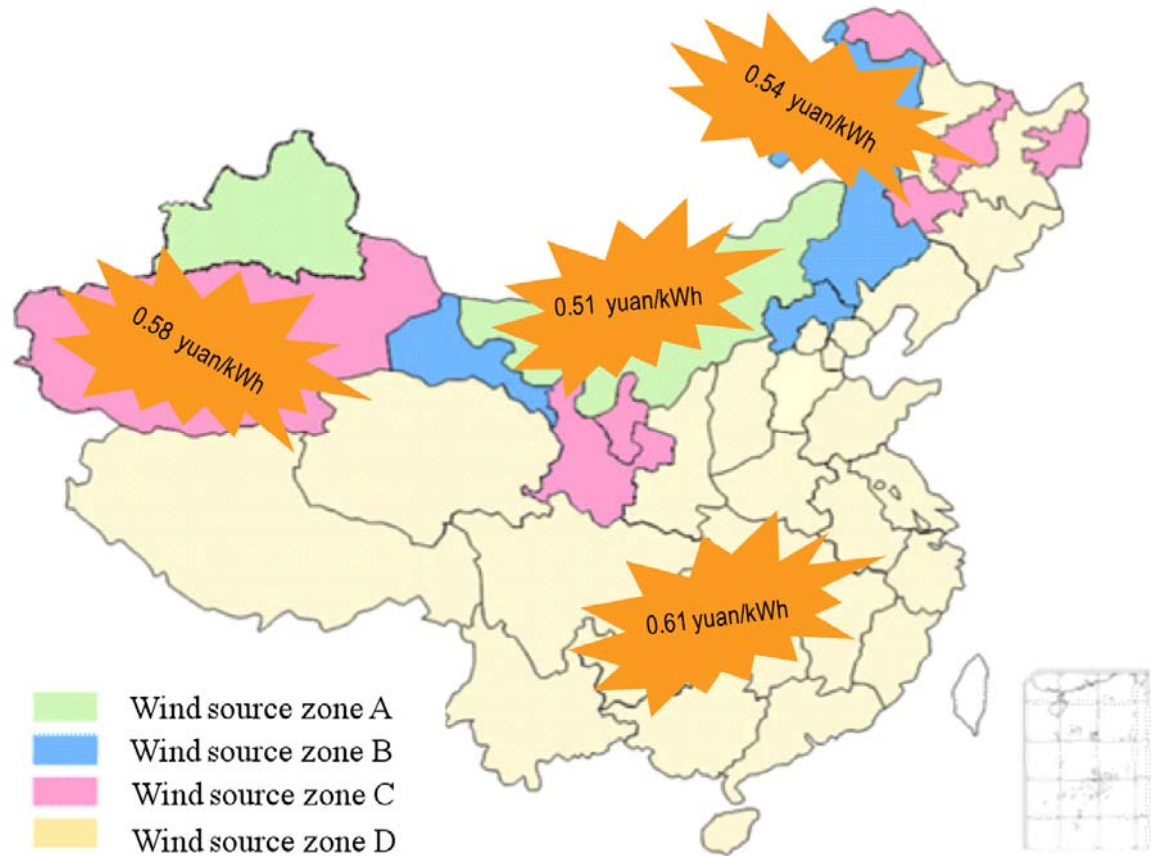
2007: Mid and Long Term RE Implementation Plan

2008: MOF subsidy to turbine manufacturers for demonstrations

2009: Feed-in tariffs for wind established; six 10 GW+ wind bases announced

Feed-in Tariffs for Wind Power

- FITs for onshore wind are differentiated into four regional feed in tariffs, which are set as a function of the level of the wind resources in the regions



New Grid Codes for Wind Turbines

- In May 2012 the State Electricity Regulatory Commission released a circular stating that all wind turbines should be bale to to maintain continuous operation during and after precipitous voltage dips (LVRT)
- This requirement was released in response to several high profile wind failure events this past spring

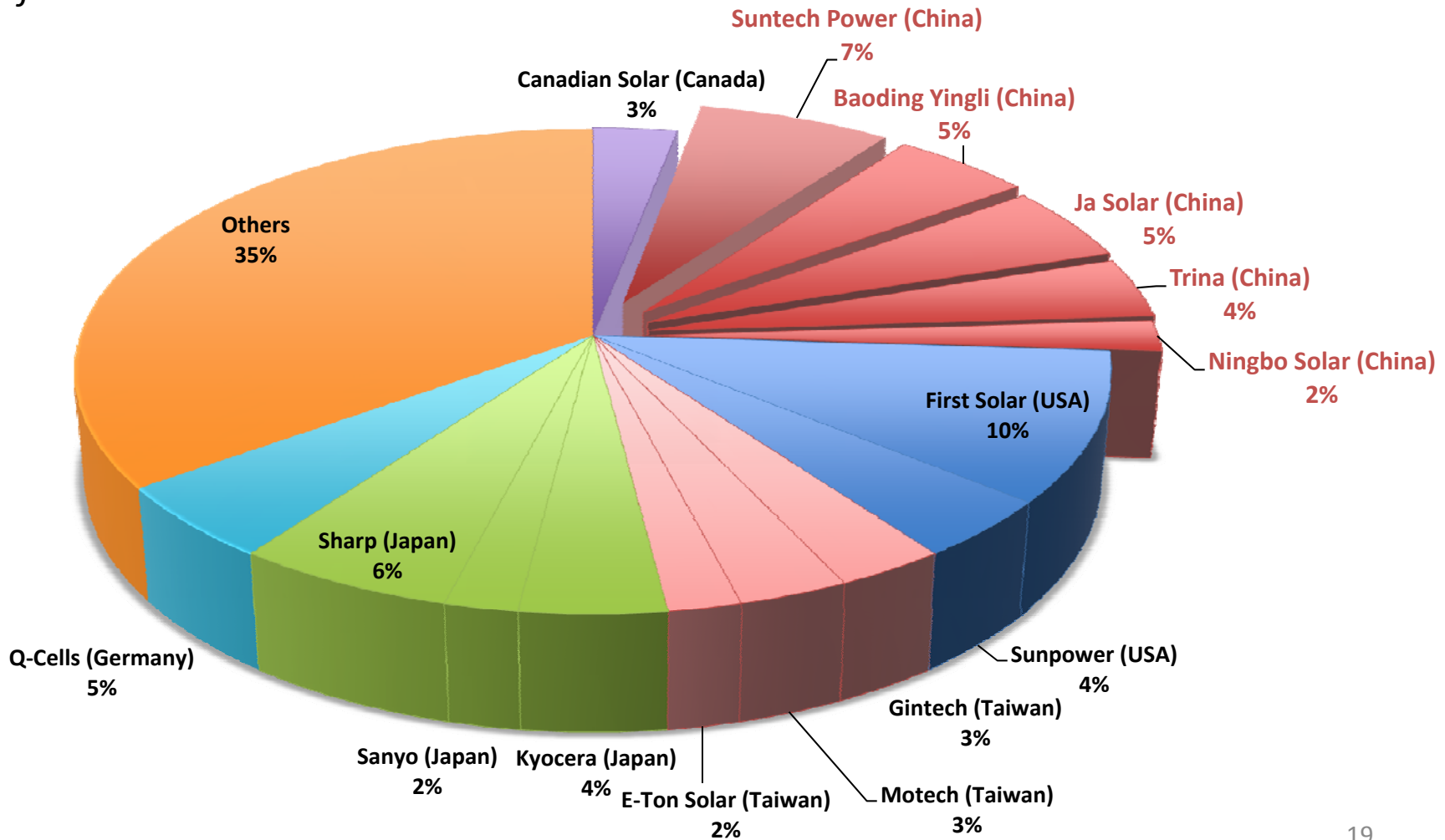


A woman wearing a blue short-sleeved shirt and white gloves is working on a large array of solar panels. She is focused on her task, with her hands positioned over the panels. The panels are arranged in a grid pattern on a workbench. In the background, another person in a light-colored shirt is partially visible, and an orange container is on the right side of the frame. The overall scene is a factory or manufacturing environment.

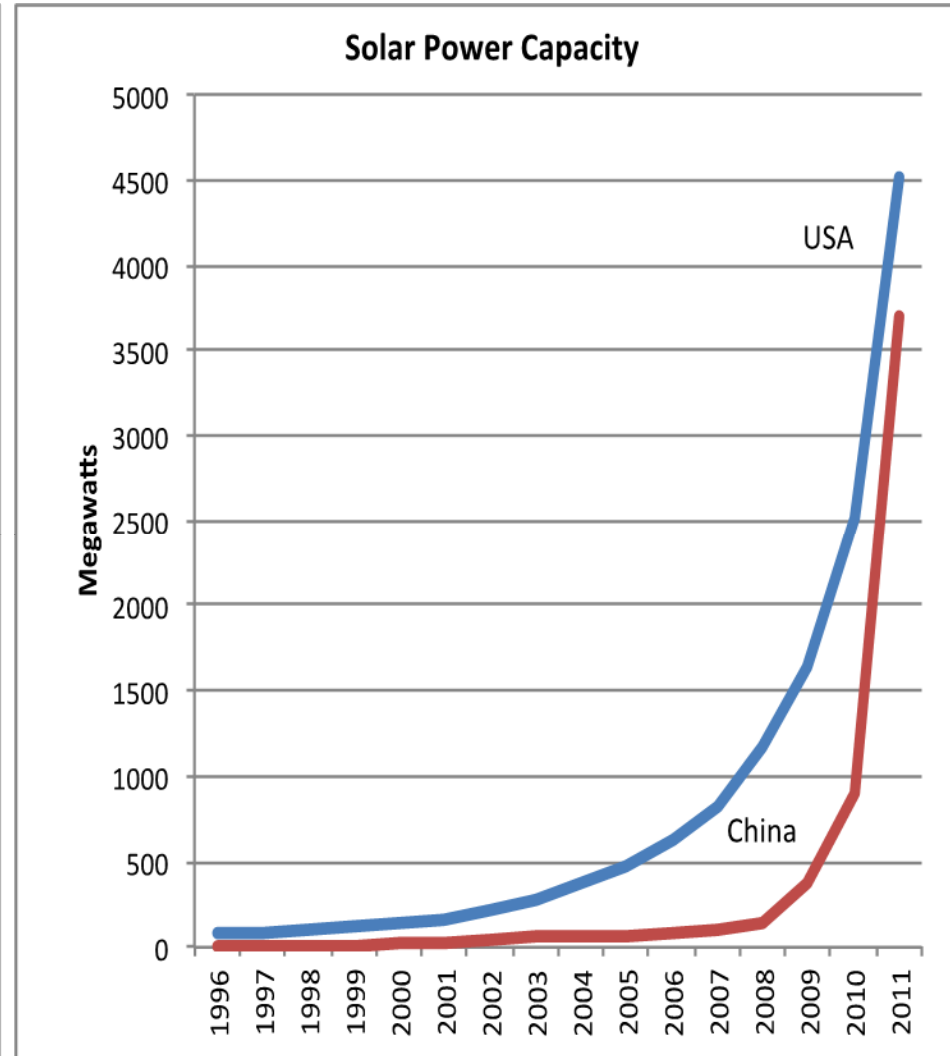
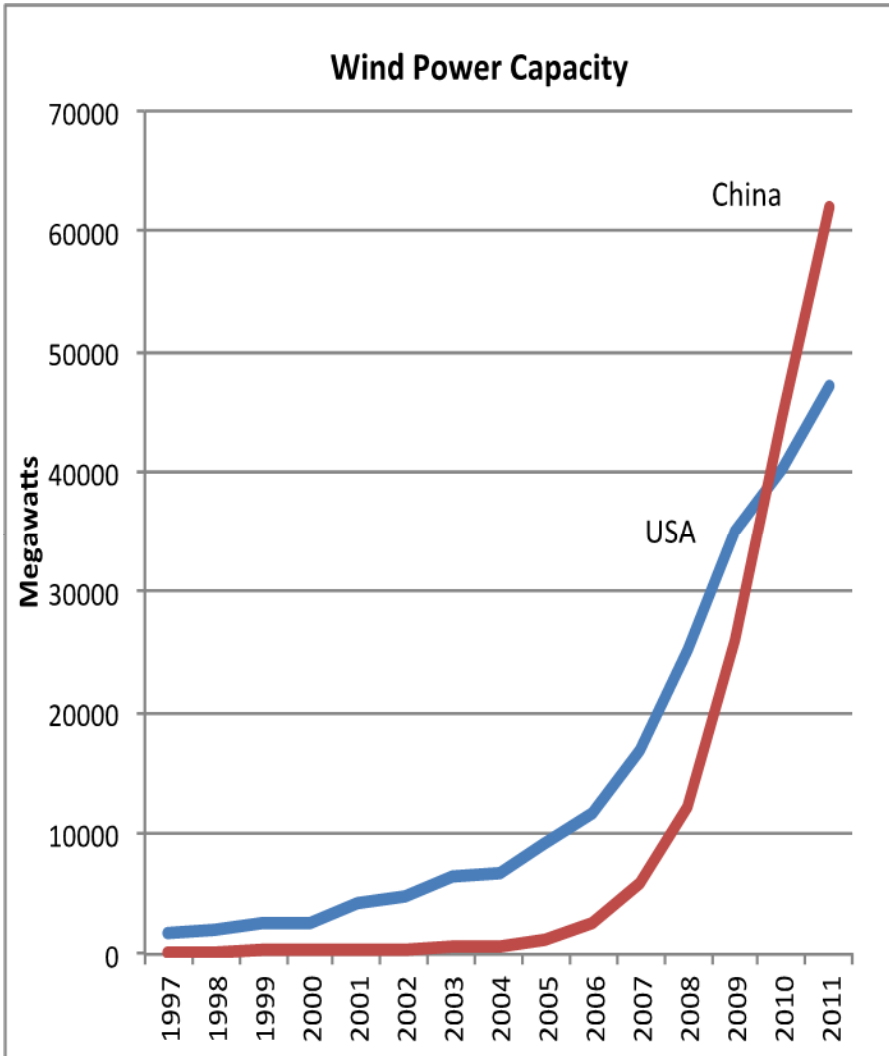
Solar Development in China

Chinese Companies in the Global PV Market

Leading module manufacturers in 2009



Wind and Solar Power Installations, USA & China



Policy Support for Solar Power

- March 2009: Solar Rooftop Program (20 RMB/kW incentives for projects >50kW)
- June 2009: Concessionary Bidding (10 MW in Dunhuang, 1.09 RMB/kWh tariff set)
- July 2009: Golden Sun Program (50–70% installation subsidy for projects >300kW, 500 MW target by 2011)
- Major provincial/city plans for solar (e.g., Jiangsu target and feed-in), particularly places home to domestic manufacturers
- Targets of 10 GW of PV by 2015, 50 GW by 2020—**much** larger than current deployment levels
- New feed-in tariff in western China announced in July 2011

Solar Feed-in Tariff

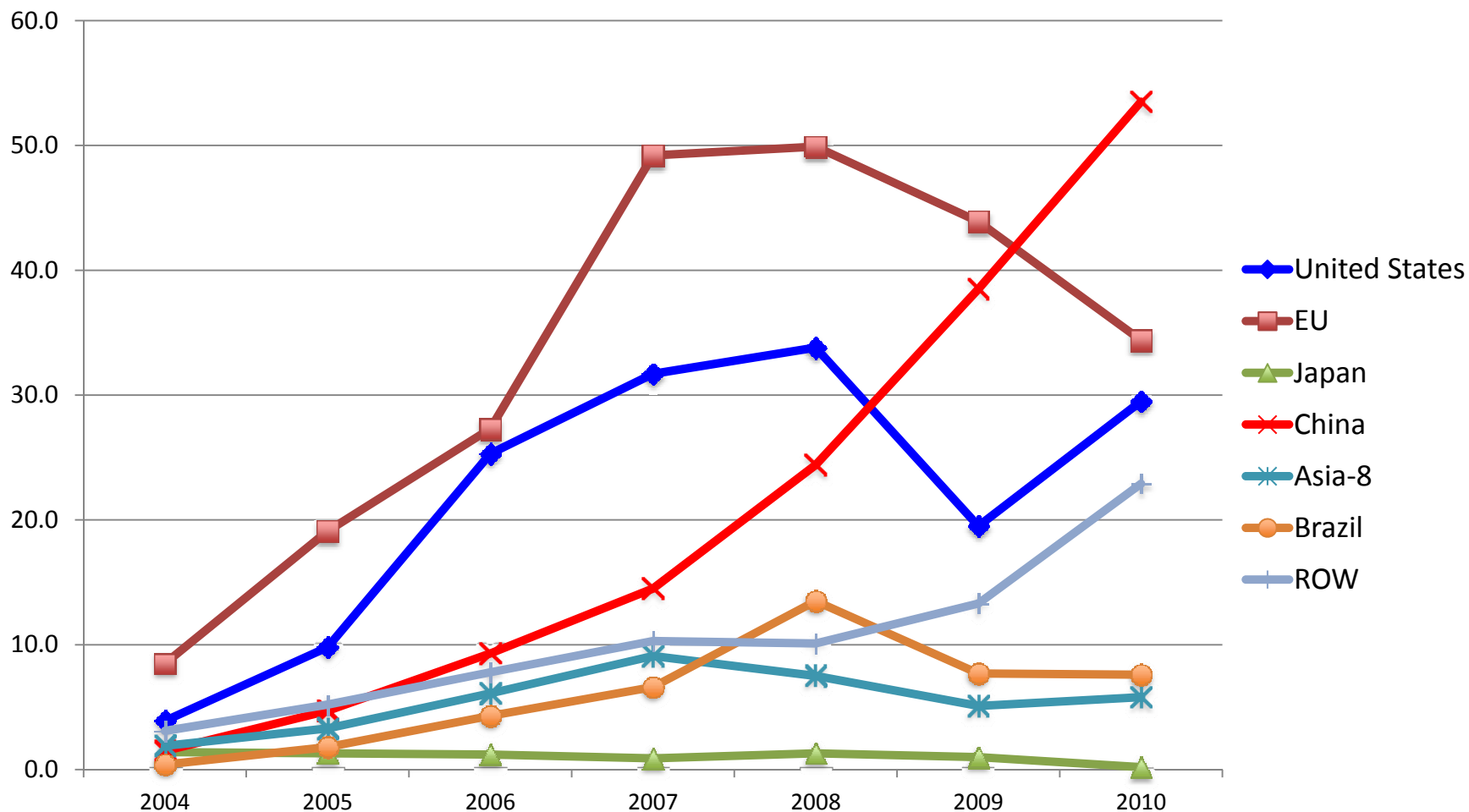
- FIT levels:
 - Solar projects approved before July 1, 2011 and completed by December 31, 2011 – received RMB 1.15 (US 17.9 cents) per kilowatt-hour (kWh), excluding solar thermal projects.
 - Solar projects approved after July 1, but not completed by December 31, 2011 – receive RMB 1.00 /kWh (US 15.5 cents).
 - Tibet keeps its preferential FIT of RMB 1.15/kWh (US 17.9 cents).
- NDRC will periodically adjust tariff rates depending on the availability of investment capital and technological advances.
- After the FIT was introduced, a rush to develop and install solar PV projects occurred in 2011 in order to capture the higher tariff before reduction in 2012
 - The province benefitting the most from this construction boom was Qinghai in western China, which installed more than 850 MW of PV by the end of 2011

Investment and Innovation



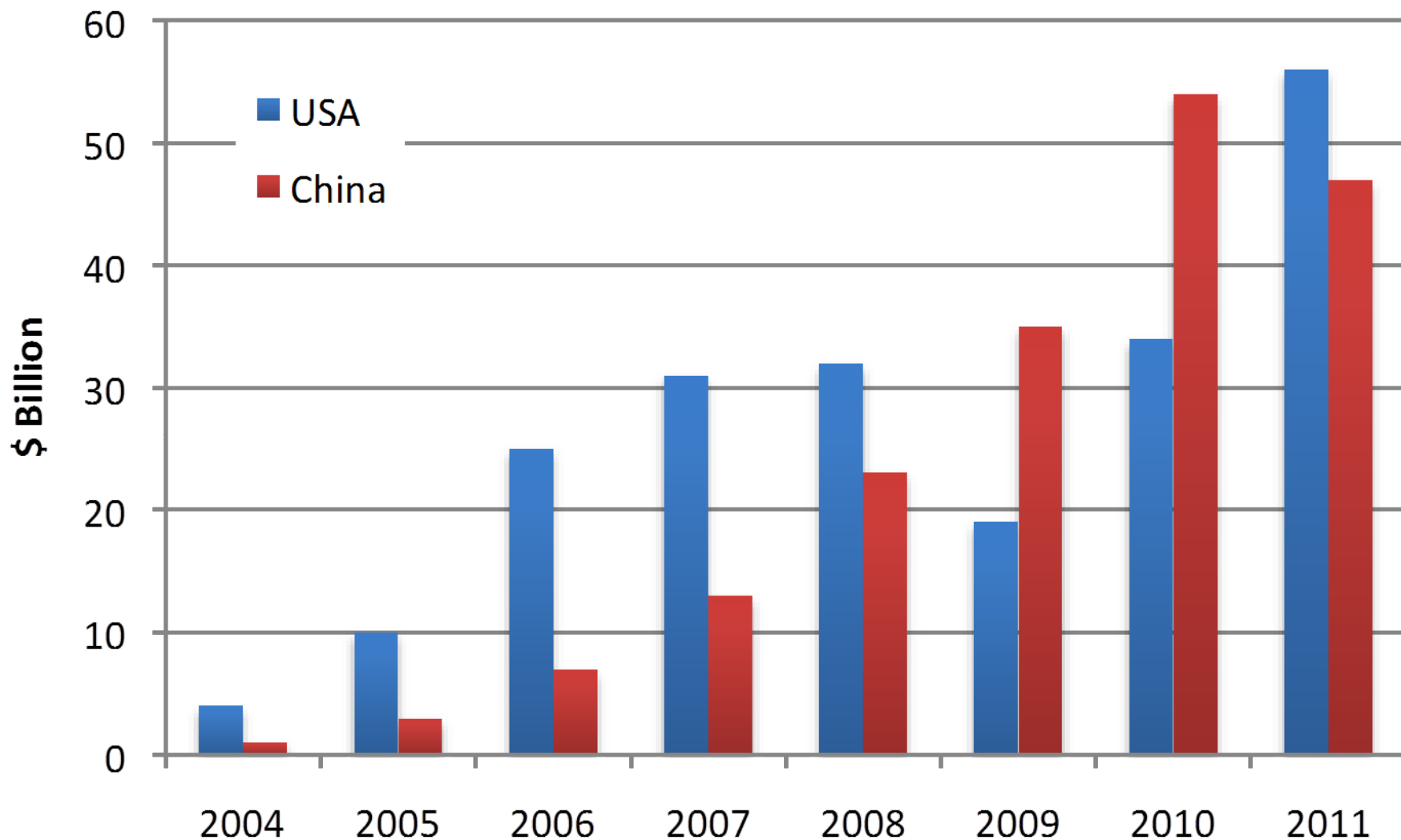
New Clean Energy Investments

Total (billion \$)

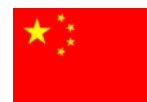


NOTES: Clean energy and technologies include biomass, geothermal, wind, solar, biofuels, and energy smart and efficiency. Financial new investment includes private and public R&D, venture capital, private equity, and public markets. Mergers and acquisitions are excluded. Asia-8 includes India, Indonesia, Malaysia, Philippines, Singapore, South Korea, Taiwan, and Thailand. Source: NSF Science and Engineering Indicators 2012

Clean Energy Investment: US & China

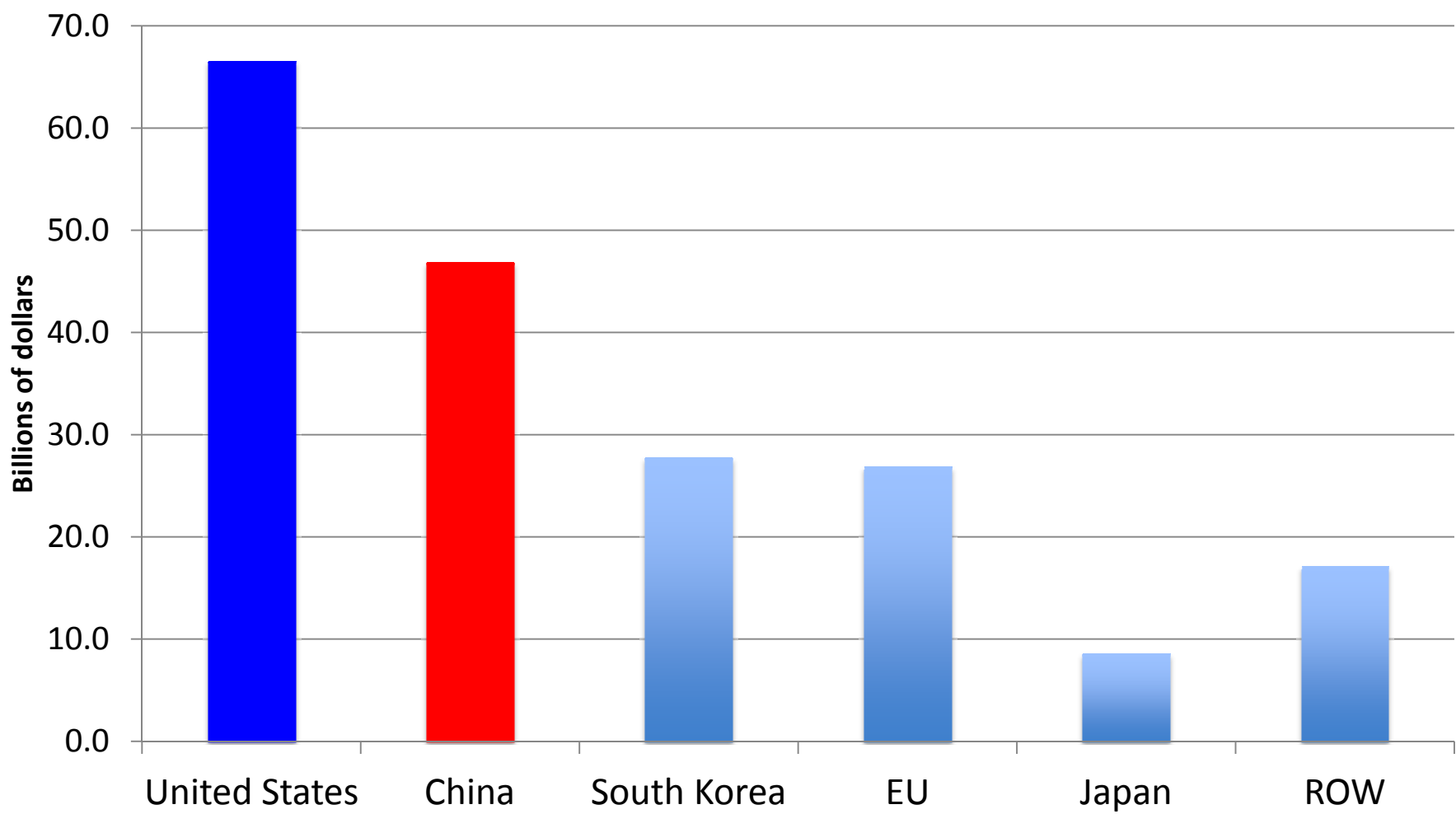


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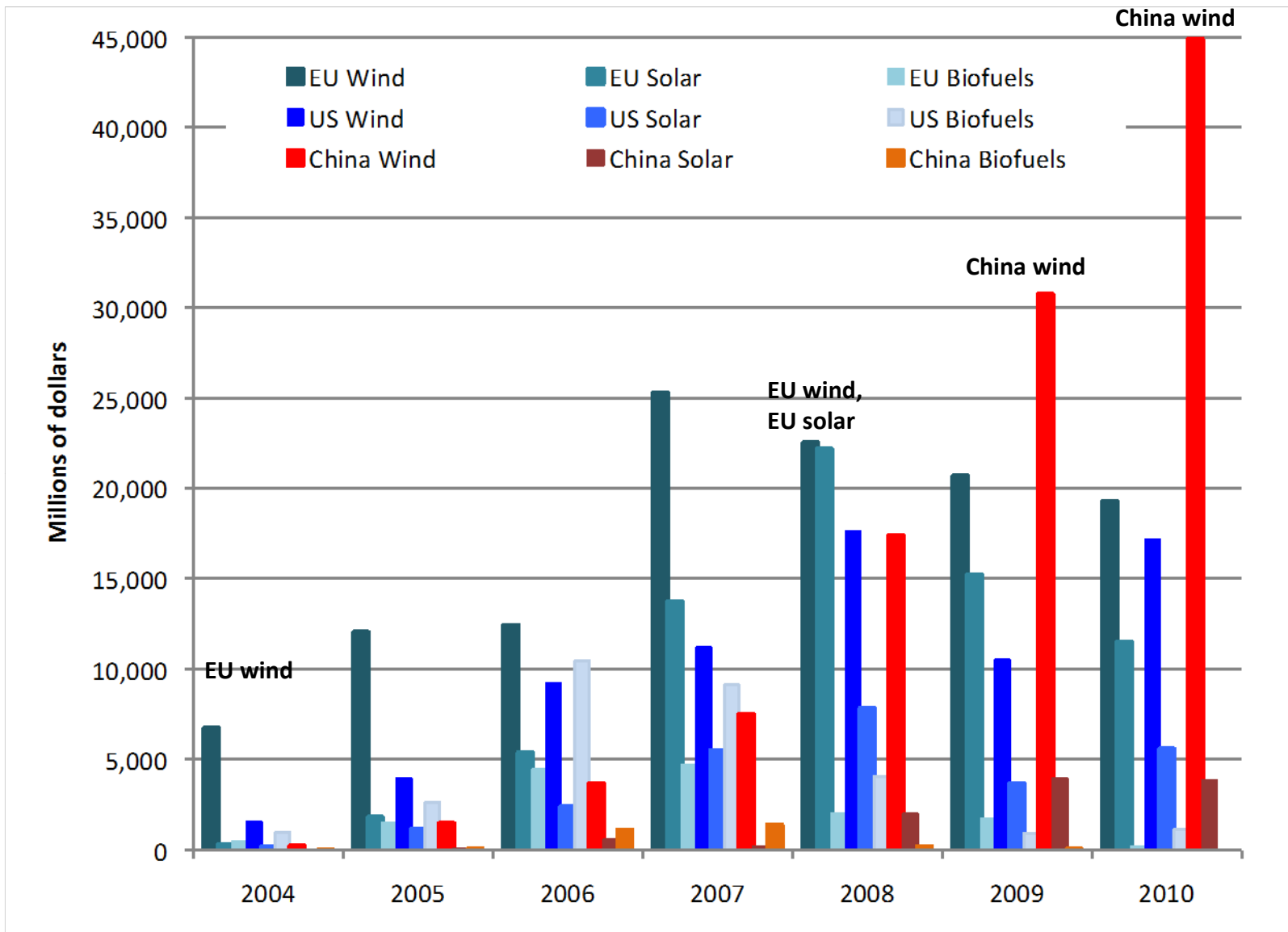


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Public Stimulus Funding for Clean Energy (2008-2009)

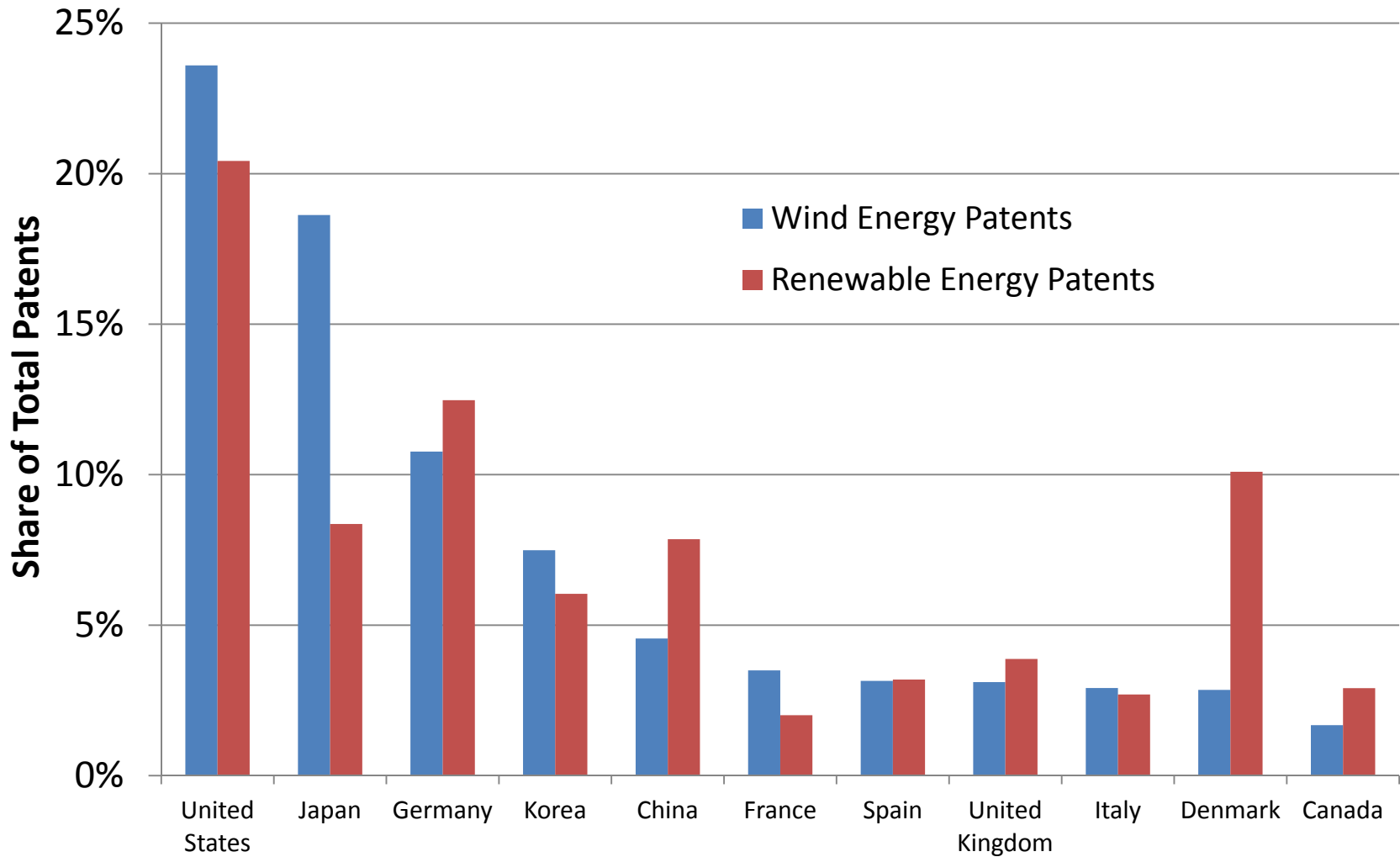


Total New Investment by Region and Technology



Source: NSF Science and Engineering Indicators 2012

Patents Filed Under the PCT



PCT=Patent Cooperation Treaty (provides a streamlined approach for applying for a patent in multiple countries).

OECD Patent Database 2011



Policy Outlook

Policy Outlook

1. 12th Five-Year Plan targets for renewable energy and carbon
 - Non-fossil energy target: 11.4% of total energy use by 2015 (15% by 2020 including nuclear)
 - Energy intensity target: 16% reduction 2011-2015
 - Carbon intensity target: 17% reduction 2011-2015
2. New renewable energy quota system
 - Aims to help overcome current obstacles in deploying RE, particularly related to grid connection and curtailment
3. Reopened discussion of electricity market reform
4. Trade disputes

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