

Factors affecting innovation in the wind and solar industries in China

Xudong Gao
Yunhuan Tong, Jianghua Zhou, Liping Zhang

Tsinghua University

Yangao Xiao
University of Electronic Science and Technology of China

Agenda

- Phenomenon and research question
- Research methodology
- Literature
- Key findings
- Discussion and conclusion
- Future research

The phenomenon

- Chinese firms making rapid progress in wind and solar
 - 2009: production capacities for silicon, wafer, solar cell, and PV module account for 25%, 65%, 50%, and 60% of world production capacities
 - Installed capacity of wind reached 25.85GW in 2009/China: 3rd largest; 2010: 44.73GW.
- Similarities but also differences

Similarities

- Rapid growth
 - Installed capacity for wind increased from 571MW in 2003 to 25850MW in 2009.
 - Production of solar PV cells increased from 50MW in 2004 to 4011MW in 2009.
- Government policy crucial
 - Without government support the cost for both wind and solar is too high to be commercially successful.
 - Government support created the two industries.

Similarities

- Many opportunities for entrepreneurship
 - Leading firms in the world emerged in both wind and solar.
 - Big value chain, including many components makers.
 - 2009: 52 blade makers, 10 gear box makers, 16 bearing makers, and 12 convertor maker
 - 2005 ~ 2007: 10 companies got listed in overseas stock market
- International technology transfer important
 - Started mainly from technology transfer (buying products, licensing, and co-design) in wind. Have made significant progress in localization.
 - Started mainly from technology transfer (buying raw materials, equipment and key processes) in solar. Have made progress in localization.

Differences

- Scale
 - Wind is much bigger. In 2009 installation capacity of wind reached 25850MW; solar 300MW (solar PV cell production was 4011MW, but more than 90% was exported)
- Market orientation
 - Domestic vs. international
- Ownership
 - State owned enterprises very important in the wind industry, private firms dominate the solar industry.
- *Wind grow much faster and* Effective national innovation system and industry diamond basically formed (*Porter, 1990*)

Research question

- Key factors leading to the different patterns of evolution of the two industries

Research methodology

- Case study method (Eisenhardt 1989; Glaser and Strauss, 1967; Yin 1989), with a historical perspective in mind (Kieser, 1994).
- Data collection: mainly interview
 - Goldwind, Dongfang, and Guodian United
 - Suntech, Baoding Yingli, CEEG
 - Power companies

Literature

- National innovation systems (Freeman, 1988; Lundvall, 1992; Nelson, 1993; Pavitt, 1985) and local “diamond” (Porter, 1990).
- Factors affecting the emerging of new technologies, new products, and new industries (Christensen, 2000; Christensen and Rosenbloom, 1995; Hargadon and Douglas, 2001; Tushman and Rosenkopf, 1992; Utterback, 1994).
- Technological capability development in developing country firms through technology transfer (Amsden, 2001; Kim, 1997; Lall, 1982; Lee and Lim, 2001; Westphal, Kim, and Dahlman, 1985) or internal technology development (Foster, 1986; Hobday, 1987, 1990; Perez and Soete, 1988; Utterback, 1994).

Key findings

- Four factors affecting the different patterns of evolution
 - Cost effectiveness of the technology
 - Government support
 - Value chain capability to support the industry
 - Leading firms’ strategies

Cost effectiveness		
	Wind	Solar
Power companies' purchasing price	<p>1.Lowest purchasing price determined through competitive bidding in the first Wind Concession Project in 2003: 0.4365 Yuan RMB /kWh.</p> <p>2.Purchasing price determined by government regulation:: 0.5~0.61Ruan RMB /kwh (from 1 August, 2009)</p>	<p>1.Lowest purchasing price determined through competitive bidding in 2009 : 1.09 Yuan RMB/kwh.</p> <p>2.Lowest purchasing price determined through competitive bidding in 2010 : 0.7288 Yuan RMB/kwh.</p>
Profitability	Power firms profitable	Power firms not yet profitable

Government support		
	Wind	Solar
Renewable Energy Law	Wind was given higher priority for development than solar because of lower cost	Solar was given lower priority for development than wind because of higher cost
Planned installation capacity	Big: 2005/760MW; 2010/5GW; 2020/30GW	Small: 2005/65MW; 2010/300MW; 2020/1.8GW
Timing of Concession Program	First came in 2003	First came in 2009
Special Fund support	600 Yuan RMB/KW for the first 50 Units of turbines (2008)	50% or more of investment could come from government subsidy (2009)
Localization rate requirement	First 50%, than 70%.	No requirement.

Value chain capability

	Wind	Solar
Cost of products	Market price for wind turbines dropped from 6200 Yuan RMB /kw in 2008 to less than 4000 in 2010	Market price dropped but still much higher than wind
Quality of products	Leading local firms are exploring leading technologies and products	High quality products
Support of expansion	Could support fast and large scale domestic expansion	Constrained by import of expensive raw materials and technology transfer
Local industry system	Effective national innovation system and industry diamond basically formed	Effective national innovation system and industry diamond not yet formed

Leading firms' strategies

	Wind	Solar
Nature of leading firms	(Integrated) users (power firms) such as Guodian	Makers (solar PV cell firms) such as Baoding Yingli and Suntech
Capability development	Balance capturing market share and development of strong internal capabilities, including technology capabilities	Emphasize technology transfer and capturing market share
Value chain coordination	Active coordination by users	Limited coordination

Discussion and conclusion

- A model?
 - Exploratory study
- Lower cost of the wind industry made it much easier for it to be accepted and promoted than the solar industry
 - A highly dynamic system could be developed if government support, value chain capability and firm strategy are supportive.
 - In the wind industry, these three factors have contributed to the continuous reduction of cost, and effectively facilitated the rapid development of the industry.

Discussion and conclusion: Theoretical and practical implications

- Development of effective national innovation systems
 - Many technical, social, political and cultural factors are at work (Freeman, 1988; Lundvall, 1992; Nelson, 1992; Pavit, 1985; Tushman and Rosenkopf, 1992;)
 - *Some factor or factors such as cost effectiveness are more important*
 - Other factors affect the building up of effective national innovation systems or local “diamond” mainly through their influence on this dominant factor.
- Technology transfer and internal development
 - If the transferred technologies are not effectively localized, they could still help with export to developed countries but their contribution to the development of local industry, or more accurately, national innovation systems or local “diamond” would be limited.

Future research

- How could firms develop and implement effective strategies in a rapidly developing environment?
 - Hard to make a balance between developing capabilities and capturing market share.
- The nature of capability development
 - The experience of an engineering company
- Impact of globalization
 - What are the benefits and costs of participating global value chains?
 - How could a firm or country effectively utilize global science, technology and market resources to develop new capabilities, new businesses and new industry?

Thank you!

Q&A