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Prospects for global market expansion of China's wind turbine manufacturing industry

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HIGHLIGHTS

- We assess the pressure to innovate in the Chinese wind turbine market.
- Customer demand is focused more strongly on turbine cost than quality.
- Formalizing connections between users and suppliers reduce pressure to innovate.
- Chinese manufacturers cannot yet compete globally in technological quality.
- Preferential supplies of project finance may provide a vehicle for exports.

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ABSTRACT

Emerging economies are increasingly contributing to global innovation, including clean-tech innovation. The development of China's wind power sector has often been used to illustrate this point. China's domestic wind power market is the largest in the world and is largely supplied by domestic manufacturers. Competition for market share in the domestic market may pressure firms to innovate, which consecutively improves prospects for global expansion. This paper reviews developments in China's domestic wind turbine market using the Technological Innovation System framework. We analyze the pressure to innovate arising from market competition and assess the prospects for global expansion of Chinese wind turbine manufacturers. We conclude that domestic customers are not pressured or incentivized to perform with respect to power output, such that turbine manufacturers are not pressured to perform with respect to turbine efficiency or maintenance needs. Pressure to innovate is further reduced by formalizing connections between wind farm developers and turbine manufacturers. Chinese turbine manufacturers cannot yet compete with leading global brands in technological leadership. The prospects for exports are improved, however, by the preferential supply of project financing from institutional investors, such as the China Development Bank, from Chinese utilities that seek global expansion and from the manufacturers themselves.

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1. Introduction

Patterns of global economic development are undergoing change. By 2025, six major emerging economies (Brazil, China, India, Indonesia, the Republic of Korea, and the Russian Federation) will collectively account for more than half of all global growth (World Bank, 2011). Economic growth and technological prowess are known to be strongly interrelated (Abramovitz, 1986; Freeman and Soete, 1997; Kim, 1997; Nelson and Rosenberg, 1993). The changing role of emerging economies in global innovative activity is attracting

increasing academic attention (De Fuentes and Chaminade, 2012; Fu et al., 2011; Lundvall et al., 2009). A number of analysts have focused on the increasing involvement of emerging economies in global clean-tech innovation, including renewable energy technologies (Bayer et al., 2013; e.g., Berkhout et al., 2010; Binz et al., 2012; Levi et al., 2010; Pew Environment Group, 2012; Truffer, 2012).

An example of this trend is the remarkable development of China's wind power sector. In 2000, new Chinese wind power installations totaled 77.3 MW, or 2.06% of global installations (Chinese Wind Energy Association (CWEA), 2012a; Global Wind Energy Council (GWEC), 2012c). In recent years, China's new and cumulative installations of wind power have ranked first globally (Fig. 1). New installations in 2011 stood at 17.6 GW, or 43.5% of the global total (Global Wind Energy Council (GWEC), 2012c).

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China's wind turbine manufacturing has experienced similarly rapid growth. In 2000, only 2.5 MW, or 0.07% of global installations, was from any of four Chinese manufacturers (Chinese Wind Energy Association (CWEA), 2012a). By 2011, China was home to approximately 80 wind turbine manufacturers, 8 of which were among the global top 15 (Fig. 2). Compared with their foreign counterparts, however, Chinese manufacturers rely on the domestic market to a far larger extent, with very limited exports (Fig. 2).

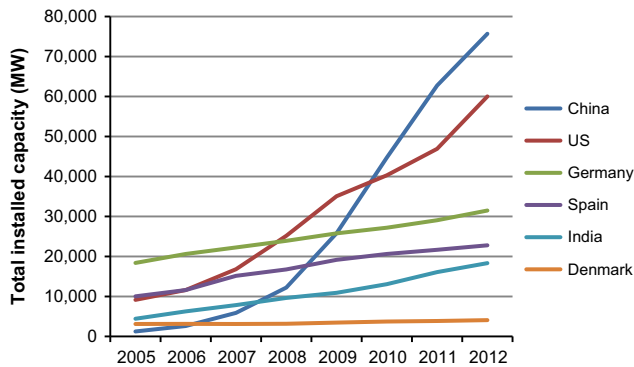


Fig. 1. Global wind power markets.

Notes: includes the top 6 countries by cumulative installments in 2005. Sources: Chinese Wind Energy Association (CWEA) (2013), European Wind Energy Association (EWEA) (2013), Global Wind Energy Council (GWEC) (2012c), Windpower Monthly (2013b).

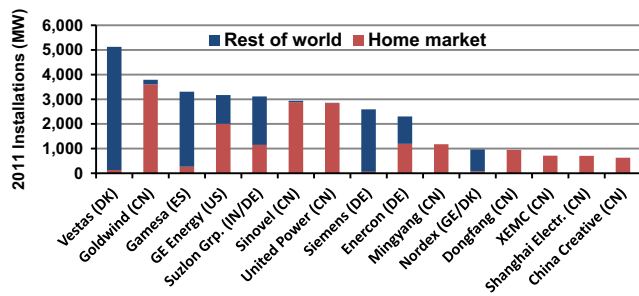


Fig. 2. Global wind turbine manufacturers.

Note: includes the top 15 manufacturers by 2011 market share. Collectively, these accounted for 84.5% of the 2011 global market. Sources: Chinese Wind Energy Association (CWEA) (2012c), IHS Emerging Energy Research (IHS-EER) (2012).

Table 1
12th Five-Year Plan policies and objectives for China's wind power sector.

- 12th Five-Year Plan for renewable energy' (National Energy Administration (NEA), 2012)
- By 2015: 100 GW of wind power, 5 GW of which offshore, and 190 TW h production
 - By 2020: 200 GW, 30 GW of which offshore and 390 TW h production
 - Focus on wind power bases, seven parks with 10 GW+ capacity and offshore parks
 - Improve innovative strength and international competition of the domestic industry
 - Improve the servicing industry, wind power standards and wind power use efficiency
 - Encourage more distributed wind power utilization to relieve grid stress

'Opinions on deepening technological system reform and accelerating the construction of a national innovation system' (2012–2020) (State Council of P.R. China, 2012)

- Focus on seven 'strategic emerging industries,' including wind power
- Improve 'indigenous' and independent innovative capacity; master key technologies with control over key IPR
- Formation of a number of industry giants with international influence and a batch of creative SMEs
- Integration of domestic education and science complex with the industrial chain
- Expansion of domestic and foreign markets

'12th Five-Year Plan: special plan for the development of wind power science and technology' (2012–2015) (MOST, 2012a)

- Shift from quantity to quality; reach international levels in turbine performance and reliability
- Master the design, production, and operation of 3- to 5-MW direct-drive turbines and 7-MW turbines and components
- Master the development, design and batch production of very large (10 MW+) offshore turbines

Further details concerning Chinese and leading global turbine manufacturers are provided in Appendix A.

China's achievements in wind power have been addressed in many earlier publications (e.g., Gosens and Lu, 2013; Han et al., 2009; Kang et al., 2012; Lema and Ruby, 2007; Lema and Lema, 2012; Lewis, 2007; Lewis and Wiser, 2007; Liu and Kokko, 2010; Ru et al., 2012; Wang et al., 2012; Zhang et al., 2013; Zhang and Li, 2012). Largely consistent with China's wind power policies, these papers have recognized China's late-comer status and have focused on processes of technology transfer, learning and capacity building. Policy plans for China's 12th Five-Year Plan period (2011–2015) appear to seek to end the Chinese wind power sector's dependency on foreign technology and to make China a competitor in global markets. Policy targets include more 'indigenous' innovation, turbine quality levels comparable with the global forefront, and global market expansion (see Table 1).

This paper seeks to contribute to the literature on China's wind power sector by assessing the prospects for global market expansion of China's wind turbine manufacturing. We build on the notion that the nature of competition in the domestic market is a key determinant of innovation and, by extension, prospects for global market expansion (elaborated in Section 2, theory and method). While most of the current literature on wind power in China has adopted a national scope of analysis, we focus on individual manufacturers. We assess their current innovative strength vis-à-vis global leaders, and analyze how current domestic market conditions spur further progress in innovation and prospects for competition in global markets (Section 3). We provide policy recommendations to improve these prospects in Section 4 and concluding remarks in Section 5.

2. Theory and method

The domestic market can be instrumental in developing technological leadership and can be a springboard to global markets. Empirically, the global success of wind turbine manufacturers has been found to be correlated to the size of the domestic market (Beise and Rennings, 2005; Lewis and Wiser, 2007). The top 15 manufacturers globally in 2011 (Fig. 2) were from the top 5 countries with the biggest markets and from Denmark (Fig. 1), which has historically been a lead market (Lewis and Wiser, 2007).

The home market can provide a requisite breeding ground for infant industries and can serve as an environment to test and

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