Localisation Strategies of Firms in Wind Energy Technology Development

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Abstract The paper looks at the localization strategies of multinational wind in emerging countries of China and India. It explains why these firms are localising new manufacturing and R&D facilities in countries like China and India, and how local knowledge and capabilities are being increasingly integrated into global technology and manufacturing networks of multinationals. It explores the reasons behind the localization of MNC that helps them gain strategic access to wind technological capabilities in emerging economies. It looks closely at the case of Vestas in the expanding wind energy cluster of Tianjin in China and Chennai in India. At the strategic level, it explains the importance of the role of local capabilities and skills in the global production networks of multinationals. At the policy level, the discussions leading from the case focuses on the concrete steps necessary to integrate technology and innovation more closely into development of sustainable energy markets in developing countries.
Key words Renewable; Multinational companies; Emerging economies

1 Introduction

Renewable energy has emerged as one of the key societal and economic topics recently. Globally, investment in renewable energy and energy efficiency has been rapidly increasing. It has grown from $33.4 billion in 2004 to $148.4 billion in 2007, nearly quintupling over this period and increasing by 60 percent in 2006. Strong growth in 2007 was driven mainly by government policies to promote renewable energy and cleaner fuels, the $100 per barrel price of oil, and rising firm and investor awareness of the opportunities in clean energy (New Energy Finance, 2009).

Clean energy has received a central role in policies of advanced economies. Emerging economies like India and China have shown remarkable progress in the development of wind and solar energy technologies too. In 2008, the global new wind energy capacity stood at 27GW, and of which India contributed 6.7% while China contributed 23.3% (GWEC, 2008). In terms of installed capacity, China doubled its capacity over 2007 by adding about 6.3 GW to reach a new total of 12.2 GW in 2008. Researchers with the Pew Charitable Trusts calculate that China invested $34.6bn in clean energy over the year 2009, almost double the US figure (Black, 2010).

China's government has taken a strategic decision to diversify its energy supply and set a target of having 30GW of installed renewable capacity in place by 2020. This target will soon be exceeded through wind energy alone (Black, 2010). The World Bank is also active in the Chinese market, working together with the Chinese government on a Wind Turbine Technology Transfer Program.

The growing wind power market in China has also encouraged domestic production of wind turbines and components, and the Chinese manufacturing industry is becoming increasingly mature, stretching over the whole supply chain. According to the Chinese Renewable Energy Industry Association (CREIA), the supply is starting to not only satisfy domestic demand, but also meet international needs, especially for components (GWEC, 2008). By 2007, China had the largest wind turbine manufacturing industry in the world, with more than 40 wind-component manufacturers including local firms like Goldwind, Sinovel Wind, Dongfang, Windey and Sewind. China is currently home to two top-10 global manufacturers, viz., Sinovel and Goldwind. And India added 1,800 MW of wind energy capacity added in 2008, bringing the total up to 9.6 GW. India is home to Suzlon, one of the top-10 wind turbine manufacturers in the world.

Government policies to promote renewable and clean energy were partly directed by international framework conditions like the Kyoto Protocol that made it mandatory for developed countries to reduce their green house gaseous (GHG) emissions. One such mechanism is the clean development mechanism (CDM), which encourages firms in developed countries to initiate GHG reduction projects in developing countries, while allowing them to gain emission reduction credits in their home country. Such projects are supposed to transfer low carbon and emission reduction technologies like wind and solar technologies to developing countries. CDM is commonly seen as a promising channel for sourcing and diffusion of modern clean technologies in developing countries and in this way putting them in a carbon friendly growth trajectory (Grubb et al., 1999; Jepma and Van der Gaast, 1999; Aslam, 2001). But CDM are mechanisms are still rift with issues such as bogus offsets, double counting and issues around what is additonality. Technology transfer and technology commercialisation aren't central to the goals of the CDM (Franklin, 2009) and which makes it sometimes doubtful as the sole source of low carbon technology transfer to developing countries.

Fortunately however, there are other forces, both market and policy, offering developing countries a unique opportunity of technological leapfrogging – where technical know-how and resources in renewable energy technologies of the developed countries are facilitating work opportunities and bridging the technical know-how gap of developing countries in low carbon technologies. More and more renewable energy firms are locating their R&D and manufacturing facilities in countries like India and China. Technology manufacturing and R&D localisation strategies of foreign firms will be an important component of any technological leapfrogging strategy to achieve lower greenhouse gas emissions in the developing world. For example, the world's largest wind turbine manufacturer of Denmark, Vestas, is setting up research and manufacturing operations in India and China. Although the products are predominantly designed for the specificities of the local market, strategically these production facilities are expected to be utilised as a global manufacturing set-up (Vestas, 2006).

In the subsequent years, we expect to see fundamental changes in the location of wind turbine and solar PV manufacturing and research and development (R&D) base away from Europe, and to countries like China and India. Of particular importance will be a massive geographic dispersion of wind and solar PV manufacturing and R&D facilities in leading Asian countries like India and China, and (silicon) solar PV manufacturing in Taiwan. For instance, Taiwan is emerging as a new primary location for the global solar PV industry, because of its existing manufacturing base in semiconductors and chip design, which is similar in requirements to solar PV modules manufacturing.

The dispersion of renewable energy technology manufacturing and R&D to Asian countries like India and China is quite different from the causes of geographical dispersion of chip manufacturing to China and Taiwan two decades ago. Other than factor price and factor endowment costs put forth by trade theorists, the real cause of the dispersion in chip manufacturing came out from being able to outsource different stages of the IC design to Asian firms, as a result of new developments in chip design (Ernst, 2004). And following the success of Taiwan in semiconductors, the country has now been playing host to solar PV manufacturing with great ease since 2000s, because of an overlap of technological capabilities in the two industries: the basic integrated chip design that uses silicon is used in solar photovoltaic development.

A corollary explaining the location of R&D and manufacturing base in developing countries is the general trend of internationalisation of corporate R&D. R&D is the least internationalisation function of multinational companies, and it has traditionally been kept in the headquarters. Modern multinationals locate their R&D subsidiaries overseas. This trend started in the Triad countries, but it is increasingly involving emerging economies. Previously considered only as locations for low-cost manufacturing, emerging economies are turning to prospective destinations for knowledge-based activities of multinational companies. More specifically, emerging economies, particularly China and India, are attracting R&D investment projects of multinational companies operating in renewable energy technology development.

This reasoning defines the objective of this paper, which is to explore the main drivers and motives of the major renewable energy multinationals to move their renewable energy technology development and manufacturing base to emerging economies. We employ a qualitative approach and present case studies of business strategies of multinational companies.

2 Literature Review

This section presents a review of literature relevant for the study of our analysis. We start with the examination of the stream of literature addressing the reasons behind corporate R&D internationalisation, which in our understanding have push and pull factors. Further, we focus on the development of renewable energy technology and the role of multinational companies therein.

2.1 R&D internationalisation and competences of multinationals

Push Factors

The academic and policy-oriented literature on multinational companies and foreign direct investment (FDI) has a long history. First publications emerged in late 1950s-1960s, following the birth and growth modern multinationals. John Dunning combined many of these contributions in his eclectic paradigm, or OLI model for analysing internationalisation patterns and the strategic behaviour of multinational companies. Dunning's (1977) eclectic paradigm became a prime framework for academic research on multinationals. According to the eclectic paradigm, a firm must possess three advantages in order to internationalise: (1) Ownership Advantage: a firm must own or control unique mobile asset it wishes to exploit, (2) Location Advantage: a firm must be cost efficient to exploit its unique asset overseas in addition or instead of its home country, (3) Internalisation Advantage: it must be in firm's interest to control the asset itself rather the contracting out the use of the asset to an independent firm.

In 1993, Dunning expanded the application of the eclectic paradigm to classify four types of FDI according to a multinational's motivations to invest abroad. They are: (1) resource-seeking (seeking natural resources); (2) market-seeking (horizontal FDI, seeking new markets); (3) efficiency-seeking (vertical FDI, seeking to restructure existing production through rationalisation and places some parts of the value chain overseas); and (4) strategic assets seeking (seeking created assets).

As traditionally understood, internationalisation implies international manufacturing of goods and internationalisation of supporting services (e.g. marketing and sales). Until recently, the technological capabilities of multinationals were far less globalised than these activities. However, the end of the 20th century witnessed increasing tempo of the internationalisation of corporate R&D. Conducting corporate R&D in foreign locations (overseas subsidiaries) relates to the strategic-asset-seeking FDI and the location advantage. A multinational company seeks to exploit its overseas location in order to enhance its competence base.

Internationalisation of R&D is not an entirely new phenomenon. Many foreign subsidiaries of multinational companies had long had R&D functions. The fundamental difference lies in the nature of R&D. Traditionally R&D in subsidiaries was aimed at adapting products and services to the needs of host countries and to local conditions close to "lead users"; i.e. R&D activities were performed to support local manufacturing overseas. Today, multinationals seek not only to exploit their knowledge and competence generated at home in foreign countries, they increasingly sources technology internationally and tap into worldwide centres of knowledge.

Intensified global competition has forced companies to innovate and develop commercially viable products and services faster. At the same time, the needed knowledge has become more multidisciplinary and more broadly located, making innovation even more expensive and riskier than ever. Hence, innovation strategies increasingly depend on global sourcing. It has become a major motive for locating R&D outside the home country.

Cantwell and Mudambi (2005) make a distinction between the competence-creating versus competence-exploiting subsidiary mandates. A competence-exploiting subsidiary is involved in adaptation of the knowledge and technology for local needs and it essentially imply a one-way technology transfer from headquarters to the subsidiary in question. A competence-creating subsidiary generates competence and expertise, tapping into a local knowledge base, and this competence is then channelled to the entire corporate network (headquarters and sister-subsidiaries). Kuemmerle (1999) expresses the same idea, but specifically arguing about R&D investments rather than competence base. The author distinguishes between home-base exploiting and home-base augmenting investments.

Echoing the idea of competence-creating subsidiaries, Birkinshaw (1998), Holm and Pedersen (2000), Frost et al (2002) and other authors introduce the idea of subsidiaries as centres of excellence, in contrast to subsidiaries inferior to others in a corporate network. Centres of excellences are responsible for complete development of certain products and services; possess superior competence and share this competence with other unites in its multinational company.

To sum up, the role of overseas subsidiaries in creation of competence and performing R&D has taken a prominent role in the international business literature.

2.2 Development of renewable energy technology in emerging economies

Pull Factors

The location of R&D and manufacturing in countries like India and China are not only based on the strategic decisions of firms to move to low-cost advantages. The location also has to do with the existing knowledge, technology and manufacturing base of the base country. High international transfers of low carbon and clean energy technologies are related to strong technology capabilities of China, while the lower rate of international transfer in the case of India is due to its own capability to diffuse domestic technologies (Dechezleprêtre *et al.*, 2008). In either case of international technology transfer, whether high or low in new and emerging energy technologies, the essence is in having an existing knowledge and manufacturing base in renewable energy technologies. It has been reiterated in OECD (2009) that technology diffusion from foreign multinational enterprises to local firms through trade or investment cannot be taken for granted. Rather, it requires absorptive capacity of local firms, and skills and mobility of local employees, in addition to openness to trade and policies to induce foreign investors to bring appropriate technology to developing countries (OECD, 2009).

There are policy advantages in India and China that have helped built their local manufacturing and knowledge and skills base. Policy measures are what governments have at their disposal to encourage localisation of manufacturing (Lewis and Wiser, 2007). China has a local content requirement that mandates a certain percentage of local content for wind turbine manufacturing in some or all projects within the country. But the success of a local content policy requires a large market size in order to lure foreign firms to undertake the significant investments required in local manufacturing (Lewis and Wiser, 2007). China has sufficient market potential to attract foreign investments particularly competence-creating multinationals. The Chinese government has begun refunding value-added tax (VAT) and import duties on core wind power turbine parts and materials in a move to promote the development of renewable energy (People's Daily, 2008)

Lewis and Wiser (2007) claim that wind turbine manufacturers usually get their head start in their home country markets, a trend that is clear in the largest markets of Denmark, Germany, US, Spain and India. Firms like Vestas (Denmark), Suzlon (India) and Enercon (Germany) that are the world's largest turbine manufacturers have had large and stable home markets. The same is true of solar PV manufacturing, where stable markets in Japan and India have led to the global success of Sharp (Japan), Konarka (Japan) and Moser Baer (India) and BP-Tata Solar (India). A stable and sizable home market can provide local manufacturers with the necessary testing ground to sort out their technology and manufacturing strategies and experiment with technology designs (Lewis and Wiser, 2007). Once equipped with years of experience and technological know-how of building wind turbines and solar photovoltaic modules in the home market, firms are moving-out their R&D and manufacturing base to developing countries like India and China.

India, on the other hand, does not have a local content requirement mandate, but has an industrial regulatory environment requiring 51 per cent , more or less, domestic equity ownership in virtually all industries[1]. This mandate is to give domestic firms access to new product and process technologies of the MNCs, and to facilitate the use of local content and skills in the development of the technology by MNCs (Feinbergy and Majumdar, 2001). By 2009, the Indian government allowed 100% FDI in the renewable energy sector and approved a generation-based incentive scheme in wind power projects for foreign investors who cannot avail benefits of accelerated depreciation available to domestic investors (Times of India, 2009). And in addition to which, India has sufficient renewable energy market potential, skills and an existing manufacturing base to attract foreign investors and undertake wind and solar energy volumes manufacturing.

3 Analytical Framework

From the discussions above, an analytical framework is constructed from the *push* and *pulls* factors that are behind the localisation strategies of firms in developing countries. The *push* factors are those of stagnating markets at home that are encouraging host-firms, with their technological capabilities and experience in the home-market, to enter new and emerging markets like India and China. One of the conditions for the host firm entry into such markets is that the emerging market must have sizable market potential (Lewis and Wiser, 2007), which acts as a *pull* factor, luring the host-firm to set-up base in the emerging market.

And in many instances, products and ideas have been designed to suit the local needs of the users of the technology or markets because they have a substantial market size. This is because user-initiated innovation is seen to be of great importance (OECD, 1999). Local users were recognized as best suited to understand the needs and possibilities of innovation (von Hippel, 1988; OECD, 1999). These products are technologically and cost-wise more suitable to the location needs than to the needs of other countries, particular the host-countries. Often in most cases, the technology and knowledge base of the multinational company is used to adapt their know-how to suit the local conditions.

The other condition alluring multinational companies to the new and emerging country is explained by the agglomeration theory of clusters. This category of agglomeration economies, which is typical for knowledge clusters, often attracts direct investments from outside (Lorenzen and Mahnke (2002).

[1] Foreign ownership of equity over and above 50% is subject to the requirement that the investors should balance all outgoings of foreign exchange on account of their operations with export earnings over a seven-year period (See Balasubramanyam and Mahambare, 2003)

Multinational companies enter particular knowledge clusters in order to benefit from the agglomeration economies that they facilitate (Porter, 1990, 1998; Saxanian, 1994; Krugman, 1991; Frost, 2001). Such knowledge clusters are often sources of skills and knowledge-bases critical to the growth of multinational companies in the regional cluster (Saxanian, 1990; 1994). Within the knowledge cluster, multinational companies often want access to a whole group of suppliers or customers, and to knowledge institutions which are not owned by any particular firm (Lorenzen and Mahnke, 2002).

Most multinational companies, like Vestas in India, have established an R&D unit that is to contribute to its global R&D network. In fact, Kuemmerle (1998; 1999) and Patel & Vega (1999) have shown that multinational companies increasingly place such small-scale R&D units in knowledge clusters to augment the multinational companies' knowledge bases through monitoring regional knowledge bases. Frost (2001) has found that such local knowledge sources are particularly important for explorative innovation. Saxenian (1990); Almeida and Kogut (1999); and Patibandla (1998) have illustrated this for high-technology industries.

The renewable energy market like wind and solar, characteristic of high cost of implementation and low performance, are dependent on policies including production incentives and local subsidies and tax benefits. The local content requirement of Chinese wind development policies (Lewis and Wiser, 2007), and the requirement of local firms in the equity partnership of foreign firms are policies that are attracting multinational companies.

4 Case Examples of Localisation Strategies

Vestas is a multinational wind turbine manufacturer headquartered in Denmark, and has been specialising in wind turbines since 1975. Today, it is the world's largest wind turbine manufacturer, having grown mostly out of its thriving home wind energy market, building a strong technology and knowledge base, and adding up more than 30 years of experience in wind turbine manufacturing. But by 2009, Denmark had sourced nearly 80% of its electricity from renewable energy, most of which came from wind power. As its home market was stagnating, Vestas laid off 1900 employees from its office in Denmark in December 2009, whereas it increased its production capacities in the growing wind energy markets of emerging economies like India and China. India and China are Vestas' two manufacturing and R&D locations outside of Europe, Singapore and the United States.

4.1 Vestas in China

Vestas was the first wind turbine company to enter the Chinese market when it installed the first turbines in Shandong and Hainan in 1986. By 2009, it had 10% of the domestic market share, and had installed wind turbines in thirteen provinces of China, making it among the biggest accumulated supplier of wind turbines in China. The company has been building a strong value chain in China sourcing components from 80-odd local suppliers. It continually improves its sourcing capabilities, with the aim of finally having a 100 per cent Chinese-made content. Although Chinese manufacturers[2] have roughly three-quarters of the domestic wind turbine market, foreign firms like Vestas are trying to break in by capitalising on better technologies such as advanced blade designs and other components.

In 2009, Vestas for the first-time customized a turbine for a single, specific and low wind resource market. It developed a new V60-850 kW wind turbine design specifically tailored for China, particularly the region of Inner Mongolia[3]. This new design has blade designs and temperature control systems that are adapted to the tough winters of Inner Mongolia. The turbine is most effective in low and medium winds, which make up 75 percent of China's unutilised onshore wind potential (Ritch, 2009). Over 90 percent of the new turbine machine's components are Chinese-made.

Previous to that, all wind turbines built in China were above 2MW of capacity. Over the years, Vestas has been building a strong manufacturing capacity in China. It built five production facilities in Tianjin and one wind turbine factory for the Chinese market in Hohhot, Mongolia. It built its first nacelle and assembly factory in Tianjin in 2007, where its main activity is to assemble nacelles and hubs for the Vestas' MW turbines, including the 2MW and 850 kW wind turbines. It also built a generator, control systems and blades production facilities in Tianjin. In 2009, the new production capabilities at the Tianjin facility included the production of control systems and machined parts, which has been added to existing generator and blades factories. This now makes the facility the most comprehensive and largest integrated wind energy complex built by Vestas, allowing the manufacture of nacelles, blades, generators, control systems and machined parts, in one centralised facility.

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[2] There are around 40 manufacturers of wind turbine components in the Chinese wind energy industry

Tianjin: The emerging wind energy industrial cluster

The above new facilities are the ‘localisation’ of production chains of Vestas in China, for both the needs of the Chinese and the global wind market. The Tianjin location has been chosen because of “its good access to port, rail and major roads in China” (Renewable Energy Today, 2006). And Tianjin is China’s growing wind energy industrial cluster, which is home to 850 wind-power manufacturers and suppliers, including domestic and international giants such as Vestas, Gamesa and Suzlon. Tianjin boasts of an annual capacity of 5,600 MW of turbines, 14,000 wind turbine blades that can equip 4,900 three-blade turbines, more than 5,400 gear boxes, 1,500 engines, 3,200 control systems, 55,000 tons of resin and other materials for blade production (Enorth, 2009).

Vestas’ localization strategy in China is creating a global wind energy production chain, in components and fully integrated production facilities, for both local and global markets.

Table 1 Vestas’ Network of Subsidiaries in China

Production Type	Location	Est. Year
Blades	Tianjin	2006
Nacelles	Tianjin	2006
Generators	Tianjin	2006
Foundry	Xuzhou	2008
Machine and Controls	Tianjin	2008
Integrated Wind Turbine Factory	Tianjin	2009
Wind turbine Factory	Hohhot Inner Mongolia	2009

Vestas is creating a production value chain partnering with 80-odd local suppliers of components for its wind turbines. The new focus of the company is Inner Mongolia where is produces the V60-850kW turbine, which is the first market-specific turbine, designed to optimise performance and production in Chinese harsh weather conditions.

Vesta’s competitor and another multinational wind turbine manufacturer, Seimens, set up a new wind turbine manufacturing facility in China in 2009, and which also marked its entry into the Chinese wind energy industry. The wind turbines manufactured are for the Chinese market, as well as for exports. Although this is interesting as a localisation strategy of multinationals, a comprehensive analysis is beyond the scope of this paper.

4.2 Vestas in India

In 1987, Dandia, the Danish financial aid agency, selected Vestas to develop six wind energy projects in India. Soon Vestas entered into a 49% equity joint venture agreement with RRB Consultants and Engineers Pvt. Ltd., to manufacture wind energy generators in India. Although the technology for wind energy generators was from Denmark, they were manufactured to suit the Indian climatic conditions. Vestas RRB had been technologically indigenising components manufacturing such as blades and control systems. As a result of its localization strategy, the company was able to achieve a 10-15 per cent cost reduction in blades manufacturing, cost-savings in terms of time and transportation, and closing the lead-time in getting the blades to the market (The Hindu, 2005).

In 2003, and back home, Vestas merged with NEG Micon, the other leading Danish wind turbine manufacturer of the time. So by 2006, Vestas strategically repositioned itself in India and divested its 49% equity stake to RRB Consultants and Engineers, on condition that RRB only manufactures wind turbines for the market below 750kW capacity, and for which, Vestas will continue to cooperate as its technology partner. It renamed its now wholly owned subsidiary, NEG Micon India to Vestas Wind Technology India Pvt. Ltd., and began concentrating on turbines of 750kW and above in capacity.

Around that time, Vestas saw a major shift in the demand for high capacity wind turbines in the Asia-Pacific region, and made its Indian facility the manufacturing and export base for wind turbines above 750 kW. It built two manufacturing setups – one in Chennai which caters to the export market for components like hubs and nacelles and the other factory in Pondicherry which caters to the domestic market.

In 2008, Vestas started a R&D technology centre in Chennai, India, which is one of its key markets. The primary objective behind the R&D initiative is to improve turbine reliability, maximise performance and lower the cost of wind energy, and which contributes to R&D in almost all core wind technology areas. In fact, the primary driver for setting up the R&D office was not only cost, although costs were lower than in Europe and Singapore, but to gain access to local skills and talents (Hindu Business Line, 2008). Chennai is the centre for reputed and high quality engineering graduates particularly from the elite Indian Institute of Technology (IIT-Chennai).

Table 2 Vestas' Network of Subsidiaries in India

Production Type	Location	Description
Hubs and Nacelles	Chennai	Assembly process consists of incoming inspection, sub-assembly, main assembly and final testing. The components are supplied by Vestas' own factories and vendors, and which they sell in international markets.
R&D Centre	Chennai	The results of this research centre is incorporated into the main global R&D network
Hubs and Nacelles	Pondicherry	Assembly for the domestic

5 Analysis and Conclusions

Emerging markets are becoming increasingly important for Western multinational companies. The companies discover new spots on their emerging markets' innovation landscape and existing strategies are redefined. With the rise of emerging multinationals, western multinational companies begin to feel competition at their home bases too. Success in this competitive battle will depend on innovation both in their home bases – advanced economies, but also in emerging markets. In other words, the world is witnessing the increased use of inventors located in emerging economies by western multinational companies as inputs into the creation of intellectual property which is used in advanced markets. So far the production of new knowledge has been dominated by inventors in the Triad; presently inventors in emerging economies, especially China and India, are making an increasing contribution.

Soete (2009) argues that if the recent trends in R&D continue then 'in 2025, the United States and Europe will have lost their scientific and technological supremacy for the benefit of Asia'. This assessment is consistent with the investment attractiveness of the world's regions. A 2010 report by Ernst & Young, based on a survey of world business leaders, states that 'Western Europe's appeal as the most attractive destination for FDI collapsed from 68% of votes in 2006 to 38% in 2010'. At the same time, China became the most attractive location for FDI in 2010 and together China, India and Eastern Europe are perceived as the most attractive regions for FDI over the next three years (Ernst and Young, 2010).

A recently published report on 'Wind Power: Opportunities in Emerging Markets' (RNCOS, 2010) maintains that emerging countries are faced with increasing power demand due to three main reasons. Firstly, most of the emerging economies are preferred destinations for industrial and manufacturing plant set up by developed countries and hence are in the need to electricity. Secondly, development of power grid connectivity has boosted up the power consumption. Thirdly, increasing population has fuelled the power requirement in these economies. And because rising fossil fuel prices may become prohibitive, these countries are adding renewable sources of energy into their power mix. In this respect, wind power represents the best choice to feed their growing energy demand. It is relatively low cost than other renewable sources and is a cleaner source of energy. Wind is to become a highly competitive source for power generation.

These developments go in parallel with localisation strategies of multinational companies and consistent with the insights from academic literature. In our literature review (summarised in the analytical framework) we identified a number of push and pulls factors that are behind the localisation strategies of firms in the wind energy technology development. The case studies exemplified these factors. As a typical western multinational company, Vestas is confronting with stagnating market at its home base, serving as a main push factor. At the same time, Vestas sees new opportunities opening up in emerging economies like India and China, offering dynamic market (a pull market-seeking motive).

It is not only the market as such that is attracting western multinationals to the emerging economies. The fact that western multinational companies place their corporate R&D centres there is a sign of asset-seeking motive. Many local subsidiaries established by Vestas in China and India are of competence-creating nature. They develop knowledge and technology, benefiting from local capabilities and skills, and collaboration with either local partners or subsidiaries of other western multinationals, usually being localised in a specialised cluster (the Tianjin emerging wind energy industrial cluster is a good example). Then the knowledge and expertise created in emerging markets are to be used and applied elsewhere in the global corporate network of this multinational. Cantwell and Mudambi (2005, p.1124) view these subsidiaries as the 'product of a process that has been going on for a decade ... the emergence of global networks for innovation'.

In terms of policy implications, host countries (and specifically emerging economies) need to take more decisive steps in ensuring a sound regulatory framework and better policy environment, better resources mapping and exploration, adapting both institutions and infrastructures to the renewable energy. From the perspective of the home countries, concerns are often raised that international expansion of western multinationals is often proceeds at the expense of their presence at home, specifically in terms of jobs in manufacturing (layoffs of workers at home). The concerns are also raised in the case of R&D internationalisation.

However, the picture is slightly different here. It might be argued about complimentarily of R&D localised in different subsidiaries of a multinational company. Establishing an R&D function at an overseas subsidiary (based in emerging economies) does not by default lead to closure of a home country corporate R&D lab. Internationalisation of corporate R&D is not a zero-sum game. Multinational companies' ability to participate in international innovation networks, which provide diversified knowledge inputs, may strengthen home country innovation systems and enhance their ability to produce innovations.

Overall, the clean energy market is set to experience further growth. Globally, investment has more than doubled in the last five years, and even the recent economic turmoil did not affect it substantially (Black, 2010).

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