Emerging Green Clusters in South Korea? The Case of the Wind Power Cluster in Jeonbuk Province

Su-Hyun Berg[*], Robert Hassink[**]

Abstract

Regional innovation systems and clusters represent a fashionable conceptual basis for regional innovation policies in many industrialized countries (including South Korea). Due to questions related to climate change and environment-friendly energy production, the green industry has been increasingly discussed in relation to regional innovation systems and clusters. This explorative paper analyzes these discussions and critically examines the emergence of green clusters in South Korea based on the case of the wind power cluster in Jeonbuk Province. It tentatively concludes that the role of the central government is too powerful and the role of regional actors (policy-makers and entrepreneurs) is too weak for the successful emergence of green clusters.

KEYWORDS: emerging green clusters, wind energy industry, regional innovation system, Jeonbuk Province, South Korea

1. INTRODUCTION

Regional innovation systems and clusters have been popular among policy-makers in industrialized countries in North America, Europe, and East Asia in order to boost regional economic development (OECD 2007, 2011; Fritsch and Stephan 2005). Recent interest has focused on emerging clusters (Fornahl et al. 2010) and the interrelationship with regional innovation systems. There has been increased interest in the emergence of green clusters and eco-innovation systems due to climate change and other environmental issues (see Cooke 2009, 2010a, 2010b, 2011; Truffer & Coenen 2012; Fornahl et al. 2012). These trends can be observed in South Korea; however, regional innova-

[*] PhD candidate, University of Kiel, Germany, berg@geographie.uni-kiel.de
[**] Professor, University of Kiel, Germany, hassink@geographie.uni-kiel.de

tion systems have lagged in development (Cooke 2011). The emergence of green clusters is popular due to the green growth strategies of the current administration (Mathews 2012; Jones and Yoo 2010) and increased interest in renewable energies after the Fukushima Daiichi nuclear disaster in Japan.

This explorative paper analyzes the emergence of green clusters in South Korea and the role of regional innovation systems as a facilitator for the emergence of green clusters. This is done by focusing on the case of the wind power cluster in Jeonbuk Province. Various regions in South Korea have a concentration of wind power firms and suppliers, such as Gyeongnam (KOTRA 2010); however, we selected the wind power cluster in Jeonbuk Province, as it is the only region where new renewable energy was designated as a 'propulsive' industry in the Economic Regional Development Plan of the current administration (Jang 2011, 288). This explorative paper will provide some recommendations for future research on emerging green clusters in South Korea based on an investigation of the processes, factors, and dynamics of the wind power cluster project.

This paper addresses three questions:

- What were the main triggers for the emergence of the wind power cluster in Jeonbuk?
- What kind of relevant knowledge for the development of the cluster was already available in the regional economy (path creation and related variety)?
- What role does the regional innovation system play to facilitate the emergence of the wind cluster and how does the emergence of the cluster affect the regional innovation system?

Data were collected in June 2012 by desk researches and ten in-depth interviews in order to analyse the national and regional institutional context and its influence on firm and network evolution. The interviewees consisted of the key stakeholders in the emergence of the cluster (cluster initiatives, provincial policy-makers involved in the project, academic experts, project consultants, and government agency officials).

We first describe the concepts of regional innovation systems, cluster emergence, and the emergence of green clusters. Section 3 describes the South Korea context for green cluster emergence; subsequently, the empirical analysis of the Jeonbuk wind power cluster follows in Section 4. Section 5 provides the main conclusions of this explorative paper with recommendations for further research.

2. THEORETICAL FRAMEWORK

The empirical analysis is embedded in three theoretical strands of emerging clusters in an evolutionary framework, regional innovation systems, and the emergence of green clusters.

First, clusters are defined as "a geographically proximate group of interconnected companies and associated institutions in a particular field, linked by commonalities and complementarities" (Porter 2000: 16). In recent years they have become the target for policy-makers and a key concept to support innovativeness and competitiveness at several spatial levels (supranational, national, and regional) (see Asheim et al. 2006; OECD 2007). One important criticism of clusters is that the literature overtly focuses on how clusters function, whereas their evolutionary development is disregarded, i.e. how clusters actually become clusters, how and why they decline, and how they shift into new fields (see Lorenzen 2005; Staber 2010). Current studies on the emergence of clusters (e.g. Fornahl et al. 2010) suggest that the processes responsible for the function of a cluster cannot explain its emergence. Storper and Walker (1989) are one of the few theorists that focus on the specific question of the genesis of new industries in a spatial view. Their concepts of new industrial spaces and windows of locational opportunity stress that a new industry arises at several locations outside of current and older industrial areas. Industries are assumed capable of "generating their own conditions of growth in place, by making factors of production come to them or causing factors supplies to come into being where they did not exist before" (Storper and Walker 1989:71). Since the location factors for a new industry do not yet exist and firms and industries are seen as capable of creating themselves, they have a great locational freedom and the windows of locational opportunity are open. However, where exactly these first locations lie is often a matter of chance. Others have strongly criticised the strong emphasis on chance and the absence of integration of actor and behavioural theories in explaining the emergence of new clusters. They refer to the concept of path dependence and path creation (Garud et al. 2010; Martin and Sunley 2006). According to this viewpoint the location of pioneer entrepreneurs as seed-beds of a new development cannot be explained by chance and small events; instead, they are strongly related to existing experience, knowledge, capabilities, and contacts that the entrepreneur carries over from previous industrial development paths.

Second, regional innovation systems are integrated systems that consist of knowledge generation, exploitation, and co-operation amongst innovation actors, such as local companies as well as regional and national governments (Cooke 2004; Cooke 2010b; Asheim and Gertler 2005; Asheim et al. 2011; Berg 2011). They can potentially play an important role to facilitate the emergence of new clusters as they provide technological paths that can lead to new paths and new clusters. The basis of regional innovation systems are regional networks and interdependencies between firms and organisations (such as research institutes, financial service providers, technology transfer agencies, or regional governments) as well as institutions in terms of norms, rules, routines, and conventions (Cooke et al. 2004). The systemic dimension of a regional innovation systems results from the coupling of three subsystems (Cooke et al. 2004) leading to synergy effects of enhanced regional innovation capacities of subsystem of finance, the cultural setting of regions defining the milieu within which the knowledge networks are embedded, and interactive learning through which new knowledge is created and exploited. By defining the conditions of these subsystems the regional innovation system approach becomes particularly relevant for regional innovation policies. The regional innovation system approach relates to the evolutionary key notes of path dependence, co-evolution, and lock-ins (Uyarra 2009). Innovations are understood as inherently path dependent because they are conceptualized as social and evolutionary processes that are characterized by

constant learning and the accumulation of knowledge. Innovations are generated through feedback loops and refer to prior knowledge; subsequently, innovative outcomes and technological standards within a region crucially depend on previous knowledge trajectories. Besides the idea of path dependence, the regional innovation system approach emphasises co-evolutionary processes. Organizations and firms claim to be embedded in institutional settings that regulate economic interactions; however, organisations and firms impact institutions in two ways: they are able to both, reinforce institutions by reproducing established behaviour or introduce new sets of practices that challenge the existing institutional context. Due to multiple systemic intra- and inter-regional linkages, regional innovation systems are potentially flexible and capable of adjustments. Importantly, there are significant differences between regional innovation systems in countries that depend on the leeway regional governments receive from central governments. Cooke (2004), for instance, distinguishes between grassroots, networked, and dirigiste regional innovation systems, in which the latter are steered by central governments in a top-down manner. Another typology of regional innovation systems distinguishes entrepreneurial regional innovation systems in market-led systems from institutional regional innovation systems where state support is more significant (Cooke 2004).

Third, significant literature is emerging on green clusters and eco-innovation systems (Cooke 2009, 2010a, 2010b, 2011). Particularly Philip Cooke (2010a, 2010b, 2011) has done ample research on emerging green clusters in California, Denmark, and Wales. Cooke stresses the role of related variety (also ex-post), technology platforms, and cross-fertilization between clusters and industries to facilitate innovation in green industries, partly initiated by individual entrepreneurs. There are some clear links to notions of evolutionary economic geography in his work. At the policy level, he stresses the importance of devolved governance in innovation and energy fields, as well as intermediary agencies (such as Bayern Innovativ in Bavaria, Germany) that stimulate technology platforms for innovations in green industries. Although the role of a supra-national and national regulatory frameworks is stressed, "regional eco-innovation policy may be ahead of national policy because of local or regional specificities of a negative or positive kind" (Cooke 2011, p. 112). Regions and cities react differently to national policies; some have assets and flexibility versus others that might be locked in the pre-carbon development model. Early transition regions "may act as 'lighthouses' … for the rest, albeit unevenly in space and time" (Cooke 2011, p. 109).

These theoretical concepts on clusters, regional innovation systems, and the emergence of green clusters will be empirically explored through an analysis of the genesis of the emergence of the wind power cluster in South Korea in the next section. However, the South Korean context concerning regional innovation, cluster policies, and wind energy is described before dealing with wind energy in Jeonbuk province.

3. THE SOUTH KOREAN CONTEXT

Concerning the context for regional innovation systems and cluster policies in South Korea strong changes have taken place during the last decades. Many scholars have argued that regional policy should be changed, away from 'top-down' decentralization policies, mainly implemented in the

1970s (large-scale heavy industrial complexes in the central and particularly south-eastern parts of South Korea) and 1980s (mainly public research establishments at Daedeok Science Town in Daejeon) to 'bottom-up' decentralization policies to develop endogenous potentials (mainly SMEs) in regions (Hong 1997). The emergence of these latter policies were facilitated by political decentralization reforms in 1995 (Hassink 2001, 2004); in addition, decentralization accelerated under President Roh Moo-Hyun: regionalization or decentralization and devolution are the main goals of the government (Kim 2007; Lee Y-S. 2009). The government established the Presidential Committee on Balanced National Development that included the representatives of 12 ministries to oversee the Plan for Balanced National Development. Unlike previous governments, this participatory government considered regional development and decentralization "as a means to strengthen the competitiveness of the country as a whole" (Kim 2007, p.9). The government pursued a "dynamic balanced development" through "competition and cooperation" among regions.

An important policy innovation devised under the participatory government was the Regional Innovation Council (RIC) that represents a key instrument to establish regional innovation systems in Korea (Kim 2007). They are composed of various regional actors, such as universities, local authorities, regionally based companies, research institutes, and intermediary organizations that are the main coordinators of regional innovation support and innovation projects. Being independent of central and local governments, they also function as a bridge for the central government and provinces. However, Kim (2007, p.21) is critical about the RICs:

> Allegedly the key vehicle for building regional innovation systems by networking and coordinating different actors, are themselves initiated by the central government and therefore quite homogeneous across regions… lack capabilities for planning, organizing, systematizing, and mobilizing consensus. Rather than acting as the key promoter and initiator of regional innovation and experimentation, most regional innovation councils turn out to be a kind of advisory board, composed mainly of local notables, and confirm what regional authorities under the guidance of the central government have already decided to pursue.

The New University for Regional Innovation (NURI) program is also an important participatory government tool where local universities become focal points for regional innovation. In order to receive financial support for their projects, they should team up with a broad range of partners in the region, such as research institutes, local authorities, firms and intermediary organizations (Kim 2007).

Cluster policies have been high on the agenda of national and regional policy-makers and there have been plenty of initiatives and agencies; however, Lee (2012, p. 161) is critical about the actual results of these policies:

> Few cases have been reported in which clusters succeeded in boosting innovation and enhancing competitiveness. In addition, while the state high-lighted its bottom-up approach, in reality the development of clusters was actually initiated, designed, and funded by the central government. Central government officials … were reluctant to devolve substantial power for fear that local and regional policy makers would be incapable of devising and implementing sound policies.

The current Lee Myung-bak Administration has changed regional development policies from

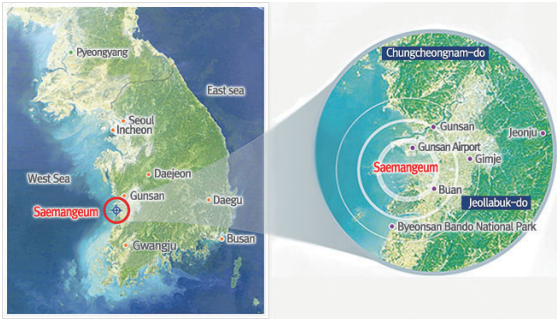
policies aimed at balance and equity to policies oriented towards specialization and efficiency (Richardson and Bae 2011; in addition, the number of planning regions has decreased to seven in order to spend public money more efficiently. Richardson and Bae (2011) expect future coordination problems between sectoral policies at the regional level as well as between the newly created larger regions and the provinces and metropolitan regions. They also point at the legacy of the South Korean top-down developmental state that might hinder enough bottom-up participation.

Concerning the context for green industries and clustering, Cooke (2011, p. 138) observes that "the first thing to note about South Korean eco-innovation strategy either nationally or regionally is how recent it is" … "Only in 2010 did the country wake up" (2011, p. 139). The wind energy industry in Korea therefore is still in an early development phase and electrical power generation from wind energy accounted for only 0.176% in 2010 (KWEIA 2012). However, after the Fukushima Daiichi nuclear disaster, the South Korean government has focused on a more energy independent renewable energy industry in South Korea and plans to increase the renewable energy supply by 6.08% as of 2020 (PCGG 2009). In addition, the Korean government accepted the Renewable Portfolio Standard (RPS) scheme to facilitate the development of a renewable energy industry (Jang 2010). Another significant action is that Korean heavy industry companies (such as Hyundai E & C, STX heavy industries, and Samsung heavy industries) have planned to globally and domestically participate in the wind energy industrial market (Lewis 2011). Green growth has been presented as a new growth paradigm for the Korean economy and the strategic development of the renewable energy industry is now a core component of the national development plan (Jang 2010).

4. THE CASE-STUDY: THE JEONBUK WIND POWER CLUSTER

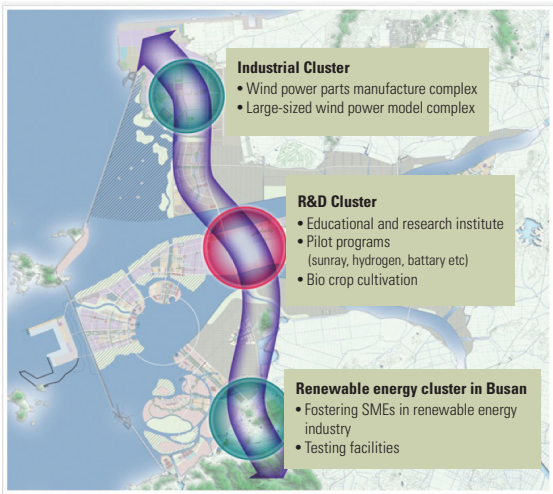
The wind power cluster project in Jeonbuk province is one of the main projects of the South Korean central government that is intended to boost the local renewable energy industry. It will be located about 30 km off the coast of Jeonbuk and neighboring Jeonnam province, in the southwestern part of the country (see Figure 1). "This plan includes also the establishing strategy of all-round renewable energy cluster including manufacturing and R&D in order to support the production of renewable energy and to create a value chain of core technologies" (Korea Herald 2010-03-30).

FIGURE 1. Location of the Saemangeum area



Source: SDPB (2011)

FIGURE 2. Development strategy for renewable energy clusters



Source: http://www.smgc.go.kr/eng/html/saemangeum/a_sub_04_05.jsp

The wind power energy cluster in Jeonbuk was the first national renewable energy project launched in 2009 and is scheduled to run until 2019. Big hopes are set on the development of this new green cluster as indicated by maps in promotional brochures (see Figure 2).

In the 1960s, rice imports in Korea rapidly increased due to food crises, drought, and cold weather damage. In the 1970s, a negotiation on land reclamation started in order to secure more crop fields. After several feasibility studies, the South Korean government decided to reclaim land from the estuaries (Gunsan, Gimje, and Buan in Jeonbuk province) at the mouth of two rivers Mangyeonggang and Dongjingang, along the west coast (SDPB 2011).

Consultation with the Korea Development Institute (KDI) started in the 1980s and the construction of the Saemangeum Seam Dikes (the longest sea dikes in the world – 33km) started in November 1991 after careful economic studies, residents' agreements, and public engagement. The initial land use plan (1991) was 100% agriculture and fisheries oriented; however, the Executive Office of Saemangeum Development Planning in the Prime Minister's Office changed the basic Saemangeum concept from internal land development into multi-functional land with advanced industry, tourist attractions, and environment and energy complexes due to its proximity to the growing Chinese market. Subsequently, the proportion of farmland to non-farmland is 30 to 70 for the revised Saemangeum land use plan (2008). The South Korean government promotes the Saemangeum development plan with the ambitious aim to build a Northeast Asian economic hub. The estimated cost of the project is about KRW 22 trillion by the year of 2012, which consist of KRW 11 trillion government expenditure, KRW 0.95 trillion provincial expenditures, and KRW 10 trillion private investment (LURIS 2011).

The total size of 2,100ha is reserved for the wind power industry cluster (with R&D infrastructure) in the Saemangeum Industrial Zone (see Figure 3). It also includes various facilities based on its abundant institutional and central government financial support. This Saemangeum wind power industrial cluster development project is executed by the Ministry of Knowledge Economy. The task of the ministry and development of the new and renewable energy cluster in Saemangeum, is coordinated by the Saemangeum Development Committee. The committee is chaired by the Prime Minister and a co-chair appointed by the President. The Korean government aims to establish a private-public partnership to install around 500 turbines off the coast of the Saeman-

geum area with an output of 100MW by 2013, 900 MW by 2016, and 1.5 GW by 2020. Combined with the onshore plant, the accumulated wind power capacity will be 5GW by 2020. In addition, the Jeonbuk government selected the renewable energy industry as one of its strategic industries

FIGURE 3. Location of the Saemangeum wind power industrial cluster

Source: SGFEZ (2010) p.4

in 2004. Consequently, it has invested over KRW 1.87 billion into the regional promotion of wind, photovoltaic, and the fuel cell industry since 2004.

There are 10 wind power corporations near the Saemangeum region (JBCC 2012). Hyundai Heavy Industries is the largest establishment in the region with 200 employees (Table 1). KM and

TABLE 1. Main wind energy corporations in Saemangeum

Company name	Main Products	Number of Employees	Location
Hyundai Heavy Industries	Large-scale wind turbines	200	GunSan National Industry Complex
KM Corporation	Blades	90	GunSan National Industry Complex
Deck Wind Corporation	Blades	300	Wanju Science & Industry Complex
Geum Poong Energy Corporation	Small-scale wind turbines	30	Jeongeup Industrial Complex

Source: JBTP (2010) p.138, JDI (2009) p.29

Deckwind are the sole Korean companies that produce wind blades and companies such as Geum Poong Energy, SeAH Besteel Corporation, and Casco manufacture the wind turbine components.

There is a strong domestic desire to develop a new industrial base for economic growth in Korea. The expansion of Chinese and Indian markets have played an important motivation support a renewable energy industry. Interviewee D expatiated that sustainability (an important global component of economic development since the Kyoto Protocol) was a main factor of the Saemangeum development project.

Environmental concerns are the last issues to be resolved for the Saemangeum wind power cluster development plan. For instance, noise solutions and migrant bird protection are incomplete due to ad-hoc decision-making by the central government.

4.1 The main triggers for the emergence of the wind power cluster

Literature on the emergence of green clusters traditionally stresses the role of related industries and individual entrepreneurs as the main triggers for emergence; however, in this case the central government plays a pivotal role. All the interviewees agreed that the Korean central government is the main trigger for the emergence of the Saemangeum wind power industrial cluster; from the onset the Korean government meticulously controlled the Saemangeum development plan. Initially the Saemangeum project emulated previous joint projects by diverse ministries, public corporations, and private industry; however, the central government eventually came to organize the Saemangeum wind power industrial cluster development project in a 'top-down' manner.

Interviewee F criticized this problem in detail. The project was originally designed as a stated-led project and not a cooperation project between the regional and the central government. The Jeonbuk provincial government has jurisdiction over the Saemangeum area and acquired a low level of decision-making power; however, it is still under central government control. For instance, the central government enacted the Special Act on the Promotion of the Saemangeum Project in 2007 that confirmed the basic design of the Prime Minister's Office for the internal development of the Saemangeum area. In addition, regional administrations heavily rely on financial support from the central government. Interviewee G pointed out the weak fiscal capacity of the Jeonbuk government. For example, total government expenditures on the Saemangeum wind power energy cluster development are projected to be KRW 120 billion by 2020; however, the expenditures of the Jeonbuk provincial government will account for only KRW 3.5 billion (Lee J.K. 2009).

A fundamental problem in the Korean political system is the hierarchical structure of the central and the provincial governments (Hassink 2001, 2004). The provincial governments have little decision-making power in policy planning for the Saemangeum project; subsequently, cooperation (which was originally planned by the central government) between the Jeonbuk and Jeonnam provincial governments and the central government is weak and nascent. Interviewee G also added a need for a 'bottom-up' approach due to the extremely over emphasized role of the central government. Interviewee G agreed that the leadership of the central government was essential at the

beginning of the Saemangeum project in terms of financial support and policy arrangements. As the project developed and became more sophisticated, there is need for decision-making power from the Jeonbuk government; subsequently, the reverse-matching system was adopted, where Jeonbuk initiated regional innovation systems based on regional specificity and the central government distributes the budget for it.

The Korean government supports the Saemangeum wind power cluster development plan through state-led projects, state-designed supporting funds, and a powerful regulatory framework.

4.2 The role of path creation and related variety

The Korean wind energy industry is still in the emergent stage. Since 2006, many Korean firms have entered the wind industry. Korean heavy industry companies (such as Hyundai, Samsung, Daewoo, Doosan, Hanjin, and STX) have entered wind turbine manufacturing export markets with offshore potential through the introduction of internationally proven shipbuilding and the heavy industry technology.

The Gunsan National Industrial Complex, adjoining the Saemangeum area (see Figure 3), was established in 1978 and is an important location for related industries. Related industries to the wind energy industry such as the shipbuilding industry and machinery industry are located here. Interviewee A added that these relevant industries will attain a synergy effects through the network of wind energy industries and the R&D combination created in the region.

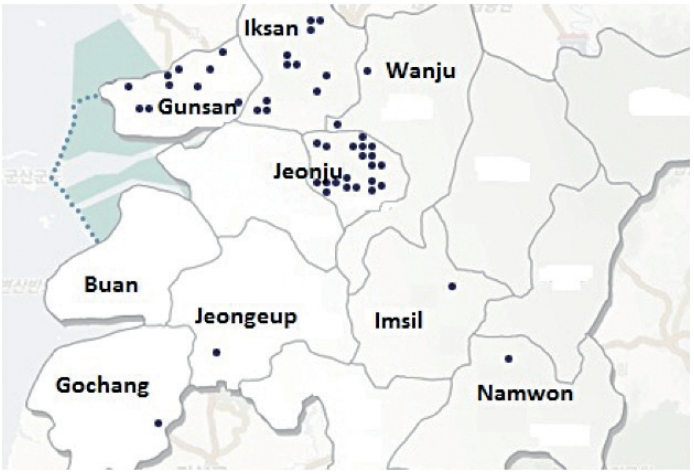
Despite the co-location of some related industries, the wind power industry in Korea is still in the beginning phase due to a narrow domestic market. Interview B pointed out that most of the wind turbine and blade manufacturers in Korea rely on global companies such as Vestas and Repower for their core technologies. Securing core technology for Korean companies is difficult because of the reinforcement of intellectual property protection by the EU and the USA. Interviewee C noted that although Saemangeum has some locally related industries, it lacks main wind energy companies as well as core technologies that cannot be improved by stated-led projects in the short term.

4.3 The Jeonbuk regional innovation system and the emergence of the wind power cluster

Regional innovation systems have an important role facilitating the emergence of green clusters as they provide technological paths that can lead to new paths and new clusters. As such, Jeonbuk province is one of the structurally weakest regions in South Korea in regards to innovation indicators and has below-average scores for innovation input indicators (R&D expenditures and R&D staff) and output indicators (patents) (Jang 2007).

Jeonbuk Technopark is an important government agency for the Jeonbuk regional innovation system. It promotes cooperation in industry, academia, and public research institutes to activate the local economy and contribute to balanced national development while promoting new enterprises; subsequently, it represents a central institution in the Jeonbuk regional innovation system.

FIGURE 1. Location of the universities and colleges near to the Saemangeum area



Source: JBCC (2012)

A total of 52 universities and colleges are located near the Saemangeum area (see Figure 4). They have total 131,872 students which consist of 11,294 graduate students, 96,900 undergraduate students, and 23,678 college students (SGFEZ 2010, p. 9).

The regional innovation system also consists of the following public research institutes: Jeonbuk Development Institute and Jeonbuk Stability Evaluation Institute. The main tasks of these institutes are research planning and policy-making activities related to regional development. The Institutes are authorized by the Provincial Assembly of Jeonbuk.

After having described the main elements of the regional innovation system in general terms, what role does it play to facilitate the emergence of the wind power cluster?

Jeonbuk Technopark considers the wind energy industry a strategic industry in Jeonbuk and provides business support as well as networking services. It aims for the creation of a network between leading local industries-universities-public research establishments and inducement of the establishment of a regional innovation system through information exchanges. Interviewees H and I designated Jeonbuk Technopark as an important agency to promote the wind power cluster. Since December, 2003, JBTP aims to create the wind power energy network between leading local industries, universities, and public research institutes through information exchanges, a data base establishment, and organization of the renewable energy forum.

Four universities[1] are specialized in new and renewable energy, with 11 departments and 360 students. There are also four Research & Development (R&D) centers within the universities

[1] Gunsan National University, Jeonbuk National University, Wonkwang University and Jeonju University

near the Saemangeum area (Table 2). They operate industry-university- public research establishment collaboration programs, such as the development project of small urban wind turbines. The Urban Wind Power Core Technology Center in Gunsan University established a project with Hyundai Heavy industry and JBTP to develop small urban wind turbines with vertical straight blades. Professor Lee, the director of the collaboration, expects a maximum effect from the project on local

TABLE 2. Renewable Energy R&D centers nearby the Saemangeum area

Organization name	Major Tasks	Remarks
Urban Wind Power Core Technology Center	Technology development for a small-scale	Gunsan National University urban wind power generator
Next-generation Wind Power Generator Research Center	Research and development for the next-generation wind power generator systems	Jeonbuk National University
Human Resources Training Center for Renewable Energy	Training professional manpower for the development of wind power clusters	Jeonbuk National University
Renewable Energy Fusion Technology (Noori Project Center)	Training professional manpower for the renewable energy industries	Jeonbuk National University, WokwangUniversity, JeonjuUniversity, and Gunsan National University

Source: SGFEZ (2010) p.9

wind power industries that will readily utilize human resources from R&D centers within local universities and attract related industries.

It is still too early to evaluate the success of the Jeonbuk regional innovation system; however, there is a beginning level of the industry-university-public research establishments collaboration. This nascent situation will be improved as the Saemangeum wind power cluster project develops. Most of the interviewees stated that it is not an optimal time to evaluate the relevance of the regional innovation system for the cluster emergence, because of the early development phase; however, they also simultaneously pointed to a low level of cooperation among public research establishments, universities, and companies in the region.

The emergence of the wind power industrial cluster in Saemangeum stimulates the formation process of the regional innovation system actors – universities, firms and public research institutes. Interviewee J emphasized that the regional innovation system of the Saemangeum is not mature enough to evaluate, but the regional supporting policy for the Saemangeum area has been clearly arranged. Interviewee J emphasized the importance to create diverse business models for wind power cluster in Saemangeum. For instance, the Saemangeum wind power generator demonstration site has been built in Buan city; subsequently, many local wind power generator industries, universities and institutes can test diverse generator models at the Buan test site and can also select the generator models at the time of ordering. Since the wind power cluster has emerged in the Saemangeum area, its regional innovation system has started to advance. There is significant room to develop and promote cooperation among companies, universities, and public research institutes due to the limited industrial base of the Jeonbuk region.

5. CONCLUSIONS

In this paper we examined the emergence of green clusters with the wind power cluster in Jeonbuk. We analyzed this cluster with the help of three issues, the main triggers for emergence, path creation and related variety, and the role of the regional innovation system. Drawing on recent literature on the emergence of green clusters (Cooke 2009, 2010a, 2010b, 2011) we would expect the relevance of path creation and related variety, technology platforms, devolved sub-national governance and agencies, and individual entrepreneurs.

From the path creation view, the initial conditions of the Saemangeum wind power cluster project were provided by the central government. However, for other innovation actors it is not a given whether they were influenced by exogenous factors or endogenous factors: it rather depends on how they draw their own boundaries. Cooperation between firms, universities, and public research institutes has started with networking and cooperative activities that will define or redefine their roles.

The emergent situation of the Saemangeum project was not a 'contingency', but instead planned and designed under the powerful political influence of the central government. Self reinforcing mechanisms of the Saemangeum project do not exist, but will be strategically cultivated by firms, universities, and public research institutes. The path creation perspective (Garud et al. 2010) is not very helpful to explain the emergence of the Saemangeum wind power cluster. In particular, the path creation theory cannot explain how the central government influences the emergence of the Saemangeum wind power cluster. This shows the limits of uncritically applying main-stream Anglo-American economic geography theories in an East Asian context, as raised by Yeung and Lin (2003).

In the past, particularly during the investment-oriented model of economic growth (Porter 1990), the central government, in co-operation with Chaebols, has been successful in starting new industries in new locations in Gyeongbuk and Gyeongam (Dormels and Hassink 2010), such as the steel industry in Pohang, the shipbuilding in Geoje (Hassink and Shin 2005; Shin and Hassink 2011) and mechanical engineering in Changwon (Markusen and Park 1993). Under the current innovation and creativity-oriented model of economic growth, it is highly questionable if the developmental state model (with a strong central government involvement) is still the appropriate approach (Nahm 2011). Political factors play an important role in the development of the wind energy sector in Saemangeum, as the central government has struggled to find the right function for this area due to the decreased importance of agriculture (Kim 2003; Rimmer 2009).

In June 2012, the Korean Ministry of Defense and the Ministry of Environment claimed to change the location of the wind farm in the Saemangeum area due to the danger of radar clutter and environmental pollution, although they approved the plan after feasibility studies in 2009[2]. The

[2] Seoul News (21.June 2012) http://www.seoul.co.kr/news/newsView.php?id=20120621016007

recent unstable situation of Saemangeum and its early development phase make it difficult to give a final judgment on the prospects of offshore wind energy as an emerging cluster in Saemangeum; however, we are skeptical based on the first findings and the relatively unfavorable local and regional conditions for the emergence of this new industry. Cooke (2011, p. 142) described this drawback in the following way, "co-ordinated markets can be slow at national level to set a regulatory and incentive framework that stimulates broadly passive cities and regions into action, as the case of South Korea showed".

This paper has an explorative character due to the limited number of interviews carried out and we realize the need to be cautious in drawing conclusions. However, based on our first findings, we conclude that the role of the central government is too strong and the role of regional actors (policy-makers and entrepreneurs) is too weak for the successful emergence of a wind power cluster in Jeonbuk province. In the early stage of the emergence of a wind power cluster in Saemangeum, the central government played a pivotal role for financial support and policy arrangements; however, as the cluster developed, the 'top-down' decision-making process of the central government encroached on the role of regional innovation systems as a facilitator for the emergence of new clusters. The interrelationship between the emerging wind power cluster and the regional innovation system is still in the early development phase and we observed some positive signs such as new regional innovation system actors related to the wind power actors that were recently established into the regional innovation system.

We provide the following policy recommendations to encourage the Jeonbuk regional innovation system to facilitate the emergence of a wind energy cluster in Saemangeum. First, the highly centralized decision-making processes by cluster planning should be decreased in order to secure the endogenous development of the Saemangeum wind power cluster. Second, co-operation between various innovation actors should be promoted to reinforce the self-sustainability of wind power cluster in Saemangeum. Third, increased efforts should be developed by regional actors to stimulate and co-ordinate platform technologies around wind energy. This could be done through bringing together company actors from different industries and technologies to stimulate cross-fertilization, new combinations, and related variety. Fourth, a 'bottom-up' approach (such as a reverse-matching system) will be needed for balanced intergovernmental co-ordination between central and provincial governments.

This is an explorative paper on a relatively new phenomenon in South Korea and more research is needed on the emergence of green clusters in South Korea. It would be interesting to do comparative research on emerging green clusters in other industries and technologies, such as solar power. Do the triggers for the emergence of other green clusters differ from the wind power cluster in Jeonbuk province? Is this a special case because of the long history of central government involvement in the Saemangeum project? More research is needed on the role of individual entrepreneurs and researchers, as well as related variety and platform technologies that stimulate the emergence of green clusters, and how the latter (which are critical for the emergence of green clusters) can be promoted.

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