Explorations of Evidence-based Policymaking (EBPM) for Reconciling Science and Policy: Developing a Conceptual Framework for Improved Understanding of EBPM in Wind Industry Emergence†

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Abstract

This study explores how to reconcile science and policy in the wind energy sector by providing a conceptual framework for better understanding evidence-based policymaking (EBPM). Regarding this framework, the core issue is to discover how knowledge is formed over time, and which factors affect this knowledge formation. Comparative cases of wind industry emergence in Spain and Britain are examined. This analysis shows that knowledge formation initially starts in the scientific arena in parallel with its formation in the practical, and is followed by political knowledge formation near the beginning of commercial projects. Regarding knowledge formation, three more comparisons are made between wind industry emergence in Spain and Britain: the different approaches to R&D projects, the different adoptions of supporting measures, and the different ways of coping with public opposition. The factors affecting the comparisons are mainly perceptions of energy supply, nuclear power, environment and science and technology. Communication and unfamiliarity are likely to affect the comparisons in EBPM.

Keywords

evidence-based, policymaking, wind energy, Spain, Britain

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1. INTRODUCTION

This study attempts to find methods of reconciling science[1](or evidence) and policy in the wind energy sector by providing a conceptual research framework for an improved understanding of evidence-based policymaking (EBPM). Policies aim to be evidence-based. In particular, technology-driven policies (including the wind energy industry) should be grounded in scientific evidence. If so, policies should be unchanged underthe same conditions. However, there are numerous examples of sudden policy changes or completely different policy adoptions under similar conditions. One example is in Britain, where a sudden delay occurred in draft prices of renewable energy included in its proposed feed-in-tariff regime (McKenna, 2013). Similar unexpected occurrences in South Korea include stalled wind farm projects despite a national initiative (KEMCO, 2014). A question arises as to why such incidents occur despite scientifically rational EBPM.

Before examining the methodology of evidence-based policies, it is necessary to look at current wind energy policymaking and the evidence it relies on. Recent studies list the factors that need to be verified as follows: (a) physical factors: abundant resources of wind, an efficient turbine, and a reliable grid and control system (Herbert, Iniyan, Sreevalsan, & Rajapandian, 2007), (b) institutional factors: financial conditions, and (c) environmental factors: bird death, land view, and noise (Al-Yahyai, Charabi , Gastli, & Al-Badi, 2012; Evans, Strezov, & Evans, 2009; Geißler, Köppel, & Gunther, 2013). If unexpected pauses or changes occur in the implementation of policy despite strict examination of the evidence, it can be thought that other significant evidence is overlooked or other factors affect the decision-making process. The current EBPM concept does not work in the wind energy sector; therefore, this study investigates current EBPM concepts and cases in Spain and Britain, and provides a clearer such concept for wind-energy decision-making in general. Here, this study considerably uses data from Ahn[2] (2009).

2. LITERATURE REVIEW

In order to investigate the way EBPM can lead to better results in policymaking, this paper reviews two streams of literature: one is a study on what EBPM is and the other is how EBPM can be beneficial to better decision-making. This section is composed of four parts: the history of EBPM studies, a review of the literature on EBPM concepts including its elements and aspects, the factors affecting EBPM, and existing empirical studies.

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[1] Science is known knowledge, and supports evidence because evidence is verified facts. Therefore, science can refer to scientific evidence when it is written to address the gap between scientific evidences and policies. Hereafter, science is used with evidence interchangeably.

[2] This paper applies data, policies, activities and events (central- or local policies, industrial-, academic- and environmental- activities and events), from a case study of Ahn's thesis. However, this paper analyses the secondary data with totally different research framework based on different literature review for the different research objective and questions. For example, Ahn's research uses concepts of entrepreneurship literature while this study utilizes EBPM concepts. Therefore, while Ahn's research presents the role and nature of entrepreneurship in the emergence of wind industry, this paper shows significant elements of EBPM for wind industry creation.

2.1. History of Evidence-based Policymaking Studies

The EBPM concept originally comes from the field of medicine (Bultitude, Rodari, & Weitkamp, 2012; Marston & Watts, 2003, pp.146–147). This evidence-based approach has been applied to public policy, particularly in the UK. The Labour government, following its landslide victory in 1997, adopted this approach over Margaret Thatcher's "conviction politics" (Banks, 2009, p. 3; Davies, Nutley, & Smith, 2009, p.1; Nutley, Davies, & Walter, 2002, p.1). In 2000, the UK government published a volume of case studies on EBPM in various sectors (Davies et al., 2009). This material describes evidence, such as its nature,[3] models for its use,[4] and difficulties[5] related to its use. It illustrates empirical cases for its generation and dissemination in various public policies,[6] and addresses analysis methods. Moreover, in Australia, the EBPM approach was applied to tariff-making (Banks, 2009). Since then, many conceptual and empirical studies have been carried out in order to find what EBPM is and how it is achieved for better decision-making.

2.2. Elements of Evidence-based Policymaking

The conceptual studies address what EBPM is and how it can be achieved. Most of the earlier research dealt with the elements of EBPM, summarised as evidence, knowledge, uncertainty and risk.

The term "evidence" has been addressed in certain research and public documents, although there is no clear definition. For example, when discussing evidence, the British government via the Cabinet Office Strategic Policy Making Team provides a list of items[7] that can be considered as evidence (Marston & Watts, 2003, p.145; Nutley et al., 2002, p. 2). Sanderson (2002, p. 3) suggests two uses of evidence, one of which is to increase accountability, and the other to improve decision-making. Wiedemann and Schütz mention two types of evidence, society-based evidence and scientific facts (Wiedemann & Schütz, 2008, p. 30). Head (2008) classifies evidence into three types: that which arises from scientific research, practical knowledge from management experience, and knowledge as applied in political judgement. In his dissertation, the word "evidence" is used interchangeably with the word "knowledge." The Department of Environment, Food and Rural Affairs (Defra, 2011) in Britain categorises evidence into three groups: hard data, analytical reasoning, and stakeholder opinions.

In terms of knowledge, Marston and Watts (2003, p.145) suggest the term "knowledge." referring

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[3] The examples of Chambers Dictionary definitions of evidence are: means of proving an unknown or disputed fact, support for a belief, an indication, information in a law case, testimony, witness or witnesses collectively (Davies et al., 2009).

[4] The models are: the knowledge-driven model, the problem-solving model, the interactive model, the political model, the tactical model, and enlightenment model (Weiss, 1979).

[5] The examples of the difficulties related to the use of evidence are: bureaucratic logic, the bottom line, consensus, politics, civil service culture, cynicism, time (Leicester, 1999).

[6] The examples of public policy case study areas are: healthcare, education, criminal justice, social care, welfare, housing, transport, areas regarding urban (Davies et al., 2009).

[7] They are: expert knowledge, published research, existing statistics, stakeholder consultations, previous policy evaluations, the Internet; outcomes from consultations, costings of policy options, output from economic and statistical modelling

to the role of "interpreting evidence." They also suggest "knowledge claims" are assumed to be composed of "shaped questions" in a context of issues and "relevant evidence." The term "knowledge" is supported by Miller, Munoz-Erickson and Monfreda (2010), who use it as a broader and more qualitative concept than evidence, for instance claims or beliefs of being true made by actors. In their research, knowledge-making and decision-making interact continuously and produce new knowledge and decisions. This process includes production, validation, circulation, and consumption (Miller et al., 2010). This interaction can be regarded as knowledge formation, and the formation can be interpreted as a learning process. Regarding this learning process, there are several concepts such as policy learning and political learning. Bennett and Howlett (1992, p. 289) propose three types of policy learning—government learning, lesson-drawing and social learning—in order to explain policy change. In their research, three questions are explained according to learning types: who learns, what is learned, and what it affects. May (1992) distinguishes policy learning and political learning, and classifies policy learning into two types further: instrumental learning and social learning.

When it comes to "uncertainty," the gap between evidence and policy is referred to as uncertainty in some studies (Jasanoff, 1994; Pielke, 2007). Some argue that uncertainty is the reason for discontinuity of policies (Lindblom & Woodhouse, 1993; Pielke, 2007). Jasanoff (1994) mentions uncertainties in the environmental policies of the US Environmental Protection Agency as a gap, and illustrates diverse erroneous policies arising from these uncertainties. Pielke (2007) explains the definition, causes, and importance of uncertainty in policy and politics. Wiedemann and Schütz (2008, pp. 25–34) categorize uncertainties,[8] and show the way evidence is reflected in policies. Instead of uncertainty, some research uses the term "risk," meaning results caused by lack of evidence (Wiedemann & Schütz, 2008).

2.3. Factors Affecting the Way Evidence-based Policymaking is Achieved

In this study, "better EBPM" means a reduction in the uncertainty between evidence and policy with an evidence-based approach, and thereby achieving better results in the wind energy sector. There are two streams of literature on better EBPM. One is research focused on the production of evidence or knowledge, and the other is research focused on the use of evidence. Miller, et al. (2010) address "knowledge system analysis"[9] in order to understand how to link knowledge and decision-making. In their study, key ideas for understanding knowledge system analysis—such as production, validation, review, and synthesis—mainly focus on evidence production. Suitable methodology and good data are suggested by Banks (2009) as essentials for EBPM. Davies et al. (2009) discuss the role of methodologies in providing meaningful evidence in policymaking. These studies aim to contribute to a reduction in the uncertainty caused by unreliability or the lack of ac-

[8] These are known uncertainty, known but unmeasured uncertainty, and uncertainty resulting from the unknowns.

[9] This is an analysis way of knowledge system. Here, knowledge system refers to "a suite of interconnected individual, social, and/or institutional practices by which knowledge claims get formulated, validated, circulated, and put to use in making decisions" (Miller et al. 2010, p. 2).

countability of evidence.

When it comes to the use of evidence, Nutley et al. (2002) state four requirements for promoting the use of evidence.[10] Wiedemann and Schütz (2008, pp. 25–34) list the factors affecting EBPM as the role of policy drafters, the role of politicians, policies, and media. The effect of the media is also discussed by Pollack (2003, pp. 23–42). Pollack (2003, pp. 43–62) also suggests unfamiliarity as a factor affecting EBPM, as it increases uncertainty. Banks (2009) lists procedural transparency, adequate time, competent and suitable experts, independence from politics, and receptive government as essentials for EBPM. Bogenschneider and Corbett (2010) discuss questioning the reasons for the connection between science and policy, and the importance of balance between community cultures.[11] Bultitude et al. (2012) refer to the importance of mutual respect, trust and the role of mediators, such as NGOs, in better communication between research and policy communities. These studies finally pinpoint the importance of better communication between evidence producers such as scientists, and evidence consumers such as policymakers. Therefore, the studies on the influential factors can be categorized into three streams—the role of scientists, the role of policymakers or politicians, and factors affecting scientists or policymakers—and will be reviewed in the following paragraphs.

In EBPM studies, the role of scientists is mentioned more by researchers than policymakers. Scientists, including experts in all sectors, are thought to play key roles as advisors in EBPM (Pielke, 2007; Jasanoff, 1994). With regard to the role of scientists in social and natural science, Pielke (2007) proposes four types—the pure scientist, the issue advocate, the science arbiter, and the honest broker of policy alternatives—and recommends that scientists should be the issue advocates or the honest brokers. In addition, there have been empirical studies on specific experts' roles, such that of the UK Royal Commission on Environmental Pollution (Owens, 2012), the USA governmental commissions on chemicals (Jasanoff, 1994), and the role of several other UK scientific commissions (Pielke, 2007). In the research of Jasanoff, Kim, and Sperling (2007, p. 8), the experts' role in science and technology policy is described in Germany as "production of collective reason" and in South Korea as "authoritative policy legitimation."

There have been trials to understand the roles of policymakers in EBPM. Wilkison (2011) shows that in Britain, EBPM was organised in three modes of ordering, rationalism, bureaucracy and expediency within the Department for Environment, Food and Rural Affairs. Wiedemann and Schütz (2008) explain the role of policy drafters and politicians in general policymaking. There are also studies showing a general requirement for EBPM in policymaking sectors, such as a need for a re

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10 The four requirements are: agreement on what counts as evidence in what circumstances; a strategic approach to the creation of evidence in priority areas, with systematic efforts to accumulate robust bodies of knowledge; effective dissemination of evidence to where it is most needed, and the development of effective means of providing wide access to knowledge; and initiatives to ensure the integration of evidence into policy and encourage the utilization of evidence in practice.

11 Bogenschneider and Corbett (2010, p. 89) starts by classifying the community cultures into professional and institutional cultures, which are subdivided into the further categories of minimal and "rigorously academic" and "policy and research-oriented."

ceptive policymaking environment (Banks, 2009, p. 18).

The factors affecting scientists or policymakers can be summarized as the effect of value issues, perceptions, and procedural justice. When there is uncertainty, the value issue is known to be an important factor, affecting choices in policymaking especially for scientists (Lindblom & Woodhouse, 1993; Pielke, 2007). For example, environmental issues, such as the death of birds, became controversial in the promotion of the wind energy industry in the UK (Ahn, 2009, pp. 153–158, 160–161). Pielke (2007, pp. 51–52) shows how strongly or not the role of science in policy and politics can be influenced by social value factors. Moving on to the non-scientific actors' role affecting decisions, Jasanoff and Kim (2009) argue the importance of the public reception of science and technology by introducing the concept of "sociotechnical imaginaries," which means the comprehensive perception of social life and order reflected in science and technology projects (Jasanoff & Kim, 2013, p. 190). They argue that this is a critical factor in shaping social responses to innovation (Jasanoff & Kim, 2013, p. 190).

2.4. Empirical Studies on EBPM in the Wind Energy Area

EBPM studies in the wind energy sector are not as numerous as those in the renewable energy area. Several studies, addressing obstacles in policymaking, do include empirical clues for EBPM, although there have not been enough studies on uncertainties or influential factors to cover the wind energy sector. Eryilmaz and Homans (2013) address market uncertainties, such as future prices and future technology, and policy uncertainties, such as consistent incentives from government, which affect investments in renewable energy in the US. In their research, they argue these uncertainties are caused by the nature of renewable energy, i.e. low cost competitiveness. In particular, policy uncertainties are mentioned as the major obstacle to renewable energy investments (Barradale, 2010). The barriers, raised by many researchers, include risk, which can be replaced by uncertainty. For example, technological immaturity and low social acceptance, which are parts of factors suggested by Tsoutsos and Stamboulis (2005, p. 757), may bring about the risk of technological development and installation. Painuly (2001) lists barriers of renewable energy technology penetration and classifies those into six categories, such as market failure and institutional imperfection. Many other expected barriers are proposed and categorized by researchers (Agnolucci, 2006; Negro, Alkemade, & Hekkert, 2012; Reddy & Painuly, 2004). From among the various uncertainties, in terms of policymaking, the largest uncertainty can be whether the policy goal is achieved or not. In the wind industry emergence case study, the goals are suggested as initial market creation, social acceptance, and wind industry emergence (Lee et al., 2015), which can be translated into uncertainties in order of time.

When it comes to influential factors, many success factors for the promotion of renewable energy including wind power are offered by researchers (Jacobsson & Lauber, 2006; Lipp, 2007). For instance, Jacobsson and Lauber (2006) suggest institutional changes, market formation, formation of technology-specific advocacy coalitions, entry of firms, and the other organizations as the success factors.

3. CONCEPTUAL FRAMEWORK DEVELOPMENT

3.1. Research Gaps and Questions

According to the literature review on EBPM theories, concepts in general on evidence, knowledge, uncertainty, and risk are useful in the understanding of the EBPM structure. Moreover, suggestions in empirical studies of factors affecting EBPM are helpful in comprehending how EBPM works. However, the elements, evidence, knowledge, uncertainty, and risk, are not defined clearly in the wind energy sector or in general. The relationship and activities of the elements are not identified, and how they are handled in the wind energy sector is not described as well. Only one or two elements of EBPM are explained for understanding EBPM in current research, and some of the elements are confusing or the terms are used interchangeably. In particular, when referring to the term"uncertainty," meaning a lack of evidence, the problem arises that this phrasing focuses on absent evidence, and so researchers designate it as "uncertainty" and try to reduce it by increasing the amount of evidence. Moreover, policymakers are sometimes very certain in their decision-making and use of the concept of evidence and uncertainty, and some researchers have expressed concerns about this inaccurate concept of EBPM (Kogan 1999; Marston & Watts, 2003). What is more important is to examine what is present but concealed, factors that actors are unaware of yet affect their thinking processes and policy decisions. This lack of studies on so-called better EBPM, including hidden things in decision-making, is the research gap used as the starting point for this research. Furthermore, the empirical studies, providing explanations of elements or influential factors for EBPM, cover only restricted fields, such as health care (Black, 2001; Victora, Habicht, & Bryce, 2004; Walshe & Rundall, 2001), environmental regulations (Jasanoff, 1994), biodiversity (Miller et al., 2010), criminology (Marston & Watts, 2003) and family issues (Bogenschneider & Corbett, 2010), rather than wind energy.

In order to achieve the research aim of better understanding EBPM in the wind energy sector and to fill the research gap of the lack of clear EBPM concepts—such as EBPM elements, explanations of their relationship, and elaborations of their interactions for better EBPM—the main research question is drawn up as:

RQ) What is a clearer concept of EBPM in the wind energy sector?

3.2. Development of a Preliminary Rresearch Framework

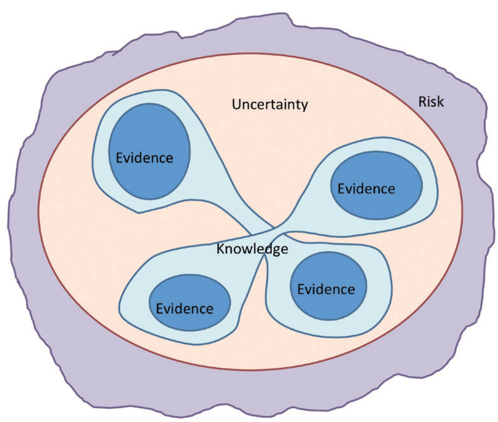
> "There is nothing a politician likes so little as to be well informed; it makes decision-making so complex and difficult." J.M. Keynes (quoted in Davies, Nutley, & Smith, 1999, p. 3)

EBPM is still a controversial issue. Kogan (1999) argues that EBPM can give legitimacy to governments even when it is used for "politically-driven priorities." Cook (1997) supports this argument emphasising that politicians are interested not in rationality from evidence but in re-election. Marston and Watts (2003) mention the risk that policy elites can make use of EBPM as their strategies to gain control over policymaking. Moreover, Perri (2002) raises the question as to whether EBPM contributes to the simplification of policymaking. This study does not deal with whether EBPM is helpful for better policymaking, but identifies, towards a better understanding of EBPM and to improve decision-making, its elements and the ways thatthese elements interact, examining the structure and process of EBPM and isolating the factors affecting better EBPM in the wind energy sector. This study is based on the output of previous research regarding the elements of EBPM, the actions of these elements over time, and the factors affecting good EBPM results.

EBPM Elements

In order to understand EBPM better, the research visualises the structure of EBPM, suggesting a diagram incorporating all of the four elements: evidence, knowledge, uncertainty, and risk. The research assumes "evidence" to be existing facts regarding problematic issues in decision-making. The discussions on its types, sources, and reliability are excluded in the research in order to draw a simple diagram. To explain the effect of evidence, knowledge is assumed to be an interpretation based on evidence. This assumption can be supported by Sanderson (2002, p. 3) who states knowledge as one of two evidence types, which can play a role of providing an explanatory and theoretical basis for policy changes. Uncertainty is assumed to be the lack of evidence in decision-making, and risk to be the fear of negative results caused by uncertainty. Figure 1 illustrates the structure of the four elements in EBPM.

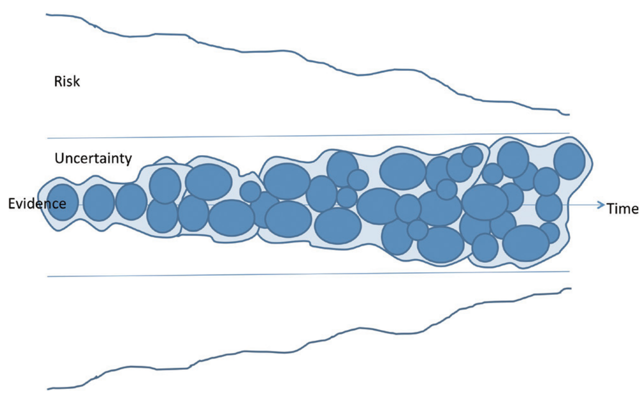
FIGURE 1. Elements of EBPM



The Activities of EBPM Elements

Evidence and uncertainty are finite aggregates of existing facts or unknowns, even though they are as yet undiscovered substances. On the other hand, knowledge and risk are unmeasured, unsubstantial and interpreted by people in different ways. The amount of evidence can grow dueto accumulated data over time, and that of knowledge can be also enhanced through increased evidence and capabilities of interpretation. However, the size of the uncertainty may diminish over time because it is defined as unknowns in decision-making, and cumulative evidence can reduce some areas of uncertainty. The amount of risk can also decrease because the size of risk is proportional to the degree of uncertainty, which goes down over time unless there is some other outside influence raising fear. The activities of EBPM elements are illustrated in Figure 2.

FIGURE 2. Process of EBPM



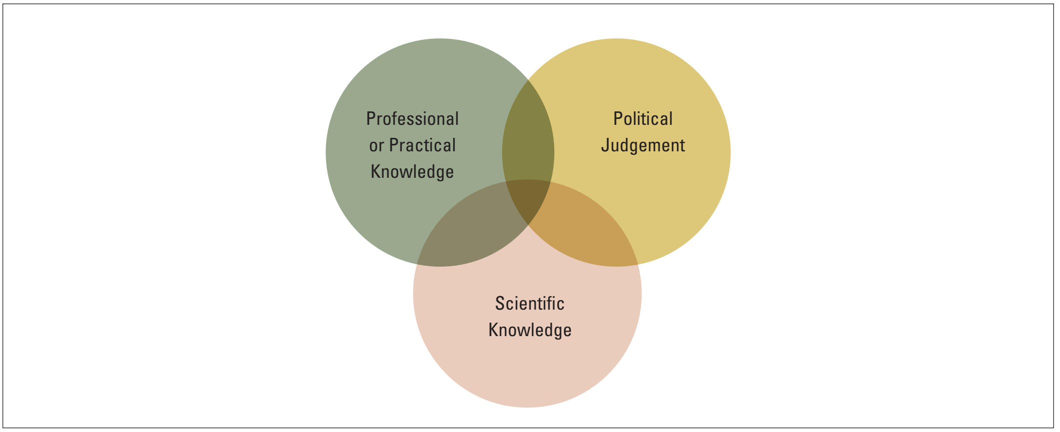
The Aspects of EBPM

This study adopts the theory of "three lenses" as suggested by Head (2008) for policy analysis or understanding EBPM. Many earlier studies have classified EBPM into two parts—the scientific and the political—even though the name of the aspects are called differently in different pieces of research (cultures, communities or views). The model of the three lenses adds one more aspect, with the concept of practical implementation knowledge, acquired from experience and linked to best practice. The three-aspect classification of EBPM is more useful for analysing cases than that of two aspects. Moreover, adding practical knowledge can reflect policy-learning concepts. Therefore, as shown in Figure 3, the research employs the three-aspect classification: the scientific, the political and the professional. Here scientific knowledge is the output of science (such as research), political judgement is the political analysis and know-how (such as results from debates), and professional or practical knowledge is results from experiencing (such as practical wisdom or organizational knowledge).

Development of a Research Framework

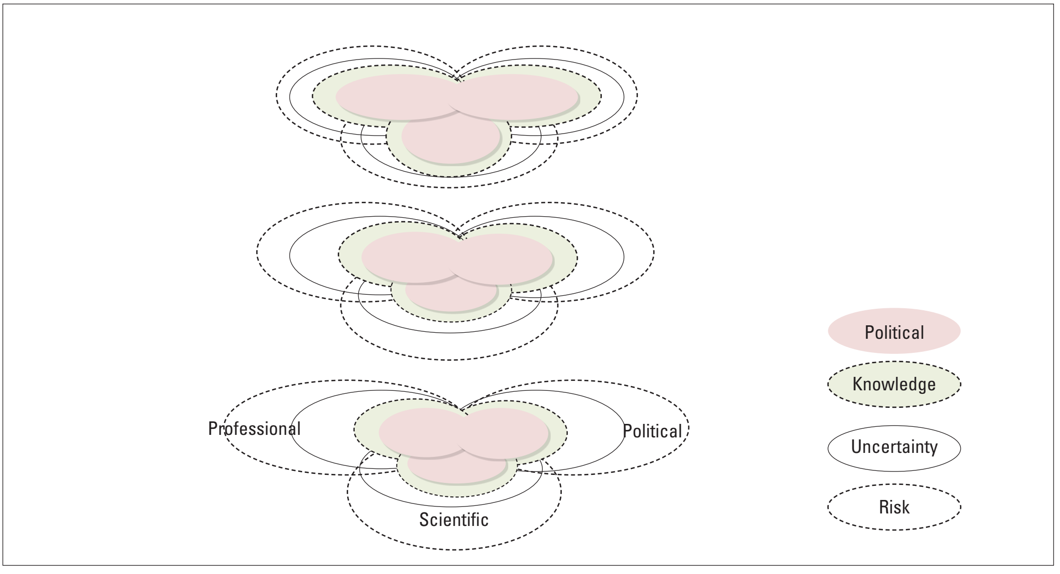
Using the results from reviewing major concepts for understanding EBPM, a two-dimensional conceptual EBPM framework can be developed, as shown in Figure 4. This framework has a geometric image comprised of three fields (the scientific, the political and the professional) and four elements (evidence, knowledge, uncertainty and risk) in each field. In this research, evidence and uncertainty are defined ontologically, and knowledge and risk are described epistemologically. In Figure 4, the

FIGURE 3. Aspects of EBPM



former is expressed with solid lines and the latter is illustrated with dotted lines. In order to look at the activities of EBPM elements, the diagram shows changes over time in aspects and elements of EBPM. The changes are classified into three stages using the findings of previous research (see Lee et al., 2015), which shows three stages—robustness[12], resilience[13] and sustainability[14]—and provides the goals of the three stages in wind industry emergence cases. Here, the uncertainties of the three stages become whether the goals of three stages are achieved or not.

FIGURE 4. Conceptual EBPM Framework in RE Sectors



[12] It is assumed to be the first prerequisite and is defined as an ability to resist short-term stress.
[13] It is assumed to be the second prerequisite and is defined as an ability to resist long-term stress.
[14] It is the final goal in wind industry emergence and shows indicators of major firms' participation.

In this work, the ontological elements of evidence and uncertainty are not dealt with because they are constant, and are included in interpreted knowledge and risk, respectively. Therefore, this study covers only knowledge and risk, focusing on the formation of knowledge (including the use of evidence) in order to enhance EBPM rather than the production of knowledge, because the framework of Figure 4 excludes the effect of reliability, accountability, or credibility of evidence. This approach is supported by Perri (2002), who states that the policymaking problems arise not from the lack of evidence but in managing information and possible players. Therefore, the research presents features of knowledge formation, and identifies factors affecting the formation of knowledge in order to reduce uncertainty and risk within three aspects in the wind energy sector. In order to clarify Figure 4, two sub-questions are introduced:

RQ-1) What are the features of knowledge formation in the wind energy sector?

RQ-2) What are the factors affecting the formation of knowledge for better EBPM in the wind energy sector?

By looking at wind energy cases in the structure of EBPM, this work points to certain influential factors that may be classed as “hidden” (i.e. not openly discussed) yet inwardly and unconsciously influential in policymaking. It seems that policy discussion analysis too readily focuses on what is or is not outwardly available, without consideration being given to what is inwardly influential in thought formation.

4. RESEARCH DESIGN

4.1. Comparative Case Studies

In order to present a clearer EBPM concept for wind energy development, a case study approach is utilized for its ability to build a new theory and test the hypothesis (Yin, 2009). The research evaluates and enhances the proposed preliminary conceptual EBPM framework based on existing EBPM theories, and identifies features of knowledge formation and factors affecting the formation of knowledge by looking at wind industry emergence cases in Spain and Britain. In order to look at the histories of wind industry emergence macroscopically, a comparative design is adopted due to its usefulness in examining historically-oriented social phenomena (Ragin, 1987, p. 13). The wind industry emergence cases in Spain and Britain are selected because they show contrasting performances despite similar backgrounds. For instance, beyond their similarities such as exposure to oil shocks and experience in windmills, they were different in how they adopted different types of policy measures and in their creation of theirwind industries (Ahn, 2009; Butler & Neuhoff, 2008).

4.2. Data Collection and Analysis

In order to test and enhance the proposed conceptual EBPM framework, this study applies data collected mainly from a previously published thesis (Ahn, 2009). An earlier published historical account can be useful in testing the assumed conceptual framework because it can be regarded as neutral. Moreover, the data can be considered objective because the thesis is mainly based on publications (Nandhakumar & Jones, 1997, p. 113). The collected data, policies, events, activities and performances, are classified in chronological orderinto backgrounds and seven types of knowledge in Table 1, and are rearranged according to the conceptual framework in Figure 4 for comparative analysis. Based on the data, relationships are established and demonstrated between these events and activities within a case. In addition, through cross-case analysis, comparative variables are explained. Through these analyses, knowledge formation used to reduce uncertainty or risk is explained, and the factors affecting the formation of knowledge in wind industry emergence are identified.

TABLE 1. Analysis Framework of Knowledge Formation

	Backgrounds	Knowledge types						
		Practical knowledge	Practical-scientific knowledge	Scientific knowledge	Scientific-political knowledge	Political knowledge	Political-practical knowledge	Overlapped by three types
↑ Sustainability								
Resilience								
Robustness								

Using the findings of previous research (Lee et al., 2015), the uncertainties of this case study can be drawn up as:

1) Whether robustness, the initial market creation, is achieved or not,
2) Whether resilience, social acceptance, is achieved or not, and
3) Whether sustainability, the creation of industry, is achieved or not.

With regard to these uncertainties, actors play a key role in the decision-making and knowledge formation that leads to a reduction in uncertainties or risks and achieves the final goal of wind energy industry creation. As discussed in the literature review section, every decision is made up of previous decisions and knowledge, and forms new knowledge in combination with existing knowledge. The activities and events recorded in the comparative cases can be interpreted as knowledge because they are outcomes of decisions. Therefore, significant policies, activities, and events can be translated into types of knowledge and re-arranged according to the EBPM analysis framework.

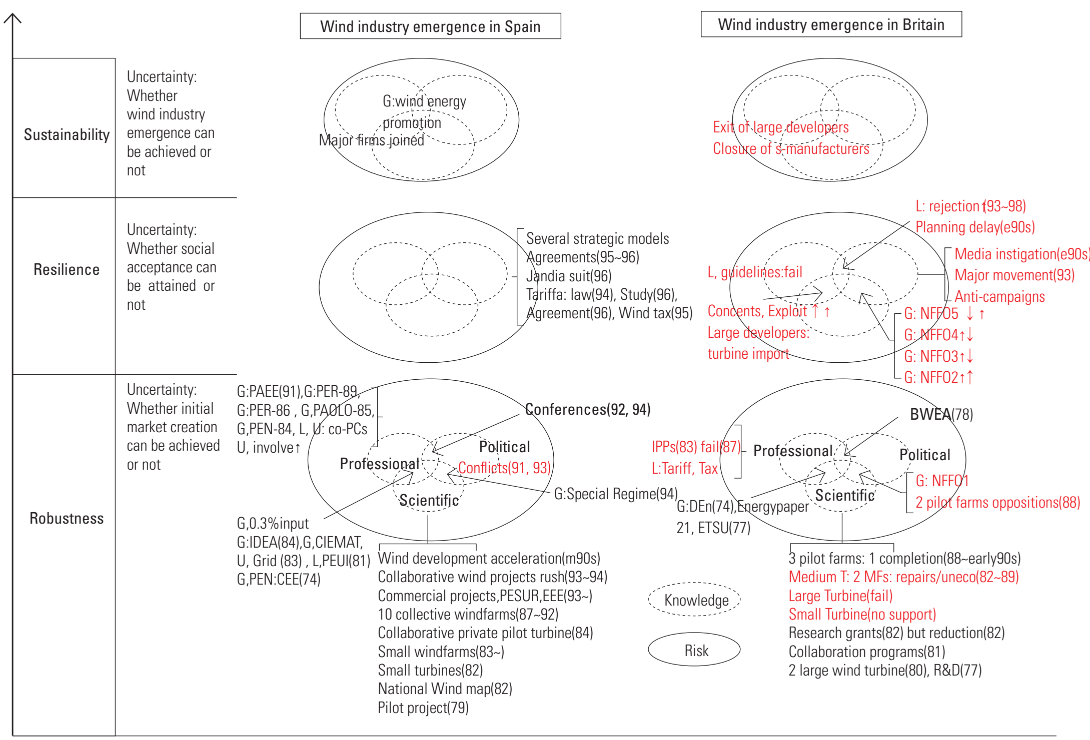
5. RESULTS AND FINDINGS

The exploratory case study does not describe policymaking in detail. Therefore, it is difficult to identify microscopically what evidence, knowledge, uncertainty and risk are, and which factors affect EBPM. This section presents the process of knowledge formation and the effects of assumed influential factors in knowledge formation or risk reduction.

5.1. Overview of Comparative Wind Industry Emergence in Spain and Britain

Significant data collected from Ahn's thesis (2009), such as policies, activities and events showing the comparative stories of wind industry emergence in Spain and Britain, are classified into seven categories of knowledge types, and are listed over time in three stages according to the analysis framework of Table 1. The results of each analysis in Spain and Britain are attached as Appendix A and B at the end of this paper. The categories of the knowledge types are determined by which types of knowledge are formed by the outputs of the policies, activities and events. The types of knowledge are composed of three main types—professional or practical knowledge, scientific knowledge and political judgement—and four overlapped sections. Their meanings mainly conform to the definitions suggested by Head (2008). For example, the efforts of central and local governments and utilities, such as policies, programs, and other planning, are classified into professional or practical knowledge because those efforts establish practical know-how in the institutions. Research and development projects are put into the category of scientific knowledge because they produce scientific evidence and knowledge. Strategies and arguments are classified into political judgement because they are used in political judgement. If the activities contribute to the formation of more than two types of knowledge, they are classified into relevant intersections. For instance, from among the activities of central or local governments and utilities, the establishment of organizations and R&D programs, which are directly helpful to scientific activities, are classified into practical-scientific knowledge.

FIGURE 5. Results of Comparative Case Study in Wind Industry Emergence Between Spain and Britain



The results are arranged according to the EBPM analysis framework. Figure 5 shows the process of the knowledge formation in order to reduce uncertainty or risk of whether the wind industry creation can be achieved or not in Spain and Britain.

According to the within- and cross-analysis, there are four main findings in better EBPM for wind industry emergence:

1) Different process and features of knowledge formation in EBPM,
2) A different approach to the formation of scientific knowledge at the beginning of wind energy development,
3) A different way to support wind development when moving on to the resilience stage from the robustness stage, and
4) A different strategy to cope with social conflicts in the stage of resilience. The findings are explained in the following sections.

5.2. Features of Knowledge Formation: Importance of Professional or Practical Knowledge Formation

According to Figure 5, the most significant finding is the knowledge-forming trend. First of all, at the stage of robustness in both cases, knowledge is primarily formed in the scientific arena in order to cope with the uncertainty of whether initial market creation can be achieved or not. At the next stage of resilience, it is mainly formed in the political or politically related arena in order to cope with the uncertainty of whether social acceptance can be achieved or not.

In the beginning, both countries released national initiatives (the Spanish PEN[15] and British Energy 21[16]), and established specialised organizations for R&D support (the Spanish CEE[17] and the British ETSU[18]) after the oil shock in 1974. These two decisions became the basis for the next practical knowledge formation in the government and scientific knowledge production by R&D support. Moreover, the two countries invested mainly in R&D programs for producing scientific knowledge in the 1980s even though their approaches to the targeted development size were different. Since the first pilot project in 1979, Spain concentrated on numerous small projects, for instance small turbines in 1982, small wind farms from 1983, and a collaborative private pilot turbine in 1984 (Ahn, 2009). As a result, between 1987 and 1992, ten collective windfarms were installed (Ahn, 2009). Based on accumulated knowledge, commercial projects, PESUR and EEE, were launched in 1990 ("Another Spanish Plant," 1990b; "America wins Spanish project subsidies," 1990a) and many collaborative wind projects were carried out between 1993 and 1994 (Ahn, 2009). Britain

[15] It was established as the energy technology support unit of the Department of Energy (DoE) and played a role of overseeing energy R&D programs (Bending & Eden, 1984, p. 240).

[16] It addressed "the prospect for the generation of electricity from wind energy" (L. J. Anthony, 1988).

[17] Centre for Energy Studies (CEE) was established as the centre for energy studies in 1974 (Morata, 1976).

[18] It was established as the energy technology support unit of the Department of Energy (DoE) and played a role of overseeing energy R&D programs (Bending & Eden, 1984, p. 240).

[19] They were a 3 MW LS-1 Orkney HAWT and a 135 kW, 25m diameter VAWT (Vertical Axis Wind Turbines) (Price, 2006).

supported two large wind turbines[19] in 1980 (Price, 2006) and collaboration programs with universities in 1981 even though the research grants were reduced in 1982 (Ahn, 2009). Despite the failure of large turbine development, the British government still pursued large projects and tried to develop medium turbines as demonstration projects for large ones in the 1980s. Among three planned pilot wind farms, only one was completed (Musgrove, 1998).

In parallel with primary activities for forming scientific knowledge in the beginning of wind energy development, there were efforts to expand professional and practical knowledge in relevant institutes, such as government, utilities and companies. In particular, Spain had many opportunities to accumulate practical knowledge; for example the central government announced several times national plans, such as PEN-84[20], PAOLO-85[21], PER-86[22], PER-89[23] and PAEE-91[24], which resulted in the promotion of wind energy development. In addition, the Spanish government managed changes of government-affiliated organizations, such as Research Centre for Energy, Environment and Technology (CIEMAT)[25] and Institute for Energy Diversification and Savings (IDAE)[26] (see Ahn, 2009). Furthermore, the local governments and utilities contributed to practical knowledge formation through being involved actively and positively in administrative processes or research programs. An example would be, in a grid connection test[27], the PEUI[28] R&D program of local agencies and rules of investing 0.3% of total revenue on renewable energy development in utilities in Spain (Calpena, 1983b). On the other hand, Britain expressed only the Energy Paper 21 as a significant national initiative and the British local agencies impeded activities for scientific knowledge formation because of the existing taxation system.[29] These different attitudes of the governments or government-affiliated institutes resulted from different energy resource availabilities, such as oil and gas reserves and nuclear power availability (Ahn, 2009, p. 96). For example, while Britain owned North Sea oil and gas, Spain had little oil and gas. In addition, while Britain depended on nuclear energy, the Spanish socialist government declared a stop in the use of nuclear

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20 Energy Efficiency and Savings Plan: A revised version of the national energy plan in 1974. It expressed ambitious intention of promoting renewable energy (Fernandez, 1978).

21 Plan for Wind Energy Utilisation: A plan for wind energy utilization which aimed at a total capacity of 35-48 MW from 1985 to 1992 ("PAOLO: The plan for wind energy," 1986).

22 A Renewable Energy Plan, which envisaged investment of ESP 55,000 million by 1992 and contributed to the installations of small wind farms in the late 1980s ("Still tilting at windmills," 1987b).

23 Renewable Energy Plan: A revised version of the renewable energy plan which increased the target of wind power capacity from 60 MW by 1992 to 83 MW by 1995 ("Spain on target for eighty megawatt," 1990c).

24 Abn Energy Efficiency and Savings Plan which envisaged investment of ESP 27 billion between 1991 and 2000 ("The new California," 1992; "Wind Energy in Spain," 1996).

25 Established as the research centre for energy, environment and technology in 1985 and involved in public research on renewable energy (Valverde, 1983).

26 Established as the institute for energy diversification and savings by transferring the Centre for Energy Studies (CEE) into more independent and autonomous organizationin 1984.

27 A utility, the National Power Company of Ribagorzana, tried to connect a 55 kW wind turbine to the electricity grid in Candasnos (Calpena, 1983a).

28 A research program which was established in 1981 and was led by large electricity companies ("El INI y UNESA acuerdan investigar y desarrollar las energías renovables," 1981).

29 The owner of wind turbines as an occupier of the land had to pay the annual property tax according to the General Rate Act (Garrad, 1989).

power plants in 1983 (Morron, 1998). In conclusion, the lack of energy resources, based on mainly scientific knowledge, and the negative position on nuclear energy, based on mainly political judgement, caused an active attitude of the government and government-affiliated institutes for practical knowledge formation in Spain, while in Britain, abundant energy resources and the positive position on nuclear energy resulted in complacent attitudes of public organizations and less formation of practical knowledge.

In the late stage of robustness, a few decisions appeared in politically related areas, such as intersection areas between political judgement and scientific knowledge. In both countries, oppositions to wind energy projects arose from communities and environmental groups around that time. The decisions were for urging political judgement. Around the same time, the governments of the two countries announced supporting policies: Special Regime[30] in Spain and NFFO-1[31] in Britain. The two decisions contributed to political judgements of relevant actors in taking their positions and scientific or economic knowledge regarding wind projects, even though the two policies adopted totally different measures. Overall, the Spanish case shows more rigorous activities for the formation of scientific and practical knowledge during this period, even though the two countries presented similar flows of knowledge formation in general.

In the stage of resilience, the formation of knowledge was seen chiefly in politically related areas in both countries. In Spain, most activities were for urging political judgements or helping that knowledge. However, in Britain, there were important activities or decisions in scientific or practical-related intersections, even if the main British activities for knowledge formation were in political judgement areas. These were activities for increasing economic knowledge or managing knowledge of an organization in Britain.

In conclusion, knowledge formation initially starts in the scientific area in parallel with the formation in the practical aspect and is followed by the political knowledge formation at the beginning of commercial projects. The comparison in the flow of knowledge formation between Spain and Britain is whether practical knowledge was formed in parallel with scientific knowledge formation. The factors affecting practical knowledge formation were perceptions on energy supply and nuclear power.

5.3. Different Approach to R&D Projects in Scientific Knowledge Formation

Spain and Britain took different approaches to scientific knowledge formation when facing the first uncertaintyin market creation. While Spain encouraged more initial participation of various institutions by investment in numerous small-scale projects and upgraded their sizes, Britain provided limited opportunities by initiating a large-scale project from the beginning (Ahn, 2009). The choice

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[30] A policy scheme based on the law, Royal Decree 2366/1994, in 1994 (Ciarreta & Gutiérrez-Hita, 2009).

[31] A policy scheme for non-fossil fuel obligation, established in 1989 and revised four times until 1998 (Surrey, 1996).

seems to have been mainly based on scientific knowledge. While large turbines were believed to have advantages in less land use and cost-effectiveness in the view of energy generation, small ones were thought to have advantages in more participation chances of designers, manufacturers, and developers, and less worry about failure (Ahn, 2009). At that point, the Spanish government took an approach favourable to small projects while the British government thought highly of the advantages of only a few large projects. Moreover, the British Central Electricity Generating Board (CEGB) affected the decision of large project development because it was used to managing large amounts of electricity generation (Ahn, 2009). In retrospect, a better understanding of wind technology led to a more successful approach. Wind technology can be said to be driven by experience and knowledge according to “scale in terms of volume production” rather than “scale in terms of size” (Clarke, 1981, p. 5). There were concerns about the British approach (Clarke, 1981, p. 5) but they were not reflected in the policy. In conclusion, compared to the Spanish decision on the small projects approach, the British approach was mainly based on incorrect understanding of wind technologyor overconfidence on technological success. Moreover, the CEGB supported the large projects due to their familiarity. In conclusion, communication between science and policy can be thought to have led to a wrong choice of development of large projects, which caused a lack of scientific knowledge at the robustness stage in Britain. Moreover, the perception on its own science and technology level and the unfamiliarity of the CEGB also caused the wrong decision to be made in Britain.

5.4. Different Ways to Support Wind Development at Commercialization

The third comparison was the way to support wind development. The two countries adopted different policy measures at around the time of promoting commercial projects that appeared just before the stage of resilience. The policy decisions were the Special Regime in Spain and NFFOs in Britain. The Spanish Special Regime, which guarantees a fixed premium price and period, is an example of FIT (Federico, 2010; “Higher prices and longer contracts,” 1995). The British NFFOs initially imposed obligations and guaranteed a premium price and period even if they were unsatisfactory, but were later even then based on bidding (Ahn, 2009). According to Butler and Neuhoff (2008), a long-term price guarantee can be more helpful in promoting RE sources, including wind energy, than the bidding price and obligation systems, even though it can be argued that each instrument has its own advantages and disadvantages (Lipp, 2007, p. 5481). Why did the two countries choose and keep to different policies?

Looking at the features and processes of each decision-making process, the key features of the Special Regime, which was adopted in 1994, were an increase in the premium price of the electricity, generated from less than 100 MW renewable energy projects, from Spanish Pesetas, ESP 10 /kWh to 11.57/kWh, a fixed guaranteed period of five years for the premium price rates, and the end to any new nuclear power plants (Ahn, 2009; Federico, 2010). Before the Special Regime, the Spanish government experienced small FITs within the National Energy Plan in 1999 to 2000 (Ciarreta & Gutiérrez-Hita, 2009) and decided to improve the FIT. Even after the liberalization of the electricity market in 1997, the special regime was ensured due to the strong demands of the Communist Work ers Commissions (CCOO), the Socialist General Union of Workers (UGT), the National Association for the Study and Defence of Nature (AEDENAT) ("Final decision awaits on premium prices, wind payments," 1997; "Unions warn against price cuts," 1996). In 1997, the Spanish government tried to cut the subsidies by 8% in line with its energy liberalization, but the scheme was hindered by the arguments from the above relevant organizations. Moreover, the Spanish government guaranteed unconditional access to the grid for electricity from renewable energy sources. It can be said that the Special Regime was a policy measure to promote the development of renewable energy sources based on the needs of the organizations involved.

On the other hand, the NFFOs cannot be said to have been established for the promotion of RE sources for their own sake (Ahn, 2009). The first NFFO was introduced despite the lack of FIT experience. Before the first NFFO, the British government tried to raise Independent Power Producers (IPPs) using small FIT, but it turned out to be a failure because of the high level of local tax to IPPs ("Air of anticipation in Scotland as Britain awaits second phase," 1987a; Garrad, 1989; Twidell, 1984). Moreover, it started with a cause of a policy for diversity in electricity supply sources. However, the real reason for its introduction was to help nuclear power, which might have had difficulties in consequence of the electricity supply industry privatisation (Agnolucci, 2005). In reality, in terms of wind energy, the benefits of the Non Fossil Fuel Obligation (NFFO) were becoming fewer and fewer, for example the guaranteed price and period decreased over time. Moreover, a bidding system was introduced in the second round of the NFFO amendment, and continued during the following rounds of its amendments. The series of the worsening conditions of NFFOs are presented in Table 4. In addition, the process for NFFO contracts was too complex and took too long, because many organizations, such as Non-Fossil Purchasing Agency (NFPA), Office of Electricity Regulation (OFFER) and Regional Electricity Company (RECs), were officially involved in the process ("The NFFO: BWEA Comments sought," 1990). Through the announcements regarding NFFOs, the involved organizations consistently expressed concerns about the uncertain and insufficient benefits of NFFOs, but their claims had no effects (Ahn, 2009). When the benefits to the industry of NFFO increased slightly in the second round of its amendment, anti-wind campaigns sprang up ("Green credentials slipping," 1994).

TABLE 2. A Series of Worsening Conditions of NFFOs

Rounds of NFFOs (announced year)	Number of projects	Contracted capacity (MW DNC[1])	Guaranteed price (p/kWh)	Guaranteed period
NFFO-1 (1989)	9	-	6~9	Until 1998
NFFO-2 (1991)	49	82.4	11	Until 1998
NFFO-3 (1993)	55	165.63	3.98~5.99	Until 2013
NFFO-4 (1997)	65	340.8	3.11~4.95	Until 2016
NFFO-5 (1998)	69	368	2.43~4.60	Until 2018

**Developed from Ahn's thesis (2009) and Energy Technology Support Unit (ETSU) (2001)*

From the comparative cases on supporting policy adoptions, Spain had scientific knowledge from experiencing small Feed In Tariff (FITs) while Britain did not have it enough to decide a suitable level of FIT because their previous trial had ended in failure. Moreover, compared to Spain, the administrative process was too complex and time-consuming in Britain. Considering the status of previous knowledge formation, it can be said that the British NFFOs were established based on less practical knowledge. Additionally, perception of nuclear energy affected the way of supporting wind energy development again. While the Special Regime prohibited new nuclear power plants, the NFFOs supported nuclear energy. The NFFOs were even criticized for their over-protection of nuclear energy, as a pretext of being non-fossil. It is not easy to clarify the reason of acceptance of nuclear energy because it is concerned with national energy structure. For example, the British government expresses the view that nuclear energy covers the minimum fixed demands for electricity because other sources cannot meet the demands consistently without greenhouse gas emissions. However, it can be said that perception on nuclear energy is an influential factor affecting the structure of wind energy-supporting measures. In terms of other factors affecting the different decisions in Spain and Britain, communication can be pointed out as another influential factor. In Spain, multilateral communications affect wind energy policy in a favourable way, while in Britain, the absence of clear communication channels for improvement in future NFFOs can be pointed out as the reason for failure in wind energy industry creation (Ahn, 2009). For example, the Special Regime was sustained even after liberalization in the energy sector owing to the demands of relevant organizations, while the first NFFO did not accommodate demands of relevant organizations. It can be said that more participation led to more robust organizations, and they contributed to improved communication in Spain compared to Britain.

Eventually, the Special Regime—which was helpful in promoting wind energy industry creation—was established, and the benefits were maintained until 1999 when the tariff was reduced as a part of the governmental anti-inflationary policy and the initial market was acknowledged to have been created (Federico, 2010). Theoretically, the procedural justice, which covers better communication and more participation of relevant actors, can be regarded as the reason for the achievement of better decision-making (Rohl & Machura, 1997). Overall, more participation of related actors for havingrobust, better communication with related actors towards achieving procedural justiceas well as perceptions of the nuclear energy are empirically potential influence factors in this pilot study of an emerging wind energy industry between Spain and Britain.

5.5. Different Strategy to Cope with Social Conflict

A different strategy to cope with social conflicts in the stage of resilience is the final comparison. Behind the oppositions, increasing awareness of the environment resulted in anti-campaigns. Regarding increasing opposition, which had arisen from around the time of commercial projects, the Spanish local agencies showed many strategic models and disseminated their know-how, while the British local governments presented high rejection rates of wind projects and the media instigated public opinion (Ahn, 2009). With regard to this issue, the Spanish, which previously had more practical knowledge than the British, coped well with the anti-movements by providing strategies, exchanging know-how, and conglomerating the strategies into exemplary models (Ahn, 2009). In conclusion, the perception of the environment caused oppositions, and these conflicts can be relieved mainly by local strategies, a type of practical knowledge. Here, communication can affect the process of reducing conflicts.

6. DISCUSSION

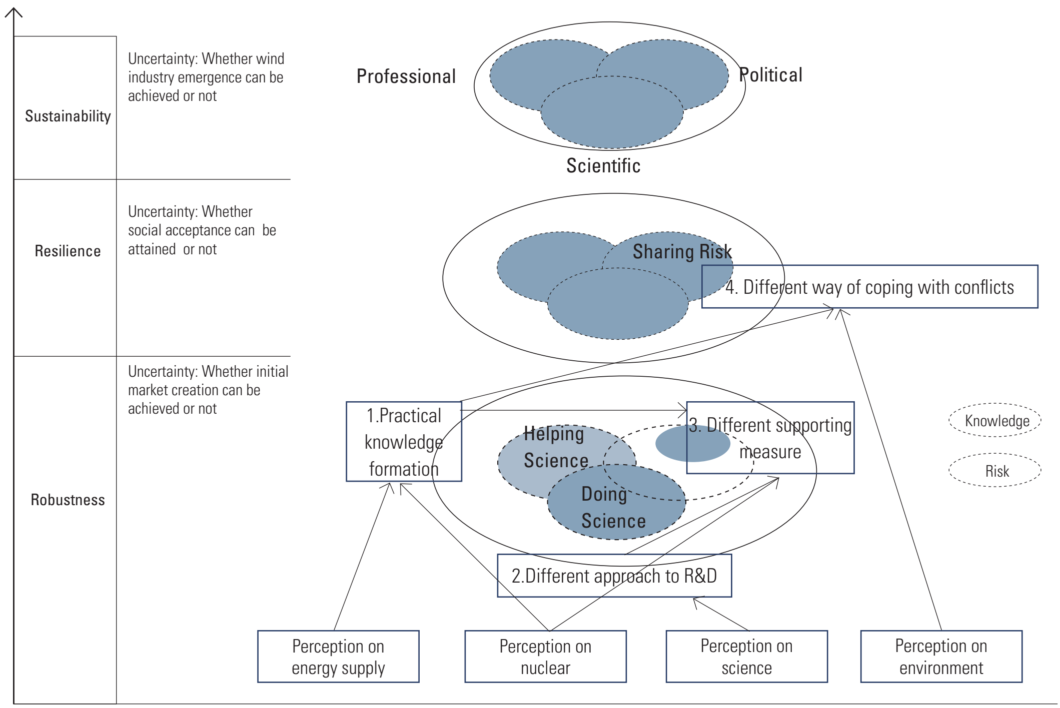
6.1. Development of a Conceptual EBPM Framework in Wind Industry Emergence

Figure 5 shows how knowledge has been formed and risk reduced over time in wind industry emergence. For better EBPM, regarding the first uncertainty (whether market creation can be achieved or not), initial knowledge formation starts mainly in scientific areas. In parallel with scientific knowledge, practical knowledge needs to be accumulated. When conflicts arise at the beginning of commercial projects, the formation of knowledge moves on into the political arena. For social acceptance after the robustness stage in initial market creation, knowledge is formed mainly in the political sector for social acceptance.

There have been four comparisons on the process of knowledge formation between wind industry emergence in Spain and Britain: whether efforts to form practical knowledge are made at the beginning of wind energy development; whether the approach to R&D projects is based on the nature of wind technology; whether guaranteed supportis determined around the occurrence of conflicts; and whether strategies are established in order to cope with the conflicts. The factors affecting the comparisons in EBPM are mainly how energy supply, nuclear power, the environment, and science and technology are perceived. In addition, communication and unfamiliarity seem to affect the comparisons in EBPM.

When it comes to trends in the ways in which knowledge is formed and its properties, scientific knowledge and practical knowledge are formed firstly and political knowledge begins to be formed significantly around the beginning of commercial projects. The properties of scientific knowledge are initially R&D projects and those of practical knowledge are governmental planning or initiatives for promoting development projects. Therefore, it can be said that scientific knowledge means "doing science" and practical knowledge signifies "helping practice." When scientific knowledge turns to business projects, the core of knowledge formation moves into the political arena. Political knowledge is mainly composed of the strategies of relevant institutions and arguments put forward by the public. The actions taken during the formation of political knowledge were taken in order to relieve the fears of the public with regard to such things as harm to the environment. Therefore, political knowledge can be said to be "sharing risk" in terms of policymaking based on science. Using the results of comparative analysis, Figure 6 can be presented as a conceptual EBPM framework in wind industry emergence.

FIGURE 6. Conceptual EBPM Framework in Wind Industry Emergence



6.2. Implications of the EBPM Framework

Figure 6 illustrates the process of knowledge formation for better EBPM in wind industry emergence. This framework can be useful for better understanding of EBPM in the wind energy sector. Compared to existing EBPM concepts, this framework classifies EBPM elements in detail, proposes empirical explanations of EBPM aspects, and describes the process of knowledge formation. Moreover, this paper suggests factors affecting knowledge formation in EBPM, and shows how these factors work in the process of knowledge formation in the wind energy sector. In policymaking for wind industry creation, policymakers can consider the process and features of knowledge formation and the factors that affect it using this conceptual EBPM framework.

7. CONCLUDING REMARKS

7.1. Summary

This study provides a conceptual EBPM framework (see Figure 6) based on a comparison between wind industry emergencein Spain and Britain, suggesting four findings arising from the comparisons. Knowledge was initially formed in the scientific area and its formation moved into the political near the beginning of commercial projects in both countries. The difference is that the scientific knowledge formation was parallel with knowledge formation in the practical in Spain. These knowledge formations can be interpreted simply as “doing science” and “helping practice.” Its formation in the political can be translated as “sharing risk.” In addition to this different process in knowledge formation, there are three more comparisons made between wind industry emergence in Spain and Britain. They are different approaches to R&D projects, different kinds of adoption of supporting measures, and different attitudes to coping with the conflicts. The factors affecting the comparisons are: perceptions on energy supply, nuclear power, the environment, and science and technology. Communication and unfamiliarity are likely to affect the comparisons in EBPM.

This study shows the importance of the role of scientific and practical knowledge formation in wind industry emergence. This does not mean that political knowledge formation is not influential in wind energy development. However, the idea that energy policy is made by politics is not absolutely true if the proper formations of scientific and practical knowledge contribute to a reduction in uncertainties and risks. Political knowledge including existing theories, such as procedural justice and political learning, also needs to be formed properly in order to help us share the remaining risks.

7.2. Future Work

This study can contribute to a better understanding of EBPM, and thus policymaking, for wind industry creation. However, the findings have limitations in terms of general application because the cases cover only two countries and only the emergence of the wind industry. Moreover, influential factors for wind industry emergence can be missed because the paper uses mainly secondary data. Therefore, this framework needs to be verified and enhanced by looking at more cases from different countries covering extended stages of wind energy development. In particular, case studies on Danish and German wind industry emergence can enhance the findings because these both are the leading countries in wind power development.

Appendix A. Analysis Framework of Wind Industry Emergence in Spain (Developed from Ahn's thesis; 2009)

	Back-ground	Professional or practical knowledge	Practical-Scientific knowledge	Scientific Knowledge	Scientific-political knowledge	Political knowledge	Practical-political knowledge	Practical-scientific-political knowledge
Sustai-nability		Major firms joined						G: wind energy promotion (99)
						Several strategic models (the late 1990s)		
						Agreements (95~96)		
Resil ience	Liberalization (97)					Jandia suit (96) pro		
						Tariff a: law (94), Study (96),		
						Agreement (96), Wind tax (95)		
				Wind development acceleration (m90s)	G: Special Regime (94)	Conflicts (91, 93)	Big Conferences (92, 94)	
		G: PAEE (91)		Collaborative wind projects rush (93~94)				
		G: PER-89:target		Commercial projects, PESUR,EEE (93~)				
		G: PER-86		10 collective windfarms (87~92)				
Robus-tness		G, IDEA: PAOLO-85	G, IDEA (fromCEE) (84)	Collaborative private pilot turbine (84)				
		G, PEN-84	G, 0.3% U, input	Small windfarms (83~)				
			G, CIEMAT (84)	Small turbines (82) Four manufactures				
		L, U: co-PCs	U, Grid (83)	National Wind map (82)				
		U, involve	L, PEUI (81)	Pilot project (79)				
	Oil shock (78)		G, PEN: CEE (74)					
	Oil shock (72)							

Appendix B. Analysis Framework of Wind Industry Emergence in Britain (Developed from Ahn's thesis; 2009)

	Back-ground	Professional or practical knowledge	Practical-Scientific knowledge	Scientific Knowledge	Scientific-political knowledge	Political knowledge	Practical-political knowledge	Practical-scientific-political knowledge
Sustai-nability								Exit of large developers (the 90s) Closure of small manufacturers (90s)
Resil-ience							L: rejection (93~98)	
					G: NFFO5 (97)	Media instigation (e90s)	Planning delay (e90s)	
		L, guidelines:fail (90~93)	Concentrations, Exploit (e 90s)		G: NFFO4 (95)	Major movement (93)		
		Large developers: turbine import (e90s)			G: NFFO3 (93)	Anti-campaigns (early 90s)		
	Raised Env-issues (late 80s)				G: NFFO2 (91)			
Robus-tness	Liberalization (88)	IPPs (83) fail (87)		3 pilot farms: 1 completion (88~early90s)	G: NFFO1 (89)	2 pilot farms oppositions (88)		
				Medium T: 2 MFs: repairs/ uneco (82~89)				
				Large Turbine (fail)				
				Small Turbine (no support)				
				Research grants (82) but reduction (82)				
				Collaboration programs (81)				
	Oil shock (78)			2 large wind turbine (80)				
	Oil shock (72)		G: DoE (74), Energy paper 21, ETSU (77)	R&D (77)			BWEA (78)	

BWEA (British Wind Energy Association)

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