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Organizational Innovations Driven by Transition: Insight from Electrical Energy Sector

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Abstract: The paper discussed the importance of organizational innovation related to renewable electrical energy sector in Finland. The study has shown that the development and the implementation of the energy strategy should be considered in the context of all the types of innovation including technological and organizational ones. The approach on how all the interested parties can use the benefits of a change provoked by a disruptive technology was elaborated and implemented. The suggested approach combines an industry analysis followed by a Delphi survey. Based on the data, the potential organizational innovations in Finnish wind and solar PV energy sector were identified. The findings of the study demonstrate that all the subtypes of the organizational innovation underlie the process of disruptive change at the institutional, industrial, and individual levels. They should be also considered when the process of renewable energy development is taken place. The results can be used by organizations involved in electrical energy generation and consumption as well as by other interested entities in the energy market.

1. Introduction

There is strong agreement in the literature that the forthcoming disruptive renewable electrical energy technologies will change dramatically the existing pattern of the industry by introducing the growth amount of various innovations (Klose, 2010). This leads the firms operating with the generating and consumption of electrical power face the challenge of fitting their business models for the new reality of the continuous industry change (Richter, 2012). The crucial issue for firms is how fast they could come with new set of innovations that lift them to the state-of-the-art stage of operating their business in the era of renewable energy sources.

The energy sector in Finland following the Global trends driven by technological, political and socio-economic factors undergo the transformational change. The last leads to considerable changes in value-creating networks, which, in turn, open up new business and innovation opportunities for the actors (Amshoff at al., 2015). There is consensus in the literature that technological innovations can be efficiently introduced provided the simultaneous evolvement of the new organizational and social regimes, as well as state-of-the-art business models (e.g., Geels and Schot, 2007; Teece, 2010), or, in other words, organizational innovation (ORI). However, some studies (e.g., Strupeit and Palm, 2016) suggest that ORI could play a role beyond the one that only supports the technological innovations. ORI can be self-sufficient to let firms obtain competitive advantages in the business environment where a disruptive technology occurs. A number of studies that deal with the problem of ORI impact on a firm's performance continuously increase. Those studies investigate modern forms of management practices, as well as how they foster the related technological innovation (Wengel et al., 2002). Some researchers (e.g., Fagerberg et al., 2012) stressed the role that ORI play in the theory of innovation. Nevertheless, the scale and the scope of the ORI studies, especially which consider the ORI as independent form of innovation activity, is scarce. Despite the fact that the organizational innovation area was widely acknowledged by the scholars, for many reasons it is less investigated and discussed than technological innovation (Sapprasert and Clausen, 2012). This comes even truer when the problem of renewable energy is concerned. To our best knowledge the energy transitions research has not explored the need for organizational innovation explicitly, though some studies addressed certain aspects of business model concept and the organizational innovation theory (e.g., Dedrick at al., 2015).

The electrical power generation and consumption industry is not a kind of unique one where the overall success depends much on innovation (e.g., Strupeit and Palm, 2016). According some studies (e.g. Richter, 2012; Kungl, 2015) the traditional electricity generation companies are very inertial not reacting promptly to the challenges that disruptive technologies dictate. As noted by Korjonen et al. (2017) in the energy sector new innovation are still emerging for the most part from activities of new entrants and even grassroots actors. The role of traditional energy companies is decreasing and the overall situation in the energy sector is changing rapidly towards the pattern set by an innovation driven business-environment (Frantzis et al., 2008).

Our study provides further knowledge on the ORI activities in Finnish wind and solar PV energy sectors. We are aiming at finding the answer to the question what organizational innovation are required to meet the challenges that are brought forward by disruptive technologies in the electrical energy sector.

2. Conceptual framework

Fast development of renewable energy generation sources shapes the forthcoming new era in energy generation and consumption. Wind and solar PV power is often mentioned in the literature as disruptive technology with high potential in the future (e.g., Manyika et al., 2013; Stoiciu et al., 2017). In turn these technologies will radically change the existing relationships between producers, service providers and consumers (Heiskanen et al., 2017).

Many studies support the idea that in order to use efficiently the technological innovation, firms at the same time must develop intensively appropriate ORI to multiply successfully the overall effect of innovations into profit (Azar & Ciabuschi, 2017; Teece, 2010). In numerous studies organizational innovation is considered as a crucial factor for a firm's successful survival in a competitive business environment (Armbruster et al., 2008; Birchall et al., 2011).

Originally the term "Organizational innovation" was introduced by Joseph Schumpeter (Schumpeter, 1934) at the beginning of the 20th century. However, the problem of the ORI has attracted not much attention of scholars in the previous century (Klette and Kortum, 2004). Various ORI definitions as well as classifications that provide in an attempt to demonstrate its specific characteristics in different contexts can be found in the literature (Lam, 2002).

In our paper we rely on the definition of ORI presented by OSLO Manual: *"An organizational innovation is the implementation of a new organizational method in the firm business practices, workplace organization or external relations"* (OECD-EUROSTAT 2005, p.51). ORI aiming at increasing a firm's performance by reducing administrative or transaction costs, enhancing labour productivity by improving workplace satisfaction, gaining access to non-tradable assets (such as non-codified external knowledge), reducing the costs of supplies, establishing new forms of external relations with customers, suppliers, R&D organizations, sub-contractors, etc.

According to the OECD-EUROSTAT (2005) ORI are broken down into three specific subtypes: 1) innovation in management practices (IMP), 2) innovations in the workplace organization (IWO), 3) innovation in external relation (IER).

The IMP subtype of ORI deals with the implementation of methods for organizing work routines that are new for the given organization. Among the other things, these methods deal with the first introduction of management practices increasing an organization's performance. As an example those could be Total Quality Management or supply system elements, as well as knowledge management related approaches, like the first implementation of practices for codifying knowledge, establishing databases, or actions to make knowledge more easily accessible to others (OECD-EUROSTAT, 2005). Knowledge management related practices enhance organizations' performance and competitiveness (Prahalad and Hamel, 1990; Grant, 1996; Spicer and Sadler-Smith, 2006).

IWO is the second subtype of ORI and it is linked with innovations in the workplace organization in order to obtain better performance on individual level of those who uses that workplace. As the overall result, the work efficiency of the organization should increase. IWO deal with new methods of organizing the work of individuals, e.g. centralization, decentralization or re-organizing the organizational structure, as well as integration or diversification of different business activities (OECD-EUROSTAT, 2005; Som et al., 2012).

The IER is the third subtype of the ORI and it encompasses *"new ways of building relations with a firm's external environment including other firms, public institutions, research organizations, customers and suppliers in order to enhance the efficiency of production, procuring, distribution, recruiting and ancillary services"* (OECD-EUROSTAT, 2005, p.52). Making usage of networking activities is a crucial competence that a modern organization aiming at developing fast in the knowledge based economy must obtain (Mothe and Thi, 2010; Sapprasert and Clausen, 2012). The degree of ability to develop this competence is demonstrated by the IER. According to Kogut (1988), Kogut and Zander (1993), Cassiman and Veugelers (2002) developing the external relations facilitate an organization to gain additional knowledge and skills by providing access to partners' complementary competences. That also increases the competitiveness of an organization as the collaboration with partners excludes duplication in R&D activities and reduces risks involved in venture projects (Jacquemin, 1988; Sakakibara, 1997). The well-established partnership promotes benefits from economies of scale or scope as well as facilitates receiving new scientific and technological knowledge for the firm's own R&D activities (Kogut, 1988; Sakakibara, 1997, 2001).

There are numerous suggestions in the literature on how innovation can be classified. Scholars made many attempts to explain and specify the levels of innovation in different contexts (Lam, 2002). For example, an innovation may occur at individual level, which means introducing an innovative solution at a level of an employee or an individual person. Often this encompasses IWO subtype of ORI (OECD-EUROSTAT, 2005). An innovation can also relate to a particular department or a function of a company as well as to its overall structure or functional principles. Those often are classified as organizational level innovation (Van Lancker et al., 2016) and are driven by the firm-based capabilities and resources (Porter, 1980).

An ORI may well be industrial level innovation that have an impact on the firm's relationship with its partners or the environment (Wengel et al., 2002). At last, an innovation can be introduced at the institutional level that effects the society in whole (Hoskisson et al. 2000; Meyer and Peng, 2005). The industrial level innovation are often driven by a certain number of the formal and informal constraints that innovators confront in the industry (North, 1990; Oliver, 1997; Scott, 1995), as industries differ in terms of structure, value-creation chain, and other determinants (Stabell and Fjelstad, 1998).

The institutional level innovations have much stronger effect onto the economy compare to the innovations introduced at the lower levels. For example, a positive progress at the institutional level could encourage investors to launch new businesses or to enlarge an existing form of partnership (Dikova and van Witteloostuijn, 2007).

3. Industry overview

The energy system of Finland has been developed during the 20th century. The cold climate of the country, long distances and increasing need of the energy-intensive industry impacted the solutions underlying the system. Rapid development of wind and solar PV technologies provoked the energy system disruption alike in all the Nordic countries.

Wind energy systems were evolving fast during the last two decades and in 2017 the global wind power market was about 50 GW (GWEC, 2017). At the present Finland got a very general strategy on wind energy development, which includes only some general targets (MEE, 2014). The renewable technologies of electricity production, such as wind and solar PV power have never been supported much by Finnish regulatory environment. The positive changes started to take place after the year of 2010 with introduction of the feed-in tariffs. The last were aiming at motivating economically both the usage and development of wind power. Wind energy covers 3.5-3.7% of the total energy consumption in Finland. It is generated by more than 550 wind turbines. In 2017 wind power capacity in Finland gets over 1500 MW due to more than180 new turbines with combined capacity of about 600 MW that were put into operation in 2016 (FWPA, 2017). The target for the country is to have by 2020 and by 2025 over 2500 MW and 3750 MW of installed wind turbine capacity correspondingly.

Solar PV power has become a globally significant alternative to generate electrical energy. In Germany, for example, the estimated annual share of annual electricity consumption in solar power systems in 2016 was over 7% and in Denmark over 2.5% (IEA PVPS, 2017). In Finland, PV systems are installed mainly at an individual level at summerhouses. In 2010 the small-sized solar PV systems had been started connecting to the electricity grid. However, despite of the increasing installation of power plants and small energy sources, the annual electricity consumption produced by photovoltaic technologies is still marginal in Finland and by the end of 2017 the grid-connected solar PV capacity was approximately 50 MW (IEA PVPS, 2017).

4. Methodology

To examine further the ORO in renewable energy sector, our study uses multiple sources of data combining industry analysis and data collected through Delphi survey that was followed by the workshop.

Firstly, we provide the technology trends related to wind and solar PV energy development up to the year of 2050 based on the technology reviews. The renewable energy generation and consumption sources were investigated in order to receive the pattern of the current event of things with the renewable energy industry in Finland. The trends of wind and solar PV energy technologies were derived from the industry related reports provided by institutions and agencies involved in industry monitoring and survey (e.g., IRENA, 2012; GWEC, 2014, 2016).

The technology trends underlie the Delphi survey which was conducted to investigate the most influential phenomena affecting the wind and solar PV electrical energy sector development in Finland. The Delphi survey comprises both the numerical data obtained by means of the questionnaire and the key insights from workshop discussions. The Delphi method used in our study to collect and analyze the data is a judgmental forecasting procedure and is often used in the situations when the method of the survey demands input from the respondents (Rowe and Wright, 1999; Wright et al., 1996). A few crucial stages underlie the Delphi method. They are: iteration, controlled feedback, and statistical aggregation of a group response (Rowe and Wright, 1999). Cheng et al. (2008) argued that the method could be well used in investigating such phenomenon as an effect created by a disruptive technology. The method also can be used for working on macro-environmental scenarios (e.g., Kuusi,1999; Nowack et al., 2011).

In our survey, we conducted the first and the second round of the Delphi survey in April and May of 2016 correspondingly. The following-up workshop was organised in June of the same year. We sent the surveys to 250 energy sector experts in Finland. The expert panel encompasses academic, industry, and public authorities. In each round 50 respondents retuned the filled in forms. At last, based on the Delphi survey results, the workshop that included 40 experts was organized in order to gain deeper understanding of potential innovations pertained to the forthcoming energy sector change in Finland.

Based on the obtained data we defined the potential ORI that seem to be of the most relevance for the further efficient evolvement of the wind and solar PV energy sector in Finland. The main findings of our study are presented in the next paragraph.

5. Data analysis and results

Table 1 demonstrates the key results obtained in the study related to the phenomena noted by the experts of the panel concerning the evolvement of wind and solar PV energy in Finland. Table 2 and 3 relate to wind energy and solar PV electrical technologies correspondingly. In these tables the noted phenomena, as it was found during the Delphi survey and the workshop, is listed in the first column. The second column suggests an ORI that should be introduced to utilize the affect of the phenomena. The third column presents the level and the sub-type of the suggested ORI. At last, the actors that should be involved in the process of the ORI are listed in the fourth column.

Table 1. The findings of the study related to the evolvement of the wind/solar PV energy in Finland

Phenomenon noted by the experts of the panel related to the evolvement of the wind/solar PV energy in Finland	Potential ORI that could be introduced pertained to the given phenomenon	Level / Sub-type of ORI	The actors involved
The energy storage technologies are not developed enough to follow the progress in renewable energy sources	The process of working on new solutions in energy storage and transmitting	Industrial level / IER	Country Government, R&D organizations
	Collaboration between energy sector actors	Industrial level / IER	Sub-contractors
Lack of demand-side flexibility in the usage of variable renewable sources of electrical energy	New models of economic relations with customers	Institutional, industrial, and individual levels/ IER	Public institutions, customers
Unintelligible city-level strategies on renewable energy usage	New organizational models for city architectural committees	Institutional level/ IER, IMP, IWO	City governments, Public institutions
Continuously increasing number of renewable energy system components come to be available for a prosumer / consumer	An efficient customer/supplier network	Industrial level/ IER	Suppliers, Sub-contractors
Scarce investment mechanisms for a private customer	New approaches in individual financing	Institutional level/ IER, IWO	Energy firms, customers
Apartment house tenants cannot easily invest into renewable energy generation systems to be incorporated into their house infrastructure	The organizational models that allow shareholders and house owners of an apartment building to invest into their house renewable energy infrastructure	Institutional and industrial and individual levels/ IER	Public institutions Sub-contractors House owners Householders
	The financial models that allow shareholders and house owners of an apartment building to invest into their house renewable energy infrastructure	Institutional and industrial and individual levels/ IER	Public institutions Sub-contractors House owners Householders

As for the results presented in the Table 1, among the technical issues the experts pointed out the need for the development of storage and transmission technologies as efficient complementary technologies to handle the problem of impossibility to control the effect of natural forces, which are in our case the strength of wind blow and the level solar illumination. In spite of the pure technical character of this problem, it demands a pertained ORI to be introduced in order to launch the process of working on new solutions as well as to develop efficient collaboration between energy sector actors. For instance, the renewable generation sources could be connected to the district heating network and heat pumps in order to take full advantage of electricity production.

However, the most of the noted phenomena demand evolvement of new organizational models, financial mechanisms of efficient investment or market related approaches. In order to develop and implement these models ORIs at institutional, industrial, and individual levels must be introduced, the most of which are at the institutional level. Numerous ORIs could facilitate bringing the renewable technologies closer to both the prosumers and the customers by means of the processes of knowledge dissemination and household adapted solutions. We have not found much evidence of the demand of ORIs at organizational level. At the same time most of them are ORIs that deal with various types of external relation establishment between different actors (IER subtype of ORI).

Based on the data collected in the Table 2, besides a few technical related matters the experts noted the need to increase the understanding of the efficiency of the forthcoming technologies within the society. Thus, e.g., by building on that understanding the relations between turbine constructors/operators and people from the local community might turn out beneficial for the both sides. Those relations could be set up by disseminating the knowledge of wind power usage and probably involving the local community as a stakeholder in the process of construction and exploitation of a wind farm. In most of the cases listed in the Table 2, the IER subtype of ORI is involved. Some of them like developing the process of working on new solutions of energy transmitting and storage require introduction of IMP subtype of ORI as new management practices must be evolve for the new processes.

Table 2. Some examples of the results obtained in the study related to the evolvement of the wind energy in Finland

Phenomenon noted by the panel experts related to the evolvement of the wind energy in Finland	Potential ORI that could be introduced pertained to the given phenomenon	Level / Sub-type of ORI	The actors involved
The arctic conditions brings forward specific technologies of the wind energy generation	The process of working on new solutions of wind-energy generation and consumption under the environmental specifics of Finland (in particular, de-icing of wind-turbine propellers)	Industrial level/ IMP, IER	R&D organizations
Opportunity to build wind power farms in locations where there is no consumption	The process of working on new solutions of energy transmitting and storage	Institutional and industrial levels/ IER, IMP	Public institutions , R&D organizations
The relations between turbine constructors/ operators and people from the local community sometimes are crucial for the success of building a wind farm	The model of involving the local residents as stakeholders	Institutional and industrial and individual levels/ IER	Public institutions , local communities turbine constructors/ operators

Table 3. Some examples of the results obtained in the study related to the evolvement of the wind energy in Finland

Phenomenon noted by the panel experts related to the evolvement of solar PV energy in Finland	Potential ORI that could be introduced pertained to the given phenomenon	Level / Sub-type of ORI	The actors involved
All the PV panels should be connected to an intellectual system in order to optimize self-consumption	The concept of production-demand control pertained to the solar PV energy generation	Industrial and individual levels/ IER	Public institutions, R&D organizations, householders
	Intellectual demand-response energy control systems	Industrial and individual / IER	R&D organizations
The role of prosumers in solar PV energy generation increases	The business models on how to involve prosumers in energy generation process on a large scale	Institutional industrial and individual levels/ IER	Public institutions, Householders, R&D organizations,
	The model of collaboration between house owners in a house cluster	Institutional industrial and individual levels / IER	House owners Householders
The most of the householders are not ready for implementing renewable energy related technical innovations in their houses	The process that foster increasing among householders and house owners knowledge on benefits of renewable energy usage	Institutional industrial and individual levels/ IER, IWO	Public institutions, householders

As for the Table 3 that relates to solar PV technologies, many of the ORIs should be introduced at individual level. This comes from the fact that solar PV systems are on average relatively small and therefore manageable by a house owner. Nevertheless, to make the process of implementing technologies going at the level of a household, some institutional ORI must be introduced prior to those of working at an individual level.

6. Discussion

Our study was aiming at showing an approach that facilitates the process of the evolvement and implementation the energy strategy in Finland. The ORIs that underlie the economic and social processes on a national level drives to a large extend the technological innovation and strategic decision at the institutional, industrial, organizational, and individual levels. This stays in line with Van Lancker at al., (2016) who argue that organizational innovations lead the social regimes to change.

As for the main conclusion, our study has found that in terms of renewable energy evolvement there is not enough interconnection, intercommunication, and mutual understanding between all the interested and involved parties. A large gap in our understanding is between the institutional the individual levels. In the context of this gap it can be decreased by improving gradually the existing legislation and by disseminating the pertained knowledge among the society.

The results demonstrate that all the three subtypes of the ORI should be equally involved into the process of renewable energy development. The IMP subtype of ORI could well support the challenges related to the knowledge management issues within the industry as well as ones on cross-industrial level by, e.g., creating the environment for efficient data collecting and data exchange. The IWO subtype of ORI plays a crucial role when the problems narrow down to an initiative that refers to a household. That, for instance, could well be one that deals with developing an organizational model of collaboration between house owners in a house cluster. At last, the IER subtype of ORI is inevitable in all the matters concerning the communication, knowledge exchange, collaboration between all the stakeholders as well as for the efficient management and usage of all the elements of the energy system.

The study has some methodological limitations. The first limit is that from all the range of renewable sources only the wind and solar PV energy related issues were considered. Apparently, taking into consideration the broader scope of renewable energy sources would allow to generalize the results in a broader context. Second, the study was carried out only in frame of one country. As it was mentioned above this fact doesn't influence the methodological issues of the study, but, however, could have a great impact on the overall end results. Third, would the data set be large, probably the greater number of ORIs and much more stronger relations between organizational and other types of technological and non-technological innovation could be found.

Our study in a way oppose the well spread statement that the renewable energy sector is driven in a large its part by disruptive technologies that in turn are associated with continuous introduction of technological innovation (Richter, 2013). In the contrary, we have shown that in many cases an ORI underlies the process of flourishing a technological innovation as well as provokes a disruptive change at institutional, industrial, and individual levels. The further research should take into wider consideration the complex of factors that lead to the appropriate ORIs.

As for the managerial implication, based on our study we would suggest that the success in introducing the various of ORI in energy sector would bring Finland onto higher level of competitiveness as well as contribute into increase of the country's independency from fossil technologies. The Finnish society will gain all kinds of direct and indirect benefits that the state-of-the-art energy system could grant, as well as from the benefits related to preserving the eco-system from destructive factors (Heinonen et. al, 2015).

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References

Armbruster, H., Bikfalvi, A., Kinkel, S., and Lay, G. 2008. "Organizational innovation: The challenge of measuring non-technical innovation in large-scale surveys." Technovation 28(10): 644-657.

Azar, G., and Ciabuschi, F. 2017. "Organizational innovation, technological innovation, and export performance: The effects of innovation radicalness and extensiveness." International Business Review 26(2): 324-336.

Birchall, D., Chanaron, J., Tovstiga, G., and Hillenbrand, C. 2011. "Innovation performance measurement: current practices, issues and management challenges." International Journal of Technology Management 56(1):1.

Cassiman, B., and Veugelers, R. 2002. "R&D co-operation and spillovers: some empirical evidence from Belgium." American Economic Review 92 (4): 1169-84.

Cheng, A.-C., Chen, C.-J., and Chen, C.-Y. 2008. "A fuzzy multiple criteria comparison of technology forecasting methods for predicting the new materials development." Technological Forecasting and Social Change. North-Holland. https://doi.org/10.1016/j.techfore.2006.08.002

Dedrick, J., Venkatesh, M., Stanton, J. M., Zheng, Y., and Ramnarine-Rieks, A. 2015. "Adoption of smart grid technologies by electric utilities: factors influencing organizational innovation in a regulated environment." Electronic Markets 25(1): 17-29.

Dikova, D., and van Witteloostuijn, A. 2007. "Foreign direct investment mode choice: entry and establishment modes in transition economies." Journal of International Business Studies 38: 1013—1033.

Fagerberg, J., Fosaas, M., and Sapprasert, K. 2012. "Innovation: Exploring the knowledge base." Research Policy 41(7):1132-1153.

Foss, N. J., and Saebi, T. 2017. "Fifteen years of research on business model innovation: How far have we come, and where should we go?" Journal of Management 43(1): 200-227.

Frantzis, L., Graham, S., Katofsky, R., and Sawyer, H. 2008. Photovoltaics Business Models. NREL/SR-581-42304. [online] Burlington, Massachusetts: National Renewable Energy Laboratory. Available at: http://www.nrel.gov/docs/fy08osti/ 42304.pdf [Accessed 18 Apr. 2017].

FWPA 2017. Finnish wind turbines and wind power projects. [online] Finnish Wind Power Association. Available at: http://www.tuulivoimayhdistys.fi/en/wind-power-in-finland/industrial-wind-power-in-finland/industrial-wind-power-in-finland [Accessed 24 Apr. 2017].

Geels, F., and Schot, J. 2007. "Typology of sociotechnical transition pathways." Research Policy 36(3): 399-417.

Grant, R.M. 1996. "Toward a knowledge-base theory of the firm." Strategic Management Journal 17 (Winter): 109-122.

GWEC. 2014. Global Wind Energy Outlook 2014. [online] Global Wind Energy Council. Available at: http http://www.gwec.net/wp-content/uploads/2014/10/GWEO2014_WEB.pdf [Accessed 18 Apr. 2017].

GWEC. 2016. Global Wind Energy Outlook 2016. [online] Global Wind Energy Council. Available at: http://files.gwec.net/register?file=/files/GlobalWindEnergyOutlook2016 [Accessed 18 Apr. 2017].

GWEC. 2017. Global Wind Energy Outlook 2017. [online] Global Wind Energy Council. Available at: http://files.gwec.net/register?file=/files/GWR2017.pdf [Accessed 02 June 2017].

Heinonen S., Karjalainen J., and Ruotsaalainen J. 2015. Towards the third industrial revolution. [online] Finland Futures Research Centre. FFRC eBook 6/2015 Available at: https://www.utu.fi/fi/yksikot/ffrc/julkaisut/e-tutu/Documents/FFRC-eBook-6-2015.pdf [Accessed 18 Apr. 2017].

Heiskanen, E., Ahonen, T., Airaksinen M., Jalas M., Kangas H.-L., Kivimaa P., Lovio R., and Temmes A. 2017. Delimitation of technologies and impacts in focus in the Smart Energy Transition project. Aalto University publication series. CROSSOVER 7/2017. Helsinki: Aalto University.

Hoskisson, R.E., Eden, L., Lau, C.M., and Wright, M. 2000. "Strategy in emerging economies." Academy of Management Journal 43, 3: 249—267.

IEA PVPS. 2017. Annual report 2017. [online] IEA PVPS. Available at: http://www.iea-pvps.org/index.php?id=6 [Accessed 02 June 2017].

IRENA . 2012. Wind Power. Renewable energy technologies: Cost analysis series. Volume 1: P ower Sector Issue 5/5. [online] International Renewable Energy Agency. Available at: https://www.irena.org/DocumentDownloads/ Publications/RE_Technologies_Cost_Analysis-WIND_POWER.pdf [Accessed 18 Apr. 2017].

Jacquemin, A. 1988. Cooperative agreements in R&D and Europe antitrust policy. European Economic Review 32(2-3): 551-560.

Klette, T., and Kortum, S. 2004. "Innovating Firms and Aggregate Innovation." Journal of Political Economy, 112(5): 986-1018.

Klose, F. 2010. Toward a Distributed-Power World. Renewables and Smart Grids Will Reshape the Energy Sector. [online] The Boston Consulting Group. Available at: https://www.bcg.com/documents/file51254.pdf [Accessed 18 Apr. 2017].

Kogut, B., and Zander, U. 1993. "Knowledge of the firm and the evolutionary theory of the multinational corporation." Journal of International Business Studies 24(4): 625-645.

Kogut, B. 1988. "Joint ventures: theoretical and empirical perspectives." Strategic Management Journal 9(4): 319-332.

Korjonen-Kuusipuro, K., Hujala, M., Pätäri, S., Bergman, J.-P., and Olkkonen L. 2017. "The emergence and diffusion of grassroots energy innovations: building an interdisciplinary approach." Journal of Cleaner Production. 140(3), 2017: 1156-1164.

Kungl, G. 2015. "Stewards or sticklers for change? Incumbent energy providers and the politics of the German energy transition." Energy Research & Social Science 8: 13-23.

Kuusi, O. 1999. Expertise in the Future Use of Generic Technologies - Epistemic and Methodological Considerations Concerning Delphi Studies. Helsinki School of Economics and Business Administration.

Lam, A. 2002. "Alternative societal models of learning and innovation in the knowledge economy." International Social Science Journal 54(171): 67-82.

Manyika J, Chui M, Bughin J, Dobbs R, Bisson P., and Marrs, A. 2013. Disruptive technologies: Advances that will transform life, business, and the global economy. [online] McKinsey. Available at: http://www.mckinsey.com/insights/business_ technology/disruptive_technologies [Accessed 18 Apr. 2017].

MEE . 2014. Energy and Climate Roadmap 2050. Report of the Parliamentary Committee on Energy and Climate Issues. [online] Ministry of Employment and the Economy. Available at:http://tem.fi/documents/1410877/2769658/Energy+and+ Climate+Roadmap+2050/9fd1b4ca-346d-4d05-914a-2e20e5d33074 [Accessed 18 Apr. 2017].

Mothe, C., and Thi, T.U.N. 2010. "The link between non-technological innovations and technological innovation." European Journal of Innovation Management 13(3): 313-332.

North, D.C. 1990. Institutions, Institutional Change and Economic Performance. Cambridge University Press: Cambridge.

Nowack, M., Endrikat, J., and Guenther, E. 2011. "Review of Delphi-based scenario studies: Quality and design considerations." Technological Forecasting and Social Change 78: 1603–1615.

OECD-EUROSTAT 2005. The measurement of scientific and technological activities. Proposed guidelines for collecting and interpreting technological data. Oslo Manual, OECD-EUROSTAT, Paris.

Oliver, C. 1997. "Sustainable competitive advantage: Combining institu-tional and resource-based views." Strategic Management Journal 18: 679—713.

Porter, M. 1980. Competitive Strategy. Free Press: New York.

Prahalad, C.K., and Hamel, G. 1990. The core competence of the corporation. Harvard Business Review 68(3): 79-91.

Richter, M. 2012. "Utilities' business models for renewable energy: A review." Renewable and Sustainable Energy Reviews 16(5): pp.2483-2493.

Rowe, G., and Wright, G. 1999. "The Delphi technique as a forecasting tool: issues and analysis." International Journal of Forcasting. 15, 353–375. https://doi.org/10.1016/S0169-2070(99)00018-7

Sakakibara, M. 1997. "Heterogeneity of firm capabilities and co-operative research and development: an empirical examination of motives." Strategic Management Journal 18(6): 143-216.

Sakakibara, M. 2001. "Cooperative research and development: who participates and in which industries do projects take place?" Research Policy 30(7): 993-1018

Sapprasert, K., and Clausen, T. 2012. "Organizational innovation and its effects." Industrial and Corporate Change 21(5): 1283-1305.

Schumpeter, J. 1934. The theory of economic development. Harvard University Press, Cambridge, MA

Scott, W.R. 1995. Institutions and Organizations. Sage: Thousand Oaks, CA.

Som, O., Diekmann, J., Solberg, E., Schricke, E., Schubert, T., Jung-Erceg, P., Stehnken, T., and Daimer, S. 2012. Organisational and Marketing Innovation - Promises and Pitfalls. PRO INNO Europe: INNO-Grips II report, Brussels: European Commission, DG Enterprise and Industry.

Spicer, D.P., and Sadler-Smith, E. 2006. "Organizational Learning in Smaller Manufacturing Firms." International Small Business Journal 24(2): 133-58.

Stabell, C.B. and Fjeldstad, Ø.D. 1998. "Configuring value for competitive advantage: On chains, shops, and networks." Strategic Management Journal 19: 413—437.

Stoiciu, A., Szabo, E., Totev, M., Wittmann, K. and Hampl, N. 2017. Assessing the Disruptiveness of New Energy Technologies - An Ex-Ante Perspective - [online] WU (Vienna University of Economics and Business). Available at: http://epub.wu.ac.at/4310/ [Accessed 18 Apr. 2017].

Strupeit, L., and Palm, A. 2016. "Overcoming barriers to renewable energy diffusion: business models for customer-sited solar photovoltaics in Japan, Germany and the United States." Journal of Cleaner Production 123:124-136.

Teece, D. 2010. "Business Models, Business Strategy and Innovation." Long Range Planning 43(2-3):172-194.

Van Lancker, J., Mondelaers, K., Wauters, E., and Van Huylenbroeck, G. 2016. "The Organizational Innovation System: A systemic framework for radical innovation at the organizational level." Technovation. 52: 40-50.

Wengel, J., Lay, G., Nylund, A., Bager-Sjogren, L., Stoneman, P.,Bellini, N., Bonaccorsi, A., and Shapira, P. 2000. Analysis of empirical surveys on organizational innovation and lessons for future Community Innovation Surveys. EIMS Publication No. 98/191. Karlsruhe.

Wright, G., Lawrence, M.J., and Collopy, F. 1996. "The role and validity of judgment in forecasting." International Journal of Forcasting 12:1–8