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CURRENT CONCERNS AND TRENDS IN THE BUSINESS OF RENEWABLE ENERGY

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Abstract
Achieving sustainable growth of the renewable energy market is vital in order to reach global targets for sustainability and environmental improvement. The present paper analyzes changes in the market of renewable energy, technological advances, potential benefits, as well as present and future obstacles. Changes of the renewable energy support systems have lead to a reconsideration of what drives investments in the field and how the business can be fostered on the long-term. Although significant reductions of the costs for renewable energy have been achieved, as is the case of photovoltaic energy, the high investment cost, as well as the difference between prices for energy from renewable sources and prices for conventional energy, still represent barriers to be overcome by the investors. Ways of improving the distribution and storage of energy from renewable energy are continuously being researched. The present paper empirically proves the importance of entrepreneurship and innovative business models in developing the renewable energy market, as well as technological research that would lead to the long-term cost efficiency of renewable energy.

Keywords: renewable energy market, renewable energy technology, support system, business models, collaboration.

1. INTRODUCTION

The need to rethink the energy system has become a primary global concern approximately 20 years ago. One of the first awakening calls regarding environmental changes was the report elaborated by the World Commission on Environment and Development, “Our Common Future” (1987). In 1993, the United Nations Conference on Environment and Development (1992) took place and lead to the Kyoto Protocol, signed in 1997 by 193 nations.

Today, energy generation from renewable sources is of major interest for governments that want to achieve the environmental targets that they have set, private companies that want to incorporate it in their business models and portfolios, and the impacted society. According to Kaygusuz et. al. (2007), renewable energy will also promote sustainable development objectives.

Recent trends in the renewable energy business have been characterized by technological improvements in order to reach efficiency and also assure sustainability, researching new energy

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sources, extending the business in emerging markets and creating new business models based on entrepreneurial motives (Buitenhuis and Pearce, 2006; Miron and Gabor, 2012; Buhrke and Wengenmayr, 2012).

Worldwide organizations have started collaboration with local governments of emerging countries in order to foster the development of clean technology and energy from renewable sources. The Global Environment Facility and UNDP are examples of worldwide organizations working on the promotion of access to renewable energy by collaborating on policies, regulatory and financing options. Loans of $41 million were announced for renewable energy projects in six developing countries by the International Renewable Energy Agency (IRENA) and the Abu Dhabi Fund for Development (ADFD) in 2014. The winning projects are in Ecuador, Mali, the Maldives, Mauritania, Samoa and Sierra Leone and involve hydro, wind, solar and biomass technology (Ross, 2014). According to the Frankfurt School – UNEP Centre report for 2013 (Frankfurt School, 2014), the balance in overall investment changed in 2012 from roughly a two-thirds-one-third split between developed and developing economies to one that was much closer to 50:50. In the 2014 Renewable Energy Country Attractiveness Index (Ernst & Young, 2014), China and Brazil were listed as the 4th attractive country for biomass, just after Japan, UK and Germany. India was in the first half of the list of 40 countries, on number 17, while Kenya managed to be above Romania and Bulgaria, both countries of the European Union.

More important, these countries have managed to produce renewable energy based on new, innovative methods, as is the example of Husk Power Systems, an Indian start-up that produces energy from rice husks (Hanson, 2012). Being mostly rural countries, with intensive agriculture, using biomass for energy generation has known a major growth in developing countries in the last few years. In the 2011 UNEP and Bloomberg analysis of trends in renewable energy investments, the examples of companies from India and Cambodia has been mentioned: they developed a business by using rice shells as biofuel. Other examples in the report included using solar energy to power large kitchens such as canteens or processing foods with solar power in developing countries. Other renewable energy sources that are highly exploited in the developing countries are hydropower and wind power, with small hydro projects and small wind parks (UNEP, 2011).

The further sustainable development of the renewable energy domain currently meets barriers on several levels: market and social, information failures, regulatory and financial (IPCC (2007), UNEP (2007) and IEA (2008)).

The main market barrier is represented by the price distortion between energy from renewable sources and conventional energy (Beck and Martinot, 2004). However, raising public awareness would also

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help support renewable energy investments, by reducing public protests against renewable energy projects (Lefebre, 2013). Instability of policies is another topic that discourages renewable energy investors (Leete, 2013).

In the development of the renewable energy business, financial support and financial models have been especially important to make it attractive for investors and to face the low costs of competitive products (Fais et. al, 2014; Boomsma et al., 2012). Due to the development of the technology for renewable energy, as well as the effects of the economic crisis which began in 2008, the financial aspects of the business have changed drastically. While some countries have known changes of the conditions under which investors receive financial support, in others, this has been completely removed (Frankfurt School, 2014). As a response to changes in financial support schemes, the business models that integrate renewable energy have become increasingly important for keeping the development of this sector viable on the long-term (Würtenberger et.al, 2012).

Even if the technology for renewable energy has debatably reached maturity (UNEP, 2011), the price parity between energy from renewable energy and conventional energy hasn't been reached yet (Bayar, 2013). The price parity between the technology of energy generation from renewable sources and conventional energy sources is only one of the current concerns regarding the field. The distribution of energy from renewable sources is also an issue. Integrating renewable energy into national grids is difficult due to the geographical location where this energy can be produced. It is the case of offshore wind parks or hydropower plants (Justus, 2005).

The current paper aims at analyzing how the business has developed in the past years, reviewing the major current concerns and the ways in which these can be overcome.

2. BARRIERS TO THE RENEWABLE ENERGY DEVELOPMENT

Following the Kyoto conference, frame programs for promoting energy from renewable resources were developed in 1998 (Morthorst, in Petersen, 1999). The European Union's ALTENER and SAVE programs, aiming at assuring energy efficiency and CO2 reduction (ec.europa.eu), were superseded by the Intelligent Energy program in 2002, which focuses on electricity from renewable sources (RES-E), heat from renewable energy (RES-H), small scale renewable energy applications and alternative fuels and vehicles (ec.europa.eu).

As the technology for energy from renewable sources has been highly expensive, in comparison with conventional energy technology (Beck and Martinot, 2004), the European Commission has set up

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Directive 2001/77/EC, which encourages the support of the Member States for renewable energy producers.

In January 2007, the European Commission presented the Renewable Energy Roadmap, which set as goals to reduce greenhouse gas emissions by at least 20% compared to 1990 levels or by 30% if possible, increase the share of renewable energy in final energy consumption to 20%, and achieve a 20% increase in energy efficiency by 2020.

To further support these goals, a support framework for the member states has been developed. The European Commission has prepared a Directive on Renewable Energy Sources (2009/28/EC) and policies in order to achieve the common goals of the Union.

2.1. Shift in renewable energy policies

Support schemes for investments in renewable energy are divided into two main categories: price based mechanisms (feed-in tariffs, premium tariffs, loans, subsidies) and quantity based mechanisms (tradable green certificates or tendering procedures) (Ecofys, 2011). Other governmental support means have been trainings and certifications for specialists in the renewable energy field (RES LEGAL Europe, 2012).

One of the most common governmental supports for renewable energy producers has been the quota system, where "the government sets a percentage of electricity to be generated by renewable sources, assigns an actor, such as electricity users, suppliers or generators, to meet the specific percentage and penalizes those who fail to meet their goal" (Mezher et al., 2012). Green certificates will be granted to electric power producers for every MWh obtained by wind power, hydro-power, solar power, biomass, landfill gas or gas fermentation sludge from wastewater treatment plants. These can be further traded on the renewable energy market, thus providing a further profit for the providers. There have been many debates regarding the efficiency of these European methods to promote renewable energy. Herman Scheer (in Petersen, 1999) considers the use of the quota system to be an inefficient method to support the production of renewable energy on the long-term. There is no control of the holders of renewable energy, and no penalties for non implementation. Companies might keep green certificates, instead of trading them, in order to influence their price and exercise an effect on competitors. The main issue, however, is that the quota system burdens the final consumer more, as the price of green certificate is included in their energy bills. According to Fais et al. (2014), countries implementing a support system must pay attention "both to promoting the most cost efficient technologies and to limiting the cost burden on consumers with the help of a clearly differentiated remuneration structure". Another issue is the

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volatility of certificate prices which theoretically could drop to zero in case of over-investments, leaving investors with high capital losses (Fagiani et al., 2013).

Other intensively used support schemes are the power purchase agreements and the feed-in tariffs. The EU states that have introduced power purchase agreements obliged power utility companies to buy energy from renewable sources at a buy-back rate of 85% of the consumer price of electricity (Morthorst in Petersen, 1999). Feed-in tariffs, on the other hand, are fixed prices that system generators receive from the government, "reflecting regulator's estimation of the average generation cost of renewable energy technologies" (Fagiani et al., 2013). A special type of feed-in-tariff scheme is the net metering policy, which allows utility customers to offset some or all of their energy use with self produced renewable energy (Poullikkas et al., 2012).

The experiences related to these instruments can help specialists define those that are most efficient for the development of renewable energy (Boomsma et al., 2012; Bürer and Wüstenhagen, 2009). In Germany, fixed tariffs for renewable electricity have been successful in promoting renewable electricity generation, raising its share in gross final electricity consumption from 6% in 2000 to 23% in 2012 (Fais et. al, 2014). In a Nordic case conducted by Boomsma et al., the authors found that the feed-in tariff encourages earlier investment; however, after the investment has been undertaken, renewable energy certificate trading creates incentives for larger projects (Boomsma et al., 2012).

Subsidies for fuel costs have been a drawback for renewable energy investments, having extended the price discrepancy between conventional energy and renewable energy. Analysis of the efficiency of fuel subsidies have shown that this governmental support needs to be reformed (IEA, 2011). Phasing out fossil-fuel subsidies by 2020 would also support the sustainability strategy of many states by adjusting the price parity between conventional and renewable energy. While in 2007, the U.S. was spending US$ 5.124 Mil. with renewable energy, versus US$ 5.992,71 Mil. on coal, natural gas, petroleum liquids and nuclear energy, in 2010 the balance was shifted: US$ 14.674 Mil. were spent on supporting energy from renewable sources, versus US$ 6.677 Mil. on conventional energy sources (IEA, 2011).

In order to overcome the specific barriers of each policy, different instruments must be mixed (Mitchell et. al., 2011) and policy mechanisms must be implemented comprehensively, instead of individually (Sovacool, 2009).

The support frameworks have been a major development factor of the renewable energy field. However, in the past two years, the European Union has questioned the correctness of the subsidies system. In a context of financial austerity, 2012 came with sudden cuts for solar support. Moreover, countries such

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as Spain, the Czech Republic, Greece and Bulgaria have announced retroactive cuts (Frankfurt School, 2014). Romania has ceased the payment of green certificates until 2017 (Emergency Ordinance, 2013). The need to rethink support systems for the renewable energy business by taking into account different factors, other than financial support, has thus gained importance.

2.2. Further barriers in the development of renewable energy

Negro et. al. (2012) identified five categories of barriers in the diffusion of renewable energy development: market structure problems such as competing incumbent substitutes, knowledge and physical infrastructure, institutional problems, interaction problems with other firms, the government, public knowledge institutes or consultants, and capability problems.

Although the positive implications of the renewable energy market development in terms of CO2 reduction are well known, the public society isn't always supportive of renewable energy projects. Many protests against renewable energy projects were motivated by their negative impact on wildlife, while others were motivated by its effects on the quality of life as is the case of noise coming from wind parks (Lefebvre, 2013). There are still debates regarding the negative effects that renewable energy technologies have on the animal population (Sovacool, 2009; Willis et. al., 2010). However, Sovacool's comparison between animal fatalities in case of wind plants, versus nuclear plants, show that nuclear plants kill birds almost 17 times more that wind parks do.

The challenges of integrating renewable energy in the national grid systems, as identified in the European Topic Centre on Air and Climate Change technical report (2010) are geographical distribution, distributed generation, variability and intermittency.

Transmission grids for renewable energy have become an important concern for governments and private sectors through the investment in an increasingly high number of renewable energy projects in regions that are difficult to reach. Unlike conventional energy resources that can be transported to a generation site that is grid-optimal (coal, gas, uranium), generation of renewable energy must be co-located with the renewable sources (IEC, 2012). This context creates a new interest in distributed generation of energy, as an alternative for AC grids that allow the transportation of energy over long distances. Before the AC innovation, distributed energy was the general case, supplying the consumers located in the near proximity. The efficiency of AC grids relies on constant supply of energy and economies of scale. Renewable energy supply, however, is characterized by intermittency and geographical limitation (IEC, 2012). In order for renewable energy mini-grids to be efficient, these barriers need to be overcome. The concept of virtual power plants (VPP) seems to be the answer to

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these issues: it implies clustering dispersed and renewable generation units (partially with intermittent power output), storage units and controllable loads. Through the management of these networks, power exchange can be scheduled and dispatched (Hammons, 2008). Research and development efforts towards the realization of a smart grid adapted to the characteristics of generation of energy from renewable sources are increasingly receiving interest from the governmental, academic and private sectors: the REISI project of the Fraunhofer Institute, the R&D activities of Duke Energy in collaboration with South Carolina Electric and Gas and Clemson University, and the technological innovations of NREL (nrel.gov)

Given the more difficult predictability of renewable energy, energy storage, as support service, becomes a major actor for the management of these grids.

3. CURRENT TRENDS IN THE RENEWABLE ENERGY BUSINESS

In the attempt of covering increasingly more of the energetic demand from renewable sources, research and development efforts have been directed not only towards improving current technologies, but also towards finding new sources for the generation of renewable energy. Many of the new changes in the renewable energy domain are market driven, being determined by the need to improve efficiency of investments, in all the terms discusses earlier in this paper. Innovation in the field of renewable energy has also been widely influenced by the business models of the actors, as it is further presented in the paper.

3.1. New and improved renewable energy technologies

Further improvement of renewable energy technologies is vital in order to mitigate the perceived negative effects, but also in order to ensure cost efficiency in the long-run. According to the EIA forecast (2014), the levelized cost of electricity from wind power will be 10% smaller in 2019, in comparison with 2012. The cost of solar photovoltaic modules have decreased by a factor of nine, with a 30% cost decrease in 2009 alone (Wüstenhagen and Menichetti, 2012).

The diffusion of renewable energy technologies may occur in the form of trade-flows, mergers and acquisitions, in-licensing and out-licensing agreements, joint ventures, strategic alliances and specific consultancy services (Pugatch, 2011).

Venture capitalists have played an important role in the development of renewable energy technologies. According to Moore and Wüstenhagen (2004), the key drivers for venture capital investments in renewable energy technologies were the deregulation of the power markets, environmental pressure

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and security needs. However, “the majority of high-tech venture capitalists prefer to invest in technologies with low-risk low-return profiles”, and most of the resources so far have been directed to “mature renewable energy technologies that are closer to grid parity, such as on-shore wind or hydro” (Masini and Menichetti, 2012). In this respect, scholars have been interested in outlining how private capital can be attracted in order to raise the percentage of energy production from renewable sources (Mathews et. al., 2010).

The findings of Bayer et. al. (2013) outlined the domestic electricity generation capacity and high oil prices as predictors of innovation in the renewable energy field, based on the number of filed patents in the domain of renewable energy technologies.

According to Ockwell et. al. (2010), the diffusion of renewable energy technology, especially in developing countries, relies on access to technology licenses. The relationship between intellectual property rights and the development of renewable energy technologies has been intensively debated (Ockwell et.al., 2010). While some authors consider that property rights do not represent a barrier for the transfer of renewable energy technologies (Helm et.al., 2014; Ockwell et.al., 2010), there are also empirical studies where intellectual property rights were considered to be slowing down the diffusion of these technologies (Mallet et.al., 2009).

Renewable energy technologies that have acknowledged significant innovations and improvements are biomass technologies (Miron and Gabor, 2012), wind power (Hampl and Wüstenhangen, 2013) and solar power (REN21, 2010; Ardani and Margolis, 2011).

New technologies in the biomass sector have regarded new enzymes and organisms that are able to break down cellulose (Miron and Gabor, 2012). A new source for bio fuels is represented by algae. In contrast to conventional biomass sources, algae don’t compete with the production of food, and can offer a significantly higher yield, up to 150 tons per hectare annually, as opposed to terrestrial plants (Buhrke and Wengenmayr, 2012). This way of producing energy solved the need for large arable ground and does not take up part of the biomass that is used for the food production industry. Further technological research in the field of bio energy seeks to produce demand-oriented electricity that can be provided by storing untreated biomass or solid, liquid, gaseous biofuels in the existing infrastructure (Szarka et al., 2013).

Barton (2007) considers that the photovoltaic industry is moderately centralized, with four leading firms that are producing about 45% of the market. However, the field represents a significant potential for new players and “solid funding for research from both governmental and venture capital sources” (Helm et.

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al., 2014). Development of technologies in the solar PV industry occurs on three levels: university and research centers, equipment suppliers and manufacturers (Buitenhuis and Pearce, 2006). The most significant technological development was marked by the finalization of the Brightsource Energy solar tower in 2014, the largest investment in this domain today. The first experimental installations for solar towers were set up in Spain in 1981/1982. The technology combines the greenhouse effect with the chimney effect, in order to obtain electrical energy directly from solar radiation (Buhrke and Wengenmayr, 2012). Another bold project in the solar energy sector is the aQuasun System, based on floating solar panels composed out of silicon cells. Both projects solve the need for large space needed to install solar panels, but still have to face difficulties of grid integration.

Wind energy is the most mature renewable energy technology (Helm, 2014). While the basic technological principle of wind energy isn’t new, the sector has been characterized by several improvements. Miron and Gabor (2012) identified technological improvements in the field such as “much lighter and more efficient blades, design of systems (for some styles of mill) to orient the windmill to changing wind directions, mechanisms to protect the system during high winds, and engineering choices needed to decrease long-term maintenance costs”.

The disadvantage of most new breakthrough renewable energy production means is yet again, the difficult way of transporting energy to large grids. A futuristic project lead by individual entrepreneurs relies on solar modules integrated into roads, which already take up a significant amount of space in cities. The project is currently under development at the “Solar Roadways” company in the US, and has produced a prototype for a parking lot that would produce solar energy. Solar roads may achieve the advantage of becoming more reliable than normal concrete roads in the future, thus innovating also another area not related to energy. Other breakthrough technologies for renewable energy production are related to osmosis power plants, hydrogen for energy storage and energy from deserts (Buhrke and Wengenmayr, 2012). The idea for the large-scale utilization of renewable energy in deserts and arid regions was put forward for the first time in its current form in the 1980s by Dr Gerhard Knies. About 1% of the desert surface of the earth would be enough, in theory, to provide all humankind with energy (Desertec Foundation, 2009). The DESERTEC project was developed by a group of scientists and politicians in order to bring this concept to reality.

3.2. Innovative business models and collaboration

While research and technological improvements play a major role in the development of the renewable energy field, business models and strategies may also foster the growth of the industry. An increasing number of companies is interested in diversifying their domain of activity by investing in renewable energy, not only utilities, but also companies with no energy background. Backward integration has been an entrepreneurial initiative used by companies that wanted to produce their own electricity from renewable sources. Examples of such companies that started to produce their own energy from renewable resources are Google (Gupta, 2010) and Sainsbury. Sainsbury has claimed the title of biggest solar power generator in Europe in 2012, with over 69.500 solar panels on almost 170 stores (Murray, 2012).

Reviewing open-source business models, which offer access to the renewable energy technological design, Buitenhuis and Pearce (2006) identified four business models: the partnership model, the franchise model, the secondary supplier model and the completely open-source design. The partnership model presented by the authors is based on sharing intellectual property. This model is further extended in this chapter through examples from the industry. The franchise model is used to create geographical boundaries while collaborating with other firms and improving R&D: "the supplier would not grant more than one manufacturer for one territory, and the manufacturer would agree to not do business outside their own territory" (Buitenhuis and Pearce, 2006). In the secondary supplier model, "encouraging the opening of design within the primary industry would be in the best interest of the secondary industry" (Buitenhuis and Pearce, 2006). The completely open-source design model is based on an open publication of all research.

Overcoming the current barriers for the further development of the renewable energy industry has relied on collaboration between more private companies, but also between the private sector and the public sector.

Renewable energy project financing may be centralized or may be the result of joint ventures. Raising capital for big investments lead to an increasing number of companies willing to collaborate in order to finance the projects and split the risk. Brightsource Energy, the company that launched the biggest solar tower in the world at the moment in February 2014, is powered by energy players such as Chevron and British Petroleum, but also by Google (brightsourceenergy.com, 2014), who had previously also invested in a wind park.

Author J. Siegel mentioned as drivers for entering the renewable energy market "achieving competitive advantage", "improving the company's image" and "government regulation compliance" (Siegel, 2008). Creating a support system based on the factors that influence the decision of utilities and diversifying companies may lead to substantial growth of the market.

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The market development triggered by the needs of the industry, but also the agglomeration of renewable energy producers in certain areas that are favorable for the industry has lead to the growing number of clusters that have renewable energy as main domain of activity. The term ''green cluster'' is used for some time now, to define all business clusters acting in an ecological field. It is based on Porter's concept: a cluster is a geographically proximate group of interconnected companies and associated institutions in a particular field, linked by commonalities and complementarities" (Porter, 1990). Other terms associated with this concept of green cluster are cleantech cluster (Global Cleantech Cluster Association), ecocluster (Wallner, 1999), or environmental cluster.

Green clusters can be created by two means: a) collaboration between green businesses (companies which develop environmental-friendly products and services) on the private sector level, governmental institutions, academic institutions and R&D centers, based on Porter's model (1998); b) collaboration between green businesses and non-green businesses on the private sector level, creating an environmental-friendly synergy effect.

The second type of cluster is based on the natural ecosystem principle, meaning that the waste produced by a corporation within the cluster would be the production raw material for another enterprise. The concept of circular economy, in contrast with the linear, classic economy, supports a system that will not cause resource exhaustion or ecological damage, but can recycle various resources. The creation of the business network and ecological value chain would require more resources, but the synergy effect can lead to more economic efficiency (Jing and Yu 2007). The synergic cluster based on the circular economy shares the same characteristics as the concepts of recycling economy and symbiotic industry. The concept of industrial symbiosis was given by many researchers the key role in future industrial systems during the nineties (Ehrenfeld, 2004). The vision of the concept assumes energetic independent industrial systems, with close to zero negative impact on the environment. Stable ecological systems are "steady-state, entropy-minimizing, highly interdependent collections of producers and consumers" (Prigogine, 1955, in Ehrenfeld and Gertler, 1997). Industrial symbiosis has been put in practice for years now, as is represented by the case of the seaside industrial town of Kalundborg, in Denmark (Ehrenfeld and Gertler, 1997). Although two of the town's four major industries rely on conventional energy, making use of the waste resulting from the park's activity has reduced the quota of coal and oil used to generate power.

Chertow (2000) identified five generic types of industrial symbiosis systems: 1) through market-based waste exchange where companies achieve multiple benefits but which relies on a low degree of coordination, 2) within a single firm or organization where waste is exchanged within the boundaries of a

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single company located in one site or across multiple sites, 3) among co-located companies (eco-industrial parks), 4) among local companies that are not directly co-located but located in close proximity and 5) among companies in a regional setting, typically involving a larger number of companies but without overall coordination of the waste exchange.

A model for symbiosis in photovoltaic manufacturing has been developed by Michigan Tech's Open Sustainability Technology Lab. The park has been designed to be composed of at least eight factories: a conventional recycling facility, a sheet glass factory, a greenhouse or mushroom grow room, the photovoltaic plant, a semiconductor recycling plant, an aluminum factory, a packaging plant and a cardboard factory. The model has been developed based on the relationship between (1) the recycling facility and (2) the glass factory to provide the necessary substrate glass for (3) the PV factory (Pearce, 2008). According to Pearce (2008), the symbiotic model of the Open Sustainability Technology Lab provides a means of obtaining economies of scale in the photovoltaic industry.

Business models based on symbiosis have also been adopted by Iceland based company Íslensk Matorka (Bjerre et. al., 2012), which produces food with geothermal water and energy from other renewable sources, but also fully utilizes the raw material and derivates, by running a greenhouse business in conjunction.

The more commonly encountered type of cluster in the renewable energy field is based on collaboration between producers of renewable energy, as well as with the academic and governmental sector. One of the reasons for the green cluster creation is technological development. In a previous study performed on green clusters, 64% percent of the interviewees listed technological development as their scope within the cluster. (Tantau and Chinie, 2013). Contributing to academic R&D and sharing knowledge assures fast access to technological improvements even for small and middle-sized companies.

Environmental strategies have been integrated with governmental efforts to promote the development of clusters and regional development. Such initiatives are the European Commission's REINA project, aiming at supporting renewable energy and enabling technologies in emerging markets, and the "Resource efficient Europe" policy. Cluster policies for the promotion and development of renewable energy have also been defined by local governmental organisms; such policies have been set up by the German government for Hamburg's business development and by France through its Sustainable Energy Development Pole. A wider expansion of this kind of policies would help assure a sustainable growth of the renewable energy business worldwide.

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4. CONCLUSIONS

Changes of the business landscape of renewable energy have triggered the need to rethink the ways to overcome barriers for the further development of the business. Although governmental policies and support schemes have had a positive impact on renewable energy investments in the past, in order to assure a long-term growth, other ways to support the business on the long-term must be taken into account.

Supporting research and development plays a major part in achieving an improved efficiency of the technologies, while also supporting the concept of sustainability in terms of environment and society and gaining a wider public acceptance. Raising awareness regarding the benefits of renewable energy may also increase the customer base and help the industry grow. Access to renewable energy technology licenses may increase innovation in the field, while also diffusing technological breakthroughs and improvements.

Empirical evidence has shown that successful development of the renewable energy business doesn't rely solely on governmental financial support. Innovative business models have fostered the development of the renewable energy business, winning also new markets, while collaboration models have lead to high capital investments in new technologies that would improve the efficiency of renewable energy generation in the future. Green clusters have received awareness from both private and public sectors and have evolved to a new symbiotic model based on resource efficiency, economies of scale and economies of scope.

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