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Lessons from Öresund Regional Innovation System on Cleantech Development, Cross-border Cooperation and Academic Entrepreneurship

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MESPOM

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ABSTRACT OF THESIS submitted by:
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for the degree of Master of Science and entitled: Lessons from Öresund Regional Innovation System on: Cleantech Development, Academic Entrepreneurship and Cross-border Cooperation

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It is attempted to create a holistic view on the regional innovation system (RIS) of Öresund, a cross-border area between Denmark and Sweden, with a purpose to develop some lessons for RISs in other regions and for Russia, in particular. Cleantech, cross-border cooperation and academic entrepreneurship were chosen as perspectives of Öresund RIS to study since they are relevant for the region and because their analysis could be valuable.

Experiences from Öresund related to networking, branding, development of cleantech clusters and education for entrepreneurship considered to be useful. Networking initiatives, supported by the interested parties on the regional, national and international level play an important role in creating of a common ground for collaboration. Nevertheless, these initiatives have limited capacity for solving specific problems of RIS of the region. Another lesson is that efficient branding could help to develop a good image and attract investors on a certain stage, but it is need to be supported with effective policy incentives. Ambitious low-carbon goals, promotion of education for entrepreneurship and organizing different stakeholders into cleantech cluster could be effective measure to promote cleantech innovation in RIS. Finally, it is suggested that studying of RIS requires utilization of analysis of the both sources: secondary, i.e. literature review, and primary: data analysis – interviewing of the regional stakeholders.

Keywords: regional innovation system, cross-border cooperation, cleantech, academic entrepreneurship, Öresund

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Table of Contents

List of Figures

List of Tables

List of Abbreviations

CCC Copenhagen Cleantech Cluster

HEI Higher Education Institutions

I&E Innovation and Entrepreneurship

ICT Information and communicaiton technologies

IIIEE International Institute for Industrial Environmental Economics

IS Innovation System

LU Lund University

MSU Moscow State University

MVA Medicon Valley Alliance

RIS Regional Innovation System

SBH Sustainable Business Hub

SME Small and Medium Enterprises

1 Introduction

1.1 Background

Öresund is a cross-border region between Denmark and Sweden separated by the sound. The region has a long history of political, social, cultural and economic interactions. Promotion and dissemination of innovations play an important role in the regional development. In the present research three perspectives of Öresund regional innovation system (RIS) were chosen to study with the purpose to develop lessons for innovation systems of other regions. These perspectives are: cleantech, cross-border cooperation and academic entrepreneurship.

There are several reasons to choose these perspectives. Firstly, Öresund has a high capacity to create and promote cleantech innovations. Therefore, obtained knowledge could be used for the analysis of other regions, which are aimed towards cleantech development. Secondly, the region is prominent for cross-border economic cooperation (OECD 2003): both of the transregional parts have similar level of economic development and capacity to produce and promote innovations (Maskell&Törnqvist 1999). Thirdly, capacity of academia is a valuable asset for the regional growth. Utilization of this capacity could help to develop RIS, it is suggested that higher education institutions (HEIs) should play more important role in the development of innovative solutions and in collaboration with business and regional authorities (Caniëls & Bosch 2011).

Clean technologies, which are also known as cleantech, could be defined as "energy and environment-related technologies developed with the objective of reducing harmful effects on the environment" (Swedish Energy Agency 2010). Development and implementation of clean technology innovations is important to achieve sustainability pathway: to improve efficiency of resource usage, reduce negative environmental impact as well as to decrease greenhouse gas

emission, which is also associated with low-carbon development. Moreover, Öresund is at the forefront position for production of entrepreneurial cleantech start-ups and commercialization of clean technology innovations (Cleantech Group and WWF 2012).

Öresund Region consists of Region Hovedstaden and Region Zealand on the Danish side and Skåne County on the Swedish side. The whole Öresund used to be a center of Danish Kingdom during the Middle Ages and until 1658, when the eastern part became Swedish. The overall population of the region in 2010 was 3 732 000, about 67% of the inhabitants were living on the Danish sides and 33% on the Swedish side (Öresund Trends 2010). At the same time, the Copenhagen-Malmö ”twin-city“ agglomeration is considered as the most densely populated in Scandinavia (Hospers 2008). The construction of the Öresund Bridge in 2000, which connected Copenhagen and Malmö, became an important step for development of integration.

The cross-border innovation system of Öresund has a number of important characteristics, which constitute its unity: common agenda in the field of innovations, similar institutions and cultural patterns (OECD 2003; Hansen 2011). There is also a number of similar stakeholders of the RIS on the both sides of the sound. For example, Zealand and Skåne have: major universities, in particular, in Copenhagen and in Lund; cluster initiatives such as Copenhagen Cleantech Cluster and Sustainable Business Hub in Malmö; incubators – Symbion and Ideon. Transnational cooperation in Öresund is one of the prominent interregional initiatives in Europe, and at least in the beginning of 2000s, this initiative was a major endeavor of the Danish and Swedish governments as well as European Commission had the ambition to develop Öresund are ”into one of Europe’s most integrated and functional border region” Cooke *et al.* (2004).

Figure 1. *Map of the Öresund Region (Source: IIIEE 2011)*

In 2003 OECD produced a report, suggesting that effective cooperation in the region could realize a significant potential for economic growth in Öresund (OECD 2003). Key areas for the development of the region were identified including: increasing of competitiveness, networking, collaboration between firms and educational institutions. It needs to be ensured that the results of research, its products and by-products are translated into real business opportunities. This approach could be effective if it is specifically focused on business needs and opening of the new markets. Creation of the joint research strategies in innovation and the supply of services in the region could be an important factor for economic growth as well (OECD 2003).

1.2 Research problem and questions

It is suggested that regional policy-makers often try to follow best examples and implement solutions for RIS that are effective in successful regions. In particular, there were

many attempts to create "Silicon Somewheres" in different parts of the world with the purpose to repeat the success of Silicon Valley (Hospers 2006). Nevertheless, achievements of RIS are not only a matter of current policy, but often a matter of institutional assets, which are difficult to replicate. In case of Silicon Valley such assets include research facilities and large universities, big venture capital funds, mature companies and appropriate entrepreneurial culture (Jackson 2011). Thereby, reasonable alternative to "best region" approach could be a strategy of "regional realism" (Hospers 2006). It assumes not copying of successful practices from successful regions, but learning specific lessons based on their experiences and getting inspiration from their achievements. From this point of view, cleantech development, cross-border collaboration and academic entrepreneurship represent prominent areas with remarkable achievements for Öresund RIS. Therefore other regions could learn from Öresund RIS.

There is a proven capacity in the region for cross-border collaboration and academic entrepreneurship to produce innovations in biotechnology (biotech) and pharmaceuticals (pharmatech). This capacity was revealed during the activities of Medicon Valley Alliance (MVA) since the middle of the 1990s (Cooke *et al.* 2004). There is also a high level of promotion of information and communication technologies (ICT) (Osborne 2006). But there is a significant difference between cleantech, on the one hand, and biotech & pharmatech and ICT innovation, on the other hand, in the way of researching, development and implementation innovations. ICT, biotech and pharmatech are more scientific-driven innovations, whereas cleantech is more policy and market driven. Therefore, sustainability transition utilizing the cleantech capacity of the region requires new understanding of types of cooperation between the sides in Öresund.

Regional innovation policy should take into consideration regional advantage (European Commission 2006). At the same time, it is suggested that entrepreneurship can be seen as a missing link that helps to transfer innovations into business outcomes (Braun *et al.* 2012).

Thereby, the analysis of chosen perspectives on the development of Öresund RIS – cleantech development, academic entrepreneurship and cross-border cooperation, should allow to get better understanding of Öresund RIS and find out about experiences as well as suggest lessons for the innovation systems in other regions.

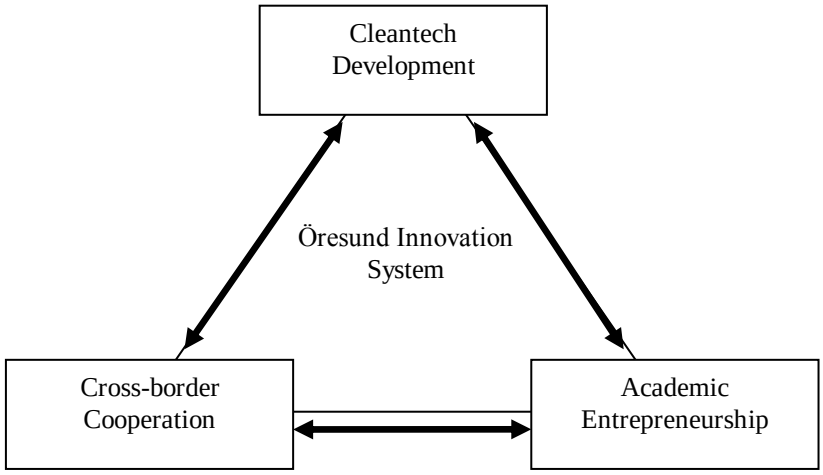

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Figure 2. *Three perspectives on Öresund regional innovation system*

In the light of these considerations the research question could be formulated as: "What could be learned from Öresund RIS from the perspective of cleantech, cross-border cooperation and academic entrepreneurship?"

Sub Question 1: "What lessons for other regions could be studied from the literature analysis of cross-border cooperation in Öresund RIS with regard to cleantech development and academic entrepreneurship?" Task: conduct a literature review on Öresund transregional innovation system, role of cleantech, cross-border cooperation and academic entrepreneurship and develop preliminary suggestions for other regions.

Sub Question 2: "What experiences based on the individual views of the representatives of stakeholders of Öresund RIS could be useful for other regions?" Task: identify stakeholders-organizations related to cleantech, academic entrepreneurship and cross-border collaboration and conduct interviews with the representatives of the organizations. In addition,

it will be attempted to apply some of the lessons to regional innovation system of Moscow, Russia. For that purpose, interviews with representatives of innovation system of Moscow will be conducted.

1.3 Anticipated results

It is anticipated that the research will help to: understand the internal dynamics of cross-border cooperation in Öresund region, drivers and barriers for cleantech innovations development and commercialization, as well as for academic entrepreneurship in Öresund; develop lessons for the innovation system in other regions, including preliminary recommendations based on the literature analysis as well as more specific suggestions supported by the views of the stakeholders of regional innovation system of Öresund; define what measures could be relevant for the innovation system of Moscow.

1.4 Expected limitations

The chosen perspectives on the study of regional innovation system of Öresund could provide broad view on it, but at the same time some other issues could be missing, due to the complexity of phenomena of RIS. Given the limited amount of time it will be attempted to analyze key information sources literature on cleantech, academic entrepreneurship and cross-border cooperation and get the relevant data from the participants of the regional innovation systems. In addition, although interviewees in Öresund and Moscow could provide valuable insights, their personal experiences could be relevant not in all cases.

1.5 Novelty of the research

Each of the chosen perspectives constitutes the novelty of the research. Firstly, studying regional innovation system in a cross-border region is a relatively new field of research. Although there were some studies done on cross-border RIS in different transnational regions, there are sufficient differences in characteristics, which could be a barriers to extrapolate the results to RIS of the Öresund region (Hanson 2011). Secondly, there were not many analyses done for RIS and Öresund regional innovation system, in particular, from the specific perspective – the studies mainly consider the RIS in general. In the present paper the analysis of Öresund RIS will be conducted from the perspective of the regional cleantech development.

1.6 Intended audience

The outcomes of the research will provide relevant information for researchers and policy-makers, who are interested to promote cleantech or study cross-border RIS and analyze capacity of academic entrepreneurship in such systems. The study could be also relevant for those who are interested on how the development of cleantech is going on and for those who is searching for some models of collaboration for innovation promotion between business, academia and regional authorities. The results could be also relevant to the specific projects for the development of different regions, such as EnergiÖresund or EcoMobility in Öresund regions.

1.7 Thesis outline

The paper is structured as follows: we first describe the context for the study of the development of cleantech RIS in Öresund region. This description is based on secondary archival sources such as peer-reviewed articles, governmental and industry reports, as well as

coverage of industry developments in the media. The description provides an overall understanding of how Öresund regional innovation system is functioning. Based on this preliminary lessons for other regions will be developed. Secondly, methodological approach for the primary data collection of this study is utilized, which is face to face interviews with some of the stakeholders of the Öresund RIS. These interviews allowed to get first-hand knowledge and specific details in order to develop more specific outcomes for other regions. Finally, findings are presented and analyzed to obtain a holistic view of the cross-border regional development, its innovation system related to cleantech and entrepreneurship as well as to suggest valuable recommendation for innovation systems and apply some of them to innovation system of Moscow.

2 Research Methodology

Regional innovation system is an analytical framework for studying regional development. RIS could be described as "a set of interacting private and public interests, formal institutions and other organizations that function according to organizational and institutional arrangements and relationships conducive to the generation, use and dissemination of knowledge [in the region]" (Doloreux and Parto 2004). This framework became popular in previous years due to the rising of competitiveness between the regions, increasing number of successful clusters and limitations of traditional models for the regional analysis (Doloreux 2004). It could be applied not only for studying the development of knowledge-intensive high tech centers, but industrial areas and peripheral zones as well (Cooke *et al.* 2004; Tödtling and Trippl 2005). In their study of biotech industry in the Öresund, Coenen *et al.* (2003) suggested that RIS is an appropriate analytical framework for conducting a research of the region.

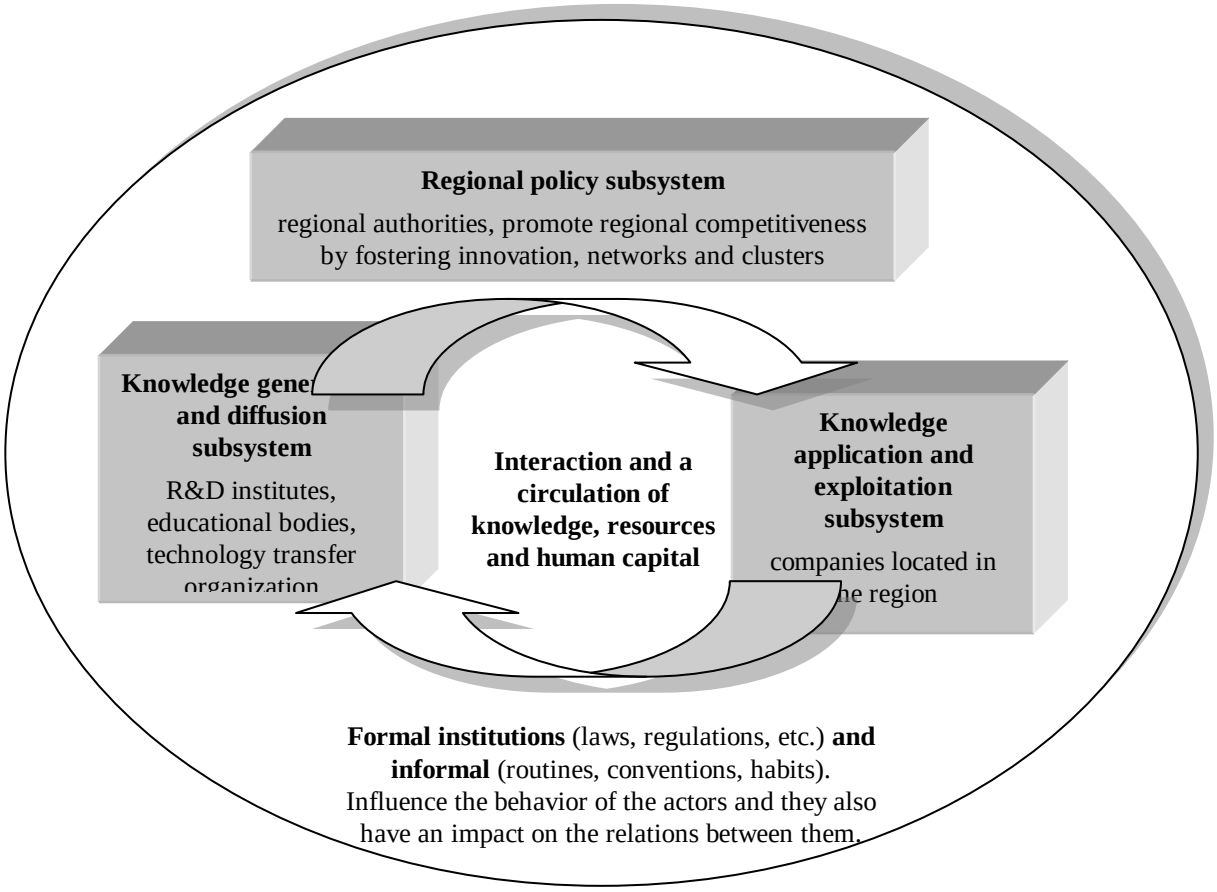

Figure 3. *Regional innovation system and its subsystem (Source: adapted from Trippl 2009)*

At the same time Doloureux (2004) depicts limitations of RIS as analytical approach. First of all, the framework itself doesn't provide an answer to the question of what good innovation system should be. Secondly, there are limitations for translation of results of the one regional study with RIS framework to another region. The reason is that every study emphasizes "local" institutional landscape. Nevertheless, Doloreux admits that further development of multi-dimensional RIS framework could help to overcome these limitations.

The framework is considered to be appropriate to study innovation and knowledge flows in cross-border regions (Trippl 2009; Lundquist and Trippl, 2011; Hansen 2011). But there is a lack of knowledge regarding the efficient policies for the cross-border innovation systems. According to Hansen (2011) few of the recent studies in this area deal with creation of common knowledge and innovation spaces. Contribution of academia in building of regional innovation system is under-researched as well, but there are different connections between RIS

and higher education institutions (HEIs) that are need to be analyzed (Caniëls and Bosch 2011). It is important since the academia play a vital role in production, using and dissemination of knowledge.

Socio-technical network approach is also considered in the present study. Socio-technical network is a "multi-actor network, involving the interlinkage of a mix of social and technical elements, which (is) defined in terms of its performance of a societal end use function such as mobility, shelter, hygiene, or communication" (Steward 2012b). This approach is an alternative to the traditional view on the innovation development, which is usually related to either firm-based level or economy wide-technologies.

It seems that sustainability transition is not only a question of new cleantech solutions, but a also a question of their commercialization and dissemination. Steward (2012a) suggested that the transition to low-carbon societies requires implementation of transformative "socio-technical" innovations on a national and regional levels. According to him incremental innovations, which are small innovations or improvements to optimize existing system of knowledge, have too narrow focus and limited capacity. On the contrary, transformative "socio-technical" innovations include not only new technologies, but social and behavioral innovations as well and could provide a good result (Steward 2012a, 2012b). Steward's suggestion seems to be relevant in the light of another finding – that the most significant reduction of greenhouse gasses emission by 2020 should be based on the existing technologies (IPCC 2007).

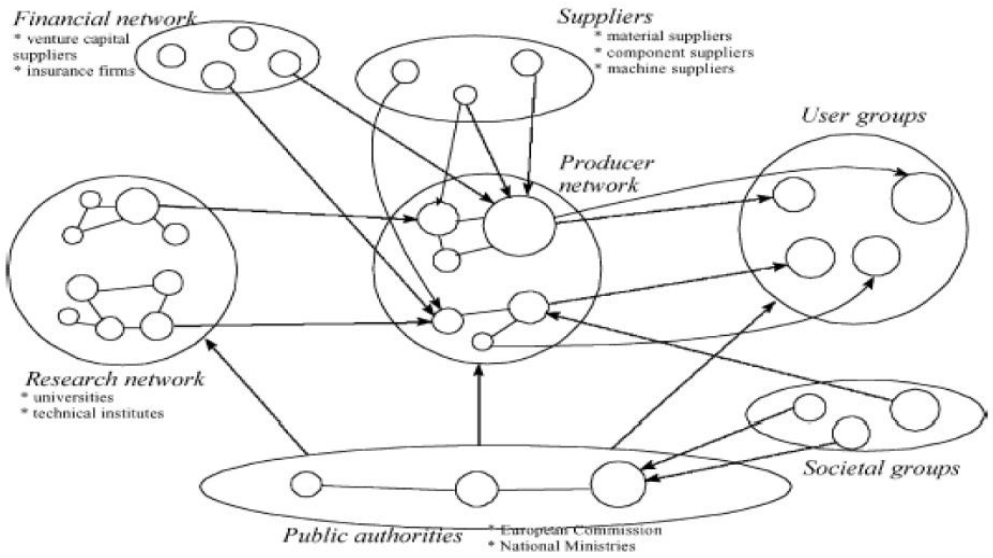

Fig. 2. The multi-actor network involved in sociotechnical regimes.

Figure 4. *Socio-technical network (Source: Steward 2012a)*

In order to answer the second sub question: "What experiences and lessons based on the individual views of the stakeholders of Öresund RIS could be useful for other regions in the world?" the interpretive research paradigm will be used. Firstly, analysis of the first-hand knowledge from the interviewees – representatives of the organizations-stakeholders of the Öresund RIS and Moscow RIS will be undertaken. Data will be collected using qualitative methods (Denzin and Lincoln 1994; Silverman 2006). For that reason inductive approach will be employed where the interviewees were given much space in order to provide their knowledge. Strauss and Corbin acknowledge the importance of a multiplicity of perspectives and "truths" (Strauss 1987; Strauss and Corbin 1990). There is a need to gain a deep understanding of a phenomenon through the interpretations from those experiencing it (Shah and Corley 2006). Following the work of other scholars (Leonard-Barton 1990; Gibbert *et al.*

2008), interviews need be carried out in close interaction with practitioners who deal closely with the development of cleantech innovation and entrepreneurship in regional perspective.

In total, nine interviews were conducted in February in Öresund and six interviews were taken in Moscow. Regional stakeholders—representatives related to academia, business and entrepreneurship were interviewed in order to understand their vision of innovations, cleantech, cross-border cooperation and entrepreneurship. Using case-study methodology (Yin 2003), methods as in-depth individual, semi-structured interviews, interviews which leave room for adjustments during the interview process were applied. The participants have key expertise in three areas: research on innovations, consultancy and networking, entrepreneurial education. One expert for each area were interviewed on both Danish and Swedish sides.

3 Basics of regional innovation system, cross-border cooperation, cleantech and academic entrepreneurship

3.1 Regional innovation system

Concept of regional innovation system is rooted in the theory of innovation and, in particular, in the developments of economist Joseph Schumpeter. He considered innovations as a ”new combinations“, which affect the existing balance in economic system. There are different types of innovations according to Schumpeter: new products, new methods, new forms of organization of business organization and penetration of new input--and output markets (Schumpeter 1943). In his view innovations destroy existing market structure and replace it with the new one, but at the same time, innovations always have basis in the existing economic structure. He argued that technological changes together with evolving institutions and entrepreneurs play an important role in economic development (Schumpeter 1943). Schumpeter also saw the special role for entrepreneurs since the entrepreneurial activity is behind the economic changes –“heroic efforts of new men to break circular flow of existing activity”. In his opinion innovations resulted not from rational thinking, but from creative pioneering process, which is usually characterized by uncertainty, vision and expectation (Hospers 2005).

Although some of the Schumpeter’s ideas were recently criticized (Hospers, 2005), many of them could help to analyze the processes of innovation development in regions. On the one hand, his views on innovation-related technological changes and entrepreneurship as drivers for economic growth became the basics for innovation policy in many regions. Some regions where such policy was effective became the examples for other regions, which resulted in copy-cat behavior in many places. For example, there were many attempts to create “Silicon Somewheres” in different parts of the world to repeat the success of Silicon Valley (Florida

2002). Nevertheless, Silicon Valley has a number of distinguishing features, which attract many policy-makers, but hard to copy: research facilities and education in the large universities, big venture capital funds, mature companies and appropriate entrepreneurial culture (Jackson 2011).

In the second part of the XX century many researchers started to evaluate the difference in innovation systems in different territories, with the conclusion that every country and region has its own innovation system that reflects the particular institutional elements (Carlsson 1995; Edquist 1997). For example, according to North (1990) innovation development is related to "adaptive efficiency", the rate at which institutions are able to change. He claimed that only few states in the past had flexible institutions conducive for growth, whereas many societies "got stuck" in an institutional setting that didn't allow from fully benefiting from opportunities. At the same time Porter (1998) identified four key reasons to explain the difference between innovation systems in different regions: factor conditions, demand conditions, related and supporting industries, as well as firm strategy, structure and rivalry.

The other theoretical foundation for RIS approach is regional development studies. There are several dimensions for the analysis of regional development related to life-setting, economic, outlook, competence/resources, institutional and political and infrastructure (Müller 2011). Traditional understanding of economic aspect of regional development could be seen in terms of growth in GDP, local income and job creation. At the same time, social development is related to regional learning (Florida 1995), cooperation and participation between the groups and institutions (Seidl *et al.* 2003) as well as pride and support for the region (Anderson 2000).

Florida (2002) provides an interesting view on the role of social factor for RIS. He suggested that promotion of urban and regional competiveness requires development rather of liberal cultural policy than traditional subsidizing businesses and supporting spin-offs. He also proposed the evaluation of the competitiveness of the different regions using his own specific

measurement Global Creativity Index, which includes the three "Ts" of economic development: Talents, Technology and Tolerance. In 2011 rankings of the Index Sweden and Denmark were on the first, and fourth places, respectively, whereas another Scandinavian country – Finland took the third, and the United States were on the second (Martin Prosperity Institute 2010). Considering Florida's Index as controversial, but providing another view on the regional development, Hospers (2006) suggests to use Trademark, as additional "T" in Florida's Index, stating that positive image is also important for regional development.

Lundquist and Trippl (2011) identify "stages of cross-border RIS development: assymetric cost-driven systems, emerging knowledge-driven systems and symmetric innovation driven systems". They also consider different types of barriers and suggest policy measures how to overcome these barriers. Barriers that are associated with hard institutional distance, e.g. laws and regulations, could be removed rather quickly at relatively low cost. At the same time, dismantling of barriers connected with physical distance requires huge public investments, but could be undertaken in a short term. Soft institutional distance barriers (e.g. cultural and linguistic) could be overcome with a relatively low investments, but this process could take years. In the end, functional (unequal distribution of the potential advantages from interaction and the problem of absorptive capacity) and cognitive distance barriers (difference in scientific specialization, knowledge bases, and economic structures) require a lot of investments and a lot of time to overcome.

Hansen (2011), in turn, suggests that effect of elimination of different kind of barriers in cross-border is "more or less black box". In particular, according to him, it is difficult to predict if the elimination of the barrier would have a long term result. Hanson also sees the both opportunities and challenges presented by cultural, technological and institutional and other variations of different parts in cross-border regions. Based on the analysis of co-authorships in Öresund in biotech industry he proposes that investment in physical

infrastructure do not necessarily lead to a higher level of cross-border integration in scientific collaboration and knowledge flows. It is need to admit that economic growth shouldn't contradict with a social development, in particular, with social values like participation, democracity and equality not to be reduced for the sake of economic growth. (Kva˚ le 2005)

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3.2 Clean technologies

Cleantech is stands for "clean technologies", which could be defined as "energy and environmental-related technologies developed with the objective of reducing harmful effects on the environment". Implementation of cleantech usually assumes an improvement of environmental performance at a lower cost, productive and responsible use of the natural resources (Swedish Energy Agency 2010). Sometimes terms greentech, sustainable or environmental technologies are used instead. It is often innovative and financial aspects of cleantech are underlined, and it is suggested that cleantech involves "wide range of innovative products and services, which contribute to both financial returns and positive environmental impacts and outcomes" (Cleantech Group and WWF 2012). Although energy innovations represent the largest part of cleantech, including energy efficiency and renewable energy, there are other important areas for cleantech: water, agriculture waste and materials. The world total market for cleantech had annual growth rate of 31% between year 2008 and 2010, from €104 bn to €179 bn (Cleantech Group and WWF 2012). According to (WWF and Roland Berger 2009) scenario clean energy technologies market could reach 1,6 trillion Euros by 2020 and, therefore, it presents an attractive investment opportunity.

Clean technology is the niches for both science and business. There is a variety of difficult socio-economic, environmental, and governance challenges including climate change, oil depletion and growing threats to natural resources such as water. Such challenges may be

seen as threats, but they may also constitute new opportunities for clean technologies. Clean energy technologies have received tremendous exposure as an investment opportunity over the last few years. It has been touted by entrepreneurs and politicians alike as the solution to our economic and environmental crisis. Many state governments are also creating cleantech initiatives. Private cleantech enterprises are being formed. It is argued that success can be viewed as a "triple bottom line" involving economic, social and environmental performance (Martin and Osberg 2007; Skoll Foundation 2007).

Traditionally, innovation development is considered as driven by technology "push" that resulted from research activities and market "pull". This traditional linear model also assumes that market size and research and development (R&D) expenditures could show the innovation potential of the country. Nevertheless, according to the recent studies innovation development and cleantech development, in particular, depends on complex ecosystem of factors (Cleantech Group and WWF 2012). Figure 5 below depicts the variety of factors, which influence on the development of energy innovations, in particular: supply and demand from different sectors, policy interventions and investment. This also imply to the cleantech innovations.

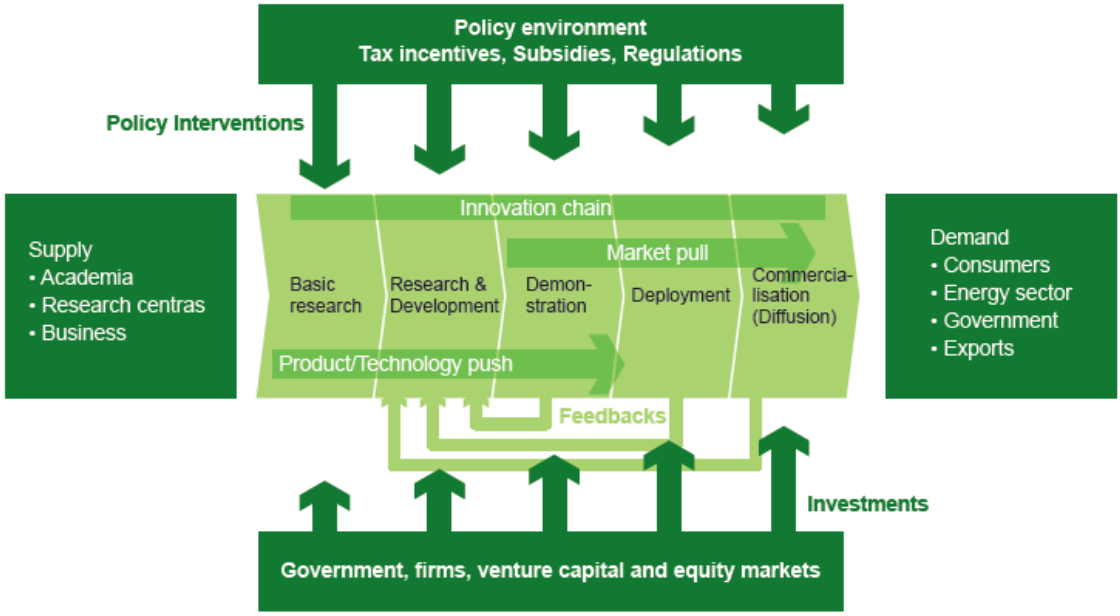

***Figure 5**. Ecosystem of innovation development (Source: adopted from IEA 2008; Grubb 2004; Foxon 2003 as presented in Cleantech Group and WWF 2012)*

On an international level there is a demand for higher political and economic priority for new clean energy technologies. During the energy crisis in 1970s there were strong governmental incentives in different countries and on international level, which stimulated the development and implementation of energy efficient technologies and renewables. Nowadays, although the energy risks associated with energy security and environmental issues became even higher, there is no relevant political and economic incentives, which could help to mitigate such risks (Ulrich 2005). For clean energy technologies there is a need that they should, firstly, be commercially proved. The exploration and utilization of conventional energy sources has a quite long period when they were supported by the policies and period for maturing of the appropriate technologies. The development of new energy technologies requires sufficient level of investment, in particular, to access high-cost energy infrastructure in order to be commercially viable. At the same time, clean energy is one of the many options for investment (Jackson 2011).

Kemp (2010) present a case of Dutch energy transition, which is titled as “guided evolution”. It is considered as one of the positive examples of political incentives, which is associated with cleantech energy development and “ecological modernization”. There is a number of distinguishing features: including the implementation of strategic learning projects such as transition experiments as well as specific programs and investment in selected innovations. According to Kemp “guided” energy transition approach has a significant difference with the initial one, which was a self-contained process and was differentiated from the existing policies of energy saving and the development of sustainable energy sources. Nevertheless, although "guided evolution" approach seems to be quite promising, Kemp concluded that real outcomes were not as high as it could be.

On the contrary, Coenen *et al.* (2010) in their comparative analysis of upscaling energy of the cases of bioenergy in Sweden, windpower in Denmark, and biofuels in Netherlands, considered the Dutch case as unsuccessful, whereas other two cases are seeing as relatively successful. Their findings show that precondition for successful upscaling of niche energy technologies are important. In particular, incentives in 1970th became important and indirectly promoted development of energy technologies, whereas current framework strategies for energy security, decarbonizatoin and supporting of domestic industries were another element of success. Coenen *et al.* (2010) also emphasized the number of factors, which could drive cleantech energy transition. Firstly, there is a need to create market demand for energy technologies and promotion of experimentation. There are some relevant measures, which were developed on the early stage including green taxes, regulations of emission as well as tradable certificates, standartization and free parking. Social experiments played an important role in order for generation and diffusion and create multi-stakeholders coalitions. At the same time, the experimentation became necessary, but not sufficient to promote changes.

Intrachooto and Horayangkura (2004) studying sustainable energy innovation in building sector identified five important barriers for promotion of energy innovation and solutions to overcome them. It was attempted to generalize these solutions in the present research for the sustainable energy transition in different sectors, see Table 1.

Table 1. *Barriers in sustainable energy innovations in building sector and solutions to overcome them*

BARRIERS	SOLUTIONS
1. Innovative solution affects multiple components requiring higher overall investment	(1) Transferring of technical risks to design teams or suppliers (2) Partial development to avoid development and business failure (3) An extensive testing and validation must be conducted and demonstrated (4) A back-up system or back up plan is integral in the design

	(5) An ongoing support during implementation operation needs to be arranged
2. Innovative solution may not be worth its investment within a reasonable period of time than the widely used standard solutions	Committing to an energy-efficient strategy in parts—not in terms of partial technology, but rather in terms of phases or segments of an overall project development
3. Innovative technology commands higher investment	The strategies may include development trade-offs. In addition, if budget is reasonably agile, tactics for limiting performance uncertainty could be explored.
4. Budget lacks financial compensation for devising	Specialized services fees and detailed categorization of service fees to help mitigate financial constraints on the design teams during technology development process. As well as responsive financing and research collaboration
5. Mismatched design and construction budget —overspending in certain areas while hoarding expenditure on basics that are necessary for implementing innovative solution	Put money where innovation is

Source: adopted from Intrachooto and Horayangkura 2004

3.3 Academic entrepreneurship

Academia and higher education institutions, in particular, play an important role for the promotion and development knowledge and innovation in regions. Nevertheless, it is suggested that the relations between HEI activities and regional innovation system been under-researched (Caniëls and Bosch 2010).

According to the traditional approach main contribution of HEIs to regional development is connected to the development of academic knowledge and providing education (first and second roles of universities). This approach is rooted in the traditional Von Humboldt's vision of universities as the centers of creation of new knowledge in order to contribute to the findings of scientific community world-wide (OECD 2007). Therefore, regional contribution of the academia is seen through the lenses of employment, generation of

patents and identification of successful commercialization of scientific output (Caniëls and Bosch 2010). There is an example of such economic impact of the university on regional development: for every $1 of investment to Penn State University, it returns more than $25 of the overall economic output, including contribution to the business volume, research activities, creation of employment, student spending and business of alumni (Penn State University 2009). A similar study for the United Kingdom shows that societal benefit from the community outreach generated from three sources, including greater political interest, higher interpersonal trust as well as health improvements is accounted to £1,31 in the UK (New Economics Foundation 2011).

Although traditional approach was dominating and show the effectiveness in the past, the changes associated with new needs of regional development could require the different ways to analyze the connection between academia and regional innovation system. Huisingh and Zilahy (2009) state that there is a growing need for making academia more entrepreneurial and promotion of collaboration of the universities with external stakeholders in order to achieve regional growth. Sweden is considered to be active in this area: it is officially stated that universities have a third mission: to disseminate research information outside the academia and to facilitate public access to relevant information regarding the research results (Edquist 2010).

Similar conclusions regarding the question how to enhance the entrepreneurial capacity of academia were made by the delegates of UNESCO Chair International Conference on Higher Education for Sustainable Development in Luneburg, Germany (HESD 2011):

1. There is a need for transition in university's education - it should be not reactive, but proactive towards social changes.
2. Universities shouldn't be "ivory towers" anymore: administration, students and faculty should collaborate more with external stakeholders, first of all, with local ones to develop and implement practical solutions.

3. One of the most important functions of new type of universities, especially, social science schools, should be to prepare leaders (decision-makers, agents of change), develop their personal skills and capacities, rather than just to provide knowledge.
4. Continuing students initiatives could be a triggering force for changes towards transition to new kind of universities.
5. During the education process students should be engaged in different projects and develop the skills of social entrepreneurs.

There are different types of interactions between academia and regional partners could be identified, including promotion of spin-offs, consulting for a local industry and policy-makers, informing public debates and shaping the traditional institution of social opportunities and services (Benneworth *et al.* 2009)**.** The ways how HEIs can contribute to regional development are presented in Table 2.

Table 2. *Ways in which HEIs can deliberately contribute to regional development*

Table 3. Ways in which HEIs can deliberately contribute to regional development

Domains	HEI – industry collaboration mechanisms (adapted from Ramos-Vielba et al. 2010 and D'Este and Patel 2007)
Research	• Content of research has a regional focus • Research agreement between regional actors – commissioned by industry/policy; undertaken by university researchers only; original research – undertaken by several parties jointly; original research – commissioned by industry; undertaken by university researchers only; no original research
Education	• Build training relationships with firms – Training of postgraduates and internships at firms (e.g., joint supervision of PhDs) – Temporary exchange of personnel – Training of firm employees provided by the university • Adapt education programs to meet firm's needs • Strong regional focus on student recruitment and graduate retention
Active collaboration with (regional) public and private actors	• Industry sponsored meetings and conferences • Setting up spin-off or start-up companies • Creation of physical facilities with industry funding / use or renting of facilities or equipment

Source: Ramos-Vielba et al.(2010) and D'Este and Patel (2007) as presented in Caniëls and Bosch (2010)

It is important that HEI could not only develop solutions for high-tech industries, but also traditional local ventures could be developed utilizing the capacity of Academia. University Jaume in Spain provides such example. It helped the province of Castellón to become leading in ceramics, by restructuring the ceramic cluster, and allowing to promote small to medium enterprises. It contributed to the development in a different ways: work-based learning of students, spin-offs, quality-certification, technology transfer (Puuka 2009).

According to Caniëls and Bosch (2010) there are two conceptual frameworks related to developing entrepreneurial capacity of Academia and regional development. First one is known as triple-helix model, it emphasizes the importance of collaboration between academia, industry and government. It is suggested that such collaboration should be hybrid, recursive and cross-institutional (Gunasekara 2006). Engaged university is another approach. It assumes a broader view on the role HEI since and initiating role of university in regional development. Thereby, academic entrepreneurship is considered as essential part of regional development (Chatterton and Goddard 2000; Holland 2001). There are different mechanisms for the engagement of universities, including promotion of lifelong learning, creation of social capital, cultural, political and cultural life, and contribution to community development integration of the region in international society (Goddard 1997). Entrepreneurial activities of universities and contribution to the regional development could not only be associated with cooperation with external stakeholders, but internal development connected with changing of educational curricula, daily practices and operations, specific research, oriented towards the regional needs. From this perspective, university could be considered as specific social environment for changes towards sustainability (see Figure 6).

***Figure 6**. Ecosystem of sustainable development at HEI (Source: Huisingh 2010)*

4 Analysis of Öresund Innovation System

4.1 Öresund innovation system

The interregional administration of the region was initiated in 1993, with the establishment of Öresund Committee by the Greater Copenhagen county authorities together with regional and municipal administrations in Skåne. The membership was enlarged in 1999. The Committee represents a regional policy forum for the cross-border co-operation. At present it is constituted by the membership (Öresundskomiteen 2012):

on the Danish side: The Capital Region of Denmark, Region Zealand, City of Copenhagen, City of Frederiksberg, Bornholm Regional Municipality, Local Government Regional Council for the Capital Region of Denmark, Local Government Regional Council for Zealand;

on the Swedish side: Region Skåne, City of Malmö, City of Helsingborg, Lund Municipality, Landskrona Municipality.

The vision of the Committee is that in 2020 "by maximising the benefits of integration and cross-border dynamics, the Öresund Region will stand out as the most attractive and climate-smart region in Europe" (Öresundskomiteen 2012).

In 2003 OECD presented a thorough research of the Öresund region, its knowledge and innovation development. The results, on the one hand, shows that there is a high potential for the development of cross-border collaboration. Nevertheless, there is a number of barriers associated with: increasing of competitiveness as well as networking and collaboration between firms and educational institutions. It is important that the results of the researches, their products and by-products are translated into the real business opportunities (OECD 2003). On the other hand, Öresund cooperation seemed to be driven mostly by regional authorities,

without long-term view on the future development. And interregional development also considered as "top-down" exercise with little volunteer involvement and collaboration with non-governmental agencies (Osborne 2006).

The importance of promotion of innovation in the region and low-carbon development is stated in the development strategy of Öresund Committee (Öresundskomiteen 2010). Knowledge and innovation is seeing as one of the priority areas as well as culture and events, diverse labor market, accessibility and mobility. On the other hand, it is stated that "Öresund Region should be a front-runner in environmentally friendly transport and a laboratory for green technology, center for cleantech solutions and sustainable urban development in order to host Öresund Region EXPO in 2020". The importance of academic entrepreneurship and triple-helix is also underlined as one of the goals: the Öresund should be recognized "as a hub of innovation, with entrepreneurs and synergies between educational institutions and trade and industry" (Öresundskomiteen 2010).

Although these statements seem to be quite promising for sustainability transition, improvement of efficiency of resource usage and reduction of environmental impact, without concrete policy incentives they could be interpreted rather as ambitious vision for the Öresund since they don't indicate concrete targets, which could be measured. At the same time, there are low-carbon goals in Öresund in the Danish and Swedish parts on the national as well as regional level and municipal levels, which are relevant for sustainability transition and cleantech development of the Öresund.

Low-carbon development as a part of sustainable development is one of the top priorities for the both sides. For instance, Denmark has recently adopted the concept of State of Green, with one of the goals to have 100% renewable energy supply in 2050 (State of Green 2011). Sweden also has the ambitious goals to achieve, in particular, to develop 50% energy supply

from renewable sources of energy by 2020 (Regeringskansliet 2009). Some of the low-carbon targets are presented in the Table 3.

***Table 3**. Low-carbon goals of Öresund region*

	2015	2020	2025	2050
Denmark		-30% GHG*		100% RES
Hovedstaden			50% RES	
København			carbon-neutral	
Albertslund	-25% GHG			
Ballerup	25% RES			
Sweden		50% RES,		
Skåne		-30% GHG*		
Malmö			100% RES	
Lund			-50% GHG*	
Kristianstad			-20% GHG*	

XX% GHG refers to XX% decrease greenhouse gases emissions.
YY% RES stands for achieving YY% share of renewables in energy supply.
* Compared to 1990 level.

Source: IIIEE 2011

At the same time, the profiles of energy systems are quite different. For example, Danish side of the region has a larger share of renewable energy produced from wind. On the country level it constitutes about 20% of overall electricity. Whereas Sweden has only 2% of wind energy in its electricity production balance (European Wind Energy Association 2011). On the other hand, Sweden is more developed in utilization of bioenergy and usage of heating pumps. This difference is important for the way how both sides of the region are going to achieve the low-carbon goals.

The cleantech and innovation development is considered as an important part of the Öresund agenda at the current time. Nevertheless, the development of the region in the past was associated rather with pharmaceuticals and biotechnologies. Potential for the creation of Öresund as a center for pharmaceutical and biotech companies was recognized in the early 1990's when it became evident that about 60% of all Scandinavian pharmaceutical firms were located in the region. By that time Denmark and Sweden had strong research tradition in bio

and pharma areas. Medicon Valley Alliance (MVA) was initiated in 1997 by Öresund Committee as Interreg EU-supported project in order to promote collaboration among the business, university and research center, and knowledge-intensive services. MVA united major organizations such as universities in Copenhagen, Lund, Malmö, Roskilde, research centers, including Wallenberg Neuroscience Center, Center for Biological Sequence Analysis, Swedish Institute of Food & Biotechnology and Science Parks, including Ideon and Symbion (Cooke *et al.* 2004; MVA 2012).

At the same time, the case of MVA is considered to be controversial. On the one hand, it seems to be successful: the Öresund was listed number three in top 10 European health care regions, there were constant funding flow from the government and formation of the targeted venture capital (Cooke *et al.* 2004). In addition, there was a growth of employment rate in a health care sector in the Öresund. And there were also increasing number of innovative foreign companies, in particular, from the United States (Cooke *et al.* 2004; Hospers 2008). There are two factors for development of Medicon Valley Alliance, which were important for the good results: an effective collaboration between business, government and academia as well as clear branding strategy. Öresund Committee played an important role by promoting the liberal policy of the "Man and his needs", which included health services (medical technology), developments of connections (bridge) as well as recreation (varied supply of culture)" (Hospers 2008).

On the other hand, there were several issues, which limited the success of the MVA. Firstly, there was lower level of knowledge-spillover than expected. It could be associated with differences in businesses and cultural environment as well as different national contexts (Cooke *et al.* 2004). Secondly, there were insufficient results for implementation of knowledge in the region. One of the reasons might be is the lack of strengths in the exploitation knowledge capacities and problems of compatibility between explorers, examiners and exploiters. Another

suggested reason is that Öresund has a strong public sector and valuable customer for pharmaceutical companies, which could monopolize the market (Coenen *et al.* 2003).

Thirdly, it was considered that there is a sufficient level of difference in Danish and Swedish systems of innovation, production and business (Edquist and Lundvall 1993) to infer a trans-national regional collaboration on the level of conventional non-interregional RIS. Finally, although there were mutual trust and communication within the national sides, there was lack of them on the interregional level (Coenen *et al.* 2003). Based on these suggestions Coenen *et al.* (2003) after studying knowledge dynamics in a cross-border RIS and cooperation in biotechnology concluded that Öresund RIS is "rather an innovation network of collaborating, competing but also conflicting actors having both their collective but also individual interests and cultures disposing of different economic and political powers in specific socio-economic contexts".

According to Lundquist and Trippl (2009) regional innovation system of Öresund is semi-integrated with biotech at the forefront of cross-border collaboration. Construction of the Öresund bridge in 2000 played an important role in integration of innovation systems of both sides. Before that time the RIS could be rather characterized as weakly integrated. There is a degree of scepticism regarding the opportunities to develop strongly integrated innovation "where economic activity in the region is fully integrated ... (and) knowledge flows are no longer confined to a few industries and no significant barriers to interaction remain" (Lundquist and Trippl 2011). This scepticism is associated with different socio-economic trends of development represented by Danish and Swedish sides (Lundquist and Winther 2006), the difference in the ways how these systems respond to economic globalization challenges (Edquist and Lundvall 1993) and there are also cultural and administrative barriers for further integration (Knowles and Matthiessen 2009).

Knowledge base for innovation development of industries within the innovation system is one of the characteristics for understanding the processes within the RIS (Asheim, 2007). The development and implementation of regional and local cleantech innovations could be associated with utilization of all three types of knowledge bases: analytical, synthetic and symbolic. Firstly, R&D stage of innovation process for cleantech companies could be based on analytical knowledge, which is associated with collaboration with universities and research facilities and creation of radical innovation. Martin and Moodysson (2011) suggested that in some areas of innovation analytical knowledge base is connected with global collaboration and networking. It is need to consider that there is a number of world-leading enterprises and research organizations for energy innovations based in Öresund. For example, Danish company Vestas, which promotes wind energy systems, or Swedish Alfa-Laval that develops solutions for energy efficiency. And there are also large research organizations such as Lund University and Denmark Technical University.

Secondly, implementation of the innovative solutions requires utilization of learning by doing approach that is typical for synthetic knowledge base. It requires collaboration with national and regional stakeholders and getting sources within the region. For example, introduction of heating pumps in Skåne or creating infrastructure for Electric Vehicles in Zealand assumes the cooperation obtaining information from regional sources. Symbolic knowledge base is associated with getting information from local development. Promotion of sustainable cleantech and energy innovations on the demand-side requires the collaboration with local stakeholders. Changes of the perception need the effective communication and creation of education programs. It is connected with production of immaterial characteristics – e.g. ideas, images and symbols that is a feature of symbolic knowledge base.

4.2 Development of preliminary lessons for other regions

In this section framework for the analysis of key activities of innovation system (Edquist 2005) will be implemented to study Öresund RIS in order to develop preliminary lessons that could be relevant to other regions, with regard to cleantech, entrepreneurial capacity of academia as well as cross-border cooperation.

Key activities in Innovation System (adopted from (Edquist 2005).

1. **Provision of R&D** and creation of new knowledge.
2. **Competence building** through individual learning (education and training the labor force for innovation and R&D activities) and organizational learning.
3. **Formation of new product markets.**
4. **Articulation of quality requirements** emanating from the demand side with regard to new products.
5. **Creating and changing organizations** needed for developing new fields of innovation. Examples include enhancing entrepreneurship to create new firms and intrapreneurship to diversify existing firms; and creating new research organizations, policy agencies, etc.
6. **Networking**, including interactive learning among different organizations (potentially) involved in the innovation processes. This implies integrating new knowledge elements developed in the different spheres of the SI and coming from outside with elements already available in the innovating firms.
7. **Creating and changing institutions** e.g. patents laws, tax laws, environment and safety regulations, R&D investment routines, cultural norms, etc. that influence innovating organization and innovation processes by providing incentives for and removing obstacles for innovation.

8. **Incubation activities** such as providing access to facilities and administrative support for innovating efforts.
9. **Financing of innovation processes** and other activities that may facilitate commercialization of knowledge and its adoption.
10. **Provision of consultancy services** relevant for innovation processes, e.g. technology transfer, commercial information and legal advice.

4.2.1 Provision of R&D

According to Edquist (2010) in the Swedish part of Öresund a sufficiently high share of public expenditures in R&D is spent on "blue-sky" curiosity-governed basic research", whereas less is invested in need-based research. It could be assumed that such problem not only relevant for Öresund, but for other regions as well. One of the solutions in this case could be a redirecting part of public investments towards more concrete and applied research in order to supply technologies and solutions for the achievement of the regional goals. Changing in regional R&D policy could also contribute to the diversification of production structure and increasing competitiveness of a region. For example, in case of Öresund, investment in cleantech could be considered among the other options. A similar approach to more efficient research expenditures could be recommended for policies in other regions.

Another possible barrier for R&D promotion in Öresund that might be also relevant to some other regions is that innovation market is dominated by large companies. Therefore, it would be reasonable for regions to search for opportunities to establish collaboration between small and medium enterprises, on the one hand, and large companies, on the other hand. Considering cleantech opportunities in Öresund, there are a number of large companies, which operates in the field of energy innovation or devote some of the resources for cleantech solutions. It includes Vestas, E.On, Schneider Electric, Siemens, Copenhagen E, DONG, etc.

An alternative approach could be to promote of small and medium innovation-based enterprises in innovation system of different regions. Nevertheless, development of innovation may require large amount of expenditures. Such amount of the resources could be difficult to get for small and medium enterprises. Large companies could develop large-scale solutions, whereas small and medium ones could find a better strategies for theirs adoption and implementation to regional and local context.

4.2.2 Competence building

Entrepreneurship capacity is important for the achievement of innovation goals related of regions. There are some recommendations suggested for development and promotion of innovation and entrepreneurial capacity of academia (Brorstad *et al.* 2009). Firstly, there is a need to develop entrepreneurial mindset among both academics and students who can become future entrepreneurs with broader mobilization among academic institutions. Secondly, it is important to invest more resources at the early stages of start-up processes for promotion of research-based innovation. Thirdly, it is also suggested to increase women participation in the process and innovation development.

There is a positive experience of cross-border promotion of academic entrepreneurship in Öresund. Öresund Entrepreneurship Academy cooperative project was active between 2006 and 2010. According to the report of the project in 2010 entrepreneurial education in involved about 8-10% of all students in Öresund in a different ways (Öresund Entrepreneurship Academy 2010). Organization of such educational initiative for entrepreneurship in academia seems to be a good example, which could be good to le**a**rn from for other region and cross-border regions, specifically.

4.2.3 Formation of new product markets

Building public demand for innovations could be an important driver for the regional innovation systems. In his studying of Swedish innovation system Edquist (2010) suggests to transform or divert regular public procurement into public procurement of innovation. This approach could be extrapolated to Öresund region and other regions, where it is important to build public demand for innovations.

Public demand for clean technologies should be an important driver for development cleantech in regions. National, regional and municipal targets for low-carbon development could serve as a guideline for policy pull for innovations. New policies for the public procurement of innovation (PPI) by local and regional authorities as well as large companies could stimulate the market share of cleantech. The examples could include: developing the requirement for getting energy from renewable energy source, installation of solar panels and restrictions for energy inefficient appliances on the market.

The options for introduction of cleantech innovation on regional markets could be based on promotion of environmental strategies and introduction of sustainable value innovations (Orsato 2009). There are four environmental strategies, which could be beneficial for creation of competitive advantages of the companies. It includes, beyond compliance leadership, eco-branding, eco-efficiency and environmental cost leadership.

Beyond the compliance leadership assumes that a company is using the advantage of better environmental performance than its competitors. For example, company could be more energy efficient or has lower carbon footprint. Eco-branding could be a solution in case of creation of environmentally superior products and services. There are opportunities for innovation companies for developing unique renewable energy technology, especially, if there is a demand for such solution on the market and from public organizations. Eco-efficiency means that a company can save on costs, which is also associated with lowering environmental

impact. The case of energy efficiency when organization is able to save energy, money and reduce negative environmental impact is a good case. If a company applies environmental cost leadership strategy it produces better from environmental point of view goods and services with an equally attractive price then competitors (Orsato 2009) (See Figure 7).

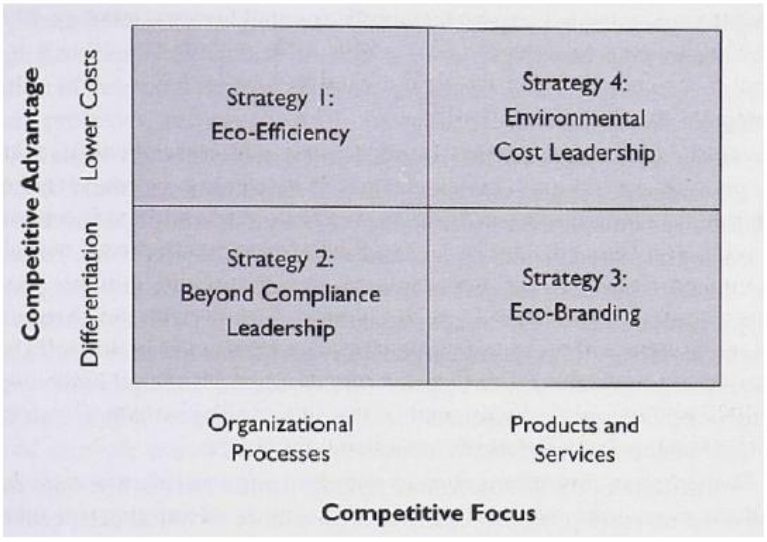

Figure 7. *Generic competitive environmental strategies (Source: Orsato 2009)*

Sustainable Value Innovation is connected with creation of differential value for consumers, with regard to better environmental performance and public benefits as well as lower costs. Such approach is associated with the development of new markets and therefore it goes beyond competitive strategies. The opportunities to promote sustainable value innovation in transport sector are presented in the Figure 8. One of the examples of such innovation also mentioned by Orsato (2009) is Better Place, EV innovation company that promotes sustainable mobility by developing "transportation islands". Better Place is also partner of Copenhagen Cleantech Cluster and there are opportunities for the energy development in Öresund region utilizing the technology of the company.

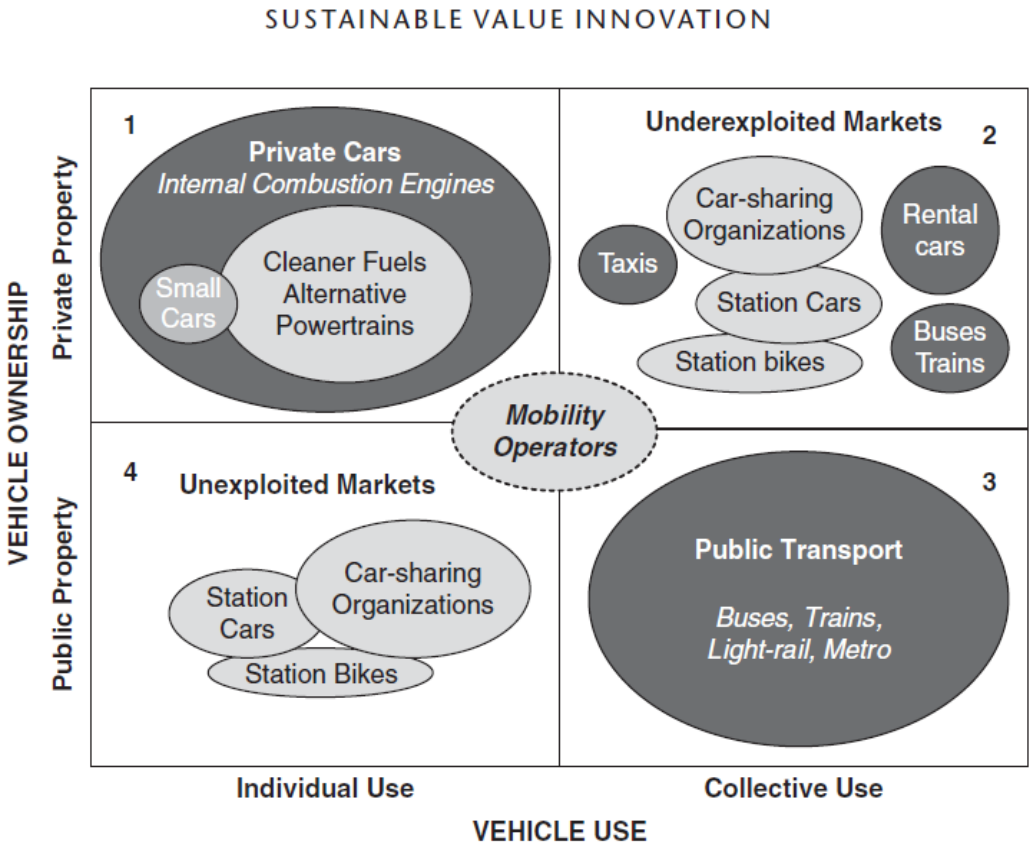

***Figure 8**. Market spaces for implementation of sustainable value innovations in mobility sector (Source: Orsato 2009)*

4.2.4 Articulation of quality requirements

One of the options for public and private companies in Öresund and other regions could be a development of the specific requirements for the products they buy in order to create demand for the cleantech innovations. Another option for authorities in different regions is to promote individual sustainability leadership among people. According to Parkin (2010) sustainability transition requires not just environmental awareness and following social patterns, even they could be quite progressive as in case of Öresund, but rather proactive behaviour on individual level.

It could result in increasing of the demand for low-carbon products on the bottom level by practicing low-carbon lifestyle and consuming low-carbon production. This in turn, could create demand for the innovations for the companies to realize innovative environmental

strategies or even create a space for sustainable value innovation. From this perspective low-carbon goals in Öresund could be set as concrete targets that would be interesting to achieve on the administration and on the social levels.

4.2.5 Creating and changing organizations

The example of Öresund shows that it could be reasonable to support innovative SMEs in regions due to their connection to local business environment and specification for developing local cleantech solutions. Supporting innovation activities among large enterprises could result in that the solutions might be implemented abroad therefore it would result in indirect investment in foreign innovation systems. It could be suggested that development of innovative SME oriented towards achievement of low-carbon goals in Öresund and other regions might also have positive effect and help to solve "innovation paradox" in different regions.

There is a special term "paradox" that was introduced to describe low real economic outcomes of the innovation process in Europe (European Comission 2006) while the investments in R&D are comparable, for example, with the United States. The innovation paradox is characterized by low entrepreneurial activity, small amount of research-based innovations, few growth companies in knowledge-intensive areas. Therefore there should be "closed loop" of benefits for the achievement of the energy goals and development of cross-border regional innovation system.

4.2.6 Networking

Networking activities resulted in significant contribution to the development of cross-border innovation system of Öresund. The region received quite a lot of attention from the

Swedish and Danish national governments in the beginning of last decade, as well as many interregional initiatives were started in Baltic Region and it also has high priority for cross-border development in European Union. Therefore there were a lot of efforts to establish networks and networking organization in Öresund. For example, there is a number of projects under EU Interreg initiative such as Öresund Mobility and Öresund Energy, as well as Öresund University and Öresund Academy. This could be a valuable experience for the different regions and their innovation systems, specifically, transnational ones.

Nevertheless there are some concerns regarding the perspectives of the networking in case of the need for the development of regional innovation system and achievement of specific outcomes (Harris 2010). Developing networking for sharing knowledge and experience doesn't necessarily require real economic application of the activities, which is important. Considering that one of the possible features of academia is that results remain "on the paper" (which is also one of the explanations behind the Swedish Paradox (Edquist 2005) lack of obligation for practical application of the collaboration results could be the issue. From this perspective creation of energy-goals oriented network with the purpose to deliver real practical outcomes in the form of the projects and startups could result in effective networking for RIS.

4.2.7 Creating and changing institutions

Universities assumes as conservative institutions which are difficult to change. Traditionally they have the main purposes to teach and research, whereas at the present there is growing need for active collaboration of university with external stakeholders (Zilahy and Husingh 2009). In Sweden, for example, it is officially stated that universities have a "third mission" to disseminate research information outside the academia and facilitating public

access to relevant information regarding the research results (Edquist 2010). It would be also important for development of research-based innovation within the academia and result not only in sharing knowledge, but its exchanging with practitioners on the field. The concept of getting knowledge outside of the organization is known as open innovation (Lichtenthaler 2011). From the perspective of contribution to the achievements of Öresund energy goals and goals of the other regions, open communication with practitioners could result in specific goal oriented innovation outcomes and would be also helpful for spreading awareness and help with implementation of new technologies.

4.2.8 Incubation

Incubation is an important stage for developing innovation. There are several incubators in the Öresund Region. For example, one of the oldest and most prominent incubator is IDEON in Lund, others include Krinova Science Park in Kristianstad, Scion DTU in Hørsholm and Symbion in Copenhagen. Nevertheless, study of the structure of IDEON incubator shows that there are not so many innovative start-ups in this incubator related to cleantech (see Figure 9). Information and communications technology sector has the largest share with 26%, life science is the second largest sector with the 20%, whereas cleantech has only 7% (Dávid 2011).There could be different interpretation for this. For example, it could mean that there is a lack of support for cleantech ventures or maybe such ventures are not as competitive and promising as ICT and life-science ones.

On the other hand, ICT and biotech and pharmatech startups playing an important role in innovation system of Öresund. Therefore, the amount of the such ventures in the incubators represent the efficiency of regional innovation policies. The valuable lesson for other regions

could be that infrastructure for development of innovations could be important for the achievement of regional goals.

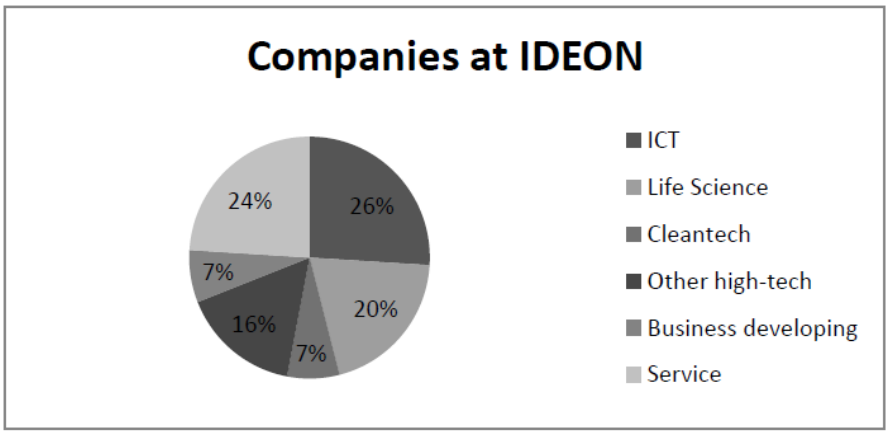

***Figure 9**. The distribution of companies at IDEON by sector type (Source: Dávid 2011).*

4.2.9 Financing of innovation processes

Establishing of effective financing scheme for stimulation sustainable energy innovation could be one of the solutions for different regions where there is a need for sustainability transition. The options for that could be: getting higher premium for development and implementation of energy innovation, tax reductions or subsidies or even market policies such as better feed-in tariffs.

According to Wüstenhagen (2011) although there is a need for the large-scale promotion of renewables all over the world, investors on energy markets are slow in adopting new opportunities. That is what is called bounded rationality, which leads to path-dependence in investment solutions: therefore, investors and venture capitalists are more likely to support what is already known. In this case they would rather invest in biotechnologies, information technologies or telecom industries than in clean technologies. The similar logic might be assumed in the case of Öresund region. Although there is need for a more specific data on that account, the description above together with the evidence from companies profile in IDEON

(see Figure 9) could be representative – and it could be concluded that there is a level of inefficiency or underfinancing of the cleantech energy innovation in Öresund.

4.2.10 Provision of consultancy services

Development of the RIS towards specific goals in different regions requires effective coordination and consultancy on the whole innovation chain. On the early stage it is important to direct new innovators on the "right track". Although, some innovations could be driven by idea, in the technological field there is also a possibility to stimulate the innovators who have the capacity to produce new technology, solution or idea to develop it within the field. It could work especially in the case when cleantech innovation concerns development of localized solution, which depends on synthetic or symbolic knowledge bases. This could be specific case for Öresund cleantech development and the development of other regions. Additionally, a consultancy could be connected with help to develop technical solutions, application solutions or policy solutions and provided by different organizations – pubic authority, university, NGOs or business organization. The specific form could be identified according to the concrete task.

4.3 Preliminary lessons

Ten preliminary recommendations for the development of innovation systems in different regions, and cross-border ones in particular, were suggested based on the analysis of Öresund regional innovation system from the perspective of cleantech and academic entrepreneurship:

1. Invest more public funds in concrete low-carbon goals-oriented research rather than in "curiosity-governed basic research".
2. Promote small and medium enterprises in the sector of sustainable innovation.
3. Develop competence building and specific education for entrepreneurship in the field of cleantech.

4. Create a demand for sustainable innovations by public and private organizations.
5. Support new environmental strategies and promote sustainable value innovations among the organization.
6. Promote bottom-up approach for cleantech innovation development by involving citizens and establishing new cultural patterns.
7. Create more efficient network collaboration with real practical outcomes in order to achieve energy goals.
8. Develop changes in academia for applying open innovation approach and more communication with external stakeholders on energy field.
9. Promote new financial schemes to attract more innovators and investor to sustainable energy innovation area.
10. Establish effective guidance and consultancy for sustainable energy solutions development and implementation

Firstly, previous example of cross-boundary innovative in the region collaboration in the field of biotech, Medicon Valley, shows that development based on the need-based policy in the region could be fruitful for the RIS. Secondly, the measures to achieve goal-oriented energy development in Öresund maybe helpul to increase the input-output efficiency of the system and help to overcome the problem of innovation paradox.

4.4 Analysis of cleantech clusters

Analysis of cleantech clusters in Öresund could be fruitful for clusters development in other regions. Clusters could play in important role in the creation, development and dissemination of knowledge in the region. Clusters are defined as “organized efforts to increase growth and competitiveness of cluster within a region, involving, cluster firms, government

and/or the research community." (Solvell 2003). There is a growing number of regional bodies that exploring the opportunities to develop the cluster model in order to achieve better regional development and economic growth. And there is an increasing number of energy clusters as wells and hubs for promotion regional sustainable energy transition. At the same time, it is suggested that there is no "typical" solution for the clusters and there is a need for individual cluster model in every region. Some of clusters are developing naturally as a part of existing industries, for example, the development of photovoltaic near semiconductors industry as well as electric vehicles close to automotive production (Jackson 2011).

The following analysis of Copenhagen Cleantech Cluster (CCC) and Sustainable Business Hub (SBH) in Malmö is based on the results of the author research, which were published in «Energy Futures Øresund – Bridging the gaps to a greener tomorrow» (IIIEE 2011).

There are two clusters for cleantech development with the emphasis on energy innovations on both sides of the sound. Copenhagen Cleantech Cluster (CCC) was organized by Danish cleantech businesses, research and public organizations with governmental support. There are five focus areas, where the cluster carries out its activities: test and demonstration, matchmaking, international outreach, innovation and entrepreneurship and facilitation (Copenhagen Cleantech Cluster 2011).

Cleantech initiatives supported by the cluster is relevant to effective RIS development for the whole Öresund Region. For example, Denmark is going to be one of the first countries to promote electric vehicles (EV) in a large-scale. There are at least two notable EV-projects, where the cluster acts as a partner. The first one is developed by Better Place. The company provides electric car net-works for mass adoption of electric vehicles through an innovative battery switch model. The other one is called EDISON, a multilateral initiative that promotes

smart integration of electric cars in a power system, with the emphasis on utilization of renewable energy and wind power in particular.

The other networking organization is Sustainable Business Hub (SBH) in Malmö. It is a non-profit organization, with the purpose to help companies with products and services with high environmental profile. SBH is considered to be a key player in environmental business development in southern Sweden (Sustainable Business Hub 2011). SBH constitutes of companies, including those that could contribute to the energy development of the region. For example, SweHeat & Cooling, the association of Swedish organizations that develop district heating and district cooling products and services. SweHeat & Cooling proved to be effective in Skåne and could help to achieve better results in Öresund region.

Sweden is prominent for its cleantech export and Skåne is one of the leading regions in this field. In 2009 51% of Swedish cleantech export was accounted for energy-related technology: biofuels, solar, wind, hydro, sustainable buildings and energy efficiency. Denmark is in fact the 5th largest importer of Swedish environmental technologies, with the turnover of SEK 2,12 billion (EUR 230 million) in 2009 (Swedish Energy Agency 2010).

The example of biotech innovation sector, which was developed successfully in the region shows that targeted cooperative policy could provide sufficient effect. According to Hansen (2011) similar effect could be achieved within the industries, where synthetic knowledge bases that is associated with regional networks. It could be suggested that cleantech industries on the both sides of the sound are complementary to each other. Nevertheless, there is a concern that cross-border integration on developing cleantech innovation between the sides of the Öresund might affect the collaboration with other regions as it happened in case of biotech development (Hansen 2011).

4.4.1 Inventory of cleantech clusters

A screening of the clusters' companies show that at least half of the partners of CCC and 25 members of SBH promote energy-related activities. Their names with description are presented below in the Tables where they are grouped under several categories. It could be suggested that Copenhagen Cleantech Cluster and Sustainable Business Hub can contribute to the energy development of the Öresund region and achievement of the project goals. These clusters have the capacity to become business drivers for the energy development in the region. There is a sufficient number of cleantech companies, which could also benefit from collaboration. This may include benefits from promotion of products within the region and oversees, organising joint ventures and cooperation with grass-roots initiatives. In the Table 4 and Table 5 inventories of the cleantech clusters are presented.

Table 4. *Inventory of Sustainable Business Hub*

MANUFACTURERS	
Multi-National Organizations	
ABB	one of the leading in power and automation technologies, with the purpose to improve energy efficiency and lower environmental impact
Vestas	provides wind energy systems and complementary services
Alfa-Laval	primary area of Alfa-Laval is heating and cooling processes
Medium- and Small-sized Enterprises	
Heatex	deals with air-to-air heat exchangers
AB	manufactures specific groundwater heat pumps
Elgocell AB	developed a heat pipe with extremely thick insulation that has superior properties
Osby Parca	produces electric boilers, oil/gas boilers and solid fuel boilers for industrial customers and district heating plants
Multichannel	manufacturers of brazed plate heat exchangers
Ripasso CSP system	developed an innovative technology for utilization of solar energy, combining stirling power converter with a parabolic mirror
SERVICE PROVIDERS	
E.ON Sverige	one of the world largest energy services provider, E.ON Sverige has large area of activities including traditional areas as well as

	climate and renewables
Schneider Electric	supplies a wide range of technologies and solutions for energy usage and optimization in energy, infrastructure and industry sectors
Catator	develops high-tech catalysis and a customised catalytic process for improvement of emission problems and energy saving
Thermofloc	support services for cellulose insulation and complex structures in all buildings insulation attics, sloping ceiling, walls and floors.
BioSep	provides food waste treatment systems, that allows to convert organic waste into "green energy"
Energy Opticon	is a software developer for load and optimization forecasting for energy-related organizations
Malmberg	develops biogas and geothermal energy solutions
Sysav	is a large waste-management company, which also recovers waste in the form of energy
Lunds Energi	deals with electricity and district heating in Lund and Lomma
CLEANTECH CONSULTANS	
ÅF Group	is a leading in technical consulting
BioMil AB	is a consultancy company engaged in sustainable solutions for biogas and the environment
EnerChem AB	works with biogas and environ-mental solutions
WSP Consultancy	promotes solutions on energy supply, clean energy production and climate change
RESEARCH AND NON-GOVERNMENTAL ORGANIZATIONS	
IIIEE	the overall ambition to advance and apply knowledge in policy and strategy for sustainable solutions
Malmö University	the university has played a central role in the transformation of Malmö from an industrial town to a centre of learning
Global Energy Transformation Institute	founded in 2007 to identify challenges and solutions with large-scale energy transformation
Sustainable Mobility Skåne	is a regional center in Skåne county, working with environmental friendly transport uses within the region
INTERMEDIARIES	
Krinova's Science Park	the large venture mutually owned by Municipality of Kristianstad and Kristianstad University
Handelskammaren	is a private enterprise, which supports business development in the southern Sweden
TEM Foundation	is working to help companies and other organizations develop sustainability issues
Minc	promotes entrepreneurship of network-based environment, and

	developing platform multilateral meetings
Hügoth Business Advisory	is focusing on generation of the grounds for successful international business agreements
Information Rapidus	is a news service company, which covers the development of industries in Sealand and Skåne

Source: adopted from IIIEE 2011

***Table 5**. Inventory of Copenhagen Cleantech Cluster*

MANUFACTURERS	
Multi-National Organizations	
Confederation of Danish Industry	responsible for market-related activities in the cluster, including Ex-port promotion and market fact finding, building knowledge of international markets, fact finding tours, building international partner-ship
Novozymes	is the world leader in bio-innovation organization, including biofuel productions. wind energy systems and complementary services
Siemens	is a part of the international Siemens Group
SERVICE PROVIDERS	
DONG Energy	is one representative organization from CCC in this category. It is the leading energy group in Northern Europe with business is based on procuring, producing, distributing and trading in energy and related products.
RESEARCH AND NON-GOVERNMENTAL ORGANIZATIONS	
The Copenhagen Resource Institute	is an independent consultancy conducting studies and analyses for private and public clients within the field of sustainable consumption and production
University of Copenhagen	is the largest institution of research and education in Denmark with about 37 000 students and 7000 employees
Aalborg University	offers challenging educations, dynamic research and unique possibilities for innovative cooperation
INTERMEDIARIES	
Scion DTU	providing access to facilities, services, consultancy and networks of the 180 research-based companies
Symbion	consists of four science parks, services facility, hosts more than 90 companies
Business Link Startvækst	is a portal for entrepreneurs and growth businesses
Copenhagen Capacity	is an official inward investment agency and maintaining foreign companies it promotes the region internationally

Source: adopted from IIIEE 2011

Copenhagen Cleantech Cluster and Sustainable Business Hub in Malmö could be a good examples of the regional cleantech clusters. They allow to integrate and involve cleantech companies, universities, authorities and NGOs in the process of low-carbon development. It seems that clusters could contribute to the achievement of better practical outcomes, increase the efficiency of collaborations between project stakeholders and help to include new solutions. Both clusters represent the platforms for communication and integration with business. Their managers should be experienced in working with different types of stakeholders, not only cleantech innovation companies, but R&D organization, consulting, incubators, etc. CCC and SBH in Malmö have connections and brand-name, so their participation could be helpful for regional development. Their further development could make the clusters business gates for the cleantech development in the Öresund region.

It seems that although both clusters initiatives on the Danish and Swedish sides contribute to the cleantech development and involve important national stakeholders there is a lack of cross-border cooperation between the sides. It is difficult to suggest without specific analysis, whether such cooperation is needed for more effective. cleantech development of the whole region, but this could be one of the directions that is good to consider. It would be also valuable for cross-border regions where there is a need to promote cleantech.

4.4.2 Opportunities for cross-border cleantech cooperation

There are some lessons for the involvement of cleantech companies in the regional development could be are suggested based on the analysis of experience of the cleantech clusters in Oresund.

4.4.2.1 Intraregional cooperation

Regions and municipalities have ambitious low-carbon development goals that require introduction of high-efficient technologies in order to achieve them. It creates market potential for the companies. At the present many of the cleantech companies are active on the local level and a new market provides opportunities to promote their products in the region. Some of the municipalities plan to increase the share of non-fossil fuel based transport in order to meet low-carbon development requirements.

For example, EDISON cars, a project on Bornholm island, which utilizes electricity produced from wind and biomass could be a good solution. Moreover they could be used as energy storage and protect electricity grids from fluctuations. Multilateral agreements could be one of the instruments for intraregional cooperation. For instance, Malmö, Lund and Kristianstad municipalities, could sign an agreement for bulk buying of EDISON cars with a discount for municipal organizational usage. Additionally, Copenhagen, Albertslund and Ballerup could order products and services of SweHeat & Cooling companies under similar conditions.

4.4.2.2 Export Opportunities

Business in both Skåne and Sjælland are interested in exporting their clean technologies. Developing mutual cooperation could also contribute to these activities. International markets for cleantech provides many opportunities, driven by the interests of both developed economies like the United States and developing ones like China. In 2007 overall volume of investments was 2,75 billion US dollars (Cleantech Group 2008). The Öresund companies could promote themselves under a "Low-Carbon Öresund" umbrella brand.

Clean technologies in Sweden and Denmark are complementary to some degree. Collaboration between specialists from both sides could result in solutions for foreign organizations. The unique situation when two separate states mutually create environment for energy collaboration could be a model for other interregional cooperation within and outside EU. Cleantech tours for foreign investors, administrations or even interested tourists could be organized, so "Low-carbon Öresund" could become an international touristic destination. Or business exhibitions and conferences could be organized abroad for the Öresund Region companies and administrations.

4.4.2.3 New Markets

Undiscovered market opportunities for clean-tech companies are available with collaboration with local NGOs, environmental entrepreneurs and grass-roots initiatives. Nowadays, citizens are becoming more involved in promotion of low-carbon development by realization of their own projects. Examples of such activities are local wind cooperatives, sustainable university initiatives, urban gardening movements. There are a number of cases of such collaborations in New-York, for example (Horwitch and Mulloth 2008).

Cleantech organizations can establish collaboration with such stakeholders, provide them with technologies and have the opportunities for testing and promotion of the production. These groups could help companies with ideas for innovations, which is known as open innovation approach. According to recent research grassroots activities could be helpful for developing new ideas and promote innovations (Horwitch and Mulloth 2008).

5 Interviewing and Findings

In order to answer the second sub question: "What experiences and lessons based on individual views of the representatives of stakeholders of Öresund RIS could be useful for other regions?" analysis of the first-hand knowledge from the interviewees – representatives of the organizations-stakeholders of the Öresund RIS was undertaken.

First of all, interviewees were asked to tell about the role of their organizations in the Öresund RIS. Then it was attempted to find out details on specific questions, if the representatives agree or disagree with the recommendation developed during the literature analysis. The interviewees also provided some insights, based on their personal experiences, and their tacit knowledge. It is important that new knowledge was not always developed as a result of the answers, but it was rather "weaved" by the both parties in process of conversation. Interviewees covered different issues during the conversation: some of them – described more how organizations are interacting and institutions are functioning, whereas the others focused more on specific functions and role of their organizations.

In total, 12 interviews were conducted: six in Öresund in February and six interviews in Moscow in March of 2012 (See Appendix I and Appendix II). In order to understand their vision on cleantech innovation and entrepreneurship development regional stakeholders of the innovation system were interviewed. Using case-study methodology (Yin, 2003), such methods as in-depth individual, semi-structured interviews, interviews which leave room for adjustments during the interview process were applied. The participants have key expertise in three areas: research on innovations, consultancy and networking, entrepreneurial education. One expert for each area on both Danish and Swedish sides were interviewed, see Table 6. In addition Lund expert from Innovationsbron, investment agency (Antonsson 2012), and two

representatives of Lund University Innovation System, technology transfer office (Olsson 2012: Bogsjö 2012) were consulted.

Table 6. *Profile of the key interviewees in Öresund RIS and their focus areas*

Focus areas	Countries	
	Sweden	**Denmark**
Research on innovations	Lars Coenen, Centre for Innovation, Research and Competence in the Learning Economy (CIRCLE), Lund University Macro-perspective on regional innovation system	Teis Hansen, Department of Geography, University of Copenhagen Macro-perspective on regional innovation system
Consultancy and networking	Jonas Velander, Teknopol Organizational- perspective on cleantech development	Rune Rasmussen, Copenhagen Cleantech Cluster Macro-perspective on partnership for cleantech development
Entrepreneurship education	Marie Löwegren, SKJ Center for Entrepreneurship, Lund University Organizational-perspective on entrepreneurship education	Christian Vintergaard, Danish Foundation for Entrepreneurship Macro-perspective on entrepreneurship education

5.1 Öresund regional innovation system

Talents are considered as a valuable asset for the regional innovation system of Öresund. The potential for promotion of research-based innovations in the Öresund is associated with scientists. ("It's all about people… bright researchers" [Coenen 2012]). Branding of the region seems also as a factor of success for interregional initiatives, in particular, in case of Medicon Valley. Nevertheless, although this project is seeing as quite successful, many pharmaceutical companies, which supported innovation development, recently moved to the other regions with more attractive policies and tax systems (Antonsson 2012). An interesting fact is that there is a

tendency for increasing number of research-based innovations, which are not related to natural science, but related to social sciences. It significantly extends the magnitude and possibility to involve academia and students in promotion of research-based cleantech innovations.

There were a lot of expectations regarding the interregional integration after the construction of the Öresund bridge. Although the construction resulted in increasing of economic cooperation and regional development, it seems that it didn't affect that much scientific collaboration (Hansen 2012). Therefore, physical proximity might not be very important for the development of research-based knowledge. Moreover, it is suggested that, physical proximity might not be as relevant for business networking and collaboration in the modern globalized world ("Why should I have a partner in Sweden if I could have one in New York?" [Vintergaard 2012]). Based on the views of Rasmussen (2012) and Coenen (2012), it could be proposed that it is not the distance to the country, which is important for business developers and investors, but economic incentives and policies.

On the other hand, physical proximity is an important factor for political cooperation between Danish and Swedish sides. The fact that Copenhagen, Danish capital and political center is situated within the Öresund region, whereas the, Stockholm, which is the capital of Sweden, is about several hundred kilometers away – is important when there is a need for mutual political initiatives. In addition, there is an assumption that Swedish government could be not as interested in development of the Öresund due to lower level of benefits for the region of Stockholm comparing to the region of Copenhagen (Vintergaard 2012).

Some of the interregional networking initiatives don't seem to be very promising anymore or at least the level of awareness about these initiatives are not as high as it was before (Vintergaard 2012). There is also a degree of skepticism about future of transnational collaboration due to unequal distribution of benefits for between Danish and Swedish sides (Antonsson 2012). The indirect evidence for that – interviewees were more interested to talk

about the innovation systems of their countries, rather than transnational innovation system of the Öresund.

5.2 Cleantech development in Öresund

Although all interviewees were relevant to or familiar with cleantech development in the Öresund, it wasn't clear if their understanding of cleantech is the same ("nowadays (even) Siemens is considered itself as a cleantech company" [Coenen 2012]). On the other hand, business practitioner who deals with a cleantech companies, provided a clear definition of clean technologies as "solutions that have a significant impact on the transition to sustainable society" (Velander 2012). There is also the difference in the views on the cleantech. Some interviewees look on a low-carbon transition from the perspective of a new technological findings, its practical implementation and commercialization (Velander 2012). Whereas others consider dissemination of clean technologies as more important (Coenen 2012). In the light of the suggestion that most of the GHG reductions by 2020 will be based on the existing technologies (IPCC 2007), the mentioned views could be interpreted this way: there is a need for further development and adaptation of the transformative innovation, and finding new business models for their commercialization in a large-scale, which also requires significant research attempts. Moreover, it is need to consider that low-carbon ambitions of the authorities in Öresund are not limited by the year of 2020 (table 1), which could also be a factor for the demand of new cleantech technologies.

It was suggested that cleantech development should be based on the cooperation with the existed non-cleantech industries. Firstly, cleantech start-ups could have some difficulties to compete with the mature industries. Secondly, successful cases for the cleantech development mentioned during the interviews were also related to the cooperation with existing industries: in particular, the case of flexfuel cars, which could use mixes of biofuels with gasoline or

traditional gasoline (Coenen 2012). At the same time examples of concrete strategies for collaboration between cleantech startups and mature industry were presented. For example, Teknopol business advisory have two cleantech related initiatives – Customer financed development and verification and Innovation purchasing. In the first case mature company, for that moment E.On, establishes the fund to help cleantech start-ups to develop their technology to the level, when it could buy it. In the second, Teknopol helps to translate sustainability needs of the large companies to a concrete demand, which could be met by start-ups (Velander 2012).

Network and cluster initiatives are seeing as quite effective by some of the interviewees. For example, Medicon Valley interregional project for biotech development, which was based on the networking and cooperation, is considered to be successful. It is suggested that cleantech innovation might have the similar patterns of development (Hansen 2012). Moreover, Sustainable Business Hub seems to be an important actor for cleantech development on the Swedish side since its effective for dissemination of new technologies – it connects local actors and promotes solutions internationally (Coenen 2012). At the same time, Copenhagen Cleantech Cluster is also focused on "filling the gaps" in regional innovation system besides the networking on the Danish side by providing different kind of supports, including the financial one (Rasmussen 2012).

5.3 Entrepreneurship development in Öresund

It is suggested that entrepreneurial capital was increasing in region during the last decade. For example, one of the interviewees from Sweden claimed that ten years ago people were rather interested to become business consultants than to be entrepreneurs (Velander 2012). Whereas the other interviewee from Denmark said that before entrepreneurship was seen as a thing for "daredevils". At the same time, there was a common perception in society in

the past that graduation from a university will automatically lead to the employment in a good company. And it is still strong (Vintergaard 2012).

Nowadays students and researchers from academia are getting more and more interested in studying entrepreneurship, having their own venture or becoming corporate entrepreneur. In addition, the crisis affects the opportunities for the employment and governments of both Denmark and Sweden are interested in the promotion of entrepreneurship (Vintergaard 2012). It seems that both sides have high level of social security and perception of risk of failure, which are important barriers for practicing entrepreneurship. It was also suggested that high tax level negatively affects the initiatives for entrepreneurship ("You lose 60% of your jackpot" [Hansen 2012]).

Öresund Entrepreneurship Academy became an important step for the development of entrepreneurial spirit in the region. Nevertheless, the project was stopped in 2010, on the one hand, due to the creation of national entrepreneurship strategies on the both sides of the sound and problem with financing of the initiative. On the other hand, it seemed that the level of interest to this project on the Swedish side was lower than on the Danish side (Vintergaard 2012).

There are two interesting examples of the entrepreneurial education projects in Öresund. First one is the Danish Foundation for Entrepreneurship. It supports entrepreneurial education from school to university ("from ABC to Ph.D." [Vintergaard 2012]) in Denmark. Another one is SKJ Center for Entrepreneurship, which started its activities in 2011 at Lund University. It provides 14 different courses on entrepreneurship at the different departments. Moreover, the center has a special international master program, which is combined with developing business venture using the research ideas, provided by Lund University Innovation System, technology transfer office. Students could also choose another track and practice corporate entrepreneurship in the companies (Löwegren 2012).

5.4 Innovation system of Moscow

Interviews with six representatives of innovation system of Moscow, Russia, were conducted (see Appendix II) with the purpose to get basic understanding of how its functioning in order to apply to it some lessons learned from Öresund

Russia is developing only two decades under market economy conditions. And only last ten years in relatively stable economic conditions. On the one hand, there is a potential for development of research-intensive innovation in Russian academia, which is inherited from Soviet time. On the one hand, there is a problem of culture of entrepreneurship among students and scientists, especially old school ones. On the other hand, interest to become entrepreneurs among students is growing. In the middle of 2000s government started to pay attention to the development of innovation in Russia. But it seems that there are a lot of "buzz" around it, rather than practical solutions for development.

Although many of research institutions are functioning in Moscow, it seems that there is no such phenomenon as a Moscow regional innovation system. Nevertheless, a development of innovation clusters within the region is going on. Moscow State University probably could serve as a good example of the research and education center that represent valuable assets of innovation system of Moscow. It is similar in some ways to Copenhagen and Lund universities and has a high potential for development and commercialize of research-based innovations. Many scientists of MSU have difficulties to promote and commercialize the results of their research. At the same time students of Moscow State University are more likely to go on corporate career path, rather than be involved in innovation and entrepreneurship activities.

Due to inefficiency of environment for innovation and entrepreneurship development factor of personality and good individual relations (with government and big business, e.g. Gazprom) is important for promotion of research-based innovation. Generally, demand for

research-based innovations is relatively low comparing to western states. There is also a perception that it is easier to promote so-called "marketing-based" innovation or even copy innovation related to ICT, rather than create research-based innovations. Nevertheless, state procurement could support scientific innovations, especially for the large projects.

6 Discussion

6.1 Stages of Öresund RIS development

Based on the findings from the literature review and interviewing of regional stakeholders three stages of interregional cooperation between Danish and Swedish sides in Öresund were identified.

1990s – mid 2000s: policy-cooperation, rise of life-science and bridging the sides

An active cooperation between the sides started in the 90s. The ground for the cooperation was associated with high intensity of talents, scientific minds, institutions, relatively equal level of economic development, social and cultural similarities as well as physical proximity. The interest of the regional authorities, national administrations and European Union to interregional cooperation in Öresund fueled the integration. The initiatives of the regional and local authorities resulted in organization of the regional forum for policy-making, known as Öresund Committee. This body identifies the goals for the whole region and develops the recommendations.

Identification of the specific niche for Öresund development – biotech and pharmaceuticals innovation in the 90s was based on regional competiveness factors: intensity of scientists and research organizations and presence of 60% of the pharmaceutical companies in the area. Effective branding of Medicon Valley, development of the networking organization – Medicon Valley Alliance together with relevant policies and fiscal incentives in the region created favorable conditions for pharmaceutical and biotech innovations development. Creation of networks, between administration, higher education and research institutions and industry resulted in increasing cooperation. There is a number of networking organizations that are still functioning in Öresund. Many of them such as Öresund University are based on the

interregional scientific collaboration and mutual educational initiatives. At the same time, construction of Öresund bridge contributed to the solution of problem of physical proximity and supported more effective cooperation between the Danish and Swedish parts.

Mid 2000s – nowadays: sober view on the networking, scientific and economic results of cooperation in the region

The results that associated with the developments in Öresund made in the 1990s and early 2000s were less than it was expected by the end of the last decade. Networking initiatives between the regions being seen as a top-down exercise of the regional authorities, supported by national administrations and regional authorities without voluntary involvement of the local organizations. The interest of EU could be considered as supportive due to the European policy of place marketing and investing funds in the regional development. At the same time inequality between the interests of the national authorities became more evident. Since the political and economic center of Sweden, Stockholm, is situated about 500 km away from the Öresund, whereas Copenhagen, the capital of Denmark is placed within the region.

This inequality of interests resulted in the undersupport of the interregional initiatives by the national bodies. Furthermore, the construction of the bridge didn't affect that much the level of scientific cooperation between the sides of the sound and not that much economic integration as it was expected. Medicon Valley, on the one hand, resulted in a good collaboration, but amount of knowledge-spillovers and local practical implementation of the results were fewer than expected. Furthermore, last years, large part of the pharmaceutical companies moved to the other world regions, with more favorable economic conditions, in particular, in New Jersey, USA.

Nowadays – the future: Öresund as "climate-smart region"? Role of cleantech development, cross-border cooperation and academic entrepreneurship

There is an uncertainty regarding to the future development of Öresund. The mutual initiatives between the sides of the sound that seemed to be fruitful in the last two decades don't seem to be so at the present time. The difference between economic and social development of the Skåne region and the Greater Region of Copenhagen together with different political interests question whether the future of Öresund will depends on active cooperation or it will be cohesive to some degree development of the both sides? The positive news is that Öresund committee, which unites the regional and local authorities is actively promoting mid-term plan for the development of the region, stating the vision of Öresund as a "climate-smart region". In the light of these considerations, cleantech innovation development, cross-border cooperation and academic entrepreneurship maybe important for the development of the region in the next years. There is also a possibility that realization of this common vision could renew the capacity for interregional collaboration.

At the same time it is not clear how achievement of the vision of Öresund as "climate-smart region" is going to be undertaken. One of the options is that the vision could be grounded to the reality by the low-carbon goals, which are set on regional and local level in the Öresund as well as relevant national Danish and Swedish goals. These goals should be translated in concrete policy measures and guidelines, in particular, supporting researching, planning & acting and communication. For example, such measures and guidelines in Malmö include: prioritizing walking, cycling and public transport, developing heat pump projects, providing sport facilities with solar heating systems (Stadsbyggnadskontor, 2009). Therefore, it could be suggested that the achievement of the Öresund vision would be coherent to the fulfillment to the realization of the low-carbon regional and local goals.

In addition, we could identify lessons from Öresund how to involve cleantech companies in a process of regional development were identified.

1. Develop information package about the region, web-site and newsletters;

2. Select the companies, which are interested and could contribute to the project;

3. Organize seminars for broad audience: municipalities, business, researchers, eco-preneurs;

4. Organize special workshops: best practices on district heating, wind energy solutions, biofuels;

5. Develop cleantech tours, knowhow classes for the broad audience, trainings to promote entrepreneurship;

6. Promote of Öresund Energy. Promotion in the media, on public events, in social networks; and

7. Organize conference and cooperation forum for future development.

7 Conclusions

The purpose of the research was to develop a more holistic view on the innovation system of the Öresund with regard to cleantech, cross-border collaboration and academic entrepreneurship and to develop some lessons, which could be valuable for other regions and apply some of these lessons to innovation system of Moscow.

Generally, the reasons for the development of innovation system of regions are associated with improvement of economic and social performance and increasing of global competiveness. There are a number of successful areas with developed regional innovation system that became quite prominent for their achievements. Silicon Valley is one of such examples. There are different regions around the globe that are aimed to follow a successful pathway of the Valley in terms of innovations and economic outcomes. In many places policy-makers try to create "Silicon Somewheres" (Florida, 2002). Nevertheless, Silicon Valley has a number of institutional assets, which attract many policy-makers, but are hard to copy. It includes: research facilities and large universities, big venture capital funds, mature companies and appropriate entrepreneurial culture (Jackson 2011). Nevertheless, many policy-makers support such initiatives in order to promote and implement practices from the prominent regions. An alternative approach, suggested by Hospers (2006) is known as regional realism. It assumes considering regions, that have remarkable achievements, for getting valuable experience and inspiration.

Öresund region also has some achievements that make it distinguishing from others region. They are: cross-border collaboration, cleantech and academic entrepreneurship. At the same time, there are some institutional settings that limit the opportunities to learn from the success of the region. It includes specific Scandinavian social, cultural, political and economic context; geographical characteristics, first of all, the sound that separate Danish and Swedish

parts of Öresund and the bridge that connects them; the density of population, as the Copenhagen-Malmö is the most populated metropolitan area in Scandinavia; high intensity of research facilities, scientists and students. Nevertheless, these features could serve as a ground for the analysis of the regional experiences, positive and negative, that could be relevant and fruitful for other regions.

Based on the analysis of the Öresund RIS utilizing a framework of key activities of innovation system (Edquist 2005) preliminary recommendations for policy-makers of different regions were developed, after that several interviews with the representatives of Öresund and Moscow RIS were conducted. According to the interviewees the process of interregional collaboration in Öresund for the development of the research-based innovations at the present seems not as promising as it expected to be several years ago (Rasmussen 2012; Vintergaard, 2012; Antonsson 2012). Biotech was a leading industry for interregional scientific cooperation (Lundquist and Trippl, 2009; Hanson, 2012) in the past, but it might be not so perspective in the future (Antonsson 2012). At the same time the region has a strong agenda for low-carbon transition (IIIEE, 2012) with specific goals, which assumes implementation of cleantech innovations.

7.1 Implications of lessons to innovation system of Moscow

Based on the analysis of some literature sources and interviews with the experts of innovation system from Moscow, Russia (see Appendix II), it is attempted to analyze the value of the lessons for Russia from Öresund RIS related to cleantech, academic entrepreneurship and cross-border collaboration.

It is need to state that the interviewees rather discussed national innovation system of Russia, than regional innovation system of Moscow. It could be suggested that some of the

important features of these innovation systems correspond and both systems have some similarities.

It could be suggested that there is a significant potential for the development and implementation of cleantech innovations in Russia, connected to increasing of energy efficiency. According to the World Bank research Russia, including Moscow, is one of the world "leaders" by the energy intensity of GDP (World Bank 2008). On the one hand, low energy efficiency presents a threat for the future development, but could become the opportunity for growth, on the other hand. The costs of the measures to improve energy efficiency of Russian economy are usually lower than in the high energy efficient economies: about 70% of this potential could be acquired with economically feasible and financial profitable investments (McKinsey & Company 2009). Energy intensity of GDP could be decreased by 45%. This amount is equal to annual energy consumption of France, Ukraine and represents 2% of total world energy demand. At the same time many measures of cleantech has been already developed.

As in Öresund, there are concrete low-carbon targets for the development of innovation system of Russia and Moscow. At the present the increase of energy efficiency as the part of green growth is one of the strategic development target for Russia – the energy intensity of the GDP should be decreased by 40% in 2020 comparing to the 2007 level (President 2008). In the official strategic development plan – Conception of Long-Term Social Economic Development of Russia for up to 2020 this pathway is called "innovative" (MEDR 2009). According to this one of Russian primary interests should be to decrease the energy intensity of the economy, create the basis for innovative growth and technological development.

Therefore, political incentives for cleantech development, at least those related to energy efficiency, in Öresund and in Russia, and in Moscow, in particular, could be similar to some degree. Nevertheless, it is a question if there the level of political interest in Russia is that

strong as it seems to be in Öresund. Previous experience of cleantech development shows that there is no that much real attention from policy-makers and real practical outcomes.

Contrary to the national authorities of Denmark and Sweden, Russian authorities seems to be not as interested in promotion of energy efficiency. Moreover, the current national brand of Russia is associated with the country as a guarantor of energy security for other states, including European ones. That could be contradictory to the brand of energy efficient state, such as State of Green, brand of Denmark. Therefore the very first lesson for the development of cleantech in Russia, at least in energy sector, could be related to learning from some institutional assets. It includes: real political interest to develop cleantech economy and achievement stated energy efficiency goals by implementation of innovations.

There was not only the factor of the national interest, which helps to coordinate the achievement of low-carbon goals in Denmark and Sweden, but also the interest of different regional and local authorities, united by the policy forum, Öresund Committee, as well as by the other networking initiatives. Such networking approach could be also useful in Russia and Moscow, in particular, in order to promote energy efficiency without strong political will on the national level.

Nevertheless, different institutional context in Russia could result in lower level of efficiency of the networking. The author has an experience of collaboration with Russian Biofuels Association, networking organization that unites different national and international actors in the field of biofuels. It is need to state that the Association have a purpose to promote biofuels. Nevertheless, the author, during his work in that organization, had a perception that there was not much real progress in this area done besides the exchange of experience and information regarding the problems of the biofuels development in Russia.

At the same time there are some opportunities for development of the clusters, moreover, there are some activities in this area are going on in Russia. For example, Skolkovo

should be a prominent cluster (Skolkovo 2012) situated near Moscow. It also has a sector for energy cleantech. Nevertheless, according to the interviewees there are some institutional problems, which would be barriers on the real development of innovations in such clusters (Kudachkin 2012; Karasev 2012).

There is a lesson could be learned from Öresund on a university level. There are some similarities between Lund University and Moscow State University, concerning the scope of the research area, size in terms of number of faculty and number students and researches, as well as the opportunities for making both universities more entrepreneurial. For example, both universities have centers for entrepreneurship, SKJ Center in LU and Department of Economics of Innovations in MSU. Moreover, there is an impression that both universities have similar problems associated with a lack of entrepreneurial spirit among students and scientist. Nevertheless, it seems that SKJ Center in LU has better efficiency due to more favourable conditions, sufficient interest of different parties and financial support (Löwegren 2012;. Ivaschenko 2012).

Another lesson for innovation systems in Russia is related to utilization of strategies for collaboration between large companies that are usually affiliated with the government with small and medium enterprises. For example, the scheme for customer financed development and verification could be appropriate. It assumes establishment of the funds by large businesses in order to help innovation companies to develop their technology. Innovation purchasing could be also applicable, when the needs of the large companies could be translated to the innovation demands for innovations for small enterprises (Velander 2012).

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Appendix I

Some of key ideas learned from the interviews with stakeholders of innovation systems from Öresund.

Lars Coenen, Centre for Innovation, Research and Competence in the Learning Economy (CIRCLE), Lund University [Research on I&E]

Lars provided macro-perspective on innovation development.

- CIRCLE as innovation expertise center for business and government.
- Indirect personal influence of experts on policy-making and role of the networks to promote solutions.
- Cleantech: importance of political factor and institutions. High uncertainty as a barrier for investors.
- Transformative innovations are needed to achieve sustainability transition goals. But current solution is to "tap into existing infrastructure".
- Main challenge for cleantech is on the diffusion side, rather than on innovation side.
- Importance of "healthy" competition in low-carbon development between regional authorities.
- State authorities should create appropriate environment, provide public procurements, mediate the interests.
- Sustainable Business Hub is doing good practical things – connecting local players and promote cleantech solutions internationally.
- Economic crisis could be not only a threat, but an opportunity for cleantech industry in Sweden, but it is very difficult to predict.
- Grass-root initiatives are good on the early stages.

- One of the factors of Swedish paradox: "multinationals" implement Swedish R&D results oversees.

Teis Hansen, Department of Geography, University of Copenhagen [Researcher on I&E]

Macro-perspective on entrepreneurship and Öresund development.

- Studied of biotech interregional scientific collaboration by evaluating the number of mutual publications: construction of the Öresund Bridge didn't seriously affect the patterns on publications.
- Nevertheless, the Bridge could have more impact on interregional research collaboration in the future.
- Overcoming of physical proximity barrier, by the construction of the Bridge, could influence economic cooperation, as well as cooperation on innovation and entrepreneurship, but in a mid- and long-term perspective.
- Currently (Danish) entrepreneurs still have national focus, rather than cross-border of international. It depends on the social networking.
- Medicon Valley Alliance as a successful case: networking helps to get people together. There is an assumption that cleantech might follow the stages of MVA.
- Danish economy: a lot of small and medium enterprises. Sufficiently low number of high-tech, but many of manufacturers in heavy traditional industry.
- High tax level could be a barrier for the entrepreneurship. "You can't g*et al.*l jackpot".

Jonas Velander, Teknopol, IDEON science park [Cleantech business]

Firm-level solutions. Personal view.

- Defined clean technologies as: "solutions that have a significant impact on the transition to sustainable society".

- Teknopol was developed with the support of Skåne authorities, which were ahead of all other regional authorities in Sweden.
- Presented Teknopol as a business advisory and "virtual incubator". Consultants are key asset since they invest experience and provide networking. Compliment to traditional incubator.
- "Cleantech in Sweden" is a subproject with the two main activities.

    1. Customer financed development and verification: with the support of large companies help to grow the technology until it become mature and companies would be interested to buy it;

    2. Innovation purchasing: helps to translate "sustainability needs" of IKEA and others large companies to concrete demand for Teknopol clients.
- Have around 50 start-ups in Sweden. Profile of entrepreneurs – engineers, 35-50 years old who want to start own ventures.
- Main drivers for cleantech innovations in Sweden: a) environmental values of Swedish people; b) the values are translated into concrete policies; c) natural for renewable energy – biomass per capita; d) increasing of energy costs.
- Entrepreneurial culture in Sweden seems to be better than before. Taxation could stimulate to start own ventures.

Rune Rasmussen, Copenhagen Cleantech Cluster [Cleantech business]

Top-down approach for cleantech development.

- CCC received the largest fund comparing to other clusters – 20 mln. SEK.
- Founders are European Union, Danish regions and business partners. One of the EU interests in CCC is possibility to invest bulk of money and outsource management of fund for the region.

- CCC is linking partners in different areas of cleantech, including wind, water and smart cities.
- On the first stage of cluster development it is important to set up a group of the partners and members.
- The main task is to feel the gap in the regional innovation system by different kind of activities, including financing. The task is to promote collaboration among partners.
- Current political situation in Denmark is favorable for cleantech development ("It is easy to be a Danish politician").
- Education for cleantech is important, but seems to be not very developed at the present time in Denmark.
- Features of Danish IS – lack of entrepreneurial asset, small domestic market, lack of investors in cleantech.
- There is a less buzz about cleantech than there was about ICT.
- Physical and cultural proximity are not the most important factors for innovation collaboration with other states.

Marie Löwegren, SKJ Center for Entrepreneurship, Lund University [Education for entrepreneurship]

Marie provided organization-perspective.

- SKJ Center for Entrepreneruship is a new center, started in autumn 2011, but it is based on previously existed activities.
- Action-oriented approach is implemented for education of students.
- There are three areas of activity:
- Firstly, teaching: 14 different courses for the LU departments on entrepreneurship and international master program.

- On master program students start their own ventures, using the developments of LU scientists accumulated in LUIS. The alternative path is to develop corporate entrepreneurship project.
- Secondly, the Center also develop research on different issues related to I&E, including entreprenruship education, academic entrepreneurship, knowledge-transfer, etc.
- Thirdly, the Center is developing collaboration with external parties – to establish better relations with regional innovation system. It promotes events to mix students with professionals.
- They collaborate with Venture Lab, accelerator, incubator and technology transfer office for LU students.

Christian Vintergaard, Danish Foundation for Entrepreneurship [Education for entrepreneurship]

Entrepreneurship professional. View on the entrepreneurship development in Öresund and Denmark.

- Christian was a head of Öresund Entrepreneurship Academy.
- The Academy was aimed on the development of the courses for faculty and curriculum development on the both side of the sound.
- The activities included: courses. training of trainers, study excursions, conferences. More than 100 courses were developed during 2 years.
- In the late 2000s both Sweden and Denmark developed national strategies on entrepreneurship, instead of mutual one for Öresund.

- After that Christian became a head of Danish Foundation for Entrepreneurship. Which is aimed on teaching entrepreneurship wide audience in Denmark "from ABC to Ph.D.": from school to doctor level
- The Foundation tries to bring faculty on entrepreneurship side and teach faculty how to teach entrepreneurship to their students and pupils ("Teach teachers how to teach").
- It is important to develop entrepreneurship in education culture. Importance of self-employment and corporate entrepreneurship.
- There is a traditional perception in Denmark that education results in getting a job.
- Upcoming crisis could change this practice: government and business should be interested.
- On the other hand, it is difficult to measure the results of entrepreneurship education. There is a perception that it helps, but it is need to be ensured.

Appendix II

Some of key ideas learned from the interviews with stakeholders of innovation systems from MOSCOW, Russia

Natalia Ivaschenko, Head of Department of Economics of Innovations, Moscow State University (MSU) [Education for entrepreneurship]

- MSU is a one of the largest and most prominent universities in Russia.
- The department is a center for education and research on innovation and entrepreneurship (I&E) in MSU.
- Natalia was one of the first movers in I&E field in 1990`s.
- Focal points of the conversation:
- During the last years situation for I&E development in MSU and in Russia became better than before.
- Her group developed an education for department of economics, and special MA program.
- There is "problem in minds" – no culture for entrepreneurs, conventional wisdom.
- But the culture is changing with the growth of new generation.
- There is a strong need for complex support from the government and infrastructure.

Alexey Kudochkin, Phd. Student of Department of Economics of Innovation, MSU [[Education for entrepreneurship]
]

- Alexey has experience in entrepreneurship as well serial entrepreneur.
- Currently, he is studying the university's models for promotion of I&E.
- He is managing the education for entrepreneurship in the department and coaching entrepreneurs as well.

- Alex sounds quite realistic and sometimes critical.
- He provided interesting examples of his experience as entrepreneur and innovator.
- There is a lot of "buzz", or brainwashing about the innovation in Russia.
- He referred to the one of the major events when his company was invited for "window dressing".
- There are some people who are talking and teaching entrepreneurship without having real experience.
- Weak institutes for I&E is a major problem. Most of Innovations are related to ICT.

Yuri Mitin, Director of MSU Business-Incubator, [Entrepreneur]

- Yuri seems to be very proud of the achievements of his incubator. He has different experiences as an entrepreneur and a coach for young entrepreneurs. Incubator is just about 1 year old, but it has good results in terms of turnover and quality of companies.
- It was quite uneasy to organize incubator in MSU. Bureaucratic problems. Not enough support from alumni.
- MSU is a good place for developing innovation cluster (according to Yuri Silicon Valley success was associated with Standford University).
- Students don't usually think about entrepreneurship as a career opportunity.
- Not all innovations in MSU business-incubator are related to ICT. In many cases ICT is a platform for communication of biotech, high-tech, design solutions, etc.
- There are many innovation projects in MSU, which look more like crazy scientific rather than real business cases.

Stanislav Karasev, Entrepreneur, graduate from Moscow Aviation Institute. Expert in Technology and [Entrepreneur]

- Stanislav has a quite realistic view on entrepreneurship in Russian academia. He is an experienced in development of innovation projects. He used to work on the project for the state company.
- Scientists have view on their product only from research prospective. They don't promote research results.
- Business doesn't know where to go to get new technology.
- There is lack of demand for innovations. Business doesn't understand how innovation could help to improve performance.
- Bureaucracy is not interested, when there is no "kickback".
- ICT innovation enterprises are more developed then research-based ones due to: lower investments needs, faster payback, because usually they don't interfere with gov's and big business interests.

Anna Nenakhova, Associate Director at VTB Capital, Investment Fund, Research Fellow at Higher School of Economics in Moscow [Business]

- Anna works in one of the largest venture funds in Russia. She considers I&E projects from an investor perspective. She sees the innovation field as a developing and growing one. She distinguishes the role of the private funds, which look for most promising ventures, and support for innovations in science.
- There was a "reverse" development of national infrastructure for I&E.

- State first promoted venture investors and recently started to think about research-based ones.
- There is a relatively low level of demand for really innovative products in Russia comparing to western countries.
- Therefore there is no supply and many start-ups are not interested in developing research-based innovations.
- There is no culture for entrepreneurship. People have problems with presenting their business ideas in a right way. Potential entrepreneurs are afraid to fail.
- Large portion of venture financing depends on governmental funds. There is a common perception that funds should support everyone. Fundraising is very difficult issue – 1 of 1000 projects could get venture financing.

Nikolai Dobrovolskiy, Experienced Entrepreneur, Vice-president of Parallels, associated with Runa Capital investment fund [Business]

Nikolai is from ICT sector.

- He is persuaded that innovation development is going better now than before. 10 years ago "there was nothing".
- Nowadays there is an information background – "term innovation is popular".
- Development of I&E requires good coaches. Entrepreneurs should be more oriented towards learning and networking rather than just finding financial resources.
- Some of innovator and entrepreneur just want to "go to Hawaii", but not to develop the business.