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Promotion of Environmental Technology Export

Governmental Initiatives and Business Concepts

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Cover photos

Photos on the front of the thesis are meant to give examples of environmental technologies. On the back of the thesis, the photos depict typical environmental problems in certain parts of the world. Establishing a connection between these environmental technologies and environmental problems within the framework of sustainable development is what this thesis discusses through an examination of how the export of environmental technology is promoted.

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Abstract

This qualitative and quantitative study examines governmental initiatives and business concepts as approaches to promote the export of environmental technology. Here, environmental technology refers to technologies (products, services, organizational models, and large-scaled technical systems) whose development and use actually provide or intends to provide a better environmental performance than their relevant alternatives from a life cycle perspective. Using literature reviews, surveys and interviews, this thesis collects primary and secondary data from national government level, private Swedish environmental technology firms and Swedish municipality-owned firms.

Three main research questions guide this thesis. These questions address how different governments in selected countries promote the export of environmental technologies and how private Swedish environmental technology firms perceive the effectiveness of governmental export promotion initiatives in realising export. In a complementary view, the thesis focuses on fundamental components of business concepts for export of environmental technologies by municipality-owned companies. These three units of analysis (i.e. – governmental initiatives, private companies and municipality-owned companies) are influenced by the characteristics of the environmental technology sector in Sweden.

The main results from the study suggest three conclusions. First, governmental initiatives intended to promote the export of environmental technology are largely similar to approaches that intend to promote the export of “conventional” technology. These initiatives can be categorised as: financial aid programs, information programs, education and training programs, and trade mobility related programs. When it comes to perceived effectiveness of governmental promotion initiatives by private firms, results indicate that firms that accessed more than one type of governmental promotion, particularly those including financial support, perceived governmental promotion as contributing to realising export. For municipality-owned companies exporting environmental technology, the thesis proposes seven fundamental components of a business concept as: market (including regulation), finance, resources, activities, partnership (private-public partnership), ownership and responsibility, and legitimacy. Among these factors, regulation, public-private partnership, and legitimacy are particular to environmental technologies.

These results suggest a dynamic balance between generic and tailored export promotion initiatives for environmental technology exporters, with much attention to program implementation as is given to program content formulation. The components proposed for municipality export opens up a potentially new research trajectory on environmentally conscious design that considers technological as well as non-technological changes based on large-scaled environmental technology systems for system-wide environmental improvements.

Acknowledgement

There is an old African proverb that goes like this: “the hunter who is tracking an elephant does not stop to throw stones at birds”. This licentiate thesis is a point of reflection in my PhD education, which is in many ways similar to tracking an elephant. I am not stopping to throw stones at birds, but to reflect on my tracking so far. To reach this stage of writing a licentiate thesis, I have received guidance and support from different sources for which I am grateful.

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List of appended papers

PAPER 1: Kanda, W., Hjelm, O., & Mejía-Dugand, S. Promoting export of environmental technologies: governmental initiatives in selected countries. (*Manuscript to be submitted*)

PAPER 2: Kanda, W., Mejía-Dugand, S., & Hjelm, O. (2013). Governmental export promotion initiatives: awareness, participation, and perceived effectiveness among Swedish environmental technology firms. *Journal of Cleaner Production*. (*Published*)

PAPER 3: Kanda, W., Sakao, T., & Hjelm, O. Design of business concept with environmental technology. (*Extended abstract submitted to the Journal of Cleaner Production – Special Issue*)

My contribution to papers

PAPER 1: Major contribution in data collection, analysis and writing. Feedback from co-authors on manuscript.

PAPER 2: Major contribution in article writing. Shared contribution in data collection and analysis. Feedback from co-authors on manuscript.

PAPER 3: Major contribution in data collection, analysis and writing. Feedback from co-authors on manuscript.

Related publications

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Kanda, W., Mejía-Dugand, S., Hjelm, O. (2012). Environmental technology exports: Analyzing Swedish government and firms' initiatives, Greening of Industry Network Conference 2012, Linköping.

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Sadri, S. (2013). Exploring business models for export of environmental technology: Cases from Linköping city, Sweden. Master Thesis, Linköping University Electronic Press, LiU-IEI-TEK-A—13/01586-SE.

Kairento, K. and Nygård, M. (2014). Export of municipal environmental technology knowledge: An analysis of previous activities and barriers. Master Thesis, Linköping University Electronic Press, LiU-IEI-TEK-A—14/01823-SE.

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1. Introduction

This chapter elaborates the problem at the centre of this thesis and the significance of addressing it both from a societal and an academic perspective. This is followed by the aim and research questions and the scope and outline of the thesis.

Climate change, biodiversity loss, and natural resource depletion are examples of significant environmental problems on the global scale. Sustainable development is often suggested as a plausible way to address such environmental problems which often have a society wide impact. Therefore, sustainable development should encompass long-term and far reaching changes in technology, infrastructure, lifestyles and institutions (Rennings, 2000). Although not sufficient, technology change is often regarded as necessary for sustainable development (González, 2009). This is because, technology is one of the important factors influencing the environmental footprints of industrial systems and improvements in technology could significantly reduce the associated environmental footprints. In this line of thought, technologies which have a better environmental performance compared to their relevant alternatives from a life cycle perspective – environmental technologies¹ are needed.

The development and use of environmental technologies holds a three-fold promise: reduced environmental footprints, improved social welfare, and increased economic competitiveness (Chertow, 2000). To effectively mitigate environmental problems, environmental technologies need to be developed and diffused rapidly on a global scale (Montalvo, 2008). However, the development and diffusion of environmental technologies (or at least some types) is often impeded by externalities and market failures, slowing the diffusion of these technologies despite the potential benefits their development and adoption could deliver (Carrillo-Hermosilla et al., 2009; Jaffe et al., 2005). On the other hand, some countries, (e.g., Sweden) are at the global forefront when it comes to developing and using environmental technologies (WWF, 2012). These countries could diffuse their technologies in emerging economies that are increasingly becoming the global centres of production for economic gains as well as contribute to environmental sustainability and social welfare. Due to its structural and strategic flexibility, export provides an opportunity to diffuse such technologies in international markets (Leonidou et al., 2011).

The export of environmental technologies is receiving increasing governmental interest worldwide, including Sweden (Kanda et al., 2012a). In Sweden, this interest is even particular because as mentioned earlier, Sweden has a top international reputation for developing environmental technologies but due reasons including the lack of proper business development (Cerin et al., 2007), the need for robust political steering (Swentec, 2008), and small firms' inability to meet customer demands (Frankelius et al., 2011), Sweden has not achieved much commercialization success compared to other top tier countries like Denmark and Israel (WWF, 2012). In addition, the Swedish domestic market for environmental technology is relatively small and could become saturated and even decline for some environmental technologies. These challenges and opportunities form a basis for keen interest in the export of environmental technology. Hence, how to promote Swedish export of environmental technologies is of interest to politicians, academics and importantly environmental technology firms (Kanda et al., 2012b).

¹ See section 2.2 for a discussion on environmental technologies.

However, understanding how to promote the export of environmental technologies is not a simple task for governments and firms as export is influenced by numerous factors such as foreign market characteristics, firm size, networks, organizational culture, business strategy, and government support, factors which vary in frequency, intensity, and importance (Zou and Stan, 1998). Nonetheless, the Swedish government's investigations into the Swedish environmental technology sector suggested five strategic action areas that would enable Sweden to become a world leader in the export of environmental technologies. These strategic actions are political steering, commercialisation, competence for sustainable development, business models and collaborations (Swentec, 2008). Although these governmental suggestions focus on *what* to do, they do not describe *how* to do it.

In the scientific literature, the promotion of environmental technology export is a relatively new topic. Previous studies on export promotion have treated environmental technologies as “conventional” technologies with no attention given to their particular characteristics that might influence their export. These previous studies have approached export promotion from generally two perspectives: that of the government and that of the firm. From a government's perspective, focus has been on support mechanisms, structures, delivery channels and program effectiveness (e.g. Lederman et al., 2010; Leonidou et al., 2011). From the firm's perspective, research has investigated how firms access and utilise export promotion initiatives in export (e.g. Kumcu et al., 1995). Although Montalvo (2008), highlights diffusion promotion as an important research trajectory for environmental technologies, this line of enquiry it is yet to be thoroughly investigated. From the gaps highlighted in governmental efforts and in the scientific literature, this thesis addresses *how* to promote the export of environmental technologies. Such a discussion could potentially be interesting for policy makers as well as firms when it comes to enhancing the export of environmental technology and also discussions on facilitating sustainable development in general.

1.1. Aim and research questions

Using the highlighted research gaps as a point of departure, the overarching aim of this thesis is *to identify and evaluate governmental export promotion initiatives and formulate business concepts as approaches to enhance environmental technology export*. This aim is supported by discussions on the implications of the analysis for firm management and public actors concerned with promoting the export of environmental technology.

Under the overarching topic of “promotion of environmental technology export”, several investigative perspectives can be adopted such as drivers and barriers for export, technology development, approaches to export, political steering and business models but to highlight a few. This thesis focuses on two perspectives – governmental initiatives and business concepts. Governmental initiatives are investigated for three reasons. First, from the theoretical perspective, governmental initiatives play a fundamental role in export due to externalities and challenges exporters encounter as a result of export related market failures. For example, spillovers exist regarding the collection of foreign market information related to consumer preferences, laws, regulations, business opportunities, etc. Private exporters need governmental support in undertaking such market research knowing very well the benefits could potentially

spillover to competitors. Second, governmental promotion is one of the means through which governments can influence the volume and type of technologies exported from their countries, making such promotion an important factor in export (OECD, 1994). Third, governmental policies and regulations play an important role in creating enabling contexts for export of environmental technologies.

The second focus of this thesis is business concepts. A business concept abstracts from specific cases how a firm creates value through the exploitation of business opportunities. This thesis investigates business concepts because, proper business concept development is considered to be as significant as technology development when it comes to the diffusion of environmental technologies. In addition, the lack of proper business development has been identified as a significant barrier to Swedish environmental technology export (Cerin et al., 2007). In a recent review of scientific literature of environmental innovations, business models and sustainability, Boons et al. (2013) emphasised the lack of both practical and theoretical knowledge on how to create win-win business strategies that encourage sustainable systems of production and consumption.

By using a combination of qualitative and quantitative research methods, empirical data has been collected from national governmental agencies in selected countries, private Swedish environmental technology firms and Swedish municipality-owned companies to provide a basis for addressing the overarching thesis aim. To operationalize the overarching thesis aim, the following research questions are addressed:

Research question 1: *How do different governments promote the export of environmental technology?*

This research question is motivated by selected government's interest in the export of environmental technology worldwide and in particular Sweden. In this regard, it is expected that countries use different export promotion initiatives based on their specific political, economic and historic idiosyncrasies. In the scientific literature on export, there was no readily available literature which answers this question. Answering research question 1 is a necessary foundation for further research trajectories on how to promote the export of environmental technology. This knowledge gap in the literature warrants the first research question. To answer this question, the study describes the activities of export promotion and export credit agencies in selected countries across Asia, Europe and North America. Answering this research question serves as a foundation for further analysis regarding firm awareness, participation and perceived effectiveness of governmental export promotion initiatives as captured in research question 2.

Research question 2: *How do private Swedish environmental technology firms perceive the effectiveness of governmental export promotion initiatives?*

After discussing how different governments promote the export of environmental technology, the next question concerns the target recipients of governmental promotion (i.e. firms). The second research question evaluates how governmental efforts to promote the export of environmental technology are perceived as effective in realising export by exporters of environmental technology. This analysis is important for Swedish governmental agencies when planning their export promotion initiatives as well as for understanding how firms access and use government support. In addition to this, a firm perception of the effectiveness of governmental support is expected to influence their participation or not in such governmental initiatives, a decision that ultimately could influence export performance. To tackle this question on perceived effectiveness, this study also assesses the awareness of and participation in governmental initiatives that intend to promote the export of environmental technology among private Swedish environmental technology firms.

Research question 3: *What are the fundamental components to consider in business concepts for export of municipality-owned environmental technology?*

In this research question, the thesis takes a complementary view to the focus on governmental initiatives to analyse business concepts for export of Swedish municipality-owned environmental technology. As highlighted earlier, export is influenced by different barriers and business concepts in this case represent a firm's means to capture and utilize essential resources needed to overcome export barriers and deliver environmental technology to customers. In addition, the export-planning phase offers more freedom to make changes in strategies using business concepts because of the flexibility and potentially lower risks involved in the export-planning phase. In addition, the business concept influences the environmental performance of environmental technologies because better environmental performance is not an inherent property of any given technology and thus the environmental performance of a given technology depends on the context and configuration within which such technologies are produced and used (Boons et al., 2013).

1.2. Research scope

This sub-chapter discusses some important choices that delimit this study.

The unit of analysis for empirical data collection in this thesis is motivated by the characteristics of the environmental technology sector in Sweden. The important delimitations in connection to this are discussed below.

1.2.1 Why small and medium sized companies?

To answer the second research question a survey was conducted among private Swedish environmental technology firms. The final list of companies to which the survey was sent was largely dominated by small and medium sized companies (SMEs) since the list was filtered to exclude municipality-owned companies and other organizations such as business hubs and

associations promoting export but not directly conducting export themselves. This focus on small and medium sized companies is motivated by the characteristics of the environmental technology sector in Sweden. Up to 90% of companies in the environmental technology sector are small and medium (less than 250 employees and €50million in turnover) and thus represent an important segment to focus on (ITPS, 2008). In addition, SMEs represent the engine for growth in many countries through job creation, paying taxes and their room for growth and expansion (European Commission, 2007). However, when it comes to export, SMEs face peculiar challenges because of their size limitations. They often lack time, financial and human resources needed to exploit foreign markets. In addition, several governments in the studied countries including Sweden have made it explicit in their promotion initiatives to target their support to small and medium sized companies in export and thus it comes as a logical extension to analyse such companies when it comes to evaluating governmental export promotion initiatives.

1.2.2 Why municipality-owned companies?

To answer the third research question, interviews were conducted with selected cases of Swedish municipality-owned companies that have some environmental technology export experience. Once again, based on the characteristics of the environmental technology sector, Swedish municipalities have long been responsible for providing social amenities and utilities such as housing, water supply, energy, transportation, and waste management (SKL, 2013). As a result of these responsibilities, many municipalities own companies that have over the years developed technical expertise which are locked in-house. Thus the thesis focuses on municipality-owned companies in answering the third research question because these companies often have tried and tested technologies and are beginning to investigate business concepts to export such technologies. In addition, most of these companies have just begun their export activities and thus face profound challenges from which lessons can be learnt to promote the export of environmental technology in general. To add this, it is in this initial phases of export development that changes and feedback can be easily made to export strategies.

1.3. Thesis outline

The rest of the thesis proceeds as follows. Chapter 2 presents the analytical framework that covers concepts and theories through which the empirical data are analysed. Chapter 3 presents the research design and method and concludes with a reflection on the choice of methods and the implications on the thesis outcome. Chapter 4 presents the results. Chapter 5 analyses the results in light of the theories and background concepts presented in Chapter 2 with an ambition to answer the research questions. Chapter 6 outlines the conclusions and Chapter 7 uses these conclusions to suggest potential research trajectories.

2. Analytical framework

The chapter focuses on the concepts and theories that form a basis for the research design and a framework to analyse the empirical data.

The analytical framework developed for this thesis is influenced by the research aim and questions as well as delimited according to the research scope. Furthermore, the framework provides a link between the research design and analyses of the results.

As mentioned in the introduction, this thesis focuses on the promotion of environmental technology export from two perspectives – governmental initiatives and business concepts. Figure 1 maps the theories that have been engaged in operationalization the research aim and questions. The understanding used to analyse the subject of this thesis is that, export of environmental technology by firms is influenced by a variety of endogenous and exogenous factors, on different levels here categorised as (see Figure 1) national level factors (e.g., regulations, policies and strategies), intermediary level factors (e.g., governmental export promoters and their initiatives) and also firm level factors (e.g., business concepts and strategies, firm size and ownership, offering type). Export is regarded as an approach to technology diffusion and thus the analytical framework discusses the technology adoption life cycle popularised by Everett Rogers (Rogers, 2010) including factors that influence technology adopters decision. The ambition here is to place the export of environmental technology in the broader context of technology diffusion. The concept of environmental technology is then discussed, to create a working definition adopted in this thesis. These elaborations on, “technology diffusion” and “environmental technology” feed into the subject of export promotion, highlighting market failures and externalities in export as the underlining theoretical justifications for governmental promotion. In addition, firm level business models and strategies to create customer value through the exploitation of business opportunities are also presented as foundations for business concepts for export of environmental technology. Moving from bottom up in Figure 1, business concepts at the firm level to export environmental technology exist in the context of export promotion initiatives which also exist in a broader context of national level strategies to promote export. Although the components are linked together as depicted, there may be no clear connections between them in practise. The underlining concepts and theories are further elaborated in the remaining parts of the chapter. The chapter ends by summarising the rationale for this study’s analytical framework which feed into the research design and also for the analysis of the empirical data.

Figure 1: Conceptual presentation of theories guiding this study

2.1. Technology diffusion

Technology diffusion describes the aggregate of adoption decisions by a population of potential adopters over time (Montalvo, 2008). The factors influencing technology diffusion are complex to model in entirety since they could be numerous with varying degree of importance (Kemp and Volpi, 2008). To deal with such complexity, diffusion studies have followed generally two research tracks: those characterising the mechanisms and patterns of diffusion and those seeking to understand the decision-making structures and processes regarding technology adoption (Montalvo and Kemp, 2008).

A model often used to study technology diffusion is the S-shaped curve. This model describes the adoption of innovations over time in a population. Attributed to Everett Rogers' seminal work in diffusion studies, Rogers (2010) proposes a diffusion curve based on normal distribution in which technology adopters are categorised according to how long it takes them to adopt a technology. As shown in Figure 2., first there are only a few adopters of an innovation, then a few more and then the number of adopters increases to a peak and then starts to level off after widespread adoption as well as when the technology becomes older; consequently substitutes to the technology emerge following a similar diffusion pattern (Moore, 1995). Geoffrey Moore uses the technology adoption life cycle (see Figure 2) based on the work of Everett Rogers to describe how a market segregates upon the introduction of a new technology. Some customers (i.e., innovators), are more eager to accept new technologies. The next group, the early adopters, buy into the technology because they understand and appreciate the benefits of the new technology. Between the early adopters and the early majority is the "chasm" where most technologies fail. The first two groups of customers represent a minority in terms of number and thus often the quantities of units sold in aggregate are small. Crossing the chasm into the early majority and late

majority is where technologies can achieve high commercial success. Finally, the last segment, the laggards, avoids the new technology.

Figure 2: Technology adoption life cycle (adapted from Meade and Rabelo, 2004)

Previous studies have examined the diffusion mechanisms of environmental technologies from different perspectives. For example, Kemp and Volpi (2008) discuss generic factors governing environmental technology diffusion, González (2009) analyses factors influencing the adoption decision at the firm level and Mejía-Dugand et al. (2012) analyse factors facilitating the diffusion of environmental technologies in cities. At the firm level, the adoption of environmental technologies is influenced by a variety of socio-economic and institutional factors. Some factors are internal to the firm – e.g., top management commitment, absorptive capacity, ownership and export orientation. Other factors are external to the firm – e.g., adoption pressure from regulations and non-governmental organisations and the firm's networks, competitors, and customers (González, 2009). In addition, the adoption decision relates to specific characteristics of the environmental technology such as complexity, compatibility, and alignment with existing systems as well as the investment cost (Mejía-Dugand, 2013).

In this thesis, the relevance of such a discussion on technology diffusion goes beyond simply contextualizing export in a broader framework of technology diffusion and export as a means to technology diffusion. The discussion on technology diffusion also elucidates the different types of technology adopters and their willingness to accept risk. This in effect highlights the variety of potential adopters that exporters face in foreign markets and the associated export challenges (e.g. customization of technology and business models to fit adoption groups).

2.2. The concept of environmental technology

The term “environmental technology” is used synonymously with other terms such as environmentally sound technologies, Cleantech, Greentech, sustainable technologies, green technology, and low carbon technology (Guziana, 2011). The term may refer to end-of-pipe technologies, technologies that measure the quality of the environment, and integrative solutions such as cleaner technologies (European Commission, 2004). There is no internationally agreed upon definition of environmental technology and thus several definitions exist in academic and

public discourses. These differences notwithstanding, attempts have been made to define environmental technology. Shrivastava (1995:185) defines environmental technologies “as production equipment, methods and procedures, product designs, and product delivery mechanisms that conserve energy and natural resources minimise environmental load of human activities, and protect the natural environment”. According to Kemp (1997:11), environmental technology may be broadly defined as each “technique, process or product which conserve or restore environmental qualities” (cited in (Guziana, 2011).

In the public domain, The European Union (2004:2) defines environmental technologies as follows: All technologies whose use is less environmentally harmful than relevant alternatives. These technologies include technologies and processes to manage pollution (e.g. air pollution control and waste management), less polluting and less resource-intensive products and services and ways to manage resources more efficiently (e.g., water supply and energy-saving technologies) (Guziana, 2011). Definitions for the concept also exist on national levels, for example, the Swedish Ministry of the Environment defines environmental technology as: “goods, systems, processes and services that offer clear environmental advantages in relation to existing or alternative solutions, seen from an ecocycle perspective”.

In this thesis, however, the term of environmental technology is used in a broad sense with the ambition to cover the different governmental promotion initiatives in different countries due to the different meanings associated with the term in practise. This broadness also allows for including firms offering different types of technologies in the form of products, services, organizational models, and large technical systems. However, the better environmental performance dimension often associated with the term from an life cycle perspective (see definitions in above paragraph) could not be applied in a strict sense in operationalizing the term in this thesis because the environmental performance of a particular exported technology is not an inherent property of the technology but also depends on the contextual configurations under which the technology is used and also the relevant alternatives against which it is compared. Thus environmental performance of a technology is not necessarily defined prior to export. To sum up, I define the term environmental technology in this thesis as technologies (products, services, organizational models, and large technical systems) whose development and use actually provide or intend to provide a better environmental performance from a life cycle perspective than their relevant alternatives.

2.3. Export promotion

Export is a function of international trade in which technologies (referred to in a broad sense as products, services, organizational models and large technical systems) produced in one country are sold in another country. Export remains a common channel for firms to enter international markets because it offers greater structural and strategic flexibility with less risk compared to other channels such as foreign aid and foreign direct investment (Leonidou et al., 2011). Although several factors determine the international flow of technologies, export promotion represents one of the principal opportunities for governments to influence the volumes and types of technologies exported from their countries (OECD, 1994). In this thesis, export promotion refers to all governmental initiatives that actually and/or potentially enhance the export of

environmental technologies or induce the commencement of such export activities at the firm level.

Strong reasons are often needed to justify public support for private ventures, in this case for governmental initiatives to promote private firms' export. The rationale for such public support can be grouped into two categories: rationales based on societal desires and rationales based on barriers faced by private ventures (Norrman, 2008). The economic justification for governments to promote export is based on the theories of externalities and market failures associated with export (Lederman et al., 2010). In export, spillovers exist regarding the collection of foreign market information related to consumer preferences, laws, regulations, and business opportunities. Private exporters would hesitate to undertake such market research by themselves as the cost involved is significant and their competitors could benefit from their investment. Pace setters in export who make ground breaking investments to open foreign markets, establish contacts, develop distribution links, and engage in other costly undertakings that could benefit their rivals also face a similar dilemma (Lederman et al., 2010). In addition, political and economic risks of buyer default have been used to justify the promotion of exports by governments (Lederman et al., 2010). In the face of such market failures, a government's concern is to design and implement strategies that correct such irregularities and create a level playing field for exporters (European Commission, 2007).

2.4. Business models

Business models have been presented differently by several scholars. Some scholars (e.g. Osterwalder and Pigneur, 2010) present the concept from a generic view applying it to all kinds of businesses and products, whereas others provide business models that are limited to particular industrial segments – heat energy generation (Okkonen and Suhonen, 2010), offering type – product service offerings (Lay et al., 2009) and even type of company ownership – municipality-owned waste management companies (Corvellec and Bramryd, 2012). In defining the concept, Osterwalder and Pigneur (2010) present the business model as “the rational of how an organization creates, delivers and capture value”. Amit and Zott (2001) states that “a business model depicts the content, structure, and governance of transactions designed so as to create value through the exploitation of business opportunities”. As Magretta (2002) puts it, a business model should tell a good story about how enterprises work. It should answer the following questions: Who is the customer? What does the customer value? How does the business obtain revenue? In total, the underlining logic that explains how value can be delivered to the customer at an appropriate cost should be the focus of a business model. From the literature, business models which are of relevance to research question 3 are presented below. And as elaborated further in paper 3, these reviewed business models deal with products, products services systems, and large-scaled technical systems.

2.4.1 Existing business models in literature

The business model canvas (Osterwalder and Pigneur, 2010), developed in collaboration with industry practitioners, presents a practical guide for business model generation. The business model canvas consist of nine building blocks: customer segments, value proposition, channels, customer relationships, revenue streams, key resources, key activities, key partnerships, and cost structure (Figure 3). To capture value while exploiting a business opportunity, these blocks should work together as one unit.

Figure 3: The building blocks of the business model canvas (adapted from Osterwalder and Pigneur, 2010)

Mason and Spring (2011) offer a generic conceptualisation to the business model drawing from the literature on business models for products. They propose three core elements for business models as technology, market offering, and network architecture. They further explore the roots of each of the core components through relevant fields of study to identify multiple dimensions of each of the core components. Technology as a core component refers to the use and knowledge of tools, techniques, and systems or methods of organization. They suggest business model analysis needs to take into account four classes of technology as: products, core process, and infrastructure. Process technologies are used to manufacture products or deliver services. Core technologies underlie the particular product technology a firm innovates. Infrastructural technologies are those that enable connection. Market offering concerns the nature of the product-user interaction, rather than any particular feature of a product or service. Network architecture refers to the relation between a firm and other organizations with which it has interactions including markets, standards, capabilities, and transactions.

When it comes to combined products and service offerings, Lay et al. (2009) offer a morphological box of important components to describe business concepts. These are ownership during and after use phase, responsibility for manufacturing and maintenance, location of operation, number of operating customers and payment model.

Corvellec and Bramryd (2012) present a business operation model based on case studies of two Swedish municipality-owned waste management companies. In their conceptualization, they argue these municipality-owned companies are exposed to four different but related markets: a political market in which their legitimacy as an organization is determined, a waste-as-material market where they compete for raw material input, a technical market where these companies decide how to process the waste using different available technical options and finally a commercial market where the products or services are sold. The authors also depict the revenue for these waste management companies as coming from gates fees for collecting waste as well as from selling their products to the heat, electricity and material markets. These business models are further discussed and applied in paper 3.

From the business models presented above and based on synergies and the desire for a generic conceptualization, the thesis selected six components for further analysis. These are shown in Table 1 as: market, finance, resources, activities, partnerships, and ownership and responsibility. This synthesis forms a basis for Table 5 in the analysis and discussions chapter where business concepts for environmental technology based on large-scaled technical systems are formulated. It must be highlighted that all these business models in the literature are influenced by the firm types, technologies and sectors from which they are conceptualised. Thus this thesis aims to identify synergies between the various models as a basis for further discussion in the analysis chapter on business concepts for the export of environmental technology. The details of this process are elaborated in chapter 5 and in paper 3.

Table 1: Business concept components, summary of previous reviewed literature

Component	Reference
Market	Osterwalder and Pigneur (2010) <ul style="list-style-type: none"> ▪ Customer segments ▪ Value proposition ▪ Channels ▪ Customer relationships Mason and Spring (2011) <ul style="list-style-type: none"> ▪ Market offering Lay et al. (2009) <ul style="list-style-type: none"> ▪ Location of operation Okkonen and Suhonen (2010) <ul style="list-style-type: none"> ▪ Investment ▪ Earning logic
Finance	Osterwalder and Pigneur (2010) <ul style="list-style-type: none"> ▪ Revenue streams ▪ Cost structure Mason and Spring (2011) <ul style="list-style-type: none"> ▪ Network architecture Lay et al. (2009) <ul style="list-style-type: none"> ▪ Payment model
Resources	Osterwalder and Pigneur (2010) <ul style="list-style-type: none"> ▪ Key resources Mason and Spring (2011) <ul style="list-style-type: none"> ▪ Technology ▪ Network architecture
Activities	Osterwalder and Pigneur (2010) <ul style="list-style-type: none"> ▪ Key activities Okkonen and Suhonen (2010) <ul style="list-style-type: none"> ▪ Operation
Partnership	Osterwalder and Pigneur (2010) <ul style="list-style-type: none"> ▪ Key partnership Mason and Spring (2011) <ul style="list-style-type: none"> ▪ Network architecture – Connection
Ownership and responsibility	Lay et al. (2009) <ul style="list-style-type: none"> ▪ Ownership during use and after use phase ▪ Responsibility for production and maintenance personnel Okkonen and Suhonen (2010) <ul style="list-style-type: none"> ▪ Ownership

2.5. Summary of analytical framework

To sum up, the analytical framework section feeds into the research design and analysis of the results. First, the discussions on technology diffusion are used to contextualize this thesis into a wider diffusion study context and to elaborate potential challenges exporters face due to the risk aversion behaviours of potential adopters. Furthermore, in this thesis, environmental technology export, is regarded as an approach to environmental technology diffusion and thus influenced by several general diffusion factors as discussed in section 2.1. The concept of environmental technology is also introduced and used in a broad sense with the intention to cover promotion initiatives in different countries. Environmental technology herein refers to technologies (products, services, organizational models, and large-scaled technical systems) whose development and use actually provide or is intended to provide a better environmental performance from a life cycle perspective than their relevant alternatives. With this definition, I acknowledge the fact that different definitions and understandings are associated with the term environmental technology and also that better environmental performance is not an inherent property of a given technology but rather environmental performance depends on the contextual applications of a particular technology. This broad understanding of environmental technology was used to identify governmental initiatives targeted at promoting the export of environmental technology. The theories of market failures are used as an underlining justification for why governments intervene through export promotion and are used to discuss which kind of initiatives governments offer to tackle export barriers. The review of previous studies on export promotion informed the formulation of the survey questions in paper 2 and also provided a categorisation for presenting results connected to governmental initiatives to promote the export of environmental technology. In paper 3, the review of existing conceptualizations on business models proved essential. First it was used as a basis for formulating the interview questions and also as a foundation from which business concepts for municipality-owned environmental technology export is developed (see synthesis in Table 1).

3. Research design and method

In this chapter, the journey leading to this study, the research process and how the thesis was written is presented. This is followed by a detailed account of the methods used to collect and analyse the empirical data in each paper including a reflection on the implications of the methodological choices on the thesis outcome. The chapter ends with reflection and problematisation of some key assumptions guiding the entire study.

3.1. Research journey

The research presented in this thesis emerged as a spin-off from the “Megatech” project at the Division of Environmental Technology and Management, Linköping University. The Megatech project was financed by the Swedish Governmental Agency for Innovation Systems (VINNOVA). The aim of the project was to analyse megacities as potential business arenas for Swedish environmental technology. In the course of the project, it was realised that analysis of the supply side for environmental technology was lacking since the researchers adopted a demand side perspective focusing on environmental challenges and the role of technologies in Cairo and Mexico City. The projects reported in this study were thus formulated to fill this gap with a focus on governmental export promotion initiatives and also business concepts for environmental technology – i.e. a supply side perspective. In addition to the Megatech project, this thesis also contains results from the “BMEX” project. The BMEX project – “Business models for Market Expansion of Swedish Municipal Environmental Technology companies” is financed by Tekniska Verken in Linköping under the Industrial Ecology Research Council. The aim of this project is to develop knowledge about designing business models for environmental technology firms at outer markets. These two separate but related projects have generated three papers which are appended to this thesis. The research process used is discussed below.

3.2. Research process

The research process for this thesis was exploratory. This approach was adopted because few studies have explored how to promote the export of environmental technology and this study is in the early phase of such an investigation. An exploratory approach is appropriate in such situations and also provides fundamental knowledge from which to narrow the research for further investigations (Babbie, 2013). The research process was inspired by finding synergies and complementarities between the various studies reported in the appended papers. Paper 1 served as a background to paper 2, while paper 3 provides a complementary view to paper 1 and 2. The entire study began with a review of literature on the topic of export promotion in general to understand the theoretical underpinnings for governmental promotion and also to synthesise governmental initiatives to promote the export of environmental technology. Because background literature on the subject matter was not readily available, paper 1 was written to document these findings and as a background for subsequent studies. After completing paper 1, there was a desire to assess the effectiveness of governmental initiatives to promote the export of environmental technology. Therefore, the study needed to narrow down from the international scope adopted in paper 1 to a national scope in paper 2 to enable handling of information and to work within time and cost constraints of the project. The study reported in paper 2 thus used a survey among private Swedish environmental technology firms to assess their awareness, participation and perceived effectiveness of Swedish governmental export promotion initiatives.

The synthesis from governmental initiatives reported in paper 1 served as an input in formulating the survey questions and aided in the structuring of the survey results. Theories of externalities and market failures presented in paper 1 were used to analyse the survey responses in paper 2. After paper 1 and 2 were written, a desire to undertake a complementary study with a different view on the export of environmental technology led to the focus on municipality-owned environmental technology companies as reported in paper 3. In particular, business concepts to export were also in focus and complementarity to governmental initiatives investigated in paper 1 and 2. Conclusions from paper 1 and 2 indicated that participation in governmental promotion alone does not guarantee successful export, a finding that gives more strength to the decision to focus on firm level factors such as business concepts in paper 3.

3.3. Thesis writing

Since I have chosen to write this thesis as a cover to the three appended papers, the natural way to proceed was to abstract first an overarching aim and research questions from the specific aims and research questions addressed in the three papers. To operationalize the overarching aim of this thesis, results from the mixed methodological approaches of literature review, surveys and interviews together with the theories presented are discussed and used to provide answers to the overarching research aim and questions. The findings from the papers are placed in a broader context to provide possible implications from this study for firm managers and public policy makers, two key actors in the sustainability quest (Boons et al., 2013). These implications for management and public policy are from the perspective presented in the analytical framework that, firm export is influenced by intermediary level actors and their initiatives in the context of national export strategies. Thus governmental promotion initiatives could be regarded as complementary to market initiatives and export strategies of firms. Hence it is a firm's responsibility to use internal resources and strategies, such as business concepts to capture crucial resources needed to overcome barriers in exports. Table 2 below shows the relation between the research questions, the appended papers, and the methods largely used in each paper. The methods are discussed in further details below.

Table 2: Relation between questions, appended papers and research methods

Research question	PAPER I	PAPER II	PAPER III
Research question 1: <i>How do different governments promote the export of environmental technology?</i>	Literature review		
Research question 2: <i>How do private Swedish environmental technology firms perceive the effectiveness of governmental export promotion initiatives?</i>		Survey	
Research question 3: <i>What are the fundamental components to consider in business concepts for export of municipality-owned environmental technology?</i>			Interviews

3.4. Mixed methods approach

Because the promotion of the export of environmental technology is a fairly new research subject, this thesis took an exploratory approach from which further specific investigations can be made. However, it should be acknowledged that the phenomenon under investigation is not absolutely new, as some previous research around governmental export promotion and business models in general can in one way or another be related to this thesis. In addition, the research questions guiding this study are of a “how” and “what” nature and such questions can be tackled using exploratory approaches (Yin, 2008). In operationalizing this approach, both qualitative and quantitative research methods have been used to gather and analyse empirical data. Qualitative methods are often used to understand the development, meaning, and characteristics of a phenomenon whereas quantitative methods emphasize the use of numeric data to establish correlations and causalities. Mixed methods, as used in this thesis combine aspects of both quantitative and qualitative methods (Babbie, 2013). These research methods will be discussed in relation to the appended papers. The three papers employ largely three different approaches – literature reviews for paper 1, surveys in paper 2, and interviews for paper 3 although the methodological sections in papers 2 and 3 also contain some background literature review.

PAPER 1 – Literature review

The methodological approach for paper 1 was based on the review of scientific and grey literature (informally published written material such as technical reports from government agencies) to answer the research question – *How do different countries promote the export of environmental technology?* This first question was motivated by a knowledge gap in the literature addressing diffusion of environmental technology particularly relating to diffusion promotion (Montalvo, 2008). To explore this gap, empirical data were collected from export promotion and export credit agencies in the following selected countries: Germany, USA, and Japan – the top three exporters of environmental technology by number of patents and market surplus; Denmark, Sweden, Finland, and Norway – Scandinavian leaders in environmental technology innovation; and Austria – an emerging eco-innovator (WWF, 2012). These countries were purposively selected to offer possible learning opportunities from the diversity in their approaches to environmental technology export promotion. The three top exporters were selected to uncover export promotion practises that potentially have contributed to their market leadership, while the other countries represent relatively smaller markets with profound eco-innovation profiles (WWF, 2012), characteristics that indicate a potential interest in export. The literature review approach was deemed appropriate in this study because the focus on international governmental initiatives is vast and using other research methodologies such as case studies through interviews would be constrained practically by time and cost. The literature review approach offered a plausible overview of governmental export promotion initiatives from which to develop deeper and more focused empirical data collection.

I was aware that each country could have several agencies with activities in one way or the other that could be regarded as export promotion, so the literature search had to be limited to grey literature from export promotion and export credit agencies with the explicit governmental mandate to promote export. This approach was also justified by the practicality of handling the

volumes of information on governmental initiatives in each country targeted at export. As governmental initiatives may have been initiated in the past, abandoned, and/or changed, a time period of 2002 to 2012 was adopted. This was informed by the time frame within which specific initiatives were being formulated to promote environmental technology export. Using the information from the selected countries, we identified and categorised governmental initiatives that aim to promote the export of environmental technologies. This information was collected in spring 2012. To examine the theoretical justifications underlining such governmental export promotion activities and the kind of initiatives offered, we used theories of externalities and market failure borrowed from economics to analyse the empirical findings.

PAPER 2 – Survey

After writing paper 1, the next step was to evaluate governmental initiatives aimed at promoting the export of environmental technology. This led to the research question 2, *How do private Swedish environmental technology firms perceive the effectiveness of governmental export promotion initiatives?* The empirical data addressing this question were collected using an Internet survey. The survey was sent to 693 private environmental technology firms in Sweden. These companies were on a database created as part of the Megatech project and based on classifications offered by the national agency responsible for statistics in Sweden – Statistics Sweden. The survey was sent to the chief executive officers of the firms when possible; using either email contacts provided or pre-defined electronic forms. The invitation included a request to forward the survey to a person within the firm with appropriate knowledge to answer the survey questions. The survey included questions about firm awareness, participation and perceived effectiveness of governmental export promotion initiatives. The questions were written in Swedish with the intention to reach a high response rate. In an attempt to increase the response rate, two reminders were sent (two weeks apart) to all companies in the database. A total of 172 companies answered the survey completely (a response rate of approximately 25%). The survey was conducted during May 2012. Using the Internet survey was motivated by the ambition to cover the entire Swedish environmental technology sector. The number of companies was well over 700 and it was practically impossible to cover such a large number with other kinds of data collection methods such as interviews and still offer a possibility for generalisation of findings.

The numeric data from the survey results were analysed using the survey tool, and responses from the open-texts were analysed manually using themes from the answers. A cross-referencing of the major findings was done with previous similar studies to highlight similarities and differences and to position this study in context with earlier research.

PAPER 3 – The qualitative interviews

The study reported in paper 3 was inspired by a complementary view point to governmental initiatives when it comes to export promotion – business concepts for export. This study uses largely qualitative interviews to gather primary data. However, due to the fact that the subject was fairly new, a comprehensive literature review was initially undertaken on relevant concepts that relate to the subject both in the scientific and grey literature. The objective was to obtain an insight into core concepts related to market expansion activities such as business models,

customization, environmental technologies, internationalization, and their interrelations. This literature review also provided insights for selecting relevant cases to study, for formulating interview questions, and for analysing the empirical data.

For the interviews, a number of cases were selected for in-depth investigation. The selected cases depended on the municipality-owned companies' experiences with export and their willingness to participate in the study. After several attempts to find municipal companies for the study, a final list of companies was reached see Table 3 below. The selected cases represent different types of environmental technology offerings which enrich this study with diversity. With such a variation among the selected cases, any common pattern that emerges is of particular interest (Olausson and Berggren, 2012), in capturing the core experiences of business concepts for environmental technology export.

In administering the research instrument, semi-structured face-to-face interviews were adopted in all the cases. This approach allows for the respondents to speak in a free manner and add extra information that they find relevant in answering the interview questions. As two researchers conducted the interviews, the discussions were improved by increasing the possibility of follow-up questions to pre-defined questions on the interview guide. The respondents in each of the cases were purposively selected based on their previous involvement in the municipal companies' export activities (See Table 3 below). The interview guide was sent to the respondents while scheduling the interviews to allow them time to prepare and gather relevant documentation rather than rely entirely on their memory. The interviews lasted between one to two hours and were recorded and transcribed within 24 hours of the interviews to keep the information accurate from the perspective of the interviewer. The transcripts were also sent to the interviewees for corrections and clarifications if needed. The use of interviews in this case was motivated by the desire for a deeper understanding of approaches to export and its related challenges. This ambition could only be accomplished by interviewing employees involved in such export activities and planning, a goal that required the chosen methodology and purposive selection.

Table 3: List of interviewees

Interviewee's position		Company	Environmental technology offering
1.	Head of business development	Teknisk Verken AB in Linköping	Solid Waste incineration
2.	Business development manager		
3.	Marketing director		
4.	Chief executive officer		
5.	Chief executive officer	Usitall AB	Solid waste incineration
6.	Chief executive officer	Svensk Biogas	Biogas production processes
7.	Project manager	Swedish Biogas International	Biogas technology and production processes
8.	Development Engineer	VafabMiljö	Solid waste recycling Biogas production

The analysis of the empirical data from the interviews focused on important factors to consider when designing business concepts to support export of environmental technology in municipality-owned companies. This analysis required synthesising previous literature on business models to identify relevant components to build upon (see Table 1 in the analytical framework, Chapter 2) and then extracting from the empirical data, important characteristics of environmental technology for business concepts. In turn, this information was added to the initial list of components from the literature review. A feedback workshop was also held with some of the municipal companies to discuss the development and make improvements to the proposed business concept. The synthesis method and development of business concepts is discussed in further detail both in the discussions chapter and in paper 3.

3.5. Implications of research design and methods

The mixed method approach adopted was considered relevant particularly when “how” and “what” type of questions were at stake (Yin, 2008). This approach offered the flexibility needed to investigate questions that might not be possible to investigate with either quantitative or qualitative methods alone. In research question 1, I acknowledge the possibility of possible implications of using a literature review and also the purposive focus on export credit agencies and export promotion agencies. This is a pragmatic approach since in every studied country there are governmental agencies whose activities in one way or the other could promote export, but all governmental agencies could not be covered since they do not have an explicit export promotion mandate and also the volume of information would be practically too large to process. Another methodological approach to discuss is the use of interviews with selected cases to answer research question 3, *What are the fundamental components to consider in business concepts for the export of municipality-owned technology?* The cases selected have municipal ownership, dealt with particular types of environmental technologies – large-scaled technical systems (e.g., district heating, biogas production and processes, and waste management systems) and operate in Swedish municipalities that have often been regarded as atypical due to their authority and financial independence. These specific conditions could influence the findings from the study and also the proposed business concepts. Thus the conclusions in relation to business concepts to support environmental technology export have been abstracted to a general level to take care of possible contextual implications. However, this approach is plausible since most of the business models reported in the literature are based on selected case examples with similar challenge of contextual dependence.

Finally, generalization from this thesis needs to be discussed. Research question 1 has a wide international approach; however questions 2 and 3 needed some specific delimitation to enable operationalization. Thus the findings and conclusions from the thesis should not be generalised without regard for the specific contexts within which the research was undertaken. Other cases – e.g., countries, industrial sectors, technology sectors interested in export could associate with some of the research conclusions, but the conclusions should be abstracted and discussed in their specific contexts. It is also important to mention that, the subject of environmental technology export has been addressed using different research methods, perspectives and units of analysis. This approach offers a form of triangulation and multiple perspectives used to explore the phenomenon giving validity and reliability to the conclusions.

3.6. Reflexivity and problematisation

In this sub-section, I will reflect and problematize some assumptions guiding this thesis. As Alvesson and Sandberg (2011) put it, reflectivity is possible only after gathering and presenting key literature and highlighting its core assumptions. My objective here is to think differently about the core assumptions that have guided this thesis so far.

The assumption that governmental promotion and business concepts represent plausible approaches to environmental technology export which could ultimately contribute to environmental sustainability is first reflected upon. This argumentation is based on market failures in the development and export of environmental technologies. However, public policy in the form of governmental intervention has been questioned sometimes for contributing to lock-in with the “wrong” technologies while trying to pick winners (Carrillo-Hermosilla et al., 2009). Reflecting on the ultimate goal of environmental sustainability through the export of environmental technology, environmental sustainability is not an inherent property of a particular environmental technology, neither a promotion initiative, but rather dependent on contextual applications of the technology during its life cycle. Thus in my opinion environmental technology export cannot be regarded as a guaranteed approach to environmental sustainability but rather as a contribution to technology change aimed at such targets.

In addition, enhancing environmental technology exports could potentially contribute to rebound effects (increased material and energy consumption on aggregated levels) as a consequence of increased efficiency at the adoption unit. The contextual dependence of environmental sustainability means that the contribution of environmental technology export to rebound effects or not also depends on the actual application of the technology from a life cycle perspective. This also depends on what consumptions takes place because of savings in material and energy from adopting environmental technologies. To add to this, export in itself can be problematized for being typically unidirectional and does not encourage innovation and the development of technologies among target adopters. Nonetheless, it is increasingly becoming apparent that export especially of large-scale technical systems without two way interactions between the needs of the potential adopter and capabilities of the supplier often leads to failed implementation or discontinuations due to misalignment and disruptions in existing systems (Mejía-Dugand et al., 2012). Thus export in some ways contributes to the development of local capacities through contextual applications and adaption to fit local conditions.

4. Results

In this chapter the empirical data will be presented in-line with the research questions laying a foundation for the follow up analysis. The results cover governmental initiatives to promote the export of environmental technology, firm perceived effectiveness of governmental initiatives, and business concepts based on environmental technology.

4.1. Initiatives to promote the export of environmental technology

Governmental export promotion initiatives are often unique in relation to the idiosyncrasies of the particular country (Leonidou et al., 2011). However, the common underlining objective of export promotion initiatives is to increase exports. To answer research question 1, (*how do different governments promote the export of environmental technology?*) the different environmental export promotion approaches used by governments in the selected countries are identified and discussed. These initiatives are grouped according to categories that reflect alternative promotion initiatives provided by Leonidou et al. (2011) and priority targets for promotion developed by the author. This categorisation is based on governmental actors and their initiatives to promote the export of environmental technology export and is discussed country by country in paper 1.

4.1.1 Alternative promotion initiatives

Financial aid-related programs

In each of the eight selected countries, there was a dedicated governmental agency supporting firms with export financing issues. The names of these organizations and their official Website information are provided in Table 1, paper 1. The operations of these organisations cover the political and economic risk of buyer default as referred to as one source of market failure in economic theory. In addition, these agencies often referred to as export credit agencies offer a portfolio of services covering export credits guarantees against political and economic risks and loans to facilitate export. This financial support is open to exporters in general and as well as environmental technology exporters. Most firms interested in export will have to apply for this financing and be screened for qualification based on purely economic terms such as risks of target market and risk of buyer default.

Despite the similar export financing support offered to general exporters and environmental technology exporters in the selected countries, there are some countries with financial aid exclusively for environmental technology exporters. In the United States of America, the Export-Import bank has a mandate to support the export of environmental technologies. In Denmark, the approach to financing environmental technology export is even more specific based on some characteristics of environmental technologies. The *Eksport Kredit Fonden*, EKF's "Cleantech guarantees" is specifically designed for Danish companies that develop and export environmental technologies. The guarantees provide insurance against default such as political and economic risk and particular defaults from environmental technologies export such as utility cost savings guarantees, guarantees against failure to issue carbon credits and guarantees for financing energy service companies. This particular financial support offered in Denmark goes beyond support for export as it can be used during the use phase and for the risks of buyer default associated with environmental technology use.

Information- related programs

All the selected countries had other agencies dealing with other export promotion initiatives apart from financial support. The information related programs to support exporters refer to information provided between potential exporters and customers in the home and target markets. This exchange of information is done through trade fairs; marketing campaigns, seminars, and exhibitions to allow potential exporters and customers to share information. These initiatives are targeted at exporters in general. Other initiatives include virtual market places for information sharing and business match making as well as magazine publications. These information-related programs are targeted at all kinds of exporters both general technology and environmental technology exporters. Gathering and delivering this market information such as consumer preferences, laws, regulations, business opportunities, policy and regulations is facilitated by embassies and consulates in target markets. Such information is provided to exporters at a consultation fee or for free.

Education and training-related programs

Export business is more complicated than doing business in the domestic market (Fillis, 2002) so exporters need education and training on export management such as documentation, logistics, language, and export sales (Leonidou et al., 2011). Several of the selected countries have initiatives to educate and train firms on the export process but there were no particularly education and training programs exclusive in content for exporters of environmental technology. This training and education support is implemented through workshops, seminars, conferences on export planning, foreign market identification and export logistics. Representatives from both the target market and also the host markets could be educated to increase the familiarity with each other's technologies and to promote potential export.

Trade mobility-related programs

Trade mobility related programs connect largely to information provision between the home and target market. The programs are related to support to enable firms to rent and/or decorate spaces to participate in trade fairs and exhibitions. These programs also can cover financial support for exporters to invite potential customers to the home market or organise business delegations to visit the target market to exploit marketing efforts. Other trade mobility related support includes governmental support offered to firms to enable them to establish initial contacts with customers, prepare trade visits, using the help from government's trade offices in the target market.

The above discussed governmental initiatives relate to activities meant to enhance the export at the firm level. However, these promotion initiatives are targeted at different actors and markets concerned with environmental technologies.

4.1.2 Priority promotion targets

For environmental technology export promotion, priority targets were identified in the selected countries related to markets, environmental technology and, firm size, and firm involvement in export (see Table 2, paper 1 for details of this categorisation). Most of the selected countries had

selected priority target markets and priority environmental technology types to promote. This means that governmental promotion initiatives such as financing, trade mobility including business delegations, demonstration projects were focused on those markets and technologies to enhance exports. For example Austria focuses on Central and Eastern Europe, Asia and Africa as target priority markets with wastewater treatment, solid waste treatment, recycling and water supply. While Denmark focuses on the USA, Brazil, Russia, India and China to promote energy efficiency, wind energy, biomass, and waste management. In Finland, focus is put on five selected sub-areas of environmental business – renewable energy, recycling of materials, resource saving processes, energy saving technologies, and water treatment – but with no specific target markets. In Germany focus is on three areas: water, raw materials, and climate protection. Norway supports investment and capacity building related to hydropower development, solar energy technologies, and other renewable energy technologies on south-eastern Europe as the priority market for the Norwegian hydropower industry, followed by sub-Saharan Africa. Priority focus areas defined in Sweden are sustainable building, transport, energy, water management, and waste targeted at Baltic countries (including Russia), Western Europe, North America, Brazil, India and China. Almost all the selected countries had an explicit focus on supporting small and medium sized companies. Figure 4 provides a synthesis categorising these governmental initiatives.

Figure 4: Environmental technology export promotion categories

The figure above synthesis governmental approaches used to promote the export of environmental technology. As discussed, the promotion activities which form the core of Figure 4 are generally similar for most of the countries and for “conventional” technologies as well but the implementation is different across the selected countries in relation to firm size, priority environmental technology types, and firm stage in export and priority markets. This serves as a basis for further discussions in Chapter 5 and as input to the survey on firm perception of effectiveness of governmental export promotion initiatives.

4.2. Firms’ perceived effectiveness of governmental initiatives

4.2.1 Awareness and participation in governmental initiatives

The second research question, also the focus of paper 2 focusses on how Swedish environmental technology firms perceive the effectiveness of governmental export promotion initiatives in realising export. This analysis is important because not only does the success of export promotion depend on the quality of the program and its implementation but it also the

interactions it has with the target firms including perception as perception influences a firm's likelihood to participate and use this support based on perceptual barriers (Kumcu et al., 1995). To evaluate perceived effectiveness, the results cover dimensions for using governmental support, awareness of fitting programs and participation in these programs as depicted in Figure 5 below.

Figure 5: Awareness, participation and perceived effectiveness of governmental initiatives (Kanda et al., 2013)

As indicated in Figure 5 above, the survey was sent to 693 environmental technology firms all over Sweden and 172 of these companies responded to the survey representing approximately a 25% response rate. Of the 172 firms that responded, 79% of them indicated they were currently exporting or planning to do so in the near future, 17% of them indicated they were not exporting or planning to do so and 4% were ambivalent about their export ambitions. Those companies that were not exporting their environmental technologies indicated that they had a local niche market, so export was not their core business (e.g., being suppliers to a larger company in the domestic market) and limited capacity or resources to export (e.g. small company with limited financial and human resources). The 79% of the firms that expressed on-going export activities and planning to do so gives an indication of the usefulness of their response on the perceived effectiveness of governmental export promotion initiatives.

For the firms that were currently exporting or planning to do so, the next survey question was to find out if they were aware of governmental initiatives that could address their export needs and if they were participating in such programs. A large share (62%) of those exporting or planning to do so were not aware of governmental programs that could fit their export needs as shown in Figure 5 above. The remaining (38%) of the exporting or planning export firms could identify governmental initiatives that fit their export needs.

Of the firms that could identify governmental initiatives that could address their export needs, the study further went on to investigate whether they participated in such initiatives. As shown in Figure 5, 31% of these firms did (could) not participate in such governmental programs. Reasons given include difficulty to access governmental initiatives (e.g. expensive to access, too bureaucratic for small companies, and unclear benefits of participation). Other non-participants indicated lack of needed resources to participate such as time and staff. Denied applications

especially in relation to financial support and future ambitions to participate were among the major reasons given for not participating in governmental initiatives to promote the export of environmental technology. However as seen in Figure 5, 69% of those firms that identified fitting programs to their export needs decided to participate in the programs.

4.2.2 Perceived effectiveness of governmental initiatives

Firm participation in governmental export promotion initiatives does not automatically guarantee successful export. However, the perception of firms about the effectiveness of governmental initiatives is important since it influences their decision to participate in such initiatives and its potential contribution to export (Kumcu et al., 1995). In this regard, the last survey question addressed which types of governmental initiatives firms accessed and whether these companies perceived these initiatives as contributing to export realisation. Of the export-oriented respondents that participated in governmental initiatives, 32% of them could relate their participation to export success but 68% could not relate the initiatives in which they have participated to successful export business.

4.3. Business concepts for municipal environmental technology export

The third research question, *What are the fundamental components to consider in business concepts for export of municipality-owned environmental technologies?* relates to developing business concepts. Developing such business concepts considers existing approaches to export by the interviewed Swedish municipal companies which are presented below as well as business modelling approaches in the scientific literature presented in the analytical framework. Paper 3 discusses in detail the approach used to export by each selected municipality-owned company and presented here in the thesis under four main headings for the sake of simplicity.

4.3.1 Existing approaches to export

Subsidiary approach

Usitall AB, now in-active, was established as a subsidiary of Tekniska Verken AB in Linköping in 2008. The subsidiary had an outspoken objective to export municipal knowledge on the development of waste-to-energy systems (incineration with energy recovery). With target markets in Central and Eastern Europe, the firm operated a business development model consisting of four phases to create customer value while exploiting business opportunities in foreign markets (Figure 6). The phases were – establishment, secure sponsor, secure financing, and construction.

Figure 6: Usitall's business development phases for export

During the establishment phase, Usitall AB conducts a market survey to understand the target countries' business contexts including legislation, business culture, and to establish contacts with municipalities and key decision making actors such as city mayors and politicians. The firm also conducts technical feasibility studies on key input parameters for a waste-to-energy facility such as waste amount, types, energy content and sources. The final component of the establishment phase is to secure contracts for both inputs and outputs from the facility including contracts for waste as raw material and also contracts for heat and electricity as products produced from incineration. During the secure sponsor phase, a private energy company or a local municipal authority willing to financially pay for the facility is sought. Following the secure sponsor phase, is the phase when the sponsor secures financing for the final construction of the facility.

Largely attributed to the limitations imposed on the company due to its municipality ownership, the company withdraws from export projects before the final phase of the business development which is the construction phase since Swedish municipality-owned companies are by law not allowed to construct, own and operate facilities abroad. On the average, it takes about seven to ten years from the first agreement to establishment a waste-to-energy facility to final construction phase.

Licensing approach

Svensk Biogas is a subsidiary of Tekniska Verken AB in Linköping. The firm's research and development unit undertakes some sporadic export initiatives upon customer request. This covers knowledge and chemical additives for optimizing biogas production. Payment for such export activities covers man hours and delivery of expert reports. The firm is in the very early and planning phase of export so there was no formal business model for export as of 2012. Rather different approaches are used in parallel including a licensing of patent agreements with a chemical manufacturer. The chemical manufacture pays Svensk Biogas based on the amount of products sold.

Developmental aid approach

Vafab Miljö is a municipality-owned company focused on solid waste management. With expertise in anaerobic digestion of organic waste and material recycling, the company engages in sporadic export activities. The motivation for export interest is to contribute to global sustainability, to make the workplace attractive to future employees, to increase its owner municipality's reputation as a sustainability actor and to create opportunities to increase revenue. In their approach, the parent municipality company dedicates some of its employees to find finance from international development-oriented organizations such as the Swedish International Development Cooperation Agency to enable the company engage in export. The costs for the municipal company's engagements abroad are thus covered but there is no guarantee for any extra revenue. This approach is also facilitated by the owner municipality's engagement in sister city collaborations within which the company can exploit their environmental technology knowledge. As of the time of this study, there was no explicit business model for export and their development aid approach as it is called in this thesis includes collaboration with universities, politicians and private companies both home and abroad to gain legitimacy while engaging in export. Their deliverables often include man hours and expert reports on feasibility studies for waste-to-energy facilities.

Privatization approach

Swedish Biogas International (SBI) is a privately owned company established in 2006 that specializes in building and operating biogas plants based on municipal technology competence. The target markets include municipalities' in Sweden and other countries such as the USA and South Korea. In the privatisation approach, a private company typically emerges as a spin-off from activities of the parent municipality-owned company. The expertise of this private company is often based on the competence of the parent company. Some employees of the parent company end up with the private company and offer their expertise on export projects. In this approach, the focus of this new private company is on foreign markets from the start. Financial inflow is completely dependent on the activities of this company abroad and possible contributions from the owners and private venture capitalist. They also proactively engage in export marketing since the parent municipal company is often strong in the home market and thus the private company might find it difficult to compete. The company has to adapt its business approach to different countries and customers because of differences between the home and target markets. For example input raw material for biogas production often has different characteristics between customers and in different countries based on for example regulations and also the products from the biogas production process have different customer value based on customer preferences and market incentives including regulations.

To develop an adjusted method for supporting design of business concept for environmental technology diffusion, it is necessary to identify the particular characteristics of environmental technology. Table 4 summarizes the characteristics on the left hand side based on the empirical findings presented above. These characteristics are further confirmed on the right hand side of Table 4 by existing scientific literature discussed under "the concept of environmental technology" in the analytical framework. Table 4 further serves as an input to develop business concepts for municipal environmental technology export.

Table 4: Characteristics of environmental technology

From the interviews	Reference/relation to literature
Complexity	Complexity exhibited by some environmental technology types requires additional training for workforce upon adoption (González 2009)
Importance of financing	High initial investment (González 2009)
Need to address different market types	Environmental technology companies have to compete and remain legitimate in different kinds of markets (Corvellec and Bramryd, 2012)
Need to adapt to the target market (including regulation)	Compatibility with the existing production system (González 2009)
Relevance of systems approach (including social and human aspects)	Sustainability driven innovations require multiple organizations to act in an orchestrated fashion (Rohrbeck et al., 2013)

The characteristics highlighted in Table 4 above can be used to develop business concepts based on environmental technology and will encompass environmental technology dimensions from the empirical studies that are not covered by business models in literature. Based on these characteristics presented in Table 4, the proposed business concept should incorporate a systems approach, including non-technological dimensions such as human and social aspects; support for private-public partnerships and the adaptation to target market including regulations.

5. Analysis and discussion

This chapter analyses and discusses the research findings using the theories discussed in the analytical framework.

The thesis departed from a background problem of environmental technologies being diffused slowly in the economy due to among other factors market failures in export and lack of proper business development. This phenomenon is explored with the objective of analysing governmental promotion and business concepts as approaches to enhance the export of environmental technology. The findings of different governmental initiatives, Swedish firms' perceived effectiveness about governmental initiatives and fundamental building blocks of business concepts for export by municipality-owned companies are discussed in the light of the theories and background concepts.

5.1. Approaches to environmental technology export promotion

In general, governments in the selected countries use fairly similar approaches to promote the export of "conventional" technology export and as well as environmental technology. These approaches include information, trade mobility, education and training, as well as financial aid-related programs.

Information-related programs typically cover information provisions for exporters on specific market profiles such as economic conditions, political/legal requirements, sociocultural environment, business norms and business practices. Education and training related programs cover training on running an export departments, export planning and managing relationships between foreign and home markets, intensive training to learn foreign languages, servicing foreign customers, and managing business relations in foreign markets. Financial aid relates to export credit guarantees that cover buyer defaults due to economic and political adversities in the foreign market and also export loans at low interest rates usually tied to specific market risks. Trade mobility related program relate to assistance in participating in trade shows and exhibitions, participation in trade missions in foreign markets and support by trade offices abroad. This similarity in export promotion approaches between conventional and environmental technologies could perhaps be related to the common economic theoretical justification of externalities and market failures in export related to information gathering, political and commercial risks that underline most governmental export promotion initiatives. In addition, export promotion initiatives are aimed at enhancing export or encouraging non-exporters to start exporting, similar initiatives used by selected countries could also be linked to similarities in the perception of the challenges faced by exporters and non-exporters and between conventional and environmental technology exporters. In summary most governmental agencies might not acknowledge any significant difference between different types of technology export.

Irrespective of these fairly similar approaches to export promotion, there are some initiatives in certain countries with content tailored based on characteristics of environmental technologies. For example, in Denmark specific financial aid is targeted exclusively as exporters of environmental technology. The "Cleantech guarantees" in Denmark covers the particular challenges of environmental technology exporters even after the initial selling of the technology phase into the use phase. While in the other selected countries, there were no explicit tailored initiatives by the export credit agencies for exporters of environmental technology. This lack of

tailored support could be related to governments not treating the environmental technology sector as a distinct sector with specific challenges in export or could relate to the capacity and financial constraints of governmental actors to design and implement tailored promotion services among a vast variety of firms and sectors in a particular country. In this regard, governmental promotion initiatives are meant to complement market initiatives and should not be expected to stand alone.

When analysing the target recipients of environmental technology export promotion, it becomes rather clear that the selected countries had different approaches for implementing financial, information, trade mobility, and education and training-related programs. These promotion initiatives are targeted at different sub-branches of environmental technologies (e.g., end-of-pipe vs. integrated solutions, different target markets, firm size, and firm stage in export engagement). These differences in approach could be linked to the idiosyncrasies of particular countries in terms of technological competence, economic, culture and political relations. These different promotion targets could influence the effectiveness of export promotion to varying degrees. For example, emerging markets such as most of Africa and southeast Asia (e.g., Vietnam) have underdeveloped environmental markets, and environmental investments are limited (DEFRA and DTI, 2002) whereas end-of-pipe environmental technologies, which cause little disturbance to existing systems, are more likely to be adopted under regulatory pressure (González, 2009).

5.2. Firms' perception of export promotion initiatives

Analysing the results from the survey on Swedish firms' use of governmental export promotion initiatives, interesting discussions could be made in relation to firm awareness, participation and perceived effectiveness of governmental promotion. As indicated in the results chapter, a large percentage (62%) of export oriented firms (exporting or planning to do so in the near future) that responded to the survey were not aware of fitting government programs to their export needs. This lack of awareness could be explained by lack of fitting governmental initiatives, improper communication channels or lack of firm's commitment. With regards to improper communication of governmental initiatives, even if these support initiatives reach firms without proper understanding of their content, firms could perceive the programs as not addressing any of their export needs. Building on that argument, the environmental technology sector in Sweden could also be very diverse in terms of sub-sectors and company characteristics and needs to the extent that, government resources are limited to design tailored support programs to meet the particular challenges of various categories of exporters. Again going back to the survey results, a majority of the firms that found governmental support fitting to their export needs decided to participate in them. This finding could give an indication of the trust exporters have in governmental initiatives once they find a clear benefit. However, participation in export promotion initiatives does not guarantee export realisation.

Establishing a causal relationship between firm participation in export promotion and export realisation has been a subject of contention in research for some time since there are several factors influencing export (Kumcu et al., 1995). However, even before participation in such programs, perception of their effectiveness remains an important driver since perception influences firms' tendencies towards participation in governmental initiatives, especially those

initiatives which are not offered for free. Of those participating in governmental export programs, 32% could relate it to export success, but 68% could not relate it to successful export business. These responses are based on their perception and cannot provide conclusive answers on the effectiveness of such programs. However, many of the respondents who reported to have participated in only one governmental initiative could not report any success while those who participated in more than one support program (particularly including financial support) perceived the initiative as successful. Similar findings have been reported by Volpe Martincus and Carballo (2010) who conclude that firm participation in a bundle of support programs was better for exporters than participating in single programs. Although, firms appreciate financial aid, this positive attitude should not be a substitute for firm competencies such as competitive products and services, and market research as export is influenced by several factors in addition to financial needs.

There are several possible explanations as to why some firms did not perceive their participation in government support as leading to export abroad. The source of failure could be on the content and scope of the governmental support, how the support is communicated to target firms (including the actors involved), procedures for implementing the support program, and firm level competencies. In this regard, export firms might simply not be ready to engage in export and should spend time developing internal firm competence such as business concepts.

5.3. Business concepts for municipality-owned companies

To be able to develop a business concept based on environmental technology, the thesis builds on existing business models in the literature and identifies important characteristics of environmental technologies from existing practises. From the previous literature on business models, the study selected six important components as fundamental building blocks. These are (i) Market (ii) Finance (iii) Resources (iii) Activities (iv) Partnerships (v) Ownership and responsibility. Further formulation of the business concept based on municipal environmental technology followed a three-step process as shown in Figure 7.

Figure 7: Adjustment of existing business models

The review of previous literature on business models which constitutes the first step was guided by the desire to review business models which covered products, products service systems and large technical systems. As shown in the review outcome in Figure 7 above, Mason and Spring (2011) provides business models for products, Lay et al. (2009) focuses on products and services while Okkonen and Suhonen (2010) examine large scale technical systems. Generic approaches to business modelling was provided by Osterwalder and Pigneur (2010). In step 2, any commonality between the different business models was valuable in drawing a synthesis between the selected approaches. As seen in Figure 7 above, six components were derived from the existing literature. In step 3, a comparison between the characteristics of environmental technologies from the interviews (see Table 4 in results chapter) and the six extracted components was undertaken. Some of the characteristics of environmental technology export are covered by the selected components while their complexity and systemic nature requiring several actors to collaborate is not explicitly covered. We introduce one new component as *Legitimacy* and also two new sub-components as *Regulation* as part of “Market” and also *private-public partnership* (PPP) as part of “Partnerships” see Table 5 below.

The new component of private-public partnership is added because of the systemic nature of the large technical systems driven by environmental sustainability which is the types of technologies particularly offered by the studied Swedish municipal companies such as district heating, biogas production and distribution systems, all of which require several actors to co-operate (Rohrbeck et al., 2013). The new sub-component “regulation” is explicitly added because of the significant influence regulation has on the environmental technology sector, particularly in the adoption of some end-of-pipe technologies. For example, regulations on various markets determine what a municipality-owned company can and cannot do. A typical waste management company has to

comply with regulations on raw material markets, technical markets, electricity markets to be legitimate (Corvellec and Bramryd, 2012).

Legitimacy refers to compliance and meeting formal and informal expectations (Bergek et al., 2008). The environmental technology provider needs a long-term track record that demonstrates its capacity and trustworthiness to deliver environmental technology and to rally relevant actors around the technology. Legitimacy is important for private and public actors to work together. The complexity of environmental technologies means that the technology and its provider have to meet both formal and informal expectations for resources to be committed towards adopting the technology. The process of gaining legitimacy is complicated and might take time and different strategies such as lobbying to change the rules of the game, choosing to follow existing norms and expectation and influencing the creation of new institutional frameworks. The final proposed components are shown in Table 5 below (bold and italic components represent new additions to existing literature).

Table 5: Proposed components for business concept

Component	Characteristics
Market	Market here is not a physical setting but relates to how a producers and customers interact. Regulations on the export market are an important consideration for environmental technology exporters. Regulations influence for example what is regarded as waste, which also represents a raw material, and what this raw material is composed of, and what can be delivered on the market from the processing of this raw material.
Finance	Includes both the cost incurred in creating customer value and the revenue obtained from delivering the value to customers. This component includes key revenue streams, payment model and cost structure.
Resources	Key resources refer to technological, financial and intellectual competence needed by the firm in operationalizing its business model. These key resources are needed to create and deliver the customer value.
Activities	Activities here refer to vital activities that the firm undertakes to create and deliver value such as field studies and investigating the customer's problem.
Partnerships	Key partners needed for the business concept to function. The thesis introduces private public partnership for export by municipality-owned companies since most municipal companies are not allowed by law to build plants abroad, but have systems operating knowledge and proof of concept, it can be crucial to partner with private firms in export. In addition, the socio-technical nature of the environmental technologies they export means that they have to cooperate with private actors and citizens for proper functioning systems.
Ownership and responsibility	This component defines the need to assign ownership and responsibility for the environmental technology during use and after use phase if applicable. With environmental technologies, the ownership and responsibility of the technology can have a significant influence on its environmental performance. (see paper 3 for discussions on ecodesign and Product Service Systems design)
Legitimacy	This thesis introduces legitimacy as a particular component of business concepts for municipal export. Legitimacy refers to the compliance of the formal and informal expectation such as complying with environmental standards and regulations in different markets.

This business concept description is intended to guide managers with fundamental components to consider when planning business concepts for municipality-owned environmental technology export. Parallels can be drawn between the proposed components and the concept of business platform as proposed by Davidsson and Klofsten (2003) who identify eight cornerstones which are essential for start-ups to acquire essential resources needed to promote firm survival and growth. The business platform consists of the idea, product/service, market, organization, expertise, driving force and commitment, customer relations and other firm relations. In many ways, municipal exporters could be conceded as starters in the export market with little experience and hence the potential synergies and overlaps between our proposed components and the business platform idea. In paper 3 however, the proposed business models are used to exploit further theoretical developments for the diffusion of large-scaled environmental technology systems.

5.4. Implications for management and public policy

The findings and discussions from this thesis have potential implications both for firm level management and for public policy concerned with environmental technology export. As can be inferred from the previous chapters, environmental technology export is influenced by several factors including at the firm level, intermediary level actors and their initiatives and national level export strategies. In addition, environmental technology exporters share some similar export barriers with “conventional” technology exporters, which can be inferred from the export promotional initiatives offered by selected country governments. However, there are some particular challenges to environmental technology export also such as the importance of regulations, financing and the complexity particularly for large-scaled environmental technology systems. Based on these challenges, governmental promotion initiatives should cover both general framework conditions for export and specific instruments to enhance environmental technology export in particular. In this regard, framework conditions to boost export in general such as alternative promotional initiatives can complement specific initiatives determined by the peculiar characteristics of environmental technology in export (complexity, high initial investment, compatibility with existing systems and policy dependence). However, based on the resource limitation and allocations of several governments towards export promotion, a dynamic balance between general and specific initiatives should be established based on governmental capacity, different needs of exporters and also complementary roles between support actors.

In addition, “one-size-fits-all” approaches to the promotion of environmental technology export seem to be common among selected countries where environmental technology exports are treated as similar to other kinds of export. Given the specific characteristics of the environmental technology sector (SME dominated) variables such as communication channels, application for support processes, and the implementation of tailored promotional initiatives should be based on the particular sector characteristics. However, tailored promotion initiatives would be based on government resources in complementary to market activities and cannot satisfy every individual firm needs. This tailoring in support delivery should be supported by a balance between a generalization and specification in the content of export promotion programs.

In addition, another important consideration from this point of view is that, focus should not be overly put on the design and content of export promotion initiatives but also more importantly on the implementation, structuring, and coordination as many firms, governmental promotion actors and their initiatives. Governmental efforts could also focus on developing firm level competence and preparing firms better for the foreign markets including focus on business concepts for export.

The components of the business concept proposed can work as a checklist at an early stage to develop business around environmental technologies. Among these proposed components, regulation, public-private partnership, and legitimacy were found as particular to environmental technologies and thus should be given the needed attention they require.

6. Conclusions

In this concluding chapter, I take a retrospective look at the aim and research questions guiding this study and provide concrete answers to them.

This thesis started with an overall aim *to identify and evaluate governmental export promotion initiatives and formulate business concepts as approaches to enhance environmental technology export*. This aim will be specifically addressed to provide concrete answers. This is accomplished by addressing each research question.

Research question 1: *How do different governments promote the export of environmental technology?*

When it comes to uncovering the different approaches used by governments to promote the export of environmental technology, the main conclusions point to fairly similar approaches in the selected countries and in particular between “conventional” and environmental technology export promotion. These initiatives are grouped as: financial aid-related programs, information-related programs, education and training-related programs and trade mobility-related programs. However, differences between promotion initiatives emerge between the selected countries relating to the implementation of governmental promotion for environmental technology export. These differences relate to the target markets, firm size, firm stage in export and also the particular environmental technology types which are prioritized for promotion.

Research question 2: *How do private Swedish environmental technology firms perceive the effectiveness of governmental export promotion initiatives?*

The effectiveness of governmental promotion initiatives in enhancing export depends on firms’ awareness, participation and also their perceived effectiveness of such programs. The findings from a survey among Swedish environmental technology firms conforms to previous studies in other sectors that many exporters are often unaware of export promotion initiatives that fit their export needs. On the other hand, there is high participation among firms that find fitting governmental promotion initiatives to tackle their export needs. When it comes to perceived effectiveness of governmental promotion, no absolute conclusions can be drawn on the effects of governmental promotion on export. Nonetheless, results indicate that firms that accessed more than one type of governmental promotion, particularly those including financial support, perceived governmental promotion as contributing to realising export. Similar findings have been reported by studies on exports in other industry sectors (e.g Silverman et al., 2002) and countries – Colombian exporters (e.g Volpe Martincus and Carballo, 2010).

Research question 3: *What are the fundamental components to consider in business concepts for export of municipality-owned environmental technology?*

For management of municipality-owned companies, a checklist of important factors to consider systematically when planning export could prove helpful. The proposed essential components for business concept for environmental technology exports share several similarities with existing business concepts employed to create customer value while exploiting business opportunities. The thesis proposes seven fundamental components of business concepts for municipality-owned environmental technology export as (i) market (including regulations) (ii) finance (iii)

resources (iv) activities (v) partnership (including public-private partnerships) (vi) ownership and responsibility and (vi) legitimacy. Among these factors, regulation, public-private partnership and legitimacy were found as particular to environmental technologies.

Answers to these three research questions identify governmental initiatives to promote the export of environmental technologies, evaluates governmental export promotion initiatives among environmental technology exporters and proposes components for the export of municipality owned environmental technology export. These represent the overarching aim of this thesis.

7. Further research

The chapter covers potentially interesting scientific research trajectories as a result of this thesis.

In extending this research further it will be interesting to move in several wider and deeper directions to explore the subject matter of environmental technology export. One such direction is the unit of analysis. Large sized private firms have not been explicitly included in this study. As it is known, firm size influences export dynamics and thus it would be interesting to widen the scope and investigate large sized firms to identify their barriers, incentives and approaches to export and if there are particularly any such differences from small sized firms and non-environmental technology exporters.

Another potential research trajectory is to go deeper within a particular environmental technology sub-branch. Different environmental technology types are expected to have different determinants of their exports. Choosing to go deeper into a sub-branch for example biogas could be interesting. For several reasons, Sweden has a well-developed value chain in the biogas sub-branch compared to other sub-branches such as energy recovery by incineration. Such an investigation could examine both new applications and feedstock for biogas production both in home markets and abroad. Theoretical frameworks such as the concept of lead markets (Beise and Rennings, 2005) have been used on national levels to analyse for example how Denmark has become a global leader in wind power technologies and could offer powerful explanations on how to promote the Swedish biogas sector into a global leadership position bearing in mind similarities between biogas and wind power, and Sweden and Denmark.

When it comes to municipality-owned environmental technology companies, the emphasis so far has been on formal structures with approaches such as business concepts but other informal processes such as organizational culture have been found to be very important in making real and sustained change in the strategy of organizations. As Hirschhorn (2000) puts it, changing organizational structure is not enough and a misalignment between formal changes in the power and structure of a firm and changes in the informal culture and behaviour at the lower levels of the firm will not lead to any sustained change. Such a direction could raise interesting questions about what changes need to take place in an organization's culture and behaviour in order to integrate an outlook on foreign markets into their traditional domestic municipal focus.

To sum up, this thesis has been an exploratory attempt to understand a relatively new phenomenon emerging in the research agenda. Deepening the understandings offered so far will require deeper case studies on governmental actors and their initiatives, wider coverage of Swedish municipality-owned companies including their drivers for and barriers to export and also an investigation of business models for private environmental technology exporters and the discussions brought into a wider context of environmental technology diffusion and sustainability.

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