

Cleantech Investments in Denmark, Finland, Norway, Sweden

Are they performing well?

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Abstract

The development of clean technology (cleantech) is necessary in order to address many prominent environmental challenges. However, financing can be a hurdle for the development of cleantech companies. Venture capital (VC) plays an important role in cleantech development. While the four large Nordic countries are regarded as performing well in terms of cleantech innovation there are signs that VC investments are not performing well in the Nordic region. Therefore, this thesis explored whether the private Nordic VC funds are performing well or not and why they perform successfully or unsuccessfully. The results from the performance review and the interviews do not support the initial information that the Nordic funds are not performing well. Only one of the interviewed funds does not have companies with a trend of growing in its portfolio. The remaining five interviewed Nordic funds have some companies in their portfolio with a growing trend. On the other hand, it is not certain that these funds are performing well as only historical trends of companies that are still in the portfolios are considered, while the actual performance of funds finally depends on the exits of the portfolio companies. Several factors that differ between the poorly performing Nordic fund and regarded successful European funds, including the fund size, specialization in investments, management of portfolio companies and the background of the fund. When comparing the other Nordic funds to the European funds, some differences could be identified too. For example, the funds from other European countries review more proposals than the Nordic ones in general. The European funds are also more open to initial public offerings (IPO) as an option for exiting portfolio companies.

Keywords: clean technology (cleantech), factors, Nordic, performance, venture capital (VC)

Executive Summary

The development of clean technology (cleantech) is necessary in order to address many prominent environmental challenges, such as access to clean water, sustainable food sources, land and air pollution, and low carbon transportation. Several countries have already seen significant growth within the cleantech sector. However, financing can be a hurdle for the development of cleantech companies, as substantial financing is often required to develop and commercialize technologies. Venture capital (VC), as one of the financing vehicles, plays an important role in cleantech development. VCs also provide networks and knowledge to their portfolio companies.

However, while the four large Nordic countries, namely, Denmark, Finland, Norway and Sweden, are regarded as performing well in terms of cleantech innovation there are signs that VC investments are not performing well in the Nordic region. Therefore, this thesis explored the following research questions:

1. How do the Nordic private VC funds investing in cleantech perform financially?
2. Why do they perform successfully or unsuccessfully?
3. Do the most successful European funds perform differently, and if so, how?

Methodology:

To address the research questions, extensive literature review aimed at identifying method to evaluate VC fund performance and factors can impact its performance was carried out. By extracting data from CleantechScandinavia and talking with experts working in cleantech investments field, 14 Nordic and three successful European private VC funds were identified for study. After research and checking with expert, it was confirmed that no data on each fund's performance are available. Semi-structured interview was adopted to ask VC fund managers about their fund performance and how they manage their investments in terms of identified factors.

After sending emails and making follow-up phone calls, six Nordic funds accepted for interviews. However, most the interviewees took the information on how the fund performing as very confidential and only made very general comments. The interviewees' comments are that their funds are doing well. Thus, analysis of performance at portfolio company level was carried out. After checking data availability and literature review on the relevance, growth rate of turnover and employees and net profit were identified for evaluating portfolio companies.

Main Findings:

The results from the performance review and the interviews do not support the initial information that the Nordic funds are not performing well. Only one of the interviewed funds does not have companies with a trend of growing in its portfolio. The remaining five interviewed Nordic funds have some companies in their portfolio with a growing trend. On the other hand, it is not certain that these funds are performing well as only historical trends of companies that are still in the portfolios are considered, while the actual performance of funds finally depends on the exits of the portfolio companies.

The findings on the reasons explaining the performance of Nordic funds were presented in characteristics of fund, characteristics of investment, and investment process, management of portfolio companies and exit strategy in comparison with the other European funds. Several

factors differ between the poorly performing Nordic fund and regarded successful European funds. The size of the fund is relatively small, and established very recently compared to the other European ones. It invests in mainly in capital-intensive sectors but mainly in Nordic companies. This fund has a much smaller number of proposals to review each year than the other European ones, and it is the only one addressed forecasted IRR as an investment criteria. The backgrounds of the investment managers of this fund are mainly from financing, while the other European funds' investment managers are with more mixed backgrounds. This fund seldom replaces members of the management team in its portfolio companies, while the other European funds do it more often.

When comparing the other Nordic funds to the European funds, some differences could be identified too. For example, the funds from other European countries review more proposals than the Nordic ones in general. The European funds are also more open to initial public offerings (IPO) as an option for exiting portfolio companies.

Conclusions:

The results from the performance review and the interviews do not support the initial information that the Nordic funds are not performing well. Most of the interviewed Nordic funds have some companies in their portfolio with a growing trend. However, the actual performance of funds finally depends on the exits of the portfolio companies.

There are many factors can impact a VC fund performance in cleantech investments. A smaller fund size can negatively impact its performance, as its operation fees are limited. The well known fund can attract more proposals for future investment opportunities. Therefore, it can improve a fund performance. For small size fund, specializing in certain segments is better to it performance. However, the specialized Nordic funds need to consider invest outside more diversely in geographically to increase the number of proposals for review each year. Non-specialized funds need to develop expertise either from in-house or outside and build networks. IPO is an option for exit as well, and the Nordic funds can be more open with this option.

Recommendations:

Recommendations were provided to the targeted audience of this thesis, who are VC funds, especially Nordics ones, the cleantech entrepreneurs, limited partners (LPs) and governments of the four Nordic countries.

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List of Abbreviations:

Cleantech – Clean technology

DCF – Discounted cash flow

GPs – General partners

IRR – Internal rate of return

LPs – Limited partners

OECD – Organization for Economic Co-operation and Development

PFC – Portfolio Company

VC – Venture capital

VCF – Venture capital firms

1 Introduction

Industrialization over the past 150 years has caused an imbalance of the global ecosystems. We are currently facing different environmental, energy and economic challenges, such as climate change, energy security, depletion of resources, etc. (Hamilton, 2007). Various solutions have been proposed to tackle these environmental problems. Proposed solutions vary from individuals taking on vegetarian diets to governments forming international treaties to regulate emission levels. Although all proposed solutions are important and worth considering, new innovations and technologies are needed as well to make large-scale and efficient changes (Knowles, Henningson, Youngman, & Faulkner, 2012).

Historical data have already shown that technology can help, when tackling environmental problems. For instance, technology can help in tackling climate change challenges. In the past century, energy efficiency of energy produced in developed countries, has increased for more than 10 times (Knowles et al., 2012). Energy production and use attributes to 74% of global greenhouse gas emissions, thus the improvement of energy efficiency is very relevant for tackling the climate change challenges (Knowles et al., 2012). Another example of helpful technological initiatives is the use of renewable energy, which optimizes our use of natural resources. All the mentioned technologies can be referred to as clean technology (cleantech).

However, there is no clear and international standard definition of cleantech, which is sometimes referred to as greentech, sustainable technologies, and environmental technologies. As an example, Cleantech Finland defined it as “Cleantech (clean technology) in references to technology, services, solutions, process innovations or products that help reduce the environmental load caused by human activity, to save energy and natural resources and to improve the living environment. Cleantech business can solve economic, ecologic and social challenges” (Cleantechfinland, ?). The different definitions from literature will be discussed later in this thesis. However, this definition demonstrates how cleantech encompasses a broad range of products and services.

The broad range of products and services referred to as cleantech is relevant to many prominent challenges, such as access to clean water, sustainable food sources, land and air pollution, low carbon transportation, and so on (Parad, Henningson, Currás, & Youngman, 2014). However, cleantech not only contribute to solutions to environmental issues but also to the overall economic growth (Ramse Andersen, 2013). As cleantech is growing and permeating throughout all realms of the economy, it impacts industries as diverse as ICT, electronics, and retailing, etc. (Parad et al., 2014).

Several countries have already seen significant growth within the cleantech sector. For example, in Denmark, cleantech contributed to 3% of its GDP in 2004, which is equivalent to approximately 7 billion USD (Christensen, n.d.). While the development of many traditional industrial sectors are in decline, cleantech makes it possible for the development and growth of new clean industries (Cluster, 2012). With its growth, cleantech development is also helpful to employment creation (Saraf, 2014). According to Employment Outlook 2012, to get employment rate back to pre- financial crisis levels, around 14 million jobs are needed in Organisation for Economic Co-operation and Development (OECD) countries. Cleantech industry provides hundreds of thousands jobs each year, and can help these countries to decrease the unemployment rate (Mashovgroup, 2014).

Although cleantech is important both for environmental and economical issues, it needs a platform to take ideas from laboratories to markets. According to Knowles et al. (2012), many players are involved for the development of cleantech, including governments, universities, investors and multinational corporations during the life cycle of technology innovation. Entrepreneurial startups are in the center among all these players, as they are the most common platforms to make an idea from laboratory to market (Knowles et al., 2012). However, to launch ideas from laboratory to market, these entrepreneurial startups have to overcome many difficulties. Financing can be one of these difficulties for startups companies, as it is required to develop and commercialize technologies.

The difficulties to get finance exit in both developing and developed countries. Since tax benefits or funding from development banks are not enough, private funds are needed (Cluster, 2012). Venture capital (VC) is one source of financing, which is vital in the acceleration towards commercialization and diffusion of new technologies. Although venture capital firms (VCF's) cannot create new technological trajectories by themselves, they are important for the development of technology. As stated by Harrison & Mason(2000), "Given that a significant proportion of venture capital-backed companies are in technology sectors, venture capital plays a direct and significant role in the process of innovation and technology-based development in modern industrial economies". According to Christensen(n.d.), VCs can provide young firms with equity financing, which helps to relieve young firms from more debt.

Furthermore, VCs firms can also provide networks and knowledge to their portfolio companies (Makomaski & Johansson, 2013). Tohmatsu (2006) claimed " venture capital is often seen as the life blood of the technology industry, offering the resources and capacity for ideas to be given the chance to develop from conception into stand-alone products/technologies, or life changing products and services"(Tohmatsu, 2006). We can see that VC plays an important role to the development of technology innovations. VC investments are also important for the development of cleantech as well as the other types of technologies. Thus, it is valuable to know whether cleantech investments are profitable to VCF's and what are important factors that impact their success. It would be helpful to know whether VCF's will continue their investments in the cleantech sector, which is vital to the on-going development of cleantech.

This thesis explores how the Nordic VC funds, including Denmark, Finland, Norway and Sweden, are performing, and they are thus selected as they perform well in terms of cleantech innovation. Moreover, a research gap has been found that there have been no studies, which put together the performance of VC funds investments of cleantech within the studied four Nordic countries. This thesis will also explore how they do in terms of factors, which are regarded as important to the success of their performance. Interviews will also be conducted with three more funds from other European countries other than Nordics, which are regarded as successful cleantech funds. This will enable comparisons to be made between the funds from other European countries other than Nordics, based on what is being done differently.

1.1 Problem definition

The four Nordic countries, Denmark, Finland, Norway and Sweden are regarded as performing very well in terms of cleantech innovation. According to Parad et al. (2014), Finland, Sweden and Denmark were in the top five of the Global Cleantech Innovation Index 2012, which was based on 15 indicators related to creating and commercializing

cleantech start-ups among 38 countries. Norway was following closely behind (Parad et al., 2014). However, the Nordic VC funds in cleantech investments are not performing well according to some initial information.

The unsuccessful investments track record could hinder investors to invest in cleantech sector. Hillestad-Andréasson & Karlsson (2010) claimed that the willingness of investing in cleantech is affected by the fact that the sector lack of successful reference cases, i.e. investments and companies that have gone through the whole process from investment to divestment and generate high return. The reason is because actors in emerging industries are more sensitive to information on successes and failures. Investors will be hesitant to invest in the sector if there are no enough reference cases (Hillestad-Andréasson & Karlsson, 2010). Since the cleantech sector is relatively new, the perception that the VC funds in Nordics are not performing well could impact future investments in cleantech sectors.

On the other hand, access to capital is very important for the development of cleantech as to all the innovation companies. Cleantech in general is very capital intensive, and it requires capitals for different crucial but expensive activities, such as building reference sites and production facilities, marketing effectively, and offering necessary service and support (Nilsson & Pettersson, 2012). Thus, it is necessary to check whether the Nordic VC funds are performing well and what are the reasons if not.

However, according to Nordic Innovation (2013) the VC performance data in general are missing and no one has managed to gather performance statistics on the Nordic market (Nordic Innovation 2013). It is even more impossible to find these data for cleantech funds in Nordic countries. There is also lack of information on how these cleantech funds are managed in terms of important factors to the success of a fund's performance. Therefore, there is a need for more in-depth research on the performance of Nordic countries' VC investments and the reasons for their successful or unsuccessful performance.

1.2 Research questions

The aims of this study are to understand how the cleantech investments in Sweden, Denmark, Norway and Finland are performing and the reasons for them to be successful or unsuccessful. The study will pursue the following research questions:

1. How do the Nordic private VC funds investing in cleantech perform financially?
2. Why do they perform successfully or unsuccessfully?
3. Do the most successful European funds perform differently, and if so, how?

1.3 Method

The research was initiated through a preliminary literature review. It served to establish a theoretical framework for the nature of innovation, innovation cycles, and venture capital financing. The main sources for literatures for this thesis are Business Source Complete, Google Scholar, and LUBSearch. Through reviewing reference lists in observed articles, papers, books, reports, etc., additional articles were found and the quotation function in Google Scholar provided information on subsequent research on similar topics.

A discussion was initiated with the experts and researchers working on cleantech investments. According to them the Nordic investments in cleantech are not performing well but the data is not available. However, there are some cleantech VC funds in Europe are performing well. It is obvious that there must be some aspects that the Nordic VC funds are performing differently. By extracting data from Cleantech Scandinavia's database, twenty-eight Nordic VC firms, which have invested in cleantech, were identified, both public and private. Since different types of VC funds have different considerations and abilities in terms of investments, the following step was to limit the types of VC funds for study to make the results comparable.

In Europe, the dominating form of VC is private firm, which accounts for 73% of the total numbers (UN, 2007). However, the private investments to cleantech accounted for a relatively small percentage of the deal numbers in Nordic countries. According to a CleantechScandinavia's report from 2014, the total number of deals reported in 2013 was 251, of which the number of private investments was only 67 (Cleantech Scandinavia 2014). Therefore the focus of this study was narrowed down to the private ones. In total, fourteen private VC firms were identified for this study.

To determine how to evaluate performance of VC funds, different indicators have been discussed, like return on investment (ROI) and internal rate of return (IRR). During the study, it was found that studies from some organizations, such as INSEAD together with European Energy Venture Fair about cleantech return analysis have been done. This study evaluated the performance of international cleantech investments for the VCFs joint by volunteering. However, the study is not accessible and data are aggregative as well. Although in theory there are other methods to evaluate cleantech funds investments, it is not accessible and practical for this thesis study. By checking websites and annual report of the fourteen VC firms and websites of a few VC financial associations, and consulting experts, it proved that the data to identify ROI and IRR are not accessible. One option to find out ROI or IRR would be to ask fund managers about their fund performance. This could be done through a questionnaire, but it is unlikely that such questionnaires would be received well if asking such sensitive information. Therefore interviews have been considered as a better way to get more information. In addition, talking to fund managers in person is also very important to understand how they do investments. Thus, interviews have been chosen instead of questionnaire as the main method for collecting empirical data.

As exploring how the chosen venture capitalists manage their investments to be successful is another purpose of this study, the author found it important to be able to use both prepared and follow-up questions. Thus, qualitative, semi-structured interviews were held with venture capitalists and financial analysts to collect primary data as a basis for the analysis. To develop interview questions, a literature review has been carried out to identify factors can impact the performance of VC investments from previous research. The interview questions are grouped into: characteristics of funds, characteristics of investments, investment process, management of portfolio companies, exit strategy and some other open and general questions.

To make comparison to the other successful European funds, the first step is to identify the successful funds. However, as data is not available and the amount of work to find all the European funds investing in cleantech, it is impossible to identify the most successful ones by desk research. Therefore, successful European cleantech funds have been identified by talking to experts in this filed.

During the interviews, a question on how the portfolio companies are performing was raised. However, interviewees took this information as very confidential. Most of them only generally said they are doing well and could reach their expectations. However, when asking about each portfolio company's performance, very few of them gave some comments. It seems the results turn out different from the initial interviews with experts. Therefore, data on their performance are important to get a real picture. Since IRR, which is the most frequently used indicator could not be found, other indicators, which can tell the performance, had to be found. By talking to some experts and checking literatures, the sales growth rate, and profit growth rate and employee growth rate in a consecutive of three to five years can indicate a company's potential of growth. Thus, an analysis of the portfolio companies' growth rate of sales, and employees, and net profit were conducted. However, even these data cannot be found for every portfolio companies. Thus, the 1st research questions were tested based on the combination of analysis and interviews.

The interviews were conducted by the interviewers having a list of questions and themes that were to be covered, however the follow-up questions varies depending on the respondent's answers. Thereafter, to test the findings of the analysis about the important factors to impact the VC investments performance, a comparison between Nordic VC funds investments and the other three European VC funds investments were conducted. Since the interviews dealt with sensitive issues, the interviewees have asked to be anonymous. Therefore, interview results will be grouped and no names to be revealed in this paper.

1.4 Framework

Since this study is very practical in its orientation, the most suitable framework consists of performance indicators used in investment analysis. The author elaborated on the use of such indicators, based on literature and on what kind of information that is available on the performance of cleantech funds. To evaluate the 1st research question, the portfolio companies' growth rate of sales and employees, and net profit were analyzed. These metrics are indicators for the companies potential for growth. Therefore, data analyses are combined with interview results to test the 1st research question.

For the 2nd and 3rd research questions, the evaluation were based on testing the factors impacting performance identified from literatures, such as specialization in industry, investment stage, fund size, etc. The interview results are analyzed based on categories of factors impacting performance of fund. Comparisons between Nordic funds and the other European funds are also used to understand how they do differently regarding the factors identified.

1.5 Scope and limitations

1.5.1 Scope

The study covers both pure cleantech VC funds and generalist VC funds in the four Nordic countries, which have invested in cleantech. The reason is because the number of pure cleantech VC funds is very few. Moreover, based on data from Cleantech group (2013) generalist VCs remain the most active investors in cleantech deals. These investors are open to cleantech deals, but do not treat cleantech companies differently from other sectors. They normally require returns over a shorter period than most cleantech companies have been able to do till date.

The type of VC funds included in this study is only private ones. As discussed above, different type of VC firms have different consideration and ability for investments, it needs the limit the study into a certain type for comparison. Since the public fund managers may not have enough experience, skills, and knowledge and they are not incentivized by performance, public VC can perform suboptimal in many cases (Saraf, 2014). Bank related VC firms might have different considerations for investments, such as future service with their bank. Corporate VC firms are not in large scale (UN, 2007). Thus, the study focused on private VC firms.

This thesis explored the performances both at fund level and portfolio companies level. There are different methods to evaluate the performance of a VC fund. In the literature review part of this study, pros and cons of different methods have been analyzed as well. However, as stated by McKenzie & Janeway (2008), lack of suitable data is a significant impediment to research on VC industry due to the fact that they are not required to disclose publicly. The study also encountered the same challenge. There is no data available or accessible on the mentioned performance index. The author tried to get it from interviews instead. However, the interviewees regarded IRR as very confidential data, and they either do not want to reveal it or they even do not calculate it before exit from an investment. Thus, the study has to combine the fund level performance and company level performance.

The study covers the funds and portfolio companies extracted from the beginning of February 2015. Any new fund investing on cleantech after this period was not added, if there is any. However, portfolio companies exited by VC funds after data extracted were also included in this thesis, and the author has noticed such kind of changes in the VC funds.

1.5.2 Limitations

Coverage: This study did not carry out a thorough investigation on all the VC funds ever involved in cleantech investments but based on data from Cleantechscandinavia and inputs from some preliminary interviews. As there is no standard definition of cleantech, the study classified whether the investments are cleantech or not based on the definition and segments categorization applied in this paper. However, it also needs full understand of technologies and their application to determine whether they can be classified as cleantech. Therefore, inputs or the interviewees' opinion are also applied in the study.

The focus of this study is Nordic funds, but the author also tried to include their investments outside Nordic countries to test whether diversified geographical investments impacts funds' performance. However, the databases were only found for companies in Nordic companies. Therefore, the study only evaluated the investments outside Nordic countries if interviewees revealed any information about them.

Evolution: The VC investments in cleantech are still young, and it is also true for the Nordic VC funds. There are not many cases of exit yet (the fund life for a venture capital is generally 10 to 12 years). Audience must be cautious to draw conclusions from data at this time. As the sector evolves and the VC fund managers engage more in the sector and adapt their strategies, the picture can be changed.

Data: The growth rate of sales is only accessible for five years from 2009 to 2013. The net profit and growth rate for employees are only accessible from 2011 to 2013, but normally VC investments can exit five to six years after investments. Therefore, the data cannot represent the full data of the investment period.

Metrics for evaluating company's performance: There are many different metrics to evaluate a company's performance. As summarized by Robert (2004) in his study, he got 278 performance variables. In this study, it is impossible to evaluate all these factors. Due to data availability, the well-accepted metrics of growth rate of revenue and employees and net profitability were applied.

Generalizability: Since the studied number of the funds is limited, the generalizability is limited. No Danish VC firms participated in interview, thus the results may not be able to represent Danish funds.

1.6 Audience

The primary audience of this thesis is VC firms from Nordic countries. Benchmarks are also an important indicator for venture capitalists themselves. VC firms from Nordic countries could assess more fully how their funds are performing, especially as compared to other VC firms. They could use these results to communicate with current and potential investors. The result of the thesis can also provide an overview of how cleantech investments are doing. VC firms, which have not invested in cleantech, can have an idea of this new investment arena. They can learn how the current cleantech VC firms treat cleantech investments differently. They can become aware of these differences when they enter into this new investment area. The current VC firms who have difficulties to manage cleantech investments can learn from the study of the successful European VC funds.

The cleantech start-ups can get an idea of how the VC works. This study can provide some insights when they pitch their projects to investors. For the ones already in cooperation with VC funds, they can also understand more on how VC funds work, so they can cooperate more successfully with VC funds. As the study will also try to explore what kind of support VCs can provide to start-ups, the result can be useful for start-ups as they can beware the other supports VC firms can support beyond financial support when they decide which VC firm they seek for cooperation.

A VC fund investment is always a long-term commitment, and 10 years are the typical investment lifespan. Although the limited partners (LPs) can receive quarterly financial reports, they would also like to know how their investments are performing by comparing to others. This is true regardless of whether the LP is a private individual, endowment, private or public pension fund. However, financial statements cannot provide this perspective. This study can provide them some benchmarks for them to compare the performance of their investment.

Governments can also take note of the findings from this study as they often encourage and even sometimes finance private VC investments. Since there are some criticisms of efficiency of public fund, government can invest cleantech funds instead. By doing so, they can support cleantech development but also leverage the professional mechanism VC firms.

1.7 Disposition

Chapter 2 provides background knowledge and literature analysis to identify research gap.

Chapter 3 presents main findings both from interviews and from research.

Chapter 4 presents analysis of the research based on findings presented in previous section; discusses and reflects on findings, analysis and research process.

Chapter 5 presents conclusions and recommendations.

2 Literature review

To answer the 1st question on how the Nordic VC funds are performing, broad searches were initially carried out on Google Scholar on combinations of key words such as ‘venture capital’, ‘private equity’, ‘equity financing’, ‘investment’, ‘IRR’, ‘performance’, ‘return’, ‘Nordic’, ‘Sweden’, ‘Norway’, ‘Finland’, ‘Denmark’, ‘cleantech’, ‘cleantechnology’, ‘green technology’, and ‘sustainable technology’. Citations and references to and from other articles have been significantly useful as well. Over 200 articles and books were found. However, no articles have put together cleantech investments performance for all the four Nordic countries.

McKenzie & Janeway (2008) claimed that literatures attempted to provide insights into the venture industry in general, including characterizing fund performance are very small. Since cleantech is a quite new investment theme and not many VC funds dedicating to cleantech investments, the literatures on cleantech VC investments are much smaller. Nordic Venture Network also verified that there is no such study. It said that although there have been long time attempts to establish return data for VC industry, the data quality is very low, and there is no separate statistics for cleantech. Cleantech Scandinavia also confirmed that there is no data available for performance of Nordic cleantech investments.

Therefore, the literature review focused on identifying indicators can be used to evaluate a VC fund’s performance and their pros and cons. Afterwards, detailed search based on different performance indicator was carried out again. However, there was still no such literature about cleantech VC investments performance for the four Nordic countries. Researches were done again to find metrics for evaluating portfolio companies’ performance. Robert (2004) reviewed previous studies and identified growth rate and employees as metrics for a company’s potential of growth and net profit as a metric of profitability. These three metrics were therefore used for evaluating performance of portfolio companies.

Regarding the second research question on why do Nordic cleantech VCs perform successfully/un-successfully, literature review focused on what factors impacting VCs’ performance. The reason to do this was to find out important factors and relevant questions can be asked during interviews. Therefore, factors identified from literature review were used for forming interview questions to test how Nordics funds are doing differently from European ones. Additional key words were used such as ‘factors’, ‘impact’, and ‘determine’. After deciding to structure the literature review based on the review from Söderblom (2006), more key words such as ‘characteristics’, ‘fund’, ‘raising’, ‘syndication’, ‘network’, ‘reputation’, ‘portfolio size’, ‘IPO’, ‘network’, ‘exit’, ‘experience’ were used.

2.1 Background knowledge& definition

2.1.1 Development and definition of cleantech

Very little attention and investments were made to environmental start-ups a decade ago, due to the poor performance of environmental start-ups. As a result of small group of entrepreneurs seeking to attract attention and resources for themselves, cleantech emerged initially from the venture capital community (O’Rourke, 2009). According to Cooke (2008), “Cleantech is a venture capital buzzword, making eyes sparkle the way ‘biotech’ and ‘infotech’ once did”. Although this is not a definition for cleantech, this statement provides an accurate opinion of the cultural origin of cleantech (Cooke, 2008).

The term “cleantech” was probably first used in 2002 by Cleantech Network (earlier known as Cleantech Venture Network, which is part of Gleantech Group) (Frankelius, Hultman, Linton, Johanson, & Gunnarsson, 2011). Attribute to its fast development, cleantech became very known in VC community since 2006. According to O’Rourke (2009) both Cleantech Venture Network and Fuscuro in 2006 claimed that cleantech was regarded as the “third largest” and “hottest” VC category. It was formally adopted as an industry category since early 2007 by two of the three dominant sources of VC information (O’Rourke, 2009). From then on, interest in cleantech continued to grow (O’Rourke, 2009).

Cleantech development has significant impact to environmental challenges and economy development. In the early 21st century, the industrial development is dominated by the two worlds of innovation driven economic growth and environmental degradation. These two worlds were separated until very recently when cleantech combined them. By being at the intersection of these two worlds, cleantech becomes a symbol of new wave of entrepreneurial and innovative activity and serving to create a more sustainable industrial economic system (O’Rourke, 2009). As with cleantech, it has potential to achieve the “big win/big wins”. That achievement will not only change the industrial landscape but also improve environmental conditions. Therefore, it can also change the understanding of the relationship among business, technology and environment (O’Rourke, 2009). Thus, cleantech is now considered as a viable venture category and has attracted VC backing (O’Rourke, 2009).

Cleantech Group (2011) also addressed that cleantech or clean technology is different from environmental technology or “green tech”, which were popular in the 1970s and 80s. According to Cleantech Group (2011), greentech, or envirotech, represent “end-of-pipe” technology of the past (for instance, smokestack scrubbers) with limited opportunity for attractive returns, while cleantech addresses the roots of ecological problems with new science, emphasizing natural approaches. Greentech has traditionally only represented small, regulatory-driven markets. Cleantech is driven by productivity-based purchasing, and therefore enjoys broader market economics, with greater financial upside and sustainability”(Gleantch Group, 2011).

The first expository effort was to find a clear definition of cleantech, and to categorize and organize the sectors included in this field. However, it is not easy to define what cleantech is and what areas can be included in cleantech category. Cleantech Group (2011), who is regarded as the first one made a definition for cleantech in 2002, defined cleantech as: “*cleantech is new technology and related business models that offer competitive returns for investors and customers while providing solutions to global challenges*”. They explained the definition further that: “cleantech represents a diverse range of products, services, and processes, all intended to:

- Provide superior performance at lower costs, while
- Greatly reducing or eliminating negative ecological impact, at the same time as
- Improving the productive and responsible use of natural resources”(Kajander & others, 2012)

However, the Foundation for Global Sustainability argues that cleantech is not an industry limited to certain sectors, but it should include all sectors applied with “eco-innovation”(FFGS, 2012). They define cleantech as “*cleantech includes all goods, services, processes and business models across all industries and all value-added steps that contribute significantly to a*

sustainable economy. The main components of this contribution are increased resource efficiency, decreased demand of natural land, reduced emissions of pollutants, the further reduction of detrimental impacts on the environment, as well as inducing beneficial changes for society” (FFGS, 2012).

Yet, it is not self evident in both conceptual and practice level to define cleantech and environmental technologies. According the definition of Cleantech Group, cleantech takes the newness of the employed technologies as criteria for a technology to be included in cleantech industry. Furthermore, they clearly exclude end-of-pipe technologies from cleantech. While the definition form FFGS (2012) does not clearly exclude end-of-pipe technologies (Kajander 2012). On the other hand, both EU (2004) and UN (2011) have in their definitions of environmental technologies including “cleaner technologies”(Kajander 2012).

The different definitions reveal not only their perceptions of cleantech, but also the different opinions of the attribute of cleantech as an investment category. Some actors who sought to more specific definitions tended to define the exact areas of cleantech (Georgeson, Caprotti, & Bailey, 2014). For example, Burits et al. (2004) defined cleantech as *“products and services use technology to compete favorably on price and performance while reducing pollution, waste, and use of natural resources.”* Even though these actors admitted the broad nature of cleantech, they were still struggled to define sub-sectors. For example, Burtis et al (2004), they stated that cleantech could encompass a broad range of industries, from renewable energy generation to wastewater treatment to environmentally sensitive consumer products. Some of the sectors, such as wind power, solar power, and air pollution control equipment have been more mature and been regarded as classical cleantech. While the other sectors are more nascent, such as environmentally focused nanotechnology and solid oxide fuel cells (Burtis et al, 2004).

Other actors followed a broader approach. One of the important broad definitions of cleantech is from Ron Pernick and Clint Wilder. Both of them were very active and relevant persons in cleantech. In their book “The Clean Tech Revolution”, they defined cleantech in the following way *“Clean tech refers to any product, service, or process that delivers value using limited or zero nonrenewable resources and/ or creates significantly less waste than conventional offerings”* (Georgeson et al., 2014). The followers of such definition often used more open definitions and felt no need to name sub-sectors. Yet, they highlighted a trend that cleantech is becoming ‘omnipresent’ (Georgeson et al., 2014).

Some actors even argued that it is not possible to define cleantech sector. Instead they take it as a “theme” of investment. They emphasized the role of cleantech as a cultural construction in attracting flows of capital and investment as a result of broader trends of the establishment and emergence of the green economy (Georgeson et al., 2014).

When looking at the various sub-sectors that make up clean-tech, it seems true that cleantech is not an actual industrial sector. The sub-sectors of cleantech neither target the same markets, nor share the same suppliers or corporations. Furthermore, the business models are normally ranging differently (Georgeson et al., 2014). The industries included in cleantech are disparate and the some applications are overlap with non-environmental applications (Georgeson et al., 2014). According to them, cleantech falls into 11 categories, as shown in Table 1.

Advanced Materials and Nanotechnology

- Non-platinum catalysts for catalytic converters
- Nano-materials for more efficient and fungible solar photovoltaic panels

Agriculture and Nutrition

- Innovative plant technologies and modified crops designed to reduce reliance on pesticides or fungicides

Air Quality

- Stationary and mobile emission scrubbers
- Testing and compliance services

Consumer Products

- Biodegradable plastic ware
- Non-toxic household cleaners

Enabling Technologies and Services

- Advanced materials research services
- High throughput screening research equipment

Energy Generation, Storage, and Infrastructure

- Solar photovoltaic technology
- Wind power
- Hydrogen generation
- Batteries and power management technology

Environmental Information Technology

- Regulatory and policy compliance software
- Geographic Information Services (GIS)

Manufacturing/Industrial Technologies

- Hardware and software to increase manufacturing productivity and efficiency

Materials Recovering and Recycling

- Chemicals recovery and reprocessing in industrial manufacturing
- Remanufacturing

Transportation and Logistics

- Fuel cells for cars
- Diesel retrofit equipment
- Hybrid electric systems for cars, buses, and trucks

Waste and Water Purification and Management

- Biological and chemical processes for water and waste purification
- Fluid flow metering technology

Table 1 Cleantech industry sub-sectors; Source: Burties et al (2004)

As seen from the analysis above, there are many different definitions of cleantech. Since the focus of this thesis is not to identify what cleantech is, it would not further review all different definitions. However, the quoted different definitions of cleantech above already showed cleantech could be interpreted differently. The sub-sectors included can also vary. This thesis did not attempt to define what cleantech is but rather based on interviewees opinion to identify cleantech investments in their portfolio.

2.1.2 Forms of main investment vehicles

The lifecycle of innovation firms can be linked to a sequential model of innovation development and funding. Different types of funding are involved in different stages of innovation. This reflects the different skills the investors have and their ability to take on risks (Reid & Nightingale, 2011). For early stage funding, the main source of funding is traditional banking services, small-scale debt, and use of credit cards, drafts and loans. According to Auserwald and Branscomb (2003:233), the percentage of funding for early stage technology development firms is: industry (31.6%), angels (27.9%), government (25.1%), VC (8%), state government (4.7%), and universities (2.6%). For development and launch prototypes, funding mainly come from VC, private equity funds and bank debt (Reid & Nightingale, 2011). Moreover, this type of investment is normally insufficient to cover the needs of enterprises (UN 2007). There are twelve main forms of investment vehicles. This

section will briefly introduce these different forms so that the audience can understand how VC investments are different from other types of investments.

Informal investors: informal investors are normally from friends, family or relatives, like it is normally captured by the phrase “friends, fools and family”. According to (Reid & Nightingale, 2011), 50% of this type of investments comes from relatives, 29% from friends and neighbors, 11% from work colleagues, and 8% from strangers. Informal investors are important in funding small firms and innovation, and they account to 60% to 90% of total capital invested. However, research suggested that the money of this type of funding is normally invested unwisely and debt is the major form of this type of investment vehicles (Reid & Nightingale, 2011).

Business angels: According to Reid & Nightingale (2011), Mason (2006) defined business angels as “high net worth individuals who invest their own money, along with their time and expertise, directly in unquoted companies in which they have family connection, in the hope of financial gain” (Reid & Nightingale, 2011). Angel funding plays a complementary role to VC funding. As angels invest their own money, they can invest in early stage, seed and start-up firms. These investments can be below VC’s minimum requirements of deal sizes (Reid & Nightingale, 2011).

Business Angel Networks: Business angel networks (BAN) are professional syndicates of angel investments. These professional networks have published routines for accessing and screening deals, undertaking due diligence, negotiating and investing (Reid & Nightingale, 2011).

Corporate venture capital (CVC): CVC involves non-financial firms making equity investments in entrepreneurial companies. By doing such equity investments, large firms can build competitive advantage by acquiring technology and building new competencies (Reid & Nightingale, 2011).

Private equity (PE): Instead of creating new asset, PE investments involve refinancing and restructuring of existing assets, such as management buy-outs, buy-ins and other later stage development finance (Reid & Nightingale, 2011).

Hedge funds: The boundaries between hedge funds and PE are blurring. Like PE, hedge funds also invest in late stage ventures. However, they also invest in public securities to make quick profits by short-term trades (Reid & Nightingale, 2011).

Alternative Investment Market (AIM): AIM, focused more on natural resources than technology, is a source of equity investment for firms seeking later stage funding. AIM investors do not provide smart money, but firms can source advice provided by VC investors externally (Reid & Nightingale, 2011).

Sovereign Wealth Funds: Sovereign wealth funds are owned and funded by sovereign nations to manage budgetary surpluses. They can invest in industries and technologies that are regarded as strategically important (Reid & Nightingale, 2011).

Charities: Medical charities are playing important roles in providing equity investment and support to biotechnology firms in EU by providing grants for technology development (Reid & Nightingale, 2011).

Governments: Governments sometimes invest in technologies and firms, which they think are strategically important. However, it seems that government's investments are not very successful as their investment decisions are influenced by non-commercial considerations (Reid & Nightingale, 2011).

Hybrid funds: Hybrid funds are the responses to the failures of direct government investments. Governments co-invest with private sector in funds run by professional, private sector fund managers (Reid & Nightingale, 2011).

2.1.3 Definition of Venture Capital

Like angel investors, government grants, debt, VC fund is one source of financial capital. Dedicated venture capital firm (VCF) emerged after World War II as a result of conscious institutional innovation effort of Business and civic leaders in East Coast, especially from New England. They were concerned about the future of New England and the financial systems' ability to recover from the Great Depression. They were very confident that small entrepreneurs ventures and small companies could bring profit for capital investments. Meanwhile, their growth could be beneficial for employment growth in New England and the US as well. However, they recognized a shortage of dedicated capital for the early stage development to achieve this. This group advocated a solution that private entities would provide funds to firms that might create new industries. After many years of evolution, venture capital as a new organizational form appeared in 1946 (Hsu & Kenney, 2005).

There is no clear definition of venture capital. The European Private Equity and Venture Capital Organization (EVCA) defines Venture Capital as following:

“Professional equity that is co-invested with the entrepreneur to fund an early stage (seed and start-up) or expansion venture. Offsetting the high risk the investor takes is the expectation of higher than average return on the investment. Venture Capital is a subset of Private Equity” (Makomaski & Johansson, 2013).

The capital of VC funds are typically from very large institutions, like pension funds, financial firms, insurance companies. These institutions invest a small portion of their total funds into VCs for high-risk investments. While they also expect a high return of investments, which is from 25% to 35% every year for the total period of investment. Since the investments to VCs only account for a very little part of these institutions' investment portfolios, they do not invest in a fund for a specific investment but the VC firm's overall track record, and their confidence in the partners themselves (Zider, 1998).

VCFs generally invest their capitals to start-ups by funds, which are in form of limited partnerships where VCF is the general partner (Nilsson & Pettersson, 2012). As a return, VCFs obtain equity stake of the company (O'Rourke, 2009). VCs only get returns of their investments if and when they sell the equity stake they get. It normally takes many years for them to be able to sell to get return (O'Rourke, 2009). To able to take an active role and manage risk, VCFs normally have board seats in the ventures they invest in. When VCFs invest in early stage ventures, they focus on monitoring daily routines. While when they invest in later stage ventures, they focus on long-term goals instead. To control risk, they invest further only when the ventures reach certain milestones in development (Nilsson & Pettersson, 2012). VCFs help the ventures they invest in to grow, but will exit at a certain point by selling their shares of the companies. The exit points vary from investments. For early stage investments, it may take ten years. On the other hand, later stage investments may only need a few years. This means the money invested by VCFs will be tied up for a long

period of time. To manage this risk, VCFs invest diversely and they create a portfolio in one fund for early stage firms (Nilsson & Pettersson, 2012).

2.1.4 How a VC fund works

VC process: VC includes four stages: fundraising, investing, managing/value adding and exiting (UN, 2007). Funds provided by VC firms are not from themselves, but normally from institution or other investors. According to UN (2007), the composition of VC funds source is like this: pension funds account 24%, finance and insurance companies 28%, individuals and families 7%, corporations 6% and the others 35%. Fundraising is an important stage of the VC cycles. VC firms can only get funds when the returns achieved by them can exceed the investors' opportunity cost and the returns can high enough to compensate the risks their investors undertake (UN, 2007).

Types of VC funds: UN (2007) divided VC firms into four types, i.e., private VC, bank-related VC, corporate VC and public VC. For private VCs, partners share profits by performance-based bonus. This structure creates incentives for VC firm partners to accumulate and manage more assets (HBR, 2014). They are thus subject to higher performance pressure. Bank-related VC firms may also consider future demand for banking services when they do investments. Corporate and public VC firms rarely in a large scale, thus less likely to make a large number of investments (UN, 2007).

Structure: VC funds are typically structured as limited liability partnerships (LLP). The institutional investors are limited partners (LPs), and the VC firm partners are general partners (GP). GP's provide very small part of the funds capital, which is typically 1%. LPs are not allowed to interfere the management of fund, but they can govern the behavior of VC managers through covenants. The term of LLP is fixed and normally is 10 to 12 years. Before termination, withdrawals or transfer of partnership stakes are not allowed. During the life of a fund, VC firm receives a management fee of 2-2.5% of the total capital of the fund. This compensation structure allows VC managers to invest in risky projects.

VC investment stages: (Robbie & Mike, 1998) P15; (Söderblom, 2006). It can be divided into stages, such as deal generation, initial screening, and second screening/valuation and due diligence, deal approval and structuring, post-investment monitoring, investment realization. Due to the difficulties faced by venture capitalists from entrepreneurs' search and decision processes and increased competition, deal generation strategy is important to a VCF. It is closely linked at the strategic level of venture capitalist' preferences of investment stages and deal size. Deal generation strategies are also linked to the availability of information and the recruitment of the executives of a VCF with specific skills to seek out transactions (Robbie & Mike, 1998). Due diligence evaluation (or screening) has a significant impact on financial return. According to Söderblom (2006), this stage includes "background check of the founders; competitive assessment of market players; market research into the size, composition, and potential growth of the firm's target market; investigations into the financial representations of the company's position; and so on." The valuation process is aiming to reach an agreement for the deal price. There are different methods for valuation, and the most popular one is prospective historic price/earning multiples in the UK, EBIT (Earnings before interest and taxes) multiples in the US and DCF (discounted cash flow) calculations in the continental European countries (Söderblom, 2006).

2.1.5 VC investments to cleantech development

Venture capital investment is a key driver in innovation. In Kortum & Lerner, (2000) the findings suggest that venture capital financed as much as 14% of all United States innovative activity. Venture capital allows entrepreneurs to undertake projects that are impossible with traditional bank finance. These undertakings create benefits for entrepreneurs, investors, industry, and ultimately consumers. Venture capital funds can provide required alternative financing. However, venture capital funds are highly selective with their investments, as those investments must present the opportunity to make large and rapid returns to fit well into a venture capital's portfolio. Venture capital funds are able to sustain this kind of high risk high reward investing because they assume that their projects will have a large failure rate, but their investments all have very large potential returns, so that while they have a large number of failed projects their portfolio can still deliver large returns (Silla, 2011).

VC firms as an intermediary function between institutional investors and enterprise enable capital from these investors to reach high potential enterprises. VC is also a critical link to provide continuity between business angels and expansion stages. In Europe, VC backed companies created 630,000 new jobs between 2000 and 2004. Furthermore, VC has been associated with economic growth. In addition, companies receiving VC also have a higher rate of patenting. For instance, VC-backed biotechnological firms obtain the large portion of awarded patents and approved drugs. The intensity of VC also facilitates the absorption of knowledge originated from universities and firms (UN, 2007).

Besides the financial capital that VC firms bring to their portfolio companies, they can also increase the value of portfolio companies by active involvements in the development of portfolio companies. The value includes active governance such as monitoring company behavior and performance, and providing strategic advice and network contacts to resource-constrained entrepreneurs. Moreover, VC firms can also provide assistance for the recruitment and professionalization of management, when it is needed to replace the original entrepreneurs with more experience managers. The reason that VC firms can influence the strategic and operational decisions of their portfolio companies is attribute to their significant board membership (UN 2007). According to Christensen (2009), VC is critical to the commercialization of new research into viable business.

According to the editor of cleantech magazine McIvor (2011), cleantech investment accounted for 23% of the US venture capital investment in 2010, which was 12% in 2007 and only 4% in 2002 (McIvor, 2011). VCFs as a big contributor of funding to new technology firms, can participate and influence the sustainable development of our world by investing in companies that aim at create a more sustainable future. VC is offered to the point where the development of product or service becomes commercially viable. In the development of information and biotechnology sectors, VC has already provided necessary aid (Saraf 2014). Cleantech innovations contribute to our world's sustainable development, and they definitely generate wealth for those investing the development of the innovation. The combination of VC and cleantech can realize new ideas, products and technology that support human being to achieve a more sustainable way of life (Nilsson & Pettersson, 2012).

2.1.6 Phases of company's investment lifecycle

According to (Makomaski & Johansson, 2013), a company's life cycle can be divided into three phases: seed phase, start-up phase and expansion phase. In seed phase, the costs are relatively low, but funding is needed for assets, forming and developing business concepts

and for research as well. Normally, the risks are high in this phase, and venture capitalists can get relatively low equity share. In the start-up phase, costs are much higher compared to seed phase, because a company in this phase needs to do market research, recruit people, and develop product. Therefore funding is needed to finance initial marketing and develop product. At this phase, a company begins to generate some revenues, but the revenues are relatively low. In the expansion phase, funding is needed to expand and grow. For example, funding can be used for product and market development, new additional people recruitment and increasing production capacity. This phase can be further divided into early expansion and later expansion phase. In early expansion phase, both production and sales are increased but companies still cannot generate profit. In later expansion phase, a company starts generate profit but extra capital is still needed to fund market campaigns, product improvement and further development of the business (Makomaski & Johansson, 2013).

2.2 Literature analysis

2.2.1 How to evaluate VC funds &PFCs' performance

This section will present the findings on how to evaluate performance of VC funds and portfolio companies. First, these findings can provide some background knowledge for audience to understand the terminologies. Furthermore, these findings can provide theoretical support on how the performance indicators were chosen to evaluate the funds selected for the study of this thesis.

Evaluation of VC funds: According to Phalippou & Gottschalg (2009), profitability index (PI) and internal rate of return (IRR) are the measures of funds performance. According to them PI is the ratio of the present value of the cash distribution to the present value of capital invested. In their opinion PI in general is the most meaningful economical measures. IRR is mostly used performance measures for private equity funds and is more popular among practioners than PI (Phalippou & Gottschalg, 2009).

Ellis, Pattni, & Tailor (2012) also claimed that two widespread measures are cash multiples and IRR. Multiples are typically calculated as the ratio of cash paid out to total funds that the investors supplied to fund mangers. There are three key measures of multiples, namely, distributions to Paid In (DPI) capital, residual value to Paid In (RVPI) capital and total value to Paid In (TVPI) capital. The advantage of multiples is that they are easy to understand. The disadvantage of multiple measures is that the timing of cash flows is not taken into consideration. IRR is the discount rate that ensures the net present value (NPV) of a series of (positive and negative) cashflows is equal to zero. However, in practice the interim estimates of returns must be based on implicit assessments of expected future cashflows. The major advantage of IRR is that it takes timings of cashflows into consideration. The main disadvantage of IRR is that it is too complex (Ellis, Pattni, & Tailor, 2012).

McKenzie & Janeway (2008) also stated that the most commonly used performance metrics are fund multiples and IRR. Fund multiple measures the total distributions relative to the total takedown. The study from Kaplan & Schoar (2005) shows a median venture fund IRR of 11% and a mean of 17%. The standard deviation is 34%. The study from Ljunqvist and Richardson (2003) showed a mean of IRR of 19.8%.

Evaluation of portfolio companies: According to Stankevičienė and Žinytė (2011), there are four mostly commonly used methods for start-up valuation, namely, discounted cash

flow, earnings multiple, net asset and venture capital method. However, it is difficult to apply these methods to evaluate new ventures. First of all the accounting information of new ventures is limited due to the fact of small operation, which results in difficulty of calculating cash flow. Secondly, there is no law requiring private firms to report financial information. Thus, it is difficult to collect and verify such data (Stankevičienė & Žinytė, 2011).

Robert (2004) reviewed all literatures on how to measure a company's performance. According to his review, growth rate of employees and sales are often used as metrics for a company's growth potential, and net profit is often used to measure a company's profitability. Robert (2004) claimed that growth is regarded as a critical performance dimension for new ventures. According to Robert (2004), sales growth is a distinct dimension of performance from profitability. Employee growth was the second most used performance indicator. Employee growth can indicate that the organization is adding critical resources necessary for its growth (Robert, 2004).

2.2.2 Obstacles for cleantech business

Cleantech sector has some different characteristics from other investment domains, such as being capital intensive, requiring longer times for payback and being regulation dependent. The typical factors impacting cleantech firms to get external funding will be explained in details in this section.

Difficult to classify: In practice, it is difficult to define whether a company is a cleantech company. Besides being an emerging industry, another reason is because the products and services of cleantech penetrate nearly all industries. Companies themselves also have difficulties to be sure whether they should be defined as cleantech. Cleantech has still not been established as a major industry or a sub-sector of an industry.

Long time horizon: timing is the essence of an investment decision, especially for new technology investment (Adenfelt, Sanders, & Stavlot, n.d.). VCFs describe time to exit as the first factor to be considered (Nilsson & Pettersson, 2012). Time-to-market is the time between start of product development and the market entry. Kajander (2012) claimed that time-to-market is an important concept for the future development of the cleantech industry. The future highly depends on the commercialization of the newly developed technologies and inventions (Kajander 2012). Kajander (2012) stated that governments and business perceive cleantech as high-risk investments due to its long and unclear time-to-market. For instance, cleantech companies may have longer cycles in terms of verification (Nilsson & Pettersson, 2012).

Timing is not only about product launch to market but also about penetrating the market, which is often underestimated. If too much time is lost, competitors can also introduce a product to the market and overpass the company a VCF invested, which result in worthless of the investment. As the time needed to reach market is difficult to evaluate, it is hard to estimate how much will have to be invested. The more time means more money needed. Cleantech, especially with a hardware, may require time longer than the usual 10 years, which is possible by investing in other sectors, to generate a desired return (Saraf 2014). Nordan (2011) claimed that the average time from investing to exit is eight years for a VC invested startup (Nordan, 2011). The money invested in cleantech has to be tied up longer than other industries. The long time horizon should be considered as an extra risk, because it has more possibility for failure in longer time horizon. Moreover, it means longer time of return for investors and more sunk cost if it fails. Lastly, if there is a requirement in VCFs, they may

have to sell the company at a certain time while the company is not performing very well. Therefore, it generates less profit for VCFs (Nilsson & Pettersson, 2012).

Capital intensive: Compared to investment in other sectors, like IT, cleantech investments are really capital intensive; especially at the beginning they demand a lot of capital (Nilsson & Pettersson, 2012). To get first deal, normally it is required for cleantech companies to show demonstration projects, which usually involves high investment (Nilsson & Pettersson, 2012). This is known as the demonstration risk, in which cases where companies have to demonstrate or test their technologies in pilot facilities in order to attract customers (Hillestad-Andréasson & Karlsson, 2010). Christensen (2009) also addressed that the amount of capital needed for cleantech, especially for energy sector is often substantial and more than VC firms willing to pay.

Lack of successful case: As being a young industry, relatively speaking, there are very few successful cases. According to Nordan (2011), VC investment in cleantech companies (CCs) only became substantial in 2006 and it is unlikely for increase in numbers of CCs go public in this decade (Nordan 2011). It is widely used to compare the company to be valued to similar projects. It will be difficult to find similar projects to be compared for cleantech sectors. Therefore, more uncertainties are created for the valuation (Nilsson & Pettersson, 2012). A survey from PWC showed that 70% of the respondent VCs admit that they need to support from external experts to make evaluation of innovation value of cleantech companies as VCs themselves lack industrial knowledge. The other surveys also showed that financial investors lack skills and knowledge on environmental issues. The difficulties to make a fair evaluation of risks and potentials of CCs may stop investors from investing at all (Nilsson & Pettersson, 2012). An interviewee from the study of (Adestam, Gunnmo, & Hedberg, 2008) also stated that due to limited knowledge and experience available for cleantech, the technical risk is higher.

Christensen (2009) also claimed that the VC firms are hindered to invest in cleantech due to the lack of history and success stories of exits. In emergent industries, actors are more sensitive to information on successes and failures. (Hillestad-Andréasson & Karlsson, 2010) stated the willingness of investing in cleantech is affected by the fact that the sector lack of successful reference cases, i.e. investments and companies that have gone through the whole process from investment to divestment and generate high return. Investors will be hesitant to invest in the sector if there are no enough reference cases. Since the cleantech sector is relatively new, which means it will probably take a couple of years for such reference cases to come along. This implies that investors may remain skeptical towards the cleantech sector for the time being (Hillestad-Andréasson & Karlsson, 2010).

Complexity for evaluation: The cleantech sector is very broad and cross many different industrial sectors, which cause difficulty and complexity for evaluation (Nilsson & Pettersson, 2012).

Information asymmetry: Information asymmetries between investors and entrepreneurs hamper investment in innovation and new technology adoption. The cleantech sector is particularly lacking a community to exchange information so as to reduce information asymmetries and transaction costs (Adenfelt et al., n.d.). Entrepreneurs claim that investors are lack of knowledge of the technology. While investors claim entrepreneurs are lack of business knowledge. If people have different information and beliefs, they will not recognize opportunities at same time. Thus, entrepreneurs may have difficulties in successfully communicating their innovations' expected potential and pitfalls (Grünfeld et al 2011).

Under these circumstances, investors may take adverse selection, which will lead to an inefficient funding gap (Adenfelt et al., n.d.). Disagreements might happen in different areas, such as amount of financing required, time to be profitable, value of future earnings, probability of success and discount rate (Sonnenschein & Saraf, 2013). Disagreements will lead to different opinions in the value of the company today and the shares of ventures equity VCFs can control (Nilsson & Pettersson, 2012).

Exit strategy: A successful exit is important to an investment of VCFs. For instance, if there are obstacles for cleantech companies IPOs, VCFs will hesitate to invest (Nilsson & Pettersson, 2012). Industrial companies are more helpful for ventures of cleantech sector. For instance, they can provide test facilities and be the first customers. A strong network with industrial companies is also an indication of a ready for exit market (Saraf, 2014). Adestam et al. (2008) claimed that the exit risk for cleantech is higher than other sectors as cleantech requires longer time to exit and there are fewer VCs active in this sector.

Dependence on policy: Cleantech market depends a lot on regulation and policy. Especially when the clean technology relies a lot in foreign market for commercialization, it more likely to take more resources to understand foreign regulations as different countries have different regulations (Nilsson & Pettersson, 2012). Cleantech sector is more sensitive to regulatory and political risks. Many cleantech companies build their business model based on favorable policies, such as subsidies. Therefore, it is questionable on how long the policies can hold and whether the business model is sustainable over long period (Nilsson & Pettersson, 2012). Cleantech Group (2013) also claimed that cleantech investments involve a great number of deals built on macro drivers around environment and resource scarcity issues. This leads to losses of relevance for private equity fund managers (Cleantech Group, 2013).

2.2.3 Factors impact VC funds' performance

This section will present the identified important factors that impact performance of VC funds. This part is based on literature review from Söderblom (2006), who carried out a literature review and summarized different factors impacting VC funds performance. The factors range from characteristics of portfolio companies and VC funds, investment process and management of portfolio companies to exit process and institutional and environmental factors. The factors, which were concluded as most important ones from Söderblom (2006), are reviewed here. Additional literatures supporting or disagreeing the arguments were also added.

Fund size: Söderblom (2006) claimed that larger fund size allows for larger initial investments and larger follow-on reserves. VCFs with too small funds are hindered themselves from following portfolio companies through in an aggressive expansion phase as it requires large amount of funding. Laine and Torstila (2004) found that due to a better reputation large VCFs have much higher rates of successful exit. Hochberg (2004) also supported this argument. Schmidt (2004) stated that fund size also determines the number of investments in its portfolio, which in turn reduces the diversifiable risk (Söderblom, 2006).

However, Kaplan & Schoar (2005) in their study concluded a positive but concave relation between fund size and performance. They claimed that when funds become very large, the performance declines.

Continuous success and importance of brand: According to Söderblom (2006), there is a 'persistence phenomena', which is the expectation that the returns of subsequent private

equity funds run by the same management team will be correlated. Fleming (2004) stated that there is strong empirical evidence that successful VC firms can perform better than their competitors over time. This is because the successful VC firms have some core competencies that cannot be easily imitated by others. Moreover, the experienced VCFs add more value than inexperienced ones from their reputation and understanding of business (Fleming, 2004). Kaplan & Schoar (2005) concluded that funds with good performance are especially favored in the fund raising process. Their studies also support the argument that the fund performance increases with GP's experience. GP's track record is positively related to GPs' ability to attract capital into new funds. The performance of a VC firm with outperforming record is more likely to outperform with the industry for the next (Kaplan & Schoar, 2005). Hsu showed that VC funds with a better VC brand can negotiate a better deal terms as entrepreneurs are more likely to accept a discount on valuation of their start-up so as to access more well-known VCs (Söderblom, 2006).

By contrast, Shepherd et al. (2003) argues that experience does not necessarily improve investments decision-making processes. VCFs with more experience may make decisions based on their experience, which cannot guarantee a higher return all the time.

Specialization in industry: Specialization allows VCFs to make more effective decisions to select right ventures for funding (Gupta & Sapienza, 1992). Robbie & Mike (1998) claimed that specialized skills of capitalists can take an enterprise to a new stage where new financial forms, corporate ownership and control are more appropriate. They also suggested that VCFs could use their specialized skills to overcome information asymmetries inherent in privately held firms (Robbie & Mike, 1998). According to Christensen (2009), there is a link between the degree of specialization and the building up of competencies. According to Söderblom (2006), specializing in portfolio companies (PFCs) in certain industry sectors, or development stages, seem to yield better returns to investors than others (Söderblom, 2006). Fleming (2004) cited Amit, Glosten, & Muller (1990) to support the argument that specialized VCF generates higher return by stating that specialized VCFs are more effective in selecting, monitoring and adding value to generate superior returns. This is the case where informational governs are important to understand the nature of risk and market opportunities. Specialization can provide cumulative knowledge that improves the investment decision-making process and lowers the required returns.

The result from analysis of De Clerq (2002) showed that VCF's specialized in a certain types of PFCs can provide more competent advice, which in turn reduce uncertainty. Specializing in a particular industry will allow for quick, incremental knowledge application, and may enable VCFs to become more directly involved in the key decision-making process of their PFCs. As a result, it reduces uncertainty related to knowledge-based factors and improves performance (De Clerq, 2002). Specializing in particular segments can stimulate the building up of skills in assessing investment proposals, monitoring and assisting management decisions after investment (Christensen, n.d.). Networks are necessary to support decision-making on screening investment opportunities, to monitor investments and to secure a deal flow. Networks are more important in cleantech industry, because most of the sales are B-to-B rather than B-to-C. This business model requires networks for entering into new market (Christensen, n.d.). Specializing in particular segments can also help to build networks, as networks, which are often very sector's specific, cannot be easily transferred (Christensen, n.d.).

On the other hand, Fleming (2004) argued that a specialist VC firm would have a portfolio with higher level of unsystematic risk because the individual companies will be related by

economic sector or stage. Contrarily, a non-specialist VC firm can decrease risk by constructing a portfolio of companies to diversify away non-systematic (or firm-specific) risk.

Regarding investment stage, Robbie & Mike (1998) stated that the VCFs specialized in a specific investment stage had a higher return. Gupta & Sapienza (1992) stated that VCFs focusing on early stage investments need specialized knowledge.

Investment stage: Many literatures support the point that investing in early phases involving higher risks and investing in later phases generating more profits. By comparing the internal rate of return (IRR) of UK VC funds, Murray (1999) concluded that early-stage investments performance is poor compared to returns from later stage investments (Murray, 1999). Kaplan and Schoar (2003) also claimed that later stage deals have less volatility than early stage deals. Adestam et al. (2008) stated that technical risks become less when investing in a later phase. Sarin, Das, & Jagannathan(2002) also stated that the probability of exit increases from early to later stage investments. According to their study, most of the late-stage investments can exit within 3 years, while only one-third of early-stage investments can exit within 3 years of investments (Sarin et al., 2002).

Gupta & Sapienza (1992) concluded the key reasons why early stage investments more risky than later stage investments are: more uncertainty of resolved demand, technical solutions of products and process design, resources (including skilled personnel, raw materials, and channels of distribution), management (such as leadership capabilities of the founder, compatibility and balance within the top management team, etc.) Murray (1999) stated that the sooner a VC could successfully liquidate an investment, the more attractive the project IRR would be. VC later stage investments tend to exit more rapidly than early-stage investments. It may take six to seven years for an early-stage investment to show a net profit. However, buy-outs, as relatively mature business, can generate positive cash flow from the first day of their ownership (Murray, 1999). Murray also claimed that the unit costs of managing the VC/investee relationship for early-stage funds are greater than later-stage funds (Murray, 1999).

However, according to Robbie & Mike (1998), the study showed that the returns depend to a great extent on the stage of investment and the early stage funds had a higher median IRR than later stage ones.

Geographical diversity: According to Streletzki & Schulte (2013), the disadvantage of focusing a certain location is that the number of choices is limited. Furthermore, the competition among VC firms is more intense. It is suggested that geographical focus should not be too narrow (Streletzki & Schulte, 2013).

Syndication¹: Fleming (2004) stated that syndication plays an important role in the venture capital investment process as it can provide portfolio companies with necessary skills appropriate to increase the possibility of success. Meanwhile, the close monitoring in a syndicated investment could decrease agency or business risk and increase the chance of

¹ Syndication is often taken to mean that two or more venture capitalists share a particular round of financing. Sometimes, however, the term is used more broadly to refer to situations where different venture capitalists invest in a given project at different times (Brander, Amit, & Antweiler, 2002).

successful exit. According to Söderblom (2006), syndicating has a positive impact on performance and can serve as multiple tools. These are risk diversification, information sharing, improving screening, increasing deal flow, gaining reputation for the firm's image, "window dress", where VC firms make syndication even though the financial returns are low but just to show potential investors an exit record.

Both Jääskeläinen et al. (2002) and Walz (2004) found that syndicated investments generate higher performance (Söderblom, 2006). Adestam et al. (2008) also support that syndication can reduce risks in many ways both when selecting investment and also after investments are made. By syndicating with others, a VC firm can share future financing requirements with its syndication partners. The possibility to successfully lead portfolio companies is also increased as all syndication partners can contribute different knowledge and skills. The negotiation power of VCs is also increased by syndication. Syndication can also create more credibility for exit and lower the risk for undervaluation (Adestam et al., 2008).

Although the majority of the findings support the positive impact about VC syndications, Fleming (2004) found a negative impact to return in Australia venture capital. He also addressed that in cases of later stage syndication for follow-on investment, a VCF may also use the information asymmetries between itself and the later investors to overstate the entry price (Fleming, 2004). De Clerq, (2002) also found that a negative impact of the degree of syndication at the initial investment round.

Screening: Schmidt (2004) claims that ability to select a few extremely well performing companies can generate a high average portfolio returns. This argument is also supported by the findings of Diller and Kaserer (2005), which claim that superior performance is caused by superior selection abilities (Söderblom, 2006).

Stage financing: stage financing refers to that VCs provide further capital after a portfolio company achieves predetermined goals, milestones or yardsticks. According to Adestam et al. (2008), a VC firm can get more information and monitor the development of a portfolio company by stage financing. This allows venture capitalists opportunities to reallocate resources or abandon a company without a bright future prospect. At the end, it minimizes the risks for big loss both for the portfolio company and for the VC (Adestam et al., 2008). UN (2007) also supported the argument that staging capital infusions can improve the effectiveness of managing uncertainties of investments. The management team of ventures can be motivated to achieve the milestones to obtain next round infusion of capitals. Moreover, VC firms are able to protect themselves by cutting their losses if they see a negative signal of the companies' performance or development (UN, 2007)

Skill set of investment managers: The skill set of VC firms' investment managers is another important success factor (Söderblom, 2006). The studies showed that European fund managers are more reactive than proactive (Megginson, 2004). Thus European venture capitalists add less value than their American peers (Söderblom, 2006). Sapienza et al (1996) stated that investors in the Continental European more often have a financial or banking background than their counterparts in the US and UK, who are often engineers or other technically trained professionals (Söderblom, 2006). While, the US VC firms have been well known for their skills in finding, nurturing, and bringing companies to market (Söderblom, 2006). Gottschalg et al. (2004) found that the more experienced a VC fund is, the higher returns can be. Diller and Kaserer (2005) also supported this. Zacharakis and Shepher (2001) mentioned that VCs are intuitive decision makers but this intuition develops through numerous venture investment decisions (Söderblom, 2006).

Active involvement in portfolio companies: UN (2007) claimed that VC firms could actively involve in their portfolio companies other than the provisions of financial capital. They can actively govern their portfolio companies, such as monitoring company behavior and performance. VC firms can also provide strategic advice and networks to entrepreneurs, which are regarded as the most valued contributions to ventures. VC firms can also support their portfolio companies to recruit and professionalize the management team. In this process, it is very often to replace the original entrepreneurs with more experienced professional managers who are better fit the needs of the venture (UN, 2007).

Exit: Coming and MacIntosh (2003) show that the exit strategy is also related to the quality of investments, and an initial public offering (IPO) generates the highest return (Fleming, 2004). The year of exit may also influence return of investment. A higher return is expected in years where the public markets are performing well (Fleming, 2004).

Partnership structure: The European VC funds are generally organized as investment companies under various laws, rather than as stand-alone limited partnership sponsored by specialist VC firms (Megginson, 2004). The sourcing of European venture capital funds are mainly from financial institutions and lesser from pension funds. According to (Megginson, 2004), governments have influence far greater than their share of capital might indicate, and the effect of the influence is generally harmful. The limited partnership form is very important for different reasons, such as tax benefits, flexibility of structure and terms, and its fixed life. Investors invested in a limited partnership can delegate investment and monitoring decisions of GPs (Gompers and Lerner 1999). They claimed that the limited partnership is vital to the operation of a mature VC market.

2.2.4 Status of cleantech in the studied countries

An overview of cleantech development and investments status in the four studied countries, Denmark, Finland, Norway and Sweden, will be presented in this section. This will help to understand how important of cleantech in these four studied countries and whether they are suitable for cleantech investments.

2.2.4.1 Cleantech development & investments in Denmark

Cleantech development: According to the Global Cleantech Innovation Index, Denmark ranked 5th in the overall index list in 2014, and 1st in 2012. Denmark is a leader in many fronts and outperforms on commercialization rate than the other top 10 countries. The top score of commercialized cleantech demonstrates a thriving cleantech industry in Denmark (Parad et al., 2014). Moreover, Denmark also ranked first for the absolute number of both companies and people employed in cleantech in the Baltic region. According to Oxford Research (2013), it was estimated that in 2010 approximately 22, 000 companies were in green production. The employees number was around 106, 000, which accounts for 8.5% of the total employees in Danish enterprises. The turnover of green production was about EUR 250 billion, corresponding to approximately 9.2% of total turnover of Danish enterprises. The green export was around EUR 11 billion, corresponding to 10.4% of total Danish exports (Oxford Research, 2013). The main sub-sectors in Denmark are utilization of renewable energy, better utilization of energy and waste management. Wind power, bioenergy and smart grids are regarded as the areas of business excellence in Danish cleantech sector (Oxford Research 2013). The other strongholds of cleantech in Denmark also include air pollution, filters, and catalysts, wastewater cleaning, etc. (Christensen, 2009).

Patenting is another evidence for the success of Danish cleantech industry. Denmark is particularly active in intellectual property right (IPR) protection. For example, Denmark overpassed all the other OCED countries in patenting renewable energy sources normalized both by GDP and overall patenting activities (Christensen, 2009). Furthermore, has also set the mechanisms that support cooperation between industry and/or academic actors. Denmark also has an advantage of the accessibility and quality of test facilities to test technologies. It has developed energy technology-, green-, and environmental- development and demonstration mechanisms to support industry in verifying ideas and building test facilities (Good, 2014).

According to CPH CC (2012), the emergence of cleantech start-ups and good track record of commercializing cleantech innovations in Denmark are attributed to the unique combination of supportive environment. Actors across all sectors in Denmark have strong belief in doing something for climate, water and energy. It has the largest public cleantech R&D budget relative to its economics. The number of cleantech clusters and government policies is also very high in Denmark, including ambitious green energy provisions until 2020 (Parad et al., 2014). Therefore, interest can be pulled in the same direction, which allows for more opportunities for Danish companies to develop. In Denmark, products and business models in cleantech are also much more advanced and mature (CPH CC, 2012). According to Good (2014), the strong home market for cleantech products in Denmark is another important factor for its success of cleantech development. The strong home market provides a solid base for Danish companies to expand internationally (Good, 2014). However, the challenge for Danish companies their home market is relatively small. Thus, additional resources are required to succeed in a new, bigger and more complex market as and they have to start export very early (CPH CC 2012).

Cleantech investments: According to Good (2014), Denmark is an attractive place to invest for cleantech in overall. Denmark has well developed technological and industrial strongholds in cleantech, and it is also ranked top in Europe for innovation finance. However, there is very little venture capital available to cleantech (Christensen 2009). According to CPH CC (2012), there are around 50 active investment companies and business angels in Denmark. However, very few of them focus on cleantech or are good at investments in cleantech. According to their analysis, the Danish venture capital cannot really match the strong performance of cleantech innovations, and a lot of entrepreneurs can face difficulty to get financing in Denmark. Some entrepreneurs also claim that it is not easy to obtain capital in Denmark (CPH CC, 2012). Christensen (2009) also claimed that the availability of venture capital in Denmark is relatively low in cleantech and the sector in Denmark has not attracted notable private capital.

Christensen (2009) stated that lacking success stories and exits hindered the growth in VC investments in cleantech area. Some specific segments in Denmark showed superior performance and market share, which is very attractive to VC investors. Indeed, the number of investments into these sectors is increased. However, the analysis showed the increase was solely because of the increase of foreign investors but not Danish ones (Christensen 2009). According to Christensen (2009), there is no VC fund in Denmark dedicated or specialized for cleantech segments. The major form is that VC firms invest part of their activities into cleantech sector. According to Christensen (2009), the reason for lacking of VC investments in cleantech is due to the immature of venture capital in Denmark but not lacking of industrial opportunities.

2.2.4.2 Cleantech development & investments in Finland

Cleantech development: Finland was ranked as the 2nd best after Israel in the Global Cleantech Innovation Index in 2014 (Parad et al., 2014). According to Oxford Research (2013), Finland has very strong R&D and innovation within cleantech. Around 2000 companies are working in cleantech sector, and 75% of them cluster in Helsinki region. Of these cleantech companies, 2/3 of them are planning for new investments, 88% are planning to expand to new markets (Oxford Research 2013). According to Cleantech Finland (2015), in year 2013, turnover of cleantech sector reached around EUR 25.8 billion, with a continuing growth rate of 5%. Although there is no number on full time employees working in cleantech sector for the whole country, Helsinki Business Hub shows that approximately 11,400 people were working in cleantech sector in the Helsinki area in 2011 (Oxford Research 2013).

However, according to Antkainene et al (2014) the full potential of Finland's cleantech business has not fully reached to its potential. There is a substantial growth potential, especially for start-ups and small and medium-sized enterprises (SMEs). In Finland, a few large companies dominated the cleantech sector, and the mid-sized companies are not as many as Denmark in cleantech sector. In 2012, the first 10 largest companies contributed more than 80% (EUR 20 billion) to the total turnover of cleantech sector (Oxford Research 2013). Within cleantech, the three main subsectors in Finland are energy efficiency, clean industrial process. Approximately 300 companies are under each of these main subsectors respectively. The other six subsectors are recycling, air protection, waste management, water resources management, measuring, analysis and automation, and consulting (Oxford Research 2013). Kajander (2012) also commented that numerous activities related to wind, biomass, clean processes and energy efficiency take place now in Finland, and the most active fields are renewable energy and electric vehicles.

Innovation policy has played an important role for the successful development of cleantech in Finland. The cleantech sector is one of the priorities of Finland's economic policy, and the government targets to make Finland a pioneer in cleantech. In 2012, the government launched the Strategic Program for cleantech. The goal of the program is to create 40,000 jobs within cleantech sector by 2020, and to double the turnover from EUR 20 billion to EUR 40 billion by 2018 (Finland, 2013). In general, Finnish innovation system is regarded as very successful. World Economic Forum 2013 awarded Finland as the most innovative business environment in the world (Antkainene et al.).

A SWOT analysis was conducted by the Finnish Innovation Fund to analyze the opportunities and challenges for cleantech development in Finland. The analysis results are shown as below:

“Strengths

- Good cooperation between companies, research and administration
- Demanding home market forces efficiency and innovativeness
- Strong technological know-how in several sub-sectors
- Good state of environment in international comparison
- Good surroundings for innovation created by goal-oriented and flexible regulatory policy of Finland

Weaknesses

- Environmental issues spread under several ministries from administrative view
- Lack of financing for start-ups

- Narrow home market
- Only few technology related services
- Unwillingness to pay for environment
- Unwillingness to take risks and go international

Opportunities

- Politically seen environmental technologies are an opportunity to improve competitiveness
- Internationalization of SMEs can have much potential
- Good level of know-how in systems and integration possibilities (for example in IT)
- Exploiting the good environmental reputation of Finland

Threats

- Shortsighted politics/ too strong emphasis on regional policy
- Stuck in the traditional successful companies and sectors
- R&D investments of companies reduced due shortsighted profit maximizing
- Inability to make a difference between matters that are more and less important for the environment”(Kajander & others, 2012).

From this analysis, we see that there are big potential of opportunities for cleantech investments in Finland. The strengths of cleantech development come from different aspects, such as the supportive home market, strong technical know in certain segments and good surroundings for innovation, etc.

Cleantech Investment: In general, access to capital is good in Finland compared to other European countries. However, the investments in cleantech are not as strong as for ICT. The public financing is recognizing and streamlining its public financial instruments to support high growth companies and to combine different elements for a longer track for companies requiring financing (Oxford Research 2013). There is a need for more growth capital for cleantech investments (Oxford Research 2013).

In 2013, the total direct investments in cleantech sector were 20 in Finland, and 11 of these were in Helsinki area. The investments were mainly in wind energy (wind farms), recycling, and consulting subsectors (Oxford Research 2013). The investors are mainly private actors and the biggest investors are from Sweden, Germany, UK, US and Denmark (Oxford Research 2013). According to Ernst & Young’s European Investment Monitor 2012, Finland is getting more and more popular for foreign investors (Oxford Research 2013).

2.2.4.3 Cleantech development & investments in Norway

Cleantech development: Despite being a wealthy country and having supportive policies in place, Norway only ranked as fourteenth in the Global Cleantech Innovation Index in 2014 (Parad et al., 2014). According to Oxford Research (2013), there were approximately 1,800 active cleantech companies in 2011, and the total turnover was around EUR 22 billion. The employees working for these cleantech companies were around 39,000 people. The major sub-sectors in cleantech in Norway are renewable energy (especially hydropower), power distribution and trading and waste management (Oxford Research 2013). The country’s renewable energy sector is not only hydropower but diversified with solar, wind, bio energy (Andersson et al., 2012). It is estimated that the value for cleantech export is approximately EUR2.6 billion including both service and products. Renewable energy dominates the export

with an amount of more than EUR1.5 billion. From the total amount of export, almost 40% was from solar energy, and another 25% was related to the export of electricity. The major export market is Europe (including Nordic countries), which is 34%. Asia is another big market with a share of 23% (Menon 2013).

Norway scores well on general innovation drivers, attribute to its strong innovation inputs and the above average entrepreneurial cultures. However, it falls below average for cleantech specific innovation drivers due to low support mechanisms for renewable innovations, low public R&D budgets and weak cleantech funds (Parad et al., 2014). On the other hand, the number of publicly traded companies, IPO and M&A is relatively high, which lead to a good commercialization of cleantech innovation (Parad et al., 2014). According to Good (2014), the percentage of innovative companies in Norway is the lowest compared to the other Nordic countries at 35%, where Denmark has 47%. These show that Norway has room for improvement in innovation and commercialization of clean technology (Good, 2014).

According to Good (2014), SMEs are regarded as the source of more disruptive and lucrative technologies in Norway, but fewer large companies do a lot of research compared to the average in Europe. However, Norway's system lacks focus on SMEs (Good, 2014). Norway focus more on the early stage technology development but less on market application and customer needs (Good, 2014). According to Good (2014), lacking suitable environment to conduct demonstration projects is one big obstacle for commercialization of new technology in Norway. As more than 95% of Norway's electricity is from renewable sources and the cost of the electricity is relative low, there is not a strong home market for Norway's cleantech companies. Furthermore, Norwegian cleantech companies also have to compete the home market with oil industry (Good, 2014).

Norway set a target in 2008 to be carbon neutral by 2050. To achieve such an ambitious goal, it requires the development of a various range of cleantech products to reduce its green house gas emissions (Good, 2014). There are incentives in Norway to focus on areas where they are already strong but need further development, such as biogas production, district heating and bio-energy programs. This is to promote the existing industry to develop towards a more environmentally stable production and market (Good, 2014).

Cleantech investment: The total raised funds decreased to the bottom in 2009 with a number of EUR 14.3 million. It increased gradually afterwards and reached to EUR 207.8 million in 2012, of which 97.5% were government raised funds. Seed investments reached to its maximum level of 2.1% in 2007 and dipped down to 0.1% in 2012. Yet, the total investments in energy and environment companies remained more than 30%, and reached the peak in 2011 of 52.9% (Saraf 2014).

IAccording to Grünfeld et al. (2011), the Norwegian venture capital industry is developed relatively well and seems to be able to recover from the financial crisis (Grünfeld et al. 2011). In 2012, the number of cleantech investments in Norway was 57 with amounting to EUR 2.3 billion in 2012. However, it is not clear how much of these investments are private. For the renewable energy sector, investments were typically from venture capital funds as organization. These venture capital funds are normally funded by the Norwegian state. For example, the investment fund Investinor is a typical this type of fund, and it accounted for nearly 50% of the overall investments in cleantech sector in Norway. Besides, the majority shareholder is the Norwegian state, most often Statkraft or the local municipality. Therefore, the total investment in cleantech is connected to state and municipal economy (Oxford Research 2013).

On the other hand, there are many applicant projects are either immature or do not have adequate financial support from private industry. Furthermore, the rate of return on private R&D in cleantech sectors is significantly lower than it is in Denmark (Good 2014). Good (2014) also claimed that Norway in overall lacks of private capital. One of the interviewees from private VC in Good's research (2014) stated that: "We can only do 25% or 45% for environmental technology and it is very hard to get the other 55%... It was easier in 2009. More people wanted to try this new thing. But now it is very hard. The venture capitalists they have used their money." (Good, 2014). Both the project viability and securing public funds can be impacted by the lack of capital (Good, 2014). Parad et al. (2014) also claimed that VC investments in Norway are below average even though there are a number of high-profile companies and environmental patents (Parad et al., 2014).

2.2.4.4 Cleantech development & investments in Sweden

Cleantech development: Sweden is ranked fourth for the overall index in the Global Cleantech Innovation Index (Parad et al., 2014). According to the index, Sweden scored well in all factors and was the first for the general innovation drivers. Many different factors contributed to the high rank of innovation drivers' scores, including strong innovation inputs, entrepreneurial attitudes, above-average public R&D, and large number of cleantech organizations. It also shows much evidence of emerging cleantech innovation, and it is also home for many high-impact cleantech start-ups (Parad et al., 2014). According to Oxford Research (2013), Sweden is on the top of the average size of cleantech companies in the Baltic Sea regions. There are many cleantech companies running in Sweden, around 3,500 to 4,000. Around 1,200 out of the total were exporting their goods, and the total amount of export was approximately EUR2.6 billion in 2005, which accounted for 2% of Sweden's total export (Nilsson & Pettersson, 2012). In 2011, approximately 75, 000 full time employees are working in around 1,800 cleantech companies in Sweden. The major investment subsectors of Sweden are wind power, biofuels, and waste handling, and the most competitive sub-sector is waste handling (Oxford research 2013).

In Sweden, SME's are the major companies in cleantech sector, and the employee number is less than 10. A large part of these companies are classified as micro companies with a turnover less than EUR 2 million (Hillestad-Andréasson & Karlsson, 2010). A big gap between 'evidence of emerging cleantech innovation' and 'evidence of commercialized cleantech innovation has already been identified. There are two possible reasons. One could be that the companies have not fully matured. The other could be that they have trouble to scale up efficiently. There is a concern for the venture capital in future years (Parad et al., 2014). According to Hillestad-Andréasson & Karlsson (2010), Sweden launched the Action Plan for Swedish Cleantech. One of the core ideas of the action plan is to improve the commercialization process of cleantech sector.

According to Peterson and Nielson (2012), the reason for Swedish cleantech companies standing out is because they benefit a lot from political instruments that can impact their growth. The set of instruments includes taxes, deposit schemes, subsidies, and so on (Peterson and Nielson 2012). They also claimed that the government agencies, such as the Swedish Energy Agency, provide a lot of contribution to the cleantech companies' development (Peterson and Nielson 2012). The Swedish Environmental Technology Council (Swentec) and the Swedish government claimed that Sweden is planning to be the leader in cleantech development and production to find solutions to environmental issues and to stimulate employment and increase export (Hillestad-Andréasson & Karlsson, 2010).

Cleantech investments: According to Good (2014), Sweden spends more money on R&D. In 2010, 3.39% of its GDP was spent on R&D. However, the return rate of investments in cleantech was 17.3%, which is not high compared to Denmark of 34.2% and Norway of 22.7% (Good, 2014). According to Oxford Research (2013), the average number of investments in Sweden for cleantech sector is 73 from 2007 to 2011, and the highest number was in 2008 with 90 ones. In this period of time, the average total value of investment was EUR 105 million in average, and the biggest was in 2009 with a value of EUR 170 million. Investments from VC in energy & environment companies have declined dramatically from 21.8% to 4.1% through 2009 to 2012 (Saraf 2014).

Hillestad-Andréasson & Karlsson (2010) also claimed that many Swedish cleantech companies have difficulties due to lack of capital. The early-stage seed capital is much lower. Oxford Research (2013) claimed that private venture capital has declined dramatically since 2007, especially for early stage investments. The challenge for Sweden is to direct its available early stage capital to the cleantech sector (Adenfelt et al., n.d.). It is also claimed that the investors in early stages become less now than a few years ago (Nilsson & Petterson, 2012). Private capital in 2011 accounts for EUR 63.2 million, and the institutional investments were around EUR 10.1 million (Oxford Research 2013). However, the main investors in Sweden are from Germany, USA and Japan, but the Nordic investors are not very prevalent in the cleantech sector (Oxford Research 2013).

2.3 Summary

The methods to evaluate a VC firm's investment include profitability index, internal rate return, fund multiples, etc. They all have their own advantages and disadvantages. Growth rate of turnover and employees are often used metrics for a company's growth potential, and net profit is often used to measure a company's profitability. The special characteristics of cleantech make cleantech difficult to get finance. These characteristics include difficulties to classify, capital intensive, lack of successful case, dependence on policy, different exit strategy, complexity for evaluation. VC firms are important to cleantech development, as they not only provide financial capitals but also provide strategic advice and network contacts. There are many different factors that can impact VC funds' performance, such as their specialization in industry, investment stage, geographical diversity, partnership structure, continuous success and brand, syndication, exit strategy and fund size, screening ability, management of portfolio companies, stage financing. The four Nordic countries, Denmark, Finland, Norway and Sweden are doing very well in terms of cleantech innovation. However, all the four countries have their strong sub-sectors in cleantech. On the other hand, Nordic VC funds are not very prevalent in cleantech investments in these four countries.

In the next chapter, the result on Nordic VC funds performance will be presented based on interviews and desk research. The reasons identified attribute to their performance based on comparisons from European funds will also be introduced in the next chapter. Recommendations will be also given based on the findings and analysis in the following chapter.

3 Findings & Analysis

In order to answer the research questions, data collection and analysis of cleantech portfolio companies and interviews with fund managers have been conducted. The data analysis was done to test how the portfolio companies are performing in terms of sales growth rate, profit and employee number. The interviews were done to further examine the performance of cleantech funds' portfolio companies and also to explore what the Nordic funds are doing differently from the European funds, which are considered to be more successful. The important factors for performance, which were identified in the literature review, were brought up in the interviews and are further analyzed below.

Fourteen Nordic private VC funds were identified as relevant for the study. They were thus identified by talking to experts and extracting data from CleantechScandinavia. CleantechScandinavia provided contact information for ten of them, eight of which contains both email address and phone number. The contact details of the other four were found on their website. First an email asking for an interview was sent out to all of the 14 funds. Then a follow-up email was sent out for all of the interviewees after one or two weeks after the first email. However, very few of them replied. Therefore a phone call was made to the others whose telephone number can be found.

At the end, six Nordic funds accepted to be interviewed. Four of them are from Finland, one from Sweden and one from Norway. Three of them are pure cleantech funds. However, all the three Danish funds refused the interview. All the three European funds that were contacted accepted the request for an interview. Table 2 is an overview of the positions of interviewees, the methods of interviews and the length of interviews.

		Position of interviewees	Interview Method	Length of the interview
Nordic Firms	1	Managing Partner	By telephone	30 minutes
	2	Partner	In person	1 hour & 15 minutes
	3	Investment Director	In person	1 hour
	4	Managing Director	In person	50 minutes
	5	Partner	By telephone	1 hour & 10 minutes
	6	Partner	By telephone	30 minutes
European Firms	1	Managing Director	By telephone	25 minutes
	2	Venture Partner	By telephone	1 hour
	3	Executive Director	In person	1 hour & 15 minutes

Table 2 the overview of participation of interviews

The interview questions covered the performance of portfolio companies and the funds, and how do they do in terms of the factors important to the success of VC identified in the 2nd part of this thesis. Some additional factors that were not covered in the literature review but identified from interviews. The detailed interview questions are attached at the end of the thesis as an appendix.

3.1 Performance of portfolio companies & fund

3.1.1 Analysis of performance based on interviews

During the interviews, some of the interviewees refused to comment on the performance of portfolio companies and some of them did not give a more specific expectation of return rate. Table 3 is the performances overview based on the understanding from interviews.

		Portfolio companies	Fund
Nordic Firms	1	Not commented	Target of four to six times of its investments
	2	3-4 are well performing	Target of 25% IRR can be achieved
	3	Two of them performing well	Performing well
	4		Performing well
	5	Only one of them not performing well	No answer
	6	75% of their portfolio companies are doing as good as planned	No answer
European Firms	1	Among exits, the lowest IRR achieved is 10%; highest is more than 100%	Target of 25% IRR can be achieved
	2	One to two stars	No answer
	3	Two flyers	Target of five times of its investments

Table 3 Cleantech investments performance overview from interviews

Based on the interview findings, it can be understood that one of the Nordic funds is not performing very well. This fund does not have any outperforming portfolio companies and only two of them are performing all right. The rest of the interviewees said that their fund could achieve their targets or are doing well. However, as some interviewees said the estimate

is still only on paper, the actual performance can only be assessed when portfolio companies exit.

3.1.2 Portfolio company performance analysis from desk research

As sated in the section 2, growth rate of employees and sales are often used metrics for a company’s growth potential, and net profit is often used to measure a company’s profitability. These data were extracted for the portfolio companies of the interviewed funds to analyze the potential of these companies.

Fund	Portfolio company	Growth rate 2010	Growth rate 2011	Growth rate 2012	Growth rate 2013	Profit K€ 2011	Profit K€ 2012	Profit K€ 2013	Employees growth rate 2012	Employees growth rate 2013
1	1	296%	95%	23%	10%	(790)	217	1,269	-12%	13%
	1	504%	-93%	1043%	33%	(861)	(928)	(1,021)	80%	33%
	2		-30%	270%	-59%	(1,511)	(1,556)	(1,557)	-15%	-52%
	3	6500%	586%	131%	191%	(309)	(323)	(298)	36%	33%
	4	-100%		-72%	-87%	(7,934)	(5,159)	(3,731)	-13%	-27%
	5		242%	165%	130%	(1,505)	(1,178)	(1,029)	-4%	0%
	6	312%	172%	74%	63%	(220)	(495)	(565)	42%	29%
2	7	6743%	-31%	-59%	5%	(411)	(7,311)	(6,443)	-34%	4%
	1	232%	-49%	-15%	-38%	(529)	(710)	(531)	-20%	13%
	2	124%	47%	29%	13%	(13,332)	(4,833)	(3,118)	-12%	-7%
3	3			-72%	-87%	(7,934)	(5,159)	(4)	-13%	-27%
	4			267%	-7%	(929)	(1,320)	(1,071)	50%	-33%
4	1	6500%	586%	131%	191%	(309)	(323)	(298)	36%	33%
	2	34%	81%	-16%	-30%	(2,891)	(5,531)	(6,380)	13%	-27%
5	1	124%	681%	-62%	21%	184	(1,754)	(1,621)	113%	-7%
	2	-82%	28%	6%	1011%	(194)	(185)	(641)	-3%	213%
	3	70%	17%	-2%	36%	(534)	41	62	-22%	-2%
6	1			15%	11%	273	(2,283)	(1,957)	-5%	-16%
	2	13%	19%	13%	103%	246	137	(319)	8%	81%
	3	6%	5%	6%	-28%	5,965	5,815	2,025	0%	3%
	4	17%	117%	4%	-56%	3,004	(279)	(2)	-2%	-4%
	5	20%	-9%	-12%	-31%	664	(81)	(4)	-4%	-25%
	6		9%	15%	2%	1,190	1,481	1,567	8%	-3%
6	7	-1%	-100%		11%		69	665	-49%	0%

Table 4 Portfolio Companies' turnover growth rate 2010-2013, total profit 2011-2013, growth rate of employee 2012-2013

Note: Not all portfolio companies of the interviewed funds are included due to data availability; the source data were extracted from Swedish, Finnish, Norwegian’s business service website, and links to these websites are included in reference; the highlighted ones are with positive growth rate of turnover and employees, which are regarded as well-performing companies.

From table 4 we can see that each of the funds has one or more portfolio companies that are growing very fast in terms of turnover and with a trend of growth in employee numbers except the 3rd fund. It only has one company growing in turnover but the employee number is decreasing. Furthermore, the growth rate of turnover is not very high compared to other fast growing companies.

3.2 Characteristics of the funds studied

The literature on fund size reveals a positive relationship between fund size and fund performance. Moreover, large funds have a better reputation. The VC’s that have a strong brand can have better deals with portfolio companies. Table 5 shows a comparison of Nordic funds and the European funds from interview results.

	Fund size (Million EUR)		Establish year	
	Criteria	No. Of funds	Criteria	No. Of funds
Nordic funds	<=50	3	Before/in 2007	4
	>100	3	After/in 2010	2
European funds	<=50	1	Before/in 2007	3
	>100	2	After/in 2010	0

Table 5 Characteristics of the funds

From the table above, we can see that there is also one European fund is smaller than EUR 50 million. It is not necessary that small funds cannot be successful. However, this European fund mainly invests in software, which is less capital intensive. On the other hand, one of the smaller Nordic funds mainly invests in hardware, which results in a small portfolio number. As a result, it cannot diversify risks. One of the interviewees also confirmed that fund size is a factor impacting the success of investments. Since the management fee is based on percentage of the fund size, smaller size fund has less money to operate. Furthermore, the smaller funds have to operate with smaller number of staff, but the bigger funds can afford more staff.

The three European funds were established in or before 2007, when the cleantech became a very hot topic to invest. As established earlier, they may be better known in the cleantech sector and attract more good potential companies. One European VC supported this hypothesis in the interview by saying that their firm is better known as they were one of the earliest VC funds in cleantech.

The results from the performance review and the interviews seem to support the findings from literature review that fund brand is positively related to fund performance. The smaller size of funds can limit fund operation, which impact fund performance at the end.

3.3 Characteristics of investments

The review of existing literature found that specializing in a certain industry allows VCF’s to make more effective decisions to select right ventures to fund, which improves the fund performance. Furthermore, the literature review revealed the argument that later stage investments involve less risks, and that a broad geographic distribution helps to diversify risks. Table 6 is an overview about the focused sectors, investment stage and geographical diversity of the studied funds.

		Focused sectors for cleantech	Investment stage	Geographical diversity
Nordic Firms	1	Do not take cleantech differently from other sectors, but only technology-related	Early stage	Nordic +some other countries within Europe
	2	Very specified area within cleantech	Early growth stage	Mainly one Nordic country +one other European country
	3	Certain area within cleantech	Early growth stage	Nordic countries
	4	Do not take cleantech differently from other sectors, but only ICT-related	Investing in different stages	Own country+ one other Nordic country
	5	Not only in cleantech but only energy related sub-sectors within cleantech	Early stage	Own country
	6	Certain sub-sectors within cleantech	Mature companies	Nordic countries
European Firms	1	Certain sub-sectors within cleantech	Early growth stage	Europe Focus Scandinavian +two other countries
	2	Different sub-sectors within cleantech	Early growth stage	Mainly Europe
	3	Different sub-sectors within cleantech	Early to mid stage	Europe

Table 6 Characteristics of Investments

From Table 6, we can see that most of the funds specialize in a certain area for investment. However, there are some differences in the level of specialization as some of the funds have a very specific investments area, while the others have a broader range. Although two of the Nordic interviewees said they have their focus area of investments, there are some companies in their portfolio outside their focused area. The focused investment area must be decided based on the fund management’s competence, knowledge, network, etc. When they do investments outside their focus area, it is more likely they to invest outside their strength area.

One of the interviewees from a European fund addressed the importance of focus. The interviewee said that “...we have a very very clear focus on what type of companies we want to invest, and

therefore we can easily select companies that we can challenge about, and we can quickly decide which one to take. I think it's all about focus. It allows you to understand the industry very well" (pers. comm. 2015). However, another interviewee said investing in different segments could spread risks *"... not to lock yourself in one segment. You need to spread your investments through out cleantech. In the Nordic market, if you only invest in one segment, it would be hard to find more than one company"* (pers. comm. 2015). But at same time this interviewee agreed to the importance of knowing the technology. However, he was confident that this knowledge could be built through the network that knows the segment very well or with internal experts.

There are also some difference in focused segments between European funds and Nordic funds. Two of the European funds said they do not invest in energy generation segments. The reason is because the energy generation sector is too capital intensive; therefore it is not easy to scale up. One interviewee said, *"Energy generation is very tough, especially from IRR perspective. They are all capital intensive. I would question it is a good investment areas from financial perspective. The financing risk is too high... On the generation side, it's capital-intensive solution. Their scale up require a lot of money, and everybody is careful with what to do with money... that's not a good place to be from an investor's perspective"* (pers. comm. 2015). Some of other interviewees from Nordic funds also claimed that cleantech segments are very capital intensive. That's why these funds avoid investing in such segments in cleantech.

An interviewee from a fund investing in early stage agreed that it is more risky to invest in early stage. The mitigation plan for managing this risk from the fund is to invest little in many companies and be more selective to choose companies. Furthermore, it invests by stage and checks the milestones before next round of investments. However, the only Nordic fund investing in mature companies said 75% of their portfolio companies are doing well. This rate is quite high compared to the interview results of the others.

In terms of geographical diversity, the European funds invest broader than Nordic ones in general. According the interviewees, the outperformers of their portfolio companies are from outside of their own country. This is an indication that investing broader geographically can increase the opportunity of having better performing companies. By investing in broader geography, it can also help a fund build networks. As a result, it can help its portfolio companies when they go abroad. Moreover, it is important for Nordic companies to be able to go abroad because the Nordic market is small as mentioned by some of the interviewees.

The results from the performance review and the interviews seem to support the findings from literature review, as most specialized funds performed better than non-specialized ones. The geographical diversity of investments seems also positively related to performance. On the other hand, I did not find clear evidence that later stage investments are less risky, as most of the interviewed funds investing in later stage.

3.4 Investment process

During interviews, some of the interviewees addressed the number of companies they review each year to make decisions for investments. The literature on venture selection highlights that that selecting a few high performing companies could increase average return. Selecting from a large numbers probably can increase the possibility of finding high performing companies. Therefore a question about the number of companies reviewed per year was added to the interviews. Literature review shows that stage financing can minimize risks. The question was raised to all the interviewees. Regarding investment criteria, each firm has criteria in different aspects, and all of them mentioned they evaluate based on technology,

market, and management team. Only the factors addressed by the interviewees or what they mentioned that was different from the others are presented here. Table 5 is an overview of the interview results on these three factors.

		No. Of proposals reviewed/year	Stage Investment & max. Investment	Investment criteria addressed
Nordic Firms	1	450-550	Yes- EUR 8 million	Growth potential for international market
	2	200	Yes- EUR10 million	Very thorough and detailed criteria and has more than twenty criteria for evaluating companies
	3	50-100	Yes- EUR 10-15 million	Profitability of IRR>25%
	4	500-600	Yes- EUR 10 million	Scalability
	5	100-120	Yes- EUR 2.4 million	Unique technology; scalability
	6	300	Yes-	Turnover above a certain amount
European Firms	1	500	Yes-	Business model
	2	600	Yes- EUR 5 million	Revenue above a certain amount; environmental impact, Intellectual property (IP)
	3	400	Yes- >EUR15 million	IP state; management team

Table 7 Interview Results -Investment Process

Table 7 shows that the three European funds review more proposals each year than most of the Nordic funds, especially than the pure cleantech funds from Nordic countries. The fund, which is not very successful, has the smallest number of proposals reviewed each year. Reviewing a large number of proposals can increase the possibility of accessing good companies, and it allows for a comparison of companies with similar technology. One possible reason for them to access more deals is as mentioned that these firms are more known because of their long history. During interviews, one of the European funds mentioned that the partners of their fund are very active in different associations or organizations. This increased their visibility and also knowledge of new technology. This can also contribute to their access to more companies. Another possible reason is the broader investment geography is broader, which can also increase the potential interested ventures.

Regarding stage investments, all the studied firms make stage investments. However, the maximum amount invested in one company is different from fund to fund. One of the European funds with bigger fund size still invests much less compared to most of the Nordic funds. By investing less in one company, it can increase the number of its portfolio. This is also means it can have a higher diversification of risks.

There is only one Nordic VC firm that addressed the forecasted return rate of companies to be invested as investment criteria. As stated in part 2, it is difficult to calculate IRR, as there are so many uncertainties to forecast cash flow. The other funds have a stronger focus on the potential of the companies rather than only looking at the financial performance. Each firm identified different factors important to their investment decision but these factors are typically not the calculated return forecast.

From the interviews on investment process, it seems that the big number of proposals reviewed can contribute to the better performance of a fund. Investing a smaller amount to one company can diversify risks. Different focus of investment of criteria can impact the performance of funds.

3.5 Management of portfolio companies

The literature on the background of VC firms highlights that US VC firms, which have more non-financial or banking background, are better known for their skills in finding, nurturing and bringing companies to market. The option to replace management team members was mentioned by the European funds, so this question was also added to the interviews and follow-up questions. Table 8 is an overview of the background of the team of the VC firms, supports to portfolio companies and chances of replacing management team of portfolio companies.

		Background of team	Support provided	Replacement of management team
Nordic Firms	1	Mainly financial background	Financial decisions; choosing service, fund raising	Very often
	2	Mainly industrial background	Not only on finance but also in management consultancy, etc.	> 70% cases replaced more than three members in the team
	3	Financial background	Network connection; strategy, operation	Happened but seldom
	4	A team focus on international market access	Support portfolio companies into international market	Replaced CEO in 30% of the cases
	5	Mixed but Mainly business background	Only in strategic decisions	>70% cases replaced management team
	6	Mixed	Only in strategic decisions	No answer
European Firms	1	Mixed	Support portfolio companies for business development	Replaced in all cases over time
	2	Mixed	No answer	Replaced in all cases over time
	3	Mixed but mainly business background	Not covered in interview	Most cases strengthened the management team by adding experienced people

Table 8 Interview Results-Management of Portfolio Companies

From table 8, we can see that the members of one Nordic VC fund are purely from financial background, and this is the fund not performing very well. It is necessary to have some industrial or business background to understand the ventures so as to make right decision to select which company to invest. Furthermore, funds with more industrial or business background can also provide more support to portfolio companies for strategic decisions and connecting to market. Last but not least, their industrial background can also help them to build network for future exit options. One of the Nordic funds has a team focusing on helping their portfolio companies to enter into international market. As the interviewee said “the market access team improves investments by selecting the best deals, building market with customer markets, attracting additional investors, and facilitating exits” (pers. comm. 2015). From this, we can see that the supports VC firms can provide are more than financial capitals.

Regarding support to portfolio companies, most interviewees said they provide support more at a strategic level through board membership. One of the Nordic firms mainly provides support on financial decisions, as their background is mainly financial. However, the other firms with more mixed backgrounds can provide support in more different areas. The other Nordic fund, with more financial background, also provides support in other area, like in operation. However, this is the firm not doing well in the overall fund performance. The other support mentioned by one of the European firms is helping in business development. The other Nordic firm provides support to access to international market by its own market access team. The support they provide can guide portfolio companies. VC firms have been involved in many different ventures, and they probably have more experience in strategy development than entrepreneurs. Their inputs to strategy can be very helpful. However, the entrepreneurs are more dedicated to the business, they probably know more on how to run operation. Therefore, involvement in operation cannot help increasing the portfolio companies' performance.

The entrepreneurs maybe good at forming business ideas, but may not good at managing a company, or it requires different skill set of management during the development. It is also possible that the investors and entrepreneurs have total different views on the future development plans. VC firms, who can identify the gap between the competence of ventures management team and the requirement from strategy development, can increase the possibility of good performance of portfolio companies. One of the interviewed Nordic funds said it seldom replace the management. Instead this firm sold its shares of its portfolio company once when it has different view of future development. This can be an indicator of whether the VC firm can identify the gap and whether they have the power to change. However, the two of the European funds have replaced management team in all of their portfolio companies along the investment process.

The results from the performance review and the interviews seem to support the findings from literature review that non-financial or banking background fund can perform better. Replacing management team of portfolio companies is also a commonly used method of managing portfolio companies. The different support of funds provided can also contribute to the success of a fund.

3.6 Exit Strategy

The review on the existing literature found that exit strategy is related to the quality of investments, and an IPO can generate higher returns. Table 9 is the overview of the exit strategies of the studied funds and their readiness for exit.

		Plan for exit	Considered exit when investing	Network with industries
Nordic Firms	1	Mainly trade & sales	Was not covered in interview	Know the industry very well
	2	Mergers & acquisitions	It is planned in very early stage	Know the industry very well
	3	Trade & sales	Not planned in early phase	Has not been focusing on building network but developing portfolio companies
	4	Mostly trade & sales	Was not covered in interview	Was not covered in interview
	5	Trade & sale	Point of exit is important	Difficult to have industrial buyers
	6	Trade & sale/IPO	Exit strategy is one criteria for investment decision	No exit yet
European Firms	1	Trade & sale	Exit strategy is one criteria for investment decision	No answer
	2	IPO; trade & sale	No answer	Was not covered in interview
	3	IPO; trade & sale	Was not covered in interview	Difficult for industrial sales

Table 9 Interview Results- Exit Strategy

Only one of the Nordic funds considers IPO for exit. On the other hand, the two European funds have planned to go for IPO for the portfolio companies. The Nordic firms limited their choices and probably a more profitable choice for exit, if they do not plan for IPO. There are three reasons mentioned by the interviewees for not considering IPO. One is because the revenue is too small to go for IPO due to the small and immature market for cleantech. The 2nd one is because the final return depends on the portfolio company's performance after listing due to long lock-up time. The 3rd reason is because of the uncertainties due to the dependence on market condition. It has been addressed by a few of

the interviewees that it is not easy for the portfolio companies to go for IPO in Nordic countries.

Regarding the other methods of exit, the mostly adopted strategy for Nordic firms is trade and sale. One of the interviewees from Nordic firms said it does not plan much in advance for exit and has not been focusing on building network for potential buyers. Another interviewee from Nordic firms claimed it is difficult to have industrial buyers for cleantech as the potential buyers are not mature or big enough themselves. The interviewee said, *“This is the problem for renewable energy and cleantech. There are no very rich companies that want to buy it.... Utilities do not want to own the companies. Some of them can be very rich, but they are not interested in being the owner”* (pers. comm. 2015). This shows the difficulties for exit in cleantech investments, as the potential buyers are limited.

One of the interviewees from the European funds stated that the exit time is very important for investments. *“...It all depends on the time of your exit... The exit of the company depends on when it has proven certain aspect of its business, the appetite of the market at the moment to acquire something, and at that timing of the appetite of the market, and then the proven point of value that has been created. That what determines where you can go? Sometimes something happens in the economy, you have to wait for a year and half because nothing happens”* (pers. comm. 2015). From this statement, we can see that timing of exit is important for a VC investments and it can be impacted by many other factors.

The results from the interviews shows that the regarded successful European funds take IPO as an important exit strategy, but the Nordic funds seldom consider it. It is difficult for industrial sales for cleantech investments, and not all of the Nordic funds have built network for exit.

3.7 Other findings

In the following sections further factors that influence the performance of portfolio companies and cleantech funds are presented. These are all factors that have not appeared as key success factors in the reviewed literature and include the structure of limited partners (LPs) and scalability.

3.7.1 Influence of LP's

Most of the LP's for Nordic funds are institutional. Most of the interviewed funds confirm that they can make their own decision on investments, and institutional LPs do not impact their decision. However, interviews with some other experts argued that government's money has some impact to investment decisions such as how risky the sector is and where to invest. One interviewee admitted the reason why it can only invest in its own country is because it is bounded by the agreement with LP's. The other interviewee also said if they have LP's from industries, it might make difference.

On the other hand, all the three European funds have LP's from industries. The industrial LP's can bring value to the success of their investments not only by brining knowledge to the VC firm but also building networks. However, one of the interviewees from Nordics had a different opinion. He argued that a fund probably would have to focus on the sectors where the industrial LP's do business.

3.7.2 Scalability

Some interviewees claimed this is a factor that impacts the performance and is also one of the criteria for their decision. If the technology is capital intensive, it will be very difficult to scale up. This means needs more investments and also takes long time to go to market. As mentioned before, if it cannot be launched into market very fast, it will also impact the exit strategy. For example, it will be possible to decrease the possibility to go IPO. Scalability can also impact the timing for exit. Since the market value for the company can be impacted by its market share and revenue, VC firms cannot sell it at an ideal price if the firm cannot scale up. Thus one of the interviewed European funds only invests in software but not hardware, and this fund is relatively small compared to the other European funds. There is also one Nordic fund that only invests in ICT sector, as the interview from this fund said ICT is easily to scale up. This fund is relatively big, but it enables the fund to have more companies in its portfolio by investing less capital-intensive segments.

One interviewee claimed that time to market is very important to the success. Otherwise competitors can come and take over. “*You should have low CAPEX². I think time to the market is the key*” (pers. comm. 2015). From this we can see that the interviewee regards time to market as an important factor to be successful. However, the capital attached to the technology can determine the time to market. If the investments are less capital intensive, it is more likely to go for market.

² CAPEX: capital expenditures

4 Conclusions

In this section, I will revisit the research questions and draw conclusions based on the findings from last section. Furthermore, I will give some recommendations to the target audience base on this research and identify areas for future research.

4.1 Discussion of research findings

The discussion of my findings is structured with the help of the research questions that I introduced and motivated above.

1. How do the Nordic private VC funds investing in cleantech perform financially?

Based on interviews and desk research of the portfolio companies' performance, one out of six Nordic funds is identified not performing well. For the rest of the Nordic funds, the interviewees claimed that they could achieve their target return rate. There are some companies in their portfolio growing fast in turnover and with a stable or growing employee number, which are two factors can be a sign of successful companies.

However, the overall evaluation of fund performance was based on interviewees' self-evaluation. Moreover, the data of growth rate of revenue is about four years, and an up and down trend has been seen for the cleantech companies. Although there are some companies that have potential of growth, the performances of portfolio companies are not equal to a fund's success. Many other factors can impact the performance of a fund, like the above mentioned exit timing, management costs, etc. As stated by some interviewees, their expectations cannot represent the final results. The interviewed funds have not fully exit from their investments yet, so no conclusive judgement can be made on whether they are performing well or not.

Even the regarded successful European VC funds also have some portfolio companies not performing well. However, they have several flyers, which can make the overall performance of the fund successful.

2. Why do they perform successfully/unsuccesfully?

There are some possible reasons are identified for the un-success of one of the Nordic funds. The size of the fund is relatively small. Due to the small size, the fund has smaller management fees. Thus it does not have more money for operation, such as having more staff from different background, building more expertise to do investments in different segments. Due to the less investments track record, it probably less known to cleantech companies, which does not allow it to attract more companies. From the small number of proposals reviewed each year, it probably not able to attract big number of cleantech companies.

Although the size of this fund is relatively small, the investment areas are not very specialized. Furthermore, most of its investments were made in capital-intensive cleantech segments. Although this fund also makes investments by stages, the maximum amount investing in one company is relatively high. Therefore, it cannot invest in many companies to diversify risks.

The backgrounds of the team members of this fund are mainly from financing. This is probably one of the reasons that this fund focuses on forecasted IRR, which is normally impossible to make very accurately. This is also the only fund claimed it involves in operations in some of its portfolio companies. Since this fund does not have much background in operation than financing, it is probably better to let the portfolio companies do the operations themselves. Instead it can replace members of the management team, if it finds the portfolio management does not perform well or fit for the company development. However, this fund very seldom replaces management team of portfolio companies.

Regarding exit strategy, this fund does not consider it in very early stage and does not build network specifically. As most of the interviewees claimed exit is an obstacle for cleantech investments, it probably will impact the performance of the fund without a well-planned strategy for exit.

3. Do the most successful European funds perform differently, and if so, how?

The Nordic funds and the European funds are doing similar for some of the factors identified impacting fund performance, such as investing by stages, evaluating from different aspects for investments decisions. However, there are also some difference are identified from research and interviews.

The interviewed European funds are bigger than Nordic ones in general. The European funds were established earlier than most of the Nordic ones, and the European funds invest more broadly than all the Nordic funds. These probably are reasons that they can have more proposals to review each year.

Not all European funds are specialized in certain segments. However, they only invest in the segments, which they have knowledge either from in-house or through the networks they have. On the other hand, the European fund with a smaller size focuses on only a certain segments. From the performance of the funds, it cannot be established that those focusing on early stage is not doing well. However, the regarded successful European funds mainly invest in the early growth stage mostly. Some of the Nordic funds invest in the early stage. However, according to interviewees they are aware of the risks of early stage investments and have strategies to deal with it.

Regarding investment criteria, each fund reviews potential companies for investments from technology, finance, management, market, etc. However, the interviewees addressed different focus area. Business models, IP state, and management team were addressed more by the European funds. Two of the European funds also have more experiences with replacing management teams of their portfolio companies.

The background of the European funds is more mixed than most of the Nordic funds. With different backgrounds, they can understand the business deeper and can provide better support to their portfolio companies. Some European funds mentioned that they also support their portfolio companies for business development. With diverse background, it probably can also have more networks to help their portfolio companies for business development.

Most Nordic funds do not consider IPO as an exit strategy, but the European funds are more open with IPO. Some of the Nordic funds know the industry very well for exit, but some of them have difficulties with potential buyers. There are some disadvantages for IPO,

but a VC firm should not exclude it from its exit strategy. If trade and sales is the planned strategy, the network should be build as early as possible.

In summary, it cannot be concluded that Nordic cleantech funds are not performing well. The regarded successful European funds are doing different in some aspects than the Nordic ones. There are many different factors impacting the performance of VC firms, a firm cannot outperform if it only performs well in one factor. How to manage its funds, each VC firm has to make its own strategy based its fund's characteristics.

4.2 Reflections on research design and methodology

For this study, the selected funds to be studied were based on preliminary interviews both for the Nordic and European ones. This way of selection is not very objective. Where there are more accessible data, it should evaluate all Nordic VC's investment to identify cleantech investments. However, there are also different definitions of cleantech as stated in chapter 2. For this study, the data about the number of cleantech VC firms are obtained from Cleantech Scandinavia. The data could be different, if it is obtained from other organizations. The regarded successful firms are also subjectively selected. However, mainly due to data availability and amount of work, it is impossible to evaluate all European VC firms.

It can be seen that there is a lack of research on the performance of Nordic funds' cleantech investments, thus the research questions are legitimate. However, for the 1st research question on how the Nordic VC's cleantech investments are performing is not fully answered due to the reasons stated in previous sessions of data availability and confidentiality. The other two research questions are answered. However, the studied number of funds is limited. Therefore, the conclusions cannot be generalized.

The portfolio companies' performance cannot fully determine the performance of a fund. There are many different factors can make them different, such as the exit point, VCF's exit strategy, policy stability, the market development of the sector, etc. However, in general the good performing companies are more possible to generate a higher return than bad performing ones. The comparison of how European cleantech funds are doing differently from the Nordics can be applied to other studies as well. If they are carried in other regions, the same factors can be evaluated to find differences.

4.3 Conclusion

To conclude, one out of six Nordic VC funds was found not performing very well. This fund does not have any company in its portfolio with potential of growth and making profit. The remaining five funds have portfolio companies performing well. However, we still cannot conclude that these funds are performing well as they have not fully exited from their portfolio companies.

From the study it can be seen that the smaller the fund size is, the more likely it is to be unsuccessful as the budget for operating the fund becomes smaller. However, smaller size funds still can be successful by focusing on less capital-intensive sub-sectors within cleantech. Unsuccessful performance can also be a result of non-specialization in investment segments. To be successful as a non-specialized fund, the management team has to have relevant expertise, either in-house or external, and strong networks.

Having a big number of proposals can positively impact fund performance. Although the four Nordic countries are performing very well in cleantech development, a Nordic fund, specialized in certain segments, limits its access to a large number of proposals if it only invests in Nordic countries. The more well-known a fund is the easier it is to attract more proposals. When making investment decisions, there are many criteria to be considered. However, focusing on forecasted IRR as investment criteria cannot guarantee a high return for an investment.

Active involvement in portfolio companies can improve a fund's performance. The active involvement also includes replacing management team members in portfolio companies if they cannot meet the development needs of the company. However, involvement in operation of portfolio companies cannot ensure a better performance. The skill sets of VC fund investment managers are also important to for performance. A VC fund with diverse background is more likely successful.

IPO is an option for exit, but it is not very often considered by Nordic funds in cleantech investments. To exit portfolio companies successfully, a fund needs to consider the exit strategy when investment decisions are made. As trade and sales is the major exit strategy and potential buyers are difficult to find for cleantech, it is important to build networks. Industrial LPs can provide knowledge and networks to a VC fund, which also enhances fund performance. As cleantech in general is capital intensive, the scalability of the invested technology can impact fund performance.

In short, it cannot be said that Nordic funds are not performing well in cleantech investments. There are many factors that can impact the performance of a VC fund investing in cleantech.

4.4 Recommendations

Since there are many different factors impacting the performance of VC investments, a VC firm has to make its own strategy based on the characteristics of its own fund. The following suggestions can be considered for VC firms in cleantech investments, especially for the Nordic ones:

- Consider investing in less capital intensive cleantech, such as ICT-related cleantech or service for the funds with a small size;
- Invest in the cleantech segments for which there either is in-house expertise or there is a very strong network that can help to understand the technology and make strategic decisions;
- Increase the deal flow by expanding investments either in different segments or in different geography;
- Expand sources of fund especially from industries than mainly from institutions when raising new funds;
- Get more flexibility in terms of investing geography and term of the fund;
- Consider other macro factors impacting cleantech investments, when evaluating a business cases, for example, whether a business case is profitable without subsidies;

- Evaluate the scalability and potential for international market when making investment decisions as to overcome the fact that Nordic domestic market is small

It is necessary for most cleantech companies to get finance, and VC is one of the most important vehicles for finance. Moreover, VC firms can also provide support other than financing. To be able to get more support both in financing and in other supports, the Nordic cleantech companies can:

- Consider how to achieve a profitable business model instead of focusing on technology only;
- Plan to enter the international market if the Nordic market is too small for its product or service;
- Choose VC firms, which know the industry very well and can bring in more value than financing only;
- Leverage the knowledge and network of the VC investors, but keep it at strategic level;

Although LP's are not directly involved in VC funds investment, they are important to the VC funds. To achieve a profitable VC funds, the LP's or potential LP's from Nordics can:

- Allow more flexibility for VC funds in terms of investing geography so as to catch more profitable companies;
- Be more active, if they can provide more support to VC funds, such as network building, expertise in technology, etc.;
- Continue or start to support the cleantech investments, as it is not as the impression that cleantech funds are not performing well.

Clean technology plays an important role not only to achieve environmental targets, but also triggers economic development. Although in the Nordic countries, the cleantech innovations are developing very well in general, the national government or institutions at Nordics level can further support the further development and expansion of cleantech companies.

- At Nordic level, it should establish or appoint an organization to evaluate the performance so as to provide a benchmark for the VC firms in Nordic region. This kind of evaluation can also be anonymous but it still can provide VC companies a benchmark;
- Promote more cooperation at Nordic level so that Nordic firms can get access to deal flows easily;
- Since one of the risk factors in cleantech investments is the stability of policies to support the cleantech development, the national governments should make long-term plans and policies.

4.5 Contributions to literature

No literatures have been found at Nordic level to evaluate the performance of VC cleantech investments. This study showed a general overview on the methods could be used to evaluate VC investments and illustrates the difficulties of obtaining the required data. Furthermore, it provides an indication about the performance of Nordic cleantech VC funds and does not support the view that Nordic VC funds in cleantech are performing significantly worse than other European funds.

4.6 Suggestions for future research

Regarding the investment process, which is very critical to the success of an investment, this study has covered what aspects the interviewed VC funds evaluate, like the strategy, the management team, and the financial status of a potential investment. However, if the time allows with the VC investors, specific study can be carried out. According to Csazar et al (2006), there are many different factors that can be evaluated in each of these three aspects. For example, in strategy aspects, it can include value offered, size of market, sustainability of competitive advantage, other assets and legal issues. The management team can be evaluated through experience of the founding team, investors, capital availability, and motivation. In the finance aspects, it can evaluate the realistic cash flow, positive indicators, and sensitivity of scenarios (Csazar, Nussbaum, & Sepulveda, 2006) (Csazar et al 2006). A more specific study can be carried out to check which detailed factors the VC firms evaluate and how they evaluate them.

It is also very interesting for future studies to investigate how the performance record impact VC's to raising fund for cleantech investments. Since exit is a big obstacle for cleantech investments, further study can be done on why it is not common for cleantech companies to go for IPOs, if they go for IPO in foreign market, whether the cleantech VC firms and cleantech companies are ready, and how can they get prepared strategically.

Since most of the studied cleantech funds are exiting their investments in a few years, it will be interesting to do a similar performance evaluation at that stage. At that point of time, it should be easier to get return data. The study can test whether the return rates are aligned with performance of portfolio companies. If not, what are the other factors can impact the return rate.

Nordics countries are top-ranked in terms of cleantech innovation. However, based on some interviews the cleantech investments are not very successful. This study is trying to look at VC investments from an investors' perspective. Future studies can also be done from the cleantech companies' perspective. It will also be interesting to investigate what can impact commercialization of a good technology. Furthermore comparisons to other countries, like the US, can provide new insights in order to see how the cleantech companies are doing differently and to gain a win-win situation with investors.

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Appendix I

Interview Guide with VCs

I. Introduction:

- 1) Introduction of the study:
- 2) Introduction of the interviewee:

II. Facts & Evaluation:

- 1) What are the characteristics of your funds?
 - i. Fund size and major investors;
 - ii. Founded year;
 - iii. Core competence and syndication
- 2) What are the characteristics of your investments? What are the focused sectors, stage, and geography?
- 3) What does your investment process look like?
 - i. Deal generation strategy: number of proposals reviewed each year
 - ii. What are important criteria for investment decision;
 - iii. Infuse capital by stages? What is the maximum amount for one company?
- 4) How are your portfolio companies of cleantech performing?
 - i. What kind of performance measurement do you use, eg. IRR?
 - ii. How are they look like for both exit & current ones;
 - iii. If they are not performing well, what do you do with them;
- 5) How do you manage portfolio companies?
 - i. What are the background of your fund's VC managers;
 - ii. What kind of support do you provide;
 - iii. Whether the start-ups have sufficient skills for management, and have you ever replace them?
- 6) What are your strategies for exit?
 - i. What's your plan for exit strategy;
 - ii. When do you start to plan for exit;
 - iii. Network with industries for trade sales

III. General:

- 1) Do you see cleantech investments differently from other sectors?
- 2) What are important factors for the success of your investments?
- 3) What macro factors (e.g policy, oil price, etc.) impact the performance of cleantech investments?