

Understanding public venture capital in the cleantech sector

Opportunities and challenges in the design of public VC instruments

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Abstract

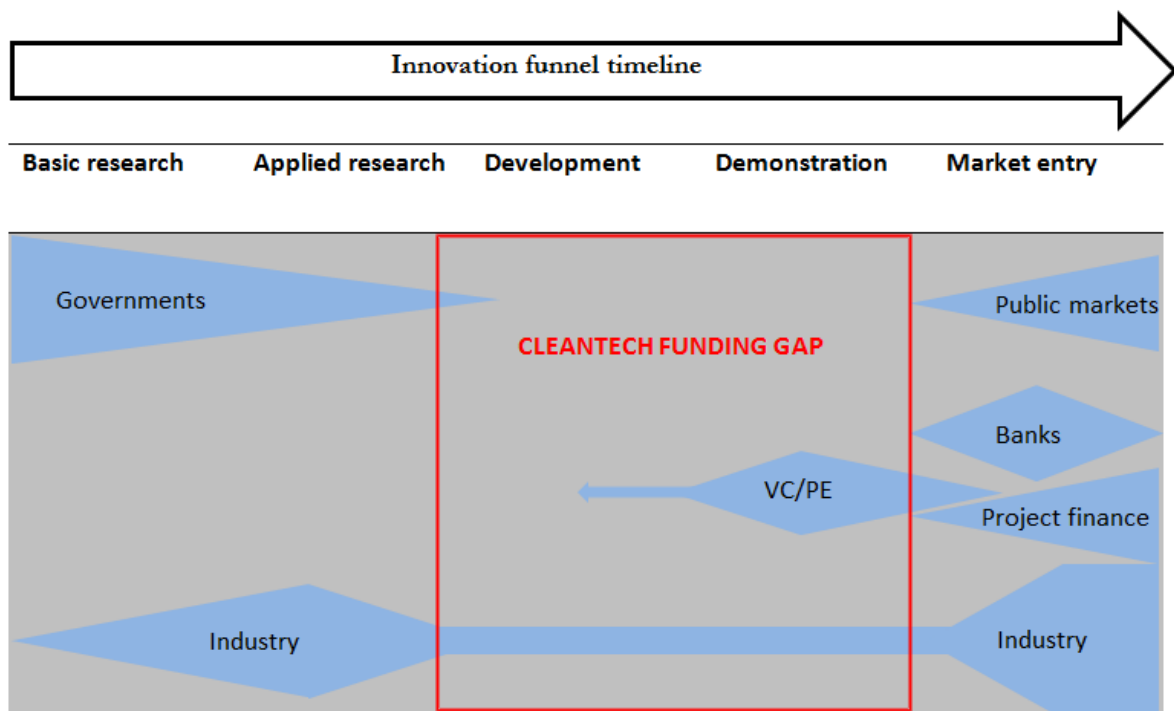
The world is currently facing a number of large environmental challenges, and cleantech is pointed at to be one of the best potential answers. However, in the winds of a financial crisis, shifting capital markets and rapidly growing information technology sector, the cleantech segment currently finds itself in a disadvantaged situation where the direly needed early-stage capital is not finding its way to the cleantech start-up companies. Arising from the situation is a funding gap which governments increasingly try to react to by getting involved in venture capital funding. This study is a response to a defined knowledge gap on how these public VC instruments should be set up in order to spur self-sustained investments in the early-stage cleantech venture market. The author used the OECD guidelines for public venture capital as a framework and looked at four different international cases of public VC involvement and conducted a number of interviews with experts and stakeholders. The findings from the open ended interviews were coded and categorized into relevant topics. In the analysis the author combined the cases and the interview findings according to the OECD guideline criteria in order to look for best practices and obstacles in public VC instrument design. The study concludes that it is difficult to generalize public VC instrument design as there are many contextual factors involved. However, the study also concludes that the shift in the provision of private VC affects how these instruments should be designed. Further the study concludes that the stage of the cleantech venture chain to be targeted also affects public design incentives. Finally, the study implies that special attention should be given to additionality considerations and that there is a rather untapped source of 'knowledgeable private VC' seeking more than just direct investment profits.

Executive summary

Cleantech, or cleaner technologies, are mentioned to be one of the major factors in shifting human activities on earth from perishable to sustainable. Cleantech is defined as technologies that have a higher benefit to the environment than already existing technologies. These can for instance be energy efficiency technologies, material reducing technologies, technologies that require less toxic chemicals, or renewable energy technologies to mention a few.

One of the main drivers of new technology development, such as cleantech, is venture capital funding. This can be described as injections of capital into businesses that are developing or that have developed a new product, ensuring that the company has the money to further develop the product and to grow in the marketplace. In the last 4-5 years there has been a shift in who provides the venture capital to the young businesses, especially in the cleantech sector. Venture capital funding has been a function of private actors, investing money in not fully developed businesses in order to create rapid growth and make a profit by holding a nominal share of the company's equity. As mentioned, in the later years, there has been a shift where the private actors are becoming less and less active in the cleantech early stage segment which has left a funding gap.

Figure 1.1 The innovation funnel and the equity gap of cleantech. (Sources: Canadian Funding Gap, SDTC, 2013)



This funding gap of cleantech has led to a need for governments to step in and cover the previous private capital spendings with public money. Behind this lies the rationale that the gap is a result of a market flaw causing cleantech ventures to receive the short end of the stick while more established technologies, such as oil & gas and other common energy technologies are not affected to the same extent. The shift has also led to governmental worries when it comes to the monetary distribution, or in other words; how to get the best 'bang-for-the-buck' in terms of how governmental money should be spent to increase the number of new cleantech ventures.

In order to address this problem the author of this paper looked at 4 different cases of public venture capital funding, representing the UK, Norway, Germany and Finland. Further, interviews with representatives from the different public funding mechanisms were conducted, along with interviews with topic professionals and other stakeholders. Further, the study analyses the information given by the interviewees and the cases through the lens of 4 OECD guidelines for public venture capital funding in the high-tech sector, plus a criteria added by popular demand revolving around legal aspects.

The cases showed different approaches to public funding of early-stage cleantech ventures, ranging from the large and broad equity funds to smaller and more narrowly focused grant programs. Interestingly, all cases tried, in one way or another, to encourage private capital coming in to the ventures alongside with public capital. All funding programs also emphasized the importance of sectorial knowledge and networks within the sector. The cases also show different ways of public intervention in the market, with particular focus on how they view their own additionality in terms of 'only filling the gap'.

The interviews were conducted in a semi-structured manner, allowing the respondent to focus on what they thought was relevant and important. The answers revealed a broad consensus that the major problems for early-stage cleantech ventures were:

- Long time to market
- Lack of funding (especially long-term funding)
- Negative history in regards to public interventions

The availability of private capital showed to be a big issue, and the interviews claimed that:

- Private capital is available, but in different ways than before
- There has been a shift in the focus of private VC; going from early-stage to later stage
- ...but also that larger sums of capital is available outside of the Nordic countries

A boundary for the early-stage cleantech ventures is to attract the available capital. On this note, the interviewees were asked how this could best be done. Their major claims were that:

- It is hard to attract private capital in isolation
- There is a need to overcome the distrust in public policies by the investors
- Not all investors have monetary goals when they invest in cleantech
- Match-funding has proved to be easier

In addition to these claims, the interviewees also pointed out that organizational capabilities, such as having a big and professional network is very important. It was also mentioned that a funding model cannot be copied because of contextual differences between the countries, that time and a clear mandate is crucial when a programme is established because both time and maneuverability is needed when a programme seeks its place in the market, and that the people working on the public side within these programmes should have experience with developing and exiting venture companies.

Finally, it was noted that legal aspects could be limiting for the profit of public VC because additionality and state aid puts limitations to the amount being invested and the size of equity being owned by the public programme or venture company.

The analysis showed that design considerations are important in terms of what approach the public programmes or entities should use when trying to attract private capital. This shows especially for very early ‘due diligence’ screening and for the size of the networks. Also, the analysis suggests that design should consider the context of the private capital available. An example is how industry in Germany has a tradition with venture funding, while industry in the Nordic countries does not. This suggests that these kinds of considerations are very important.

The analysis also suggests that public funding should not be limited to one stage, as several interviewees noted that the entire ‘venture capital bridge’ was linked together and that one part would not function without the other.

Further, it suggests that the shift in private VC focus, from private venture companies to sector-knowledgeable industry leads to a more trusting investor market as private VC will carry more insights to what they are investing in than their successors; the general venture capitalist.

The analysis also uncovers that additionality should be considered very carefully when designing the public VC instrument. This is because additionality can be limiting to the portrayed ‘success’ of public VC, but also because it can be accounted for in various ways. More thorough thought should be given to what it means for public capital to be truly additional.

Having private involvement in public VC programmes can be seen as important and difficult. Important because it allows for a result oriented focus of public capital, an difficult because the incentives for private actors managing public capital are not ideal for the cleantech segment. Because private management companies are given a remuneration based on the size of the funds they attract, they are incentivized to attract as large funds as possible, and not adding development value to their portfolio companies.

The study concludes that there is no ‘one way’ or best practice when it comes to public VC instrument construction. However, the study does find that there are a number of different factors that influence how public VC instrument design should be set up, and a number of approaches that are suitable to remedy those factors First of all, the study concludes that in order to attract private capital it is necessary to know what kind of private capital the instrument is going to attract. The analysis show that the investment incentives for industrial VC and „normal“ VC companies might differ because of different interests. The study also concludes that because there is a shift in the VC market where normal VC has fled the cleantech sector and industrial investors and business angels are getting more involved in the same sector, public VC instruments should respond to this by not only focusing on for instance fund profit Other important conclusions and recommendations are:

- Match-funding is looking most plausible in the current market
- Attention should be paid to state-aid argumentation and to additionality
- Public interventions in the form of VC funding in the cleantech segment should aim to decouple private and public VC, not make public VC a prerequisite for private capital.

Keywords: Cleantech, Public venture capital, Policy instrument design

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1 Introduction

“...Clean tech manufacturing is a great business opportunity and an essential element for getting onto a sustainable development path. But if Europe wants to get back into the race it needs new and ambitious goals to pull its clean tech manufacturing to new levels of performance, and to stay competitive in the 21st century economy” Jason Anderson, Head of Climate and Energy Policy WWF Europe

The global environmental challenges of today are of a significant scale. Our continuously increasing population and our quest to meet the needs of all adds a growing strain on our natural resources and natural environment. As a consequence we are facing major challenges such as depleting natural resources, food shortages, lack of clean water, soil degradation and toxification, and human impacts on the climate (UNEP 2013). As one of many important responses to these challenges, cleantech has been singled out to be a key element in overcoming these obstacles. Cleantech (also referred to as CT), can be defined as an activity which develop, produce or implement new or improved processes or products which contributes to production of renewable energy or materials, reduces use of natural resources, reduces harm caused by fossil fuels, or reduces pollution through products, processes or advice (UNCSD UN-Report, 2012); or put in a more simplistic manner: technological efforts that mitigate environmental harm. Such technologies include everything from photovoltaic panels for the capturing of solar energy to hose nozzles for saving water when cleaning slaughterhouse work stations. Looking solely at the manufacturing of clean energy technology however, it is observed that the market sector has been, and is currently, outgrowing global GDP. Though having an impressive global growth, the market is maturing and growth stabilized at 11% in 2011. However, the forecasts predict that the total clean energy technology market in 2015 will be in the area of EUR 240 and 290 billion; in fact catching up with the oil and gas equipment market. (WWF 2012) Important to notice on the other hand is the global distribution of where the cleantech growth is strong. As of 2010 China has been the number one country when it comes to cleantech development, accounting for 49% of all global cleantech initial public offerings (IPO's), with the US and Europe trailing behind at 2nd and 3rd place respectively. Interestingly, China was behind both the US and Europe in terms of receiving international and domestic venture capital funding, so called high-risk capital, with US\$410 million, making it the third largest cleantech market in the world. As cleantech is a matter of innovation and carrying a venture to the market, the situation cannot be explained merely by low-cost manufacturing in China (Ernst & Young, 2010). This mismatch between investments and successful IPO's suggest that both the US and Europe are failing to provide the same bang-for-the buck as China, which further could indicate national policies that do not operate or function effectively to generate the desired outcome; CT companies on the market that make a profit, gain market shares, create jobs and inflict environmental benefits while doing so. Venture capital (VC) for developing and nurturing the cleantech industry is being pointed at as one of the main drivers for innovation and successful CT enterprises (Gompers & Lerner, 2004), and public policies are among the main facilitators of VC investments (Ernst & Young, 2010). Alongside being the facilitator of external private investments, the government also increasingly invests public capital into CT ventures to adjust for the current lack of private capital going into the sector (Collen & Lidgren, 2012). This trend gives the government multiple roles in cleantech venture funding, acting as a facilitator, investor, public stakeholder, and possibly shareholder in CT venture equity. Holding a complex position in CT venture capital funding, the government face multiple challenges in terms of delivering a direct support policy to make cleantech a successful proliferating sector. This thesis will explore some of those challenges and seek to find a remediation or best practice through case studies and interviews and draw from several European experiences.

1.1 Background

Why cleantech is important

Facing such environmental challenges as increasing consumption, waste production, energy use, climate change, and an overhanging challenge of transitioning from fossil to renewable energy sources does challenge the reach of technology. Part of an answer to deal with these challenges can be attributed to cleaner technologies. The World Economic and Social Survey of 2011 states that major investments are needed and will be needed in the future in order to scale up renewable energy production, climate-proofing infrastructure, reducing waste production and making food production more sustainable. The report estimates that investments in the scale of USD 1.9 trillion per year will be required in order not to compromise the sustainability of our planet. (UNCSD- UN Report, 2011) As a response to international unification in regards to these problems, companies and corporations have started to look towards the transformational opportunities that come along with the global transition. In relation to this and according to an Ernst & Young report (2011), a segment which is being held up as the most important is cleantech. In the same report, E&Y foresees that cleantech will grow rapidly as companies move away from value technologies and aim for breakthrough technologies that can open up completely new streams of revenue.

Cleantech venture capital

Venture capital, often mixed with private equity, is high-risk capital invested in early stage business or product development. Its bigger brother, private equity, is an active form of investment which often aims to better the operations of a company that is not listed on a stock exchange over multiple years. Hence, venture capital is a kind of private equity, but with focus on early stage businesses. (EVCA 2012) The rationale behind a VC investment is to, at an early stage, provide a company with capital in exchange for equity so that the company can develop a technology, service or general business idea to the point where the company reaches market and can generate a profit for the investors. A VC investor often diversifies his portfolio (group of companies) over a wide range of technologies or markets in order to reduce the risk of his investments.

Generally speaking, global venture capital as a whole has been on a downwards slope the later years with a decrease of 20% in 2012. In a European perspective the decrease was 16% the same year, but also showing a shift towards later-stage investments. The financial unease regarding the Eurozone and the tightening of the financial market in terms of new regulations (e.g. the Basel III and Solvency II Directive) has made capital more expensive in more ways than one, hence decreasing the will to invest in VC's. (Ernst & Young, 2012) Following the decline of private capital, governments started to invest the larger share of the VC funds, hence making themselves the major player in cleantech venture capital funding. This is in particular true for the Nordic countries and most European countries.

The hurdles of cleantech and governmental problems in addressing them

The funding gap of cleantech, or so-called "Valley of Death" (see Figure 1.1), is described as the notorious enemy of cleantech caused by the industry's inherent long-time-to-market problem. The technological development is regarded as quite capital intensive, hence making

both difficult and sometimes undesirable for investors to invest. At the same time, commercializing a never before used technology is noted to be a challenge that even further delays market entry. Also, to understand the situation of the CT industry, consider this example given by the Green Alliance, UK: an executive manager for a major oil company was asked why he so easily could invest a substantive sum of money in a new oil technology that would not pay back in ten years or more. The reply was simply that he knew people would use the product (oil) he invested in also in ten years. (UK Green Alliance, 2013) It is a lot easier investing in technology that is aimed at delivering something known to be desired or used in the future than investing in technology with high market uncertainty. This uncertainty is directly transferable to risk, a limiting investment factor to most investors. Also, there is uncertainty where in the venture chain the public should focus their efforts. Should public funding for cleantech target more R&D or should later stages, like demonstration and commercialization be the main objective for public VC? This question is indicative of uncertainty whether more money for R&D will generate the desirable ventures needed to attract private VC, or if public support should be aimed at later stages, like commercialization and demonstration. (Private Communication, 2013) This question poses one of the major challenges to governmental cleantech intervention, and is debated heavily (DN-Debate, 2013).

1.2 Purpose and Aim of the study

1.2.1 Purpose

The purpose of this thesis is to add to the current knowledge on how policies for public VC funding of cleaner technologies can be carried out in an efficient way. Having the current understanding that public funding for early-stage cleantech ventures is not a one-size-fits-all system; the author believes that it is beneficial to explore the functionalities within intricate funding models in order to best be able to construct a better working public funding system for cleantech in the future. While not undermining its' importance, the purpose of this study is not to elaborately explain the full context of every funding system, but rather look at determinant factors that are relevant on a more general basis.

1.2.2 Aim

The author aims to do so by looking at some international cases of public early-stage funding for cleantech, getting inputs from stakeholders, determining good practices and obstacles with the individual cases, and finally provide a number of recommendations on what a public VC policy for cleantech funding should take into consideration.

1.3 Research question(s)

How should governmental VC instruments be constructed in order to spur increased and self-sustained cleantech investments?

- (I) How can public investment instruments be constructed to attract and leverage private capital?
- (II) How can national and supra-national regulations affect the operation of public VC instruments?

1.4 Methodology

In advance of this thesis, a preliminary literature review was conducted in order to establish the main problems related to the topic, as well as for the sake of determining the areas on

which to focus. The author considered three main issues when arriving at the problem definition. It was first noticed that (1) there is an existing funding gap in cleantech and that (2) governments are increasingly spending public capital to cover the diminishing private investments, making themselves the main investor in the sector. Further it was noticed that there are multiple variations in which way governments fund the cleantech venture sector, and also variations in level of success, which made the author wonder (3) what the role of governments should or could be in the scenario at hand. On the background of this, the author's logic was to see whether it was possible to find a set of good practices and notable limitations based on multiple different learning cases in a European context.

After the initial literature review, the author chose a number of countries to find case studies in. The reasoning behind choosing the specific countries was to have both Scandinavian and European examples, hence covering both small-region and large-region contexts and views. The countries chosen were Germany, the UK, Norway and Finland. Germany was logically on the list because of their success in establishing and running two consecutive large-size cleantech venture funds. UK was chosen because of their innovative public governance in relation to cleantech funding, Norway because they were one of the best in cleantech in Scandinavia up until recently, and finally Finland because of good connections with TEKES, the Finnish funding agency for technology and innovation.

As this study addresses venture capital funding for the cleantech sector, and not one type of venture capital funding for cleantech, the author chose to select case studies that not necessarily had the same approach in order to get a wider view on the subject.

Having established the main question at hand and the countries to look at, a literature review was conducted. The author deemed that this thesis topic is bilateral, dealing with two principal issues; public governance and financial systems. Hence, literature from both areas was looked into. The purpose of the review was to establish what is currently known about governmental funding systems in relation to cleantech (covering both public governance and financial theory). Emerging from the review were a set of topics which are relevant in the context of public funding for the cleantech venture sector, and these were again used as criteria, or framework, for the analysis section of this paper. In addition to the criteria defined by literature, one criteria regarding legal context was added upon request by the initiator of the public funding for cleantech project.

The data collection was based on two main methodological approaches: interviews and literature search on the cases. Having a defined problem and a defined set of criteria emerging from the literature review the author set up interviews with a number of people, representing various roles in the complex cleantech funding system. The roles represented in the interviews were fund managers, cleantech venture consultants, public cleantech venture fund/grant officers, public policymakers, and cleantech business owners. This was done to get a holistic perspective of the issue.

The interview questions were carefully tailored to fit the interviewees, acknowledging the different perspectives and knowledge prevailing within their respective working roles. The questions were also guided by the criteria defined by the literature review, enabling the answers to be used for benchmarking/comparison in the analysis. The questions had two main objectives; letting the interviewee express his or her opinion on certain issues, and to get additional information on a specific case. Further, the interviews were semi structured and open ended, allowing the respondent to develop the answer in the direction he or she saw natural. The author did however have a distinct idea of what he wanted from the

interviews; hence follow-up questions were asked if the respondent did not answer the original question. Follow-up questions were also asked when the respondent developed an answer providing new information to the author. The author also chose the interviewees based upon an idea that it would be beneficial to interview someone who had connection to the instruments in question, plus to get the external view of experts on the field.

The interviews were then transcribed in detail and prepared for qualitative coding. Emerging from the interviews as a whole was a set of topics that had come up in one or more ways. These topics were made into headings under which the author sorted the different coded statements. Since the questions for the interviews were guided by the analytical framework, the topics, or headings, emerging from the interview answers could be compared to the framework.

In the analysis, interviewee findings and case data was merged and addressed under the appropriate heading in the framework. From this it became possible to unravel some of the main factors in terms of public VC instrument design.

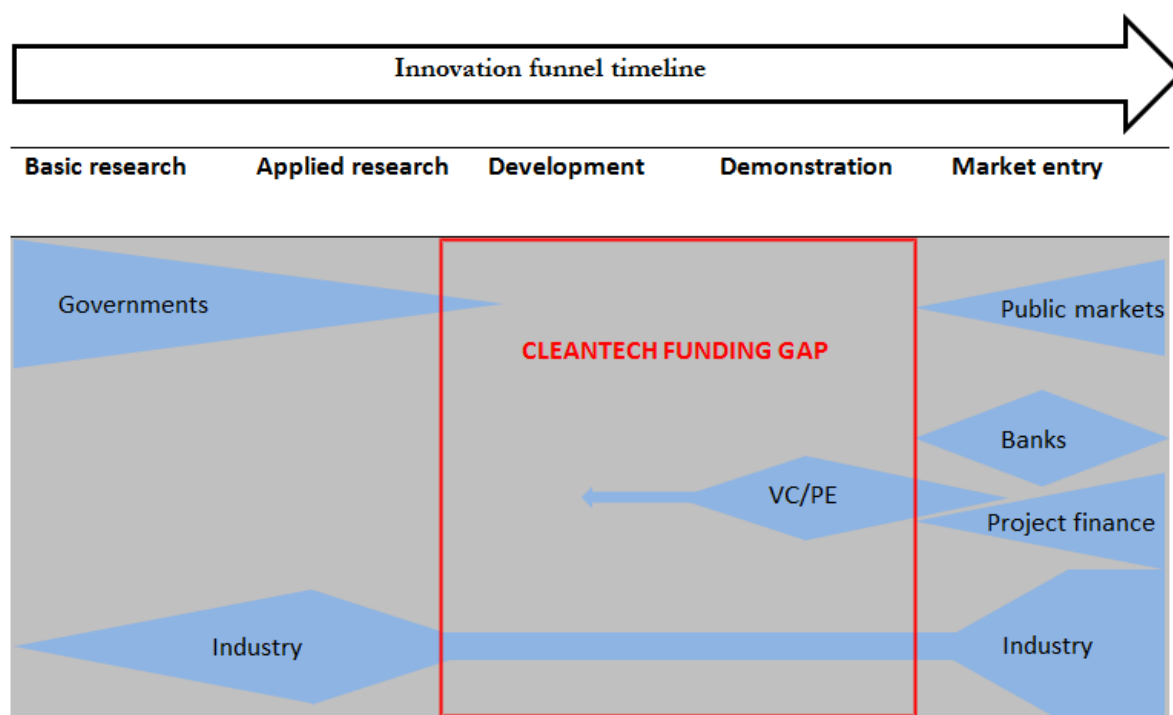
1.5 Scope and limitations

Within the sphere of governmental funding for tech venture companies, there are three main public programmes according to the OECD guidelines for governmental funding of technology based companies (1997):

- i) *Direct supply of capital* to venture capital firms or small firms. This often takes the shape of low interest loans, grants, or equity investments made by the government either directly through public venture capital funds or through hybrid capital venture funds (private-public).
- ii) *Financial incentives* for investing in a venture capital firm or a small firm. Typical incentives are for instance tax credits or deductions and different types of financial guarantees; i.e. on loans and private equity.
- iii) *Regulations*, controlling types of venture capital investors. There are regulations that prohibit or inhibit specific institutional investments. They can be seen as the laws, policies, or guidelines that regulate who should be allowed to invest in what and even how much can be invested. One example could be the allowance of public pension funds to invest in the cleantech venture capital market.

While not underestimating the effect or necessity of the regulations the focus of this thesis will be the direct investments and some financial incentives, or the direct supply of capital to venture capital firms or small firms. Hence, the last category will not be part of the scope of this study. Developing the scope further, direct venture capital investments into cleantech cannot be characterized as one single financial transfer of capital. Depending on how scholars define and divide it, the so-called innovation funnel consists of four to five phases, and in this case the author chose to use five: applied research, basic research, development, demonstration, and market entry. Finances are needed at all stages of the funnel, but the capital intensity differs significantly and hence, so does the providers of the capital. The financial incentives addressed in this study will aimed at funding within the funding gap.

Figure 1.1 The innovation funnel and the equity gap of cleantech. (Sources: Canadian Funding Gap. SDTC, 2013)



A limiting factor to this paper was the fact that many of the stakeholders desirable to interview are very busy. This goes especially for the fund managers and the private investors of the different funds. The author of this paper had to, according to the restricted time of some of the interviewees, cut many questions. Although this was in part negative, the author had foreseen this issue and knew which questions were most relevant. The original number of interviewees had to be cut as well, as there was a low response rate to the interview requests (primarily requests by phone). Another limiting factor was the fact that the thesis work took place during summer; and the author experienced that many public employees were on holiday, not being able to reply or be available for interviews until very late in the thesis process.

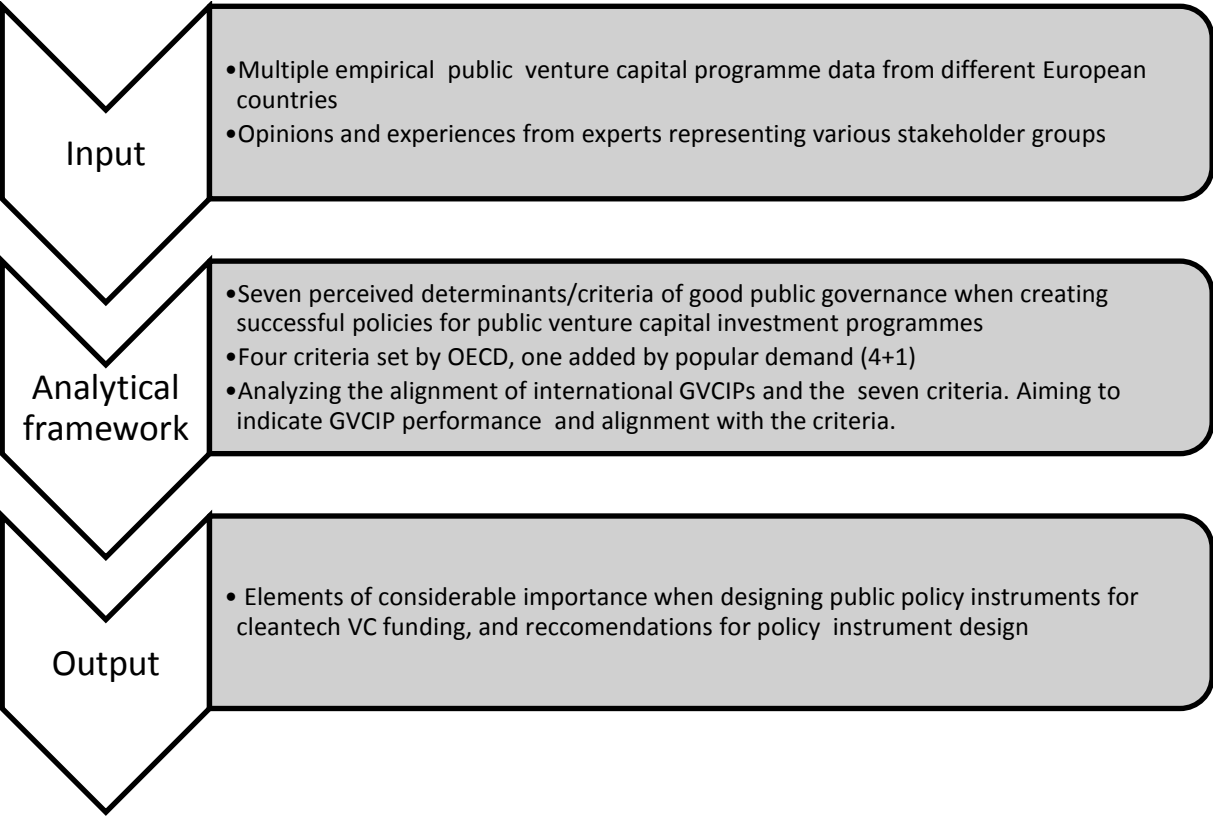
Another limitation of this thesis is that a GVCIP is not a stand-alone instrument or tool to deal with the entirety of cleantech growth and innovation. As this thesis only looks at direct governmental investment programmes aimed at cleantech venture capital, it should be seen as an exploration of one policy segment as a part of a larger policy package. As discovered from literature, direct public venture capital investments in cleantech are questioned in regards to their contribution to innovation, but at the same time regarded as necessary to overcome and fill the ‘funding gap’ of this particular tech sector.

It should also be noted that the author does not address whether public supply of venture capital is better than other policies, such as for instance lowering the taxes on VC revenue. This thesis works with VC and public VC instruments in isolation to what others might claim to be better alternatives.

1.6 Analytical framework

The OECD Guidelines for governmental funding of technology based companies (1997) mention six main criteria that are of high importance when designing a funding policy, being of a direct or indirect nature. As previously mentioned, this thesis will focus only on the direct supply of capital to venture capital firms and small companies. The six criteria will serve as the main analytical tool for this paper; not only in terms of benchmarking different approaches, but also as an indication of whether there are other aspects of direct funding that might be of importance that is not covered by the criteria.

Figure 1.2 Research framework and conceptual research idea



The criteria set by OECD can be found in their entirety below. In addition, one analytical criterion was added by the author because of a need exposed by the initiator of the Swedish Cleantech Funding Project. Two criteria, transparency (how well the policy is communicated), and Process were removed from the framework as it would be too substantial for this thesis to look into.

Design - The configuration of schemes must consider the nature and extent of the investment incentives, whether they are aimed at venture capital firms or directly at small

firms, the stages of investment to be targeted, risk factors and the leveraging effects on private capital.

Additionality - Venture capital programmes should seek to stimulate private sector funding and create a commercially viable market, which would allow government schemes to be phased out as private sources of capital expand.

Management - Successful venture capital programmes are those which elicit private sector participation in the design stage and where the private sector plays a professional role in the programme's management.

Evaluation – One criterion for measuring success is the extent to which venture capital funds or small firms are created which can operate on a commercial basis, i.e. generate an attractive rate of return.

Legal acting – This criterion is externally added. In terms of legal acting space there are laws and regulations setting certain standards for what a government is allowed to do and for what governmental instruments can do. The creativity and movement of governments and institutions within the legal sphere is thought to be important when it comes to designing and operating successful policies for direct venture funding of early stage tech firms, and for cleantech firms in particular.

The logic behind the authors choice of this particular analytical framework is that policies are constantly evolving, not only as a response to governmental desires of perfecting policy performance from a societal point of view, but also due to changing external conditions; such as evolving markets, new technologies, new laws and regulations, and industrial motivations. As cleantech is indeed a quick moving market with development of new technologies that are of interest for both society and industry the author chose to use a rather wide analytical framework in order to not miss the latest policy innovations or the latest cleantech VC segment problems. The relative width of the framework was deliberately chosen because the thesis touches upon rapidly changing financial markets, and the author did not wish to address “yesterday's problems”, as has been pointed out to be an issue with public policymaking for cleantech venture capital financing.

1.7 Literature review

This literature review will cover the following:

- i) A more general review of governmental intervention in financial markets, and the relationship between venture capital and innovation.
- ii) Review of literature that cover aspects of governmental venture capital funding

1.7.1 Governmental intervention in the VC market and the innovation/VC relationship

The foundation of this thesis rests on an assumption that governments intervene in financial markets, such as the early stage capital market for cleantech ventures, because of asymmetric information. According to Akerlof (1970), this is caused by varying levels of information obtained by different actors within a market and can skew the success of investments, and also suppress entire sectors and cause a market failure as noted by Brander, Egan & Hellmann (2008). The latter mentioned scholars also suggest that asymmetric information can cause adverse selection among investors as a result of wrong or hidden information. As

markets are complex, navigating the information needed to manage investment risks can prove to be difficult. In relation to cleantech there are quite a few hard-to-manage risks that could possibly affect the willingness to invest. One of them is the long term uncertainty about the market demand, especially for low-carbon technologies. Another is the interlink between markets and sub-markets ; relative certainty about demand and supply for crude oil will for instance affect the demand for low-carbon technology in one way or another since both are part of a single energy market (Spencer & Arwas 2012; Bürer & Wüstenhagen 2009; and Hargadon & Kenney 2012). The experts in navigating asymmetrical information is claimed to be the venture capitalists, gaining an advantage by seeing through and understanding wrong or hidden information. Following, the venture capital market exists because of this market imperfection, allowing venture capitalists to become experts in deciphering information according to Amit, Brander & Zott (1998).

The rationale for governmental intervention in financial markets is explored by Stiglitz, Vallejo & Park (1993) and they suggest that unaccounted externalities can cause severe information asymmetries. This can be directly transferred to the relationship between low - and high-carbon energies, making governmental intervention rational in order to balance the market. How they intervene is however up for wide scholarly discussion and debate, delivering no lack of literature. Not being able to justify addressing all literature regarding state interventions, the author will focus on literature surrounding the support of early stage innovative cleantech ventures as a logical response to an imperfect market, as this is the main topic of the thesis.

An important aspect discussed in literature is whether early stage investments actually spur innovation, or if it just serves as a buffer to help the specific innovation enter the market; basically trying to answer the question: Does venture capital help the development of cleaner technologies? Lerner & Kortum (2000) tried assessing this question by looking at the relationship between venture capital and patents. They found a strong positive relationship between the two, suggesting that VC indeed did contribute to innovation. Also, they raised the question whether innovation was as well spurred by the venture capital process, and not just the capital investment, signaling that the involvement of industry was of big value for the innovators. However, Lerner and Kortum's research does not indicate the relative disbursement of capital in the innovation process. The positive relationship between patents and venture capital does, according to Demirel & Parris (2010), not provide the full picture of this relationship. They investigated 80 venture capital backed CT firms in the UK and found that most capital became accessible to the CT companies when they were granted a patent for their innovation. They also found that the first round of investment was on average 0,5 years after companies were being granted a patent, and that merely 16% of all VC investments were deployed to the CT companies before a patent was granted or applied for. Hence, they imply that VC does have a positive relationship to innovation if the measure is number of patents. However, their findings suggest that venture capital follow patents, not technology development. Mazzucato (2011) additionally adds to this statement by claiming that the increase in patents can better be explained by shifting patent laws and new strategic reasons why to use patents, rather than linking it to increased innovation. According to Zider (1998), venture capital plays a small role when it comes to innovation. He estimates that 80% of the venture capital goes towards later stage (commercialization) development, and only 6% goes to the start-up phase of a company. Interestingly, research points to the funding gap (commercialization) as the major problem of the cleantech venture sector and yet, most of the external venture capital is spent at this stage. This signals that there is, not necessarily lack of capital in the VC market, but at least lack of attractiveness of the cleantech sector when it comes to venture capital investments.

1.7.2 Governmental venture capital funding

Bürer & Wüstenhagen (2009) conducted a survey among venture capital investors and asked them what kind of governmental policy they preferred; technology-push or market-pull policies. The answers were very clear, indicating a preference for market-pull policies with most of the investors ranking feed-in-tariffs the highest. On the other hand, technology push policies were less popular, and the single policy that came out with the lowest rank was public venture capital funds. From the private investors' point of view, governments should only establish investment incentives, not overrule the market by picking winning technologies. Bürer and Wüstenhagen partly try to explain the lack of support for public venture capital funds by suggesting that governments, by entering the venture capital market, compete with the private investors, something that is also noted in by the Swedish government in a published report on Swedish risk capital (2010). With reference to the guidelines of OECD, additionality should, according to them, be one of the key goals for governmental venture capital involvement in technology-based companies. Additionality, in the context of venture capital programmes, is to aim for stimulation of the investment market, allowing the programmes or schemes to be phased out as sources of private capital expand. (OECD 1997) However, while this might be a good criterion for public venture funding when the risk market is assumed equal across sectors, the cleantech sector possess some traits that would present CT firms with the short end of the stick if the underlying assumption is that private investors are rational and allocate capital to wherever the risk/potential benefit calculus is better. Manigart & Beuselinck (2001) suggest that VCs suffer from so called 'equity gaps' because venture capital is hard to obtain from private sources, hence the logic of public intervention (public funding). Baldock (2012) adds a critical point to the equity gap debate by claiming that there is a shift in private equity investments towards larger funds aimed at later stage developments, mirroring the fact that early stage investments are not anymore regarded as the best option by private investors. Baldock mentions high-risk, technological barriers, market uncertainties as critical points, as well as the perceived management requirements needed by the VC firms. This portrays a picture where cleantech venture firms, with their particularly high market and technology risks, would per theoretical economic definition not be able to attract private investments in the current market assuming rational investors, making the funding gap especially critical for the CT sector.

Another key aspect of public cleantech VC funding is additionality. Additionality is, as interpreted by the UK government, *the extent to which an activity takes place at all, or is undertaken on a larger scale, or earlier, to a higher standard, or within a policy target area, as a result of public sector intervention*. The rationale behind this is to avoid unnecessary public spending by trying to reach as high of a degree of additionality as possible. A fully additional intervention is regarded as a situation where a given activity would not happen at all without public involvement. (UK Gov – Economic Appraisal Guidance, 2013) According to Brastad & Furre (2011) there are however different ways of measuring the additionality of public interventions. The first method of measure, *input additionality*, is commonly used to measure the degree of project initiation as a result of public input. This method does however not take into consideration whether the supported project was successful or not, and it's normally measured by asking the receiver: "What would happen to the project if you did not receive this support?" *Output*, or *result additionality*, is another option that focuses on the results of the initiated projects rather than on the initiation itself. Commonly, this will include looking at how well the public financial support initiated *successful* projects, products, services or innovations. As it is public money, the measure of success is based on a socio-economic point of view. (Brastad & Furre, 2011) This leaves space for different outcomes in terms of calculating public capital performance and efficiency. A study carried out by Friends of the

Earth suggests that there are major differences in the way public finance institutions calculate their leverage on private capital. The major problem according to the study is that there often is no differentiation between private and public capital, meaning that they count it all, hence inflating the leverage ratio. They argue that public funds cannot be leveraged as they are already earmarked and would have been used for achieving the objective anyway (i.e. support the demonstration stage of cleantech products). (Friends of the Earth, 2013). Another UK government best practice guidance document on additionality states that 100% additionality can probably never be achieved, because of the great challenges in controlling all factors from a state intervention point of view. However, best practice suggests that state interventions should aim to 'design out' any possible non-additionality. (UK GOV Additionality Guide, 2008) What can be seen from literature is that additionality, or non-additionality, in financial terms, is per definition determined based on the way of measure. Hence, additionality, or rather the choice of additionality measure becomes a key factor when assessing the efficiency of public VC policies for cleantech.

Highly linked to additionality, the aspect of 'crowding in' or 'crowding out' is an important issue of governmental VC funding. This aspect revolves around whether governmental funds, or interventions, displace private capital or if they attract it. In a still unpublished study by Lidgren & Dalhammar (2013) it was noted that for a start-up venture in Finland it is almost a prerequisite to have been granted public funds from the public body TEKES in order to get access to private venture capital at a later stage. The rationale is, according to the study, that governmental funding represents a lower-level boundary that start-ups at least need to pass. The survey in the same study found that the receivers of public funds benefited from these grants because VC was lacking. From one point of view it can be argued in this case that the governmental grant funding crowds in, or at least enables, private VC to come in at a later stage. Brander Egan & Hellmann compared the performance of governmental backed and privately backed ventures in Canada, and found evidence of private capital being crowded out. They reason that privately funded ventures outperform the governmental funded ventures, and it is linked to how well the companies are managed, and especially what values VC management has been able to transfer to the venture. Also, Mazzucato (2011) claim that through their interventions not only fix current market flaws, but also create new ones, which can be seen in relation to potentially crowding out private investments.

Yet another aspect of public VC funding for the cleantech segment is the management issue. Suggesting that VC, and VC receiving firms, can greatly benefit from good and extensive networks, Hochberg, Ljungqvist & Lu (2007) note that the performance of well networked venture capital funds is far superior of those who have poor networks. Noting that fund performance is superior, they also indicate that the portfolio companies have much better success if the VC fund management is well connected. Further, the authors imply that VC networks are being constructed around the leader of the deals (Hochberg, Ljungqvist & Lu, 2008), which evidently indicate that it is beneficial to lead transactions in the VC sector, especially in the long run. Lerner (2004) also argues that the requirements of a small-venture manager are very dependent on previous experiences. As an example he note that the manager should be able to navigate through and avoid legal issues, as this might severely affect the firms ability to attract private VC at a later stage. Therefore he suggests that the lack of experienced business managers in the early-stage ventures can present a big obstacle to achieving effective public funding measures.

Though noting the lack of literature on the subject, in a study addressing the design of public venture capital programs, Josh Lerner (2004) note some major challenges that in his view is important. First of all he claims that there is a tendency that some governmental programs

tend to exploit other governmental programs with the aim to increase their own private capital leverage ratio. Secondly, Lerner suggests that the firms, or ventures, that apply for and get public grants will get considerable insights to the grant process, making them more capable of securing later grants as well. This should be seen in relation to his statement that to some degree, publically backed (grants or equity funded) companies tend to be underachieving (in a US context) (Lerner, 2004), hence it is an inefficient use of public money. Further, Lerner makes a point of the fact that the underachieving companies can easily attribute their failure to utilize R&D funds to the high-risk nature of their business; hence they will never have to be held accountable for their poor work. As a remediation, he suggests that the funding agency should be more critical in terms of funding the same company over and over, and especially those who already have acquired private capital prior to the governmental grants without any significant results to show for. The logic, Lerner argues, is that state funds then are unlikely to have a major effect on the commercialization of the product.

2 Legal context and background

This section of the thesis will provide (1) the legal context of public VC funding in the cleantech sector, and (2) an overview and presentation of three smaller case studies from the UK, Norway, and Germany. The cases are representing various forms of public venture capital initiatives in the cleantech sector; both public grant funding mechanisms and venture capital funds.

2.1 EU competition regulations

One of the most relevant legal considerations in public venture capital is State Aid. State Aid is implemented in the EU treaty and governed by the European Commission spawning from the rationale that a company that receives governmental aid will gain a competitive advantage over its competitors. It is defined as *advantages in any form whatsoever conferred on a selective basis to undertakings by national public authorities*, and contains the following features:

- An intervention by the State or through state resources (e.g. grants, tax reliefs, guarantees, interest or governmental holdings in a company).
- The intervention gives the recipient a competitive advantage on a selective basis (based on region, sector or specific companies)
- Competition has been or may be distorted
- The intervention is likely to affect trade between Member States (European commission – Competition 2013).

To avoid that some companies, sectors or regions get this competitive advantage, there exists a general prohibition of state aid. However, state aid can be given if the benefit of doing so exceeds the negatives. Due to its complicated legal nature, the author will not look at what those situations might be, but on the other hand look at situations where state aid is allowed for intervention purposes. In general, state aid is bound to mandatory notification to the Commission. There are on the other hand a few exemptions where notification is exempted. Aid below EUR 200 000 per undertaking within a three year period, also referred to as *de minimis* aid, is exempted from mandatory notification. Perhaps more valid for this thesis are the Block Exemptions.

The General Block Exemption Regulation came into force in 2008 and regulates the specific exemptions given to State Aid. It provides exemptions for a number of different public undertakings, but in this case it is Article 29; “Aid in the form risk capital”, that is most interesting. In order to be exempted from mandatory notification under Article 29, the aid should take the form of public participation into a profit driven private equity fund, managed on a commercial basis. Further, the maximum allowed capital single undertaking is EUR 1.5 million per year, whereof 50% should be from private investors. In terms of budget allocation, 70% should be invested in equity or quasi-equity (i.e. subordinated debt). Having a profit-driven risk capital measure is regarded as important, and this must be secured through fulfilling these criteria:

- A business plan shall exist for each investment, containing details of product, sales and profitability development and establishing ex ante viability of project.
- A clear and realistic exit strategy shall exist for each investment.


Finally, there are conditions that must be fulfilled in order to secure the commercial operation of the investment fund;

- There shall be an agreement between a professional fund manager and participants in the fund, providing that the manager’s remuneration is linked to performance and setting out the objectives of the fund and proposed timing of investments.
- Private investors shall be represented in decision-making, such as through in investors’ or advisory committee.
- Best practices and regulatory supervision shall apply to the management of funds. (General Block Exemption Regulation 2008)

It is however important to remember that this merely constitute the requirements for notification *exemption* in relation to public risk capital and state aid. There are also cases where state aid can be provided through notification to the Commission as explained in the next section.

According to the Treaty for the Functioning of the European Union (TFEU), Article 107; state aid must be compatible with the internal market. The same article divides aid compatibility into two categories; aid that shall be compatible, and aid that can be considered to be compatible with the internal market. In the case of “considering compatibility”, the suggested risk capital policy will be evaluated against “Community guidelines on state aid to promote risk capital investments in small and medium-sized enterprises”, hereinafter referred to as “The Guidelines”. The guidelines constitute the legal interpretation of “considered compatibility” for TFEU Article 107 (3) (c). The hierarchical order of regulatory considerations a nation’s state aid scheme has to go through when notifying the Commission can be seen in the table below.

Table 2.1. Order of considerations for notified state aid exemptions (EU Commission, 2013)



Regulation/Consideration	Explanation of regulation/consideration
TFEU Article 107	Any state aid that distorts or threatens to distort competition certain goods shall be considered incompatible with the internal market and not allowed
Section (3)	Aid considered being compatible with the internal market as exemptions.
Sub-section (c)	Aid to facilitate the development of certain economic activities or of certain economic areas, where such aid does not adversely affect trading conditions to an extent contrary to the common interest.
“Community guidelines on state aid to promote risk capital investments in small and medium-sized enterprises”	Legal interpretation of Section (c), putting forward prerequisites for when state aid can be considered to be in accordance to the internal market, and conditions for being exempted (burden of proof).

2.1.1 The EU Community guidelines on state aid to promote risk capital in small and medium enterprises

As noted in the table above, The Guidelines constitute the interpretation and evaluation of whether a state aid scheme for public SME risk capital is in line with the common interest, hence also the internal market. Important to notice is that this applies only when the scheme is notified, and not when it is exempted from notification.

The Guidelines are structured into two main sections; one which assesses the compatibility of the risk capital scheme in terms of compatibility with TFEU Article 107 (3) (c), and one that, in detail, assesses the compatibility of risk capital measures that *are not compatible* with Article 107 (3) (c), in regards to positive and negative effects of the aid. The latter section can be seen as cost-benefit assessment that stipulates whether the aid is in line with the common interest of the Community (when benefits outweigh the costs) despite not being compatible with the TFEU. This means that a particular aid scheme, or parts of it, can be considered *to not be* in line with TFEU Article (3) (c) in section one, but considered *to be* in line with the same in section two because of a more detailed weighing of pro's and con's. To explain further, two examples of different considerations are shown below.

Figure 2.2 TFEU compatibility considerations beyond the stated compatibility criteria. (Source: The Guidelines 2006)

Example 1: Maximum levels of investment tranches

Section 1: The risk capital measure must provide for tranches of finance, whether wholly or partly financed by State aid, *not exceeding* EUR 1.5 million per target SME over each period of twelve months.

Section 2: The Commission is aware of the constant fluctuations of the risk capital market and of the equity gap over time, as well as of the different degree by which enterprises are affected by the market failure depending on their size, on their stage of business development, and on their economic sector. Therefore, the Commission is prepared to consider declaring risk capital measures providing for investment tranches *exceeding the threshold* of EUR 1.5 million per enterprise per year compatible with the common market, provided the necessary evidence of the market failure is submitted.

Example 2: Restriction to seed, start-up and expansion financing

Section 1: The risk capital measure must be restricted to provide financing up to the expansion stage for small enterprises, or for medium-sized enterprises located in assisted areas. It must be restricted to provide financing up to the start-up stage for medium-sized enterprises located in non-assisted areas.

Section 2: The Commission recognizes that certain medium-sized enterprises in non-assisted areas may have insufficient access to risk capital even in their expansion stage despite the availability of finance to enterprises having a significant turnover and/or total balance. Therefore, the Commission is prepared to consider declaring measures partly covering the expansion stage of medium-sized enterprises compatible with the common market in certain cases, provided the necessary evidence is submitted.

The examples above show two (out of a total of seven) examples of how the Commission opens up for a wider interpretation of TFEU Article 107. Assuming that a fictive state aid

scheme is designed with a maximum financial tranch of EUR 3 million, it would be found not compatible with the internal market when notified according to example 1, section 1. However, if the State provides sound proof that the market failure specific for the chosen sector can justify the EUR 3 million financial tranch, it might still be considered in line with the internal market according to example 1, section 2. The second example describes a limitation for the width of public financial measures aimed at middle-sized enterprises, but open for exemptions if the State can prove that there are sectorial limitations in expansion capital for the same kind of companies. Common for both examples and for these exemptions in general, is that legitimate proof must be provided by the State, and that the suggested deviation (suggested by the State) must be proportionate to the evidence (i.e. that the deviating amount of public expansion financing for middle-sized companies reflects the lack of available sectorial expansion capital on the market). An example of how these considerations are applied in reality will be provided in the next section of this paper.

2.1.2 Legal application

Case introduction

The German High-Tech Gründerfonds II (HTGF II) notified the Commission about their early-stage high risk capital fund in 2011, and the report from the trial committee was published online the same year. The purpose of the HTGF II is, as stated by the German government; *to close the current seed financing gap persistent to the high-tech sector and to fund small companies that have an R&D project at the core of their business and to enable them to reach 'proof of concept'*. In the report given by the trial committee, the HTGF will provide seed funding and seek to include private investors while doing so. It is also stated that follow-up investments will be made in some of the companies that initially got seed funding to show that the fund believes in them (in order to attract private VC) and to avoid dilution of the shares owned by the fund. Some of these follow-up investments will exceed EUR 2.5 million, but private investors will provide at least 50% of this amount. Further, if possible, fresh capital will not be used for the follow-up investments, as it is preferable to make use of the subordinate convertible loans (from an earlier phase of seed funding). The size of the fund will be in the range of EUR 260 to 280 million and it is estimated that over 300 companies will receive funding. The German government will provide about 85-90% of this capital, and private investors the remaining amount.

Commission case ruling

The Commission pointed out that the HTGF II was initially not compatible with the internal market according to TFEU Article 107 as it could potentially distort competition. However, on the basis of Article 107 (3) (c), which is an exemption in regards to “aid that facilitates the development of certain economic activities or of certain economic areas, where such aid does not adversely affect trading conditions to an extent contrary to the common interest”, the aid scheme was tried against the criteria manifesting the above mentioned exemption, namely The Guidelines.

The Commission found that the HTGF did not comply with the maximum financing trench of 2.5 million per undertaking per year, as the follow up investments would make the sum larger. They also found that the funding did not stipulate ‘state aid’ at the level of the fund or at the level of the receiving companies as they claimed that the HTGF was a vehicle for delivering funding to companies that did not have access to this capital on the market; hence the HTGF did not benefit from the aid, and neither did the receiving companies as they basically just got what they should have had in the first place.

The Commission pointed out that the participation of private investors in the fund was not guaranteed for follow up investments, and that the share of private capital in the fund was not close to 50%. However, they claim that since follow up investments will be made with at least 50% share of private capital and equally shared risks, it is a '*pari-passu*' situation and that it because of this does not stipulate state aid on the investor level; hence it is in accordance to The Guidelines.

The final ruling was, despite non-conformance with 'size of tranches' (over EUR 2.5 million per investment) and 'participation by private investors' (not a 50/50 capital share in the fund), that the HTGF II was declared compatible with The Guidelines and therefore also compatible with the internal market according to TFEU Article 107 (3) (c). As compatibility with The Guidelines is a cost/benefit weighing, the final ruling can be seen as somewhat of a 'positive compromise'. On the pluss side of the weight scale the Commission pointed out, amongst others, that:

- Private investors are openly called to acquire shares in the fund.
- The Fund will be managed commercially
- The size of the fund is sufficient to absorb transaction costs
- The number of funded companies is sufficient for spreading risk
- The scheme will in all probability "crowd in" rather than "crowd out" private investors

Conclusively, this case shows that design of public risk capital schemes or policies are limited to some extent by EU Competition legislation, but that there is room for interpretation and maneuverability in terms of divergence from legislation. (EU Commission – Letter to Member state, 2012)

3 Governmental VC funds for cleantech development

3.1 The policy instruments

3.1.1 The Carbon Trust Fund, UK

The Carbon Trust is a UK government backed company, or green body, that was originally set up to accelerate the move towards a low-carbon economy in the UK. The company has developed and provides advice for both businesses and governments in terms of low-carbon development. Besides acting as a consultant, the Carbon Trust also finances, develop and deploy low-carbon technologies. The venture funding arm of the Carbon Trust is advised by 350 Investment Partner LLP, a venture capital fund management company that spun out of the Carbon Trust as their public venture capital engagement commenced in 2001. 350 IP identify appropriate investment opportunities, conduct due diligence, negotiate and structure the transactions, as well as monitor and manage investments made by the Carbon Trust fund until the companies exit. In addition to the Carbon Trust, 350 IP also manage an EU-regional cleantech evergreen investment fund, called the North West fund. Out of its EUR 184.8 million, EUR 20 million is earmarked for cleantech; specifically addressing the equity gap and gaps in lending. (350IP-About us 2013)

The portfolio under 350 IP's management consists of about 30 companies, most of which have a connection to energy generation, consumption, infrastructure, and services. The focus on energy can be seen in relation to the fundamental goal of the company Carbon Trust: to accelerate the transition towards a low-carbon economy. The Carbon Trust fund, advised by the 350 IP, is one of the largest investors in early-stage cleantech in the UK. However, they do only co-invest alongside private investors, taking a maximum share of 50% of the total investment. Typically, the Carbon Trust contribution is between EUR 290K - 4.7 million, while the typical total investment (with co-investors) is EUR 585K – 11.7 million.

As most VC funds, the Carbon Trust also has a set of investment criteria that companies need to fulfill in order to be eligible:

- Must be UK based
- Must be innovative – Prove innovation in technology design or its application
- Have a clear financial position – Provide a detailed statement of the organisation's economic viability
- Must have management experience – Relevant sector experience and commitment to turn business plan into reality
- Show competitive advantage
- Provide market assessment – Profile key commercial markets and critical market drivers
- Intellectual property – Confirm what intellectual property rights (IPR's) exist prior to investment, and show how IPR's will be utilized and protected after investment.
- Funding partners – Identify other private investors; we only invest up to 50% in any one transaction. (350IP Investment Focus)

During its years of existence, the Carbon Trust fund has had five exits whereof three of them were trade sales and two of them were listings. In terms of exit success, all exits were

profitable, though some more profitable than others. The latest exit was in March 2013 when the company Arieso, a network optimizing solutions provider, was acquired by JDSU for USD 85 million. This was a trade sale generating a 4.7 times return for the CTF. Another example is a fuel cell company that was traded for a 2.7 times return. Though having 5 successful exits, the CTF has had 4 companies going under during the years. These so-called write-offs make out about 11% of the portfolio companies that was ever in the portfolio, and the fund is despite these profitable as a whole. (350 IP web, and Personal Communication, 2013)

3.1.2 High-Tech Gründerfonds, Germany

According to a study performed by the World Wildlife Fund in 2012, Germany ranks 3rd in the world when it comes to sales of clean technology, only beaten by China and the US respectively. When comparing cleantech sales as a part of the country's total economy (relative ranking), Germany still ranks 3rd, only beaten by Denmark and China. (WWF 2012) This makes them a major player in the cleantech industry, and well worth having a look at in terms of how they spur CT growth and innovation.

The High-Tech Gründerfonds (HTGF) is an early stage venture capital fund set up in 2005 on the provisions of the German Federal Ministry of Economics and Technology. It is not solely a public venture capital fund as it is also open for industry and co-investing angels or other private capital. However, the main part of capital is provided by the government; more specifically: the first fund was EUR 272 million which of the government provided EUR 240 million, which leaves EUR 32 million provided by private capital. The second fund was EUR 301.5 where the government contributed with EUR 220 million and the private sector EUR 81.5 million. (Interview 1) As can be seen from this, the first fund proportionately had a higher degree of public capital than the second fund. This can be explained partly because of a higher number of industrial companies that took part in the fund (HTGF Web 2013). Since the beginning of the fund, approximately 250 companies have received investments from the HTGF, whereof 19 within the cleantech segment. (HTGF Web 2013) As the fund is not fundamentally a cleantech venture capital fund, it has a much diversified portfolio, expanding across start-up companies within the high-tech sector in Germany. The primary aim of HTGF is to support the German seed market for high-tech early-stage companies, something that is highlighted in the company's mission statement (HTGF Mission Statement 2013). In order to receive investments the eligible companies must comply with the HTGF investment criteria; below presented in a comprised manner.

- There must be a technical orientation that is significant in innovation, and the idea or product must be close to “proof of concept”. In addition, the human capital in the company should possess technical knowledge, and intellectual property rights should be protected and exclusive for the company.
- In terms of market position the product or service should have a clear benefit for the end user as well as provide a competitive advantage. There should also be considerable barriers to entry for competition. Finally, the market should enable big growth potential for the company.
- The company team should be characterized by a high degree of motivation, know-how, willingness to succeed, and business experience. There should also be an appropriate financial contribution from the company.

- The company should not have been operating for more than one year. Further, the company should be defined as a small company according to the EU, having no more than 50 employees and not having a turnover that exceeds EUR 10 million. (HTGF Investment Criteria 2013)

If complying with the criteria, the start-up company must fulfill the investment terms; the provisions of engaging in a business relationship with HTGF. These terms are comprised below.

- The initial funding consists of a subordinated convertible loan up to EUR 500K. In exchange the HTGF acquire a 15% nominal share of the company.
- HTGF reserves an additional EUR 1.5 million for follow up funding that the company can access by reaching targets and milestones.
- The loan has a term of 7 years with an interest of currently 10%. Interest will however be deferred for 4 years to maintain the company's liquidity.
- The company needs to match 20% of the HTGF investment, either provided by own money or sourced through other private investors (HTGF Investment Terms 2013)

In practice, this means that the HTGF lends a company up to EUR 500K in the initial phase. The loan subordinate and convertible, which means that if the company should file for bankruptcy, the loan has last priority when settling debt. The convertible element allows for the loan to later be transferred into equity; in this case a 15% nominal share.

3.1.3 Environmental Technology Scheme, Norway

The Environmental Technology Scheme (ETS) is a specific financial support fund for new environmental technologies governed by Innovation Norway, the governments' most important instrument for innovation and development of Norwegian enterprises and industry. Funding can be granted to any company in Norway, big or small, as long as the developed technology is within the cleantech area. In addition, one criterion is that the grants should be for preparing and entering the market, and not early stage tech development or operational costs. The support available is divided according to the size of the company. The different shares of total project contribution can be seen below.

Figure 3.1 Shares of total financial support according to size of the enterprise. (Source: Innovation Norway – ETS Pamphlet, 2013)

	Small enterprises	Medium enterprises	Large enterprises
Funding support in %	45%	35%	25%

A thorough explanation of the thought behind the ETS is given in the policy and guideline document meant to support the arrangement. The overall goal, as stated in the document, is promote Norwegian cleantech in national and international markets and contribute to the strengthening of Norwegian industry. Further, the selection of projects to receive support is guided by some general provisions:

- The project should be socioeconomically profitable before receiving support, and after receiving support.
- The project should have a high degree of innovation and the technology or service should have a considerable growth potential internationally.
- The environmental benefits of the project (technology/service) should be quantified and proven to be better than already existing technologies or services.
- The ability of the applicant to carry out the business plan is important.
- Financial support is only given to Norwegian businesses

Additionality is also mentioned as one important aspect of the financial support. According to the policy, the financial support provided by ETS aims to enable the execution of demonstrative cleantech projects that would not have been carried out under normal circumstances. As the ETS aims to support development projects with high risk, governmental support is thought to be important. However, the policy also states that governmental capital is alone not enough to carry out the full business plan, hence the owners' capital and access to capital is given consideration when selecting who should be granted funding. This can be seen in relation to the overarching goal of the ETS, that they spark the development of a cleantech product or service so that it can be commercialized and successful on the market. As a further response to this, the ETS provide bonus capital injections to those companies who manage to attract private co-investors to the project. Given that the private investors are companies within the EU/EEC and provide no more than 70% of the total project funding, and additional 15% funding bonus can be provided by the ETS. The ETS is not a stand-alone tool for bringing ideas to market, but should be seen as one helping step on that road, something that is highlighted in the policy. The public funds allocated to the ETS are about EUR 33 million per year and it is given out as grants for cleantech projects. (Innovation Norway Web 2013, and Personal Communication, 2013)

In 2011, Pöyry Consulting conducted a survey on the funding performance of the capital provided by Innovation Norway. The report looked at the degree of additionality of the funding, the funds relative contribution to innovation within a specific sector, the characteristics of the fund receiving companies, the geographical width of the developed product or service among the fund receiving parties, and the funds importance to the businesses regarding their ability to secure a bank loan. According to the survey, 63% of the funding provided by the ET scheme was characterized as having a high degree of additionality, 30% had a medium degree of additionality and 4% a low degree. Additionality was calculated based on one question asked to the grant receiving parties: "What do you think would happen to the project/service if you would not have received the grant from Inovation Norway?" Further, 76% of the products that got support by the ETS were innovative on an international arena according to the survey. (IN Customer Effect Analysis 2012)

3.1.4 Vigo Accelerator Programme, Finland

The Vigo Accelerator Program (VAP) is a funding program designed to bridge the gap between the early-stage technology ventures and international venture funding. The program selects the best companies with the best executives and co-invests alongside with them in order to achieve aligned development goals and effort. The fund is under the management of Profict Partner Oy, a company that employs expertise in internationalization and growth in tech-companies (Vigo – About, 2013 & Profict – About 2013). The goals of the VAP are defined by four main points:

- Give incentives to the best business developers in order to help the most promising start-ups grow into successful companies.
- Ensure early-stage funding for start-ups, increase their shareholder value, and make the start-ups attractive targets for venture investors.
- Continue to raise significant venture capital investments after the acceleration stage to support expansion of the target companies.
- Invigorate the Finnish venture capital market and bring more international acceleration and venture capital players into Finland. (Vigo – Goals, 2013)

In addition to these goals, there is a goal to cover the equity gap by phasing out the VAP and letting a self-sustained market operate freely. The idea is that, through the incentives given by the VAP, the private market will be covering the equity gaps. (Vigo Report, 2013 and Private communication, 2013)

Through a public procurement process (public tender) the VAP acquired a number of Accelerators; experienced private companies with proven business expertise, networks and funding experience. The ventures being granted access to the program will be assigned an Accelerator company who then co-invests with the venture and takes a role in terms of both operation and strategy, adding valuable expertise in raising private VC and managing the company towards growth. In order to be selected as an Accelerator, the company must comply with a number of criteria as set put by the tender.

In order to be an Accelerator, the company must:

- Be a limited liability for-profit company
- Be able to invest in the venture portfolio
- Managers must own the majority of the shares of the company (Accelerator)
- Have a clear operational focus based on the skills and expertise of the managers
- Employ two managers full-time to work with the portfolio companies
- Have experience in founding, developing and internationalizing innovative businesses and acting as responsible investors in young innovative enterprises (Vigo – Open tender criteria, 2013)

The Vigo Accelerator Programme can not be seen as a fund, but rather as mobilizer and attractor of private funds. The rationale for being an Accelerator is first of all increased exposure and access to prospective venture firms that in the long run can give returns in relation to exits. Second of all, the Accelerator companies can charge their portfolio companies management fees, something that the ventures again can write off as projects costs and get refunded from another Finnish VC grant instrument called “Funding for Young Innovative Companies”, or YIC. The portfolio companies under management of the Accelerators qualify for ‘preferred treatment’, a regulation that gives them access to YIC grants for a period of 18-24 months. In addition to giving them access to YIC grants, they also get streamlined priority access to other public grants and financial benefits in order to accommodate the development of the portfolio. (Vigo Report, 2013)

There is no requirement that the different Accelerators have the same organizational structure of function as long as they fulfill the targets of the Vigo programme (developing early-stage firms by investing and securing external investments) (Private communication,

2013) Further, in the deployment of the programme, risk sharing was emphasized to be important. This could be achieved, according to the Vigo report, by require the Accelerators to invest in the portfolio and take an active role. Cleantech Invest, being the Accelerator for the cleantech segment, was evaluated in a mid-term report in 2013 and was found to be the top investor among all the Accelerators, having spent 65% of their budget, as well as being ranked 4th in sourcing external capital to the portfolio and 4th in terms of acquiring the most portfolio companies. Further, Cleantech Invest consists of a smaller team of four members and the company has an investment focus in their interventions. (Vigo Report, 2013)

Since its start up in 2009, the VAP has raised EUR 100 million accumulatively for all the ventures involved, and EUR 130 million if IPO's and exits are counted as well. Out of the raised EUR 130 million, 60% comes from private investors. (Vigo press release, 2013)

3.2 Policy instrument comparison

The policy VC instruments looked at in this study display different ways of developing early-stage cleantech. The idea of this comparison is to point out the various approaches in order to create an

First of all, the widths of the programs are not the same. The Environmental Technology Scheme in Norway has a narrow focus on the demonstration stage of cleantech and a mandate to only support projects. The two funds, the Carbon Trust Fund and the HTGF, have a wider investment focus in terms of stage of the business; from R&D seed to exit. However, the fund with the seemingly most independent stage focus is the Carbon Trust Fund. As they function as a normal private VC company, they are free to invest at whatever stage of business they feel is attractive (as there is no age criteria for the ventures), both for them and for their private co-investors. This allows them to fit both the venture and the stage of the venture to the potential investor, something that can be seen as positive in order to secure the best potentially lucrative deals. The HTGF on the other hand has majority focus on seed funding with a mandate to invest in firms under the age of 1 year. This can be seen in relation to the purpose of the fund, which is to support the seed market of high-tech firms in Germany. Though focusing mainly on seed funding, the HTGF also provide follow-up funding to potentially successful ventures that also received seed funding. This is done on a secondary basis (not the main priority in the mandate of the fund), and happens through 50/50 public/private investments, with capital provided from the convertible loans (no fresh capital). The author interprets the HTGF to be a broad seed fund with an aim to create attractive firms that are able to attract private VC in the future. The follow-up investments should be seen as success-statements for the seed funding rather than the purpose of the HTGF. These differences in the design and mandate of the two funds can be seen as different approaches to support cleantech development. On one hand it can be claimed that a VC fund with a relatively marginal impact surface, such as the Carbon Trust Fund, does not constitute the needed effects in order to have a real impact on the cleantech VC market. This can be thought to be the case when the average VC fund in the US (among 462 VC companies) manages EUR 133 million and the Carbon Trust manages EUR 55 million. (NVCA FAQ, 2010) On the other hand it is reasonable to argue that the private VC companies operate free of all public geographical and sectoral guidelines, hence the size of the funds are not comparable in terms of potentially focused impact on the cleantech segment, especially considering the funding gap. The size of the budget of the ETS cannot be fully compared to the VC funds as it can be regarded to be sunken costs from the public point of view. The Vigo Accelerator programme is operation with at least two main objectives; namely to support the seed market and to increase the number of companies that get 'A-round' funding. They define the size of 'A-round' funding to be somewhere between

EUR 2-5 million and aim to have at least 20 companies (across *all* venture segments) to get this kind of external VC. (Vigo Report, 2013) Though having some of the same fundamental objectives as the HTGF, the VAP is not a top-managed fund where all capital is gathered in a single pot.

The impact scope of the HTGF can be thought to be somewhat wider as they have seed-funded a larger number of companies, though only a smaller amount of them being in the cleantech segment. The author interprets that the general thought behind the fund, seed-funding for creating attractive firms for private VC, is based on the rationale that ‘what exists must be improved’, as opposed to the Carbon Trust Fund rationale that the author sees as ‘what is there is good enough, but not tapped into and managed correctly’. The rationale behind the ETS is also similar to the Carbon Trust Fund, having focus on promoting what already exists.

In terms of type of investments, the Carbon Trust Fund has no maximum limit to how much equity they can own in any given portfolio company. The HTGF on the other hand can only own 25% equity in any given company. The rationale, as previously mentioned, is that the German government wants to avoid a large number of state-owned companies. In one way this limits the funds ability to make the big profits on single companies, but it is also a risk diversifying measure. Further, the number of portfolio companies in the fund can be seen as more risk absorbent than the smaller Carbon Trust Fund. This means that the Carbon Trust Fund is more sensitive to sectoral changes, such as energy prices, changes in private capital flow, etc.

Figure 2.3.1 VC instrument aim, type and size

Policy instrument	Aim of instrument	Type of instrument	Capital availability (EUR)
Environmental Technology Scheme, Norway	Promote Norwegian cleantech in national and international markets.	Grant scheme	32 million per annum
The Carbon Trust Fund, UK	To accelerate the commercialization of clean energy	Fund	55 million
High-Tech Gründerfonds, Germany	Support the seed market through a wide number of investments	Fund	301.5 + 272 million
Vigo Accelerator	To stimulate the Finnish seed market while creating new private seed-funds.	Organisational - Fund	Unknown

Figure 2.3.2 VC instrument eligibility criteria and investment types

Policy instrument	Eligible ventures	Type of investments
Environmental Technology Scheme, Norway	SME's and large enterprises that are initiating demonstration projects	Grants; provided that the project can be fully financed with the help of private VC.
The Carbon Trust Fund, UK	UK based ventures in the energy efficiency sector	50% matchfunding (co-funding). Both seed and later stage VC. Equity and quasi-equity.
High-Tech Gründerfonds, Germany	Primarily German ventures operating for less than 1 year.	EUR 500K initial seed investments + follow-up investments and some later-stage VC. Could exceed EUR 2.5 million. . Equity and quasi-equity.
Vigo Accelerator	Ventures younger than 8 years in a wide cleantech perspective	The program pays for management consulting, and the Accelerators invest in venture equity.

4 Interviews

List of interviewees:

Interviewee 1 (I-1) – Program grant officer at Innovation Norway, Norway.

Interviewee 2 (I-2) – Project Manager at Cleantech Scandinavia

Interviewee 3 (I-3) – Long-time public and private cleantech consultant and co-owner of Heather Energy, UK.

Interviewee 4 (I-4) – Communications Manager at High-Tech Gründerfonds, Germany.

Interviewee 5 (I-5) – Partner at 350 Investment Partners, UK.

Interviewee 6 (I-6) – Head of the Vigo Accelerator Programme, Finland.

4.1 Perspectives on the main obstacles of cleantech VC funding

As one of the initial questions in the interview, the author asked I-1 what he regarded to be the main challenge(s) of cleantech venture companies (from now on referred to as ventures) now, and if possible, in the future. I-1, from his experience with grant funding in Innovation Norway, thought that **one of the biggest problems is that many start-up cleantech companies have problems finding the capital they need to actually go through with their project.** The reason for this, he explains, is that the Norwegian oil and gas market is very lucrative, offering better opportunities to invest in. Further he explains that this has been enhanced by the financial turmoil, causing people in general to take fewer risks and sticking to what they know works. This view was also shared by I-5, saying that one of the main problems facing cleantech ventures is the **lack of funding availabilities.** He explains that challenges from the past are still hanging on, causing the general private investment willingness in the early-stage cleantech sector to lag. Those challenges are related to previous venture capital investments in the cleantech sector that were not very successful; the exits did not come through, the stock market closed, a lot of people lost money, and as a result **both specialists and normal VC investors moved into later-stage, lower risk funding.** (Interview 5)

Another challenging aspect pointed out by I-4 is **the long-time-to-market syndrome** that characterizes the cleantech venture segment. He also points out that in the context of Germany; the cleantech seed market is weak (Interview 1), something that can be seen as a confirmation of what has been previously noted by both I-5 and 1. Even Interviewee 6 confirms that the major problem is the long lead time of the cleantech segment. Further, I-3 indirectly confirms the problem with lacking venture capital by stating that a high degree of policy uncertainty, especially in the UK, has had an offsetting effect on private investors. I-2 notes how cleantech venture capital funds have lacked profitable returns, and that this should be considered to be a big problem. Just like I-5, I-2 also argues that the financial crisis and lacking results created a general uncertainty in the market, causing fund managers to have problems raising their funds. Further she notes, just like I-3, that inconsistent policy measures caused investors to lose money, hence **there is, not distrust in policies, but a disregarding of public policy as an investment incentive.** Also I-6 mentions that the **changing public policies in Finland have made the investment environment unpredictable, which in hand has a negative effect on the cleantech ventures.** I-2 says

that most investors generally do not like products that are dependent on governmental support in the first place. (Interview 2) I-3 also believes that there is a **lack of long term funding**, caused by inconsistency in funding and capital availability, especially in the European venture capital model where investments are made in small slices and inconsistently. The next category looks into how to solve one of the major obstacles mentioned, namely how to access the necessary private capital.

4.2 Views on the availability of private capital

The availability of private capital in the cleantech venture capital market is a much debated subject. The identified funding gap in the cleantech venture chain indicates that there is lack of private VC going into the sector. The funding gap can however not be seen as an indication of lacking availability of VC. It is suggested by an Ernst&Young European VC trends report that tighter regulations in the area of financial services, such as capital lending terms, is playing and will play a key role when it comes to the availability of VC capital in general (E&Y 2012). However, some of the interviewees did indicate that **private VC is absolutely accessible, but in different ways than before**. First of all, I-4 from the HTGF noted that **all private VC coming into their top-managed fund was provided by large corporations and not investment companies**. Business angels and private investors were on the other hand invited to co-invest alongside with the HTGF. (Interview 1) Secondly, I-5 pointed to the fact that corporations (though not necessarily UK based) and business angels are investing more into VC now than before as a result of tax exemption regulations, to mention one reason. He further claimed that **there seems to have been a shift in the focus of private venture capital investment companies; going from early-stage VC to later-stage operational investments**. This is in particular true for the cleantech segment, and less true for segments thought to be very quick and profitable, like ICT, apps etc. I-5 also indicates that this is a current trend, saying that: “There is a tendency that some of the venture funds are either folded or turned into later stage funds”.

Additionally, I-5 replies followingly when asked whether he feels that investment opportunities and the seed of companies is good enough: “Yes, there are for us, because there are not really anyone else doing early-stage investments besides a few corporates and business angels...I think that the problem at the moment is, you know... R&D has carried on in the universities and there are incubator programmes that try to commercialize them, and then there is early-stage venture. At least in the UK you need to have all the players in there to make it work, and at the moment in the UK the R&D has tariff opportunities to some extent, but the whole venture bridge is under pressure. So, if the R&D doesn't get commercialized it tends to disappear quite quickly; the patents don't get updated or paid annually, relapse, and then suddenly 10 years or university research becomes very difficult to commercialize because there are no patents. So I think that if you get 2-3 years of very low venture capital support, the whole machine stops”.

I-2 paints a bit of a different picture of the situation. She notes that there is a big lack of private capital and private investors in particular. This should however be seen in the context of Scandinavia. I-2 claims that getting a hold of investors willing to invest in somewhat significant cleantech projects or companies (EUR 5 million+) are not easily found, and especially not in Scandinavia. On the other hand I-2 notes that foreign private VC can be made accessible through co-investments, but this requires that there are domestic investors as well. She explains: “...if you are a French investor you would not like to invest alone in Sweden. So if you have a fund, governmental or not, it does not matter, they you can team up and co-invest, which make it easier to get access to capital”.

4.3 Views on attracting private capital

Attracting private capital can be seen as essential in order to lower the public capital tie-up and risk taking. Pointed out to be of high importance by the interviewees, access to private capital, wherever in the cleantech VC chain it may be needed, is a multifaced issue. The respondents had mixed experiences and opinions on this subject, as (the author assumes) they come from different areas of the venture capital chain, dealing with both grant funding and venture capital funds. I-2 gave some interesting input when asked about the viability of attracting private VC funding, making it clear that **it is not a question of attracting private VC, but how to find private VC to attract**. She makes an example of the Swedish Energy Agency which matches the investments of private investors without taking a stake in the company. This, according to her is very, very attractive to private investors as it is considered to be easy money. The investor gets double the money and a severe risk discount. The problem, she says, is that there are way too few private investors, and if she would look for an investor right now for any significant amount over EUR 5 million, she would look abroad. Further, co-investments are according to I-2 more common than single investments as many investors team up to cooperate. (Interview 2) However, this example is from the current practice of the Swedish Energy Agency, which is a type of soft loan granted to the investing parties. On the complete other side, I-3 argues that **it is very hard to attract private capital in isolation**. He suggests that attracting private VC becomes much easier and more beneficial when there is a systematic set of interventions in place, such as different types of funds, soft loans, grants, etc. Additionally, I-3 points out that you should **never underestimate the sophistication of private investors** as they take a very rounded, overall view and invest in whatever fits their judgement. Hence, he proposes, that stand-alone initiatives that are not very well integrated tend to be less interesting. As an example, Paul tells a story about when he was asking energy investors why they were not investing in the UK market. The answer he got was: “Because we did invest in UK power market in the 1990’s, and the government screwed us”. This is, according to him, a fundamental reason why stand-alone support policies are doubted by private VC investors, and shows that **previous bad, or good, experiences stick with investors for a while**.

In the HTGF, giving industries insights to the high-tech venture market is being used as a method to attract private capital according to I-4. He further makes it a point that **not one of the private industry investors has economic profits as the main reason for investing in the HTGF**. The minimum investment an industry can make into the fund is EUR 2.5 million, something that is a minuscule sum compared to the total fund size of EUR 272 and 301.5 million. (I-4) As I-2 points out, having some knowledge on the HTGF herself, the German government basically let’s the industry participate on soft terms, and the rationale for the industry to do so is to get access to the cleantech venture deal flow (Interview 2). I-5 is partly agreeing with I-2, claiming that it is possible to attract private capital and get matching private capital. However, he makes a clear distinction between the types of options he believes can be attractive to private investors: **You can get your private capital matching if you do it on an investment-to-investment basis**. This way you can match the investment focus of your private investor to the selected cleantech venture company. There is little chance that an industrial company interested in lighting solutions would be ok with investing in wind turbine technology, he says. I-5 further explains how he sees it as unlikely that private investors would pay a lump sum of money into a top-level managed fund with a diversified portfolio, and trust a governmental body to manage it. (Interview 5) This is also somewhat of a statement in line with what both Interviewee 2 and 4 argued; that industry in particular want to see and invest in technology that matches their business focus.

Also, I-5 argue that by leading the transactions; performing due diligence, screening companies, finding the right company, and matching the venture company with the right investor; the management team removes an important boundary for private capital, namely the risk of picking something early. This risk removal is regarded to be valuable in attracting private VC

I-3 also noted that many cleaner technologies are not compatible with the timescale and returns of current private venture capital companies, saying that “They think in terms of a 10 year closed fund, a 20% return target and so on. You will never get that (in cleantech). The same view is shared by I-5, claiming that “Everyone is waiting for that EUR 10-15 million revenue type of deal”

Finally, both I-2 and 5 mentioned that they had to look abroad when seeking private VC, but that national and regional fund were to some degree available.

4.4 Organizational capabilities

Acknowledging the complexity of the cleantech venture capital market, organizational capabilities becomes an important factor in determining how well public VC is managed. Starting off with a somewhat funny observation; while discussing the seemingly good success of the HTGF in raising two big VC funds while at the same time including large multinational industrial corporations in both human -and monetary capital terms, I-2 expressed her excitement with the HTGF and jokingly stated: “We should just copy what the Germans do...I’m joking of course...Or not really”. On the other side however, communications manager of the HTGF, I-4, made it an important point that “**From our point of view, it is not enough to just copy a model of a fund and think that it will work**”. (Interview 2 and 1) Though it is portrayed by the author as a humorous coincidence, it clearly underlines the potential danger of a simplistic policy approach when addressing complex issues.

When asked about his impression of the governmental goals and targets concerning cleantech venture funding, I-3 replied that in his view, the government should become clearer about what they want to achieve with their funding. Following this statement he argued that since there is no traditional industrial policy in the UK, being clear and consistent from the governmental side is a hard thing to do, and that in general, **it is hard to give the public bodies governing public VC the time and independency to do what they need to do**. Addressing the time perspective, I-3 points out how it took the Carbon Trust 3-4 years to build the organization, and when they started doing interventions (various types of support strategies, like the Carbon Trust Fund) it took them another 4-5 years to become really good at what they were doing. He explains that **it takes time for such organizations to find their place in the market, and actually figuring out where they can add value**. Many institutional bodies, including the Carbon Trust, he says, become victims for turning tides in politics. Therefore, because it takes a long time to build institutional capabilities, **the mandate for any such organization should be very clear and it should be established at the highest possible level**.

According to I-5, good organizational capabilities are essential for being successful with public cleantech venture funding. He points out **good networks as one of the main factors in building capacity**. In terms of the Carbon Trust fund, managed by 350IP, the 350IP fund managers have benefitted greatly from the networks of the Carbon Trust, giving them access to big technological -and marketing teams. I-5 mentions the challenges facing a 3-4 man management team; various new technology proposals coming in regularly, each of them

maybe in a different market segment. Hence these things take a lot of time and it limits your ability to actually do the good stuff. What makes 350IP succeed in Interviewee 5's opinion is that they do have the external **capacity to quickly review proposal and perform an initial due diligence screening**.

I-2 also mentions the fact that within the Nordic public grant systems there are very few professionals; meaning that there might be industrial experience, but not what is thought to be needed, namely **entrepreneurial and investment experience**. She explains: "I'm not saying that the people who work there (public grant systems) are useless by any means, but **serial entrepreneurs or investors that have tried, failed, invested, developed, and exited; they know some things that other's don't**" (Interview 2)

Additionally, I-4 claims that the **big corporations bring along networks and expertise that the venture companies and the fund management greatly benefit from**. In the HTGF, industry is represented at board level and elicit some influence over management decisions.

4.5 Evaluating public VC success

This section should not be understood as how overall VC success, profitability or efficiency is measured, but rather as indications of how public VC initiatives are evaluated. The efficiency of a cleantech venture capital grant scheme, or the profitability and efficiency of a public VC fund is often being used as a measure of the success of the policy instrument. While acknowledging the fundamental differences between a grant scheme and a venture fund, the author recognizes differences in what public capital administrators choose to define as success.

Starting with the Environmental Technology Scheme in Norway, according to I-1 it has since its start-up in 2010 initiated total investments in the cleantech segment of approximately EUR 320 million. Considering that the annual budget of the scheme is EUR 32 million, the private capital make up (320-112) EUR 208 million. This constitutes a private/public ratio of about 1 to 3. The Carbon Trust fund on the other hand has invested EUR 50 million and raised EUR 222 million, giving a private/public ratio of 1 to 4.5. In case of the German High Tech Gründerfonds (second one) the ratio is 1 to 2.7. So, if trying to determine the success of attracting private capital, the ratios can tell that the UK Carbon Trust fund is most successful in having the largest share of private VC compared to the public investment. However, the ratios cannot be compared as all three VC policy instruments regard success to be different. First of all, the Norwegian Environmental Technology Scheme measures their success in **initiated project costs**. The UK Carbon Trust fund uses both **investment profitability and attracted private VC ratio as measures of success**. Thirdly, the German Gründerfonds, according to I-4, seems to use **the number of venture companies helped and funded as a measurement of success in addition to longer term overall fund profitability**. (Interview 1,3 and 4)

4.5.1 Profitability

Assuming that profitability can only be measured and considered if the policy tool in itself is set up on a commercial basis, the two cases suitable for such consideration is the UK Carbon Trust fund and the German High-Tech Gründerfonds. However, because cleantech venture capital funds often are long-term investments, the profitability is hard to measure or say something about. According to I-5, the Carbon Trust fund is currently profitable. Having 5 exits to show for so far, all of them being profitable, the Carbon Trust has a 10 to 1 beverage

despite having had to write off 4 companies. However, I-5 points out an interesting thing, clearly indicating that easy profit is not the only thing that matters when public capital is used for venture funding of cleantech: **“It’s a tough area, and if you want easy investments it’s probably not for you”**. I-4, communications manager of HTGF, claimed that it was too early and too hard to say anything about the profitability of the two funds they have under management. However, **it was the author’s impression that profit was secondary** compared to fulfilling the overall goal of supporting the seed market through venture capital investments. This impression was strengthened by I-4’s claim that **“...none of our corporate investors have profit as the number one incentive for investing. Sure, they want their money back, but if they don’t get all of it, that’s ok for them”**

4.5.2 Efficiency

To measure the efficiency of a single policy instrument can be a tough thing to do. Most policy tools are part of larger policy packages that together aim to deliver the desirable results. On the other hand, knowing the effect of single policies is important, allowing for adjustments or refinements that further increase efficiency. In terms of public venture capital, efficiency can be defined differently depending on the goal of the policy tool. As implied by I-1 from Innovation Norway, the efficiency of the Environmental Technology Programme can be defined as **the additionality of the grants** given to the venture companies and the **initiated project costs** that is covered by private capital. In the Carbon Trust fund, efficiency includes profitability of the fund and the share of raised private capital in co-funding; the latter one being the indicator of how good of a catalyst for attracting private capital the fund is. Though measures of efficiency are vague in the commercially profit-driven funds, it is still possible to interpret that they define it as a mix of profitability and level of achievement in terms of doing what they were meant to do from the public point of view; i.e. supporting the seed market while attracting private VC (HTGF), or having the main focus on attracting private VC through leading the due diligence screening and seeking private investors that might potentially end up buying the cleantech venture invested in. I-6, representing the Vigo Accelerator programme, claimed that they look at **the rate of which the Accelerators are able to generate value for the portfolio companies and furthermore raise external private VC on their behalf**.

4.6 Legal considerations

Public venture capital, in the form of both public funds and public grant schemes, are under regulation by national and international law. Assuming that laws and regulations affect the natural maneuverability of venture funding policy instruments, it becomes relevant to find out what those limitations are and how they could affect the effectiveness of a given policy. The author asked I-1 representing Innovation Norway if he felt that the current regulations in relation to the Environmental Technology Scheme was limiting in any way, and also what he would like to do that he cannot currently do because of those regulations. The interviewee replied that **“It is a very hard question to answer...but of course it would be nice to be able to give extra grants to the companies that we really, really believe in and especially those who have problems attracting private capital”**. I-1 further points out that the ETS is limited to the funding of projects, and not companies or people. This means that the ETS can fund the same company more than once, but that a given project is limited to a given sum of money. I-1 explains the logic behind this in the following manner: **“If a company gets a grant from us and fails, that does not mean that the same company can’t receive another grant. If the company has an idea that is better than before, we will support it. Because then the company and the private investor probably has more and better**

knowledge on what the product needs, and if it works the second time it might be the solution to a big problem”

From the public venture fund point of view, I-4 at the HTGF points out the investment guidelines as one of the regulatory limitations in terms of functioning like a fully free venture capital investment company. These guidelines are set by the HTGF board and apply to all investments made by the HTGF. Also, the German government made an indication of the funds to the European Commission that lay down some laws that we have to follow as well. In particular, I-4 mention the fact that they **cannot acquire more than 25% equity in any venture** as an important limitation, but further note that this limitation exists in order to avoid too many publically owned and dominated companies. HTGF is also **limited to investing in companies that are one year or younger**, according to I-4.

I-3, having multiple work experience in the field, note that in the UK situation, state aid clearance can be “...a bit of a pain”. **As all schemes above a minimum level require state aid clearance**, which in I-3 opinion does complicate things as laws and regulations often follow. He also points out that **some countries do get around the regulations**. As an example he mentions Germany who provide soft loans for wind power with rates as low as 4-5%, something that is way below commercial rates for large scale projects. This can be seen in contrast to state aid regulations which say that “You have to invest on a commercial basis”. Jokingly, I-3 adds that he has no idea how they get around the regulations, but that it seems to be possible to do so with a bit of creativity. **”Either that or they simply don’t give a shit”**

Staying in the UK, the Carbon Trust Fund management partner (I-5), note that there are some screens in terms of how they can operate with public money. For the Carbon Trust Fund however, **it is state aid clearance and additionality that influence 350IP’s maneuverability the most** according to the interviewee. In terms of additionality, the same person point out that a major challenge is to balance the encouragement of private capital through co-investments and knowing when to say: “This will happen without us”. The 350IP is not the only voice in the management of the Carbon Trust Fund, and there has been occasions where the Carbon Trust Company has put down the line and discouraged co-investment. This is not because the deal has been bad, but because public money is simply not needed, according to I-5. Futhermore, the Carbon Trust Fund comply with one of the major provisions of state aid, namely that capital should be invested on a commercial basis, by **having at least 50% private capital in every deal**.

I-6 did not see any legal issues or considerations, especially **since the VAP does not constitute state aid and operates on a free market**. She also noted that the VAP had full declarance from the EU Commission and that there were no legal obstacles in their operations.

4.7 Additionality and public VC instruments

Additionality, from the public point of view, can be interpreted as a measure of efficiency in public spending. It was mentioned as one of the major considerations by the representatives from both the Carbon Trust Fund and the Environmental Technology Fund. In the first case, I-5 noted that they sometimes have potentially good funding opportunities that they have to reconsider because of the additionality perspective. Though the venture might be very attractive to invest in, the fund management had to evaluate whether, in the interviewees (5) words:

“...they will make it without us”.

This indicates that there are ventures that might not need additional public funding, something that is also noted by I-2:

“If the business is good enough, there will always be people interested”

Another perspective on additionality and public VC instruments is the way additionality is measured. The Environmental Technology Scheme measures additionality in *initiated private investments*. In the Norwegian situation, companies need to have a private investor in order to secure a grant through the scheme. I-1 noted that they had initiated total project investments of EUR 330K whereof EUR 76K came from the public grant scheme.

In the case of Carbon Trust and HTGF, the author got the impression that additionality was measured in two ways: (1) The actual leverage ratio on investments, meaning that if the Carbon Trust Fund would symmetrically co-fund a venture with two other industrial investors, their contribution would be 33.33% and the private capital contribution would be 66.66%, hence the leverage ratio would be 1 to 2. I-5 claimed that their normal investment was a symmetrical 50/50 investment, meaning a leverage ratio of 1 to 1.

For the Vigo Accelerator Programme, additionality in terms of financial leverage on private capital seemed to be less of an issue. I-6 noted that the Vigo Portfolio companies (accumulated ventures acquired by all Accelerator companies) had raised approximately EUR 130 million since the start-up of the programme in 2009. Though the VAP is an organizational entity with no real capital budget, it is aimed at direct VC investments and does not operate freely from public finances as seen in the description of the programme previously in this study. However, I-1 saw the potential for additionality in VC stages where the funding gap was present and further noted that **the VAP is designed to have temporary public involvement**. The same I-also made it clear that **the additionality of the VAP should be seen in the light of transitioning financial coverage of the funding gaps from public to private**.

5 Analysis

The analysis section of this study will look at the findings and the relationships between the different findings and compare them to the five OECD criteria for governmental funding of technology based companies. Since these criteria propose *what* the public policy for VC should take into consideration, the rationale behind the analysis is to emerge with best practice suggestions on *how* public VC policy should consider the criteria of the OECD framework. The cases and the interview findings are used in a complementary manner in order to analyse how governmental VC instruments should be set up, and what issues and problems they might encounter.

5.1 Designing the policy instrument

The configuration of schemes must consider the nature and extent of the investment incentives, whether they are aimed at venture capital firms or directly at small firms, stages of investment to be targeted, risk factors and the leveraging effects on private capital.

5.1.1 Leveraging and attracting private VC through instrument design

Venture capital is synonymous with risk. There are multiple risk factors present in the cleantech venture capital chain, making this VC segment particularly difficult to invest in. It was noted by some of the interviewees that the reason why private VC is hard to attain for the cleantech sector is because of specifically high risk, often seen in relation to the long-time-to-market syndrome, unproven technology, insecure markets etc. (I-3,4 and 5). In order to close the alleged risk gap, the policy instruments under study in this paper are all designed to some degree to minimize investment risks for private investors. The Environmental Technology Scheme supports cleantech demonstration projects with 25-45% of the total costs if it can be assumed that private capital can cover the rest (I-1). This can be seen as a risk deduction for the private investors as they, simply put, get money for investing money. On the other hand, the author interpreted that the ETS require that the cleantech ventures to have access to private capital *before* getting the grant. Private VC will have to cover minimum 55% (small enterprises), and be sufficient for covering the project in its entirety. This means that the risk bound to carrying out due diligence of ventures rests with the private investors. A funding instrument doing the complete opposite is the Carbon Trust Fund. The fund will carry out due diligence screenings and match the attractive ventures with interested investors. By doing this the fund acts as more of a catalyst for attracting private VC earlier than it would normally come in, and will hence have a positive effect on reducing investor risk. A fundamental difference is however that the Carbon Trust Fund does not provide 'free money' like the ETS, but they will share the main investment risk at a lower level. The author does acknowledge the different stages that the instruments operate in, but note that both are trying to promote investments in hard-to-fund stages of the venture chain as proposed by the funding-gap model, namely very early-stage and demonstration.

The odd case out in this context is the HTGF. In this case, risk deductive measures for private VC is linked to the terms of which private capital can participate in the top-level managed fund. The minimum limit of investment is set at EUR 2.5 million, something that one interviewee claimed to be 'soft terms' for access to the deal flow. When part of the fund, the industrial investors participate at the board level of management, giving them influence over the portfolio. The author interprets that this is a risk reducing incentive for private VC, as they are given broad access to the potential investment ventures; hence they can limit their own efforts in due diligence screening. It should also be considered that the broad seed-

funding focus of the fund, in time, will have a leveraging effect on private capital even though these results are not yet available.

Again, I-5 noted that it is much easier to get private VC matching if the instrument is designed to be on an investment-by-investment basis. The same interviewee argues that it is very hard to get private VC, and especially industrial VC, to invest in a top-level managed fund that has a wide range of cleantech companies in its portfolio. This statement is also somewhat supported by the statement of I-4, claiming that the industrial investors of the HTGF value closeness to their sectoral seed-market and the deal flow as more important than profits. The fundamental design difference of the HTGF and the Carbon Trust Fund is that of a top-level fund and an investment-by-investment fund. The first one can be interpreted to be a good approach when there is a broad base of portfolio companies within the cleantech segment, giving the industrial investors multiple venturing inputs and ideas as a result of exposure to the deal flow. However, if the fund is structured to have a smaller and narrower portfolio, this value is not present and it makes more sense to match the venture and the industrial investor on an investment-to-investment basis.

The VAP is designed to attract the best VC companies to become Accelerators through giving their chosen portfolio companies streamlined access to public capital and exposure to the best ventures in Finland. The additionality perspective of using public capital is discussed more thoroughly in the additionality section of the analysis, but the author wishes to highlight a statement given by I-2 in regards to this section:

“There is, not distrust in policies, but a disregarding of public policy as an investment incentive”

According to this statement, the VAP approach to attracting private VC is not in line with the preferences of private investors. Assuming that the ventures have, and in the future will have access to public capital, there will be no real decoupling of cleantech venture capital and their reliability of public support.

5.1.2 Proportionality of instrument design

Something that becomes an evident issue when looking at the different risk-reducing approaches for attracting private VC is whether the design measures taken from the public side are proportionate to the costs of risk from the private side. In other words, are the policy instruments cost efficient? There were quite a few interesting comments and statements in terms of how a cleantech VC policy instruments should be constructed to attract private VC. I-2 noted that:

“It is not a question about attracting private VC, but finding private VC to attract”

This claim indicates that private VC in general is not hard to attract, especially in the cases where governments match investments with grants or soft loans, as noted by I-2. A similar indication is made by I-1, noting that the ETS spent 75% of their annual budget within the first 6 months. On the other hand, both I-3 and 5 claimed that getting private capital into the early cleantech segment is very hard to do. The author notes that I-2 was addressing grant schemes in particular, and that I-1 also works with grant funding. The author would argue that since private VC has declined on a general level in Europe (E&Y 2012) and that it has been claimed to be hard to find private VC for the cleantech sector, the grant schemes, such as the ETS, might indicatively not be cost efficient. One could state that this size of risk

reduction is necessary in order to attract private VC, but a counter argument is provided by I-5:

“...we would argue that you can still get your private sector matching...it’s much easier to do that on an investment-to-investment basis; sort of what we have done. That is how we managed to get our 10-1 beverage.”

First of all, the basic difference between the grant scheme and the fund in this case is that the ETS ‘gives money away’, while the Carbon Trust Fund still holds a nominal share of whatever project of venture it invests in. This would indicate, considering the statement above, that the extent of risk reducing investment measures of the ETS is not proportionate to the current costs of risk for private investors, but rather higher.

I-5 mentioned a very interesting capability of the fund management well worth noticing:

“...we’ve been lucky enough to have the relationship with the Carbon Trust (company), which has meant that we’ve had access to large technological teams and marketing teams, and we can very quickly review proposals and say if a business is interesting or not. If you are just a 3-4 man team...it can take quite a long time to get through things”

In relation to the previous section, this statement indicates that the risk carried by managers of public capital can be absorbed by having skilled networks. Especially, this can be thought to be valid for the due diligence stage of very early investments. If the managers of public funds can manage the added risk of due diligence better than the single industrial investor, or the single business angel, it can be assumed that public due diligence screening is beneficial. The single investor gets a risk rebate, and the public cost of managing the risk is lower than the investors cost of the same; hence it can be interpreted as a cost efficient public incentive.

5.1.3 Policy instrument target stage - the cleantech venture capital bridge and private VC trends

Should public funding for cleantech target more R&D or should later stages, like demonstration and commercialization be the main objective for public VC? This question is indicative of uncertainty whether more money for R&D will generate the desirable ventures needed to attract private VC, or if public support should be aimed at later stages, like commercialization and demonstration. (Private Communication, 2013)

An explanation of why there is an equity gap in the UK was provided by I-5:

“R&D has carried on in the universities and there are incubator programmes that try to commercialize them, and then there is early-stage venture. At least in the UK you need to have all the players in there to make it work, and at the moment in the UK the R&D has tariff opportunities to some extent, but the whole venture bridge is under pressure. So, if the R&D doesn’t get commercialized it tends to disappear quite quickly; the patents don’t get updated or paid annually, relapse, and then suddenly 10 years or university research becomes very difficult to commercialize because there are no patents. So I think that if you get 2-3 years of very low venture capital support, the whole machine stops”

This statement indicates that the target of public policy should not be limited to one specific stage. Further, the same interviewee claimed that the investment opportunities for the Carbon Trust Fund was very good since they were basically alone doing early-stage VC, which is an implication that, in the UK context, there is a lack of private early-stage VC.

Additionally, according to Demirel & Paris (2010), early-stage VC is very much linked to patents, and hence the author interprets that because of the patents' vulnerability to low VC support as projected by I-5, further public R&D funding in such context could increase the inefficiency in public spending.

The findings also indicated that understanding of the current venture capital market is crucial when it comes to public policy instrument design. First of all, I-5 pointed out that general private VC has fled the early-stage cleantech market in the UK.

“...the generalist investors who came into cleantech 3 or 4 years ago took the wrong deals, lost a lot of money, and then disappeared rather quickly. The specialist venture funds and the larger funds came under a lot of pressure, having problems raising the next fund, and then went for lower risk, later-stage funding”

I-3 also made a similar note when he claimed that the investors he talked to did not want to invest in the UK clean energy market because they had lost lots of money there due to failing governmental policy support. Both statements indicate that there is distrust in the cleantech VC market, but not necessarily that cleantech is bad business. Further, I-5 claimed that there is a shift in the provision of private capital; going from VC investment companies to industry and business angels. This is supported by the HTGF case where all private VC in the fund is industrial. Also, I-4 note that these investors are looking for the actual dealflow within their sector rather than the potential profit, implying that their investments are somewhat linked to, for them, interesting products. In addition, I-1 mentions that, because of the current financial turmoil, investors stick to what they know.

The author interprets this as a shift to private VC that also carries market knowledge; hence they will have reduced market distrust. The implication is that the design of new financial policy instruments should acknowledge this shift and target 'knowledgeable private VC'. Further, from the findings of this study it can be said that any claim of sufficient risk capital availability in the cleantech market should be seen in relationship to current private VC trends. The idea of what is an attractive venture company has shifted, as noted by I-5 and 3, implying that cleantech ventures are potentially profitable, but simply not as profitable as ICT, apps and other quick-and-big return investments, hence they will not attract the same amount of external private VC. This can be supported by a statement from I-3 claiming that the private VC investors will take a well-rounded view on the market and invest in whatever they see as attractive. This indicates that private VC investment logic is to invest wherever chances of return are best, and not to limit investments to a specific sector or stage. As I-5 noted, even sector-bound cleantech investors have moved to later stage investments because they are more attractive, hence it cannot be assumed that these investors will stay in early-stage cleantech when the general product market changes.

5.2 Additionality of the policy instrument

Venture capital programmes should seek to stimulate private sector funding and create a commercially viable market, which would allow government schemes to be phased out as private sources of capital expand

I-6, representing the Vigo Accelerator Programme, claimed that additionality of the programme should be seen in light of the defined equity gaps in the Finnish venture chain, and that the programme has managed to raise EUR 130 million in VC accumulated among all portfolio companies. Further, there was no indication of considering the actual additionality in terms of leverage on private capital for the program. However, as the program has an organizational approach, financial leverage ratios might be thought to be unnecessary. On the other hand, this particular instrument does not operate free from all public capital, but is designed to streamline the access of public funds for the ventures. From the VAP case study it became clear that only 60% of the raised finances came from private capital, exemplifying what the study by Friends of the Earth claimed, that ratios are often double-counted (Friends for the Earth, 2013) This makes an interesting case for quite a few reasons. First of all, one of the goals of the VAP is to make the early-stage VC market self-sustained. When considering that 40% (more if exits are not counted) of the capital comes from the public and that the main motivations for VC companies, or Accelerators, was to get access to this capital through ‘preferred treatment’ and indirect consultant write-offs, it can be questioned what remains in terms of motivation *if* the public support-capital is removed. Further, if the public support-capital is not removed it can be argued that the program has not achieved its goal in shifting the coverage of the equity gap from public to private capital, but merely made it easier to cover.

I-5 claimed that there were occasions where the Carbon Trust Fund had to recede from investing in a venture, not because the deal was bad, but because they were not needed from a financial point of view. Other statements, such as I-2 noting that if the venture company is good enough, there will be interested private capital, indicate that additionality, per definition, can be a limiting factor to for-profit VC funds.

Another aspect in terms of additionality, which goes for both the VAP and the ETS, is whether public VC grants are truly additional. First of all, the ETS does require the applying venture to have a private investor prior to receiving the grant. Considering that Lidgren & Dalhammar (2013) found, in the Finnish context, that receiving a public grant has become a prerequisite in order to get future private VC, it should be questioned if the grants actually make themselves additional. It cannot be excluded that this so-called ‘minimum threshold’ for venture companies has increased the level of additionality of the grants; and the author of this study would assume that it most probably has. Logically, if there were no public grants, there would be no prerequisite for venture firms to access them. The same can be claimed to be the case for the VAP, as it is structured and founded upon access to public grants. The UK guidance document on additionality suggests that any form of non-additionality should be designed out (UK GOV Additionality Guide, 2008). Though this might be correct, the findings imply that additionality can be artificially created by public funding instruments, hence it should be considered whether the designed additionality is actually really additional. Mazzucato (2011) suggests that governments also create new problems in the market when not being careful about the intervention; something that can be supported again by Lerner (2009 and 2004), claiming that overshooting public capital into the market can create significant public spending inefficiencies. Hence, this might be a case of just that.

Further, something that came up during the interviews was at what stage, and in what size range public VC should be injected, regardless of method for injecting it. First of all, I-2 pointed out that:

“There is a lack of understanding from the governmental side in terms of what VC for cleantech is needed for.”

The same interviewee also claimed that the current VC provided by government in Sweden is marginal in terms of per-investment size and that it does not cover the actual need of the sector. In addition, I-1 stated that:

“It would be nice to be able to give extra money to the ventures that we really, really believe in.”

Both these statements point in the direction that there are untapped and potentially positive sources of additionality in the cleantech VC chain that public intervention could address. It also indicates that methods of raising the bigger VC amount (in the EUR 5-10 million range according to I-2) for the commercializations stage is not supported to the same degree as lower sums of investment by the public. However, I-2 also claims that if the company or the product is good enough, investors will be interested. This can be seen as somewhat of a contradiction, as one could assume that a EUR 5-10 million investment would be attractive to private VC if it was a good business idea, hence public VC would not be needed. By this logic, additionality suggests big public VC investments in non-attractive (by market standards) businesses.

5.3 Management of the policy instrument

Successful venture capital programmes are those which elicit private sector participation in the design stage and where the private sector plays a professional role in the programme’s management.

5.3.1 Benefits and drawbacks of including the private sector in program management

Both funds of this study (Carbon Trust Fund and HTGF) are managed on a commercial basis by private fund management companies. Beyond the private management company, the HTFG include industrial representatives at board level, allowing for industrial insights and contributions in the fund management. These two statements from the funds communications manager provide an indication of the rationale behind the inclusiveness:

“The main reason why we invite private investors is because we are convinced that we can support our portfolio companies through this cooperation with industry”

And;

“They (private industry investors) bring a lot of expertise and networks along with them, and of course, it is good for the image of our funds”

Though the industrial investors financial contribution is at a relative marginal level compared to the total fund (on average less than 1%), the author interprets that they add network and expertise value, something that also, as shown in a previous section of the analysis, has monetary value in terms of absorbing risk. From one point of view it can be argued that

industrial investors are given access to the HTGF on soft terms, but on the other hand they also add value to the fund through expertise and market knowledge.

Further, another interesting statement, from I-2 and 5, was that they often looked abroad when seeking private VC investments. This could indicate that the networks being built around public VC funding mechanisms should seek to be international.

Also, as mentioned previously in the private VC trends section of the analysis, the distrust in the cleantech VC market could potentially be reduced by giving investors access and relevance in the program management.

Though there seems to be big benefits from including the private sector in program management, a drawback was also mentioned. Both I-2 and 3 notes that the current profit incentives for fund managers are not ideal:

“Since they (fund management companies) make money from the annual management commission which is relative to the size of the fund, they are incentivized to raise as big of a fund as possible, and not so much as to securing the the development of the portfolio companies” (I-2)

Though this statement indicate that the investment company profit criteria might challenge the results of the portfolio companies, there are also plausible positive effects of such a incentive scheme, depending on what the fund is aimed at. It can be argued that in the case of the Carbon Trust Fund, with a relatively small portfolio, the above mentioned scheme would have negative consequences for the portfolio companies. However, if the fund has a wider portfolio with a focus on seed-funding for the spurring of necessary product developments, like the HTGF, an incentive to maximize the fund could be interpreted to be positive as it would potentially enable the fund to widen the portfolio and hence, improve the performance of the fund according to what it was meant to do. This is however based upon an assumption that it takes less managerial efforts to manage seed companies than to manage a firm from seed to exit.

5.4 Evaluation of the policy instrument

A criterion for measuring success is the extent to which venture capital funds or small firms are created which can operate on a commercial basis, i.e. generate an attractive rate of return.

There are several ways that success has been defined and measured in the cases of this study. First of all, the Environmental Technology Scheme measures success in terms of leveraged private capital. Compared to the leverage ratio of i.e. the Carbon Trust (1 to 1) the ETS ratio of close to 1 to 4 can be interpreted to be pretty good. However, the major difference is that the ETS *only* looks at the leverage ratio while the Carbon Trust Fund also measures profit ratios. As claimed by I-5, the fund has a profit beneficiary of 1 to 10. Further, though not directly measured, the fund also created cleantech companies that are currently functioning and making a profit on the market. The HTGF, with a focus on very early seed investments, is still not at the point where they have been able to exit too many of their portfolio companies yet. And as I-4 claims, it is impossible to say anything about the actual profitability. The fact that VC funds in general operate over a number of years, it becomes hard to evaluate them on the basis of this particular OECD criterion. I-3 states that.

“It is hard to give the public bodies governing public VC the time and independency to do what they need to do”

And;

“It takes time for such organizations to find their place in the market, and actually figuring out where they can add value”

Further, I-5 states that:

“It’s a tough area, and if you want easy investments it’s probably not for you”

The top two statements indicate that, first of all, premature evaluations VC policy instruments run the risk of undervaluing the instrument in question because of the complex and time-dependent nature of public programmes. Secondly, the statements indicate a risk related to the independency of these programmes; namely that many of them have ordained governmental guidelines that limit their ‘free’ operation. It is indicative that evaluations of, especially, public for-profit VC funds should take into consideration the operative restrictions that these funds work under. Furthermore, considering the last statement, since public VC for cleantech is operating in equity gaps and a sector thought to have a longer profit lead time, it is unreasonable for these funds to be benchmarked against private VC funds operating freely.

I-4 however states that they consider the additional benefits they create for the industrial investors to be a measure of success since these investors do not prioritize profit in regards to their investments. This is an interesting statement, and it clearly advocates that there is no set measure of success for VC funds in general, and that success of a fund is related to its original goals. The Vigo Accelerator Programme, like the ETS, also measure success in terms of leveraged private VC. But, in addition, they also consider the ability of the instrument to transfer capital coverage of the equity gaps from public to private.

5.5 Legal maneuverability of the policy instrument

In terms of legal acting space there are laws and regulations setting certain standards for what a government is allowed to do and standards for what governmental instruments can do. The creativity and movement of governments and institutions within the legal sphere is thought to be important when it comes to designing and operating successful policies for direct venture funding of early stage tech firms, and for cleantech firms in particular.

In terms of legal maneuverability the interviewees expressed a number of limitations to their operation. First of all I-1, representing the ETS, noted that he would like to be able to give extra financial support to those ventures or projects that he, or the evaluation panel of the programme really believed in. Further he conveyed that this support would especially be good for those projects or companies that struggle to get access to private capital. Based on the scheme’s interpretation of additionality, “Initiating what would otherwise not happen”, the author assumes that ‘extra financial support’ would have a higher degree of additionality than the the projects which have access to private VC. However, it can be argued that there is a reason for why those projects do not have private investors, but nevertheless, it cannot be excluded that those projects are affected by a scewed VC market where the definitions of what is a good investment has changed significantly, as noted by I-3 and 5 earlier. If the instrument’s definition of additionality is used in definite terms, it can be argued that the legal

context is limiting maximum additionality. On the other hand, the author does see the perspective on the viability for projects being fully realized. Yet, based on a skewed investment market, the author questions the reason for why some projects do not find private capital.

I-4 representing the HTGF management registered that the investment guidelines of the fund was a limiting factor for them. He noted that the guidelines were set at board level with influence from government, the EU Commission, and the private industrial investors. Among the limiting factors expressed by I-4 is the fact that the fund cannot invest in more than 25% equity in any venture and the venture in question needs to be under the age of 1 year. However, it should be expressed that I-4 is representing the for-profit management company managing the fund and might be prone to answer in line with management preferences. Still, the statements should not be undermined as the HTGF is a for-profit fund per definition and the interviewee seeks to achieve just that. On the other hand, the author interprets that the guideline limitations of the HTGF are set in order to achieve the original goal of the fund, namely to support the broad seed market. Interestingly, the same interviewee was very excited to tell about the other benefits of the fund, such as giving industry access and insights to cleantech seed companies. If it can be assumed on a general basis that the historical profitability of a VC fund is a determinant factor when it comes to raising another fund, the author interprets the value-creation of the HTGF as a way of overcoming lacking profit potential due to limiting investment guidelines. This indicates that investment guidelines that limit potential profitability of a public fund by default can be overcome by creating other values for the investors. This should on the other hand be considered contextual, as not all countries have industries with venture capital arms, as noted by I-2 and 5.

The Vigo Accelerator Programme is exposed to very few legal limitations as it is not directly a financial instrument, but more of a capital-organisational instrument. As I-6 claimed, the VAP is declared by the EU Commission and operates freely without significant restrictions. The author interprets the VAP to be a hub-like programme, connecting cleantech ventures and VC companies which in turn together seek other sources of private capital while having streamlined access to public capital support tools. The functioning of -and the idea behind the VAP indicate that VC-connected instruments might not necessarily need to provide the capital directly, but rather streamline access to other means of public money.

I-5 representing the Carbon Trust Fund management company, 350IP, claimed that the biggest legal limitations from his perspective were additionality and that all their operation had to be on a commercial basis. The additionality perspective, he pointed out, means that 350IP cannot invest in potentially interesting cleantech ventures if the same venture already has sufficient access to other private VC. Again, this is suggesting that additionality does restrict the potential profitability of public VC in legal terms. The same interviewee also mentioned that they had to invest on a commercial basis and that they achieved this by doing 50/50 co-investments with other private industrial investors or business angels. Further he claimed that, as opposed to top-level managed public funds, it was easier to find investors on a 50/50 co-investment basis. This suggests that legal limitations, such as limiting investment size and share, do not necessarily affect the successful operation of a public cleantech VC fund. It further indicates that finding the right operational approach for the given context is essential.

6 Discussion

As noted in the introduction of this study, governments currently hold, indeed, complex and important roles in VC funding for cleantech. Additionally, as the cases, findings and analysis show, there is no one way of constructing a public VC instrument that helps the further development of cleaner technologies. The study uses the OECD criteria for public VC funding as a guideline for indicating if there are any best practices or major obstacles with public VC instruments in the cleantech sector.

First of all, the study finds that a best practice standard is very hard to obtain because of a large variety in contextual factors. Such factors turned out to be for instance the historical context of earlier national investment incentivizing policies and the performance of earlier private VC. Two other examples are the industries history of being involved in VC funding, which varies across Europe; and finally the different industrial sectors being prevalent in various countries. The study does however find that there are varying levels of leverage ratios on private capital, different approaches to minimizing investment risks for private investors, different ways of including the private sector in the management of the fund, and finally, that there are other values than merely profit that is valued in the public VC funds.

Because of the methodological approach of the study the analysis does not go into the deepest details of the abovementioned results. That was on the other hand not the purpose of this study. The purpose of the study was to find determinant factors that can influence the efficiency of public VC instruments on a wider basis; especially in regards to leveraging/attracting private capital, and the potential boundaries connected to legal limitations.

It should also be noted that the OECD framework suggests a model and a set of criteria in terms of public venture capital that may not be perfectly aligned with what a government is supposed to do. It implies that it is the government's job to make sure that private companies make money, especially through the 'need to be profitable'. It can be questioned whether public money should be spent for governmental *or* private profit purposes. Do these funds really need to be profitable? Also, the framework may not be the best way of evaluating how governments best can support the cleantech venture business as other interventions, like tax deductions on cleantech investments or for cleantech companies could very well be just as effective, if not even better.

The author found that the different stakeholder interviews presented a good view on the current challenges of early-stage cleantech and public VC funding for the sector. Surprisingly, even the interviewees in charge of the various public instruments were not reluctant to criticize their own operating prerequisites. Though not being strong in nature, the criticism was mostly aimed at state aid, related to equity shares, and their possibilities for fulfilling the governmental additionality perspective fully. It is noteworthy that fund managers saw operating guidelines as limiting, while grant officers made no such remark. The author interprets this result to be connected to capital ownership. It could suggest that public capital is best spent with private management companies as vehicles for distribution as they have more incentives to household capital with larger criticism. A counterargument to that statement is that such management companies would most likely pick the ventures that are as close to the best 'free market' ventures as possible. However, this can be regulated through properly set governmental guidelines as displayed in some of the cases in this study.

In relation to fund profitability and measurement the author wishes to post the question: Do public VC funds need to be profitable? It is of course given that in order to attract external private capital there must be something worth while for the investors. However, the case of the HTGF and their communications manager, it does not have to be profit. This challenges the original view of how venture capital investments work and suggest that industrial interest in venturing cleantech companies should be considered to be more than another potential source of invest-for-profit capital.

Further, the author sees the potential for public/industrial co-investments where the common goal is to develop the venture to be included into the industrial investors' business; in other words: public investments should aim for buy-outs. This approach also includes a natural market based additionality perspective where risk is shared 'pari passu' until risk is naturally low enough for private capital to carry it alone. The author would argue that as opposed to a normal IPO acquirement, the industrial investor gets the chance to form the venture to fit the business during development if it is a co-investment leading to a buy-out. The author bases this approach upon the analysis regarding investment-by-investment basis versus top-managed funds, and the shift in the private VC market.

The author also found that additionality is a difficult, but yet important factor of public VC funding. From the point of view of fund managers it can be seen as a limitation to potential profit as they are, per definition, not allowed to invest in the ventures that already have enough private capital. This is based upon an assumption that those companies are regarded as the 'cleantech cherries' in terms of VC investments. However, it should not be forgotten that the role of public support (according to additionality) is not to make a big profit, but to supply a gap with the capital they would normally have in the case of a fully functioning market. Therefore, the proportionality perspective addressed in the analysis becomes a very important issue. Which ventures would, in a perfect market, get access to private VC, and how much would they have access to? This question can in the authors' opinion help to design proportional VC instruments that take into consideration VC stage, type and aid size.

Though the contextual importance makes it hard to conclude on general terms, the study does find that it seems that private capital is easier attracted to public VC funds operating from 'seed to market' when an investment-by-investment approach is used. The case looks to be different when there is one set stage for public VC, i.e. seed capital. This suggests that designers of public policy instruments for cleantech VC should carefully consider what investment incentives private investors are looking for at different stages of the cleantech VC chain; and more importantly what incentives they are capable of creating (see organizational capabilities).

When it comes to the actual execution of the study, the author found it difficult to set an agenda for what issues should be discussed in the interviews. This was first and foremost because there is a lack of studies covering the subject (see Lerner, 2002). Because of this and because of a comment provided through private communication, that public policy often lags behind the current VC market situation, the author chose to make questions rather open in order to get the up-to-date insights. Interestingly, even though questions were open-ended, the topics that were addressed by the interviewees were rather consistent. The fact that some answers were diverging, the author chooses to attribute to national contextual differences and also, in some cases, different professional backgrounds. However, the diverging answers turned out to be a good thing as the study then managed to get a wider view on the topic. The drawback was on the other hand that results became less generalizable. On a further note the author wishes to stress that generalization would not be valid for long in such a

quick-moving market. If given the opportunity to conduct a similar study again, the author would most likely include people responsible for R&D in Universities and other research institutions in order to get their experience with patent funding. This would allow for more extensive conclusions on the VC chain equity gaps.

The author also experienced problems when it came to getting interviewees. The author does acknowledge that the number of interviewees is not extensive, but that the cases do complement the analysis to make it valid. If done again the author would conduct the study outside of national holidays and refine his own pitching technique.

7 Conclusions and recommendations

The study concludes that there is no one way or one best practice to construct a public VC instrument that can spur self-sustained investments in the cleantech sector. However, the study does find that there are a number of different factors that influence how public VC instrument design should be set up, and a number of approaches that are suitable to remedy those factors. First of all, the study concludes that in order to attract private capital it is necessary to know what kind of private capital the instrument is going to attract. The analysis show that the investment incentives for industrial VC and 'normal' VC companies might differ because of different interests. The study also concludes that because there is a shift in the VC market where 'normal' VC has fled the cleantech sector and industrial investors and business angels are getting more involved in the same sector, public VC instruments should respond to this by not only focusing on for instance fund profit.

The author recommends that new public venture capital instruments focus on creating additional values for industrial investors beyond direct capital investment profits.

The study also concludes that there is little early-stage VC in the cleantech segment and that because of this it should be seen as the governments role to incentivize private capital to come in earlier than it normally would. Conclusively it is also seen in the study that public risk absorbtion plays a key role in this.

The author suggests that public VC instruments are designed in a fashion that allows for public leadership in finding, screening (due diligence), and marching the ventures with 'knowledgeable VC', such as industry.

Another conclusive note is that any public VC instruments should be thoroughly thought through in terms of additionality. Additionality is found to play a major role from multiple perspectives and can, if not managed correctly, compromise the efficiency of public spending.

The author recommends that any provision of public VC, be grant or fund, should not be designed to become a prerequisite for further private venture capital investments. The aim should rather be to design for decoupling of private and public VC.

The major importance of having extensive networks is another conclusion of this thesis. It is shown that good networks can limit risk, make qualified investments, and connect cleantech ventures with suitable private VC.

The author suggests that any public VC instrument should be constructed to include as many stakeholders as possible in order to increase the organizational capabilities of the instrument.

Also, the author suggests that the government should consider taking on a role for increasing the interplay between state, industry, cleantech ventures and other private VC companies by acting as a network-hub. This could take the shape of cleantech investment seminars or even

something simple as a happening, like “Investor-Venture Speed Dating”.

On a more general note the study concludes that early-stage VC for the cleantech segment is not completely gone, but that is coming from other sources. Tapping into these sources presents one of the major boundaries of public VC instrument design.

The study also concludes that additionality can pose a limitation to for-profit public VC funds as it limits their investments to secondary fruits. However, it is also concluded that because of the noted shift in VC, to quicker and bigger profits, governments should not be discouraged to believe that these investments are bad, but merely not as good as the best. The investment guidelines that come with public VC funds are not designed to prohibit profit!

The author therefore recommends that governments do engage in VC funding for cleantech despite being limited by additionality.

The study also indicates that national and supra-national regulations take the form of state-aid regulations and additionality perspectives. Conclusively, these should not only be seen as negative from the public point of view, as they are present to limit public over-spending and new market failures. However, it is also concluded that, because of a lack of understanding for what public VC funding is needed for, these regulations might limit public acting that would be proportionate and beneficial for the cleantech venture segment.

Finally, the last conclusion is that the most plausible way of structuring a public VC fund, considering the current VC market and the governmental desire to attract private VC, is to have a public portfolio that is matchfunded on a case-to-case basis.

The author recommends that, unless able to create common non-profit values for all investors, public VC funds should be designed to co-invest on a case-to-case basis rather than trying to attract private VC into a common portfolio pool

The study did find elements of importance for public VC instrument set-up and also design factors related to attracting private capital. Some obstacles and limiting considerations were also found. Conclusively the study fulfilled its purpose and aim by answering the research questions.

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