Public cleantech financing in Denmark, Finland and Norway

Sonnenschein, Jonas; Saraf, Saurabh

2013

iiiee

Public cleantech financing in Denmark, Finland and Norway

IIIEE Report 2013:01

Jonas Sonnenschein and Saurabh Saraf

INTERNATIONAL INSTITUTE FOR INDUSTRIAL ENVIRONMENTAL ECONOMICS AT LUND UNIVERSITY

Foreword

This is a report commissioned in the project "Financing cleantech in the early development phases: international outlook and implications for Sweden".[1] It is a research project carried out at IIIEE, Lund University. It is funded by the Swedish Energy Agency. The main aim of the project is to examine how different countries work with public support for cleantech startups and what we can learn in Sweden.

The report is written by Jonas Sonnenschein and Saurabh Saraf. Carl Dalhammar has been the project coordinator at IIIEE, while Alexander Lidgren has been the project manager at the Energy Agency.

Carl Dalhammar

Lund, December 2013

[1] Finansiering av cleantech i tidiga utvecklingsfaser: omvärldsanalys och implikationer för Sverige.

Table of Contents

Acronyms

ATF	Advanced Technology Foundation (Denmark)
BIA	User-driven Research based Innovation (Norway)
BIF	Business Innovation Fund (Denmark)
EC	European Commission
EEA	European Economic Area
EFTA	European Free Trade Association
EU	European Union
EUDP	Energy Technology Development and Demonstration Programme (Denmark)
FGDB	Fund for Green Business Development (Denmark)
FII	Finnish Industry Investment Ltd
GBER	General block exemption regulation
ICT	Information and communication technology
MDF	Market Development Fund (Denmark)
PE	Private equity
PVC	Private venture capital investor
R&D&I	Research & Development & Innovation
SME	Small and medium-sized enterprises
TFEU	Treaty on the functioning of the European Union
VC	Venture capital

1 Introduction

1.1 Research background

There are two large background trends that indirectly drive political decisions about how (much) to support the cleantech sector in Europe. First, there are **intensifying environmental challenges**, with climate change being the all-dominant one. Three main arguments can be brought forward why climate change will remain on the political agenda: the global emissions of greenhouse gases (GHG) are still increasing, the scientific evidence about anthropogenic climate change is stronger than ever, and the number and severity of large extreme weather events is increasing. In order to decouple GHG emissions from economic development, large efficiency improvements in the way we generate and consume energy are necessary. This will require radical innovation and large-scale deployment of clean technologies.[2]

In its 20-20-20 targets the European Union has set itself targets until 2020. GHG emissions have to be reduced by 20% compared to 1990 levels, the share of renewable energy has to be increased to 20%, and the final energy efficiency has to be improved by 20%. Countries within the EU/EEA have to take different efforts for achieving the overall 20-20-20 targets (see also Table 1). Within the EU ETS there is a common emissions cap for all participants and emission allowances can be traded across borders. However, there are annual *national* allocations of GHG emission allowances that change over time. This allocation reflects different targets for different countries. But it is not yet defined which country will contribute how much to the overall target of minus 21%. For non-ETS emissions the EU has defined national emissions reduction targets in the effort sharing decision. All Nordic Countries have to reduce GHG emissions more than the European average.

Table 1: Climate and energy targets 2020 (base year 2005), source: (EEA, 2013)

	EU	Denmark	Finland	Norway
GHG emissions under EU ETS	-21%	-21%	-21%	-21%
GHG emissions non-ETS	-10%	-20%	-16%	-30%[3]
Share of renewable Energy (gross final energy consumption)	20%	30%	38%	68%

The second large background trend is the **economic crisis in Europe** which exemplifies the need for rapid development of innovations in order to stimulate employment and economic development. Ironically, the economic crisis is at the same time one of the largest barriers towards more ambitious environmental policies. Stricter environmental standards and market-pull instruments such as feed-in tariffs are by some perceived as a burden to the economy rather than important stimulus for the development of the cleantech sector.

In order to achieve environmental targets and create employment and export opportunities, the role of cleantech financing seems to become more prominent; whereas radical market-pull

[2] The author of this report is convinced that efficiency improvements are *necessary* but not *sufficient* to solve current environmental challenges. How a more systemic perspective and socio-technological innovation can help to avoid the rebound-effects that have in the past occurred whenever efficiency improvements were achieved, is only briefly touched upon in this report.

[3] Overall GHG emissions reductions compared to 1990.

instruments, which would be needed in order to incentivize large private investments into cleantech innovation, are hardly politically viable. Since the economic crisis has also altered the risk-averseness of private venture capital investors (PVC) and driven them out of early stage start-up investments, there is the urgent need for the public sector to organize effective financing of cleantech innovation all the way to commercial viability. "Since green technology is still in its very early stage, when Knightian uncertainty is highest, venture capital funding is focused on some of the safer bets rather than on the radical innovation which is so needed to allow the sector to transform society in the ways that the 20-20-20 policies are hoping." (Mazzucato, 2011, p.101)

One further argument for governments to invest in cleantech innovation is the "green race", i.e. the attempt to become a recognized technology leader in one or more sub-sectors of cleantech, which can give additional boost to exports and economic development.

There is a clear need to know more about how government funding of cleantech start-ups can effectively interact with and complement private funding, so that radical cleantech innovation is brought to the market in order to reach environmental targets and contribute to economic development. Hence, the central questions that are dealt with in this report are:

- How does EU state aid regulation limit public funding of cleantech in practice?
- What should be the target of public cleantech funding?
- How can additionality of public funding of cleantech be ensured?
- Should the state take ownership in the companies and projects it supports?

1.2 Methodology

This report is the result of a commissioned research for the Swedish Energy Agency and the International Institute for Industrial Environmental Economics (iiiee) at Lund University. Therefore, the main research questions were given from start. After an initial screening of the existing literature in this field the research questions were refined by the authors. Valuable input for the literature review and the research focus was provided by a recent Masters' thesis at the iiiee (Ramse Andersson, 2013).

Most of the information that is presented in this report was drawn from a series of interviews with relevant stakeholders in the three focus countries Denmark, Finland and Norway. The interviews were all conducted in person or via phone or Skype. The interviews typically lasted 30 minutes to one hour. All interviews have been transcribed. In a few cases follow up questions were sent via email. The interviews were structured with the help of an interview guide, which comprised three lead questions with several respective follow-up questions (see Annex 1).

This report is subject to some limitations:

- The geographic boundaries of this study mean that the results cannot be transferred to other countries without adjusting for regional particularities.
- The focus on public actors creates a bias in favour of existing public financing instruments. Even the inclusion of private investors would not necessarily remove this bias since they mainly benefit from "cheap" money provided by the state. The author tried to account for this structural bias as much as possible.
- Interviewees were very aware about EU state aid issues, which is one of the main research subjects of this study. However, the author faced a lack of in-depths knowledge about practical implications of EU state aid regulation.

- The limited time for this research assignment did also limit the number of interviews that could be carried out. While this did not impact the more factual information about existing programs and their operation, it did have an impact on the depth and variety of subjective evaluations of the existing public funding infrastructure.
- The focus was on public actors, hence we did not gather much data from private venture capitalists, who might have added a different perspective on issues like additionality and crowding out.
- The topic of the report has not been researched thoroughly, yet, which means that we had to rely almost exclusively on primary sources.

1.3 Some definitions and foundations

This section gives a brief overview of some concepts and interrelations that are relevant for the further understanding of the report. It is mainly based on literature review.

What is cleantech?

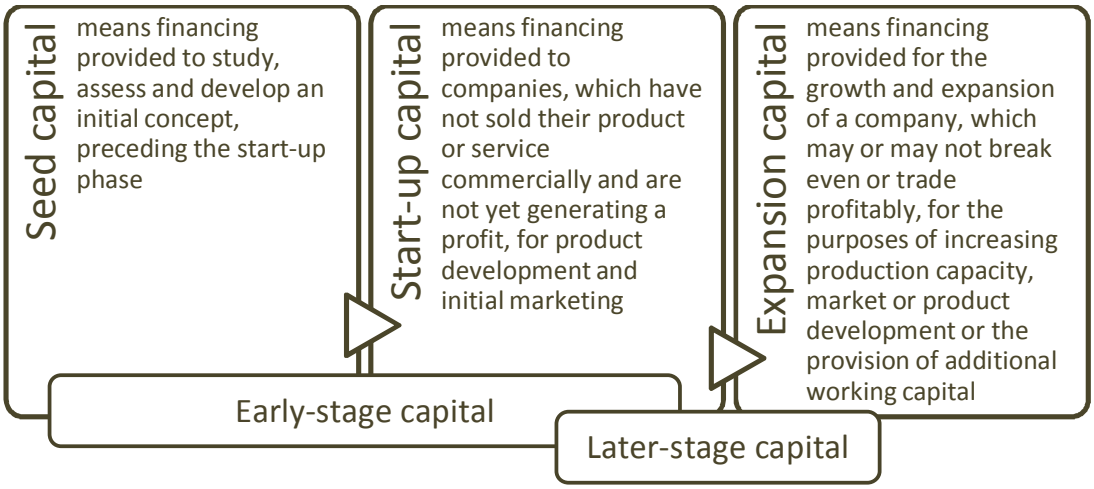
The question "What is cleantech?" is almost as ambiguous as the question "What is a green job?" At the core of the problems is the differentiation between sectors that have the potential to improve the state of the environment and those that merely lessen negative environmental impacts. The latter group includes for example efficiency or safety improvements in the extractive industries, oil and gas, refining etc.

It goes beyond the scope of this report to argue well for a clear cleantech definition. However, it is important to be aware of the scope of cleantech when discussing public support schemes. In the worst case scenario public support to cleantech might even counteract radical innovation efforts by making the most polluting industries look somewhat cleaner and, hence, more resilient to change.

The Innovation Cycle

The author assumes that the reader is aware of the main stages of the innovation cycle – from basic research to market development and expansion. However, different institutions and companies use slightly different wording when talking about the stages of the innovation cycle. In this report the definitions given by the European Commission are used (European Commission, 2006b). These are not necessarily the best definitions, but they are most useful when discussing the issue of EU state aid.

Figure 1: EC definition of funding phases[4]



Government interventions: market push vs. market pull

Both market push and market pull interventions are used by governments to influence the development of the cleantech market. Technology push policies aim at increasing the supply with technological solutions. This is done through research, development and innovation (R&D&I) investments, e.g. tax credits or grants for demonstration projects. On the other hand, technology pull policies are aimed at creating a sustained demand in the market. This is done by implementing subsidies, by setting regulatory standards, by targeted government procurement etc.

Whether one type of intervention is superior to the other depends on the context of application. Regarding sustainable energy technology a study by Bürer & Wüstenhagen (2009) showed that market push instruments like public venture capital funding, were not as popular among private venture capitalists as market pull instruments, such as feed-in tariffs, reduction of fossil fuel subsidies and tight environmental standards. In this context it is important to be aware that different stakeholders might evaluate the same intervention differently. Recent research indicates that the most successful strategy is to apply both push and pull policies in a complementary fashion (Lidgren & Dalhammar, 2012). In this report the focus is clearly on market push measures, including various kinds of R&D&I and commercialization funding for cleantech.

[4] These are the definitions as they are given in (European Commission, 2006b). Early-stage capital means seed and start-up capital. Later-stage capital is not explicitly defined by the EC. According to (Grünfeld, Iverson, & Grimsby, 2011) "later stage […] may be interpreted as the more mature end of start-up and the less mature part of expansion."

2. Legal framework

One research question of this report deals with the role of EU state aid regulation with respect to public funding of cleantech development. The information that could be obtained from the interviews is not deep enough to provide sufficient guidance about how to address state aid regulation when designing a public support instrument. Therefore, this section gives an overview of relevant regulations and guidelines and explains what to consider when dealing with different stages of the innovation cycle and different forms of public funding.

2.1 Treaty for the functioning of the European Union (TFEU) and General block exemption regulation (GBER)

According to article 107 (1) state aid which threatens to distort competition by affecting trade between member states is generally incompatible with the internal market.[5] There are several exemptions from this rule. Relevant for public funding of cleantech is article 107 (3) (c):

3. *"The following may be considered to be compatible with the internal market:*
   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;"*

The following article 108 deals with procedural issues like notifying, reviewing and deciding about existing or planned aid schemes. The practical application of these articles is regulated in the General block exemption regulation (GBER), which is "declaring certain categories of aid compatible with the common market in application of Articles [107 and 108] of the Treaty"[6] (European Commission, 2008b). If an aid measure fulfils the conditions outlined in the GBER, it is <u>not</u> subject to the notification requirements under article 108 of the TFEU. There are nine different categories of aid under the GBER for which the application of article 107, i.e. ensuring the compatibility with the common market, is further exemplified:

1. Regional aid
2. SME investment and employment aid
3. Aid for female entrepreneurship
4. **Aid for environmental protection**
5. Aid for consultancy in favour of SMEs and SME participation in fairs
6. **Aid in the form of risk capital**
7. **Aid for research and development and innovation**
8. Training aid
9. Aid for disadvantaged and disabled workers

For each of the nine categories further guidelines and framework documents exist that provide even more specific legal interpretation of aid in the respective sectors. Reference to these guiding documents is typically made when the aid measure goes beyond the limits that are set by the GBER. The underlying structure of the balancing test is the same in all cases:

1. *Is the aid measure aimed at a well-defined objective of common interest, such as growth, employment, cohesion and environment?*
2. *Is the aid well designed to deliver the objective of common interest, that is does the proposed aid address the market failure or other objective?*
   i. *Is State aid an appropriate policy instrument?*

[5] Regarding state aid the same provisions exist for EEA countries, like for example Norway. In this report the relevant articles of the EEA regulation are not referenced for reasons of simplicity.

[6] When reading state aid related legal documents it is important to know that articles 107 and 108 of the Lisbon Treaty have previously been articles 87 and 88, and still before that articles 92 and 93. However, most decisions concerning state aid still refer to article 87 and 88.

ii. *Is there an incentive effect, i.e. does the aid change the behaviour of firms and/or investors?*
iii. *Is the aid measure proportional, i.e. could the same change in behaviour be obtained with less aid?*

3. *Are the distortions of competition and effect on trade limited, so that the overall balance is positive?*

Below is explained what the practical implications of this balancing procedure are for the three categories in bold, which are most relevant for innovation and commercialization of cleantech.

2.2 Environmental Protection Guidelines

The "Community guidelines on state aid for environmental protection" (European Commission, 2008a) mainly deal with investments that help to reach community standards for environmental protection or even go beyond these standards. Various types of investments that help environmental protection are eligible, including among others aid for environmental studies, energy saving, renewable energy sources, cogeneration and waste management. The most relevant form of aid with respect to the cleantech sector is the "Aid for undertakings which go beyond Community standards or which increase the level of environmental protection in the absence of Community standards". It explicitly refers to investment aid for eco-innovations. This type of aid is not useful for directly targeting cleantech start-ups, but rather for demand side measure.

While several different categories of aid for environmental protection are eligible, the amount of aid within these categories is not unlimited. Both aid intensities (see Table 2) and thresholds for aid within block exempted schemes are limited.

Table 2: Maximum aid intensity under the environmental protection guidelines

Enterprise size	small	medium	large
Aid to undertakings increasing the level of environmental protection (beyond Community standards)	70%	60%	50%
Aid to undertakings increasing the level of environmental protection (beyond Community standards) *in the field of eco-innovation*	80%	70%	60%

2.3 Risk Capital Guidelines

The "Community Guidelines on State Aid to Promote Risk Capital Investments in Small and Medium-sized Enterprises" cover various forms of aid via risk capital measures (European Commission, 2006b). Risk capital measures can be very complex because "public authorities create incentives for one set of economic operators (investors) in order to provide finance to another set (target SMEs)". The most common risk capital measure is the constitution of VC funds in which the State is a partner or investor. More complex measures include guarantees to VC investors/funds against investment losses, fiscal incentives for these funds or other financial instruments to provide additional capital for investment.

Risk capital measures are automatically considered compatible with the internal market if they fulfil seven conditions outlined both in the risk capital guidelines and the GBER. These conditions are in short:

- The maximum level of investment tranches is 2.5M EUR per target SME per year.[7]
- The risk capital measure must be restricted to provide financing up to the expansion stage for small enterprises and up to the start-up stage for medium-sized enterprises.
- The risk capital measure must provide at least 70 % of its total budget in the form of equity and quasi-equity[8] investment instruments into target SMEs.
- At least 50 % of the funding of the investments made under the risk capital measure must be provided by private investors.
- The risk capital measure must ensure that decisions to invest into target companies are profit-driven.
- The management of a risk capital measure or fund must be effected on a commercial basis.
- To the extent that many private sector funds focus on specific innovative technologies or even sectors (such as health, information technology, biotechnology) the Commission may accept a sectoral focus for risk capital measures.

Aid schemes that fulfill all of above criteria will be block-exempted. All other aid schemes become subject to a more detailed assessment as the crowding-out of private investments and distortion of competition become more likely. The detailed assessment is based on the information that the public authority, which is proposing the aid measure, has to provide. This additional information includes among other things more detailed data about market failures, equity gaps, crowding-out effects etc. Typical examples for measures that do not fulfill all criteria include aid above the 2.5M EUR threshold, aid for medium-sized enterprises in the expansion phase, measures that seek to include follow-up investments, or aid with lower participation of private investors. All these cases are by default considered incompatible with the internal market. However, if the balancing decision of the EC comes to the conclusion that an aid measure has a net positive impact on the common interest, the Commission will decide not to raise objections. (European Commission, 2006b)

2.4 Research and development and innovation framework

If instead of risk capital, aid is given in the form of innovation grants or soft loans, the "Community framework for state aid for research and development and innovation" (European Commission, 2006a) provides the most relevant legal guidance regarding public funding of cleantech.

Aid to research and development and innovation (R&D&I) is mainly justified because of some severe market failures. Knowledge spill-overs of R&D&I activity do not have a market price but often create net benefits for society, even for projects that are would not be profitable without public support. Moreover, lack of knowledge on the investors' side might prevent economically beneficial projects from happening.

For aid measures under the R&D&I framework there are three different ways to comply with state aid regulation. The easiest one is to fulfil the conditions outlined in Table 3 and additionally comply with following criteria: the project aid goes only to SMEs and is not above 7.5M EUR, or the aid goes to "young innovative enterprises". Young innovative enterprises can receive direct

[7] In 2010 the maximum level of investment tranches was increased from 1.5M to 2.5M EUR. This was justified with a widening equity gap. The EC explains "Based on the latest available data and the experience of previous downturns, there are strong indications that particularly early stage technology businesses will experience a prolonged undersupply of risk capital, even if these companies have growth prospects." (European Commission, 2010)

[8] The risk capital guidelines define quasi-equity investment instruments as "instruments whose return for the holder (investor/lender) is predominantly based on the profits or losses of the underlying target company, are unsecured in the event of default. This definition is based on a substance over form approach." (European Commission, 2006b). In practice this includes for instance unsecured high-risk loans.

aid (not project aid!) if the enterprise is small and less than 6 years old, if it is innovative (external evaluation and at least 15% R&D expenses in one of the 3 years preceding the aid), and if the aid does not exceed 1M EUR. Under the conditions described above, R&D&I aid scheme will be considered compatible with the common market according to article 107 (3) (c) of the TFEU. No further scrutiny and investigation are necessary. With the exception of the criteria for young innovative enterprises, the same conditions for block-exemption without prior notification are listed in article 31 of the GBER.

Secondly, aid that fulfils the criteria of Table 3 but not the additional criteria listed above has to provide additional information for demonstrating the "incentive effect", i.e. showing that as a result of the aid the recipient will increase R&D&I activity in size, scope, amount spent or speed. It is considered sufficient if the public authority can show that the aid will increase at least one of the elements of R&D&I activity (size, scope, amount spent, or speed).

Table 3: Maximum compatible aid intensities and thresholds under the R&D&I framework

Type of research project/ feasibility study	Enterprise size			Threshold
	small	medium	large	(M EUR)
Fundamental research	100%			20
Industrial research	70%	60%	50%	10
Industrial research + bonus	80%	75%	65%	10
Experimental development	45%	35%	25%	7.5
Experimental development + bonus	60%	50%	40%	7.5
Technical feasibility studies (industrial research)	75%	75%	65%	7.5
Technical feasibility studies (experimental development)	50%	50%	40%	7.5
Innovation clusters (investments)	35%	25%	15%	5

For all other aid measures a much more detailed balancing test is required. This typically concerns aid beyond the given thresholds. Member states have to provide all the information they consider necessary to proof compatibility of the aid according to various criteria outlined in the R&D&I framework. If the EC is satisfied with the provided information it will not come to a formal state aid investigation procedure. This is very likely the case when aid is granted to activities that are far away from the market. (European Commission, 2006a)

2.5 De minimis aid

De minimis means literally "about minimal things". In the context of state aid it means aid that is too small to be even considered state aid. The EC has formulated several criteria for *de minimis* aid, of which the most important one is that total "aid granted to any one undertaking shall not exceed EUR 200 000 over any period of three fiscal years". Furthermore, the EC states that where "aid is awarded in a form other than a grant, the aid amount shall be the gross grant

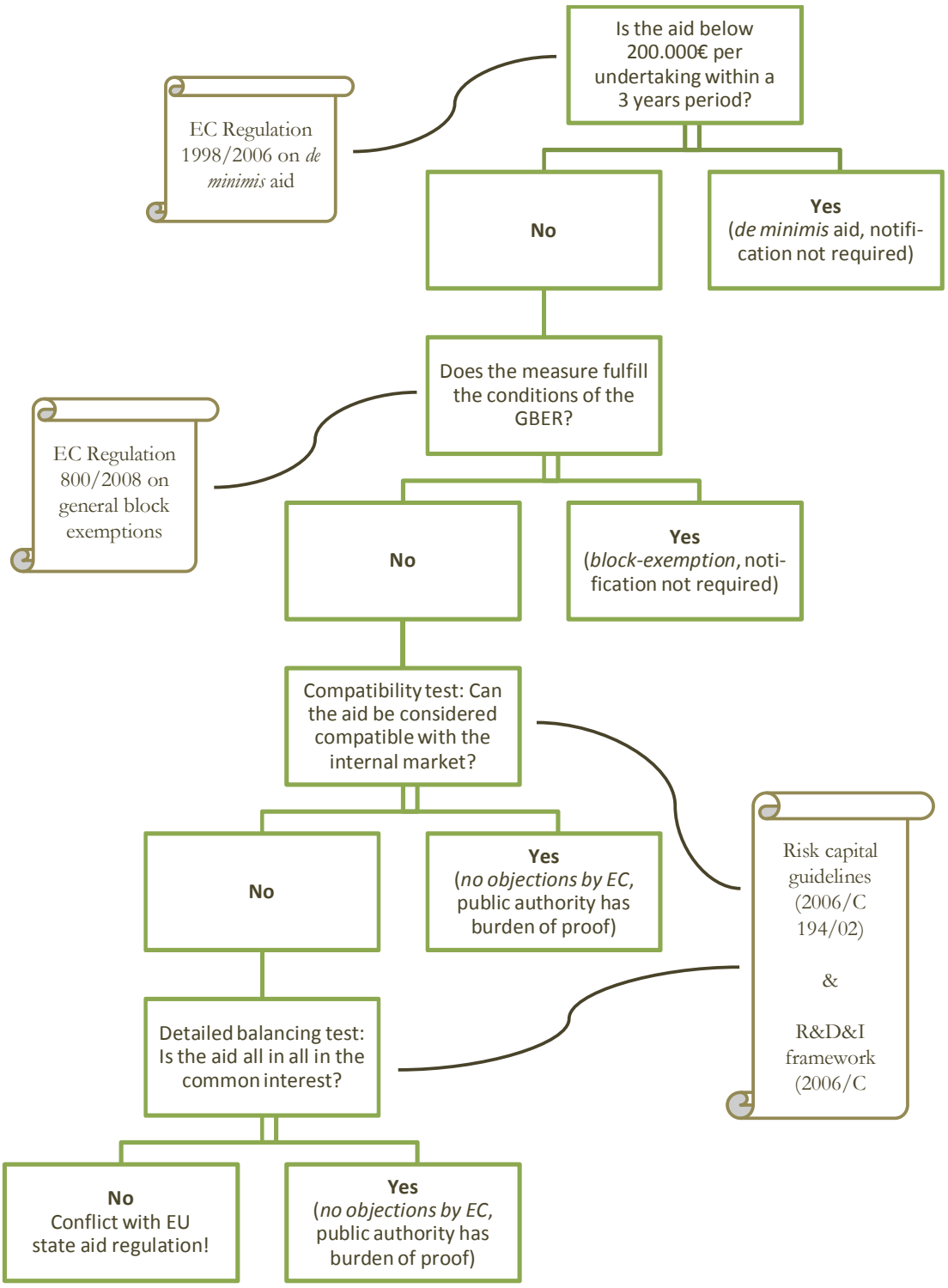
equivalent of the aid." While for soft loans the gross grant equivalent can be calculated, it is – according to the EC – not possible to calculate it for risk capital investments. Therefore, aid in the form of risk capital investments is only considered *de minimis* aid if it remains below the ceiling of 200 000EUR. (European Commission, 2006c)

2.6 Overview of options for state aid to cleantech

The sections above describe different options for supplying aid under the EU state aid regulation and guidance. There are three different procedures for ensuring that state aid is in line with regulation (see also

Figure 2 below). Firstly, there are forms of aid that do not have to be notified at all (*de minimis* and aid fulfilling GBER conditions). For aid under the GBER a simple reference to the EC regulation is sufficient. Secondly, aid that fulfils certain criteria outlined in the risk capital guidelines or the R&D&I framework has to be notified to the EC. This notification does not require extensive amounts of additional information and follows formal requirement. Thirdly, aid beyond the limits set by the guidance documents have to go through a detailed assessment procedure, for which public authorities have to provide extensive information.

Figure 2: Compatibility checklist for EU state aid and relevant legislation



3. Case studies: cleantech financing

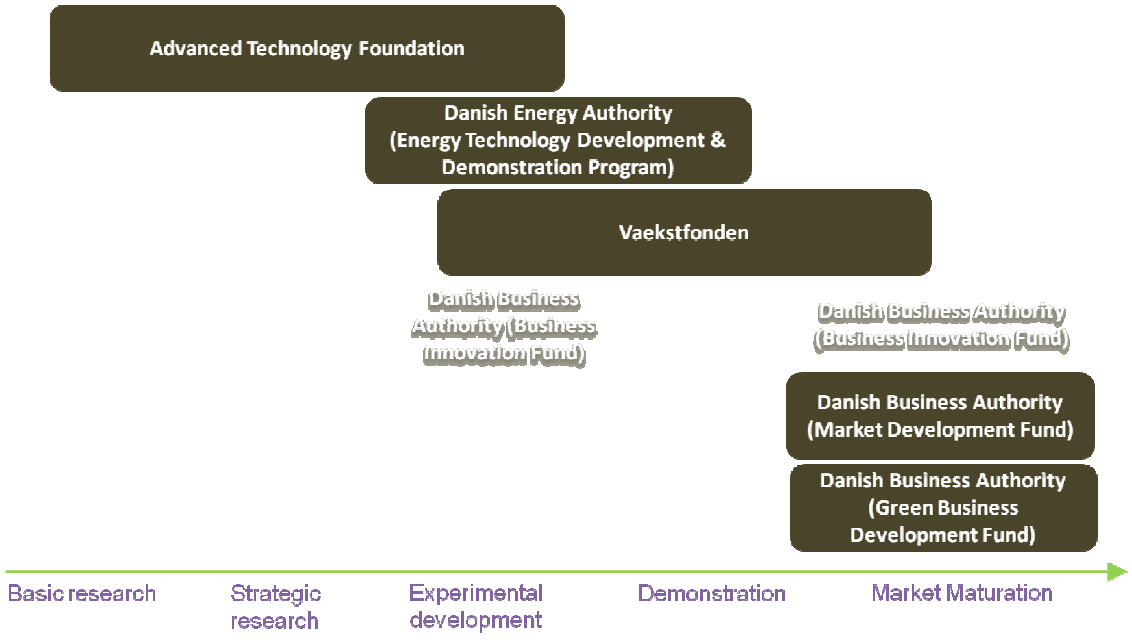
3.1 Denmark

Denmark is clearly number one on the Global Cleantech Innovation Index 2012 (Knowles, 2012). The index considers general innovation drivers and cleantech-specific innovation drivers on one hand, and evidence of emerging cleantech and evidence of commercialised cleantech innovation on the other hand. No other country on the index has such strong cleantech-specific innovation drivers in place, and in no other country there is as much commercialized cleantech innovation on the market as in Denmark. The wind industry certainly plays a large role in this success story, but also sector like smart-grids, energy efficiency and low-impact transportation are well developed in Denmark.

The turnover from green technologies, goods and services amounted to DKK 253 billion in 2012, which is 9.2% of total turnover and 10.4% of Danish exports. About 106 000 people were employed in green production of goods and services. In the manufacturing sector more than 15% of all employees dealt with green production. (Danish Energy Agency, 2012)

As mentioned above, cleantech-specific innovation drivers are well-developed in Denmark. Public funding is present in all stages of the innovation process – from basic research to market development (see Figure 3). With respect to the commercialization of cleantech, there are mainly four relevant actors: the Advanced Technology Foundation, the Energy Authority which runs the Technology Development and Demonstration Program, the Growth Fund (Vaekstfonden), and the Danish Business Authority which runs the Market Development Fund and the Green Business Development Fund.

Figure 3: Adjusted research and innovation system in Denmark 2013 (adapted from Government of Denmark, 2012)



Advanced Technology Foundation

The Danish Government founded the Advanced Technology Foundation (ATF) in 2005 and gave it the mandate to support advanced research and innovation in order to enhance growth and

strengthen employment in Denmark.[9] The ATF brings together companies and universities which carry out research with a clear goal and commercial perspective. The ATF offers grants to research platforms, projects and postdocs. While most of the research that is supported is pre-demonstration, the applicant has to present a clearly visible commercialization path. Each project has a single point of contact within ATF which follows the project closely and takes part in all steering committee meetings. ATF has also the option to stop funding a project that had been initially approved. This has proven to be a successful instrument in the past in order to ensure efficient project management and progress. ATF's role as project enabler at the organizational level is supported by the fact that it pays all project (or platform) participants directly, which removes a lot of administrational work.

Since 2005 about one quarter (EUR 171 million) of the total investments went into technology research in the area of energy and environment, where ATF investments represented 3/6, private investments 2/6, and other public investments (universities) 1/6. If the industry partners are small enterprises the share of the ATF can be up to 60%. Altogether 47 investments in the energy and environment sector have been made by ATF. There is no mandate for a certain share that energy and environment technology should have in the total ATF portfolio. The selection of projects depends exclusively on the quality of the application. (Advanced Technology Foundation, 2013)

About 100 projects have been finalized so far. ATF evaluates the success of these companies in terms of technology development and commercial perspective. For about one third of the projects everything has worked out fine. Another third has overall managed to develop the technology, but it is not clear what will happen with it in the future. For the rest of the projects neither the technology development has succeeded as intended, nor is there a commercial perspective.

Table 4: Elements of Danish innovation grant schemes

Element	ATF	EUDP	BIF	MDF	FGDB
The fund's operation is based on its own law.	X	X	X	X	X
The focus is on SMEs.	X		X	X	X
Applicants are invited to apply at a certain deadline.	X	X	X	X	X
Applicants submit a declaration of interest before they are invited to submit a full application	X				
Applicants are asked to provide information on the "additionality" of the grant.	X	X	X	X	X
Applications are reviewed by external experts.	X	X	X	X	
Evaluation results are sent back to applicants.	X	X	X	X	
The fund's external board makes the final decision.	X	X	X	X	

[9] The Advanced Technology Foundation will soon be merged with the Strategic Research Council and the Council for Technology and Innovation into a common institution in order to achieve synergies in administration and simplify the funding environment for companies and universities (see "Danish council for strategic research, innovation and advanced technology" in Figure 3).

The fund's staff actively involves in project management.	X				
ATF = Advanced Technology Foundation; EUDP = Energy Technology Development and Demonstration Programme; BIF = Business Innovation Fund; MDF = Market Development Fund; FGBD = Fund for Green Business Development					

Danish Energy Authority

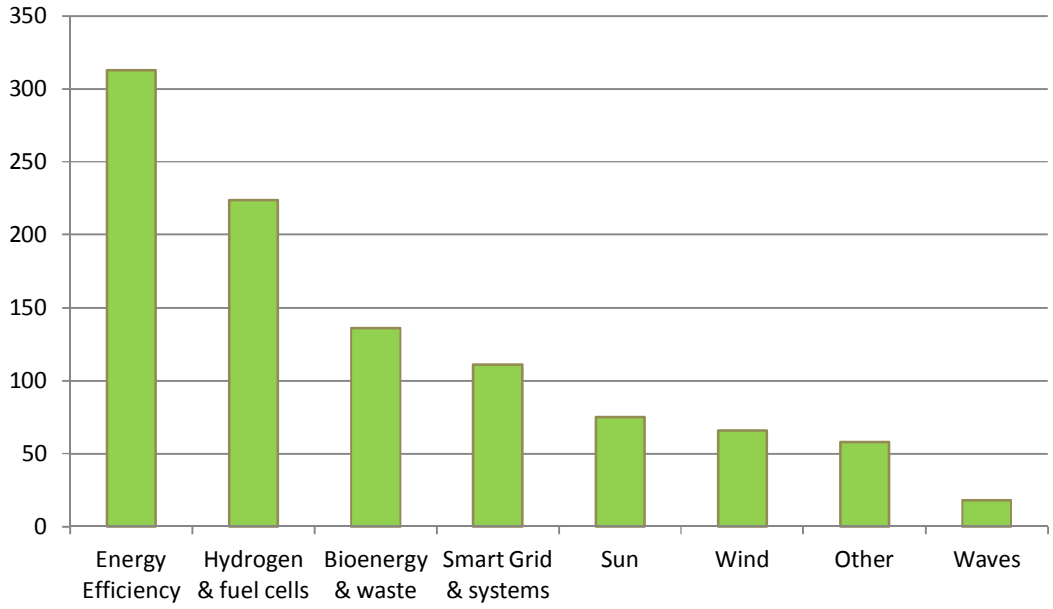
The Danish Energy Authority has a department that deals with energy technology development. It funds a variety of projects that have to do with research, development and demonstration of renewable energies, energy efficiency, smart grids, hydrogen and fuel cells. In 2012 the total public funding for energy technology R&D&D was 1bn DKK, which triggered co-financing of another 750M DKK. There are some programs that have the purpose of bringing technologies closer to the market for commercial application and deployment (see also Figure 4).

The main support scheme that is managed at the Danish Energy Authority is the **Energy Technology Development and Demonstration Programme** (EUDP). It has been established under consideration of the explicit wish from Danish industry to have a more commercial view on technology development. From the perspective of the Danish Energy Authority this goes hand in hand with the long-term target of de-carbonizing the energy supply system in Denmark, since technologies without commercial potential will never contribute significantly to de-carbonization.

The EUDP has an annual budget of 375M DKK which is invested in two rounds (see also Table 4 for structural elements of the fund). The project size under the EUDP varies a lot with an average total investment of about 10M DKK per project, of which 5M DKK is typically grant money. Some large projects (> 40M DKK) have failed in the past as they did not succeed in organizing private co-financing. Grants that go beyond 7.5M EUR per participant have to be notified to the European Commission individually. Smaller grants are covered by the notification of the whole programme. The maximum aid intensity for industrial research is 50%, with a bonus of 20% for small companies and 10% for medium-sized companies. It is possible to receive an additional 15% bonus if the project is carried out by a certain type of consortium.

The split between different types of applicants for EUDP grants is roughly: one third small enterprises, one third large enterprises, one quarter universities. Medium sized companies represent only a small fraction of all applicants. The typical project duration is 2-4 years. For each project specific milestones regarding technology development and commercialization are agreed.

Figure 4: Public funding for energy technology areas in 2012, DKK million (Danish Energy Agency, 2013)



Vaekstfonden

Vaekstfonden summarizes its general activity quite well on its **website**: "Vækstfonden is a state financing fund, which aims to create new growth companies by providing venture capital and competence. Since 1992 Vækstfonden has, in cooperation with private investors, co-financed growth in 4.500 Danish companies with a total commitment of approx. DKK 12 billion. Vækstfonden invests equity or provides loans and guarantees in collaboration with private partners and Danish financial institutions. The companies which Vækstfonden has co-financed since 2001 employ approx. 20,000 people all over the country." Vaekstfonden is a self-owned entity whose chairman of the board is appointed by the government.

This report covers only the venture capital activity of Vaekstfonden and not its other financial products, which include high risk loans (also subordinated loans) and loan guarantees. Vaekstfonden is the largest VC investor of Denmark and invests in ICT, cleantech and the medical sector. Vaekstfonden has to cover these three sectors but there is no strict mandate for the actual distribution of funds. The focus of Vaekstfonden is on start-up and later stage investments. The fund is purely profit-oriented and has 1.1bn DKK under administration. There is no limitation of the duration and number of investments, which are typically between 5 and 25M DKK and represent a share of 20-30%. Vaekstfonden does not hold 50% or more of one venture. Within cleantech the current investment focus of Vaekstfonden is *not* renewable energy, which is both due to the limited size of the fund and the lack of trust in the attractiveness of the market. Vaekstfonden has cleantech investments mainly in energy optimization and pollution control.

Danish Business Authority (Erhvervsstyrelsen)

The Danish Business Authority is an organization under the Danish Ministry of Business and Growth. It has a department for Growth and Business Development, which among other things manages funds for business development. Three recent funds are relevant from a cleantech

perspective: Business Innovation Fund (2010-2012), Market Development Fund (2013-2015) and Fund for Green Business Development (2013-2016). All funds focus on SMEs and mainly provide grants. The overall target is to stimulate economic growth, employment and exports (see also Table 4 for the general structure of the three funds).

The **Business Innovation Fund** (BIF) had two legs, innovation and market development, and accordingly supported early start-ups on one and later stage ventures on the other side. It provided funding for cleantech, for the welfare sector and for structural change in economically strained areas. Cleantech secured more than half of the funding. Over the three years of its operation the fund had a total budget of 760M DKK. More than 80% of the funding went to small companies with less than 50 employees. A midterm review of the fund's success by Deloitte in 2012 came to the conclusion that the support to cleantech and medical companies was likely to have significant positive macroeconomic impact, while the support to economically strained companies was less likely to pay off. Deloitte estimated that if revenues of the funded projects amount to only 10-20% of what was stated in the project applications, that would generate 0.5 to 1bn DKK public sector revenue over five years for every 100M DKK in support. According to Deloitte this is a realistic magnitude of the public revenue effect (Deloitte, 2012).

The **Market Development Fund** (MDF) can be seen as a continuation of the BIF. The main differences are that the innovation instrument has been abolished and that there is no sector focus any longer. The MDF has 135M DKK each year from 2013-2015. Most of the funds are earmarked for market development of Danish companies. Companies can use the MDF funding to test existing prototypes and concepts in a realistic environment or a potential customer's site. Smaller fractions of the MDF are also used for two demand side measures. The procurement of public institutions is supported with 20% of the total funding volume. And 10% of the funding are earmarked for a guarantee instrument that mitigates the buyers' uncertainty. The aid intensity is limited to a maximum of 60%, which applies for a small enterprise in a consortium. Larger companies receive less, but at least 25%. A considerable amount of the total funding goes into cleantech, but it is still too early to analyze and evaluate the activity of the fund more in detail. The MDF is open for various technologies, i.e. the share of funding for cleantech is not pre-defined but a result of the application process.

The **Fund for Green Business Development** (FGBD) has in contrast to the MDF a dedicated aim, which is "to support Danish companies in dealing with the resource scarcity that characterizes the future" (FGBD). The focus areas of the fund are product innovation (re-design of products), developing new green business models[10], promotion of sustainable materials in product design, green transition in the fashion and textile industry, less waste of food, and sustainable bio-based products based on non-food biomass. The FGBD has been established following a political agreement of the Danish government and the Red-Green party (Enhedslisten). In addition to the macroeconomic targets that are common to all DBA funds, the FGBD aims at the long-term green transition of the economy, which includes the adaptation to future resource scarcity. In contrast to other innovation funds in Denmark, the FGBD does not rely on external expertise for the evaluation of applications. Both the screening of applications and the final funding decision are made by the DBA. The external board of the FGBD has merely advisory capacity.

[10] According to the DBA a green business model is a business model that ensures a lower environmental impact and at the same time is economically viable. Typically, green business models include new types of collaborations with customers, suppliers or otherwise agreements that support more environmentally friendly solutions in a broad sense. Examples for green business models inlcude selling services instead of products, cradle-to-cradle design, and take back schemes. (Danish Business Authority, 2013)

Table 5: Overview of cleantech support instruments in Denmark

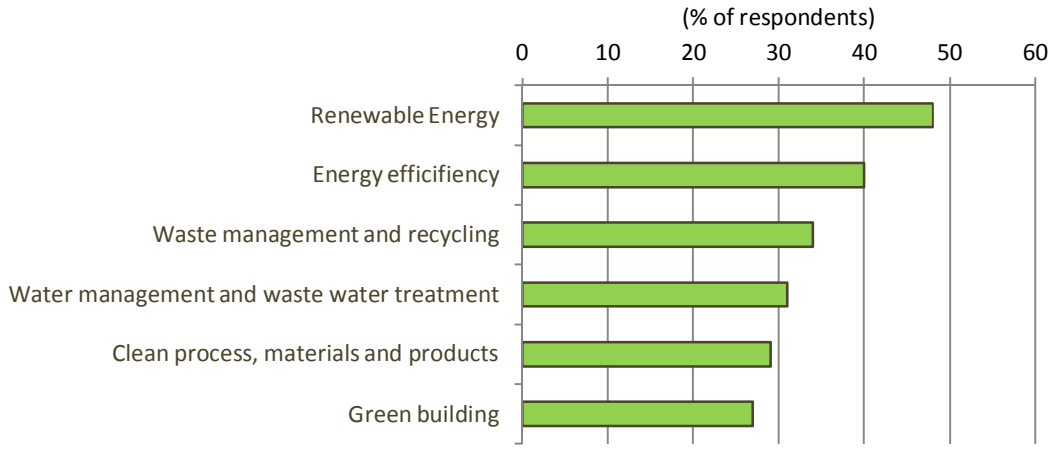
Name (Organization)	Type	Target	CT funding	Volume (in millions)	Stage	Max. aid intensity	EC notified about program
Vaekstfonden	VC	profit & economic development	partly	1 100 DKK	start-up & expansion	< 50%	no
EUDP (Danish Energy Authority)	grant	decarbonization of the economy	exclusively	375 DKK (annually)	early stage (demonstration)	60%	yes (N479/2007)
Business Innovation Fund (Danish Business Authority)	grant	economic development	mainly	760 DKK (2010-12)	seed & later stage	60%	no (GBER)
Market Development Fund (Danish Business Authority)	grant	s. nomic development	partly	405 DKK (2013-15)	later stage	60%	no (GBER)
Fund Green Business Development (Danish Business Authority)	grant	economic development & green transformation	mainly	141 DKK (2013-16)	later stage	60%	no (GBER)
Advanced Technology Foundation	grant	advancing research and economic development	partly	70 EUR (annually)	research & early stage	60%	yes (N269/2005)

3.2 Finland

Finland ranks fourth behind Denmark, Israel and Sweden on the Global Cleantech Innovation Index 2012. Finland's high ranking is based on a strong presence of cleantech innovation drivers and the emergence of cleantech innovation, while the commercialization of cleantech innovation is slightly lower than in the leading countries in this sub-category. (Knowles, 2012)

Cleantech generated a turnover of EUR 24.6 billion in Finland in 2012 with an annual growth rate of 15%. In contrast, the overall turnover of Finnish industry decreased by 0.6% in 2012. The growth of the cleantech sector is even expected to increase in 2013 (Tekes, 2013a). The success of the Finnish cleantech sector might be partly explained by an extensive public funding infrastructure. However, when asked about public funding needs in cleantech, participants in a study of the national network Cleantech Finland came up with a long wish-list. On top of the list of cleantech sectors that require public support are energy technologies (see Figure 5).

Figure 5: Which cleantech sectors are in most need of public funding in Finland? (Cleantech Finland, 2013)

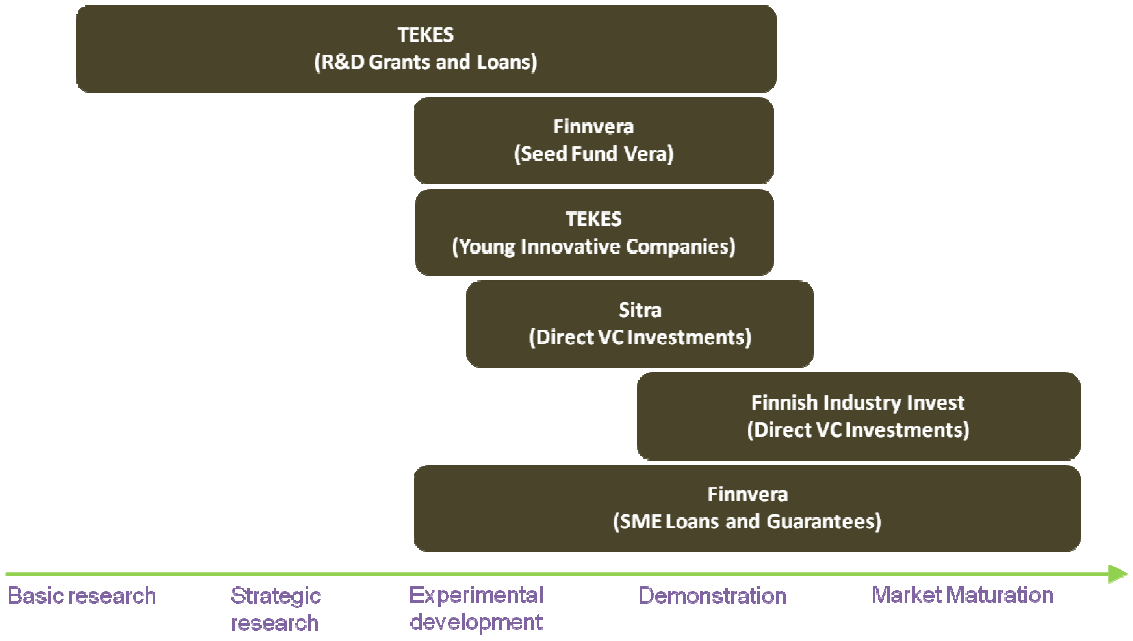


Already now, public funding is present in all stages of cleantech innovation and commercialization in Finland (see Figure 6). Core public actors in this field are Tekes (public funding of research, development and commercialization), Sitra (independent fund under supervision of the Finish parliament), Finnvera (state-owned financing company) and Industry Invest (state-owned investment company).

Tekes

According to its website "Tekes is the most important publicly funded expert organisation for financing research, development and innovation in Finland." It is has run various programs with relevance for cleantech financing in the past years. Tekes does not take equity in the enterprises or projects it supports. Companies can apply for funding in the form of grants or loans continuously. Tekes is an umbrella organization that collaborates with other public actors who are involved in innovation financing. Therefore, it is helpful to differentiate between Teke's own funding schemes and its support programs, which do not provide funding directly but guide participants to potential funding sources and provide business development consulting. The participation in Teke's support programs is not necessary in order to receive public grants, but it turns out that participation is very helpful in practice.

Figure 6: Organizations and instruments in the Finnish innovation system (adapted from Grundsten, 2012)



There are two general funding schemes that provide significant support to beneficiaries, which are called "R&D aid scheme" and "Young Innovative Companies Programme". Both schemes have been notified to the EC since state aid is granted. Under the R&D aid scheme various programs have been funded (see Table 6). Both funding schemes utilize the state aid rules almost to the largest extent possible. The young innovative companies program seems to have taken the description of young innovative enterprises in the Community framework for state aid for R&D&I as a blueprint for the funding measure.

Table 6: Tekes programs with cleantech relevance (European Commission, 2013a; Tekes, 2011)

Program name	Years	Total budget/Tekes share (million EUR)
BioRefine (new, biomass-based products)	2007-2012	250/100
EVE – Electric Vehicle Systems	2011-2015	80/40
Fuel Cell	2007-2013	144/50
Green Growth	2011-2015	n.a./79
Green Mining	2011-2016	60/29
Groove – Growth from renewables	2010-2014	n.a./95
Sustainable Communities (mainly real estate/ construction)	2007-2012	91/47

Young Innovative Companies (not only cleantech)	2008-	n.a./20 (annually)

In addition to the funding schemes there are two programmes that provide support with organisational issues, i.e. "Development of organisation, management and processes" and "Planning for global growth". Neither of the two has been notified to the EC as the value of support falls under *de minimis*.

Furthermore, Tekes runs several campaigns for commercialization of innovation and growth companies. The most relevant campaigns for the cleantech sector are the "Vigo accelerator program" and the "Growth track program".

The **Vigo programme** does not have an own budget for funding but builds on the Young Innovative Companies Programme. Participating companies get access to the know-how and the network of a dedicated accelerator, a private VC company. For the cleantech sector this is Cleantech Invest. Together with the accelerator companies get short-track access to a 1M EUR public grant of the Young Innovative Companies Programme. The accelerator then co-invests smaller amounts of about 30 -300 000EUR (in few cases more than 700 000EUR) into the portfolio company. The period in which the accelerator actively works with a portfolio company is typically 1.5 to 2 years. The accelerator has in theory the opportunity to charge the portfolio company a fee of up to 9000EUR per months. In practice the accelerator gets a its "payment" in the form of a higher share in the portfolio company, as the portfolio companies often do not have sufficient cash flow to pay the fee. VC invested into portfolio companies comes both from private and public sources. Public VC is provided by Finnvera, who is partner of the Vigo programme. Finally, it is important to note that not just participants of the Vigo programme have access to the up to 1M EUR grant under the Young Innovative Companies Programme; but the access is certainly easier for participants.

There is neither a comprehensive evaluation of the Vigo programme nor of the Young Innovative Companies programme, yet. In a 2011 ranking of Finnish investors 19 out of the 20 most promising start-ups were Tekes-clients, of which 13 got funding from the Young Innovative Companies Programme and 9 participated in the Vigo programme. (European Commission, 2013a)

The **Growth Track programme** guides SMEs to public expertise and financing services in order to enable growth and internationalization. It addresses a much later stage than the Vigo programme, but just like Vigo it builds on existing funding schemes. The growth track programme is jointly run by Tekes and several other organizations, which are all members of the Enterprise Finland network. The network combines all information and services that both start-up and established enterprises need.

Strategic Centres for Science, Technology and Innovation (SHOKs)

SHOKs carry out long-term strategic research in important research areas. Though research tends to be pre-commercial, various industrial companies are involved in the centres. One of the six SHOKs deals with cleantech. It is called Cluster for Energy and Environment and claims to be "designed to bring focus and industry lead to the research." The cluster operates as a platform that connects and steers public and industrial R&D&I activity. It receives base funding from Tekes, while funding for the seven research areas come from public programs (mainly the Tekes programs mentioned above) and the industry stakeholders.

Sitra

Sitra is an independent fund operating under Finnish parliament supervision and has its own law that regulates the operation. Sitra has a clear sustainability agenda, but is still a profit-oriented fund. One investment track is cleantech, which includes both direct and fund investments. Currently there are four investments into cleantech funds worth 24M EUR. Moreover, Sitra holds ten direct cleantech investments. Sitra invests in total about 10M EUR into ventures every year. After the first funding round Sitra typically has shareholding of 10-30%. Investments typically range from 300 000EUR to 1M EUR. Sitra strives for syndication in all of their investments, but can also invest alone. The typical exit route for direct investments is trade sales. A few IPOs have happened in the past but they are rare exceptions. There is no specific guidance for the share that cleantech investments should have in total investments.

Sitra is completely independent from state financing, i.e. does not receive funding from taxes or the state budget. Its operations are exclusively funded from the returns of endowment capital and capital investments. Therefore, Sitra is not subject to EU state aid regulation. Considering the rather small size of investments, the typical shareholding of clearly under 50%, and the double bottom line approach of Sitra (profit and social benefit), the fund would most likely comply with EU state aid regulations. While Sitra is financially independent of the state, it is politically influenced. There is a specific framework law about Sitra. The members of the supervisory-board are appointed by the parliament and three Ministries have to represent on Sitra's board.

Finnvera

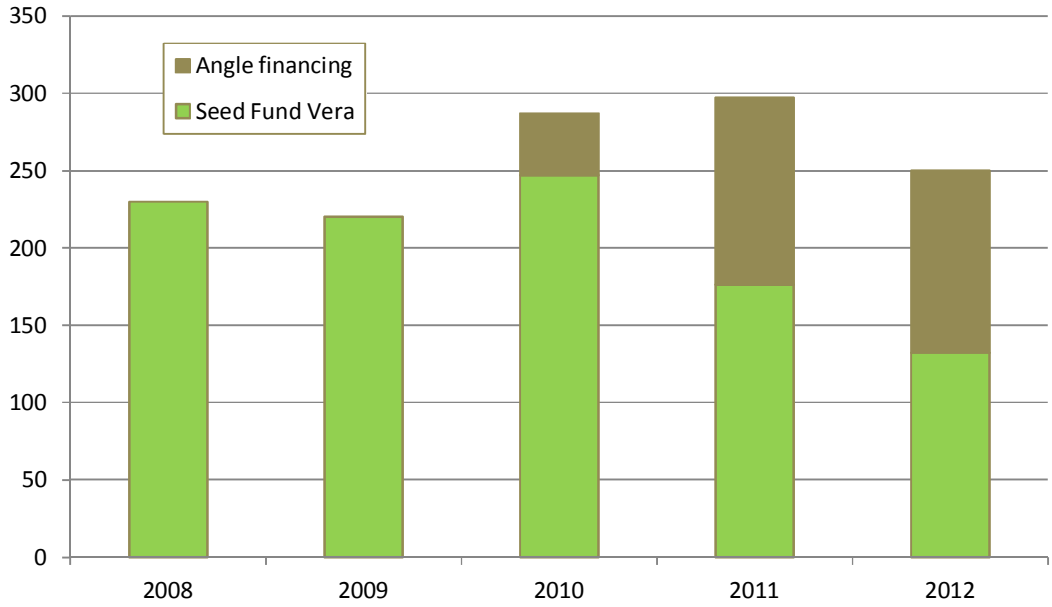
Finnvera is a state-owned financing company that is active in three business areas: SME financing, export financing and VC investments. This report focuses on Finnvera's VC activity, notably on the two VC entities Veraventure Ltd (100% ownership) and Seed Fund Vera (93% ownership). Since 2003 Veraventure has the mandate to manage regional VC fund investments for Finnvera. Currently it holds significant minority shares in 12 regional VC funds.

The goal of Seed Fund Vera is "to cover shortcomings existing on the market between product development funding and private equity investments. Finnvera does not compete with private financiers; instead, it strives to supplement the financial market." (Finnvera, 2013b) Seed Fund Vera's holding is 10-40% per venture. Initial investments are up to 0.5M EUR. In 2012 the fund made 76 investments with a total value of 17M EUR. Seed Fund Vera is a revolving fund, i.e. all returns from the fund are invested in new target enterprises. Currently less than 10% of the portfolio companies are from the energy and environment sector.

The EC has been notified about the Seed Fund Vera in the context of state aid regulation. The fund remains within the limits set by the risk capital guidelines so that no formal investigation procedure had to be started in order for the EC to decide that the measure is compatible with the common market.

In addition to the two VC funds, Finnvera administered for several years a network of business angels, whose operation was transferred to the newly-founded Finnish Business Angels Network in early 2013. The network tries to fill the funding gap between product development and private equity investments by adding to the available public funding. (FiBAN, 2013)

Figure 7: Dealflow of Finnvera's direct investments



Finnish Industry Investment

Finnish Industry Investment Ltd (FII) is a state-owned investment company with the mission to support domestic business through venture capital and private equity investments in order to stimulate employment and economic growth. FII is both fund investor and direct investor with a total annual investment volume of about 100M EUR. In all its direct investments FII is minority owner. Direct investments are focused on the expansion stage. FII's initial investments reach from 0.5M to 10M EUR. Cleantech represents a minor share of FII investments. The only dedicated investment sector is mining. The main purpose of FII's VC and PE activity is to increase the available amount of funding by providing public funds and crowding in private capital: "Our key principle is to work hand-in-hand with private investors from Finland and abroad, to share risks while boosting the availability of funding […]." (Industry Investment, 2013) In addition to its direct investments, FII has currently invested 680M EUR in funds, of which more than 100M EUR are dedicated towards Finish VC funds.

Table 7: Overview of cleantech support instruments in Finland

Name (Organization)	Type	Target	CT funding	Volume (in millions)	Stage	Max. aid intensity	EC notified about program
Young Innovative Enterprises (TEKES)	grant	economic development	partly	20 EUR (annually)	seed	unlimited	yes (N309/2007)
R&D aid scheme (TEKES)	grant	advancing research and economic development	partly	300M (annually)	early stage	< 80%	yes (N356/2007)
Seed Fund Vera Ltd (Finnvera)	VC	economic development	partly	17 EUR (invest. 2012)	early stage	< 50% (< 93%)[11]	yes (N395/2007)
Sitra	VC	profit & socio-economic development	partly	ca. 20 EUR	start-up	< 50%	no
Industry Invest	VC	profit & economic development	partly	22 EUR (invest. 2012)	expansion	< 50%	no

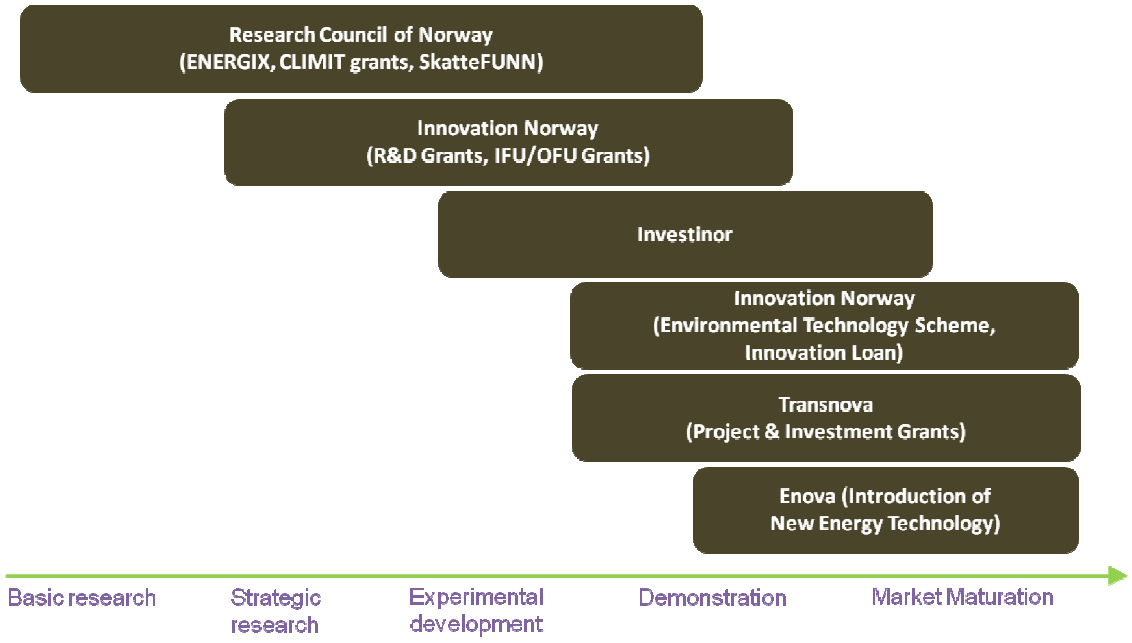
[11] About 93% of Seed Fund Vera is public capital. Seed Fund Vera can make investments alone if they are limited to 0.5M EUR within 12 months and 1.5M EUR within the total investment period for one venture.

3.3 Norway

Norway ranks eleventh on the Global Cleantech Innovation Index 2012. Despite the presence of general innovation drivers and emerging cleantech innovation, Norway missed a higher ranking due to the lack of cleantech-specific innovation drivers and less evidence for commercialization of cleantech. (Knowles, 2012)

In 2010 some 47 000 people were employed in cleantech in Norway, the turnover of the cleantech industry was 195bn NOK, and exports summed up to 23bn NOK, which makes cleantech the eighth largest industry of the country. The by far most significant sub-sector is hydropower with about one third of total revenues. (Intpow, 2012)

Figure 8: Public cleantech innovation support instruments and their interconnenctions (Innovation Norway, 2012b)



Innovation Norway

Innovation Norway is the central public instrument for innovation and development of Norwegian enterprises and industry. Companies have access to various business support services and financial means. In some cases the actual support (in the form of loans and grants) comes from organizations outside Innovation Norway, like the Research Council of Norway and Enova.

Innovation Norway has a set of support instrument, which do not have a cleantech focus:

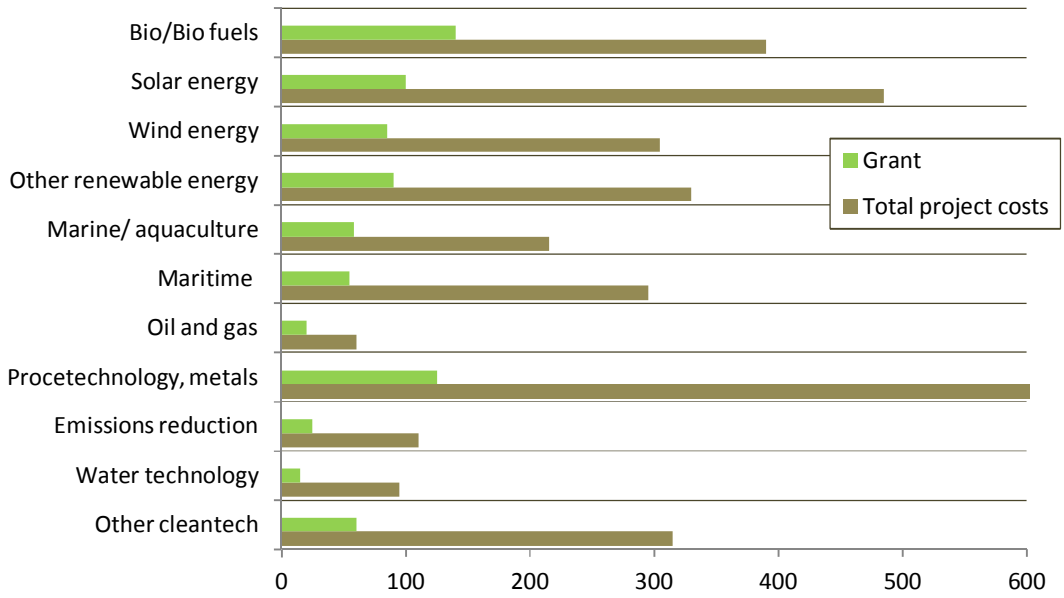
- **Grants**. The regular grants are accessible for (mainly) SMEs in all sectors. The grants comply with EEA state aid regulation, i.e. both the aid intensity and the thresholds are limited depending on the size of the enterprise, the purpose of the funding, and the geographical location.

- **IFU/OFU grant scheme**. The scheme provides grants for industrial R&D, up to 50% for SMEs and 65% for consortia including SMEs. Basis for the grant is an agreement between applicant company and a (private or public) client who is in need of the technology. Clients are typically large established companies with market access and a strong need for the applicant's solution.
- **Innovation Loan**. This is the high-risk loan instrument of Innovation Norway. It operates with an expected loss rate and finances innovative projects with profit potential that have difficulties finding financing on the market. The innovation loan can be used to finance up to 50% of a project. The interest rate for the loan is above the rate for well-secured loans, however not fully reflecting the risk of the projects it is used for. Interest-free loan periods can be negotiated. The innovation loan is targeted at the expansion phase and helps to finance market development and internationalization.
- **Low risk Loan**. The low-risk loan instrument of Innovation Norway is not very different from regular banking loans and not targeted specifically at innovation funding. It provides well-secured long-term financing and operates without an expected loss-rate. The two loan instruments of Innovation Norway are currently under evaluation.

In addition to the general funding instruments, Innovation Norway has various sector specific programmes. Among others there are programmes with cleantech relevance:

- The **Environmental Technology Scheme** is a grant scheme targeted at cleantech companies in the late start-up phase. Innovation Norway co-finances innovative cleantech companies. The aid intensity ranges from 25% for large enterprises to 45% for small ones. A 15% bonus can be obtained if the project is carried out together with additional private companies. In 2012 public funds worth 33M EU were allocated to the program. Per individual project funding of up to 7.5M EUR is possible.
- The **Innovation Cluster Scheme** is jointly run by Innovation Norway, the Research Council of Norway and SIVA and includes two main programmes: ARENA and the Norwegian Centres of Expertise. ARENA supports networks that do not fully function as industrial innovation clusters, yet; while the clusters under the NCE programme are more mature and aim for international growth and increasing competitiveness. One of the 12 centres of expertise is in the cleantech sector and deals with smart energy markets. In the ARENA programme four of the regional clusters are in the cleantech sector (two wind energy, one bio energy, one material technology). The Innovation Cluster Scheme offers both advisory and financial support and had a volume of about 100M NOK in 2011. (Innovation Norway, 2012a)

Figure 9: Grant from environmental technology scheme versus total project costs 2011-2013 (Innovation Norway, 2013a)



Investinor

Investinor is a public VC investment company that manages 550M EUR. It acts on the same terms as a private investor. Investinor takes minority ownership and always syndicates its investments. In recent years no investments into cleantech have been made. Investinor still has 4 cleantech companies in its portfolio of overall 29 companies, but did not get any new portfolio company in this sector since 2010. In 2012 the government mandate of investinor was slightly modified in order to give it more freedom in prioritizing sectors. The old mandate earmarked certain amounts for sectors like maritime and cleantech. The change of the mandate is, hence, in line with investinor's shift away from cleantech. Investinor still has a large amount of capital at its disposal for new investments. Just 150 out of 550M EUR are currently invested. (Investinor, 2013)

The Research Council of Norway

The Research Council of Norway engages in cleantech R&D from basic research to industrial research and experimental development. It runs dedicated energy technology programs, but also programs that address the commercialization of innovation in general. Most support programs have deadlines for application. All programmes are notified to the authorities to comply with EEA state aid regulation. In the area of energy R&D there are currently three relevant programmes:

- **ENERGIX** is an applied energy research programme with a budget of 45M EUR per year. It succeeds the RENERGI programme. The primary goal is not macroeconomic development but the restructuring of the Norwegian energy system. Organisations and consortia from the research community and from industry are eligible. In the first funding round in 2013, 25 projects have been awarded funding. The demand, especially from industry, was so large that the programme's board decided to award more to industrial

research than outlined in the call for proposals. The Research Council received 122 applications for more than 1bn NOK. The success rate was exceptionally low at about 20%.

- **CLIMIT** is the Norwegian research programme for Carbon Capture and Storage (CCS). It is run together with the state-owner CCS company Gassnova. CLIMIT has a budget of about 12M EUR per year.
- The **Centers for Environment-friendly Energy Research** conduct focused long-term research and receive funding for the duration of 5 to 8 years. The centres involve universities, research institutes, and companies. The Research Council of Norway funds up to 50% of the budget of the centres. The potential for innovation and value creation is a clear target of the scheme. There are currently 8 centres in cleantech which mainly deal with renewable energy and CCS. The annual volume of the scheme is about 15M EUR.

In addition to the energy specific support schemes, the Research Council of Norway also runs general schemes for R&D commercialization:

- **User-driven Research based Innovation (BIA)**: BIA is one of the largest programmes of the Norwegian Research Council and aims at crowding-in industrial R&D funding in order to increase the total level of R&D in Norway. In 2013 the programme had a budget of 400M NOK for the first application round. The funding was allocated to 45 applicants. The programme is open to R&D projects in all branches of industry or thematic areas. Typically consortia from industry and the research community apply jointly. State aid rules apply and set the limits of this funding scheme in terms of aid intensity and funding thresholds.
- **SkatteFUNN**: SkatteFUNN is a tax incentive scheme that gives all companies that are subject to taxation in Norway the chance to apply for a tax relief. Certain R&D project costs can be deducted from taxes. If tax deductions are greater than tax liabilities, companies get the difference in cash. However, just 20% of the costs of an R&D project can be claimed up to a total of 5.5M NOK or 11M NOK if research services are procured from recognized research organizations. The budget for the SkatteFUNN project is not limited, i.e. application is not competitive. Aid under the SkatteFUNN scheme accumulates with other public aid and has to be considered in order to stay below maximum aid thresholds.

Enova

Enova is a fully state-owned energy fund which has three means of financing: the state budget, a levy on the electricity price, and interest generated by the fund itself. Enova is a relevant actor with respect to the market introduction of new energy technology. They offer different support schemes both for the producers of innovative energy technology and the clients. Most relevant is the **Programme for the Introduction of New Energy Technology**. This programme supports concrete, physical installations. Their success is measured both in kWh (produced from renewable energies, or reduction of energy consumption) and in monetary terms. The revenues from energy production or savings must be higher than the operating and maintenance costs. The scheme operates according to EEA state aid rules, which means that all the support cases above 7.5M EUR are notified to the authorities.

If Enova's energy technology funding for building are not considered, the funding for the Introduction of New Energy Technology summed up to 93M NOK in 2012. Enova keeps track of the energy production/savings that were triggered by their support and also calculate the funding level per kWh for different projects and sectors. (Enova, 2013)

Transnova

Transnova is a public support program for climate efficient transportation (EVs, biogas, hydrogen, infrastructure around it). For 2013 Transnova's budget is 87M NOK. The main support instrument is competitive grant programmes to projects that are between R&D late phase and market introduction. There are different thematic programmes throughout the year. The programs have deadlines, and different applicants compete for the grants. Funding by Transnova fall under the GBER and therefore did not have to be notified to the EFTA authorities.

Table 8: Overview of cleantech support instruments in Norway

Name (Organization)	Type	Target	CT funding	Volume (in millions)	Stage	Max. aid intensity	EFTA notified about program
Investinor	VC	profit & economic development	currently not	353 NOK (invest. 2013)	start-up & expansion	< 50%	no
Environmental Technology Scheme (Innovation Norway)	grant	economic development	exclusively	ca. 33 EUR	early stage	25-60%	no (GBER)
Innovation Cluster Scheme (Innovation Norway)	grant	economic development	partly	100 NOK (in 2011)	early stage	< 50%	EFTA decision 09/11/COL
ENERGIX (Research Council of Norway)	grant	restructuring the energy system	exclusively	45 EUR	early stage (demonstration)	25-60%	EFTA decision 93/183
CLIMIT (Research Council)	grant	advancing CCS technology	exclusively	12 EUR	early stage (demonstration)	25-60%	EFTA decision 302/05/COL
Centers for Environment-Friendly Research (Research Council)	grant	innovation through research	mainly	15 EUR	early stage	< 50%	no (GBER)
User-driven Research based Innovation (Research Council)	grant	economic development	partly	400 NOK	early stage	25-60%	EFTA decision 93/183
SkatteFUNN (Research Council)	tax break	increasing private sector R&D activity	partly	unlimited	early & later stage	< 20%	EFTA decision 16/03/COL
Introduction of new energy technology (Enova)	grant	economic development & emissions reduction	exclusively	93 NOK	later stage	< 70%	EFTA decision 248/11/COL
Transnova	grant	substitution of fossil fuels	exclusively	90 NOK	later stage	< 80%	no (GBER)

		in transportation					

4. Results of interviews and case studies

4.1 Public cleantech funding instruments

Before presenting and analyzing different cleantech support schemes and their respective designs, it is an important question to ask whether public funding is an adequate policy instrument at all. All interviewees generally agreed that direct support to cleantech companies is necessary for the development of the sector and that framework regulation and demand side measures alone are not enough. One interviewee summarized this finding very well: "You need both a push and a pull. Of course, you can make the pull so strong that you don't need grants anymore. But that would require unrealistically strong pull instruments. So balancing these two may be the ideal way of doing things." (Interview 3). While there was consent about the importance of public support schemes, the target, the objectives and the design of the respective schemes varied significantly. The following presentation of interview results addresses this variety and follows mainly the structure of the interviews which were conducted (see also Annex 1 for the interview guide that we used).

Targets

At a political level there are various reasons why supporting innovation and market development of the cleantech sector might be a good idea. It is cost effective, helps to achieve environmental targets, and stimulates economic development (jobs, exports, growth). If there is enough capital on the market the economic rationale alone should be enough for the sector to develop. In practice the sector is experiencing for several years in a row severe funding gaps. A Norwegian expert of the Nordic venture capital market summarized the situation in his country as follows: "In Norway I experienced in early stage investments a lot of focus on clean energy and energy efficiency from 2003-2008. Then, as a result of the financial crisis and unmet expectations, cleantech financing collapsed and never recovered." (Interview 10) Especially companies in energy production have problems to find sufficient financing, since upfront investments are high and time to market is long. Problems of getting financed on the private capital market, the economic crisis and nevertheless growing markets for cleantech are the context for many public support schemes.

Economic development, i.e. more jobs, more exports and more turnover, appears as a target in all funding schemes that were researched for this report. If support instruments are close to the market it appears as a very immediate target, but it increasingly appears in more R&D focussed schemes as well. The EUDP of the Danish Energy Authority added some years ago the commercial perspective to the demonstration projects it supports. While the de-carbonization of the economy is still the main target, projects have to prove that they are commercially viable and scalable. "The EUDP programme took into consideration the explicit wish of industry to have a more commercial view on technology development. In the end a technology can only contribute significantly to de-carbonization if it is successful and can be widely applied." (EUDP)

On the other hand, support instruments that do not explicitly focus on cleantech but that are purely focussed on economic development can have a positive **environmental and social impact**. The evaluation of one of the funds of the Danish Business Authority came to the conclusion that if the "investment of public funds in the Business Innovation Fund is

considered a societal investment, a 5-10-doubling of the invested funds in five years seems to be a realistic magnitude of the yield." (Deloitte, 2012)

Besides economic and social targets, public equity instruments operate with a third category of targets and that is **profit**. Within public VC profit is widely regarded as the main target, not least as a means to sustain activity: "A government VC fund should work as private. If they don't have profits then they would need money every year. The only way you can sustain activities is to you keep on getting profits to make new investments." (Interview 1). However, public VC funds usually have some additional mandates. "We operate with a double bottom-line approach. The target of the fund is to make profit, but we are also looking for positive social impact in Finland, e.g. in terms of emissions reductions or job creation, which are positive for the national economy" (Interview 7). The question whether public equity instruments should focus on profit alone or take the social welfare perspective into consideration is further discussed below (see section 5.2).

Targeted phase of the innovation system and enterprise size

The target or rationale behind a public cleantech support instrument has a large impact on the phase and the size of enterprise it supports. Economic development is the major focus of schemes that support market development and enterprises in the expansion phase, while support in the demonstration phase is more often motivated by attempts to advance clean technology and restructure the energy system. Currently government is more or less involved in all phases of the innovation system in the Nordic countries – from basic research to expansion (see Figure 3, Figure 6 and Figure 8). Irrespective the limits that are set by European state aid regulation (see section 4.2), there are three main factors influencing the phase of the innovation cycle and the enterprise size that is targeted by public interventions: the occurrence of funding gaps, the additionality of the aid and the consideration of existing funding instruments.

It is important to **avoid gaps and discontinuities** in funding in order to assure that innovations, which are often developed with the extensive and costly support of public research infrastructure, find their way to the market. In fact, the Danish, Finnish and Norwegian governments are active in all phases of the innovation system. Still this does not automatically remove all funding gaps since the investment volumes of the public sector might be insufficient. In Finland a gap has been identified in the seed-stage with respect to follow-up investments. Since it is not expected that the private sector will fill this gap "Tekes is making preparations to launch early-stage venture capital investments" (Finnvera, 2013a) The situation in Norway is comparable. The funding gap for early stage ventures has been identified and systematically researched (Grünfeld, Iverson, & Grimsby, 2011). As a consequence the government notified the EC in 2012 about a seed capital scheme covering six funds with an investment volume of up to 500M NOK each.

Whenever a clear funding gap has been identified it is likely that public funding will be additional to what the private capital market can offer. In practice it is often difficult to completely **avoid funding that is not additional**. The cyclical nature of both the economy and the investment activity of VC and PE funds make it difficult to pinpoint a particular phase of the innovation system, in which public investments are generally additional. Currently there is, however, wide consensus that the early stage is particularly under-capitalized. A Danish VC investor explains this with the risk in that phase, which is currently

too high for private investors: "The seed stage has to be governmental. That's when the people only have an idea, and they have a lot to do to make it into a viable business model. The level of risks is then so high that it's better if the Government pitches." (Interview 1). Although it is difficult to make robust assumptions about additionality in different phases of the innovation system, there exist proxies for approaching additionality in practice. One proxy is the enterprise size. Most support schemes that are covered by this report focus on SMEs, assuming that large enterprises have the means to finance the commercialization of innovation themselves. The second proxy is other funding. If a venture already secured large amounts of funding via loans or equity of large investors, it is likely viable without public support.

When a government decides to increase funding activities in a certain phase of the innovation system, it is important to **avoid large overlaps with existing support instruments.** Instruments that address similar target enterprises are often inefficient as they require double administration and add complexity in an already complex environment of public funding instruments. Norway is closest to having a streamlined innovation support system. Innovation Norway manages various different funding instruments and moreover guides enterprises to additional support schemes. Denmark is still reforming its public innovation support infrastructure. The Business Innovation Fund of the Danish Business Authority still had two legs – innovation (early stage) and market development (expansion). Its successor, the Market Development Fund, abolished the innovation part in focuses exclusively on market development. Furthermore, three institutions that are financing pre-commercial R&D&I projects will soon be merged into one, "The Danish Council for strategic research, innovation and advanced technology" (see Figure 3).

Sector targeted within cleantech

Initially this research addressed cleantech as a whole. During the research process it turned out that there are large differences between sectors within cleantech and between countries. Therefore, this section briefly covers the important aspects to consider when differentiating within cleantech. A recent study of the market potential of Nordic cleantech among other things mapped the respective strength of the Nordic countries within cleantech (see

Table 9).

It is particularly important to break down the cleantech sector into sub-sectors in order to tap the full economic development potential. An interviewee from Norway summarized the need for focus in his home country as follows: "Investing public money in the cleantech sector regardless of focus and technological opportunities is waste of money. In Norway government money for cleantech should be spent where private sector returns are as good as possible. And usually you find these kinds of projects in the context of strong industrial clusters, such as oil and gas, maritime, and aquaculture." (Interview 10) The interviewee further elaborated that wind support might make sense in Denmark, where innovation can built on an existing industry and trade channels, while this is not true for Norway. Similarly you might argue for bio or wood based energy in Sweden or Finland.

Table 9: Ranking of strongest cleantech sub-sectors in the Nordic countries (Andersson, 2012)

Country	Cleantech competency
Denmark	1. Wind 2. Bio energy 3. Water 4. Energy efficiency, esp. smart grid
Finland	1. Energy efficiency 2. Bio energy 3. Env'l monitoring & measurement 4. ICT in cleantech
Norway	1. Hydro power 2. Solar 3. Wind, esp. offshore 4. Bio energy

The case study research illustrates two different strategies how competitive strengths in sub-sectors of cleantech are currently conosidered when designing public funding instruments. The first approach is to have open schemes that cover various innovative technologies and simply pick the most promising and robust applicants/deals. This approach was chosen by the Danish Business Authority and also the Danish Advanced Technology Foundation. Their funds are not earmarked for cleantech, but still a significant share of total investments goes into cleantech. Supported cleantech projects typically have a strong commercial perspective.

The second strategy is the complete opposite of the first and implies focusing on a narrow sub-sector of cleantech. This can be especially observed in technology areas were the race for technology leadership is still ongoing. Both Finland (Tekes) and Norway (Innovation Norway) recently ran specific support programs for bio-refineries. It remains to be seen whether this approach is successful. Several interviewees casted their doubts about governments "picking the winners". There certainly is justified doubt about the efficiency of government planning. On the other hand, some clean technologies would have never seen the light of day without extensive government intervention.

Type of instrument

Public cleantech financing is given in various different forms, such as grants, loans, guarantees and equity. With the exception of grants all other financing instruments are also available on the free market. The main differences are that the costs for debt or equity financing on the private market are significantly higher and that some enterprises do not get financing on the private market at all as their associated risks are too high.

Grants are the most straightforward funding instrument and turned out to be popular with start-ups and private co-investors alike. They do not require much involvement of the public investor and are easy to administer. Interviewees pointed out that grants are especially suitable for pre-seed or seed financing when the risks are extremely high. Furthermore, grants are relevant for financing large demonstration projects that would not be implemented without "cheap" public money. On the other hand, venture capital investors were critical about public grants in later stages. VC investors certainly appreciate public grants to their own portfolio companies, but they also criticise the uneconomical use of public money. One investment manager asked: "If they put all this effort into screening applicant companies and then grant them significant amounts of money, why shouldn't they also take a share in the

companies? Just one great success story could pay back a whole annual budget of the scheme." (Interview 6)

Lack of fiscal sustainability is one of the main arguments against grant schemes, which fully depend on payments from the state budget. Another critical factor is the incentive structure. Grants do not create a strong pressure to commercialize a technology as quick as possible. That is different if entrepreneurs have to pay back a loan or satisfy the claims of equity investors. This lack of incentives is partly addressed by splitting the grant payment into tranches and formulating milestones that have to be reached for the payments to proceed. Most of the researched grant schemes operate like this, which is certainly better than unconditional grants but does not fully replace the incentive effect that loans or equity deploy.

Loan instruments are very diverse. In a regular bank loan the interest rate should reflect the associated risks. The support element of a public loan is typically the lower interest rate, but it might also be the period over which the loan has to be repaid, interest free periods, the fact that it is subordinate to other loans, or the fact that a loan is granted at all. What is common to all of these support elements is that they make the loan cheaper, which means more costly for the public authority that is issuing it. With respect to state aid the aid element of a loan is expressed as "gross grant equivalent", which has to be calculated by the authority that is notifying the aid measure to the EC. The same procedure is applied for aid in the form of guarantees. Only aid for which the gross grant equivalent can be calculated without a comprehensive risk analysis is considered "transparent aid" according to the EU state aid rules.

Loans played a minor role within this research. The main reason for this is their complexity and that the specific aid element is difficult to quantify. Some public loans are just marginally different from bank loans. Innovation Norway offers a dedicated innovation loan, which is a high risk loan with an expected loss rate of about 30%. This loan goes far beyond what banks are offering. The evaluation of this instrument is ongoing. It can be expected that this instrument has a high degree of additionality, while performing poor on the financial incentives it generates.

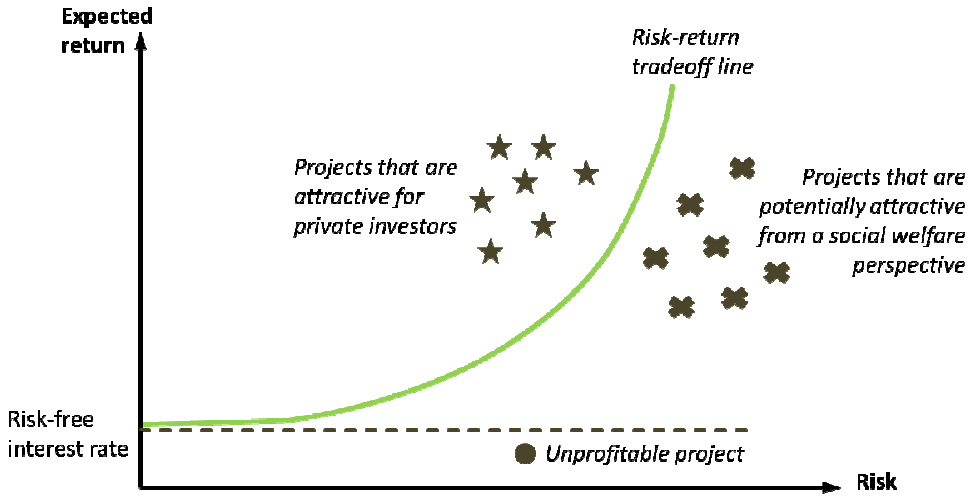
In addition to grants and loans, cleantech start-ups also receive support in the form of **guarantees**. These are especially relevant for securing debt financing, for example from local banks, in the early stage of an enterprise. When facing market introduction of an innovative technology, guarantees can help to reduce the risk for the buyer of that technology. The Danish Business Authority, for example, issues guarantees for up to 60% of the costs that occur if the innovation element of a new technology system that has been bought by a client of an innovative company does not work. The remaining costs are equally carried by the buyer and the seller of the technology. In Finland Finnvera offers guarantees to SMEs and in Norway it is Innovation Norway that offers favourable guarantees for young enterprises seeking debt financing. The Danish Vaekstfonden also offers two guarantee instruments.

In addition to above mentioned financing instruments, all Nordic countries also have **public VC** activity. There are two general types of public VC, direct investments and funding of funds. Currently the most prominent players are Vaekstfonden in Denmark, Sitra and Seed Fund Vera in Finland, and Investinor in Norway. The capital of the funds has partly been

raised by extraordinary events. Vaekstfonden's initial capital stems from the sale of a state-owned insurance company and Sitra has become so large because it owned shares of Nokia.

All public VCs have cleantech companies in their portfolios, though none has a dedicated amount of funds set aside for cleantech only. Both Vaekstfonden and Sitra have active cleantech investments tracks. In contrast, Investinor has not done any initial investments into cleantech for several years. In their direct investments public VC funds are always minority shareholders. However, all interviewees stressed that public funds should operate profit-oriented and invest *pari passu* with private investors. Like that the only mission of public VC would be to increase the availability of capital. On the other hand, the mandate of public VC often includes targets that go beyond direct profit, including economic development objectives or even environmental objectives. Therefore, projects that are not expected to be profitable from a private investor's perspective might be profitable from a social welfare perspective (see Figure 10).

Figure 10: Selection of potentially profitable projects from a private and public VC investor's perspective (adapted from Grünfeld et al., 2011)

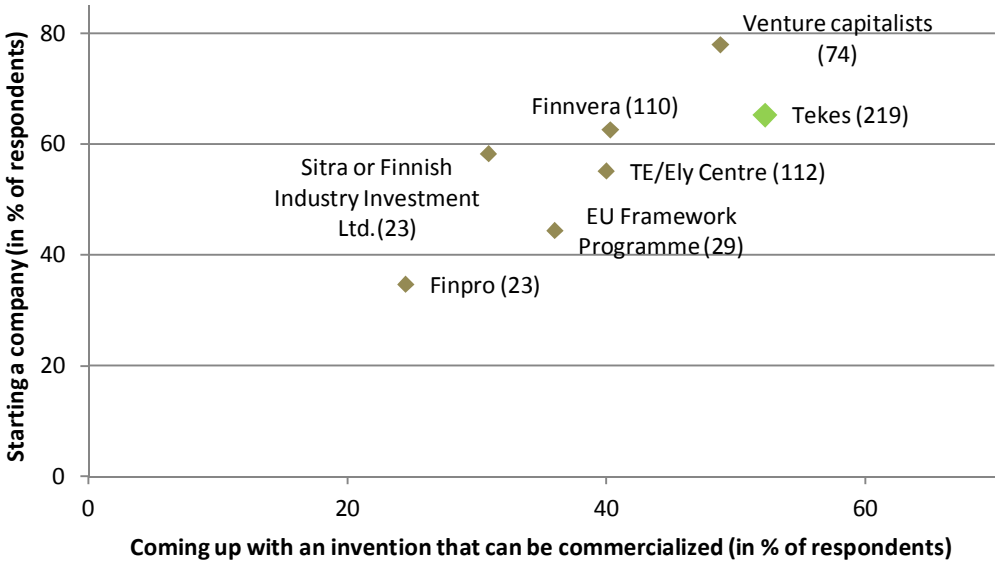


The differentiation between internal profitability of a project or venture and the social welfare perspective was also reflected in the interviews and the case study research. On one hand, public VC managers pointed out that their activity is purely profit-driven, that they seek for the best deals, and that they prefer later stage investments due to lower risks. On the other hand, two experts of VC investments in cleantech stressed that public equity instruments should, of course, be profit-oriented and professionally managed; but additionally they should be much more risk-taking than private VC, move into earlier phases of the start-up, and provide larger amounts of capital, since cleantech start-ups in particular are very capital intensive upfront.

Despite the problems of defining a clear mandate for public VCs, the development of public VC is very dynamic. In Norway six new seed-funds with a total volume of 3bn NOK got the state aid approval from the EFTA authorities early 2013 (EFTA 104/13/COL). The state participates with 50% of the funding while taking only 42.5% of the shares. This subsidy is meant to crowd-in the required private capital and fill the gap in early stage investment

capital. The asymmetric design of funds with public involvement can be seen as a step into the direction of higher risk taking of the public sector. Similar models can be found in some regional funds (e.g. the Northern Startup Fund in Oulu, Finland). Moreover, Tekes is preparing an additional public VC scheme in Finland in order to fill the funding gaps in early stage innovation. Despite expansive public equity funding policies, no programs targeting cleantech in particular are currently in preparation. The focus is rather on ICT, gaming and apps, and the medical sector.

Figure 11: Significance of various actors in early stages of SMEs; in brackets number of supported companies that were analyzed (Tekes, 2013b)



There is strong evidence that different forms of public cleantech financing should be there at the same time. Many enterprises have both debt and equity financing. Furthermore, the stages of the innovation system have different degrees of risk that are best addressed with different funding instrument. Accordingly, there is not one single public financing instrument that is able to solve all challenges in the innovation process. One interviewee summarized well:

> *"The type of support that governments should give depends on where you are in the maturity stage. Currently, there are virtually no success stories in the Nordic countries when it comes to public sector equity instruments. In general it is hard to find good success stories in non-specialized early stage venture funds – also in the private sector. However, there are the other two instruments: grants and loans. From my perspective we should have grants for applied research; and then there should be loans that don't have all too much risk attached to them, so that you have an expected loss rate of maybe 10-15%. You'll cover a field where banks will never go, but it's not going to be extremely risky". (Interview 10)*

This view is also supported by a review of the Finnish innovation financing infrastructure conducted by Tekes (see Figure 11). The most significant actors with respect to starting a

company and commercializing an invention in Finland turned out to be Tekes (mainly grants), private VCs, and Finnvera (SME financing). It is important to note that there was wide skepticism about public equity instruments among most interviewees, but still no interviewee ruled them out completely (see also section 5.4).

Aid intensity and thresholds

The aid intensities of project or company funding and the maximum thresholds for public support largely followed the specifications of the European state aid regulation. Therefore, aid intensity and funding thresholds are discussed in the state aid section below (section 4.2).

4.2 EU/EEA state aid regulation

The research of limitations arising from EU/EEA state aid regulation in the area of public cleantech financing has resulted in three general findings:

- People working with public cleantech financing are without exception aware of the relevance of EU/EEA state aid regulation for their activity.
- The in-depths knowledge regarding EU/EEA state aid regulation is very limited. This is mainly due to the third finding, which is that
- EU/EEA state aid regulation is in practice not limiting the *operation* of public cleantech funding instruments.

The more specific findings are presented below, following the main questions of the interviews.

Does state aid regulation apply and has it been notified?

With minor exceptions all support instruments that were subject to this research have been notified to the EC (or in the case of Norway to the EFTA surveillance authority). Sometimes aid programs are notified one by one and in other cases the notification applies to larger funds or funding schemes that include various programs. The Norwegian energy fund Enova, for instance, operates with one notification for all its activity. Moreover, Tekes operates with only one notification for various R&D grant programs. The programs that have not been notified fall under the GBER and therefore do not require notification. One example for grant schemes that are not notified is the Market Development Fund of the Danish Business Authority. Furthermore, the Danish VC fund Vaekstfonden operates without notification.

If schemes are notified to the EC they include the specific framework of the aid measure, which – in many cases – reflect the limits set by the R&D&I framework (for grants and loans) and the Risk capital guidelines (for equity instruments). Usually the notifications contain a provision dealing with aid that goes beyond the limits specified in the notification. The responsible authority commits itself in this provision to notify individual aid beyond the threshold.

The framework set by the official state aid decision is reflected in the guidelines and procedures for managing public funds. In many cases funds have their own national laws. This is a possible explanation why state aid regulation did not appear to be a challenge in

daily operations of public funding instruments, once the framework for the instrument had been decided.

What are the requirements for justifying aid measures with respect to state aid regulation?

All aid measures that require notification have to be notified *before* they become active. Typically the EC does not raise objections against proposed measures. In a few cases further information or clarification was requested. As long as aid measures remain within the limits set by the R&D&I framework or the Risk capital guidelines, the requirements for getting the state aid clearance are purely formal. If the measure goes beyond some of the limits that are deemed compatible with the internal market by the EC, further justification is necessary. This goes beyond mere formal procedures and requires detailed information in order to justify the respective measure, e.g. about the existence of market failures on the market for company financing.

One example for a very straightforward state aid notification procedure is Young Innovative Companies programme of Tekes. The programme is virtually a reproduction of the type of programme which is described in section 5.4 of the R&D&I framework, which is called "Aid for young innovative enterprises". Therefore, it was not problematic for Tekes to receive the decision of the EC not to raise objections against the programme. (state aid decision N 309/2007)

In contrast, the newly announced Seed fund scheme for Norway had to provide much more detailed information and analysis of the market failures when it comes to VC financing. The scheme does not fulfil three of the seven conditions for compatibility with the internal market, which are listed in the Risk capital guidelines (see section 2.3 above). The scheme allows partly or wholly public companies to invest in the funds to match the 50% public funding, which effectively removes the limits for public funding. Furthermore, it lacks restrictions with respect to follow on investments. Therefore, the scheme had to go through a detailed compatibility assessment, for which the Norwegian authorities provided research reports of a consultancy and the Norwegian Venture Capital Association. Finally, the scheme got the approval, since the Norwegian authorities could conclusively show that there is a large VC funding gap; that funds which are too restrictive about follow on investments cannot crowd in sufficient private capital; and that the presence of state-owned companies (which work like private companies) in the Norwegian market is disproportionately high. (state aid decision 104/13/COL)

Up to which aid intensity can public authorities finance cleantech?

The maximum aid intensity that is allowed under state aid regulation depends on the type of aid, the size of the enterprise, the geographical region, and the project partners. Risk capital is generally restricted to a share of up to 50% of the overall capital needs. In less developed areas of the European Community this share can be up to 70%. If adequate proof of an equity financing gap can be brought forward, the Commission is even ready to accept aid intensities beyond the general limits. Vaekstfonden, Investinor and Sitra do not invest beyond the 50% limit. One public investment manager explained why such limitations of the share of invested capital is not problematic and why they want to keep the public share in a company low to give incentives to the entrepreneur to develop the business. "We want the company

founders to be motivated and, hence, want them to have a large share in the company. Therefore, a stake of 50% or more in the capital doesn't sound like a good idea for us." (Interview 1)

On the other hand, public VC funds that operate in the seed and early start-up phase have large difficulties crowding in private money. Both Norway's newly notified seed fund scheme and Finnvera's Seed Fund Vera explicitly mention investments beyond the 50% limit. They justify this with a particularly severe market failure, or in the case of Norway a large proportion of state-owned companies that are likely to co-invest. In order to get the approval from the EC, both schemes had to build in additional safeguards to avoid aid that might distort competition. The Norwegian scheme limits investments into individual ventures to 15% of the total investment volume of the fund. The Seed Fund Vera limits initial investments to 0.5M EUR in case private co-financing is not sufficient (i.e. 50% or more), and investments during the whole investment period to 1.5M EUR.

The grant and loan instruments that were researched for this report generally stick to the limits set in the R&D&I framework. This does not imply that grants always fully exhaust the maximum aid intensity. Innovation Norway for instance describes the following practice in its grant guidelines: "The rules on state aid in the EEA Agreement specify the maximum subsidy rates of our grants depending on the target of the grant, company size and geographic location. In practice the maximum support rates are rarely used. The size of the grants is normally limited by what is considered to be necessary to realize the project." (Innovation Norway, 2013b) The Danish Advanced Technology Foundation even stayed slightly below the maximum aid intensities of the R&D&I framework when designing and notifying the aid program. An interviewee with knowledge about this program commented: "There was the legal potential to give more, which means higher shares of the project value, but the Advanced Technology Foundation decided to give less. Some own investments of companies and universities ensure that they are serious about it."

What are the absolute thresholds up to which public authorities can finance cleantech innovation?

Just like aid intensities, the upper thresholds for public financing are set by the state aid regulation. Again this does not mean that these are typical investment amounts. **Risk capital** can be given up to 2.5M EUR per enterprise per 12 months period. If higher initial investments or follow-on investments are foreseen, the EC requires more detailed evidence of the market failure that is tackled with the aid measure. The case of the new Norwegian seed fund scheme, which includes the option for follow on investments, has already been discussed in the two sections above.

One opportunity that is offered for company financing under the R&D&I framework is the **aid to young innovative enterprises**. This scheme is used by Tekes and allows direct SME financing of up to 1M EUR in the form of grants. This threshold has been exhausted in several cases by Tekes. The 1M EUR threshold has in practice not been considered a limiting factor. Private investors would certainly not criticise even higher support to their portfolio companies, but did not evaluate the 1M EUR limit as problematic. In the context of EU state aid regulation they found it much more problematic that young innovative company that receive the aid are not eligible for some public funds within a three year period. Deciding for

the aid for young innovative companies means at the same time deciding against certain other aid instruments within three years after the funding.

The **thresholds for R&D&I project financing** reach from 20M EUR for fundamental research (which is not very relevant for cleantech start-ups) down to 10M EUR for industrial research and 7.5M EUR for experimental development. Notified R&D&I schemes never go beyond these thresholds. If there are individual aid cases that go beyond these thresholds they have to be notified individually. In the regular operations of the researched support schemes these thresholds have not at all been limiting. A Danish manager of a fund that operates within the R&D&I framework summarized: "State aid has not been a limiting factor in the funding of individual projects. As long as the projects are in accordance with the percentages in the General Block Exemption, we can support as many projects as we want. There are no upper limits [sic!], but we do not get applications for large amounts anyways as the applicants usually have problems of getting the co-financing. In practice our minimum grant-amount of 3M DKK with co-financing requirements is a larger challenge than maximum grant thresholds." (MDF) The view that the upper thresholds are quite generous was also shared by a Norwegian consultant: "In cleantech state aid regulation is not that strict and you can fund up to 7.5M or 10M EUR. That is quite a lot. It is more difficult in other sectors. But in general I'm not too much concerned about state aid. For very large projects it might be a problem, but then the government should just own the whole thing." (Interview 10)

The issue of cumulation of aid has just come up once in all the interviews, which is not very meaningful since the interview guide did not explicitly address the issue of cumulation. It is very relevant though to consider the interaction between different forms of public funding. The R&D&I framework specifies that thresholds shall "apply regardless of whether the support for the aided project is financed entirely from State resources or is partly financed by the Community". Furthermore, *de minimis* aid (200 000EUR within three years) shall be cumulated with the R&D&I aid, i.e. the thresholds cannot be increased by 200 000EUR. In contrast, capital that is granted under the Risk capital guidelines is not cumulated with aid under the R&D&I framework, which means that a company can receive both public risk capital and aid under the R&D&I framework up to the full thresholds. If a company receives aid under any other block exemption regulations while at the same time receiving public risk capital funding, the thresholds of the respective block exemption regulation are reduced by 50%.

Further results with respect to state aid regulation

Not all state aid issues are related to funding. One interviewee pointed at some legal requirements that have been limiting in practice: "The limiting factor has not been the amounts and percentages of state aid, but mostly that all intellectual property shall by regulation belong to universities. That was problematic for companies, as they wanted to secure the benefits of the project as well. But there is a lot of room for interpretation, and a compromise has been found." (Interview 4) The problem of "dividing" intellectual property rights comes up when consortia of enterprises and public research organizations receive project funding. The R&D&I framework allocates the property rights by default to the research organization, unless the enterprise(s) bear the full costs of the project or the enterprises compensate the research organizations with an equivalent of the market price for the intellectual property rights.

There are some more aspects that are important with respect to state aid in R&D&I and via risk capital measures, but that have not been relevant in the researched cases. Investments into companies in difficulties are much more regulated and usually not eligible for state aid approval; the aid thresholds and intensity levels for companies in assisted areas[12] are in many cases higher. However, there are very few assisted areas in the Nordic countries.

4.3 Interaction with private capital

How to show additionality in practice?

Additionality is the degree to which public money constitutes a source of funding that is additional to what is available on the private financial market. Public support measures can either expand the market for funding or crowd out private capital. Additionality is of importance for two reasons. First, there are formal requirements in the context of state aid regulation, which make proof of additionality necessary. Second, there is the wish of governments to have a practical impact by providing funding. If aid instruments have a low degree of additionality, it means that public money has a low leverage.

In state aid regulation additionality appears in the requirements to show an "Incentive effect" of the aid measures and the "Proportionality of aid". If all conditions of the Risk capital guidelines or the R&D&I framework are fulfilled, the EC considers this as sufficient proof of an incentive effect and proportionality of the aid. Aid measures going beyond the conditions have to go through a detailed balancing test, which has the proof of the incentive effect and proportionality at its core. Schemes that have been approved by the EC do not have to show additionality for individual investments.

However, most schemes include questions about the additionality of the funding in the application process. This shows that it is a relevant question even without the formal requirements (which are not very limiting in practice). Despite several attempts, additionality is extremely hard to prove – both in advance and in retrospective. Below are some of the practices that were found during the research.

One fund manager stressed that additionality is unlikely if a company applies for innovation grants in **the field of its core competencies**. This approach has some shortcomings as it leaves much room for interpretation. On one hand, it does not exclude funding of a multinational industrial company that applied for funding just slightly outside its core competencies. On the other hand, it might exclude small innovative companies that do not have the means to further the technological development exactly within its core competency.

Another approach that was described by an interviewee focused on **available co-financing**. "If the company is backed by a big venture fund, why would we give it additional grants? But the final decision about this is with the board" (Interview 2). The underlying assumption of this approach is that innovations that are good enough to attract large VC funds are good enough to be realized with private capital only. On the other hand, it shows that it is hard to formulate stringent additionality criteria. The final investment decision is still made by an external board of experts.

[12] Assisted areas are economically weak geographical areas in the European Union that are eligible for certain kind of funding (e.g. for regional development, or in this case higher amounts of company financing).

When it comes to risk capital measures, there are also procedural practices to induce additionality. These practices are for instance described in the state aid decision about Seed Fund Vera (N 395/2007):

"in order to ensure that Avera is not crowding out private investors, auxiliary principles and practices are applied:

- *Avera does not restrict the target undertaking's or entrepreneur's freedom to negotiate with other investors using any kind of term-sheet or similar letter of intent, so the undertaking can pull out of the negotiations at any time;*
- *Before the implementation of any investment, Avera requires an assurance from the target undertaking or entrepreneur that the undertaking has not been offered an investment from a private party during the previous three months."*

This is a the text of a state aid decision from 2007. Currently the supply with private VC is so low (especially in early stages) that interviewees were **not concerned about non-additionality of public VC** at all. One investment manager argued that public VC actually might crowd-in private VC: "Our activity lowers the risk assessment of private capital. If only private capital was there then this capital would be extremely expensive and too little. The price would have gone sky high if there wasn't any public capital. Therefore, in the current situation there is no competition among public and private capital." (Interview 1). This view is shared in another Nordic country: "We don't see much competition in the deals that we make, as we typically try to form partnerships with private players. Private players see us as a risk sharing party in the deals. Competition isn't a problem for a fund like us. There are anyways not many risk taking investors in the cleantech segment." (Interview 7)

Despite large consensus among interviewees, it is not possible to generalize the finding that there currently is no problem with additionality of public support to cleantech, because the methodological shortcomings of a purely qualitative research are significant. Public fund managers are hardly critical of their own instruments. Private venture capitalists, on the other hand, are usually not critical of public investments, either. One interviewee summarized well private VCs' perspective on public money: "VCs are tough financial guys. They are always searching for cheap money, and if they can get cheap money from the government they will take it and then ask for more. They like best the soft money, which means grants. Secondly they are in favor of co-investments from the government such as Investinor, Industrifonden, Vaekstfonden and Finnvera. But that is the second best option. Still they will take that money, and always say that there is not enough of that money, either." (Interview 10)

Third party **evaluations of public funding programs** face the same methodological challenges as this report. An independent review of a fund of the Danish Business Authority came for instance to the conclusion "that the Business Innovation Fund has tangible additionality effects at project level." The basis for this conclusion is the interviewer's "impression from in-depth interviews with a number of the companies" that received support from the fund. (Deloitte, 2012) The extensive review of all Innovation Norway support instruments tries to go a step further and compare the additionality of different support instruments. They did this by asking companies the question: "What do you think would happen to the project if Innovation Norway had not given you support?" The results are impressive, reaching from 100% medium to high additionality down to 74%. Considering that these numbers are based on the subjective evaluation of supported companies, and that

medium additionality is included in these numbers, the absolute values have to be reviewed with care. However, the differences between the numerous support instruments are telling. At the bottom of the additionality score are two low risk loan instruments, which do not differ much from regular bank loans. High up in the ranking are for instance direct grants, high risk loans and also the grants under the Environmental technology scheme. (Pöyry, 2013)

There is no study comparing the additionality of grants and loans against the additionality of equity instruments. Still there is evidence that the additionality of public VC is high. Various studies show that supply with private VC is low, especially in early stages (an extensive quantitative study has been done by Grünfeld et al., 2011). At the same time VC has the potential to give strong incentives for start-ups to commercialize their innovations (see Figure 11). The EC sees it similarly and increased the threshold for public VC funding in 2010 from 1.5M to 2.5M EUR within a 12 months period, and recently approved public funds focusing on early stage VC , which even go beyond that threshold.

Selection and treatment effect

The additionality of public VC funding should at best be expressed in the kind of ventures a public fund selects for its portfolio. The public sector does not only have to focus on investments that promise to be profitable by themselves, but can also include ventures that are expected to be profitable from a social welfare perspective (see Figure 10 above). Therefore, there is (and should be) a *selection effect* on profitability that results in different performance of private and public funds.

Fund managers influence the profitability of their portfolio investments in two ways. In addition to the selection of ventures, they interact with portfolio companies. With a good "treatment" of portfolio companies, profitability can be increased significantly (*treatment effect*). While the differences in the selection effect are due to differing notions of profitability, discrepancies in the treatment effect between private and public funds are typically based on more practical issues, like for instance management expertise.

The case studies of public VC funding in Denmark, Finland and Norway did not find a structural difference of the selection of portfolio companies as compared to private VC. Interviewees clearly stressed the profit target and expressed the preference of investing in later stages that have lower risks. With the exception of Seed Fund Vera, none of the researched public VC funds has an investments focus on the seed or early start-up stage. Both Vaekstfonden and Investinor stress the importance of direct profitability of their investments and state a preference for later stage investments, where risks are lower. Moreover, Investinor did not invest in cleantech at all in recent years, although cleantech is a typical sector for which short term profitability is difficult to reach, whereas longer term profitability is likely, especially from a social welfare perspective.

With respect to the treatment effect the professional staffing and management of public funds was stressed by several interviewees, some of which were very sceptical about public equity instruments. One public investment manager argued that the treatment effect of professionally managed public funds can keep up with private funds: "Government VC can also do good against private VC. That depends on various factors. It depends on what kind of people do you hire, what kind of salaries you pay and whether they are competitive on the

market." (Interview 1). The importance of professional fund management is also acknowledged by various reports and studies. Moreover, the risk capital guidelines for state aid lists professional fund management among the conditions for the compatibility of a risk capital scheme with the internal market.

5. Discussion

5.1 How does EU state aid regulation limit public funding of cleantech in practice?

This study did not find any major limitation for public cleantech financing arising from EU state aid regulation in practice. The notification of state aid measures is an administrative burden that has to be dealt with. If an aid scheme fully utilizes the maximum limits outlined in the Risk capital guidelines or the R&D&I framework, public authorities have quite some flexibility in granting aid. If it can be foreseen that those limits will have to be exceeded in many cases in order to make the aid efficient, the aid measure should seek state aid clearance for an aid measure with higher limits. This can be done by providing additional information about the respective market failure, e.g. the insufficient supply with VC. Once an aid scheme is notified, public authorities can support individual companies or projects beyond the limits that are defined in the notification to the EC, but this aid has to be individually notified and justified. The prospects of an individual notification to pass the assessment of the EC are good if there are clear environmental benefits attached to the project/company or it can be clearly shown that the project/company would not receive funding otherwise.

While the interviews did not bring up any major limitations that would arise from state aid regulation, an additional literature review provides evidence that there is a clear difference between R&D&I instruments and public risk capital measures. The current review of the GBER and the connected guiding documents provides particularly insightful information. With respect to the **reform of the R&D&I framework**, public authorities from the Nordic Countries largely backed the view that was provided by the interviewees. The Finnish Ministry of Employment and the Economy comments on aid intensities and aid levels as follows:

> *"The present aid intensities are sufficient taking into account the global market and the needs of different technology and innovation fields. However, the present intensities are not used to their full extent as many Member States and agencies prefer using lower levels of aid to ensure sufficient commitment from the recipients of aid. [...]National (or regional) budgets do not often permit the use of maximum levels of aid, even though the allowed higher levels might lead to higher positive impact. The allowed aid levels should not, however, [be] decreased as the possibility to fund remarkable projects with higher aid intensities should be ensured." (TEM, 2012)*

The view expressed by the Finnish authorities is shared by the Norwegian Government:

> *"In our opinion, the permitted aid intensities, aid amounts and bonuses provide a flexibility which is useful. Hence, even if Norway does not fully exploit the aid intensities permitted, we do not see the need for limiting the aid intensities" (Government of Norway, 2012).*

On the other hand, the **consultation process for reviewing the risk capital guidelines** has raised some more critical issues, which indicate practical barriers for granting public VC. When commenting on the draft version of the revised risk capital guidelines (European Commission, 2013b), Denmark raised various points that show a rather critical attitude towards the functioning of the old guidelines and to some extent also towards the draft revision:

- Denmark explains how it has so far avoided applying the risk capital guidelines to its Growth Fund (Vaekstfonden), by letting it operate like a private investor. This brought various problems with it (how to demonstrate that individual investments were made *pari passu*, how to invest in seemingly profitable ventures if there is virtually no private market that could co-invest). Denmark criticises that these practical problems are combined with the requirement to show overall profitability of the fund, even in financial crises, which resulted in "even less risk capital to the layer of basically sound and well run SMEs just below the best run and potential most profitable SMEs".
- With respect to the planned revisions, Denmark "welcomes higher thresholds for venture capital funding with public engagement, and the possibility of funding SMEs in their different stages of development". The safe harbour thresholds of 2.5M EUR (guidelines) and 1.5M EUR (GBER) were criticised by various member states as outdated and not reflecting the current market failure anymore. The revision of the GBER and the risk capital guidelines foresees a significantly higher new threshold of at least 10M EUR.
- Moreover, Denmark states that the revised guidelines are still "very complex, technical and difficult to understand and use for government officials and undertakings. Especially the balancing test and measures subject to a detailed assessment have been pointed out as particular obstacles for the use of the guidelines." This criticism aims at the process of notifying aid under the guidelines. It does not regard practical limitations for aid schemes, once they are approved by the EC. (EVM, 2013)

The review of the consultations about revised risk capital guidelines indicates that previous funding limits for public VC to cleantech have been limiting. The draft guidelines even refer explicitly to "the capital intensive nature of [...] green energy investments" (European Commission, 2013b) when outlining conditions under which aid beyond the new 10M EUR threshold will be acceptable. All Nordic Countries approve the new thresholds. The fact that also the European Venture Capital Association is in favour of higher thresholds shows that the risk for crowding out private VC is very low. However, a strong criticism of the high administrative burden, both before and after the revision, can be observed.

Hence, it can be expected that the notification and reporting of state aid will remain a burden for public authorities, while the practical limits for funding cleantech companies via the R&D&I framework or the Risk capital guidelines will become even smaller.

5.2 What should be the target of public cleantech funding?

The three main targets of public cleantech funding that could be identified in this study are economic development, social and environmental benefits, and profit. In this section the connection between different targets, the connection between the maturity of a project and the appropriate target, and the significance of the profit target are discussed.

The **profit-target** can be frequently found in public VC activity. From a theoretical perspective it is hard to understand why the public sector should focus on profits only, while there are further projects/ventures that promise to be socially beneficial in terms of employment and revenue generation (see also Figure 10). From a practical perspective, the profit target, which is also demanded by state aid regulation, constitutes a limitation for the

selection of ventures that receive public VC. In the current situation there are very few cases in which private co-investments can be attracted, for which the same terms are valid as for the public share of the investment. However, it has to be taken into consideration that this study along with several others found much scepticism about public involvement in activities that are more efficiently run by the private sector. Therefore, professional management and profit-orientation are critical for the success of a public VC scheme. Hence, it seems to be useful to make a distinction between profit-orientation as a necessary *mode of operation*, and profit-maximization as a questionable *target*.

All researched cleantech support instruments had **economic development** as a target. This typically includes growth in turnover, exports and employment. Economic development is heavily interconnected with reaching environmental targets. At a macro-level the environmental crisis has an impact on economic development, e.g. through the costs caused by natural disasters or through the depletion of valuable natural resources. On the other hand, economic development is one of the main drivers of environmental problems. But when leaving the macroeconomic perspective and zooming in on cleantech, economic development loses its environmentally damaging aspect. It becomes clear that cleantech companies can only help achieving environmental targets, if they are economically successful. A technical solution to an environmental challenge has to be scalable in order to have an impact.

For a cleantech specific support scheme it is therefore important to have a commercial perspective and clear economic targets. On the other hand, there are many support schemes that do not focus on cleantech. In these cases an explicit **environmental objective** for the programme is relevant, if it is supposed to help the commercialization of cleantech innovations. Cleantech innovations are often capital intensive and have a long time to market. That makes policy interventions necessary.

Environmental targets for funding instruments or dedicated cleantech support programmes are just one part of the policy mix for the widespread application of cleantech innovations. Several interviewees stressed the importance of **demand side measures**. One investment manager concluded: "half of our investments in cleantech wouldn't be viable without government policies/ subsidies" (Interview 1). This illustrates the importance of designing a consistent set of policy measures. If for instance renewable energy companies, which were partly established with public funding and which benefitted from regulation such as feed-in tariffs, suddenly go bankrupt as feed-in tariff schemes are discontinued or phased out earlier than planned, this means a large welfare loss and significantly lowers the welfare return on the public investment.

All targets that are described above can be found in the objectives of the Finnish R&D&I policy:

1. "Increasing of the effectiveness of R&D&I policy by extending the mix of demand-oriented measures and policies (e.g. procurement, regulations, standards and norms) [...].
2. Enhancing economic growth and improving industrial competitiveness [...]
3. Tackling the grand societal challenges by R&D&I policy, including measures on sectors of environment, energy, health care, employment and education." (TEM, 2012)

As for all targets it is crucial to develop an effective action plan in order to achieve them.

5.3 How can additionality of public funding of cleantech be ensured?

Additionality can never be fully ensured as you can never be absolutely certain what would happen without public funding. Nevertheless, in practice there are many ways to give evidence for additionality that is considered sufficient from a formal (i.e. state aid) perspective. Within the R&D&I framework it is for instance sufficient to show that aid increases R&D&I activity either in size, scope, amount spent or speed. It does not seem to be very challenging to show that public funding has an impact on the amount spent on R&D&I. Considering furthermore that the maximum aid thresholds within R&D&I are hardly ever fully utilized, it does not seem to be a challenging task to formally demonstrate additionality. With respect to risk capital measures, additionality is shown by sticking to the limits or providing evidence for a market failure, i.e. a VC funding gap. Considering the higher thresholds that will apply once the GBER and the risk capital guidelines have been revised, and considering the extensive evidence for the VC funding gap, it should not be problematic to formally demonstrate additionality of public VC measures in the current situation.

Public authorities have further motivations than merely formal ones to ensure the additionality of their funding schemes. Public money is a scarce resource which has to be managed efficiently. In order to have a high leverage of public money, public authorities have to find a way to pick the most promising projects and ventures that would not receive funding anyways. Some procedural approaches have been outlined in section 4.3 above, but in the end the public authority and in some cases an external board make the decision about who receives funding and who does not. Often the screening process focuses on the best and most viable projects and not on the ones that are in most need of funding. This "malfunction" can be rooted in wrong targets. The strong presence of a profit target for public VC may lead to a selection of projects that are also attractive for private VC investors, and in that sense less "additional" than other potential projects.

In addition to the screening process also the volume of the aid scheme plays an important role for additionality. It is not possible to infer from the success of a public support program that it is unboundedly scalable. The mid-term review of the Danish Business Innovation fund found a large leverage effect for the input of public money. On the other hand, the review explicitly states that the "positive assessment of the macroeconomic effects is closely linked to the specific projects receiving support. Naturally, it is crucial that there are relevant projects to support […]. Thus, the reported effects cannot necessarily be scaled in relation to any larger budget for the Business Innovation Fund in the future either." (Deloitte, 2012)

Additionality has to be considered by public authorities when designing support instruments. But in the current situation in the cleantech sector it is very unlikely that well-targeted R&D&I funding or public VC is not additional.

5.4 Should the state take ownership in the companies and projects it supports?

This study did not result in a clear position towards public equity instruments for financing cleantech. The main argument in favour of public VC funds is the financial sustainability of the support scheme. A fund that has a couple of successful exits generates revenue that can be reinvested without requiring additional funding from the state budget. On the other hand,

there was some criticism with respect to the competence of investment teams in public funds, and the dilemma between profit-maximization and selecting companies which are too risky for private investors. One manager of a support scheme explained that they considered at first to invest equity instead of giving grants, but then decided against it because they "did not have enough trust that it will pay back, because these are all projects that are not financed by private sector alone, and that has its reasons." (Interview 4)

In a situation in which private investors are moving out of early stage funding, there is a stronger rationale for the public sector to fill this gap, as there are promising ventures that can – with a patient and professional investor – generate decent returns. Both the professional investment teams and the long-term focus for investments are among the core recommendations for early stage VC funding of the public sector. A study by the Finnish public investment fund Sitra came up with six important aspects to consider:

1. *"Focus on industry, not geography;*
2. *Foster close links to corporations that are customers for high tech ventures and often also potential acquirers;*
3. *Build close links to universities and research institutions to identify opportunities for technology-based ventures;*
4. *Invest in a small number of companies which you truly believe in and which you can help become global successes;*
5. *Reserve sufficient funds to allow follow-on investments and fund diversification; and*
6. *Syndicate your investments actively with value adding co-investors" (Sitra, 2006)*

Some of these recommendations are backed by our research, while we did not research the difference between regional and industry focus, the link to research institutions, or the number of companies in the portfolio. A study of the Norwegian early stage VC market results in similar recommendations for (additional) public involvement. According to this study, the success criteria for public early stage equity instruments are the ability to follow the ventures all the way to exit, attracting professional private co-investors, and the competence of investment team (Grünfeld et al., 2011).

The current conditions on the financial market seem to be right for additional and well-thought-out early-stage equity investments of the public sector. If equity appears as a too complex instrument also hybrid instruments should be considered. A subordinate high-risk loan with a moderate anticipated loss rate, which falls into the poorly defined category of quasi-equity, could be a compromise solution.

5.5 Areas for Future Research

- How to effectively link funding instruments and demand side measures (demonstration projects, public guarantees for innovation procurement)
- How to overcome the public equity funding dilemma between professional profit-oriented management on one side, and a clear mandate to go into higher risk segments than private investors on the other hand.
- Arguments for/against a sectoral focus (e.g. on cleantech) vs. general innovation financing instruments
- How does/should public cleantech financing interact with large industrial enterprises?

References

Advanced Technology Foundation. (2013). *Yearbook 2013*. Copenhagen: The Danish National Advanced Technology Foundation.

Andersson, M. (2012). *Strategic global marketing of Nordic cleantech clusters and competencies* (No. 2012:4). Oslo: Nordic Innovation. Retrieved 10 December 2013, from http://nordicinnovation.org/no/publikasjoner/strategic-global-marketing-of-nordic-cleantech-clusters-and-competencies/

Bürer, M. J., & Wüstenhagen, R. (2009). Which renewable energy policy is a venture capitalist's best friend? Empirical evidence from a survey of international cleantech investors. *Energy Policy*, *37*(12), 4997–5006.

Cleantech Finland. (2013). *Cleantech industry in Finland 2013*. Technology. Retrieved 10 December 2013, from http://www.slideshare.net/cleantechfinland/cleantech-industry-in-finland-2013-27055392

Danish Business Authority. (2013). Hvad er en grøn forretningsmodel? - Grøn omstilling. Retrieved 10 December 2013, from http://groenomstilling.erhvervsstyrelsen.dk/hvad-er-en-groen-forretningsmodel

Danish Energy Agency. (2012). Green production in Denmark. Retrieved 10 December 2013, from http://www.ens.dk/sites/ens.dk/files/policy/green-production-denmark-contributes-significantly-danish-economy/Green%20production%20in%20Denmark%20-%20web%20111212.pdf

Danish Energy Agency. (2013). *Energy13. Annual report on the Danish energy research programmes*. Copenhagen. Retrieved 10 December 2013, from http://fivu.dk/en/publications/2013/files-2013/energy13.pdf

Deloitte. (2012). *Mid-term review of the Business Innovation Fund.* Retrieved 10 December 2013, from http://markedsmodningsfonden.dk/file/221559/midterm_review_bif.pdf

EEA. (2013). *Trends and projections in Europe 2013. Tracking progress towards Europe's climate and energy targets until 2020* (No. 10/2013). Luxembourg: European Environment Agency. Retrieved 10 December 2013, from http://www.eea.europa.eu/publications/trends-and-projections-2013/full-report-ghg-trends-and-1

Enova. (2013). *Annual report 2012*. Trondheim. Retrieved 10 December 2013, from http://www.enova.no/download.aspx?object_id=3188E398DBD34B2B9C9E692C74A2D5FC.pdf

European Commission. Community framework for state aid for research and development and innovation. Official Journal of the European Union 2006/C 323/01 (2006).

European Commission. Community guidelines on state aid to promote risk capital investments in small and medium-seized enterprises. Official Journal of the European Union 2006/C 194/02 (2006).

European Commission. Regulation No 1998/2006 on the application of Articles 87 and 88 of the Treaty to de minimis aid. Official journal of the European Union 2006/L 379/5 (2006).

European Commission. Community guidelines on state aid for environmental protection. Official journal of the European Union 2008/C 82/01 (2008).

European Commission. Regulation 800/2008 (General Block Exemption Regulation).

European Commission. Communication amending the Community guidelines on state aid to promote risk capital investments in small and medium-seized enterprises. Official Journal of the European Union 2010/C 329/05 (2010).

European Commission. (2013a). Erawatch. Platform on Research and Innovation systems. Retrieved 27 November 2013, from http://erawatch.jrc.ec.europa.eu/erawatch/opencms/

European Commission. (2013b). *Paper of the services of Directorate General Competition containing the draft Union guidelines on State aid to promote risk finance investments.* Brussels. Retrieved 10 December 2013, from http://ec.europa.eu/competition/consultations/2013_risk_capital/risk_capital_draft_guidelines_en.pdf

EVM. (2013). Denmark's response to the consultation on Risk capital guidelines. Ministry of Business and Growth. Retrieved 10 December 2013, from http://ec.europa.eu/competition/consultations/2013_risk_capital/denmark_government_en.pdf

FiBAN. (2013). Finnish Business Angels Network. Retrieved 23 November 2013, from https://www.fiban.org/

Finnvera. (2013a). *Online Annual report 2012*. Helsinki. Retrieved 10 December 2013, from http://annualreport2012.finnvera.fi/en/

Finnvera. (2013b). Venture Capital Investments. Retrieved 23 November 2013, from http://www.finnvera.fi/eng/Venture-Capital-Investments

Government of Denmark. (2012). *Denmark – a nation of solutions Enhanced cooperation and improved frameworks for innovation in enterprises*. Copenhagen. Retrieved 10 December 2013, from http://fivu.dk/en/publications/2012/files-2012/innovation-strategy.pdf

Government of Norway. (2012). Research, Development and Innovation State aid Framework Consultation paper. Response of the Norwegian Government. Retrieved 10 December 2013, from http://ec.europa.eu/competition/consultations/2012_stateaid_rdi/norway_en.pdf

Grundsten, H. (2012). *Industry Investment - Experiences from Finland (2012)*. Presented at the Nordic-European Public Investor Workshop, Stockholm.

Grünfeld, L. A., Iverson, L. M., & Grimsby, G. (2011). *The Need for Government Supported Capital measures in the market for early stage risk capital in Norway* (No. MENON-publication no. 18 / 2011). Oslo: MENON Business Economics.

Industry Investment. (2013). About us - Finnish Industry Investment Ltd. Retrieved 23 November 2013, from http://www.industryinvestment.com/about-us

Innovation Norway. (2012a). Naeringsklynger – for fremtidens innovative næringsliv. 2012. Retrieved 10 December 2013, from http://nce.no/Global/NCE/Resultater/Naeringsklynger_web_spreads3.pdf

Innovation Norway. (2012b). *NORGE SMART NASJON - en attraktiv innovasjonsarena for energi- og miljø!* Retrieved 10 December 2013, from http://www.innovasjonnorge.no/Documents/old/PageFiles/15438/Presentasjon%20virkemiddelapparat_web.pdf

Innovation Norway. (2013a). *Miljøteknologiordningen fra Innovasjon Norge Bygger bro fra idé til marked*. Retrieved 10 December 2013, from http://www.innovasjonnorge.no/PageFiles/727/Folder%20Milj%c3%b8teknologiordningen_web.pdf

Innovation Norway. (2013b). Tilskudd: Vi deler risikoen med deg - Innovasjon Norge. Retrieved 4 December 2013, from http://www.innovasjonnorge.no/no/finansiering/Tilskudd/

Intpow. (2012). *The Norwegian Cleantech Industry - statistics 2010*. Oslo. Retrieved 10 December 2013, from http://intpow.com/ext/ver2/docs/Cleantech Report 2012/Menon Statistikkrapp EN 2012_3.pdf

Investinor. (2013). Annual report 2012. Retrieved 10 December 2013, from http://en.investinor.no/upload/2013/08/09/investinor-annual-report-2012-summary.pdf

Knowles, V. (2012). Global Cleantech Innovation Index 2012. WWF. Retrieved 10 December 2013, from http://awsassets.panda.org/downloads/coming_clean_2012.pdf

Lidgren, A., & Dalhammar, C. (2012). *Public Policy and Cleantech Growth* (Working Paper). Lund University, International Institute for Industrial Environmental Economics.

Mazzucato, M. (2011). *The Entrepreneurial State*. London: Demos.

Pöyry. (2013). *Kundeeffektundersokelse blant kunder som mottok stotte i 2012*. Oslo. Retrieved 10 December 2013, from http://www.poyry.no/sites/www.poyry.no/files/r-2013-022_lfb_kundeeffektundersokelse_blant_kunder_som_mottok_stotte_i_2012.pdf

Ramse Andersson, T. (2013). *Understanding public venture capital in the cleantech sector*. Lund University, International Institute for Industrial Environmental Economics.

Sitra. (2006). *The Prospects for Successful Early-Stage Venture Capital in Finland* (No. 70). Helsinki. Retrieved 10 December 2013, from http://www.sitra.fi/julkaisut/raportti70.pdf

Tekes. (2011). *Towards green growth? The position of Finland in environmental technologies* (No. Tekes Review 282/2011). Helsinki. Retrieved 10 December 2013, from www.tekes.fi/Julkaisut/towards_green_growth.pdf

Tekes. (2013a). Rapid growth for Finnish cleantech sector. Retrieved 20 November 2013, from http://www.tekes.fi/en/whats-going-on/news-2013/rapid-growth-for-finnish-cleantech-sector1/

Tekes. (2013b). *The impact of Tekes and _innovation activities_ 2013*. Retrieved 10 December 2013, from http://www.tekes.fi/Global/Tekes/The%20Impact%20of%20Tekes%20and%20innovation%20activities.pptx

TEM. (2012). Research, Development and Innovation State aid Framework Consultation paper. Response of the Finnish Ministry of Employment And Economy. Retrieved 10 December 2013, from http://ec.europa.eu/competition/consultations/2012_stateaid_rdi/finland_en.pdf

Annex 1

Interview Guide

Introductory questions (if unclear)

- What are the core activities of (name of organization) ?
- What is the organizational set-up of (name of organization) ? (public agency, publicly owned company, publicly funded company etc.)
- What is your role/position in (name of organization) ?

The "product"

Opening question: Could you please describe what kind of funds you are allocating to cleantech companies and how the funds are allocated?

Follow up questions (if not answered, yet):

- What is the target of th e fund?/ How do you evaluate the fund's success? (high private capital leverage ratio, profit, benefits for industrial investors, shift to private funding)
- What size of ventures are targeted/ in the portfolio? (SMEs, large companies …)
- Which phase of the innovation and start-up process is targeted? (R&D, applied research, seed, demonstration …)
- What kind of funding is provided? (VC, grants, soft loans, a mix)
- What is the fund allocation method? (volume based, number of ventures, outcome-based, by sector)
- How is the due diligence screening carried out? (private vs public, internal/ external experts)

Public vs private VC – competitive or complementary?

Opening question: What should be the role of government in cleantech financing?

Follow up questions (if not answered, yet):

- Is it a necessary condition that ventures secure private capital in addition to the public funding?
- Does public VC funding change the risk assessment of private capital?
- Is public VC additional to private VC? (crowding-in vs crowding-out)
- Is there competition between public and private VC?
- What kind of private VC is attracted by public funding? (VC firms, VC arm of large industrial companies)
- Which phase of the start-up process is (should be) supported by government?

The legal/regulatory framework

Opening question: Which regulation is limiting (public) VC for cleantech and which policies are supporting the sector (e.g. by reducing investment risks)?

Follow up questions (if not answered, yet):

- Have there been conflicts with EU state aid regulation? (which?)

- Is EU state aid regulation in practice a limiting factor for the fund management?
- Are there additional limits set by national regulation? (national policies might in turn be affected by European regulation)
- Are there any limitations arising from the guidelines for managing the fund?
- What role does the organizational set-up play? (public agency, publicly owned company, publicly funded company etc.)
- Which public policies (other than financial support) have supported the development of the cleantech sector?

Annex 2

State aid decisions

The list below presents relevant state aid measures that have been notified to the authorities. The cases have been extracted from two online databases:

- The case search of the EC's directorate general for competition: http://ec.europa.eu/competition/elojade/isef/index.cfm
- The state aid register of the EFTA surveillance authority: http://www.eftasurv.int/state-aid/state-aid-register

Denmark

- Energy Development and Demonstration Program (case N 479/2007)
- Advanced Technology Foundation (case N 269/2005)
- Loan guarantees issued to SMEs by Vaekstfonden (case SA. 33022 2011/N)
- Tax incentives to corporate investors who invest equity in SMEs (case SA.33535 2011/N)

Finland

- Tekes aid for Young Innovative Enterprises (N 309/2007)
- Tekes R&D aid scheme (N 356/2007)
- Risk capital aid scheme Seed Fund Vera (N 395/2007)
- Tax deferral of taxable capital income for Business Angels Scheme (case SA. 35401 2013/N)

Norway

- SIVA innovation aid scheme (EFTA decision 785/08/COL)
- Innovation Norway's Innovation Cluster Scheme (EFTA decision 09/11/COL)
- Norwegian Energy Fund scheme Enova (EFTA decision 248/11/COL)
- The "SkatteFUNN" scheme concerning tax deduction for R&D expenses (EFTA decision 16/03/COL)
- National seed capital scheme (EFTA decision 104/13/COL)

Annex 3

List of interviewees

- Interview 1: Investment manager at public VC fund
- Interview 2: Manager of grant scheme for market development
- Interview 3: Manager of demonstration grant scheme
- Interview 4: Communication manager of public R&D fund
- Interview 5: Private VC investment manager cleantech
- Interview 6: Private VC investment manager cleantech
- Interview 7: Investment manager at public VC fund
- Interview 8: Coordinator of support scheme for the commercialization of innovation
- Interview 9: Private VC investment manager
- Interview 10: Private consultant in innovation and VC financing

Published in 2013 by IIIEE, Lund University, P.O. Box 196, S-221 00 LUND, Sweden,
Tel: +46 46 222 02 00, Fax: +46 46 222 02 10, www.iiiee.lu.se

ISBN: 978-91-87357-04-6
ISSN: 1650-1675

iiiee

Public cleantech financing in Denmark, Finland and Norway

IIIEE Report 2013:01

The study examines public support schemes for cleantech startups in the Nordic countries and discusses the implications for Sweden. The research is based on literature studies and semi-structured interviews. Special focus is devoted to the implications of European Union rules for state funding and the relationship between private venture capital for cleantech startups and public support schemes.