A thesis submitted to the Department of Environmental Sciences and Policy of Central European University in part fulfilment of the Degree of Master of Science

# The main characteristics of cleantech investors in Europe

With special focus on venture capital funds and the incubator program of Climate-KIC

Ágnes DEME

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#### **ABSTRACT OF THESIS**

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The global economy does not operate in a sustainable approach. New disruptive technological innovations are required, which are able to compete with the existing and polluting market solutions. Environmental entrepreneurship seems the most effective way to transit the traditional economic paradigm into a more sustainable operation. Since there is a limited number of studies about the European cleantech startup ecosystem, this research aims to identify the main characteristics of the cleantech facilitators who support business development and the financial background of the startups with clean innovative ideas. To determine this attitude, three main market players were examined, using structured and semi-structured interviews, personal communication and the review of Climate-KIC's internal documents. As a preliminary expectation, the startups, the venture capital funds and the Climate-KIC cleantech incubator program were identified as the most significant market players. In contrast based on the findings the intergovernmental and governmental institutions are also dominant market players, they financially support the venture capital funds and the incubators as well. The main problem with the market is that it is difficult to express the positive environmental impact in financial terms, therefore it is not included in the company value during evaluation. As in every market cleantech investors are also looking for profitable solutions which are rare, risky and it takes a long time until the profit is realized in this field. Therefore, the research points out that the cleantech market in general is not viable without any governmental or intergovernmental support or regulation.

Keywords: environmental entrepreneurship, startup, venture capital fund, cleantech, environmental impact, Climate-KIC

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## List of abbreviations

BMWi - Federal Ministry for Economic Affairs and Energy

CLP - ClimateLaunchpad

EIB - European Investment Bank

- EIF European Investment Fund
- EIT European Institute of Innovation and Technology
- EU European Union
- VC Venture capital

#### 1 Introduction

Climate change is apparently a worldwide realized problem and to decrease the environmental degradation, economical and business model transformation is required. To move closer to a more sustainable world, environmental entrepreneurship and sustainable business approach seems to be a good solution accelerating the global response to climate change. The conventional large sectors such as energy, transportation and manufacturing are producing more and more in every year with high GHG emission and waste through their regular operation. In the near future this will rise continuously according to population growth forecasts. Environmentalists realized the problem of overconsumption and significant exploitation of the natural resources. The Earth Overshoot Day is a good example for this, which is the point when the population demand for ecological resources and services exceeds the capacity of Earth. It arrives every year earlier than the previous year, which means we are not even getting closer but move away from the approach of sustainability defined by the Brundtland report.

For the problems of climate change the only fast growing solution would be the introduction of new innovative technologies, because this way it is possible to transit the most polluting sectors into more sustainable business models, with a chance of fulfilling the triple bottom line (TBL) of Elkington. This means that besides the financial bottom line, corporations should take into consideration the environmental and social impacts of their operation and value them as part of the business valuation (Elkington 1997).

In the last decade the most significant change in the market was observable in the internet sector. From zero startups developed the most profitable sector the high-tech. Most ventures started their operation from a garage but achieved extraordinary growth to become top leaders in the producing and software sector, like Apple or Microsoft to mention only the well-known examples. Why? Because they were willing to change, they were committed to create out-of-box solutions and ideas for the market, which at the beginning were not accepted.

All of the factors mentioned above confirm the conclusion, that the development of cleantech entrepreneurships is critical to alter the mature markets, because the large incumbents have no interest in changing their dominant roles. The denomination of cleantech means a new investment sector, which includes all those technological innovations that use limited or zero nonrenewable resources and produce significantly less waste, than the conventional possibilities (Pernick et al. 2007).

The main purpose of this thesis is to identify the characteristics of cleantech investors and the Accelerator who are the main market players of sustainable venture capital. Four main aspects can be distinguished in the examination of investors and the Accelerator program:

- 1. How cleantech facilitators and the market price the environmental impact?
- 2. Who are the main supporters of cleantech startups?
- 3. What do they offer to the startups?
- 4. What do they expect from the startups?

To find the answers for these questions I used mixed methodology, structured interviews with the investor funds and semi-structured interviews with the startups. Besides these, to analyze the Accelerator program I used my working experience and access to the internal documents at Climate-KIC Hungary. During my internship I had personal communications with startups, coaches and other regional leaders of the Accelerator program, with using their experience as well I covered the most important aspects of the incubator program.

Cleantech financing is a key activity to facilitate the startups' presence which can contribute to the continued shift into a more sustainable economy. Due to high failure rates in case of the new and innovative ideas, they are sentenced to death without appropriate financial funding, and for this purpose venture capital funding is recommended (Nobel 2011). To achieve VC fund, startups have to prepare their business model and finalize the research and development of their prototype. For this purpose, Climate-KIC's incubator program offers the best know-how and development support in Europe, awarding the venture's performance with non-refundable financial grants. To finance radical innovations such as cleantech not only financial backing but willingness to bear risk and a mindset of experimentation is needed; venture capital is a central source of finance for commercializing radical innovations all-over the world (Nanda et al. 2013). Therefore, this thesis focuses on the three main market players in Europe which are: cleantech venture capitalists, the Accelerator program of Climate-KIC and startups.

My hypothesis – related to the first question – is that in case of cleantech investment the environmental impact eventuates a premium in returns. This means that cleantech investment funds take environmental impacts into consideration during their evaluation and decision making process; and calculate it as an additional company value. This can be supported by the increase of environmental awareness among stakeholders especially among final consumers. However, my research shows that not all cleantech funds are affected by these factors. Half of the investigated investment funds measure the environmental impact of their portfolio companies, but the other half does not consider the extent of these factors. Basically none of the cleantech investors calculate the positive environmental impact as part of the company's value. This is mainly due to the lack of commonly-used and unified environmental metrics. In case of the Accelerator environmental impact is clearly one of the most important factors at the beginning, but after the first and second stages, the profit producing capability of the venture becomes more important.

A wide variety of literature, like Brown, de Lange, or Gaddy et al. prove that cleantech and especially energy investment does not match entirely with the traditional venture capital model. The main reasons are the hardware based product, which needs incremental financial support, the costs and long period of research and development, the long termination and lifecycle, and the problematic hunt for possible acquisition companies. However, others like Marcus et al. highlights that venture capital is the most important source of finance in case of startups to achieve the commercialization, but the VC models have to be changed to become a money-making fund.

Several cleantech specific venture capitals and investment funds operate in the European market, and they must generate profitable results to stay on the market and satisfy their investors with appropriate returns. I chose ten investment funds to identify their main aspects and to understand their model through structured interviews. Based on my results it seems that the established cleantech VC model, which is used by the examined companies is suitable for cleantech investments, and even for hardware based solutions. They have longer investment period, and they start to invest in earlier stages, and repeat the investments in several rounds for years. At the investment stage the capital requirement is lower for these ventures, during this longer termination the VCs slowly increase the invested amount to support the startups to achieve the growth stage based on the ventures' performance. From the expectations perspective, the most important factors that a cleantech VC consider are the team, the technology and the product during the decision making procedure. With using the collected data, I established a general cleantech VC model, which I compared with the traditional model. The main differences are the longer length and the lower amount of investment due to the higher risk in this sector.

Climate-KIC offers incubation programs in twenty-five countries in Europe. Since its foundation, it has built up the largest network of cleantech startups. Climate-KIC role is to prepare the teams from a seed or pre-seed stage to the startup period, therefore it provides business development services and non-refundable grants to the best ventures to finance their pilot projects. Based on the startup's experience without the support of Climate-KIC they hardly achieve the venture capital investment in this short time of period. Climate-KIC has similar expectations like the VCs, the product and the technology are the most important factors besides the environmental impact of the venture. The incubator program offers all its support for free, and they do not receive anything from the startups, besides their future contribution to the better world.

Two startups from the Hungarian Accelerator program were demonstrated as success stories in this thesis. I evaluated their most important aspects through the concepts of the VC's expectations, both of them fulfilled the main requirements. From the startup's perspective the incubator program offered them enough financial grants to finalize their prototype or minimum viable product, and the VC helps them to launch the product on the global market in one case, and in case of the other it offers them further cooperation opportunities with large energy companies, who might be future acquisition companies. This approved the preliminary expectation about the important role of the VCs and the incubator program. Based on their market experience they confirmed that positive environmental impact is not an advantage for investors.

The previously mentioned facts might suggest that the cleantech sector has a viable market, although if one looks at the source of the investment funds and the grants more detailed, it can be identified that large amount of the money spent in the cleantech market is from the institutions of the European Union and government agencies. This thesis dedicated a special focus on cleantech venture capital financing, because the preliminary expectation was that their role is essential to create waves of clean technological innovation and to transform the economy into a more sustainable approach. But based on the results it has become apparent that the bodies of the European Union and various governmental agencies are also real dominant market players, they influence the market through several interventions like the Climate-KIC program or with investments funds who are specialized on innovation support.

In conclusion, this market requires external support and funds from these institutions, because the investors, even impact investors are looking for profitable solutions which are rare and take a lot of time in this field. It would be impossible to imagine a "laissez-faire" cleantech market with high investment returns, therefore, the legislation and supporting initiatives play a crucial role in the development of a sustainable future.

The existing literature about venture capitals in the cleantech sector mainly study the differences and deficiencies of the traditional model. Most of the studies have focus on the United States and the energy sector. However, this thesis focuses on VC funds which operate in Europe and invest in all types of cleantech innovation. The purpose of the thesis is to analyze the characteristics of the cleantech specialized investors and understand their model. In the literature there is no specified study about the cleantech incubator programs, therefore this research aims to help the existing cleantech supporting market players by supplementing this deficit. On the other

hand, the second part of the research, which identifies the expectations for the startups aims to contribute to the preparation of startups. I summarize the investors' and incubators' evaluation process highlighting the most important financial and non-financial factors therefore, this study might help them to adapt the expectations in their model.

#### 2 Literature review

The main purpose of this literature review is to define the startup and especially the cleantech startup concept, and the important role of the possible financial and operational supporters based on the previously issued publications. First, I look through the general lifecycle of a startup, since it is basically a similar process for all types of startups. The general model is used as a basis for the specific cleantech entrepreneurs with some identified differences. Secondly, the roots of environmental entrepreneurship will be demonstrated with special focus on the behavior of investors in case of sustainable products or ventures. The important role of innovative entrepreneurs in the field of environmental protection can be described with the words of Westly "nothing can change public behavior faster than entrepreneurs who create new world-class products and services... any time they have the power to change the world far more quickly than new government regulations ever could" (Westly, 2009). Thirdly I look through the available investment sources for a startup in each phase of their operation. After understanding the conventional approach of a startup and its possible financial sources, this literature review focuses on the analysis of the characteristics of the cleantech investors. Several forms of financial resources are available for startups; it can be distinguished by the volume needed, the timing or the type of asset. Lastly other market participants will be mentioned who has positive enhancing effect on startups and facilitate the expansion of the cleantech industry.

#### 2.1 Define the startup and its financing background

To define a startup, we can use the "lean method" definition: "temporary organization designed to search for a repeatable and scalable business model" (Ries 2011). Or the definition of

Blank: "A startup is not a smaller version of a large company. A startup is a temporary organization in search of a scalable, repeatable, profitable business model" (Blank 2012). Both definitions agree that the entrepreneur has to build a repeatable model to achieve possible growth; the first will be used in this thesis, because profitability is sometimes reached after the transformation of that temporary organization. However, one has to understand that the essential aspect to run a startup is the uncertainty. One cannot predict either the market or the customers' response for the product or the future competitors or the business growth. Besides the definition it is more important what happens exactly with the venture during the phase of startup.

Various approaches exist to define the key stages of entrepreneurial venture; the most common theories differentiate four or five levels to complete until the desired exit opportunity. According to Petch the five levels are: the seed and development, startup, growth and establishment, expansion, and lastly the maturity and possible exit (Petch 2016). In the model of Picken separates four stages which are the startup, transition, scaling and exit, therefore he does not mention the seed stage separately (Picken 2017). In this thesis four stages will be analyzed the seed, the startup, the growing and the mature, because in terms of investment these are the most suitable categories to evaluate the growth of a startup. We must also keep in mind that based on the market experience every startup lifecycle is different at least on a minimum base, so no perfect solution or general success model exists for the growth path.

The path starts at that special moment, when the entrepreneur sets up his business idea and analyses whether it is a solution, or an answer for "market pain" in other words for the market problem (Petch 2016). After confirming that the market exists for one's product; then comes launching the startup using the "lean startup" method which currently leads to the most innovative, the less risky and expensive venture foundation. Before launching the perfected product, Ries suggests confirming the product's feasibility through experimenting and validated learning with involving of the customers (Ries 2011). The main differences between the lean framework and the traditional business plans are that the first focuses on the experimentation with creating a minimum viable product instead of an expensive prototype; it collects frequently customer feedback to redesign their product or service instead of following the strict business plan (Ries 2011). With using hypothesizes and testing them continuously it leads to a less expensive, faster and risk reducing method to see one's product would survive in the market (Ries 2011).

The startup stage means an essential bridge between the seed and the growth phases. This period allows the startup to prepare for the fast growth with collecting new resources, and to develop internal and external efficiency. To achieve the growth or scaling phase entrepreneurs have to stress their partnership too (Picken 2017). This is the time for pivot or preserve, so startups have to make a fundamental change in their strategy in order to generate higher gain. They look for opportunities to validate other costumer segments too. If the pivot fails ventures get stuck in the "land of living dead" where they still operate but cannot achieve the growth phase ever (Ries 2011). The growth phase can be described by the words of Ries: "new customers come from the actions of past customers", this is the momentum when startups find a widespread set of customers for their product (Ries 2011). When ventures arrive to operate within a validated business concept and sustainable business model their life is almost complete, at this point it is required to generate higher and higher profit to provide gain for the investors (Picken 2017). For all of the lifecycle theories the best case scenario leads to the maturity and exit; these options vary, but the most commons are the initial public offering (IPO), acquisition, merger or private sale (Picken 2017).

After the description of the general lifecycle of a startup one has to understand the importance of their uncertainty. In case of startup investing "the failure is a norm" and every participant are aware of this fact. This characteristic received significant attention in the literature (Nobel 2011). Startups without venture funding hardly survive their first four years due to lack of capital to continue their model; while ventures with funding starts to fail after the fourth year when investors start to decrease the amount of financial support (Nobel 2011). In general, after VC investment around 30-40% of the startups totally fail without generating any profit, 30-40% return approximately the original amount of investment and only 10-20% achieve substantial gain. This

approach is used as the rule of thumb of Gage in 2012 (Gage 2012). Others, like Ruhnka et al. claim that the percentage for failure is greater; according to them around 75% of the venturebacked firms become unsuccessful after few years (Ruhnka 1992). This rate of failure is very high especially in the transition period. Nobel refers to Ghosh's study, which examines 2000 venturebacked startup companies in the United States and based on the result he reveals that only the 5-10% of the startups succeed through the transition to an extraordinary exit (Nobel 2011). Gosh points out a controversial fact that large funding is able to turn a little failure into large breakdowns. The potential of enough financial background might disadvantage the management of the start-up because funding can cover up all the malfunction (Nobel 2011). These statistical numbers help to understand the significance of risk bearing in the area of startup financing. The most common factors to failure are poor-exit potential, limited growth-potential, inadequate profitability, and operational/management problems (Ruhnka 1992).

Even with using the "lean startup" method the risk of new innovative solutions cannot be reduced to zero, the startups still known as one of the riskiest investment asset class. Therefore, conventional financial sources usually cannot be taken into consideration when one is looking for financial support. In general, startups do not generate profit after starting their operation in the next few years, therefore a bank loan or credit payback with monthly installments would be problematic without any revenue (Bottazzi et al. 2002). The financing of startups is more specified than in case of other new small enterprises, it usually takes series of rounds. So in the next paragraph I will identify the possible sources of finance for startups through the different stages. Figure 1 below illustrates well at which phase which investor type has bigger contribution to the development of the startup.



1. Figure: The role of investors in the maturing of entrepreneurial businesses (Marcus et al. 2013)

To set up the venture at the first stage the seed capital is needed, which generally comes from the founders, the trio of the family friends and fools (FFF), the business angels, and accelerators. The group of FFF basically are the believers, so they believe in the entrepreneur not because they understand the business model and see the extraordinary future results, but they trust in the person due to any kind of personal relationship or sometimes they are just fed up with the constant talk about one's brilliant innovation (Startup Explore 2014). Business angels are high-net worth individuals who receive ownership equity or convertible debt in exchange for their capital injection (Startup Explore 2014; investopedia.com). In some cases, angels have expert knowledge in the startup's industry or they are successful previous startup founders (Bottazzi et al. 2002). There are individual or investing groups which collectively explore opportunities. Both angels and FFFs use their own money for the investment. Accelerators are quite new source of funding, these appeared only in the last ten years, but currently most of the big cities have at least one or more commonly several accelerator programs (Startup Explore 2014). These organizations offer also mentorship, advisory, strategic help and even office-place in return for 5-10% equity (Startup Explore 2014). Several types of accelerators exist; one specialization is the corporate accelerator organized by large companies. Their main purpose differs from just capital gains, they are more into discovering innovative solutions which can create added value for the company and bridge the gap between startups and corporations (Kohler 2016). At the end in case of successful cooperation with a corporate accelerator a possible acquisition can take place also directly (Kohler 2016).

Next financial need is the startup capital which can be originated from venture capitalists (VCs), professional business angels, or the new era of crowdfunding (Startup Explore 2014; Investopedia.com). This money mainly spent on permits, licences, development of prototypes, manufacturing, marketing, or any other expenses (Investopedia.com). Business angels' investment policy is usually more adventurous, they accept to give money even in those cases when the start-up held really high risk and VCs refuse to take these consequences (Marcus et al. 2013).

Crowdfunding is a new alternative money collection method; it started to grow exponentially around the year of 2011 (Cumming 2017). It means literally a "general request for money via an open call" and it varies based on the rewards received by supporters; the three main types are donation, lending, and equity crowdfunding (Paschen 2017). Through donation the venture receive money without offering any kind of reward to the supporters, this way is suitable for smaller goals (Paschen 2017). Lending crowdfunding have three subcategories: the presale model, when the customers pay in advance for the final product which they will receive, the traditional lending and the forgivable loan model. In case of the latter the startup repays the money received only if it starts to generate profit so it reaches the breakeven point (Paschen 2017). The equity or investment crowdfunding is similar to the previously mentioned investor categories; they receive equity or bond-like share in exchange for money (Paschen 2017). Donation can be convenient also in the pre-seed or seed stages, when financing also works as part of the startup capital (Paschen 2017).

Venture capitalists are professional investors, they raise funds from wealthy individuals, institutions, corporations, pension funds, or others to invest on their behalf (Bottazzi et al. 2002). They are specialized to invest in young, unlisted, risky but dynamic firms through equity or convertible securities in the hope of above-average returns in the future (Botazzi et al. 2002).

Usually VCs contracted with their capital investors for a ten years long partnership, and typically set up a portfolio with ten or twenty ventures, from this portfolio they expect one or two successes and the residuals will fail or at least reach the breakeven point (Gaddy et al. 2017). In general, they are looking for ventures with possible ten to hundredfold returns of the initial investment after three to five years of the financial and strategic support (Gaddy et al. 2017). To get funded by a VC is a prestigious moment in every start-up life, this not only financial support for the company, but also legitimizes the operation in the eyes of potential customers, other investors, competitors, and future business partners (Marcus et al. 2013). Besides the crucial financial support, they also actively take part in the management of the venture with providing strategic advisory, board presence and networking opportunities which leads to achieve further investment resources (Botazzi et al. 2002). Corporate VC funds, which are a special type of VC funds, where the equity mainly comes from large companies; focus on those specific innovative ideas which later might benefit the mother company to increase the value of the corporation in the near future (Kasdin 2009). This scenario might hold an extra advantage for the start-up, because if it operates successfully the exit or acquisition can happen easily through the owner corporation of the VC fund. This source on the other hand narrows down the start-ups' future opportunities for acquisition.

The funding area of growing or scaling usually takes more series of rounds, where we can differentiate series A, B, and C (Startup Explore 2014; Investopedia.com). Series A funds mainly contribute to the optimization of the business model; series B are for building and expanding their market reach; and through series C investment the funder inject money to double its return, when scaling actually happens (Startup Explore 2014; Investopedia.com). Then in the mature or exit period large corporations play the key role to acquire the company or provide financial support to strengthen the company usually in order to reaching the IPO (Bottazzi et al. 2002).

For my thesis research it is essential to understand the operation and lifecycle of a startup and the possible investment resources which would foster their development. To sum up the new ventures have four main stages, and from the investors' perspective the startup and the growing phase are the most important. The startup phase should contribute enough money for research and development, while the growing phase attempts to commercialize the product or service. In case of possible investors, the role of the venture capitalists is obviously the most significant, they are the ones who are able to facilitate the startup into a successful company.

#### 2.2 Environmental entrepreneurship and financing

#### 2.2.1 Market view of sustainability

The financial industry is rapidly accepting sustainability as a profitable business strategy. Elkington was the first who challenged the idea of the transition from the traditional capitalism to a sustainable corporation system with the purpose to complete the "triple bottom line" (TBL). This sustainability framework encourages to examine each company's environmental, social and economic impact (Elkington 1997). It was issued 25 years ago and since then sustainability became a widely-known approach around the world in business management areas, and even an individual sustainability sector was developed. This year Elkington recalled this concept to do some "strategic tuning" because in his opinion most of the TBL users does not measured the "health of our planet" and their real impact on it, only the profit and loss factors were considered under the umbrella of the TBL (Elkington 2018). Elkington's main purpose with framing the TBL approach is to encourage the corporations to follow and manage their value added and destroyed through the three main extent (Elkington 2018). From the perspective of the companies this means a huge challenge to maximize their profit in parallel with environmental and social responsible behavior; but it has to be done to reach a sustainable economy worldview. Several studies deal with the topic of corporate social responsibility and whether this sustainable approach can create added value to the companies or not. It seems that the CSR activities of a company is already being used as one proxy for good performance. Large companies prefer and are more eager to follow this path mostly to reach a better reputation, but in case of SMEs it is more expensive and difficult to start CSR activities (O'Rourke 2002).

The study of de Lange examined a 300 start-up sample from 30 cities of the five continent to identify whether sustainability is rewarded by investors, and this study is also completed with a national sustainability context (de Lange, 2017). In general, for investors a sustainable mission either environmental, or social, or both is not favorable. They do not seem to have any motivator to pick environmentally friendly firms before others; their priority is to finance an entrepreneur who focus more on the exit opportunity rather than sustainability (de Lange, 2017). Especially in countries with a high Environmental Performance Index - which determines the value of the policy strength in the area of human and ecosystem health in each country – investors showed lower willingness to funding environmentally friendly corporation. It is supposed that they connect the serious regulations with higher costs and slower payback period (de Lange, 2017). From a policy perspective the key suggestion of the de Lange study is to increase support for sustainability entrepreneurship by the government because the huge market players do not care about this aspect without any financial incentives (de Lange, 2017). The latter study has a broader focus on all the investor types and does not narrow down the area neither for huge institutions, corporation nor for venture capitalists.

Controversial theories exist about the cleantech investment behaviors whether it is expanding and investors are getting more interested in this area or not. The volume of investment is definitely increasing; however, this is not necessarily thanks to the growth of environmental consciousness. It is interesting to mention that in one study a green venture capitalist declared that they are more sometimes do not promote their environmental side because of the evade rejections, as he says "Our name often makes investors think that we just ride bicycles and eat vegetables" (Randjelovic et al. 2002). This sentence completely describes the cases when the lack of knowledge can mislead potential investors thanks to their superficial prejudice. The OECD report argue that good environmental, social and governance (ESG) factors indicate an efficiency on operational and financial terms too for investors. It also highlights a study where positive correlation was detected between environmental responsibility and long-term stock performance, especially in the first three years of operation (OECD 2017). This approach is a bit different from the pure cleantech ventures, but it determines that the market now match remarkable performance with social and environmental responsibility. Bocken's survey with leading sustainable venture capitalists and other key stakeholders of the sustainable market results that the interest in sustainable investments does exist and it is growing (Bocken 2015).

But in contrast to how investors commitment to environmental sustainability is questionable, Nielson demonstrates the fact that customers are willing to pay more for sustainability, and one of the key purchasing driver is the environmentally friendly production method and background (Nielsen, 2015). According to the research 45% of the global responders care about this factor before they decide to buy a product or service, and 58% is willing to pay more for this, and this ratio continuously increase year by year especially among the millennials (Nielsen, 2015). The question that whether they are willing to invest their money also in environmentally friendly funds versus the faster return generating high-tech ventures is partially answered by the equity crowdfunding research of Vismara and Bento et al. These studies assume that crowd funder individuals are happy to spend their money on a sustainable venture with environmental friendly impact (Bento et al. 2018; Vismara 2018). But does this approach appear in the financial market in general and influence the selection process of the cleantech investors? For this question the answer is double-edged, more information and results are detailed in the analysis of the interviews with the cleantech VCs.

#### 2.2.2 Environmental entrepreneurship and investing

Environmental entrepreneurship is "entrepreneurial activity which seeks to promote environmental welfare generally and address various sustainability problems specifically, while being financially sustainable" (O'neil et al., 2016). Technological innovations are viewed as the best adaptation and mitigation options to the climate change impacts (Bocken 2015; Reuters 2018). Therefore, this important area is crucial for the development into a sustainable future, and to a 1.5 °C consistent transition to achieve the goals of the Paris Agreement of United Nations Framework Convention on Climate Change (COP21). Besides the climate impact several social impacts exist of the environmental entrepreneurship such as job creation, increased investment value and social responsibility (Doval et al. 2014). Basically, regarding the behavior of entrepreneurs, – quite similar to the customers in the Nelson study – they are passionate about the green concerns, they are happy to address and find solutions for the environmental issues; in the focus of their business plan is to solve these market deficiencies (O'Neil 2016). Most of them realized the fact that business activity is the best mechanism to resolve the climate problems. However, even in this case they have to realize that without identifying what matters to the customers - which is not obviously the environmental factor -, their environmental conscious approach worth nothing (O'Neil 2016). Therefore, at this point the lean startup experimentation and validated learning should be included to start their startup and after that they can look for investors (Ries 2011). Ventures with disruptive technology require large amount of financial support to run their business; either in forms of grants, or investments, or other kind of money. Therefore, in the following the forms of investors with environmental concerns will be defined.

Lately several investing types with a focus on environmental issues developed. These can be differentiated by their main focus area, the most generally-knowns are socially responsible investing, cleantech investing and sustainable or impact investing. Ethical or socially responsible investing mainly looking for social benefit opportunities, mainly it has greater potential than just a financial benefit of an investment asset, it also facilitates the transition of market behavior to more sustainable patterns of production and consumption (O'Rourke 2002). Eurosif which is the main European association which promotes and supports the spread of sustainable investment methods determines the definition as "Sustainable and Responsible Investment (SRI) is a long-term oriented investment approach, which integrates the environmental, social and governance (ESG) factors in the research, analysis and selection process of securities within an investment portfolio. It combines fundamental analysis and engagement with an evaluation of ESG factors in order to better capture long term returns for investors, and to benefit society by influencing the behavior of companies" (Eurosif 2016). This approach with the focus on the ESG of triangle is followed by most of the analyzed investors in the later chapters. Sustainability investing or "impact investing" is looking for investment opportunities which align the TPL benefits; their purpose is to support those ventures who generate measurable environmental or social impact beyond the profit (Bocken 2015).

Cleantech can be defined in several ways; according to Kasdin "cleantech is not a movement, but rather a new investment sector that emerged in the past few years... because people saw an opportunity to make money through cleantech technologies, not because of environmental passion" (Kasdin, 2009). Pernick et al. defines it as "cleantech refers to any product, service, or process that delivers value using limited or zero nonrenewable resources and/or creates significantly less waste than conventional offerings (Pernick et al. 2007). In this thesis the latter definition by Pernick et al. will be used as the determination of cleantech, and greentech will be used as a synonym for it. The eleven cleantech categories determined by the Cleantech Venture Network are the following:

- Energy generation
- Energy storage
- Energy infrastructure
- Energy efficiency
- Transportation
- Water and wastewater
- Air and environment
- Materials
- Manufacturing or industrial
- Agriculture
- Recycling and Waste

the energy related categories will be treated as one category the clean or smart energy in this thesis, because the investors who specialized on energy usually treat these categories all together and do not distinguish between energy storage or efficiency in terms of focus area (Stack et al. 2007).

#### 2.2.3 Evolution of the cleantech market

In 2002 Randjelovic et al. argue that the main determinants for greentech expansion would be the technological and government push and the success stories of cleantech ventures (Randjelovic et al.). Since then several success stories happened especially in the energy sector like in 2005 three energy ventures went public with 100 million USD (Q-Cell, Sunpower, Suntech); Evergreen Solar raised 72.5 million USD in stock offering in 2009; EnerNOC went public on NASDAQ in 2007; or Nest Lab had an acquisition by Google in 2014; these all increased the VCs appetite for greentech investment.

Between the period 2004 and 2008 clean energy technology boom started, and an extreme number of startups appeared in the market with venture capital fund, however the financial crisis broke this exponential funding growth sharply (Gaddy et al. 2017). At beginning, in between 2002 and 2004 the venture capital investment returns of clean energy outperformed the returns of information technology; this approach legitimized the success of cleantech, and provided market endorsement for investors to join this segment (Marcus et al. 2013). The energy sector, which is the most elaborated area within the cleantech industry was influenced by different market effects like the remarkable oil price increase, the implementation of Energy Policy Act of 2005 in the United States creating the Investment Tax Credit and the Production Tax Credit, and also the public awareness was raised with Al Gore's movie the Inconvenient Truth which followed by huge media coverage (Vandilay 2016; Marcus et al. 2013).

However, after this seemingly successful period the investors realized the special disadvantageous characteristics of cleantech which are completely different than the high-tech sector. The study of Gaddy et al. compares the different failure, risk and return performance of cleantech (clean energy) with the medical and software sectors performance; this study confirms

all the previously specified differences in case of cleantech and the traditional high-tech ventures (Gaddy et al. 2017). The failure after A round series investment is around 70% in case of high-tech, while cleantech has more than 75%, if we tighten the definition of failure for ventures the failure of percentage significantly increase in case of cleantech, more than 90% of the ventures did not succeed to at least double the amount investment per year, in case of high-tech it is also around this volume (Gaddy et al. 2017). The value of the internal rate of return (IRR) calculated for the whole cleantech sector (includes the failed companies value too) is negative for this period except the year 2008, when Nest were acquired by Google; in contrary the IRR performance of high-tech is much more promising (Gaddy et al. 2017). The worst results were generated under the exit opportunities, cleantech firms exited less often and were less likely to find acquirer, software companies achieved this prominent phase three more times than cleantech (Gaddy et al. 2017).

Despite the high number of cleantech investments (around 25 billion USD by VCs were invested until 2016 in the United States), most of them, terminated with failure or performed poorly, so the investors realized only small amount of their initial investments; therefore cleantech became an avoided segment for VCs (Vandilay 2016). Until 2011 the demand for cleantech ventures dropped and government initiatives are required to implement in the clean energy and greentech area to increase the investors interests again and the attractiveness of cleantech firms (Marcus et al. 2013). Gaddy et al highlights that the behavior of investors changed recently in this segment and show that in 2014 they started to favor the software or software appliances in this segment, which is closer to the high-tech investing approach with a faster success cycle (Gaddy et al. 2017).

The study of Cumming et al. determines that media coverage, formal institutions and uncertainty avoidance influence the cleantech VC investments. The flow of information through the media channels helps to build reputation, image and legitimacy so it positively affects the market. The economic, political and contractual rules provide a better environment for businesses, and the government effectiveness also positively increase the growth of new markets. In those countries where people are more risk seeking and open to new innovative ideas cleantech business have more prospects and are more accepted by investors and costumers (Cumming et al. 2016).

This chapter contributes to my research with defining the concept of environmental entrepreneurship and cleantech. The historical overview and evolution reveal the two most important periods in the life of cleantech investment. First is until the financial crisis, when huge amount of money was injected into this sector. The second is the realization of the problematic characteristics of cleantech venture and the high rate of failure, which decreased the attractiveness of this sector. Currently we are in the third important period, when investors have to adapt a new model to offer financial and strategic help to startups and in parallel generate significant profit. Because as it was mentioned in the subchapter of environmental entrepreneurship the new technological innovations, which are able to move the economy are mainly starting to evolve from startup ecosystems.

#### 2.3 Characteristics of cleantech investors

In this subchapter I will summarize the academic literatures about the specific characteristics of the cleantech investors which have been already issued. The main aspects of venture capitalists are used as the foundation for the interviews and the analysis through the latter chapters. Understanding the main characteristics of the cleantech investors in Europe is still an evolving study area, most of the literature focus on clean energy and the territory of the United States. However, the future development of cleantech market is extremely promising due to the main drivers such as growing demand for energy services per capita, the shortage of water supplies, the necessity to decrease greenhouse gas emission to avoid climate change impacts, and the scarcity of fossil fuels (Balbach 2009).

#### 2.3.1 Motivators and differences of the cleantech investors

Cleantech entrepreneurship is a completely different approach than the conventional startup innovations. In case of cleantech appears the 'substitution problem', which is the most

important aspect, because on contrary the evolving segment of high-tech, cleantech must substitute existing and mature infrastructures and markets such as energy, transportation, construction, and manufacturing (Marcus et al. 2013).

These innovations are more capital-intensive, need higher costs of consumer adoption than the general high-tech software developments which were in the focus of typical startup investors like VCs in the Silicon-valley (Brown 2009; Cumming et al. 2017). According to Brown the three main aspects that differentiate cleantech investment opportunities are the following: first, the installation of these new assets are more time- and cost-consuming; second it requires a longer development and testing cycles; and third it has to influence and change whole industries which were formed long times ago (Brown, 2009). Westly also approves the view that clean-tech is more capital-intensive, due to mostly its hardware-based new technology; but in parallel he believes that their investment return will be higher than the previously favored segments (Westly, 2009). To validate his view, he stresses the main advantages that different in case of green initiatives, which is the higher support received from the public, the governments and the investors. (Westly, 2009). According to him people all around the world have already started to become more sensitive to environmental issues, they prefer to buy products which keep safe their children and the planet (Westly, 2009). Governments and international organizations promote environmental friendly policy-making, and investors prefer to invest in sustainable companies which supposed to outperform non-cleantech companies (Westly, 2009). Other studies also confirm that the sectors of energy, transportation, water, and minerals are characterized as generating the best revenues for investors (Cumming et al. 2017).

From the investor point of view, the positive advantage of sustainability is not confirmed. The statistical analysis of de Lang shows quite different results, it supports the view that investors in general do not pay attention to environmental factors and impacts of a company, they more likely to rank based on the exit opportunities (de Lang, 2017). In the book of "Green Venture Capital" the authors also promote the evaluation of the financial factors and aspects of a possible investing asset before take into consideration of any environmental factor, Kasdin clearly emphasize that venture capitals should not focus too much on one's environmental aspects, because this easily leads to subjective decision-making and higher percentage of failure (Kasdin 2009).

In contrary the analysis of Bocken shows that commonly the most important motivation of venture capital investors and stakeholders to run a business in this sector is the "practical idealism"; meaning they use their business approach for a higher good; a smaller proportion of respondents' purpose is to operate in a radical new approach and make change through of it because they disagree the current non-sustainable business models (Bocken 2015). The latter study examines the perspective of the sustainability stakeholders and not the whole market so the opinions are a bit distorted to use it as general theory for the whole investor market, however it reveals that new range of investors appeared in the market with a new financial and sustainable perspective, so the transformation is moving to a more sustainable path.

Cleanteach hold higher risk factors for investors because it is still a new market and the financers face greater information asymmetry in contrast the non-cleantech sector (Cumming et al. 2017). These characteristics of capital-intensity, long payback period and mature market to change are true for most of the cleantech subcategories. Regularly the top three reason to failure are the lack of financial support by venture capitalists, strong existing industry and the short-term mindset (Bocken 2015). Bocken researches the reasons for success in this sector, and the seven most important are the following:

- Innovative business model
- Credible collaborations and networks
- Focus on a strong business case
- Sustainability (the respondents claim that sustainability itself leads to a good business, creation of new demand)
- Good team

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#### • Government policy and legislative environment

these factors are similar to the non-cleantech startup cases, but the study also strengthen the unique skill requirements in case of sustainability investment: the business acumen and the ability to deliver societal and environmental benefits through the business model (Bocken 2015).

Two uncertain approach should be mentioned here too. In case of exit opportunities cleantech is in a disadvantageous situation versus medical and software technology; the main clean energy acquires are utilities or industrial corporations who are more likely risk-averse and profitoriented during the valuation in contrary the view of large companies who acquire high-tech startups (Gaddy et al. 2017). Another problematic barrier in case of the valuation of cleantech ventures, that still environmental impacts are not priced appropriately in the market, this can be solved by governmental or international institutional regulations; so operational advantages have to be set up to increase the value of cleantech ventures versus non-cleantech ones, therefore their attractiveness will be better for investors (Randjelovic 2002).

To summarize the aspect of cleantech versus the high-tech innovations the main differences are the higher capital need, the hardware based solutions, lower rate of return and the longer time frame to achieve an exit. It is interesting that most of the studies highlight the profit generating and other financial aspects as the main motivation to invest in cleantech, and in general attach little importance of the climate impacts. However, in point of view of the environmental entrepreneurs the importance of environmental awareness to run their business is an important aspect. The behavior of investors contradicts my hypothesis, claiming that environmental impact is part of the business valuation. Later in my study I will focus on the behavior of cleantech specific investors who has partially different opinion about this topic, the details will be presented in the fifth chapter.

#### 2.3.2 Business Angels

Cleantech angels can take part and offer support during more stages of the start-up lifecycle, from the beginning through the growth stage. As mentioned previously business angels more willing to take risk if they see other kind of opportunity in the startup. They preferably invest in those areas where they have expertise or value; although, in case of cleantech the sector knowledge is one of the challenges for them, because the development of cleantech goes very fast lately (Kasdin 2009; Energy Post 2017). Also angel groups exist with special sector focus, for example in the area of cleantech the Finnish Business Angels Network or the European Business Angels Network (EBAN) offers this type of sector specification or the French Cleantech Business Angels. EBAN recently started a partnership with Innoenergy, the smart energy incubator program of the European Innovations and Technology Institute (EIT) to have direct access to the best clean energy innovations and support them to achieve the market (Energy Post 2017). According to Johnson, the head of EBAN "Business angels can be crucial for bringing cleantech innovations to the next level", because they are more patient investors than VCs, which more suitable for clean energy innovations which have longer lifecycle (Energy Post 2017).

#### 2.3.3 Crowdfunding

The research of Cumming et al. about clean energy crowdfunding campaigns of Indiegogo results that this type of financial support collection method is more popular and more common in countries with low level of individualism and their success is influenced by the oil prices (Cumming et al. 2017). These campaigns more likely to have higher capital goals and more detailed description than the non-cleantech campaigns, this shows well, how the founders attempt to reduce risk through decreasing informational asymmetry (Cumming et al. 2017). Crowdfunding investors are usually less concerned about the business plans but more interested in sharing the ideas and values of the startup (Cumming et al. 2017). They also invest smaller amount of money which they prefer to spend on ventures with responsible social or environmental impact (Bento et al. 2018). In case of equity crowdfunding sustainable ventures attracts more restricted investors, however sustainability essentially does not increase the attractiveness of the company; this means that professional investors prefer to pick more attractive opportunities in the terms of value, while small investors are more sensitive to the noble goals of the companies (Vismara 2018). Apparently

crowdfunders does not account the technological risk associated the project they fund, they mostly consider only the country risk (Bento et al. 2018). Apparently the returns on crowdfunding share are not reward the technological risk, its only price the country risk; this is totally controversial to the modern finance where returns are positively related to higher risk (Bento et al. 2018). This means that crowdfunders accept to bear additional risk for the same return, although this behavior might be driven by non-financial aspects like the environmental impacts risk (Bento et al. 2018). Despite the high risk, the studies show that crowd funders accept to receive lower returns because they have different motivators besides the gain generation. In spite of all these, the expected return for an initial investor does not significantly differ from the benefit offered by a venture capital fund (Bento et al. 2018). This can be reasonable if we take into account that in case of VCs additional cost appears for the investors, while in case of crowdfunding equity one should not pay management fee.

#### 2.3.4 Venture capitals

The main purpose of the VCs without any cleantech or non-cleantech specialization is to identify and invest into the future leading corporations (Marcus et al. 2013). Although, clean technology is a completely different approach than the conventional business criteria of VCs (Brown, 2009). For example, VCs usually have short term horizons with the focus on fast growth, large return generating, low capital intensive ventures which is typical for the high-tech sectors. To have a specific sector example under the frame of cleantech, take a look on the clean energy venture investing which is quite different than the IT segment due to its huge early adoption costs, large inventory and working capital requirements and the market is already dominated by regulated incumbents; VC should find the economic opportunity to rely on clean, low-cost and renewable energy (Sakoda, 2009). Some, like Ghosh et al. question whether the traditional venture capital model is suitable for the cleantech investments, especially in the energy sector due to structural challenges such as the longer period to reach exit opportunities (Ghosh et al. 2010). Some, like Randjelovic et al. and Gaddy et al. also argue that venture capital model is not appropriate for
cleantech investment (Randjelovic et al. 2002; Gaddy et al. 2017). The approach of Randjelovic et al. based on discussions with specialists in the VC field in Europe and the United States, they claim that similar to Ghosh the main barriers would be the lack of proper greentech network, the external perspective which means that investors perceive eco- and environmental innovations as less profitable options; and the deficiencies of the cleantech entrepreneurs (Randjelovic et al. 2002). The latter determines that cleantech founders tend to focus more on the environmental impacts in their business plan than describing a well-detailed and deliberated financial model (Randjelovic et al. 2002). While it is still an immature market the participants usually have no professional experience and the no good prospects for exceptional exit opportunities (Randjelovic et al. 2002). But one has to consider that the issue date of this study was 15 years ago when green venture capital was only an emerging phenomenon, since then the market became more mature, the sustainability professional knowledge increased, cleantech market expertise appeared and the technological innovations in the greentech sector have become more and more sophisticated.

On the other hand, Gaddy et al. empirical study show that in the period between 2006 and 2011 the performance of the cleantech investments was much worse than the medical and software ventures in terms of return and risk (Gaddy et al. 2017). This and the facts mentioned above confirm the thought of Marcus et al, that for the improvement and financial support of the cleantech startups venture capitalists definitely needed, however the traditional model requires a change to become a win-win situation for the investors as well (Marcus et al. 2013).

"Green venture capital refers to investments in companies that reduce our dependence on fossil fuels or improve the quality of the environment" (Westly, 2009). The role of VCs is very important and crucial in case of any start-up especially in an emerging sector and technology as mentioned before. Actually cleantech was a rapidly growing sector, the fastest between the period 2000 and 2013 in the venture capital industry; and VCs became the main player of the market who take the high risk in backing seed companies with expecting future acquisition or exit (Cumming 2017; Kasdin, 2009). VCs establish and provide the supporting resources for entrepreneurs that need to move toward full-scale commercialization (Marcus et al. 2013). In the growth phase it bridges the gap between the early seed stage investors like FFF, accelerator and governmental funding and the later-stage bank or public market financing; this gap in several cases the "valley of death" (Kasdin, 2009; Marcus et al. 2013).

The main activities of the venture capitalists will be described in the next paragraph, because their role is so much more than just injecting some money into the startups. They have to understand the market and demand for the product or service; they are also backing the start-ups with strategic, technological advices and offer them networking opportunities with possible customers, investors and partners (Bocken 2015; Kasdin, 2009). VCs nurture the start-ups' development to achieve exit opportunities either via initial public offering (IPO) on the stock exchange market either acquisition by another corporation (Marcus et al. 2013). Some, like Gompers et al. and Kortum et al. claim that this kind of intensive involvement and help to the start-ups have a positive impact resulting higher return rates, better performance and growth model than the non-VC funded companies (Gompers et al., 2001; Kortum et al., 2000). These sound not so dissimilar like the role in case of non-cleantech venture-backing, however cleantech VCs have to match the business acumen with sustainability skills as well (Bocken 2015). In return their investment they take equity stakes in the companies and receive management fee from the limited partners, however in case of failure no gain is realized for the VCs. The injection of money is usually given in several rounds, like mentioned in a previous chapter, this mitigates the outsized risk, because after series A investment one can decide upon to follow the financial support based on the venture performance; it is not unusual that VCs abandon firms with poor performance (Marcus et al 2013). In case of cleantech investment there is a special focus on this review and performance follow-up to generate the best case performance of the portfolio (Marcus et al 2013).

The operation structure of a VC can be divided into two main partner level, the investors, in other name the Limited Partners (LPs) and the General Partners who run the fund (Marcus et al. 2013). There are different types of VCs based on the source of the equity, it can come from pension funds, insurance companies, corporations, investment banks, foundations high net-worth individuals or other investors (Marcus et al. 2013).

After understanding the significant role of the venture capitalists, this chapter continues with the details of the startup selection process and the expectations for the possible portfolio companies from the VC point of view. So first one has to determine the ideal period or phase when they start to finance the venture. Westly suggests to avoid seed stage companies based on the previous experience with conventional VC supported business like software start-ups, because lot of factors like competitive landscape change so quickly altering the market and the growth opportunities for early stage companies (Westly, 2009). The risk of failure is quite high in case of early-stage investments; one out of ten will overperform; only forty percent will achieve good results and the rest will fail completely (Kasdin, 2009). Despite the successful IT investment procedures, that VCs brings into the life of the start-up in the phase of "exploitation", the cleantech approach has to be re-considered and VCs need to join and support the venture at early-stages during the research and development assessment, therefore expand their participation for the "exploration" period too (Marcus et al., 2013; March, 1991). However, VCs do not fund experiments, they expect a product which only needs a push to step into commercial stage and soon deliver return to the VC (Marcus et al. 2013).

After determining the ideal phase for the VC, the investors have to find and identify the startups, these can happen through several sources like industry conferences, and through the personal networks or VC community; but it also usual that VC has cooperation with technological universities or entrepreneurship programs or labs organized by the government or other institutions (Kasdin 2009). Based on the experience of Kasdin university are one of the most important sources to find future opportunities of commercialization (Kasdin 2009).

Based on the characteristics of cleantech several evaluation and assessment factor exists to pick the best opportunities. Based on the interviews of Bocken with sustainability investors and stakeholders he sums up necessary startup activities to become more prepared for venture capital investment. The most important factor is the innovation in the business model; secondly the triple bottom line effect to generate financial profitability through positive environmental and social impact creation; thirdly to collect financial support from other suitable resources like crowdfunding or peer-to-peer lending; and last the venture has to have a clear business case, and sustainability is not required to be highlighted in their business model because strong environmental impact is not enough to be considered as a possible portfolio company (Bocken 2015).

As cleantech is a new industry it holds higher risk factor, therefore returns supposed to be also higher to affect limited partners. Brown argues that besides the longer-term funding access there is no other key expectations from venture capitalist for cleantech compared to non-cleantech entrepreneurs; but he highlights that composition of syndicates clearly different and will determine the future development; the importance of partnership also appears in the study of Bocken as one of the most important factor to successfully develop the ventures (Brown 2009; Bocken 2015). Kasdin partially approves Brown's argument, he confirms that venture capitalists only give cash if they were convinced about the recognized opportunity; environmental protection is only the byproducts of the venture, not the main purpose (Kasdin 2009). Sakoda directly opposes that VCs put emphasis on the climate impacts during their decision making process; he mentions the energy sector where to reach a competitive advantage you have to become the lowest cost producer (Kasdin 2009). Some study, like Randjelovic et al. claim that green VCs consider the ventures' capacity of eco-innovations as an added value during the evaluation process, in contrary the mainstream VCs who consider the environmental issues as risk factor only (Randjelovic et al. 2002). So in this area controversial perspectives exist whether one price the environmental impact or not for the investment decision. After these environmental factors as part of the evaluation and risk assessment according to Kasdin the three most important aspects are the market adoption, the ability to grow the business and the exit opportunities, without these they are less likely to invest (Kasdin, 2009). The latter mentioned factors agree with the expectations for the conventional or high-tech startups too. In the investment decision making process the government supports should also taken into consideration; it is not an explicit expectation, but a positive advantage to effect the final decision (Kasdin 2009). But any technology they invest in, must be able to achieve profitability and be economically viable without depending on subsidies, rebates and other government intervention, otherwise it becomes an undesirable asset (Kasdin, 2009). Westly believes that financial benefits will be higher for cleantech funds than for other sectors in venture capital (Westly, 2009). At his company the performance metrics in case of green VC are the same investment fundamentals that any venture firm would focus on like revenues, growth rate, market size and the competence of the management team (Westly, 2009). At another VC the factors taken into consideration during the assessment process are the breakthrough technology, management team's experience in the sector, measurable milestones, exit potentials and high returns (anticipated revenue, return on investment), in addition the impact of government regulations (Kasdin, 2009). In case of energy technology risks, there are the government regulations and supports, the financing, capital-intensity, the required life-time of the technology product, durability and reliability, the technology evaluation and scaling (Sakoda, 2009).

In the evaluation process a special non-financial factor the founders and management of the startup has significant importance. Kasdin claims that management's experience in the sector and with seed start-ups as well can increase the value of the company during the evaluation for the investment (Kasdin, 2009). On the contrary in the view of Sakoda, focusing on clean energy industry, he says that the experience is quite important, but not essential; he places emphasis more on the "cross-polination of management talent" (Sakoda, 2009). The valuable approaches in case of an ideal management is, that they understand the market opportunities, they identify whether the company's solution meets the market's need and plan how to manage the venture to become successful (Kasdin, 2009). Bjornali also highlights the necessity of political background and knowledge in the management team, because this would give competitive advantage to the ventures in this highly regulated industry (Bjornali 2014). Based on the study of Randjelovic et al. a few specific characteristics were identified in 2002. This year around forty-five green venture capital fund exists in the United States and Europe with 100 million total investments into this area, which was only the 0.08% of the mainstream VC investment size (Randjelovic et al. 2002). This year, based on the results of the study in general 1.1-million-euro was invested in ventures for 3 or 5 years long termination, and the source of capital the VCs collected to their portfolios mainly came from high net-worth individuals (Randjelovic et al. 2002). Since then lot have changed, new cleantech funds appeared in the market and it seems that their characteristics have also changed, but these results from the Randjelovic report will be compared in the fifth chapter with the results of the interviews.

#### 2.3.5 Enhancing market participants

In the initial period, governmental grants, university and research institution support is the most common besides joining an incubator program which is organized either by corporations or institutions (Gaddy et al. 2017). This area, which talks about this kind of support, that a venture can gain from these programs, is not well-supported by academic literature. Therefore, in my research I dedicated a chapter for the introduction and demonstration of the European cleantech incubator program, the Accelerator organized by Climate-KIC. In this fourth chapter I highlight the important role of the Accelerator, and their provided support to the startups.

According to Gaddy et al. thei VC's model is not suitable for clean energy investment at all, they described other types of better matching investors who have substantial capital to invest and are more patient for the investment return (Gaddy et al. 2017). Gaddy et al. offer a few examples of these financial supporters with longer time horizons: pension funds, family offices, institutional investors, philanthropies, foundations other charitable organizations (Gaddy et al. 2017). In contrary, based on the interview results with European investment funds, they established their model to be suitable for cleantech startup financing, which is detailed in the fifth chapter.

The role of the governmental support is crucial in the segment of cleantech entrepreneurship. In the previous chapter it was determined that without appropriate financial support, the startups and their innovative ideas to alter the conventional markets, cannot success. The investors, especially venture capitalists need the active involvement of the governments against the large incumbents in the United States to successfully foster the ventures to transition the economy into a more sustainable production (Ghosh et al. 2010). Also argued that the future profitability of the green investments is highly dependent on the "environmentally friendly regulation" background (Randjelovic et al. 2002). Despite the fact that government regulation has the power to positively influence the improvement of the market, one has to realize the possibilities of market distortion and also negative effects of the radical policies on the innovativeness of cleantech firms (Bjornali 2014).

Different types of government programs exist to support the entrepreneurship, in case of cleantech, a greater focus is needed to head the economy into a more sustainable operation. The government can affect the cleantech market in three ways, first with building customer demand directly or indirectly, secondly with providing extra financial backing and thirdly with business development assistance (Stack et al. 2007). The increase of the demand directly can be reached by obligations for renewable energy use for different kind of market players or institutions or energy efficiency raising regulations for new buildings. To encourage costumer demand with indirect policy subsidies and incentive can be used for cleantech product (Stack et al. 2007). In the phase of transition or growth to escape from the 'valley of death' the government financial support can be used to decrease the risk of startups and bridge them with the demand of venture capitalists, this phase most useful examples are the business competitions or state-level public-private funds (Stack et al. 2007). To provide business development help for entrepreneurs, different tools can be used such as incubator programs, public education, inter-regional cooperation or public promotion (media coverage) (Stack et al. 2007). Until now, several types of government initiatives were implemented in the cleantech market around the world with more or less success, but still lot of barriers have remained and the transformation of the market have just started.

In the United States to foster the renewable energy development, the Department of Energy (DOE) set up a 2.4 million USD stimulus fund, which distributed different kind of grants, seed investments and loans for entrepreneurs (Kasdin 2009). This kind of non-dilutive grants gives the chance to the startups to grow faster and achieve the commercialization without external majority shareholders, although these grants are not covering long term operational costs, but enough to set up the prototype or finalize the research and development (Kasdin 2009). According to Marcus et al. the initiation of the DOE was supporting for the grows in the clean energy use, however it did not alter significantly the conventional market (Marcus et al. 2013). After several years of operation Gaddy et al. suggests the idea that in the United States DOE should increase funding for their entrepreneurship programs to finance cleantech incubator programs; in addition, targeted incentives should be implemented to influence the investors and partners' behavior to raise their cooperation with startups (Gaddy et al. 2017).

Another kind of government intervention appears in the Chinese market, where the national sovereign fund (The China Investment Corporation) with city and state organizations set up a venture fund to support entrepreneurship within the country; this might seem a strong intervention, although China is one of the leader country in terms of cleantech companies achieving particular IPO (Westly 2009; Marcus et al. 2013).

On the other hand, some other indirect regulatory push happened already besides the direct stress on eco-entrepreneurship to improve the market, for example the pension legislation in Germany and UK, which obliges pension funds to disclose information about environmental, social and ethical characteristics in their investments, so it encourages funds to looking for sustainable assets (Randjelovic et al. 2002). This approach is extended for all the member states with implementing the IORP II; all pension funds operating in the European Economic Area will be required to include their environmental, social and governance (ESG) factors in their annual reporting (OECD 2017).

Based on the thoughts and ideas mentioned in the last paragraph we can claim that lot of government policy were implemented, however these did not influence much the whole market approach. In this thesis I describe two types of intergovernmental support from the European Union. First, the Climate-KIC which provides business development assistance and direct financial support for the startups free of charge. This model is similar to the DOE's fund; it is financed completely by the body of the EU. The other way to provide extra financial backing occurs through the VCs, because in several cases in the examined population European Innovation Fund (EIF) invested in the venture capital. This fund is established to foster entrepreneurship in the EU, it can be similar partially to the Chinese state-owned fund.

#### 2.4 Conclusion of the literature review

The three main cleantech source of finance are: the business angels, the crowdfunding and the venture capitalists and each have different aspects. In case of VCs and angels the sector knowledge and experience is important for the investors, while anyone without any experience can join crowdfunding. The amount of capital invested is the lowest in case of crowdfunding and highest in case of venture capital, however in some cases business angels are also able to inject large amount of money into one venture. Crowdfunders and business angels are less strict in terms of the venture capabilities, they are more willing to consider non-financial factors with higher impact in the decision making. The presented studies highlights that environmental impact consideration is the highest in case of crowdfunding and less in case of venture capitals.

Venture capitals are the most important sources of finance for new ventures as it was proved in the literature, however it seems that their model is not totally suitable for the cleantech investing. The characteristics and most important aspect identified in this chapter were the basis for the interview questions. First the selection process of startups and the evaluation factors. VCs find the possible investment opportunities in university labs, or in incubator programs. After this, they evaluate the startups based on the following aspects: Some argue that there are no huge differences in the evaluation process in case of cleantech startups, the most important factors mentioned are: the innovative business model, the breakthrough technology, the competencies of the management team, government support, ability to grow the business, ROI, and the lifetime of the product. With using the 'triple bottom line' environmental and social impact should be also part of the evaluation process. In my research I will investigate the use of environmental metrics during the selection process. After the investment VCs actively take part in the management with board representatives and also with strategic advisory.

# 3 Theoretical framework and methodology

This chapter provides an insight into the framework and methodology which was created for my research to identify the main characteristics of the cleantech investors. As there is no similar research in the academia, therefore I set up my analytical framework based on the literature review. My starting point is the triple bottom line approach by Elkington, because as it is described in the second chapter, this theory claims that environmental impact should be considered as part of the pricing for the business valuation models. The three bottom refers to the people, the planet and the profit, with this reporting methodology companies may demonstrate their commitment to corporate social responsibility (CSR). Elkington points out the importance to present the environmental and social impacts related to the company, because these two aspects with the financial performance would give the real value of the company (Elkington 1997). He argues that the environmental impact of a company is measurable and it can be expressed in terms of money (Elkington 1997). Based on the existing theory I assume that environmental impact measurement means an added value for the environmentally aware corporations. Therefore, my hypothesis is that from the perspective of European cleantech investors, environmental impact means a premium, and it is valued appropriately before the investment decision.

To understand the main characteristics of the cleantech investors I have distinguished two aspects. The first, related to my general hypothesis is to identify the investor's main motivations and reasons to enter the cleantech market. The second is to understand their main internal characteristics and external expectations for the startups. In this second part I raised three main questions:

- Who are these supporters?
- What do they offer to the startups?
- What are they expecting from the startups?

#### 3.1 Analytical framework

I established an analytical framework for the analysis of the cleantech supporters. It was also used as a basis to establish the interview questions. The framework can be separated into two phases, which is demonstrated in Figure 2 below. The first phase is related to the TBL approach of Elkington, and the second more specifically investigates the internal and external characteristics of the cleantech supporters.



#### 2. Figure: Analytical framework

The first phase aims to identify the value-creating attitude of environmental impact from the cleantech facilitators perspective. Based on the literature conventional investors are profitdriven, they do not consider environmental impact as an advantage. But in case of cleantech investors, as they are considerably new market players other factors might influence the decision making method besides the financial return. It is very difficult to identify whether environmental impact is a significant factor for cleantech investors during their portfolio composition, or they also focus only on the financial bottom line. In the background of environmental conscious behavior usually marketing or reputation enhancer purposes stand. The lack of commonly used non-financial factors for impact measurements strengthens the sensitivity of this neglected area. Therefore, in my research I will identify whether the investigated investors focus on the environmental impact or not; and is the environmental impact assessment built into their operation.

The analytical framework regarding the supporting role and expectations of the investors is based on the studies of the book Green Venture Capital: Leading VCs on Analyzing Greentech Market Opportunities, Evaluating Investment Potential and Risks, and Predicting the Future for Green Investing. This book was issued in 2009 in the United States. The chapters were written by successful VC investment directors, they describe the characteristics of their investment approach and include suggestions for future cleantech venture capitalists. Detailed summary is represented in the literature review chapter about the most important factors and requirements of the evaluation and assessment process of the four authors, Brown, Kasdin, Westly and Sakoda. In a few cases they have different perspectives, especially whether the environmental impact is needed to be included as part of the evaluation process or not. This book gives a good perspective to understand the fundamentals of the cleantech investments before 2009 in the United States. However, since then a lot have changed, several governmental commitments and initiatives were introduced to foster the environmental entrepreneurship. To understand the main characteristics of these investors in the European Union I used the mentioned authors framework to identify the most important aspects.

First, who are these cleantech facilitators; and more importantly who offer financial investment to them. The source of capital is one of the most particular question. Who has the money and the motivation to invest in cleantech solutions and why. The next critical question, is the geographical location. Where exactly these cleantech investors operate in Europe, and in which

countries do they look for possible investments. During the literature review I realized that energy is in the focus in most of the academic literature about cleantech investment. It can be claimed that this seems to be the most profitable and promising category. But in my research I aim to understand what other kind of focus areas exist in the market, and what kind of preferences investors have. Besides their individual characteristics the potential collaborations and syndicates also play an important role in this growing sector as it was mentioned by Brown (Brown 2009). Therefore, I included the importance and the nature of these syndicates in my research.

The next main topic of my research is the support provided by the cleantech facilitators for the startups. As it was mentioned before the cleantech segment is a capital intensive market, because these new technological solutions have to compete with incumbents (Ghosh et al. 2010). Therefore, they need substantial amount of money to finalize their research and development and to launch their product. The volume of the investments is a sensitive question, because investors prefer to give small amount of money in case of high risk investments. In this step I identify the average volume of investments which can be achieved by cleantech entrepreneurs. Besides money, investors usually offer other additional benefits to support the improvement. In case of conventional investment these are usually strategy advisory support.

The last investigated area is in connection with the expectations of the facilitators and investors. What type of financial indicators and besides these what else they take into consideration during the selections process. This part of the thesis identifies the most important milestones which a startup has to achieve to apply for any kind of investment. In the literature review it was determined that cleantechs have different features compared to other conventional startups. Cleantechs requires more time and money to achieve exit opportunities. In this segment I will identify the main areas of interest in case of the evaluation.

With this analytical framework I aimed to identify all the important aspects of the cleantech investment. I included all the critical issues mentioned in the academic literature regarding this area, to understand how the market players react or adapt solutions for these problems.

#### 3.2 Methodology

To identify the focus area of my research I looked through the startup lifecycle to see what are the most critical milestones and which market players can provide support in these momentums. The first problematic stage is when the startup has to develop its business model and finalize the research and development activities for its pilot. To serve these needs incubator programs are the best solutions. The second critical moment is when the startup is looking for financial support in the purpose of growth; at this point two paths exist, one goes directly to the valley of death and the other goes to the VC investments. This phase the risk of failure is very high, the ventures are not likely to achieve commercialization without the appropriate financial and strategic help of the investor funds. Based on these two critical moments, in this thesis the biggest cleantech incubator program in Europe, the Climate-KIC Accelerator and ten selected European cleantech investment funds were analyzed through the analytical framework. To understand the perspective of the startups two venture-back success story is included in the thesis as well.

This study is primarily targeted to assess the characteristics of the three main cleantech market participants. Methodology with mixed methods was utilized to analyze the incubator program, the investors and the startups. Semi-structured interviews with key stakeholders were used to collect information about the motivation of the investors and their operational methods. Besides the qualitative interviews, I spent four months as business development project assistant at the partner organization of Climate-KIC. Therefore, my personal experience, and communications, participations in national and international programs gave me the chance to have a more accurate picture about the operation of this cleantech incubator program and the whole startup ecosystem.

#### 3.2.1 Data collection

As I mentioned I have worked at the partner organization of Climate-KIC Hungary during the thesis preparation period. My goal was to have practical working experience in the cleantech startup ecosystem which I can synthesize with the literature I reviewed. During this period, I took part in the organization and coordination of the business development programs. Therefore, the data collection happened directly in the working space of Climate-KIC. All the internal documents were available for me to understand their operation better. I had access to the application files, the evaluation documents, all the materials prepared by the startups during the program. Besides my local work, I have also participated in an international partner meeting in London in June. There I had the chance to meet with representatives from other regions, and during personal conversations I learnt more details about their operational model and investor connecting methods. In case of unknown areas in the analysis of Climate-KIC, I consulted with my supervisor, the project manager who has over five-year experience in the cleantech sector.

#### 3.2.2 Structured and semi-structured interviews

I used in-depth interviews to understand their background, motivations and expectations, because no sufficient public data or similar publication with adequate dataset was issued in this field. According to Seidman interviewing is the primary way to investigate a process or institution, because in this way the researcher understands the experiences of the individuals who are responsible for the process or working at the organization (Seidman 1998). Therefore, in this thesis research the best method to identify the main characteristics and expectations of the investors is to ask them about it. This perspective is also used for the success stories of the startups. Because in this case it is more important to have personal conversation with the founders and listen to their experiences in this ecosystem.

The previously detailed analytical framework was used to establish the structured interview questions of cleantech investors. It can be separated into two parts, first, the cleantech market and second the VCs operation and their evaluation process. The semi-structured questions are demonstrated in the Appendix A.

The interviews with the investors took place online or via phone call, one respondent could not participate a call, therefore he only filled out the questionnaire without direct consultation. The responders were mainly investor directors of the VCs. The length of the interviews due to the busy schedule of the interviewees was limited to thirty minutes, however in some cases it happened to be longer, for example the longest interview was about sixty minutes. The results of the interviews are discussed in the fifth chapter.

In the semi-structured interviews with the startups the focus was on their performance, their activities and their way to achieve this milestone to be funded by a VC. In this case also the analytical framework was used as a basis. Several aspects were asked related to it, for example, the type of support received, the circumstances of the application for the fund, the importance of the Accelerator program, and the difficulties to find VC support. The list of these questions can be found in the Appendix A.

#### 3.2.3 Sampling and identifying investors

To choose the interviewees I looked through the available venture capital funds operating in Europe. I consider my sampling method as random sampling using reliable databases. Since there is no common up-to-date cleantech VC database, I searched on the internet for successful market players. First I looked through the list of EcoSummit<sup>1</sup> about the smart green venture capitalist in 2018 (ecosummit.net, 2018). Before contacting the possible candidates, I verified their existence with looking through their websites and made sure that their mission meets the requirements of the cleantech definition.

In total 22 interview request were sent to different VCs based in Europe from the EcoSummit list. From this amount seven investor were willing to participate the interview, so the response rate was around thirty percentages. The list was completed with a few investor contacts of Climate-KIC, from this side four possible respondents were asked and three of them were able to take part in the research. With them in total 10 investors were included in my research, nine of them are different types of venture capitalists and one is an investment manager. To have a mixed set of perspectives I picked VCs which have special attention on the energy sector and funds who

<sup>&</sup>lt;sup>1</sup> EcoSummit is an organization which main purpose to accelerate cleantech startups, investors and corporates through its conferences held in London, Berlin, Paris, Amsterdam and Düsseldorf; it operates with several agencies and corporation partners and most of them from the energy sector (ecosummit.net, 2018).

have a broader focus area within cleantech. Therefore, I included three VCs with the specific focus on smart energy and five who are looking for all kind of sustainable ventures, and two which focus on sustainable agriculture projects.

#### 3.2.4 Identifying startups

To understand the market opportunities and the path of a startup to achieve venture capital funding, two startups were interviewed from the Climate-KIC Hungary Accelerator program. To find the perfect examples I set up a few conditions. First the startup had to take part in the Accelerator program, and it had to join it in the seed stage. Second, the startup had to show particular performance, for this I used the grant history of Climate-KIC. Because in this program only those receive financial grants, who have successful performance and show growing potential. My last criteria was, that the startup had to receive venture capital funding before they left the incubator program. The selected startups are the TrucksOnTheMap and the Heatventors. Both of them are in the Stage 3, which means they are finishing the incubator program. To gain a broader overview I chose the companies to have different operational models. Heatventors' product is a hardware based energy storage, while TrucksOnTheMap provide an online platform and mobile application for the trucking sector.

#### 3.3 Research ethics

Based on CEU Research Ethics Policy and Guidelines all participants were informed about the nature and topic of the research. The responses are treated confidentially, and all respondents were asked to confirm their willingness to participate in the research. All information regarding the data sharing was shared with them during the personal conversations. At the beginning of the interview I asked their permission to include the name of the company in my research, only one VC decided to participate in anonymously. After the interviews all transcripts were sent to the respondents to approve the information included in the research.

#### 3.4 Analysis

To identify the main characteristics of the Climate-KIC and its incubator program the main factors of the analytical framework were used. I determined their operational background highlighting the motivation and importance of the organization. Then, I examined its supporting role from the cleantech venture perspective and their main expectations for the startups. In this this chapter my analysis based on my working experience, the personal communications with stakeholders and the internal document review.

All the interviews were recorded with the permission of each interviewee, therefore I wrote down the transcripts using the recordings without missing any substantial information. After I looked through all the received information, I used the labelling approach to analyze the interviews with organizing excerpts from the transcripts into categories (Seidman 1998). In case of the interviews with the investors these categories appeared as subchapters in the fifth chapter. These labels are basically connecting to the main aspects of the analytical framework. The established categories are: the environmental awareness, the background of the investor, the role of the governmental or EU support and the expectations for the startups. Based on the ten interview responses I compared the unique cases with each other in terms of every important aspect established in the analytical framework. My main purpose in this research area is to understand the unique operation of each fund and to set up a general model for the European cleantech venture capital. I closed the results comparing the cleantech VC model with the conventional VC model and with a previous green fund model established in the Randjelic et al. study.

In the results part I used open coding method for the environmental impact and expectations part. This open coding can be defined as "the analytical process through which concepts are identified and their properties and dimensions are discovered in data" (Strauss et al. 1998). The transcripts were analyzed in depth to identify general concepts and create categories. In case of the environmental awareness, for example "governmental commitments", "change of behavior", "interest" and "risk" are all noted concepts. In case of expectations, the main concepts are included in Table 1, presented in the fifth chapter.

For the analysis of the interviews with the startups I also used the same labelling approach, but I have partially different categories, because they experienced a different market perspective. In this case I established the following labels: the demonstration of the product, the competitive advantage, the team structure and background, the development path, the received financial support, the role of the Climate-KIC and the main motivation behind the VC investment. In this analysis I also used additional data from the previous materials created by the teams such as their pitch presentations and onepagers<sup>2</sup> to complete the information received through the personal conversations. At the end of the sixth chapter I compared the two startup cases identifying the main similarities and differences.

#### 3.5 Limitations

There were multiple limitations and challenges that the research faced. Firstly, due to the research period (June and July) many possible respondents the investment directors and the startup founders were on holiday in June and July, therefore it caused a difficulty to make an appointment with them. This leads to a lower response rate in case of the investor research. I attempted to use Climate-KIC's investor database as the main basis for my research, although I did not get access to this dataset, therefore I had to contact more investment funds by myself, without direct contact. This increased the preliminary expected time for interviews.

As I used random sampling method due to the lower response rate, I did not have a chance to create bigger groups with similar backgrounds. Therefore, the results cannot be considered as

<sup>&</sup>lt;sup>2</sup> Onepager, is a one-page long summary of the startup's operation, it aims to include all the important aspects, which a potentional investor would be interested eg.: the product, the team, the improvement and the business model.

full sampling, which might cause distortion in the final results of the investment funds compared to the whole cleantech VC system. Further utilization of the results requires cautious treatment.

In the research only success stories are represented, because in the Climate-KIC Accelerator program none of the startups which received VC have gone bankrupt. Including a wide range of startups with successful development but with rejected venture capital applications to analyze and compare with venture-backed startups can be considered as a further development opportunity, because in this case the deficiencies can be also identified.

## 4 Climate-KIC

This chapter provides an insight of the operation and supporting role of Climate-KIC, and their most important incubator program the Accelerator. As it was summarized in the second chapter it is very difficult to reach financial support in the seed phase. Conventional funding sources like bank loans are not suitable for young ventures. It is a challenge for the startups to find non-dilutive funding, however, in the increasing impact on fostering entrepreneurship in the European Union several programs and funds were established to support startups with different kind of grants. Several national and international initiatives appeared in the market to foster the starting of eco-innovation entrepreneurship, and the "leading climate innovation initiative" in Europe is the Climate-KIC (climate-kic.org).

After describing the background and entrepreneurship support of Climate-KIC, I examine the Accelerator program using the analytical framework determined in the chapter 3. Therefore, the main focus areas are: the importance of the environmental impact, their expectations and selection process, the details of the support provided to the startups, and their role in bridging startups with investors.

#### 4.1 Climate-KIC background

Climate-KIC is one of the three original European Knowledge and Innovation Communities (KICs). It is supported by the EIT, an independent body of the European Union. EIT was set up in 2008 to boost innovation and entrepreneurship across Europe. Climate-KIC was established in 2010 and since then it operates in twenty-five European countries with around three hundred partner organizations such as universities, businesses, cities and NGOs. The main hubs are in the geographic territories of the Mediterranean, the North-Eastern, the Benelux, the Alpine and Hungary, the Nordic, UK and Ireland. It mainly receives financial support from the EIT, but in several cases the partner organizations provide co-funding to the programs of the local Climate-KIC.

The mission of Climate-KIC is "to bring together, inspire and empower a dynamic community to build a zero carbon economy and climate resilient society" (climate-kic.org). It connects expertise from the areas of business, academia, non-profit and public sectors to accelerate the transition towards a zero-carbon economy in Europe. Climate-KIC has several programs with four focus areas, which are: the urban transition, sustainable production system, sustainable land use, decision metrics & finance. It offers programs in the field of education, research and innovation, and entrepreneurship; with the purpose to transform ideas and theoretical researches into climate-positive businesses.

In this thesis I focus on the entrepreneurship field. The organization has three main programs to catalyze and nurture environmental entrepreneurship: ClimateLaunchpad, Greenhouse and the Accelerator program. As we can see it is a versatile organization with fostering the environmental awareness in as many areas as possible. In the next paragraph I summarize the main aspects of the first two programs, and in the following chapter the details of the Accelerator are described.

ClimateLaunchpad (CLP) is an idea competition which encourages young entrepreneurs, mostly university students to make up an idea and join the two-day long Boot Camp. This preparation helps them to understand the fundamentals of entrepreneurship. The centrally-created learning material includes topics from the founders' dream through the market segmentation, the customer value proposition, the financials and key value drivers to the pitch deck. At the end of this program the participant teams have to pitch their idea in front of a professional jury, who chooses the best three teams. These teams have the chance to take part in the international competition with facing other CLP teams from around the world. This program runs outside of Europe as well, also in Asian and African countries like Kenya, India or Kazakhstan. After this competition the best innovative ideas would be given the opportunity to continue their development through the Accelerator program.

Greenhouse is a pre-incubator program, which is mainly set up for university students, to develop their idea while studying. But based on my experience anyone can apply with at least a two-member team, business idea and plan, and motivation to develop. The target of this program is to provide the essential knowledge of starting a business in the cleantech sector. This is a half-year long program, every month with a group session covering different topics. The main themes are the: leadership, market and customer validation, business model canvas, lifecycle analysis, finance and the pitch preparation. Similar to the CLP this program ends with the pitch presentation as well. However, in contrary to the other two business development programs, Greenhouse offer 2 500-euro non-refundable grant for all the teams who participate in the sessions and fulfill the requirements. This program is unique from the financial perspective because it offers an assured amount of grant at the end. While in case of the other two programs the teams have to perform well to receive any grant.

#### 4.2 Overview of the Accelerator program

Accelerator is for seed stage ventures, but they have to be in a more mature phase than the ideas of the CLP or the Greenhouse. At least the product research and development should be started, or the idea has to be more concrete in this stage. This program is one-and-a-half-year long, and basically helps the teams to develop their idea into a viable startup business. That being provided Climate-KIC approaches to bridge the gap between the startups and the investors.

In every country Accelerator programs are organized once or twice a year, and all the applicants have to fill a document with several questions regarding the most important factors. This document includes fields with introducing the company, the team, the description of the idea with the environmental impact of it, the collected information of the market, and their preliminary progress. The program coordinators rank the startups based on a centrally-prepared scoreboard, the factors of which main are: innovativeness, feasibility, team, climate impact, scalability, long term perspective, and suitability for the program. In the next paragraph I discuss the details of these factors.

The factor innovativeness means whether the product or service is unique on the market or have the ability to be protected by patent in the future. If there are similar innovations in the market, it is unlikely to pick the idea into the program. Feasibility claims the possibility of the product's technological realization. In this case having the prototype already made would be a huge advantage compared to other teams still in the research phase. Although this being an incubator program, it is not a precondition to have the prototype finished at the beginning. After the factors regarding the product, the team has also an important aspect in the evaluation. It is substantial that the team members have the right competencies for the improvement and having market experience means an advantage for them. The next two factors measure the future performance of the startup, their ability to launch the product also in international markets, and their capability for long-term sustainable operation. The last, the program fit is more a subjective factor; based on the experience of the reviewers they decide whether the idea is interesting and suitable for organization's profile. They also measure whether the team would be able to cooperate well with Climate-KIC.

The climate impact is one of the most important aspects in the selection process. From the perspective of Climate-KIC it is the principal factor that has to be accomplished, because the whole program was set up with the aim to support environmental entrepreneurship. Therefore, the main idea has to offer a solution or reducing effect on an environmental problem. Climate-KIC is flexible in this question, they support all kinds of cleantech innovations, the program does not specialize

in any specific field within climate change. Based on my experience and the requirements of Climate-KIC it can be claimed that at the beginning environmental impact is crucial to join the Accelerator program.

The first year can be distinguished for two main areas: Stage 1 the fundamentals, and Stage 2 the validation. After the groups were selected they start the program with a two-day long intensive BootCamp, also organized at the beginning of the Stage 2. Stage 1 offers the basic business development knowledge with five or six group sessions during the half year, and all of them followed by personal mentoring with the coaches. The topics appear in the first stage are similar to the topics of CLP. This period the teams identify their beachhead market, their competitive advantage and carry out the market segmentation and the customer value proposition. During Stage2 the topics related to mainly the validation process, the teams set up and rank their assumptions, learn more about the decision making processes and customer valuation, and examine their own market validation through different testing methods. After the first year the program continues with Stage 3, when the mentors focus more on the individual startups, therefore no group sessions are organized in this period, only personal consultations. This half year aims to finalize the financial plan of the startup and support them to find possible investors to reach commercialization. At the end of every stage a pitch preparation session is held to improve the pitch deck of the startups, which they might present for potential investors.

Like it was mentioned before in case of other Climate-KIC programs, all stages terminate with a Demo Day, where every startup teams present their pitch in front of a professional jury. The amount and allocation of the grants differ in every Climate-KIC region. Some offer grants for every teams accepted to the Accelerator program, some offer preliminary determined grants for every stages. In Hungary the jury only reward those teams who achieved particular performance and have the ability to develop continuously. In my opinion it is a good approach, because the teams are motivated to perform their best at the Demo Day and not only focus on the minimum. Every team can be rewarded maximum 40 000 euros non-refundable grants during their participation in the Accelerator program. This grant is ought to be spent on product development and any related costs.

At the Demo Day the jury use a scoreboard to evaluate the pitches, it is similar to the first evaluation scoreboard but have different aspects as well. The main factors are: climate impact, unique selling proposition (USP), scalability, team skills, pitch quality, time to reach the market, and volume of sold products. This point the viability and future prospects of the startup are evaluated as well. There is still focus on the climate impact, however the purpose at this stage to support those startups who are able to become profit-generating ventures and have global market opportunities. Therefore, if one has strong environmental impact, but the business model is closer to a non-profit operation, Climate-KIC will not support them as much compared to other more profitable businesses.

Besides its business development and financial support, Climate-KIC also play an important role to attract and network with potential investors. In every region several programs are organized to attract investors. It is common to invite possible investors like VCs or business angel community leaders to the Demo Days to take part in the evaluation of the teams. This is the most important benefit of a program based on my personal conversation with other Accelerator program leaders, who organize other kind of investment networking events as well, like investor dinners, investor matchmaking or pitching events, rapid date meetings, and joint-events with business angel communities. It is also a common practice that all the teams write a onepager including all the important information about them, and the coordinators send it to specific investors. These are all local initiatives, but this year a central online platform the investor marketplace was introduced, where investors can search for climate-change startups based on their preferences.

To summarize this chapter, the main motivator of Climate-KIC to support cleantech startups is to support the transit of the European economy towards a circular, zero-carbon economy. It will also have a potential positive impact on the future external trade balance of the European Union, if environmental awareness becomes a stronger global trend and these scalable solutions can work profitably in the future.For this reason, the environmental impact is one of the most important expectations for the startups. Besides this the product feasibility, the team and the future scaling are the most important factors. The Accelerator program provides business development advisory, networking opportunities and also non-refundable financial support for the startups. These are all very important aspects at the seed and startup stages. Therefore, this incubator program reduces the risk of failure in the first few years of the startup operation with professional expertise backing.

## 5 Venture capital models and expectations

The incubator programs of Climate-KIC gives structure and assistance to start-ups and SMEs to develop their idea and take the first steps into the market. However, besides those trainings and small amount of financial support the new startups hardly find venture capital investors in the market.

As it was mentioned in the second chapter by several authors a few modifications are required in the model of traditional venture capitalists to become suitable for cleantech investment. In this chapter I will identify the main characteristics and expectations of the European cleantech VC investors based on ten semi-structured interviews. After understanding how these VCs adapted the cleantech requirements into their model, I set up a general cleantech VC model. This chapter closes with the presentation of this cleantech general VC model and its comparison with the green fund model of 2002 and with the traditional VC model of 2018.

#### 5.1 Environmental impact

According to the respondents cleantech does not mean a premium from the general investor's perspective, most of them claim that general VCs are only looking for the higher return and cleantech investment would mean an additional risk factor for them. Especially after the high failure rates in this sector, investors did not look for cleantech innovations. This period of

stagnation seems to change nowadays, because most of the respondents claim that there is growing interest in the field. Especially due to the commitments and legislative initiatives of the governments; and the increased environmental awareness of the population. One VC director pointed out very well the essential of this movement, that younger generations, such as the millennials are much more concerned about the impact of their investments, besides return ratios, than the older generations. This trend will force institutions to provide green investment opportunities when this generation will accumulate wealth and replace today's investors. Many institutions already recognised this demographic trend and are preparing for that, but today these investment opportunities like impact investment funds, are more like accessories on the product range of the institutions, and they also serve marketing purposes. Also the profitable potential of the clean energy arrived to the market, which attracts more and more financial investors.

I grouped the main motivation behind cleantech investors into three categories, which are the impact, the sustainability and the greentech investments. Impact investors have the highest environmental awareness in their operation and selection process, while greentech investors are more profit-oriented than the other two categories. Sustainable investors are somewhere between the two other categories. Three out of the ten funds I interviewed are impact investors, for them environmental impact is one of the most important factor and a significant part of their assessment. They actively monitor the environmental performance of the companies, and they consider cleantech investments because the fund aims to support the transit to a sustainable economy. Two sustainability investors were included in the sample, in this case they have also environmental impact measurements before investment, but in these cases it is not such an important part of the evaluation as for the impact investors. Some of the greentech investors also consider this aspect, but many them, especially those who operate in the energy industry, do not measure environmental impact at all. They invest cleantech to make money, not to make a better planet. According to one of them it is not competitive to consider only the environmental aspect. The main difference between the greentech investors and the other two is that greentech investors don't evaluate and select the companies they invest in bases on environmental impact metrics while the other two usually do.

About the measurement of the environmental awareness, few interviewees reacted surprised, one confessed that she has never considered it. Although all the impact and sustainable investors use environmental metrics to calculate the portfolio companies environmental impact. A few example was mentioned like saved or reduced amount of GHG or waste, the amount of saved water; re-cycled materials of a product, or CO2 footprint. One of the greentech companies prepare annual reports about the environmental performance of their portfolio companies, and issues this to the limited partners. In my opinion with considering the other operational background of the company, this act is more realized as to increase their reputation, however in this case it also encourages the portfolio companies to reduce their impact.

In conclusion my previous hypothesis that environmental awareness means a premium for cleantech investors failed. General market participants invest in this sector only with profit or reputation increasing purposes. Cleantech investors partially do it to improve the environment, but part of them obviously start to invest clean technologies because they realized the high financial return which it can provide. However, it has to be considered, that in the end of the day it does not matter whether a venture has a high sustainability index or not, if one cannot lead to a profitable path. Even in case of impact investors without a working business model and financial plan none of them would work with the life-changing technology if there are no future prospects for acquisition or any other type of exit.

#### 5.2 Classification of the investment funds

As it was mentioned before the examined investors consist of one investment manager, two corporate VCs, one crowdfunded VC and six conventional VCs. In this chapter I will analyze their main characteristics and classify them into groups based on the similarities and differences. The table used for this summary is in the Appendix A, with including the most important features of the funds.

Based on the year of foundation the examined funds can be separated into two groups. Four of them started in 2005 or before, the firsts were established in 2002; and six of them after 2010. This significant difference can be traced back to the historical development of cleantech investors. As it was detailed in the second chapter, the first boom of cleantech investment was around 2002 and 2005, in this period the highest amount of investment was injected into this sector in the United States. The foundation of this four VCs underline this market behavior, they also reacted to the rise of the cleantech, and fortunately these funds successfully continued their operation in this industry. Later on in this thesis this group will be called as the early believers. After the financial crisis governmental and EU initiatives influenced the market to become attractive again to the investors, which caused the launching of the second group of VC investors for this period, this group will be named later as the late investors.

The early believers have already at least two funds, but more commonly three. In case of their first funds usually most of the companies made an exit with more or less success. Unfortunately, the performance of these exited companies handled as confidential information, therefore in this thesis it cannot be included. The late investors have one investment fund, and also there is one examined VC which is still in the fundraising phase. From this group only Quadia had some exited ventures, and Sustainale Ventures had only one, this also underlines the approach that cleantech ventures need time to make a particular exit.

The base of the investment funds is mixed: three are German, two of them have their base in London, two operate from Switzerland, and I also examined a Czech, a French and a Norwegian VC. It can be stated that they are located mostly in Western European countries. In terms of geographical focus area two of them have major country limitations due to their operational structure. Sustainable Ventures cannot invest outside the territory of the United Kingdom, because they utilize the SEIS tax relief for increase equity crowdfunding which cannot be used for foreign seed investments. High-Tech Gründerfonds (HTGF) can invest outside of Germany under one condition, if the venture set up a subsidy in Germany. This approach aims to keep the invested money inside Germany, because their majority of their capital financed by public investors who might prefer to support the entrepreneurship inside the country. Besides these examples the other investors prefer to choose portfolio companies within Europe, but some of them also have investments in the United States or Asia.

The variety of equity sources are very different; it is difficult to find any group-forming criterion. But it can be noticed that several VCs are supported partially or completely by public money or a body of the EU. The capital of VNTM, Demeter and Fund1 were partially set up by the support of the European Investment Fund. Inven Capital received this year investment from the European Investment Bank. HTGF has public fund investors, the BMWi which is the Federal Ministry for Economic Affairs and Energy, and the German promotional bank, the KfW Group. The most special case is the Sustainable Ventures; because their first fund was partially financed by the London Authority and individuals through crowdfunding. This is a unique model, and currently they are working on to set up their second fund completely fundraised by crowdfunding. Two companies, the Statkraft Venture and the Inven Capital has corporate backing by their owner company in the field of energy. Besides these there are private investors, corporations, family offices, institutions (banks, insurance companies), high-net worth individuals, and other funds.

To compare the volume of capital, I converted all the venture capitals into million euros with using the annual average exchange rate of the European Central Bank. Based on this, three groups can be differentiated: the highest with capital over 800 million euros, the middle range between 100 and 250 million euros and the lower range capitals below 50 million euros. In the highest group the two VC funds with long-term experience included. It has to be mentioned that one of them the HTGF is not completely a cleantech investor, it has in their portfolio also life science and other technological ventures. In the mid-range five, in the low-range only three companies are. This distribution claims that in general more VC funds have capital in the range between 100 and 250 million euros, and the high-range can exist only in particular circumstances and after over 10 years of experience in the cleantech market.

In this sample the 30% of the VCs have clean and smart energy focus, other 20% have broader environmental focus but highlights clean energy technologies within its focus areas. 30% of them focus on all types of sustainable solutions, and 20% of them have agritech interest. It is obvious that renewable energy and every related topic, like energy storage or energy efficiency have high demand in the cleantech market. According to the investors based on the market after energy, sustainable food production and agritech is the second most wanted field in the market.

The last attribution investigated in this subchapter is the willingness of co-investment. Most of the investors were optimistic about the co-investment opportunities, but it depends on several factors like the technology or the phase of the venture. They like to take part in syndicates and share the risk with other investors. This is also a good opportunity to share the know-how, the expertise and the network. Especially in those cases when they do not have the industry or local experience. Based on their experience, as the market is not too big, and the main participants know each other and their expertise; therefore, they can look for and find co-investors without huge efforts. But they prefer to be the leading investors and collaborate with VCs with similar interests and values. Quadia, the investment manager fund almost always has strategic co-investors. Besides collaboration of other funds, the VCs also have partnerships with corporations, incubator programs and institutions

### 5.3 The role of governmental and European Union support

As mentioned in the previous subchapter three VCs receive investment from the European Innovation Fund. All of them belong to the group of the early believers. Inven Capital received one third of its capital from the European Investment Bank. Demeter also have investment support to their several funds from the BPI France which is the Public Bank of Investment in France. Until now no more VCs received financial support from the European Union, but for example Dybaw might expect it in the future. Both Sustainable Ventures and HTGF received their capital from local authorities.

Besides the capital investments, only Sustainable Venture mentioned a supporting legislation. In the UK they introduced the Seed Enterprise Investment Scheme (SEIS), which provides 50% tax relief after every seed investment for at least three years. It is a perfect example how the legislative background reduces the risk of the early stage investments, and encourages the citizens to invest their money in startups. As Sustainable Ventures raised its capital by crowdfunding this SEIS tax relief helps them to increase the attractiveness from the general individual perspective.

Several investors mentioned that their portfolio companies usually receive government grants or subsidies. From the investors point of view this is usually a positive advantage, because the venture receive money without giving up equity shares; it can serve as a reserve against losses, protecting the investors. This also means great access to many things, and validate the venture from other investor's perspective, because only a feasible technology or product would receive grants. However, one VC highlighted that in some cases these grants and subsidies might have conditions and limit the future operation and expansion or complicate further investments into the startup. For my question whether these supports are essential, investors from the energy field answered that currently there are cleantech companies who are able to be profitable without any governmental aid.

#### 5.4 The details of the venture capital investment

In general, the investigated VCs are looking for investment opportunities through their personal network, incubator program and university connections, and they also attend international events and conferences. They receive applications directly to their e-mail box as well, and suggestions or co-investment opportunities from other VCs. Some of them actively monitor all kind of data sources to identify the best and most innovative ideas before other investors. Some prefer and claim that the best deals arrive through personal network. Almost all VCs mentioned the importance and their connection with incubator programs. Five of them mentioned Climate-KIC, with three of this five I connected through the organization, but the other two were just picked from the Eco-Summit list randomly. Based on this I claim that incubator programs play a significant role in finding the future portfolio ventures.

VCs prefer to invest in early stage, usually they do seed or series A investment in the ventures. Obviously it is a riskier concept, although according to them they can buy shares on a lower price and achieve higher returns as well, compared to the conventional VC approach. The investment manager is the only one, who finance only later stages, because its organizational methodology differs from the VC's risk seeking behavior. Quadia prefer lower risk, this also reflects from their ratio of failure which is 5%, significantly lower than in case of the VCs, with is around 20-30%. Inven also prefer round B or C investments, although these are earlier stages than Quadia preference. VNTM and Demeter, the two early energy investors finance later stages as well. Few funds mentioned minimum requirements for the investment which is the working prototype or any commercial sign which refers to the future scaling of the venture.

The average investment size is between half and two-three million euros, the lowest is provided by Sustainable Ventures where the maximum a seed company can receive is 300 thousand euros. The highest financial support is 30 million euros, which is the maximum amount Inven offers to their portfolio companies. Usually VCs have a predetermined range, and they decide the volume of the investment based on the technology, the maturity and the needs of the startups. In exchange to their investment they receive minority stakes from the equity. It can be between 10-15% but in some cases it can reach up to 50%. Usually they have higher percentages of ownership in riskier companies, where the final result is very uncertain.

After the investment all VCs and the investment manager fund take actively part in the portfolio companies' development. Every investigated investor receives board seats and voting rights. Most of them support the companies in terms of operation, strategy, and technology; some

like Demeter or MVP are more intensively active in the day-to-day management, but even they definitely do not manage the company instead of the founders. They are more active in questions regarding scaling, commercialization, funding, or finding new team members. On the other hand, Statkraft states that during the selection process they carefully select the founders, to find the best person who is able to run the business without significant help. VCs also facilitate partnership with their corporational network for commercial, R&D, or any other purposes. This is typical for those VCs who have corporate investors or an owner company, who aim to find and acquire new technologies to build into their operation.

#### 5.5 Expectations for startups

VCs are looking for seed or early stage ventures, but the startups have to fulfill several requirements to achieve the expected capital fund. In this chapter I will detail the most important factors that the investors take into consideration during the selection process. First the company can be in a seed stage, but it should have a working prototype showing the feasibility of its technology, or commercial sign, for example validation that it will be a popular product. VCs claim that they do not finance research and development operation, they are giving money to help the scaling and strategy shaping mechanisms. They prefer if the venture share their values and mission approach.

As the ventures are generally in the early stage, and as I mentioned previously that startups at their first years are only burning money instead of generating any revenue, the financial factors are not that relevant in the selection process. The companies have to set up a viable financial and business plan, and should have positive growing future prospects, but these assumptions are very uncertain. Therefore, based on the results of the interviews, non-financial factors are having more influential role in the decision making process. I set up a table identifying the most important factors mentioned by the interviewees and the literature that I looked through in the second chapter. I collected all the concepts, which were mentioned by at least two respondents or authors, or one VC and one author. Based on the concepts I created thirteen categories, which are represented in Table 1 below.

Category	Concept	Literature			Investors
Minimum viable product	Working prototype/Finished minimum viable product				4
Unique product	Uniqueness of the product	Sakoda			1
Technology	Breakthrough technology/Disruptive technology/Technological uniqeness /Unique technology	Kasdin			4
Business model	Innovative business model	Bocken			2
Team	Governance/Competence of the management team/Good team/Well- balanced team/People/Team dynamic	Westly	Kasdin	Bocken	8
Problem solution	Product market fit/Answer for customer pain				2
Customers	Unique customer proposition				2
Growth	Potential growth/Scalability/Growth rate/Long-term growth	Westly	Kasdin	Sakoda	4
Global market	Market size	Westly			3
Competitiveness	Competitive advantage				3
Environmental impact	Environmental impact/Sustainability /Positive environmental factors	Bocken			3
State regulations	Goverment support/Potential impact of regulations/Government regulation and support	Kasdin	Sakoda	Bocken	0
Exit	Potential for high returns with multiple exit opportunities/Exit opportunities	Kasdin			2

#### 1. Table: The concepts and categories of investors' expectations

All the concepts were mentioned by the authors or the respondents, I collected these concepts and categorized into the thirteen most important factors. The top three factors mentioned were the importance of the team, the growth potential and the disruptive technology. Some cases, like the minimum viable product or the competitiveness were mentioned only by the interviewed investors. On the other hand, the government policy and legislative environment was only highlighted by the authors. With grouping the factors, it can be claimed that three categories are connected directly to the product and its technology, most of the respondents prefer to invest in a unique product or technology. Five of them are related to the future prospects and the performance of the company. The venture has to improve itself and grow fast to reach global markets with

creating a powerful competitive advantage for itself. The potential of exit opportunities was mentioned only a few times, but it might be because the previously mentioned factors are supposed to lead into exit opportunities. Only a few of them referred to the importance of the environmental impact as part of the decision making.

Among the most important factors the investors have high return expectations for the companies even so that these financial indicators are difficult to measure and forecast at the moment of the investment. Almost half of them have preliminary expectations for the return on investment (ROI) or for the internal rate of return (IRR). The amount of ROI is between 20-30%, in general the investigated VCs expect 25% return. Few of them measure the IRR in terms of the expected benefit, this value is around 5-15%, but VNTM and Sistemiq have higher expectations over 20%, but these numbers all depend on the maturity and type of the venture. Some also mentioned that they do not have preliminary expectations for the return, but they want to earn back at least the invested money with interests.

The timeframe to keep the ventures in the portfolio until the exit differs in case of all the investigated investors. In average they expect at least five years until any exit opportunities occur, but most of them are flexible and can wait up to ten years. It is a hotly debated topic in the academic literature reviewed in the second chapter, and this long termination of cleantech ventures appeared as a disadvantage and controversial to the traditional VC model (Ghosh et al. 2010; Brown 2009). As we can see based on the interviews, these investors have more patient attitude, they realized the problem and shape their expectations based on the previous market experience. Only one, Dybaw have shorter expectations for two or three years, but its investment focus is very specialized on agritech and it have not started to operate yet, so it might increase it after the first market experience.

Another critical issue was raised in the academic literature: the investors' preference on the hardware or software based solutions. According to the mentioned articles the VC model is slightly suitable for hardware based innovations due to their more capital intensive feature (Brown 2009).
In contrast the interview participants have different opinion about this, most of them do not make any difference between these two types. Only one of them committed directly that the energy VC looks for only software based solutions. Another one claims that they might prefer softwares due to the lower cost, but they are not rejecting hardware solutions. As an interesting aspect the investment director of Demeter says that in the past they preferred hardwares, because their management is assembled mainly from engineers and have technical background, therefore they are more comfortable analyzing these solutions. To conclude these results, there is no clear difference in terms of this question from the cleantech investor's perspective.

#### 5.6 Genereal cleantech model and its comparative analysis

In this chapter I set up a general cleantech VC model based on the characteristics of the nine VC examined in the previous chapter and I compare this model with the conventional VC model and with a green fund model from 2002. The base for the green fund model was the study by Randjelovic et al., and for the traditional VC fund the article of Cumming et al., the details are represented in Table 2 below.

	Mainstream VC	Green VC	Traditional VC	Cleantech VC
Investigated year	200	2	2018	
Average amount of investments	120 mEUR	1.1 mEUR	50 mEUR	0.5 – 3 mEUR
Duration of investment (years)	2-3	3–5	2-5	5-10
Environmental aspect	Environmental risks and liabilities	Environmental screening	ESG factors, or considered as risk	Environmental impact assessment, env. metrics
Sources of financing	Pension funds and banks	High net-worth individuals	Pension funds, institutions, corporations and banks	Pension funds, corporations, EU funds, institutions, high net-worth individuals
Investors' orientation	Typical return on investment (ROI)	ROI plus ecological orientation	ROI	ROI, env. impact, governance
Current targets for investments	Communications, software, information technology	Renewable energy, water and cleaner technology equipment	Healthcare, blockchain, AI, IoT, transportation, fintech	Circular economy, renewable and smart energy, agritech, sustainability

2. Table: Comparison between the traditional and cleen VC funds in 2002 and in 2018

Based on the results and information received through the interviews the cleantech VC would invest money between half and three million euros for a five to ten-year length. The main sources of financing are institutions, state or EU funds, corporations and high net-worth individuals. Besides the ROI, the fund has environmental impact assessment with using different kind of metrics. They expect from the startups to have positive environmental impact, dynamic teams and profitable future prospects.

Compared to the green funds form 2002, the amount of investment clearly increased, and now venture capitalists have more sophisticated metrics to measure the environmental impact. The target area also expanded, new types of cleantechs appeared in the market, but clean energy is still the most popular. Also the sources of financing changed a lot, now not only high net-worth individuals consider green investments, but others as well. The sources of finance got closer to the traditional VC model.

The main difference between the cleantech and the traditional VCs is the amount and the length of the investment. Traditional VCs are more courageous to invest higher amounts of money, because the exit opportunities are closer to the investment date than in case of cleantech VCs. Cleantech investors prefer to invest smaller amount of cash at the beginning, but it is usual that they invest in more rounds after some risk are reduced. Compared to the example from 2002, I think today the two types of VCs are getting closer, and even general VCs started to invest in cleantech as one kind of portfolio diversification. Therefore, I expect that in the future the differences will be decreased

## 6 Success stories of venture-backed startups

This chapter provides an insight of two successful Hungarian startups, who went along the path to receive venture capital investment. As previously mentioned, this investment is one of the most important milestones in the life of a startup to achieve commercialization and extend its operation to serve global demand. In this chapter I describe the story of these two startups from the beginning – when the innovative idea was born – to the achievement of the VC investment. Besides the growth of the startup I also illustrate the role of the Climate-KIC Accelerator program in the business improvement process. The main purpose of this chapter is to understand the perspective of the startups and see their experience with the incubator programs and the venture capitalists. In the success stories I highlight the most important factors mentioned and analyzed in the fifth chapter by the VCs. These factors are: the background and the expertise of the team, the minimum viable product, the successful validation, and the competitive advantage. Both startups joined the Hungarian Climate-KIC Accelerator program in 2017, but their industry and product are completely different. These differences contribute to have a broader perspective about both the hard- and software based innovative solutions.

#### 6.1 TrucksOnTheMap

TrucksOnTheMap offers a successful software based solution to decrease the information asymmetry in the trucking industry. The founders realized the market problem, that in average 12-27% of the long freight truck journeys run totally empty. Most of the founders have great experience in the logistic industry, and they all agreed that an optimization procedure is required to cut back the empty kilometers of freight carriers. Therefore, they developed the online map and professional social medium, where the shippers and freight brokers have access to examine the current and future available trucks in their area. They can book through the system at any future time with reaching the closest available truck to their pick-up point. This IT solution aims to decrease the amount of empty truck runs; and in addition, helps cost-reduction. Currently there is no standard solution for this problem in the market, therefore according to the founders their competitive advantage is that they were between the first players, who realized the market pain and started to develop the solution for it. Thanks to that, they have started to advance the real-live and customer-feedback based product development earlier, so currently they have about a yearlong product development advantage compared to other competitors. The idea of the truck availability map was born in 2013. Soon other three logistic experts and two IT developers joined and all together they set up the foundations of the venture. The experts from the logistic industry have over fifteen years of experience in the European industry and they have also worked with each other before this startup. This team seems ideal from the perspective of the investors because founders have experience in the industry where they operate, and also the team includes software engineers who are responsible to develop the software continuously therefore they are able to answer costumer feedbacks immediately. According to one of the Climate-KIC's coach, in case of a software based innovation it is crucial to have the IT developers in the team, and not only involved as external employees, because in this case they are more committed and reliable to their work.

At the beginning they only had a paper version of their idea, and the validation started around 2014. In 2015 they created the first coded prototype, which was presented at the largest industry conference, the Transport & Logistics in Munich. At this conference nine out of ten leader transportation companies valuated positively and reflected their future demand for this product. Two of these logistic companies injected money to the company and became the first private investors of the startup. After this positive market approach, they developed and launched their beta version in 2016. During this four-week long operation around 150 users utilized their beta version. Based on their positive feedbacks they decided to finalize the product. Therefore, in the summer of 2017 they launched the final truck-availability map, and after a year they have already worked with more than four hundred customers. Among their key customers are large transportation companies, like Vredenstein, DHL Freight and C.H. Robinson.

From the environmental perspective their approach leads to significant reduction of the global greenhouse gas emission produced by freight trucks; which means a positive environmental impact. This impact and their viable business model also contributes to the decision of Climate-KIC to choose this team to their Accelerator program. They applied to the program in the beginning of 2017 to receive coaching in the field of environmental entrepreneurship and business

development, and to have access to the international network of Climate-KIC. After two years of cooperation, it can be claimed that from both side the initial expectations were fulfilled. The startup took part in all the Hungarian and international trainings, to develop their business ideas. They joined the Accelerator program in the first half of 2017, when they have already finished the market validation and their beta project, but their significant expansion and the launching of the viable product happened during the program. According to the founder three main aspects of the Accelerator program helped them in this path. First the program structure is very good and helpful for the environmental entrepreneurs, because based on his experience this cleantech area is not very supported in the market. Secondly the financial grants were spent on fundamental assets, and without these the development would be more problematic and slower for the venture. Thirdly they connected to their venture capital investor through the Demo Day of Climate-KIC, therefore they are very grateful to this program.

About their financial background: first the team members invested their savings into the development of the startup. After they validated the idea by the main sector participants one founder quitted his regular job and dedicated his time completely to the improvement of the new business. Besides the team members, other two first time investors joined after the showcase at Transport & Logistics. The two logistic companies RT Logistic and Eurogate Logistics Group also injected 150 000 euros of funding to the startup. Both the founders and corporate investors received minority stakes in the company. Besides these financial investments, during the Accelerator program of Climate-KIC Hungary, the startup received grants at every three Demo Day where they pitched. And they also represented their idea at the international cleantech startup competition the Slush, where they won the first prize of the climate impact battle. This means that in 2017 they get non-refundable financial support in total of 70 000 euros from Climate-KIC and in 2018 they received 20 000 euros at their last pitch day. In the end of 2017 they wrote the contract with Hiventures, who offered them 500 000 euros venture capital in exchange for minority share.

Among the reasons why they decided to look for external venture capital investment was mainly the need of additional money. As it was mentioned only one founder was able to work in the venture, others complete their tasks in addition to their full-time job. In general, the startups burn money, as usual not only in the first year, but until they achieve the market commercialization which takes a few years. Last year they realized the company value target, and with this value they were able to start negotiations with VCs in the hope of a suitable and good deal. They connected to around seven venture capitalists and they had term sheet negotiations with five of them, but finally they chose Hiventures because, they offered them the best conditions.

According to the founder the most important factors from the perspective of a VC are: the validation, the founder team and the customer base. During the due diligence process, they looked at their financial and business plan, the balance sheets, the customer base and their cost-efficiency indicators. He highlights that in case of the team the professional connection and knowledge is very important and also the experience in the market. He thinks that the aspect of environmental awareness is significant around the world, however during the negotiations with possible investors the environmental impact of the startup is not significant, sometimes they consider these aspects but only if it is measurable in financial terms. According to his personal opinion it is unfavorable how little investors and the financial markets consider these aspects (Domonkos pers. comm.).

To summarize the achieved milestones until the VC investment, the TrucksOnTheMap made a great performance. First they started with the market pain, their product is an answer for the information asymmetry. They had a good market validation process, with their beta prototypes and also with private investors from the logistic sector. Their team have members with experience in the sector and also IT developers who support the technical realization of the product. Their work has been recognized also within the professional area of logistics, and determined as a promising venture in the media for example in the article of Forbes magazine (Sándor 2017). They have had a clear mission and vision what they want to achieve and how. Based on their performance and validated product it does worth to invest in this venture from a VC perspective.

#### 6.2 HeatVentors

HeatVentors offers a thermal energy storage with phase change materials (PCM). Without digging into the technological details, with the usage of this particular technology, instead of changing the temperature of the water in the thermal storage like other similar storage methods, they change the phase of the PCM. Their competitive advantage is the particular PCM technology of the storage. With this unique technology they created a more efficient and smaller storage than other thermal ones, and this can be used also for cooling purposes. With highlighting the different use-cases it is important to mention that this technology, besides of utilization for heating and cooling, can be used also to improve renewable energy system efficiency. In this case many market participants have already realized the problem of energy storage, and several technologies appeared in the market. In contrast to the previous case here the technological innovation is more important than the discovery of the market.

Two university students started the investigation of this technology and later on they became successful entrepreneurs. The two founders have mechanical and energy engineering background with six-year long R&D experience with the thermal storage. After they started their business they learnt a lot about running their startup through their mentorship, however they realized the need to have a business development expertise in the team as well. Therefore, last year a new member joined the venture with over fifteen years of experience in IOT, sales and trade. From the VC perspective this teams seems very strong regarding both the technological and business aspect.

The whole idea started as a university research project supported by academic professors. The two founders examined the mechanical part theoretically and they made several measurements related to the project. After they received several academic acknowledgements they decided to create the storage and continue the development in practice. In 2017 after participating a startup competition in Hungary, they met several representatives of the Hungarian startup ecosystem and decided to establish their own startup with the help of a mentor. This mentor has over fifteen years of experience of entrepreneurship, therefore his personal mentoring was substantial at the commencement of the startup. They joined the incubator program of Climate-KIC soon, and later also the program of K&H Bank. This latter provided them personal mentoring and co-working office area, where they can manage the business, because currently both of them work full-time on this venture. They finalized the prototype at the laboratory of the Budapest Technological University, where one of the founder is a PhD candidate. They also participated in several national and international competitions, and won most of them. These prizes mostly include non-refundable financial supports, but also networking opportunities with investors. After the successful year of 2017, they got an offer of a venture capital investment from Innoenergy, which they accepted in 2018.

After joining the Accelerator program, according to the founder the most important aspects were the sales, marketing and financial know-how for them, because both of the founders have engineering educational background. She claims that this program was very useful for them because they learnt how to start their business. Also the financial grants were very beneficial to them to finalize their request and obtain the Hungarian patent of PCM. Similarly to TrucksOnTheMap, they also received grants from Climate-KIC Hungary at all the three Demo Days when they pitched.

From the financial aspect, at the beginning only the founders invested their time and their money into the venture. They received support from the university also to develop their first prototype there for free. They received grants in several international and national competitions, for example 3 200 euros at the MVM the Hungarian energy utility's competition, and 20 000 euros at the PowerUp competition organized by Innoenergy. Climate-KIC supported them in 2017 with 15 000 euros, and with 5 000 euros in 2018, so in total 20 000 euros were received by the team until they finished the Accelerator program. This year they signed the contract with Innoenergy, and they received 150 000 euros venture capital investment in exchange for minority shares. Besides financial support Innoenergy provides educational programs, networking opportunities and

conference participations to the company. Currently they have negotiations with the two Finnish business angel investors.

They wanted to operate their startup without external investors as long as possible, because they aimed to have higher company value to negotiate from a better position. Therefore, they did not look for investors, in this particular case the investment was offered to them. Last year in December they won the competition PowerUp, and not only received financial grant, but Innoenergy offered them a venture capital investment. They accepted this offer more due to the networking opportunities than the financial support. Because they plan to cooperate with Schneider Electric who is one of the partner of Innoenergy. With becoming the portfolio company of Innoenergy they have access to all of the industrial partners of the VC.

According to the founder the most important factors for Innoenergy in case of HeatVentors were the working prototype and the team. They have also undergone a due diligence process to look through the background of the company, and they had several discussions via skype and also in person about the collaboration. Based on her experience VCs prefer when a startup needs them not only in financial terms, but also for their network and strategical support. Money is crucial for the success but other connection points might be helpful to convince the potential investor (Farkas pers. comm.).

To sum up the performance of HeatVentors, what they achieved in the last years is very particular. They made the majority of the research and development of their hardware based innovation with the help of the university and also the incubator programs. Therefore, they achieved a phase to demonstrate their idea in reality with a working prototype to impress possible investors. The team is very important and in case of HeatVentores all the founders' background contribute to the success of the venture, and suitable in this market.

#### 6.3 Comparison and conclusion

As we can see in the success stories, both startups received their investment several years after the idea was born. This confirms that VCs prefer to invest after the majority of the validation and R&D operations finished with success. In case of TrucksOnTheMap the final product was already launched on the market, although in case of HeatVentors, only the prototype was ready, they haven't yet sold any product on the market. This basically shows the main difference between the hardware and software based solutions. Because while HeatVentors has a working technology with a prototype, it cannot start to produce it without appropriate financial support. In contrary TrucksOnTheMap burnt also a huge amount of money until it reached the launching phase, but still not that capital intensive than the hardware based solution.

Besides the viability of the product, the team structure and experience is excellent in both case. They have the right people with the right knowledge and experience to run the business to success. Both of them have their unique competitive advantage. In case of TrucksOnTheMap they are ahead in the development than any of their competitors, and they have the timing as their main advantage. They have already developed the working program to optimize trucking, while the digitization in logistics is yet to come. In the second case the breathtaking technology is their most powerful asset. None of them consider environmental impact as an important factor in the decision making process of investors.

The financial and business development backing of the Accelerator program is significant for both of them. Based on the personal communications with the founders they would improve the prototypes slower or maybe involving additional external investments without the grants. HeatVentors also mentions the importance of the learning materials and coaching sessions provided by Climate-KIC in the design and management of their business model. Basically both of them received money from a VC who has external governmental or EU support. Innoenergy is mainly financed by the EIT and other LPs, while Hiventures capital is supported by the European Union support fund and the state-owned MFB (Bank of Hungarian Development). This underlines the important role of the governments and the EU in fostering the entrepreneurship in Europe.

### 7 Discussion and conclusion

My preliminary expectation was that the market price appropriately the cleantech solutions, and favor them compare to the non-cleantech innovations. This expectation failed in this form. Based on the results profit generation is the main motivator in the cleantech segment as well.

To connect the three result chapters, I demonstrated the interrelations between the selected three market players on Figure 3. This figure represents the most important aspects how each player interacts with the others in the cleantech system.



3. Figure: Interrelations between the three main cleantech market players

The Accelerator incubator program supports the startups with business development services and financial grants to finalize their pilot projects to prepare them to receive further investments. It functions as an innovation hub for investors, because due to their national and international database of different cleantech startups it offers a simple way to connect investors with ventures. In some cases, VCs offer funding to the Accelerator in exchange to the startup offerings or other services. The main motivation behind the Accelerator program is to foster environmental entrepreneurship in the European Union. In this research their environmental awareness is the highest compared to the other market players. However, the model of Climate-KIC is not sustainable in terms of finance. Climate-KIC does not work purely on a competitive basis, therefore, does not generate substantial revenue, only spends the money of EIT. From this perspective this is not a traditional market player, because it was established by EIT with a main purpose to fight against climate change problems. This is a type of market intervention created by the European Union, to influence the cleantech development.

Cleantech investment funds receive equity shares in the startups in return for investments or convertible loans. Besides their financial support they also provide technical, strategic advisory and networking opportunities for the startups. Based on their main motivation to invest into the cleantech segment two groups can be separated. The impact or sustainable investors who consider environmental impact as an important factor, and the other group where the sustainability or smart energy is a preliminary condition, and they do not measure the environmental impact of their portfolio companies, they are more profit driven. Basically all of the examined investment funds have the preliminary condition that the venture has to create a positive environmental impact or provide clean energy solution. The problem is that these environmental impacts are not part of the final company valuation. Therefore, at the end, all of the VCs have the same opinion based on cleantech ventures, because their later performance will be measured based on the generated profit. It is very difficult to calculate the financial aspect of the environmental impact without commonly used metrics. Currently few VCs have their own metrics, but in the European Union there are no commonly used environmental metrics. Therefore, it cannot contribute to the company value. Consequently, a venture with lower performance but higher environmental impact is likely to be dropped out from the VC's portfolio. From the selection perspective the most important factors are the team, the potential to growth, the product and the technology.

Based on the results represented in the fifth chapter I claim that the investigated VCs adapt a business model which is suitable to finance cleantech investments. They have longer investment periods than conventional VCs. But they are still more cautious than conventional VCs, because the investment amount per startup is lower than in the general cases. The cleantech markets start to become more mature, VCs had the opportunity to understand and examine the market, and with this experience it seems that they are able to establish profitable funds. Few of the investigated VCs were founded over ten years ago, and they operate with large capital, therefore they operate with a lot of investors who are satisfied with their performance. Although, if we consider the source of equity, half of the investigated VCs received money from state or EU funds. Again the state and intergovernmental bodies appear in the equation.

Startups give unique products and ideas to both of the partners. It is important to mention that in case of investment funds technological innovation serve different purposes than in case of the Accelerator. Investment funds are looking for new opportunities to achieve extraordinary profit with financing technological breakthroughs. On the other hand, the Accelerator searches for new ideas which are able to contribute to the transformation into a sustainable economy. In the success stories of the two startups most of the expected VC factors were fulfilled, like the experience of the team, the validated product or the working prototype, and the potential for scaling. Both of the founders highlighted the importance of Climate-KIC and other incubator programs in the development of their business model. And in terms of the VCs' source of equity they also derived from state and EU funds.

Based on the previously mentioned facts, the Figure 3 should be completed with the European Union and their several funds, and also with government agencies. Since despite the increasing market interest in cleantech, this is still not a fast profit-generating sector. It requires external support and funds from the governments and the EU to develop further, and also to exist because the investors, even impact investors are looking for profitable solutions. This is the paradigm of the traditional economical approach, but not necessarily sustainable. It would be impossible to imagine a "laissez-faire" cleantech market with high investment returns, therefore, the legislation and supporting initiatives play a crucial role in the development of a sustainable future.

Future research should include increased sample to have a broader view on the main characters of the cleantech VCs. In case of a bigger sample, segmenting can be also used to have homogeneous groups and understand better the differences between the special focused like energy or agritech VCs and the more general focused cleantech VCs. Based on the interviews the lack of commonly-used environmental metrics decreases the success of environmental impact measurement, therefore a future study can be determined the set up this set of metrics for every segment of cleantech. Before this environmental metrics study would be considered the appropriate taxonomy of cleantech should be established. The segments of cleantech have very diverse attitudes, with different variables and environmental factors. Therefore, the environmental metrics should be set up with considering all the influential factors in each segment to calculate the right value.

# Appendix A

Interview questions to the investment funds
1. General questions about cleantech investment
Do investors favor clean technology companies?
What is the main motivator for cleantech VCs to operate in this sector?
Does environmental awareness can be mesaured and be calculated as a premium for
investors?
2. About the company
When was the year of foundation?
What is the source of equity? Volume of capital?
What is the VC's geographic focus area?
Does the compnay receive any type of government/state or European Union subsidy or
support?
Do you have any industrial and government partnership?
3. Startup selection process
How do you find the investment opportunities? Which one is the most succesful source?
What is the most important financial and non financial factor which you check during the
assessment?
Does the company use metrics to measure environmental impact?
Does the company policy favor software or hardware based innovations?
What it the preliminary expectations for ROI/IRR?
What it the preliminary expectations for the length of the investment?
What it the preliminary expectations for failures?
4. After investment
Does the VC take actively part in the management? How?
Did any of the portfolio company already exit? If yes, please tell about its performance

**3. Table:** Interview questions to the investment funds

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Interview questions to the startups Could the startup's path from the foundation until the VC offer? What kind of other support or grants did you receive? How do you find the help of CKIC? When did you decide to apply or looking for VC funding and why? What are the most important financial and non-financial expectations? What kind of other investors do you have? How do you see the importance of environmental impact in the market?

4. Table: Interview questions to the startups

	HTGF	Dybaw	Inven Capital	Demeter	Fund1	Quadia	Systemiq	MTNV	Statkraft Ventures	Sustainable Ventures
Type	ΛC	VC	Corporate VC	ΔV	ΔC	Investment	VC	VC	Corporate VC	VC
Environmental imp	greentech	impact investing	greentech		greentech	impact	impact	sustainability	greentech	sustainability
Source of capital	33% from private investors (corporations), 67% public funds BMWi and KfW	Family offices, pan-European institutions	ČEZ, a.s (180 mEUR) EIB (50mEUR)	Corporates, private companies from the environmental or energy sector; Initutions (insurance companies, banks) Public money: EIF Family offices	Public money: EJF, private investors, corporate investors, fund in funds, institutional investors strategic investors and family offices	High-net worth individuals, institutions	High-net worth individuals	EIF and Finnish institutions	Statkraft and Norwegian Power Firm.	Crowdfunding London Authorit
Total investment 1	892,5 mEUR	40-50 mEUR	230 mEUR	1000 mEUR	192 mEUR	170 mUSD	25 mGBP	157 mEUR	100 mEUR	7 mGBP
Total inv. (mEUR)	892,5	40-50	230	1000	192	148,75	28	157	100	7,84
Year of foundation	2005	2017	2015	2002	2005	2010	2016	2003	2015	2011
Number of funds	Fonds I Fonds II Fonds III	ı	1	4	First Fund Second Fund	n/a	1	Power Fund I Power Fund II Power Fund III	1	1 (fundraising for the second)
Base	Germany	Geneva, Switzerland	Czech Republic	France	Nordic countries and Germany	Zurich, Switzerland	London, Munich, Jakarta	Helsinki, Norway	Germany	London, UK
Focus area (geopraphic)	mainly Germany	Europe	Europe, Izrael	France, Spain and Germany	Europe, some case USA	Europe	Europe, Asia	Europe, Nordics and German-	Europe, US	UK
Focus area (type)	Cleantech and energy	Agritech (Fintech,	Smart energy	New energy and ecological transition	Sustainable, environmental and	Clean energy and agritech	Sustainability	Clean and smart energy	Energy and related sectors	Sustainability
Stage to invest	Seed	Early stage (seed and series A)	Series B or C, later stage	All stages	Seed, series A and B	Late stage	Early stage	early and late	Early stage	Early stage
Investment size	0 6 - 3 mFI IR	0 5 - 2 mEUR	3 - 30 mEUR	first round ~1 MEUR; 0.5 - 30 mHTR	up to 15 mEUR	n/a	(1-2 mIISD	0 5 - 5 mFI IR	80 5 - 4 mH	50 - 250 kGBP
Investment size (mEUR)					<15 mEUR	n/a				0.056 - 0.28 mEU
Ownership (avg)	Minority	20-50%	Minority, 10- 15%	10-40%	up to 25%	Minority	Minority	Minority, 10-50%	Minority	Minority, 10-15%
IRR	-		i	1	I	5-6% nets	seed 15%; 20-30%	25% (webpage)	-	5-15%
ROI	invested cap + overheads + interest back.	25%	25-30%	·	1	different in case of all projects	20%	25%	ı	30%
Time-frame	4-7 yrs	2-3 yrs	3-7 yrs	5-6 yrs	7-10 yrs	5-7 yrs	5-7 yrs	10	5-10 yrs	5-8 yrs

5. Table: Summary of the interview dataset

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