THE EMERGENCE OF GREEN VENTURE CAPITAL

by

J. RANDJELOVIC*
A. O’ROURKE**
and
R. ORSATO†

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* Research Assistant, International Institute for Industrial Environmental Economics (IIIEE), Lund University, PO Box 196, 22100 Lund Sweden.

** Research Associate, INSEAD, Boulevard de Constance, 77305 Fontainebleau Cedex, France.

† Assistant Professor, International Institute for Industrial Environmental Economics (IIIEE), Lund University, PO Box 196, 22100 Lund Sweden.

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Jelena Randjelovic, Anastasia R. O’Rourke, and Rj Orsato

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ABSTRACT

Innovative financing mechanisms are needed to facilitate sustainable development. In the past few years, socially responsible investments have emerged as a successful type of financing scheme but many ecological-oriented start-up companies remained under-funded. Apparently, environmental innovations have only recently caught the attention of an important financial sector: venture capital (VC).

The article describes the emerging phenomenon of environment-related VC (or green VC) and provides an overview of the current market for this type of investment- it reveals the characteristics of the industry, its processes and mechanisms. The study also uncovers the main problems faced by entrepreneurs starting eco-oriented enterprises, as well as venture capitalists interested in such type of start-up businesses. Finally, the paper identifies the drivers for eco-innovations and analyses the potentials of green VC to expand which all resulted in a proposal for a green VC definition.
INTRODUCTION

One of the main mechanisms for financing innovative start-up companies is venture capital (VC)\(^1\). Increasingly, venture capital is being directed towards entrepreneurial ventures that demonstrate various aspects of sustainability (be it environmental innovation and/or social benefits). Eco-innovations by companies such as Ballard Power Systems’ fuel cell technologies have been recognised by investors as having the potential of drawing big returns of the scale that venture capitalists are after.

This recent interest in sustainable solutions may be an indirect result of the successes and popularity of Socially Responsible Investment (SRI), which have so far been mainly channelled into mutual funds. Indeed, there has been a phenomenal growth of such funds, the amounts invested, and the rapid proliferation of investment and analytical products catering to this segment. According to the Social Investment Forum, the total assets under management in portfolios screened for socially concerned investors in the United States of America (USA) climbed from €1.69 trillion in 1999 to €2.31 trillion in 2001 (SIF, 2002). This trend is not confined to the USA only. The universe of retail ethical funds doubled in size every three years in the UK during the 1990s, from €517.9 million in 1990 to €5.15 billion in 1999\(^2\) (UBS Warburg, 2001).

Despite these successes, environment oriented start-up businesses have not caught the attention of most venture capitalists (Diefendorf, 2000). What explains this situation? Is it likely to change? What drivers would help environment-oriented start-up companies get the flow of capital and expertise – available through venture capital – to make their businesses grow at a faster rate?

This paper address these questions by delving into a new stream of venture capital emerging in different places worldwide, which we label Green Venture Capital (henceforth green VC). We argue that green VC shares some features of other types of Venture Capital (VC) and yet it also demonstrates some unique features and innovations of its own. The paper should be situated within the ongoing debate over the sources of profitability of green firms (Lenox and King, 2002), on profitable eco-innovation (Rennings, 2000), and the ongoing concern of many practitioners to make the ‘business case’ for sustainability\(^3\).

BACKGROUND AND METHODS

The paper stems from discussions with a number of specialists in the VC field in Europe\(^4\). Initially, a search on the topic of ‘green venture capital’ (and related nomenclature) in VC practitioners’ databases was undertaken. We soon found that no such category exists currently. Classifying ‘green VC firms’ cannot be done straightforward. Many firms use the words ‘ecological’ or ‘environmental’ as a way of promoting some their environment-related activities. Curiously, others firms purposely do not market themselves this way because they assume it would be more difficult for them to secure funding. Neither venture capital associations have

\(^1\) Venture capital is used in this paper to refer to venture capital funds, that does not encompass individual private investors.

\(^2\) Note: All currencies have been transformed into Euro by using Universal currency converter, at http://www.xe.com/ucc/convert.cgi on 13/03/02

\(^3\) For a critical review of this debate, see Dyllick and Hockerts, 2002

\(^4\) The data presented here has been drawn from research undertaken for a Masters thesis at the IIIIEE, Lund University (Randjelovic, 2001), and represents part of an ongoing research program on forms of Innovative Finance for Sustainability at INSEAD Business School’s Centre for the Management of Environmental Resources (CMER).
separate sections on green VCs. Overall, although substantial literature review was undertaken, we found very little academic and popular literature that makes an explicit link between environment (or sustainability) with VC.

Despite this gap in the literature, we found many VC practitioners who were investing in start-ups that had an environmental benefit or theme, and many eco-entrepreneurs who had launched their companies using venture capital.

The research was necessarily exploratory in its nature. Data was compiled through websites, company material and interviews. It is thus subject to bias and we must be somewhat careful with results. Thirty-three semi-structured interviews with European green and mainstream VC firms and managers, and specialists or practitioners in VC were undertaken between July and August 2001. Additionally, five eco-entrepreneurs, with start-up companies in varying stages of their development, were also interviewed. Many of these interviewees at this stage prefer to remain anonymous – explaining why some of their quotes included in this paper are not assigned.

We limited our study to ‘environmental’ innovations rather than attempting to discuss ‘sustainability’ innovations, which would necessarily include social issues. From our preliminary reading on the topic, we found that socio-oriented start-ups tend to face different issues and problems than environmental start-ups; not the least because most of them have their main market based in developing countries. Furthermore, many of these firms are funded by a kind of ‘venture philanthropy’ (i.e. sponsorship and foundation based funding that uses some venture capital processes), which moves the discussion away from profitability and mainstream take-up of eco-innovation. Thus this paper is limited to studying venture capital financing originating and destined for developed countries only.

FEATURES OF VENTURE CAPITAL

Venture capital is a rather recent phenomenon. The VC industry draws its origin in the USA in 1946, while in Europe VC was established only in 1970’s (Metrick, 2001; EVCA-a, 2001). Since then, various governmental mechanisms, such as tax exemption and subsidies, have enhanced the VC growth in many countries (in particular, the United Kingdom), which resulted in VC to become a strong source of financing (Bovaird, 1998). In conceptual terms, “venture capital is a type of financial capital provision, usually in equity form, which is invested in high-risk ventures and which offers the possibility of significant gains to compensate for the risks involved in such investments” (Reid, 1998, p.14). VC can also be seen as a type of early-stage private equity that provides capital to enterprises that have not yet been quoted in the stock market (or which will never become a public company). More broadly, VC refers particularly to investment made for the launching, early development or expansion of the business (Serge, 2000).

Venture capital managers are often actively involved in the management of the start-up companies they invest in. In return for the capital invested, venture capitalists receive equity shares and privileges, such as active participation in the enterprise’s governance, management and profit sharing. This is why VC has often been described as a ‘hands-on management’.

5 Equity is capital invested in an enterprise, which is not quoted on a stock market (hence, it is private capital). This capital can be used for the development of new products and/or technologies, to make acquisitions or to strengthen a company’s balance sheet. For more details see European Venture Capital Association (2001). http://www.evca.com/, [2001, December, 6]
VC is highly risky. Investment is made in the very early stages of development of the investee companies (normally start-ups), and only a small percentage of entrepreneurs succeed in the market – only one or two out of ten investments return profit (Bovaird, 1990). Because of such high risk, VC has the potential to provide a superior Return on Investment (ROI). In return for financing the company’s start-up and growth, venture capitalists might expect return rates of capital at around 1000% over five years (Zider, 1998).

**Structure and Flow of Venture Capital**

The venture capital industry has three main players: entrepreneurs who need funding, investors who invest in a VC fund and venture capital managers who choose entrepreneurs that will receive funding and who make sure that the start-up will be successful on the market in order to multiply the investment. Figure 1 presents the parties involved as well as the simplified flow of capital among them:

**Figure 1. The venture capital structure**

![Venture Capital Structure Diagram]


Venture capital begins with investors who invest in a VC fund (Phase I in Figure 1). As Sahlman (1997, p.103) puts it: “Investors, of course, are looking for businesses in which management can buy low, sell high, collect early, and pay late”. There is pressure from the investors on VC managers to find appropriate investee companies.

Because of VC’s risky nature, venture capitalists use sophisticated investment decision procedure (Phase II in Figure 1.). They tend to place emphasis on the market attractiveness, product differentiation, managerial capabilities and competitive threat (Tybjee and Bruno, 1997). They also perform detailed due-diligence assessments of the company and assess potential liabilities. Thus, VC managers need to have expertise (or a network of experts available to them) to realize the potential of the product and its market potential. The process of choosing to invest ends with providing funding to a start-up and receiving equity shares in return.
VC can be invested in different stages of the investee company’s growth: in the very early stage as a seed or start-up capital, or in a later stage, close to the moment of selling the investee company on the stock market. Put simply: the earlier the investment, the riskier. This is why many venture capitalists are reluctant to invest in the early start-up stage, which is normally left to ‘angel investors’ and/or family and friends of the entrepreneurs.

Once VC managers have made the investment, their involvement is not yet over. The term period between investing and exiting (i.e. selling equity shares on the stock market), can take from one to five years. The exiting means returning investment together with the profit gained to the initial investors (see Phase III in Figure I). To exit successfully, VC managers tend to perform various post-investment activities, such as financial statement monitoring, business strategy advice and overall monitoring of the investee company (Van Osnabrugge and Robinson, 2000). Such levels of involvement in the management can be seen as ways of ‘controlling’ the risk VC managers run when investing in start-ups. Although in the view of an uninformed person venture capitalists are gamblers on new businesses, the ‘hands-on management’ implies levels of commitment to the enterprise not seen in other types of investments. Does this commitment serve only economic rationale? The next section explores this topic.

THE EMERGING PHENOMENON OF GREEN VC

From the description of venture capital in the previous section, it would seem that VC and the concepts and practices of sustainable development are worlds apart. VC is often thought of as a short-term way of financing start-up companies, independently of kind of a start-up business. Sustainable development, on the other hand, is concerned with the direction and the actual content of companies’ products, services and practices, having a commitment to long term orientation (Rennings, 2000, p. 322).

A business-oriented understanding of sustainable development, however, tries to find the link between environmental and social activities performed by firms and their financial performance. Under the rubric of the ‘triple bottom line’ of sustainability, investing in eco-innovations is expected to create shareholder value. For example, the Swiss group Sustainable Asset Management (SAM) defines sustainability as: “a business approach to create long-term shareholder value by embracing opportunities and managing risks deriving from economic, environmental and social developments.” (SAM, 2001)

So far, most sustainability-oriented capital has been invested in large-cap companies, via the inclusion of (positive and negative) screening criteria by mutual and pension fund analysts and rating agencies. Here analysts try to identify profitable corporations that also strive to minimize the ‘environmental footprint’ of their operations, while contributing to the economic and social development of the communities in which they operate internationally (UBS Warburg, 2001).

The screening methods employed by European Socially Responsible Investment (SRI) tend towards a ‘best in class’ approach, rather than using only negative criteria which would, for example, avoid nuclear and tobacco industries. Companies are judged in relation to others in their sector, against criteria such as their environmental policies and programmes, the use of environmental management systems, renewable resources, and conditions placed on suppliers,

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6 Angel investor is a private investor who provides capital directly to start-up companies, usually in the very early stage of development, and in smaller amounts of capital, when compared with VC managing firms.

7 ‘Cap’ is short for capitalization. That is a market value for the company’s stocks which is calculated as the amount of stocks multiplied by the stock price. There are small, mid and large cap companies. Large cap companies usually have a market value of greater than €3 billion.
quality of stakeholder relations, the quality of environmental reports and communications, among other criteria.

Although green VC can be considered a type of SRI, it could not easily use the same criteria for the selection of their investments. This is because in their initial phase, start-up firms often consist of two or three people and only the idea for the innovative product or service, which, in most cases, has not yet reached the manufacturing and/or commercialisation phase. Start-ups could thus be considered as the ‘concept of the firm’; they normally do not have management systems, supply chain issues or environmental/social reports. The evaluation of the environmental aspects of the business must thus be based on different grounds – more to do with the future, rather than the actual performance (environmental, social and financial) of the company.

Therefore it would appear that a green VC’s environmental orientation depends on the content, direction or effects of the start-up company that it decides to support. How then do we decide if a start-up company is indeed ‘green’? One approach is to look at the concept of eco-innovation to see the future environmental and social implications of the products and services that a firm will eventually generate. According to Rennings, (2000, p.322), eco-innovations can be defined as: “measures of relevant actors (firms, politicians, unions, associations, churches, private households), which (i) develop new ideas, behaviour, products and processes, apply or introduce them, and; (ii) contribute to a reduction of environmental burdens or to ecologically specified sustainability targets”. In our research we mainly focus on product-based eco-innovations developed by start-up firms.

A typical example of eco-innovation financed by VC is the manufacturing of wind turbines for the generation of electricity. Wind energy can be considered a type of green VC investment because of its obvious environmental benefits - the use of renewable energy and zero emissions in the use of the turbines. Of all the new renewable energy technologies, wind power has made the most significant commercial progress. Today, wind energy is much cheaper than nuclear power and competitive with all forms of fossil fuel based power generation. More importantly, it is estimated that costs will decrease up to 45% within the next 15 years (Turkenburg, 2000).

In October 1999, the European Wind Energy Association, the Forum for Energy and Development, and Greenpeace International jointly released a study (Windforce 10), which contends that wind energy could meet 10% of the world’s electricity demand by the year 2020 (EEA et al., 1999). Clearly, this represents a significant opportunity for green VC financing. The recent growth in the use of energy from wind power was partially supported by governments such as Denmark and Germany via legislation and financial mechanisms (EEA, 2001). However, future profitability of such investments and other renewable energy innovations certainly depend on the existence of what Porter and Van der Linde (1995) call ‘environmentally friendly regulation’.

State of the Art in Green VC

A growing number of venture capitalists invest in environment-oriented start-up companies. As an emerging phenomenon, both the number and variety of green VC fund-types are expected to change in coming years. For a number of sub-categories, we compare the current features of green VC with conventional or mainstream (or non-green) VC companies. This comparison makes it possible to discuss about the unique qualities of green VC. One of the most explicit differences is in the size of the industry. In 2000, mainstream VC investment in Europe and the USA totalled €154 billion. This figure dropped substantially in the first half of 2001, when private equity and venture capital investment reduced 13 % in the USA and Europe (EVCA-c,

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8 Contrary to the USA, In Europe private equity and venture capital investment are often used interchangeably. For details on the data provided here, see: [http://www.evca.com/Venture.htm](http://www.evca.com/Venture.htm).
Two main reasons account for such decrease: the downward momentum of the Initial Public Offerings (IPOs)\(^9\) of venture-backed companies – particularly in the Information technology (IT) industry – and the lack of innovative projects in Europe, which could eventually be targeted by venture capitalists (Gompers, 1998; EC, 2001). Figure 2 presents venture capital investments in the USA and EU during this period.

**Figure 2. European and US Venture capital investments during a five-year period**

![Graph showing European and US venture capital investments from 1997 to 2001.](http://example.com/graph.png)

*) This is valid for the first half of the year 2001

Source: Compiled data from: (i) PriceWaterHouseCoopers and 3i Group plc (ii) Venture Economics and (iii) EVCA a. The USD currency was converted into Euros by using Universal Currency Converter at [http://www.xe.com/ucc/convert.cgi](http://www.xe.com/ucc/convert.cgi), (03/01/02).

The figure also shows that VC investments in both the USA and Europe have increased over the past five years. The total amount invested in the last five years was around €540 billion. To give a sense of scale, this is equivalent to the aggregated GDP of Scandinavia (Denmark, Norway, Sweden and Finland). Compared to this figure, green VC is in its infancy – we estimate that in 2000 green VC accounted for approximately €33 million in Europe and €67 million in the USA, which represents only 0.08% of the total amount invested by VC industry\(^{10}\).

Besides size, there are other quantitative and qualitative differences between mainstream and green VC. Table 1 summarises the main differences found in these two types of investment and the following paragraphs explore these differences, selectively taken from the table, except the size which was previously explained with the Figure 2.

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\(^9\) Initial Public Offering (IPO) is the process of launching a company for the first time by inviting the public to subscribe in its shares on the stock market

\(^{10}\) This data was gathered from various sources such as interviews and websites. Because some venture capital companies did not want to disclose information, it is possible that the real amount invested is higher than the one presented here.
Table 1: Differences between mainstream and green VC firms

<table>
<thead>
<tr>
<th>VC in Europe and USA</th>
<th>Mainstream</th>
<th>Green VC</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Investment size</td>
<td>€154 Billion</td>
<td>€100 Million</td>
</tr>
<tr>
<td>(Figure 2.)</td>
<td></td>
<td>(0.08% of the size of the mainstream)</td>
</tr>
<tr>
<td>b) Number of VCs</td>
<td>Around 1600</td>
<td>Around 45</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(4.5% of the number of mainstream)</td>
</tr>
<tr>
<td>c) Average amount of investments</td>
<td>€120 Million</td>
<td>€1,1 Million</td>
</tr>
<tr>
<td>d) Duration of investment</td>
<td>2-3 years</td>
<td>3-5 years</td>
</tr>
<tr>
<td>e) Environmental prerogatives</td>
<td>Environmental risks and liabilities</td>
<td>Environmental or/and social screening</td>
</tr>
<tr>
<td>f) Sources of financing</td>
<td>Pension funds and banks</td>
<td>High net-worth individuals</td>
</tr>
<tr>
<td>g) Investors orientation</td>
<td>Typical Return on Investment (ROI)</td>
<td>ROI plus ecological orientation</td>
</tr>
<tr>
<td>h) Current targets for investments</td>
<td>Communications, Software, Information Technology</td>
<td>Renewable energy, water and cleaner technology equipment</td>
</tr>
</tbody>
</table>

Source: J. Randjelovic, 2001. Data for mainstream VC was mainly gathered from websites and publications of EVCA and Venture Economics. Data for green VCs was gathered from interviews with green venture capitalists and public information in www.sustainablebusiness.com

The total number of active mainstream VC companies in Europe and the USA situates at around 1600, with more than 850 active firms in Europe\(^\text{11}\) (row ‘b’ in Table 1). Compared to mainstream VC, the number of green VC firms in Europe and the USA is much smaller. We found twenty

\(^{11}\) Number of companies listed as members of the European Venture Capital Association (EVCA) and the National Venture Capital Association (NVCA). Since there are companies that are not members of these associations, this number is expected to be higher.
European and around twenty-five US companies dealing with green VC. For example, when searching in the member list of the European Venture Capital Association (EVCA) we found seventeen VC companies that have ‘environment’ as an investment category, which represents only 2% of the total number of EVCA members. Conversely, some mainstream VC companies actually invest in environment-oriented start-ups, such as in fuel cell technologies, but they do not claim such orientation. Our research included the first category only. The average amount invested is very small compared to that invested by the mainstream VC industry (row ‘e’ in Table 1). While the average amount of mainstream VC invested was about €120 Million, some sources interviewed approximated that around €1.1 Million (approx. $1 million U.S.D) is usually invested in eco entrepreneurial companies in Europe.

Both the USA and European mainstream PE firms provided a similar portion of financing to early stage enterprises (start-ups), which accounted for around 14% of all VC investments (EVCA-b, 2001; Venture Economics, 2002). However, this portion is fairly small, compared to later stage financing. As a consequence, nowadays the time to exit the mainstream VC investment is around 1-2 years – an investment period which may not be enough for eco-innovations to become commercially viable. Indeed, our research indicated that the time to exit averages five years for most green VC investments (a difference represented in row ‘d’ in Table 1). Many of the eco-entrepreneurs interviewed by us expressed the need for a longer period of product development to reach a market breakthrough. These start-ups are often product-based and the product cycle is longer than service-oriented innovations such as ‘dotcoms’.

Environment prerogatives are, as one could expect, the core difference between mainstream and green VCs (row ‘e’ in Table 1). Mainstream VCs usually include environmental issues in their investment decision procedure as a risk factor only. Environmental issues are seen as a risk carrier or a potential liability to the start-up. Often, external consultants are hired to assess environmental and/or social risks related to the specific potential investee company in due-diligence procedures. Green VCs, on the other hand, consider the capacity eco-innovations have to add value to an enterprise, besides the risk reduction factor. Hence, it can be said that green VCs have the potential to generate ‘double-dividends’ – the creation of both low environmental impacts or risks and financial returns (see: Porter & van der Linde 1995).

Mainstream and green VC have somewhat different sources of financing (see row ‘f’ in Table 1). The main source of financing for mainstream VCs is provided by institutional investors, which are composed by pension funds and banks. In 2000, pension funds accounted for 24% of the total investors in VC funds, while banks accounted for 22% (EVCA-c). For green VC funds ‘high net worth’ individual investors represent almost 50% of their investors, which have often chosen green VC funds because of their environmental and social beliefs and/or the understanding of the potential double-dividends of sustainability related investments. This, in fact, constitutes the fundamental difference between the typical orientation of investors (or drivers for investing) of mainstream and green VC shown in row ‘g’ of Table 1.

The main difference between mainstream VC and green VC is found in the type of target investment (row ‘h’, Table 1). Mainstream VC managers tend to invest in fast growing sectors, such as information technology (IT) or communications, which account for 23% of total invested

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12 The number of companies was identified by compiling data provided by participants in the Sustainable Private Equity Conference, held on 19th of January 2000 in Switzerland. Additionally, data was also collected from various websites that provide information for eco-entrepreneurs, such as http://www.sustainablebusiness.com, (10/07/01).
13 Data from the EVCA website section created for helping entrepreneurs that seek financing. Using ‘environment’ as a searching criteria in each industry sector, 17 start-up companies could be identified, (15/08/01).
14 Data were taken from the member list of EVCA (2001), because it has data on all participative venture capital companies, size of the investments they have and sectors they invest in.
15 Interview with anonymous VC firm
amount in Europe (EVCA-c, 2001). Our data shows that green VC firms currently invest in the following groups of technologies: (i) Wind, solar, and wave energy; (ii) Desalination and water recycling; (iii) Organic agriculture; (iv) Fuel cells; (v) Industrial processes technologies.

Wavegen, a start-up funded by green VC provides a good example of an eco-oriented start-up. The company was established in 1992 in Scotland to research innovative technologies and manufacture equipment for wave energy production (Ross, 2001). In 2000, the company secured a 15-year contract with the Scottish electricity utility to supply wave energy to the grid (Wavegen, 2002). The expressed commitment of the UK Government to reduce carbon dioxide emissions by 20% by the year 2010 under the United Nations Framework Convention on Climate Change (CEPS, 2000), and to have 10% of the energy supplied by the grid coming from renewable energy sources is expected to facilitate the adoption of wave technology. In other words, there are many grounds to believe that wave energy technology could repeat the success of wind energy in the 1990s. Considering the projected unit cost of electricity generated by wave technology16 in the first decades of the 21st century, wave energy could become an attractive investment for green VC.

Companies such as Wavegen have the potential to be targeted by green VC funds, such as Sustainable Asset Management (SAM). This green VC firm established two funds in the year 2000 with a total amount of €86 Million (SAM, 2002). Approximately 40% of the investors in the fund are high-network individuals, with particular interest in sustainability-oriented firms. SAM-PE (Private Equity), for instance, invests in three main areas: emerging energy, resource productivity and healthy nutrition17. When screening for eco-innovative start-ups to invest in, SAM-PE assesses social, economic and macro-societal environmental trends. Because of its commitment to investing in more environmentally sound companies, SAM-PE is a didactic example of a green VC enterprise. In this respect, Wavegen could eventually create value to VC financiers, such as SAM. However, not all eco-innovations get the necessary funding and not all green VC managers find appropriate eco-innovations to invest in. The following section explains why such situations happen; it provides an overview of the current problems faced by both ‘sides’ of green VC industry.

ECO-INNOVATORS AND GREEN VC: A PROBLEMATIC RELATIONSHIP

Many eco-innovators and green VCs alike consider the words ‘sustainability’ or ‘environmental’ problematic for the promotion of the enterprise. Often, start-up companies and VCs are reluctant to use these words even if sustainability principles are somehow embedded in their products. As one green venture capitalist stated: “Our name often makes investors think that we just ride bicycles and eat vegetables”18. Although such type of interpretation constitutes an important barrier to be overcome within the industry, it is certainly not the only one faced by green VC managers and eco-entrepreneurs. Below we selected the most prominent ones, identified in our research.

Lack of a proper network: Since entrepreneurs and VC firms normally ‘find each other’ via active networks, the lack of a good network can certainly represent an impediment for the start of such relationship. In Europe, for instance, there is no formal network for eco-entrepreneurs and green VC firms. Neither are conferences, trade fairs and information platforms for

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16 The projected unit cost of electricity generated by wave technology situates at around €0.08, while the cost for wind energy is estimated to be €0.06. Wave generated electricity has the potential to achieve substantial cost advantages in next 20 years and, eventually, transform fossil fuel generated electricity into anti-economic activity. For more details see UNDP (2000).

17 For more details see http://www.sam-group.com/

18 Anonymous Interview (04/07/01)
information and knowledge sharing about green VC, such as the Investors Circle\textsuperscript{19} in the USA. Some initiatives have emerged recently in the UK. There, a network has been formed\textsuperscript{20} to match investors with entrepreneurs in the field of digital technologies that contribute to social and environmental change. Although this represents a step forward, such type of network still needs to be extended to other members of the European Union.

\textbf{Different meanings for ‘sustainability’ and ‘environment’:} Many entrepreneurs and green VC firms mentioned that environment and/or sustainability is perceived as less profitable (and even as a costly burden) that hampers the chances of getting funding. Indeed, many eco-entrepreneurs eliminated the environmental perspective out of their business plans so they could access mainstream funds more easily. For green VC firms, there are also some differences in perception as to what constitutes ‘sustainability’ or ‘environmentally responsible’ behaviour, and what will be a profitable investment.

\textbf{Lack of a ‘good’ business plan:} According to some venture capitalists, funding for start-ups is often refused because entrepreneurs submit a ‘bad’ business plan. Venture capitalists perceive a ‘bad’ plan as an incomplete or inconsistent business concept, a lack of essential data (e.g. expected revenues), or too much irrelevant data (such as an overemphasis on world environmental problems). For instance, a green VC firm representative\textsuperscript{21} told us that an entrepreneur submitted a business plan with ten pages on the science of climate change, and only four on the business concept. Apparently, ‘bad’ business plans is not unique to eco-entrepreneurs but rather a pervasive problem in the industry.

\textbf{VC finance timing:} Many eco-entrepreneurs have their requests for financing refused simply because of the stage of development of the start-up. From the point of view of venture capitalists, start-ups in a very early stage of development represent too high risk. As many of the green VC firms are themselves quite new, they have so far tended to favour businesses that are relatively ‘mature’, if compared with ‘good’ business ideas that still need to be ‘incubated’. Such a situation generates a gap in financing, which is not totally filled by other types of investors, such as angel investors.

\textbf{Lack of expertise and skills:} Lack of skills and expertise is a problem on both ‘sides’ of green VC investment. On one side, the research showed that VC firms or managers refused to finance eco-innovations because they did not understand a particular technology or the industry the entrepreneurs wanted to enter. On the other side, venture capitalists have the opinion that eco-entrepreneurs lack the business skills, such as marketing, management or financial skills, which are necessary to run their businesses. Thus, entrepreneurs may need proper environments, such as ‘technological incubators’ to be properly developed. In such contexts, the eco-entrepreneurs, who tend to have a technical orientation, learn the managerial competences necessary to make their ideas succeed in market terms.

\textbf{Lack of potential market breakthrough:} Many entrepreneurs are refused financing because their technology seem not to have the potential to be commercially viable within the lead-time expected by investors. Financing may also be refused for start-ups that are expected to compete in a mature industrial sector (automotive industry, for instance), or they think that the technology – and the team behind it – will simply not attract enough attention on the market in the short-term.

Having described existing problems of the relationship between green VC managers and entrepreneurs, it is now appropriate to discuss the potential green VC funds have to expand. The

\textsuperscript{19} see www.investorscircle.net
\textsuperscript{20} see http://www.vitamin-e.net/
\textsuperscript{21} Who prefer to remain anonymous.
following section summarises the peculiarities of the *green* VC market by looking at the drivers for eco-innovations, as well as the sources of innovation in the *green* VC’s themselves.

**THE POTENTIAL OF GREEN VC TO EXPAND**

According to the arguments presented in the previous sections, *green* VC is expected to have some intrinsic uniqueness – when compared with the broader categories of VC. Obviously, there are also many common issues faced by both types of investment. Because *green* VC is, in essence, a niche market in the broad area of VC investment, it inherits many problems from its ‘parent’ investment segment.

Many of the problems faced by *green* VC can expect to be resolved in time as the field becomes more sophisticated and as the market ‘learns’ about sustainability. Apparently, what is now needed are some ‘big successes’ in *green* VC to draw attention and capital towards earlier stages of financing start-ups. The VC industry needs to learn about eco-innovations and, similarly, eco-innovators – whether they are start-ups or other environmental professionals – need to learn about *green* VC and other innovative finance mechanisms. Venture capitalists operate in one of the riskiest zone of investments and they expect to be compensated for this risk by high returns on their investments.

The point at which VC managers (whether *green* or not) would describe the relative ‘success’ of a venture would be at the stage wherein equity shares of the *investee* company are sold to other shareholders, usually as an Initial Public Offering (IPO). Of course, many ventures do not even make it this far. The primary aim of venture capitalists is to gain sufficient return on investment in order to repay their investors, as well as to keep a percentage of the profit as income for themselves. Thus, the success of the venture is judged by the way in which the market considers the potential for the business to create value in the future. For *green* VC managers, this means that *what* they are funding is innovative and subject to particular market and non-market drivers (regulation, in particular), and *how* they are funding it (i.e. how they manage their investments and bring the eco-innovation to the market) requires a unique approach. These two aspects are covered in the following sections, schematically represented in the figure below.

**Figure 3. Determinants of eco-innovation expansion**
The main drivers for eco-innovations and subsequently green VC expansion, represented in the figure, are regulatory and technology push and market pull (Rennings, 2000). Technology and regulatory push can motivate entrepreneurs to start companies with environmentally beneficial new products (such as wave energy), while market pull, based on the investors’ demand and competencies of green VC managers can also influence the development of eco-innovations (see Figure 3.). Below the drivers and competencies are further discussed.

**Drivers for value creation**

Traditionally, environmental ‘externalities’ are not adequately priced or valued by the market. Rennings (2000, p 326) reminds us of market imperfections – long debated by economists – that can hinder eco-innovations: “As long as markets do not punish environmentally harmful impacts, competition between environmental and non-environmental innovation is distorted.” One way of curbing such imperfections is via environmental regulations, such as the IPPC Directive. Regulatory guidelines such as IPPC have the potential to trigger the development of ‘cleaner’ technology, such as wave and wind energy, discussed in the previous sections. The regulatory push is expected to have more influence than other determinants for eco-innovation expansion.

Green VC’s success rests firmly on how well the market – in our case translated in the view of green VC managers – perceive the potential value-creation of the start-up and/or the eco-innovation of an existing business. This is especially true of new green VC funds, which only have a small number of investments and thus cannot easily spread their risk like larger VC firms. As it can be observed in Figure 3, the regulatory push is a relevant factor influencing both the development of new technologies and the willingness of investors to fund eco-oriented start-ups. The regulatory push influences the eco-oriented start-ups as well; by direct governmental measures (such as the IPPC), that have a direct impact on new established eco-oriented start-ups. Thus, because of the ‘triple’ influence (see Figure 3) the relevance of regulations is maybe the most important in development of eco-innovations and their VC fund raising.

Changes in the pension fund laws in Europe consist of a special type of regulatory push that can induce investors to fund eco-oriented start-ups. For instance, Germany has recently issued a law for pension funds to disclose information about ecological, ethical and social characteristics in their investments (Article 115 of the German Pension Legislation Act, 2002). The UK has a similar law, which obliges pension funds to declare the extent to which social, environmental or ethical considerations are taken into account. According to EIRIS (2002), this regulatory approach is expected to be broadened and made more stringent in the future – eventually covering all EU countries. Since pension funds are currently the main investors in VC funds (24-25% in Europe and the USA respectively), such changes have the potential to significantly affect the investment market for green VC. As a result, one can expect that the amount of capital available to eco-entrepreneurs via green VC firms and managers can significantly increase in the near future.

Without the backing of venture capital many eco-innovations will not be able to grow at the rate needed to reach the commercialisation stage. This means that the perception of investors, in the potential profitability of eco-innovations is of crucial importance to lifting many of these businesses off the ground. The perception of investors and green VC managers of the commercial viability of eco-innovative start-ups together with green VC managers’ internal competencies represent part of the market pull explained in the next section.

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22 IPPC directive stands for Integrated Pollution Prevention and Control issued in 1996 on EU level. The IPPC directive would drive emerging start-ups to be able to fit into existing supply chain of companies already following IPPC directive, in other words IPPC directive could become an eco-innovation driver.

Source: Adapted from Rennings (1998, p.326)
Competences of Green VCs: nurturing and managing start-ups

As discussed previously, regulatory push in some cases (e.g. pension legislation) influences investors to seek more environmentally and socially responsible funds, such as green VC funds to provide capital to eco-innovations (see Figure 3). Once the actual investment is selected and capital raised, the success of the investment is, to a certain extent, reliant on how well the start-up is managed and how ‘well’ the financier exits the investment. Hence, a particular competitive advantage of green VCs may be located here. If the VC (whether green or not) firm or manager has particular competence in techniques of corporate environmental management, they will be in a position to help investee companies to grow ‘right’ from the start. This would mean screening, assessing, stipulating and assisting entrepreneurs in ensuring that their business processes and products are managed in a way that have low environmental impact and social burden. They would thus be able to assist start-up companies (whether eco-innovative or not) avoid many environmental problems and costs in the future. This is one area wherein green VCs could lead other VCs, creating positive environmental outcomes in the process.

Furthermore, after a green VC firm successfully sells the shares of an eco-innovative start-up in the stock market (technically, ‘exiting’ the investment), it certainly will be in a better position to justify the investment on eco-innovation, as well as to attract more investors. In this respect, a ‘cleaner company’ would be a selling argument for investors – it lowers costs and liability risks, as well as demonstrates an interest in creating value over the long-term. With an increasing number of investors searching for sustainability attributes in companies (such as the SRI-oriented mutual funds), this could result in a profitable venture for green VC. For instance, during the period of June 1995-October 2001, Dow Jones Sustainability Index (DJSI) continuously outperformed the Dow Jones Group Index (DJGI)\textsuperscript{23}.

FINAL CONSIDERATIONS AND DIRECTIONS FOR FUTURE RESEARCH

In this paper we explored an emerging phenomenon within the venture capital industry: the environment-related VC or ‘green’ VC, as we named it. We initially described the characteristics, market and processes of VC and, in order to demonstrate the unique aspects of green VC, we compared it to the so-called mainstream VC. We also discussed the main barriers and drivers currently faced by green VC firms and managers and the eco-innovations supported by them. By doing so, our article arranged dispersed data, which allowed us to systematically describe and analyse this emerging phenomenon.

We emphasised that, as a unique thriving type of financing, the development of green VC seems to depend on the implementation of some specific types of regulations. This would positively influence the general conditions for green VC, such as changes in the rules that facilitate funding for eco-innovations (the ones guiding pension funds, for instance). On the other hand, green VC managers, eco-entrepreneurs and investors need to develop competences on environment-related strategies and practices, which can create economic value and reduce environmental impacts/risks.

According to our study, comparing the financial performance of green VC funds with mainstream VC is fundamental for further development of the research area of venture capital financing. This is why we endeavored to carry out this exploratory research. By providing some

\textsuperscript{23} Obviously, one could question the extent to which the pre-requisites forming the Index reflect environmentally responsible companies. The stocks also included some blue ships, such as General Motors, Shell, and Dow Chemicals, which also blurs the real reasons for investors to put their money in those stocks. Nonetheless, one cannot ignore that the allegedly ‘cleaner’ companies were valued more by investors than of those that presented an image of proactive sustainability – even if this event was coincidental. For more details see http://www.sustainability-index.com/
(anecdotal) success stories of green VC, we expect to have persuaded academics to follow up on our research. In the organization & environment\textsuperscript{24} front, for instance, future research could assess governmental measures and mechanisms that improve the general climate for the development of eco-innovations in existing businesses, as well as the emergence of eco-oriented start-ups. In studies of technology, it seems essential to identify (alternative) technologies that are not only technically feasible to materialize in the coming years (such as wave energy technology, mentioned in this article) but also able to become candidates to receiving green VC funding. In fact, such demand suggests that technology and management studies have to be brought together in future venture capital financing research. In order to facilitate such a process (in particular, research design), as well as a general discussion on the topic, based on the article, we propose the following definition for green VC:

\begin{quote}
Green venture capital is a type of financial capital provision invested in high-risk environment-oriented ventures, which offers the possibility of ecologically sound business practices, as well as significant gains to compensate for the risks involved in such investments.
\end{quote}

This definition – and the study in general – have also important implications for practice. Based on the research presented here we hope to have convinced practitioners in financing – in particular, mainstream VC managers – to pay more attention on the potential value-creation of green VC. We demonstrated that there is a growing market for investment in eco-innovative companies but so far only those who see sustainable development principles and eco-innovations as vehicles for value-creation have targeted it. We wonder how long it will take for other venture capital firms to catch up with these visionaries.

\textsuperscript{24} For an overview of the Organisation & Environment field, see: Orssatto (2001).
References


