Venture Capital Syndication as a Tool to Mitigate Financial Constraints of Clean Energy Startup Companies

Department of Economics
and Accounting
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Supervisor: Jukka Pirttilä

Jonna Saarinen
80807

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Tutkin työssäni pääomasijoittamisen keinoja lieventää epäsymmetrisen informaation aiheuttamia ongelmia ja edistää tätä kautta puhtaan energian startup-yritysten rahoitusta Euroopassa. Keskityn erityisesti syndikaatioon eli yhteissijoittamiseen, jonka avulla pääomasijoittajat voivat tutkimusten mukaan helpottaa tuottavien sijoituskohteiden valintaa, hajauttaa portfolioriskiä, investoida pääomaintensiivisempiin kohteisiin, jakaa resursseja ja lisätä näin onnistuneiden irtautumisten todennäköisyyttä. Perustelen syndikaatioiden tarpeellisuutta Casamatan ja Haritchabaletin teoreettisella mallilla. Mallin mukaan epävarmuus investoitavan yrityksen tai sektorin kannattavuudesta lisäisi tarvetta yhteissijoituksille. Koska puhtaan energian investoinnit altistuvat monille erilaisille riskeille, kuten regulaatioriskille, syndikaatio olisi täten perusteltua kyseisellä sektorilla.

Pankit ovat usein vastahakoisia rahoittamaan riskisiä alkuvaiheen hankkeita, joten nämä hankkeet tarvitsevat riskinottohaluisia sijoittajia. Monet startup-yritykset eivät kuitenkaan onnistu houkuttelemaan myöskään pääomasijoittajia, sillä sijoitukset voivat olla liian riskisiä tai pääomaintensiivisiä. Usein rahoittajat ovat myös sitä mieltä, että aloittelevilta yrityksiltä puuttuu liiketoimintaosaamista. Sijoittajien voi olla vaikea hankkia riittävästi luotettavaa tietoa sijoituskohteena olevan yrityksen toimista (asymmetric information), mikä pätee erityisen hyvin silloin kun sijoituskohteena on teknologiayritys. Yrittäjä saattaa johtaa yritystä tavalla, joka maksimoi heidän oman hyvinvointinsa ulkopuolisen sijoittajan kustannuksella (agency problem). Elinkaaren alkuvaiheessa olevat kasvuyritykset kohtaavatkin usein ns. pääomakuilun, jossa he eivät saa tarvitsemaansa kasvurahoitusta. Yhteissijoittamisen lisääminen voisi olla yksi keino lisätä kasvuyritysten rahoitusta.

Koska puhtaan energian sektorilla on paljon hankkeita, jotka ovat sekä riskisiä että myös pääomaintensiivisiä, syndikaation lisääminen voisi parantaa puhtaan energian startup-yritysten rahoitusta ja lisätä onnistuneita irtautumisia. Monissa pääomasijoituksissa onkin syndikoitu sekä julkisia että yksityisiä rahastoja. Pääomavajeen täydentämiseksi tarvittaisiin myös lisää kansainvälisiä riskipääomasijoittajia, joten perehdyn työssäni kansainväliseen yhteissijoittamiseen. Vertailen työssäni myös Euroopan ja Yhdysvaltojen syndikaatiokäytäntöjen eroja, ja pohdin, voisiko sijoitusten syndikoinnin tehostaminen edistää aikaisen vaiheen rahoitusmahdollisuuksia puhtaan energian sektorilla Euroopassa.

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1 INTRODUCTION

1.1 Background

"An increasing number of experts in the technology development ecosystem are concluding that there is an unhealthy and unsustainable imbalance between diminished resources devoted to planting the seeds for breakthrough new ideas and excessive harvesting of the fruit from breakthrough ideas that flowered 30 years ago."

Pascal N. Levensohn, Founder and Managing Partner at Levensohn Venture Partners LLC (2009)

The financing of innovation and particularly the financing of young high tech firms is an essential element in economic growth. A key aspect of venture capital is that it facilitates the provision of funding to startup firms despite the huge risks associated with unproven technologies. Since startups with new technologies are often financially constrained and they are too risky to get debt finance from banks and other financiers, the provision of venture capital can be critical for their survival. The emergence of several new industries, such as biotechnology and the internet industry, has been driven in large part by the availability of startup venture capital for new startups.

However, the venture capital process is also subject to asymmetric information and different risks, which can create problems for investors or entrepreneurs. Many entrepreneurial companies have difficulties in raising venture capital financing, even if they are technically proficient and might have had little difficulty obtaining public funding. Especially in times of a financial and economic crisis, they encounter difficulties in raising the funds required to finance their product development or commercialization efforts.

Given the economic and social relevance of start-ups, it is important to understand why these companies are financially constrained, and how venture capitalists could better mitigate these

problems and offer funds more effectively to young, innovative companies. Therefore, I will find out what mechanisms venture capitalists can use to alleviate financial constraints caused by asymmetric information and several risks inherent in the early stage investments. I will especially focus on syndication, using Casamatta's and Haritchabalet's model to demonstrate syndication theoretically. I will examine if efficient syndication could help venture capitalists select their investments better, share risks and combine different resources and skills that could increase the chances of successful exit of an investment.

After presenting general theory of venture capital and syndication, I will explore venture capital investing in clean energy. The importance of the clean energy sector to the world economy continues to grow. Climate change, increasing oil demands, and rising living standards in many parts of the world are continuously increasing the demand for clean energy innovations. Commercialization of new energy technologies is important in order to achieve a development of the economy that is environmentally sustainable. Innovation and green growth are also key to EU2020 Strategy, which proposes actions to develop innovative financing solutions and making an efficient European venture capital market a reality. Venture capital has the potential to make a significant contribution in enhancing cleantech companies' profitability and this way economic growth.

However, there are several risks in clean energy investments that increase financial constraints in this sector, which I will introduce in this thesis. Venture capital firms have often high risk tolerance but relatively limited capital. In contrary, project financiers and bank lenders typically have high levels of capital and can commit to longer-term investments, but they have little or no technology risk tolerance. It has been speculated that no existing class of financing institutions is effectively positioned to address investments that are both risky and capital-intensive. Therefore, I will find out how efficient mechanism syndication is to mitigate capital constraints and asymmetric information problems that especially capital-intensive clean energy investments face. I will also compare syndication practices between Europe and US and examine if increasing and strengthening syndication could foster a more vibrant clean energy venture capital market in Europe.

Finally, it should be noted that increasing syndication and optimizing other venture capital investing strategies is not enough in improving financing possibilities of young, innovative clean energy companies. The problem is that for clean energy technologies to really change the world, they must first be proven at commercial scale. From a venture capital perspective, the road to market often is long. In addition, clean energy innovations deliver a positive externalities, such as reduction in external costs from environmental damage. However, they do not necessarily bring any private benefit for consumers. Therefore, regulation and government support is often needed to increase the demand for clean energy innovations, promote entrepreneurship and enhance venture capital investments in the clean energy sector.

1.2 Objective of the Research

The main objective of this research is to examine **whether syndication is an effective mechanism to mitigate financial constraints of clean energy startup companies.** To reach this objective, I have strived to answer these key research questions:

- Are there significant efficiency gains from syndicating venture capital funds? Does syndication increase chances of successful exit?
- What is the role of syndication in alleviating financing constraints of clean energy start-ups? Does it help alleviate the funding gap that especially capital-intensive early stage clean energy investments often face?
- Could more efficient syndication of investments foster a more vibrant clean energy venture capital market in Europe?
- What is the role of government in supporting good venture capital investing climate in the clean energy sector?

1.3 Methodology

There are some venture capital databases that charge a fee for using their services, such as Venture One or VentureEconomics. There are also some databases providing information about clean energy investments specifically. For example, Bloomberg New Energy Finance is the leading provider of independent analysis, data and news in the clean energy and carbon markets. This data is for registered members only.

In this research, I did not use these databases to get quantitative data. Instead, I did a comprehensive literature review on venture capital syndication and its role in alleviating financial constraints that especially startup companies face. In addition, I use Casamatta's and Haritchabalet's model to examine venture capital syndication theoretically. The academic literature on venture capital's role in mitigating financial constraints and promoting entrepreneurship in clean energy sector is sparse, which sets challenges for my thesis. Therefore, I interviewed Tarja Teppo from Cleantech Scandinavia to gain some empirical view to the subject. The main results of this half-structured interview will be presented in chapter 4.3. The questions asked are listed in the appendix IV.

1.4 Structure of the Research

This research is divided into six main chapters.

The first chapter introduces the background of the thesis, research problem and objectives, methodology and key terms and definitions.

The second chapter introduces the history and general characteristics of venture capital industry.

The third chapter examines venture capital's role in alleviating financial constraints of startup companies. I will introduce how problems caused by asymmetric information hamper financing possibilities of startup companies. I will present the mechanisms venture capitalists use to

alleviate financial constraints caused by asymmetric information and risks. I will especially focus on syndication, using Casamatta's and Haritchabalet's model to examine the subject theoretically.

The fourth chapter introduces venture capital investing in clean energy sector. Clean energy investments globally and in Finland are introduced in this chapter. Financial constraints and risks inherent in clean energy investments are also studied.

The fifth chapter examines how financial constraints can be alleviated by syndicating clean energy investments. First, I will study the motives for syndicating clean energy investments. Next, some comparison between syndication practices in Europe and US is made. After that, I will find out why syndications with corporate investors and cross-border syndications are needed in Europe.

The sixth chapter draws conclusions based on the analysis in the previous chapters.

1.5 Key Definitions

Venture Capital

A venture capital fund - referred also as VC - pools money from institutional and high net worth investors, such as pension funds, banks, insurance companies and individuals, and invest the funds in portfolio companies in exchange for equity shares (Tykvová 2000, 2). Unlike traditional lending institutions, VC firms often specialize in start-up and growth companies and develop a thorough understanding of specific industries.

There are differences between American and European ways to define venture capital. According to the American definition, all professionally managed, equity-based investments in private, entrepreneurial growth companies as venture capital. Europeans tend to differentiate between venture capital that focuses on *early-stage* entrepreneurial growth companies, and private equity investment that is used for later-stage companies. (Megginson 2001, 23.)

Although there are differences in definitions, a unique characteristic for private equity and VC is that they create a strict relationship between the investor and the entrepreneur.

When discussing venture capital, one must carefully differentiate between *institutional venture capital funds* and *angel capitalists*. An angel investor is a high-net-worth individual who typically invests in small private firms, on his own account (Megginson 2001, 7). In this thesis, I focus on institutional VC companies.

Syndication

VC syndication is often defined as two or more VC firms joining together to take an equity stake in an investment. Sometimes the term is used more broadly to refer to situations where different venture capitalists invest in a given project at different times. Syndication is a prevalent feature of the venture capital industry. For example, according to the research of Deli and Santhanakrishnan (2009), 63% of investments made by venture capital partnerships in US firms between 1980 and 2005 were syndicated.

Financial constraint

The concept of constraint is central to the activity of economic theorizing. Along with preferences, constraints are said to determine choice and decision-making. (Hawkins 2003, 5.) Financing constraints can explain why firms do not take advantage of profitable investment opportunities. A firm can be considered more financially constrained as the wedge between its internal and external cost of funds increases. Based on this definition almost all firms can be classified as constrained, just considering the transaction costs of external financing.

Korajczyk & Levy (2002) define financially constrained firms as a group of firms that do not have sufficient amount of cash to carry out their investment opportunities. In general, unconstrained or less constrained firms are those firms with relatively large amounts of liquid assets and net worth that can be used as a collateral. (Kaplan & Zingales 1997, 172-173.) Cressy and Olofsson (1997) define a supply side finance constraint as a capital market imperfection that

leads to a socially incorrect supply of funds to projects or the incorrect interest rate charged on funds.

In my thesis, I will not approach the financial constraints issue from the internal relative to external costs but rather define financially constrained firm as a firm that has difficulties in getting external financial sources. All firms face the imperfect market conditions on some degree, but there is a significant difference among firms with respect to their accessibility to external financing. While there is a consensus to consider financially constrained firms as those that face difficulties in obtaining external finance, there is no clear way to identify these firms. However, especially startup companies seem to have difficulties in obtaining financing, so it is rational to focus on studying startups.

Funding gap

Funding gap occurs when needed investment is *too capital intensive* for the high-risk venture capital, but *too risky* for traditional debt providers, such as banks. (Jamison 2010, 5.) Especially capital intensive, risky clean energy investments face this challenge. The disconnect between entrepreneurs and investors is holding back the clean energy market from reaching its fullest potential.

Cleantech and clean energy

The term "clean technologies" is relatively new and has taken on a variety of meanings. Cleantech can be defined as products and services that (1) provide superior performance at competitive costs, (2) greatly reduce or eliminate negative environmental impacts and (3) improve the productive and sustainable use of natural resources. Cleantech Group, a leading cleantech market research company, divides cleantech into 13 categories: agriculture, materials, water and wastewater, air and environment, recycling and waste, wind, biofuels and biomaterials, smart grid, energy efficiency, solar, energy storage, transportation and others, such as hydrogen production. (Cleantech Group 2011a.)

In this thesis, I will focus on technologies aimed at transforming the carbon base of the *energy* sector. There are different approaches to defining sustainable energy. In very general terms, it can be defined as those technologies that *reduce environmental impacts, are socially acceptable and can be economically competitive.* (Moore & Wüstenhagen 2004, 237.) Bloomberg New Energy Finance has categorized its investments on sustainable energy in five major markets - clean energy, energy smart technologies, carbon capture & storage, nuclear, and the global carbon markets. These markets are described in the appendix III which gives a more profound picture of the clean energy sector.

Clean energy technologies are predominantly on the supply side and refer to renewable energy generation technologies, such as solar, wind and tidal energy, or biofuel technologies. Biofuels are liquid fuels derived from biomass rather than petrochemicals. On the demand side, clean technologies refer to technologies which improve the efficiency of energy demand, such as smart meters. (Knight 2010, 3.)

Innovation

Innovation can be defined as "a process that begins with an invention, proceeds with the development of the invention, and results in the introduction of a new product, process or service to the marketplace" (Edwards & Gordon, 1984, 1). Joseph Schumpeter, an Austrian-American economist who focused on studying innovation and economic trends, defined innovation as: 1) introduction of new products, 2) introduction of new methods of production, 3) opening of new markets, 4) development of new sources of supply for raw materials or other inputs and 5) creation of new market structures in an industry (Schumpeter 1961).

Startup company

The term startup in this paper refers to newly founded firms, small and medium size enterprises, where the size of the financing is at a scale that requires access to the capital markets. At the early startup stage, the firm is mostly concerned with company formation, technology development, acquisition of customers, cash flow and survival. Since most young innovative

firms are owner-managed, the poor managerial background of the founder could typically be an obstacle to a successful start-up or the expansion of a young innovative firm.

Seed and early stage investment

VentureXpert classifies firm development into one of four broad stages: (1) startup/seed, (2) early stage, (3) expansion, and (4) later stage. These stages of development can be defined as follows (Deli & Santhanakrishnan 2009, 13):

- *Startup/seed*. Companies that have not yet fully established commercial operations, and may also involve continuing research and product development.
- *Early stage*. Companies that are beyond the startup/seed stage with potentially continuing product development, as well as initial marketing, manufacturing, and sales activities.
- *Expansion*. Companies that have products and services currently available, but may require additional capital to expand production to increase revenue.
- *Later stage*. Companies that have an already established product or service that has already generated revenue, but may not be making a profit. These companies may become candidates for IPO or acquisition.

In my thesis, I will focus on seed and especially early stage investments, where the entrepreneur decides to bring the product or service to the market.

Exit Process

The success of the venture capital industry depends heavily on the exit process. Venture capital firms only realize returns from their investments at the time of exit. As a consequence, venture capital returns are directly linked to the exit from an investment. Exits can take five forms, of which the first two are most relevant: (1) an initial public offering of the company's shares (IPO), (2) a trade sale or acquisition, where a larger company acquires the shares of the venture, (3) a secondary sale, where the VC sells its share in the company to a third party like a strategic

investor or another VC, (4) a buyout, where the VC sells its share to the entrepreneurial firm or its management, and finally, but less desirable, (5) a write-off in case of the venture's failure. (Wüstenhagen & Teppo 2004, 16.)

2 VENTURE CAPITAL INDUSTRY

2.1 History of Venture Capital

The decision by Spain's king Ferdinand to finance Christopher Columbus' voyage of exploration can be considered one of the history's most profitable venture capital investments. However, modern *venture capital* - defined as a professionally managed pool of money raised for the sole purpose of making actively-managed direct equity investments in rapidly-growing private companies - is a much more recent financial innovation. The first VC company, American Research and Development (ARD), was founded in 1946 by MIT president Karl Compton, Harvard Business School professor Georges Doriot and local business leaders who sought to commercialize the technologies developed for World War II. The first limited partnership, which resembles the common type of VC company nowadays, was founded in 1958. (Gompers & Lerner 2004.)

A fundamental change in the American VC market occurred during the late 1970s, which can be traced to two public policy innovations. First, Congress lowered the top personal income tax rate on realized capital gains from 35 to 28 percent in 1978, thereby significantly increasing the effective return to value-creating entrepreneurship. In 1979, the Labor Department relaxed its "Prudent Man Rule," thus effectively authorizing pension fund managers to allocate up to five percent of fund assets to private equity investments. As a consequence, total funding increased from $68.2 million in 1977 to $978.1 million in 1978. (Megginson 2001, 7.)

Until the early 1990s, venture capital remained essentially an American phenomenon. However, the information technology hype of the late 90s boosted the VC industry, increasing VC investments and returns also in Europe. Funding during these years was concentrated in internet and telecommunication investments. The market peaked in 2000, when over 100 billion dollars were reportedly invested in venture capital. Considerable sums were devoted to supporting highly similar firms. However, during the first three quarters of 2001, venture capital funding

fell back to “only” $34.0 billion. Failure to exit Internet companies quickly forced VC firms to liquidate. (Megginson 2001, 7.)

Other example of excessive adjusting to the changing demand conditions was the peak period of biotechnology investing in the early 1990s. While the potential of biotechnology to address human disease was doubtless substantial, the extent and nature of financing seemed to be excessive, and the valuations of these firms often were too high. Hence, biotechnology valuations fell precipitously in 1993. Most of the biotechnology firms financed during this period ultimately yielded very disappointing returns for their venture financiers. (Lerner 2010.)

Unlike the last slowdown of VC activities following the collapse of the New Economy bubble in the year 2000, the 2008 slowdown came more as an exogenous shock to the VC market. In the 2007-2009 crisis, the downturn of VC activity was not initiated by unrealistic expectations of the Internet and the New Economy but instead problems in the financial sector. (Block et al. 2010, 16.) With limited amount of investors being able to invest in VC funds after the crisis, and decreased exit opportunities of portfolio companies, these funds suffered from the financial crisis.

Conditions in the VC industry have improved now, reaching a more favorable risk-return balance. For the most part, entrepreneurial finance looks slightly better now than at the end of the recession, but worse than before the downturn began. M&A activity was up over the prior year, and post-IPO performance has been relatively strong. However, the industry continues to feel the effects of the global economic downturn - most notably in the form of limited exit opportunities. (Thomson Reuters & NVCA 2011.)

Americans are still leading the VC market in terms of amounts invested. However, the slowdown of VC activity due to the crisis seems to have been more severe in the US than outside the US. Venture capitalists in the US widely expect their industry to contract. The US respondents feel the industry has suffered from a weak IPO market and unfavorable tax and regulatory policies. (Deloitte & NVCA 2010.)

The recent trends show that VC is increasingly becoming a global phenomenon. Since the early days it has spread also to Europe and Asia. Many developing economies have undertaken public policies in order to foster VC investments, and new venture capitalists are continuously arising in these developing economies.

2.2 General Characteristics of Venture Capital

A venture capital fund pools money from institutional and high net worth investors, such as pension funds, banks, insurance companies and individuals, and invest the funds in portfolio companies in exchange for equity shares. Venture capitalists can thus be seen as intermediaries between investors supplying the funds and entrepreneurs that demand those funds to be able to develop their business. (Tykvová 2000, 2.)

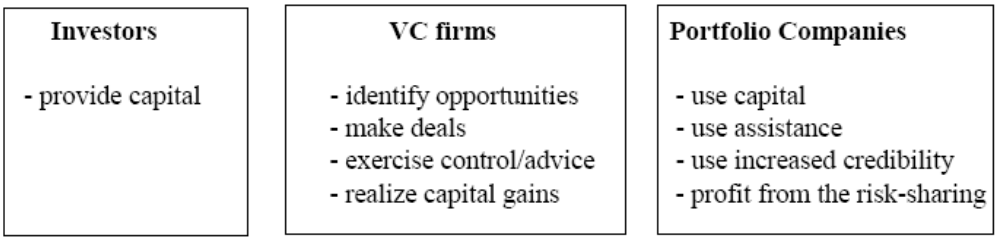

Figure 1 Structure of the Venture Capital Market (Tykvová 2000, 2)

Unlike traditional lending institutions, VC firms often specialize in start-up and growth companies and develop a thorough understanding of specific industries. While banks mostly monitor only the financial health of firms they lend money to, venture capitalists also check the strategy very profoundly. Venture firms often play an active role in their investees' board of directors, providing oversight, strategic advice, and credibility to the company. (Tykvová 2000.) Many of today's most dynamic and successful corporations received VC at the initial stages of their lives, such as Amazon, Apple, Google, Genentech, Intel and Microsoft.

Venture capitalists are usually structured around a private limited partnership model. This means that stakeholders who invest in the VC fund have limited responsibility. Hence, pension funds, insurance companies or other investors who invested in the fund can lose only their investments at maximum. The funds themselves are run by venture capitalists who are general partners during the fund's life. They pay the limited partners a return on their investment. (Gompers & Lerner 2004.)

The whole process of venture capital investing is called a venture capital cycle. The cycle starts by acquiring financing from limited partners, after which the funds are invested in portfolio companies. Venture capitalist often takes an active role in helping to build the company, and then finds an exit strategy such as a sale to a larger company or going public through an IPO. Venture capitalists usually watch over the portfolio company as long as they think there is a chance for a profitable exit. The cycle ends when the profits are returned. VCs do not exit at the time of an IPO. Instead they retain shares for several months or even years and then typically distribute shares back to the limited partners. (Gompers & Lerner 2004.)

Earlier research has indicated that IPOs are the most profitable way of exiting from venture capital portfolio companies. IPO exits allow entrepreneurs to maintain some control over the firm post venture capital exit. Several empirical papers confirm the positive role of a viable IPO market on VC activity, and that IPOs are most often used for the highest quality firms. (e.g. Black and Gilson, 1998.)

Historically, only about a third of VC-backed companies will go public; another third are acquired by larger firms, and the remaining firms typically go out of business. Some studies in Europe find that exits through mergers and acquisitions (M&A) are more likely than through IPO exits, while in the US exits through IPO are more likely. The absence of an active IPO market for venture-backed companies has been viewed as the perhaps single most important reason for the slow development of venture financing in Europe. (Black and Gilson, 1998.)

2.3 Venture Capital in the Global Financial System

The global financial system consists of financial companies, regulators and institutions operating on a supranational level. It can be divided into regulated entities, such as international banks and insurance companies, regulators, supervisors and institutions like the European Central Bank or the International Monetary Fund. The system also includes the "shadow banking system" that consists of lightly regulated or non-regulated bodies, such as money market funds, venture capital firms, private equity firms and hedge funds. These companies are often able to step into businesses that big banks may cut back on under a stricter regulatory regime. (Masters 2011.)

Venture capital can be categorised as a part of alternative asset class. Alternative asset means any non-traditional asset with potential economic value that would not be found in a standard investment portfolio. Unlike traditional asset classes - stocks, bonds, and cash - alternative assets may include specific physical assets, such as natural resources or real estate, or methods of investing, such as hedge funds or private equity and venture capital. (Investopedia 2011.)

Alternative assets often are highly dependent on novel investing strategies or individual skill in selecting specific investments. For example, hedge funds exist to pursue investing strategies that often rely on the manager's judgment. Alternative assets tend to be less liquid than traditional investments. Thus, investors who favor alternative assets may have to consider a longer investment horizon. For example, venture capital investments are often long-term and illiquid, so venture capital investors must have predictable long-term financial liquidity. (NVCA 2010.)

There are different opinions among academics and politicians about the role of alternative assets' contribution on the financial crisis of 2007-2009. Some people argue that too much risk taking of the less regulated alternative investment caused the financial system to become increasingly fragile. For example, because some hedge funds used great amounts of leverage and other risky investment techniques, they were blamed of contributing significantly to the global financial crisis. However, according to U.S. Treasury Secretary Timothy Geithner,

contrary to for example hedge funds, venture capital presents only minimal, if any, systemic risk. (NVCA 2010.) Systemic risk is the risk of collapse of an entire financial system or entire market. It refers to the risks imposed by interdependencies in a system or market, where the failure of one institution to meet its obligations could cause other institutions to be unable to meet their obligations when due. Hence, such a failure may cause bankrupt or bring down the entire system or market. (European Central Bank 2004.)

There are several reasons for why venture capital does not present systemic risk as other alternative assets may do. First, (1) ***venture capital firms are not interdependent with the world financial system.*** They do not trade in the public markets, and unlike for example hedge funds, most venture capital funds restrict or prohibit short selling or other high risk trading strategies. Whereas a hedge fund in distress may leave a chain of unsettled transactions, venture capital has not the same kind of risk. In the private limited partnership model, pension funds, insurance companies or other investors who invested in the fund can lose only their investments at maximum. (NVCA 2010.)

Second, (2) ***the venture capital industry is insignificant in size relative to other alternative asset classes***. For example, in 2008, US venture capital funds held approximately $197.3 billion in aggregate assets. That same year, US hedge funds held, in the aggregate, approximately $1.3 trillion in assets. (Celarier 2009.) In addition, venture firms traditionally raise smaller sized funds.

Third, venture capital firms (3) ***do not use long term leverage.*** Borrowing is typically only used for short term capital needs, and many venture capital funds significantly limit the amount of borrowing to certain limits. In addition, (4) ***venture capital firms do not generally rely on short-term funding.*** Venture funds call down equity capital commitments from investors over a period of approximately ten years. Hence, venture capital funds rarely rely on short-term debt funding for their investment activities.

Finally, (5) ***venture capital funds are not a source of credit to any entity.*** Venture firms do not lend to households or governments, nor do venture capital funds act as a lender to

counterparties. Therefore, venture capital funds do not act as a source of liquidity for the financial system, but they only provide capital to a select few portfolio company investments. (NVCA 2010.)

3 VENTURE CAPITAL AND FINANCIAL CONSTRAINTS OF STARTUP COMPANIES

Several empirical studies show the positive influence of innovative startup companies on economic development (e.g. Keuschnigg 2004). They are important drivers of aggregate innovation and productivity. However, especially start-up companies often face large problems to get external capital. For example, according to Schröder (2009, 19), European young firms face specific challenges in obtaining capital for realizing their innovative ideas in marketable goods and services due to moral hazard, adverse selection and lack of collaterals.

In this chapter, will find out why especially startup companies are financially constrained. I will first introduce the concept of asymmetric information, and then I will move on to two problems caused by asymmetric information: adverse selection and double-sided moral hazard. Finally, I will introduce what tools venture capital has to mitigate this problem. I will especially focus on syndication.

3.1 Finance Constraints due to Asymmetric Information

A company can finance its investment by issuing either equity or debt. Equity represents ownership in a company, and debt represents a fixed payment to the lender. The Modigliani and Miller (1958) theorem states that in perfect capital markets, the value of a firm is unaffected by how that firm is financed, and it does not matter if the firm's capital is raised by issuing stock or selling debt. In this case, there is no need for financial intermediaries, and borrowers would obtain their loans directly from depositors. This result relies upon three basic assumptions holding that there are (i) no possibilities of default on loans (ii) no taxes and (iii) no transaction costs. (Canepa & Stoneman 2002.) These conditions apply in the Arrow–Debreu environment with complete markets, where there are no transaction or bankruptcy costs or taxes. (Tirole 2006.)

However, such conditions do not hold generally, and reality is different from theoretical models. Economic theory emphasizes that financing constraints do occur due to capital market imperfections. Investors and lenders (outsiders) are in a principal–agent relationship with the borrowers, entrepreneurs, or managers (insiders). *The asymmetric information problem* refers to the fact that an inventor frequently has better information about the likelihood of success and the nature of the project than potential investors. Agency costs arise when the 'agent' can make decisions regarding the use of the 'principal's' - money, and when the interests of the two parties conflict. The interactions between venture capitalists and their portfolio firms are characterized by high asymmetry of information, high risk, and uncertainty. (Hall & Lerner 2010.)

Two types of risks are present when there is information asymmetry:

1. Adverse selection, which is a risk exposure that exists *before* the money is lent or invested and
2. Moral hazard, which is a risk *after* the financial transaction.

3.1.1 Adverse Selection

The marketplace for financing the development of innovative ideas looks like the "lemon" market first modeled by Akerlof (1970). Entrepreneurs sometimes overstate the attractiveness of their proposals to secure funding. Thus, venture capitalists must be aware that entrepreneurs might try to sell them a "lemon". Because venture capitalists are not sure if investments are good or bad quality, they offer the finance conditions according to their assumption that the investment is average quality.

However, above-average firms decline to accept such a valuation and withdraw from the pool, thereby causing the average value of firms in the pool to decline. Investors anticipate the withdrawal of above-average firms and assess the average value of the pool accordingly. Subsequently, the firms whose value is above the new adjusted average will withdraw, and the dynamic will continue until the market for financing ventures disappears. (Klausner & Litvak 2001, 3.)

Adverse selection risks seem to be most pronounced for start-up firms. Investors have more difficulty distinguishing good projects from bad when the projects are long-term and risky R&D investments. (Hall & Lerner 2010.)

3.1.2 Double-Sided Moral Hazard

Moral hazard occurs in situations when outsiders cannot observe the insiders' carefulness in selecting projects, the riskiness of investments, or the effort they exert to make the firm profitable. Because participants - in this case venture capitalists and entrepreneurs - are sharing the ownership and profits of the project, they also share responsibility for the company. When relinquishing control rights to venture capitals, entrepreneurs may get incentives to misbehave and pursue private benefits. Conflicts of interest between management of a company and investors can take any of the following forms: (a) managers failing to exert optimal effort; (b) managers using firm resources, or neglecting opportunities, to create private benefits for themselves; (c) managers adopting strategies that entail too little (or sometimes too much) risk relative to expected return; and (d) managers departing from the firm at a time when replacement is costly. (Klausner & Litvak 2001, 4.)

The early financial contracting models assumed a pure principal-agent relationship in which the venture capitalist, as principal, suffers from moral hazard problems from the entrepreneur, as agent. However, the relationship between a venture capitalist and an entrepreneur goes beyond the standard "principal – agent" framework. In this relationship, also venture capitalists' effort is essential for the success of the investment because the entrepreneur usually has neither enough business experience nor the necessary networks. Because in venture capital both the entrepreneur's and financer's effort are important, the problem is actually a double-sided moral hazard. (Repullo & Suarez 2004, 2.)

In double-sided moral hazard, both participants – venture capitalists and entrepreneurs – may contribute less than the first-best level of effort, reducing the social surplus. The stronger incentives are given to the one agent, the less the other agent is induced to increase his effort. To

overcome the problem of double-sided moral hazard, incentives must be provided both to the entrepreneur and outside financer. (Repullo & Suarez 2004.)

3.2 Venture Capital's Role in Increasing Innovations and Mitigating Financial Constraints

The economic reason for the existence of the venture capital industry is based on its ability to finance young, risky and innovative companies. The contractual structure of the venture capital provides incentives for both the entrepreneur and VC investor to add value to the enterprise and solves agency problems related to the financing of new ventures (Gompers 1995). According to Chan (1983), the information asymmetry between venture capitalists and the entrepreneur is not as severe as that between ordinary investors and the entrepreneur, because venture capitalists see many projects and have industry and technical expertise. Venture capitalists use several mechanisms to mitigate problems caused by risky investments and asymmetric information. These mechanisms will be described in the chapter 3.3.

A common interpretation of the results found in the literature is that by relaxing financing constraints that innovative firms face due to asymmetric information and moral hazard problems, venture capital enhances growth and innovation of start-up firms. This can be called the *VC-first hypothesis*. However, this interpretation is one-sided, because there may be an opposite causality. An arrival of significant innovation is supposed to create new business opportunities and trigger firm startups. Therefore, the venture capital market may grow. On contrast to the VC-first hypothesis, this view is called *innovation-first hypothesis*. For instance, a drastic cost reduction in computer technology enlarged the scope of computer users. As a result, a number of new computer manufacturers, such as Apple, emerged and entered the market that used to be dominated by IBM. (Hirukawa & Ueda 2008, 1-3.)

Peneder (2007) conducted a study on the impact of venture capital on innovation and firm growth on Austrian companies. According to him, one can distinguish at least three different

transmission mechanisms by which venture capital may mitigate financial constraints and exert an influence on overall economic performance:

- The specific '*financing' function* applies because venture capital market enables the pursuit of business operations that would otherwise lack the necessary resources due to particularly high uncertainty and asymmetric information.
- The specific '*selection function'* involves the allocation of financial resources to projects with the best prospect of profitability.
- Finally, *value adding function* applies because venture equity involves not only the contribution of capital, but also of managerial experience, professional monitoring and advising.

The empirical findings of Peneder's (2007) research confirm that VC-backed firms are constrained in their ability to obtain financing through traditional channels. The majority of firms said they would no longer exist or have been able to finance their projects without venture capital. Venture capital is thus shown to provide financial resources to firms operating at the margins, as the specific *financing function* suggests.

In his research, Peneder (2007) illustrates venture capital's role in mitigating financial constraints caused by asymmetric information. Figures 2-4 emphasize the importance of the monitoring skills of venture capitalists.

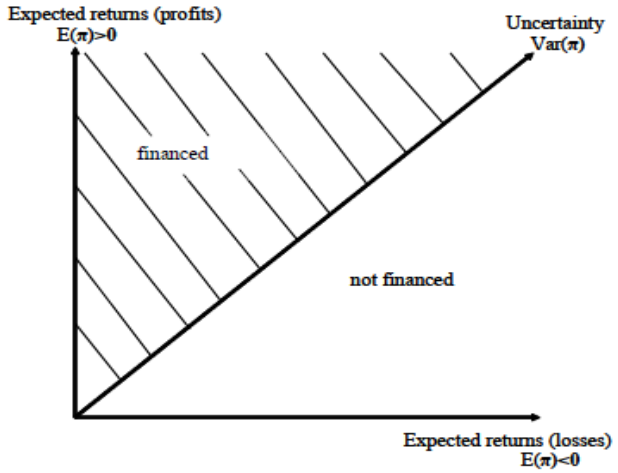

Figure 2 Perfect capital markets without asymmetric information (Peneder 2007, 33)

Figure 2 describes the expected profits and uncertainty of the project's success in the form of its variance. The vertical axis depicts financing projects with a positive value of expected profits, and the horizontal axis analogously depicts projects with expected losses. The area below and on the diagonal line shows all projects that are not in a position to receive financing because they have an expected profit value equal to or less than zero. In the ideal case of perfect markets without information problems, the amount of financially feasible projects for risk-neutral capital investors is exclusively determined through the expected profits, independent of the extent of uncertainty *Var(π).* It corresponds to the hatched surface above the diagonal line in Figure 2. (Peneder 2007, 6.)

In imperfect markets with asymmetric information, selection and monitoring is needed to mitigate problems of adverse selection and moral hazard, and thus additional costs *m* are generated. In figure 3, the boundary of financially feasible projects with a given *Var(π)* therefore moves upward and away from the diagonal by the distance *m*. In the figure we assume that the monitoring costs are negligibly small up to a critical level *Var(π) = k* and have no effect on the financing decision. (Peneder 2007, 7.)

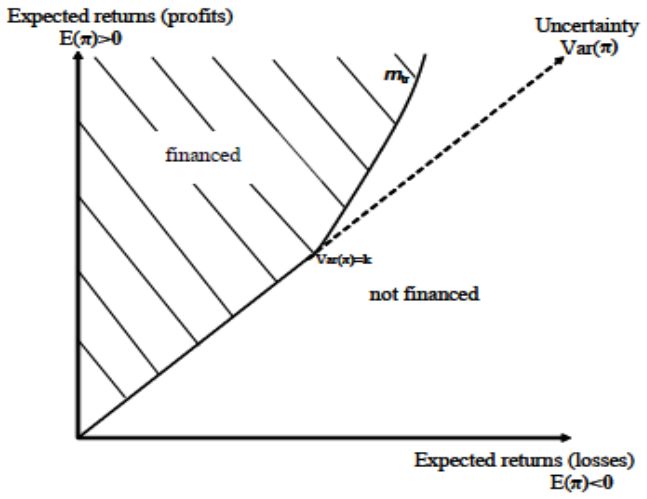

Figure 3 Imperfect capital markets with asymmetric information (Peneder 2007, 33)

Monitoring costs increase with the uncertainty of the project. In this situation a *financing gap* arises, as certain projects are no longer considered financially feasible due to increased monitoring, advising, and control costs. Here, venture capital funds take advantage of their role as specialized finance intermediaries. Due to specialization advantages, the marginal costs of overcoming problems of asymmetric information are lower for projects financed by venture capital (m_{VC}) than for those using traditional financing instruments (m_{tr}). As a result of their diligent project screening, monitoring and accompanying advisory services, they shift the boundary of financially feasible projects outward. Therefore, the supply of venture capital will *increase the number of feasible projects and thereby reduce the financing gap resulting from market failures.* This is illuminated in figure 4. (Peneder 2007, 7-8.)

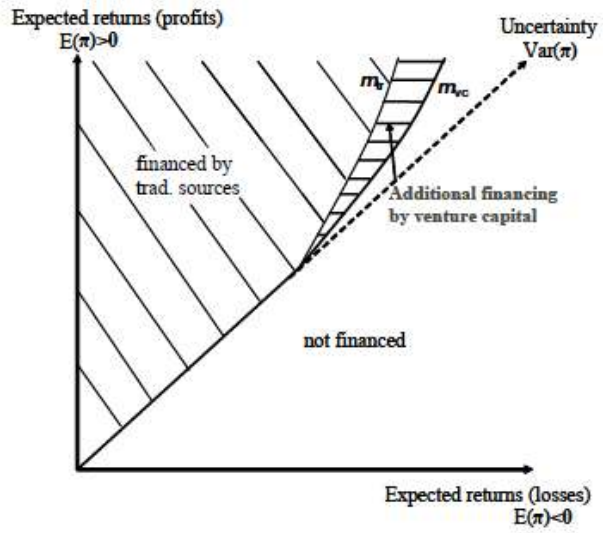

Figure 4 Imperfect capital markets with asymmetric information and venture capital (Peneder 2007, 33)

According to Peneder (2007), firms with venture capital financing seem to grow faster in terms of turnover and employment than other firms. However, the observed differences in innovation performance prove to be the result of pure *selection effects*. In other words, according to this research, venture capital makes firms grow faster but does not make them more innovative. Venture capital equity tends to finance firms with above average levels of innovation rather than making the firms more innovative. From the perspective of the economy at large, this evidence

of the *selection function* is telling us that venture capital succeeds in allocating resources to innovative firms, thereby fostering structural change and development. (Peneder 2007, 19.)

In their study, Kortum and Lerner (2000) found out that venture capital is associated with a substantial increase in patenting. However, this does not necessarily support the VC-first hypothesis. Venture capital may spur patenting while having no impact on innovation if venture-backed firms for example patent more to impress potential investors. (Kortum & Lerner 2000, 675.) In addition, patents are not always reliable measure of innovations. Not all inventions are patentable and industries differ significantly on the basis of their propensity to patent. For example, industries like pharmaceuticals and chemicals are known to use patents most frequently. In addition, the quality of patents varies widely and many patents include only minor improvements of little economic value. Patent data can be thus interpreted as a signal of innovative activity rather than a strict indicator of innovative products and processes.

Besides financial contribution, venture capital investors' assistance in management and marketing issues and their access to their network of business partners can thus be essential in enhancing firms' growth. In addition, venture capital backed firms generally appear to have a stronger orientation towards international markets, a more frequent introduction of new products, and a greater inclination to protect their innovations by intellectual property rights. (Peneder 2007, 14.) Engel and Keilbach (2007) argue that venture capital investors focus mainly on commercialization of existing innovations and growth of the firm, rather than in further innovation. They found evidence that venture-funded firms display significantly higher growth rates compared to their non-venture-funded counterparts. This evidence supports the *value-adding function*. (Engel & Keilbach 2007, 166.)

Overall, these findings underline that rather than helping firms' to create more innovations, venture capitalists seem to focus on *enhancing the commercialization of existing innovations*. Even if there was no clear evidence of VC-first hypothesis, venture capital can still contribute to the economy as a whole by promoting the development of high growth companies that create jobs and generate wealth.

3.3 VC's tools to mitigate financing constraints

Venture capital investors employ a variety of mechanisms which help them monitor the projects more efficiently and can be critical in alleviating financial constraints (Lerner 2010, 6). They *(1) screen investments before investing, (2) use convertible securities, (3) stage investments* and *(4) syndicate them.* I will describe each of these mechanisms shortly. I will focus on syndication more profoundly in the next chapter.

3.3.1 Screening Investments

A selection of those firms that promise high future profits is a very difficult task for venture capitalists. Venture capital investors, such as banks and other investors, use screening process when selecting investment opportunities. By intensively scrutinizing companies before providing capital, venture capital organizations can alleviate information gaps and reduce capital constraints. Venture capital investors can analyze different aspects of businesses when assessing investment opportunities (Bruno and Tyebjee 1984):

- Market attractiveness (size, growth, and access to customers)
- Product differentiation (uniqueness, patents, technical edge, profit margin)
- Managerial capabilities (skills in marketing, management, finance and the references of the entrepreneur)
- Resistance for different threats in the business environment (technology life cycle, barriers to competitive entry, insensitivity to business cycles and down-side risk protection)
- Cash-out potential (future opportunities to realize capital gains by merger, acquisition or public offering).

VC firms are typically specialized in a particular industry or in a relatively narrow set of industries as well as in investments in certain firms' stages or regions. Specialization and high competence in management make the evaluation of uncertain projects easier. In addition, a signal which certifies either the quality of the founder, such as a diploma or a business plan, or

the entrepreneur's ex-ante acceptance of penalties in case of bad firm's performance, can diminish the adverse selection problems in the VC market. (Tykvová 2000, 4-5.)

3.3.2 Using Convertible Securities

It would be tempting to assume that, because venture capitalists are known as equity investors, they simply purchase the common stock of the portfolio companies in which they decide to finance. However, because the venture capitalist and the entrepreneur rarely put considerable effort on the business without incentives unless they have intrinsic motives, it is usually necessary to design the proper incentives. This is why venture capitalists often use convertible securities.

Convertible securities hold both debt and equity-like features, and they are typically used in venture capital to mitigate the problems caused by asymmetric information. Convertible securities are like debt contracts at first, but if the project proves to be successful, they can be exercised and thus exchanged for company stock. In case the firm is shut down, the investors have a senior claim to the entrepreneur and other existing owners on any remaining assets. Therefore, risk can be shifted from the venture capitalist to the entrepreneur. On the other hand, preferred stock or subordinated debt is a junior claim to debt, so funding a company in this way also preserves its borrowing capacity, thus making it easier for the firm to arrange trade credit or bank loans. (Megginson 2001, 18.)

A properly designed convertible debt contract leads the entrepreneur to invest more effort than under mixed ownership because she expects a larger effort by the venture capitalist. Convertibles can distort the manager's incentive to take excessive risk, since the investor can use the conditional properties of convertibles optimally in different situations. Through acceptance of convertible securities, highly skilled entrepreneurs may demonstrate their capabilities and their self-confidence towards the venture capitalists. (Tykvová 2000, 6.)

Based on the observation that convertible preferred equity is most often used in the US, a number of theories explain why convertible preferred equity is the apparent 'optimal' form of

VC finance. However, although convertible securities are dominant in US, they are less used in other markets. For example, convertible securities are used three times less often by European VCs compared to their US colleagues. (Schwienbacher 2008, 196.) There exists less acknowledged literature in support of other securities in venture finance.

3.3.3 Staging Investments

Instead of providing all the necessary capital upfront, venture capitalists often invest in stages to be able to monitor the firm before making re-financing decisions. Such stages, for example, might be the pilot production, the first date the firm makes a profit, or the introduction of a second product. At each stage, the firm is given just enough cash to reach the next stage, and the venture capitalist preserves the option to abandon the project in case it does not turn out to be successful. The higher the risk in the project, the higher the value this exit option has to venture capitalists. (Wang & Zhou 2002, 1.)

Several theoretical papers show that stage financing may mitigate the moral hazard behavior of the entrepreneurs. Venture capitalists cannot usually predict if a project they are investing will be profitable in the long term. Entrepreneurs may be happy to continue investing someone else's money as long as there is any chance of success, although this chance would be almost inexistent. In an empirical paper, Gompers (1995) argues that staging is important for lowering agency costs. In addition, Bergemann and Hege (2003) suggest that stage financing increases entrepreneurial effort and mitigates financial constraints. They propose a contract in which the share of the entrepreneur on the project decreases over time. Under this arrangement, the entrepreneur gets an incentive not to postpone the successful realization of the project through fund diversion.

However, staging investments cannot be used as a standalone solution for information asymmetry since it is often followed up "window dressing"and hold-up problems. Window dressing occurs when the threat of the venture capitalist abandoning the venture induces the entrepreneur to put more effort into making the venture a success. He/she may then manipulate short-term performance signals upward to fool the venture capitalist into continuing to finance

the project. This can be harmful since boosting short-term earnings may reduce long-term earnings. Hold-up problem occurs because venture capitalist can use the threat of liquidation to dilute the entrepreneur's stake in the firm by negotiating better terms for himself in later-stage financing. This can affect entrepreneur's effort or willingness to participate and thus reduce overall value. (Fluck et al. 2004.)

3.4 Syndicating Investments

3.4.1 What is Syndication

Syndication is a prevalent feature of the venture capital industry. For example, according to the research of Deli and Santhanakrishnan (2009), 63% of investments made by venture capital partnerships in US firms between 1980 and 2005 were syndicated. VC syndication is often defined as two or more VC firms joining together to take an equity stake in an investment. Sometimes the term is used more broadly to refer to situations where different venture capitalists invest in a given project at different times.

Syndicates are typically formed by a lead investor who contacts potential investors. The management of a syndicated investment is typically the responsibility of a lead investor, who co-ordinates the syndicate and functions as an interface with the venture. Typically, the lead investor is more often involved in the board, is more frequently in interaction with the venture and monitors the venture more actively. (Wright & Lockett 2003.)

Syndication is not unique to venture capital. It is quite common in many financial market segments, such as loan provision, reinsurance, underwriting of securities. Hence, venture capital syndication is just one example of a general phenomenon in which one party to a project brings in partners. However, the motives for syndication might vary from case to case. Syndication of venture capital investments has been rationalized in several ways in previous theories. Manigart *et al.* (2006) have suggested that the motivations for syndicating fall under four headings: 1) finance-related motivations, such as risk reduction and diversification; 2) deal flow motivation,

denoting the function of syndication as a mechanism providing access to increased deal flows; 3) deal selection, as joint decision making enhances the accuracy of assessment regarding the potential of ventures, and 4) value-added motives referring to the complementary contributions of syndicate members to the post-investment development of ventures.

3.4.2 Selection Hypothesis vs. Value-Added Hypothesis

According to Lerner (1994), one rationale for syndication in venture capital investments is what we call the *"selection hypothesis".* According to this hypothesis, there might be an advantage to having more than one venture capitalist evaluate a project before it is selected for investment. Two - or more - independent venture capitalists might screen projects more effectively than one, because each can learn something from the others' evaluation.

However, the formation and management of syndication is complex and entails additional agency and transaction cost. The financier who syndicates his deal must share the profit with his partner. Moreover, the asymmetry of information causes moral hazard problems. When the effort of each investor is neither observable nor verifiable, they may shirk. Furthermore, investors may not syndicate the most profitable deals because they are afraid that their partner might steal the project idea and exploit it on his own account. (Tykvová 2005, 3.)

Therefore, it is perhaps ideal for the venture capitalists to invest alone in a company if there are credible signals about the quality of the venture and there are no capital constraints. Nevertheless, if a venture capitalist wasn't sure about whether a project was high or low quality, he would be more eager to syndicate to be able to find better quality projects. According to the selection hypothesis, standalone projects should perform better because when investing alone, investors want to be sure a project is good quality. (Lerner 1994.)

Lerner (1994) attributes the underlying idea for the selection hypothesis to Sah and Stiglitz (1986), who argue that groups can be superior to individuals in their capacity to gather, evaluate and process information. Although Sah and Stiglitz (1986) do not mention venture capital

finance in their model, and it is not obvious that their model would apply to venture capital, Lerner (1994) interprets this theory as suitable for venture capital investments.

Besides selection hypothesis, there is also *value-added hypothesis* that implies that syndicated projects perform better than standalone projects. According to value-added hypothesis, venture capitalists syndicate only if the expected benefits of syndication exceed the expected costs, sharing the returns with other venture capitalists. (Brander, Amit & Antweiler 2002, 3.) Syndicated venture capital investments can be more profitable because different venture capitalists have heterogeneous skills and information; some might be helpful in organizing production, others might have valuable networks and international contacts. In particular, if one financier has less expertise in a specific business area, he may benefit from the skills and competencies of his partners. Syndicated venture capital investors can often offer an improved managerial support, a higher reputation, and a larger variety of contacts for their portfolio firms than a single VC investor. Also, the fact that two or more VC firms are willing to co-invest in a single deal may communicate favorable private information to the capital markets. (Brander et al. 2002.)

In their research, Brander et al. (2002) test the selection hypothesis against the value-added hypothesis. Using Canadian data, they confirm empirically that syndicated projects offer higher returns than projects which are financed only by a single venture capitalist, which supports the value-added hypothesis. (Brander et al. 2002.) There are also other research papers declaring that ventures backed by a syndicate produce higher returns on investment and reach successful exits faster and with a higher probability than non-syndicated ventures (e.g. Tian 2011).

In their research, Das et al. (2010) find that ‘‘selection” and ‘‘value-added” hypotheses are complementary. The results of this research attribute improved multiples to the selection efforts of the syndicate, and more likely and timely exit to value-addition along with selection effort. Therefore, according to this research, the role of VC syndicates is multifaceted. However, like many other research papers, this paper studied U.S. VC industry. It is important to remember that studying different VC firms, industries or countries could lead to different results. In

addition, there is a possibility of reverse causality. Successful ventures grow large, thus requiring financing from larger syndicates.

3.4.3 Casamatta's and Haritchabalet's Model

Casamatta's and Haritchabalet's (2007) model - from now on referred as CH model - provide a rationale for the syndication of venture capital investments based on the trade-off between the need to gather accurate information on the quality of an investment opportunity and the need to maintain monopoly profits. According to the model, the relationship between syndication and expected returns depends on the level of experience of VCs. The important point is that syndicated investments can exhibit higher expected returns than standalone investments, but this depends crucially on the level of experience of VCs. This result is to be contrasted to the result of Brander et al. (2002) who stated that syndicated projects offer higher returns than projects which are financed only by a single venture capitalist.

The model starts from considering the situation faced by a risk-neutral, cash-poor entrepreneur who needs an initial expenditure I to start an innovative investment project. The project yields a verifiable risky outcome Ṙ. For simplicity, we assume that the project can either succeed or fail, hence Ṙ can take two values: Ṙ > 0 in case of success and 0 in case of failure. The probability of success depends on the quality of the project. If the project is good, the probability of success is p_h (thus 1 - p_h is the probability of failure of a good project), while if the project is bad, the probability of success is $p_l < p_h$. We assume that only good projects are profitable. With risk-neutral agents, and a riskless interest rate normalized to zero, this implies that:

$$p_h R > I > p_l R.$$

Since we are concerned with a new, innovative project, the true quality of the project is initially unknown. Hence, q_0 is denoted as the a priori probability that the quality of the project is good. This prior is common knowledge.

CH model assumes that unlike traditional, non-specialized investors, VCs have the ability to better identify the true quality of the projects they are proposed. This assumption reflects the fact that VCs concentrate their investments in specific lines of business and can use their expertise to infer the quality of new projects. Consequently, it is assumed that venture capitalists can complete an investment analysis, to obtain a signal related to the project true quality. For simplicity, it is assumed that generating this signal is costless. This signal can be either good ($s = H$) or bad ($s = L$) and is all the more precise that the venture capitalist's expertise is high. In other words, all venture capitalists have the ability to screen projects, but they have different levels of observable ability. Therefore, although specialized in the same line of business, some venture capitalists may be more experienced than others. Formally, the signal s_i received by a venture capitalist with expertise α_i has the following properties:

$prob(s_i = H = p_h) = \alpha_{i,}$
$prob(s_i = L = p_l) = \alpha_{i,,}$

where $\alpha_i \in [\frac{1}{2} ; 1]$. The probability of receiving a good signal conditional for good projects increases with the venture capitalist's expertise. After observing a signal, the venture capitalist updates his belief on the project's quality.

VCs can use their expertise to provide business advice once the project has been funded. It is assumed that VCs can exert a costly contractible effort that increases the probability of success of the project, if the true quality is good. To keep things simple, there are only two possible levels of effort. If the VC exerts effort (decision e), he incurs a private cost $c > 0$ and increases the probability of success of a good project by $\epsilon > 0$. The probability of success of a bad project remains unchanged. If the VC does not exert effort (decision $\bar{e}$), the probability of success remains unchanged. The assumption that effort affects only good projects is motivated by the fact that the returns to bad projects are typically very low, whatever the effort of the VCs.

Another important assumption is that only one agent - lead venture capitalist - needs to exert effort. This is in line with casual observation about the role of the lead venture capital investor

in a VC syndicate. For example, in their research, Wright and Lockett (2003) used survey data on the UK VC industry and found that lead VCs are more hands-on in monitoring, more likely to have frequent contacts with investees, and that they have more access to management-based information.

The net present value (NPV) of the project depends on the agents' beliefs, the project's quality, and the effort decision. Denote q_{si} the updated belief after a signal s_i of the lead venture capitalist is generated and $qs_i;s_j$ the updated belief after two signals s_i and s_j . For instance, after one signal, the NPV is written:

$$NPV\,(e, q_{si}) = -I - c + q_{si}(p_h + \epsilon)R + (1 - q_{si})\,p_l R; \qquad (1)$$

if the effort is exerted, and:

$$NPV\,(\not{e}, q_{si}) = -I + q_{si}(p_h)R + (1 - q_{si})\,p_l R, \qquad (2)$$

if the VC does not exert effort. Since very innovative projects that are potentially highly profitable, also have a highly uncertain quality, a priori NPV of the project is negative. Hence, the entrepreneur needs to rely on VC financing to implement his project.

The timing of the game is the following. The entrepreneur proposes an investment opportunity to a first VC (labelled VC_1), who generates a signal s_1. Then, VC_1 can:

- either reject the project,
- or stop collecting information and invest immediately,
- or call for a second evaluation performed by a second VC, labelled VC_2.

In the latter case, we assume that the signals are freely observed by the two VCs. If the project is implemented, VC_1 takes the effort decision. Despite this assumption, it is sometimes optimal to invest, but not to exert effort. It must be the case that for some α_i, $NPV\,(\not{e}; q_{s1}) > NPV\,(e; q_{s1}) > 0$. Intuitively, this is the case if the effort is not very efficient.

When the VC_1 calls for a second evaluation performed by VC_2, they have to negotiate a joint offer to share the project's NPV. According to the model, the bargaining between the two VCs leads to the Nash solution: when the VCs have the same bargaining power, they split evenly the surplus from negotiation. If negotiation fails, the two VCs engage in Bertrand competition and obtain zero profits. Their reservation utility in the bargaining process is thus equal to zero, and the surplus from negotiation is equal to the project's NPV. Each VC can thus obtain only a half of the project's NPV from negotiating. In conclusion, if VC_1 sticks to his own evaluation, he enjoys a monopoly position, and captures the whole project's NPV. If however he calls for a second evaluation, because of the threat of competition, he cannot capture more than half of the project's NPV.

We assume that VC_1 is able to capture all the project surplus, so that he maximizes the project's NPV. VC_1 asks for a second evaluation *only if it increases the project's expected NPV*, compared to the current NPV. The higher the profits venture capitalist can capture when being the sole investor, the more reluctant he is to syndicate. Syndication forces the two venture capitalists to share ownership of the firm, which weakens the incentives to exert effort. Asking for a second piece of information becomes costly for VC_1: disclosing the investment opportunity to the second VC destroys his monopoly position, and VC_1 must forgo part of the project's surplus. Also, VC_2 may propose a competing offer to the entrepreneur, if he is contacted by VC_1. According to the model, very experienced venture capitalists suffer from potential competition and are more reluctant to syndicate. Therefore they need to choose more experienced partners or to forgo syndication.

When VC_1 is more experienced, he invests if he obtains a good signal. A second piece of information can be useful to deter investment. In that case, the more experienced VC_1 is, the higher must be the experience of VC_2 to make him change his mind. The second piece of information can also be used to modify the effort decision. For instance, if VC_1 is moderately experienced and obtains a good signal, he prefers to invest and not to exert effort unless he receives a second good signal. The experience of VC_2 required to exert effort decreases then with VC_1's own experience. The above discussion is summarized in the next proposition.

Proposition 1 *The minimum level of experience of VC_2 increases (decreases) with VC_1's own experience when they disagree (agree) on the investment or effort decision.*

Next, I will show how the model illustrates the decision to syndicate. The trade-off faced by VC_1 is the following: He can either rely on his own evaluation and enjoy a monopoly position, or he can call for a second evaluation that yields more precise information on the project's true quality. As mentioned earlier, in that case, VC_1 gives up half of the monopoly profits to avoid competition. Formally, VC_1 chooses to syndicate if and only if:

$$\max\{0;NPV(e,q_{s1});NPV(\cancel{e};q_{s1})\} \leq E_{s2}\frac{1}{2}\max\{0;NPV(e,q_{s1,s2});NPV(\cancel{e};q_{s1,s2})\}.$$

Proposition 2 *If VC_1 is rather inexperienced (in the sense that $\alpha_1 \leq \alpha_I$) or if VC_1 has received a bad signal, syndication occurs whenever information gathering is optimal.*

Proposition 2 means that potential competition has no incidence on inexperienced or pessimistic VCs. Because inexperienced VCs are not able to screen efficiently the projects under evaluation, their monopoly profits are equal to zero, and they have nothing to lose when contacting a second evaluator. Since syndication is costless, it takes place each time the second piece of information is valuable, and the project is profitable. The same is true if VC_1 receives a bad signal: it is not profitable to invest alone, and VC_1 contacts VC_2 anytime his information is valuable. Therefore, both the realization of the signal and the experience of the venture capitalist determine the extent to which he is hurt by potential competition.

A central prediction of CH model is that the level of experience of venture capitalists should be a major determinant of their decision to syndicate. Because syndication incurs costs for experienced investors, it would not be profitable for them to syndicate their investments with less experienced investors. However, this model can also be criticized. For example, according to Tykvová (2005), sometimes it may be useful for experienced investors to syndicate with unskilled investors, who cannot push project returns the same way experienced investors can.

Young financiers may gather valuable know-how for future deals when they invest in a project together with skilled partners. Due to the know-how transfer between partners and reputation building, inexperienced investors can accept comparably worse conditions with respect to their payoff. (Tykvová 2005, 3.)

According to CH model, highly experienced VCs can perform standalone investments better than inexperienced venture capitalists. More experienced VCs are able to screen more efficiently projects, and circumvent more accurately the project risk. In this case, there is less need for syndication. However, Casamatta et al. also state that the venture capitalists' ability to generate precise signals on the projects' quality (α in the model) depends on the general level of uncertainty of those projects. The ability to screen projects should be lower in younger and more innovative firms (Casamatta & Haritchabalet 2007). As a consequence, one should observe more syndication for young, risky, uncertain and innovative industries, such as clean energy industry, which I will discuss more in chapter 5. Before that, I will find out how venture capitalists have performed in the clean energy sector and what challenges there are in this sector from the investor’s perspective.

4 VENTURE CAPITAL INVESTMENTS IN CLEAN ENERGY

The myth is that venture capitalists invest in good people and good ideas. The reality is that they invest in good industries.

Bob Zider (1998)

Venture investing tends to focus on highly innovative industries. Venture capital has played a central role for example in the biotechnology, computer services, and semiconductor industries. In recent years, venture groups' activity has been expanding rapidly in the environmental field. The concern of climate change, concentration of oil reserves in a few countries of the Middle East, and strong demand coming from emerging countries like China are providing a fertile ground for clean technology innovations. It is thus no wonder that cleantech has become one of the most important VC investment sectors. In this chapter, I will examine clean technology sector more profoundly. I will focus on technologies aimed at transforming the carbon base of the *energy* sector. Market trends indicate a continual pull away from unsustainable sources of energy like petroleum and natural gas, so there is a good chance for venture capitalists to gain profits in this sector.

4.1 Cleantech and Clean Energy Investments Globally

According to Bloomberg New Energy Finance report, global financial investment in clean energy rebounds to signal recovery from recession. Venture capital and private equity investment had a strong year in 2010, and they were up 28% from 2009. This was driven by venture capital investors, who showed confidence in 2010 by committing $4.6 billion, which is the highest level since 2004. The US was again the primary source of venture capital across all regions, being responsible for some 90% of this type of investment. Regarding clean energy types, energy smart technologies, solar and bioenergy accounted for 90% of total venture capital investment. (Bloomberg New Energy Finance 2011.)

As can be seen in the graph below, cleantech investments seem to be increasing again. This graph includes also other clean technology investments, not just clean energy investments, but it illustrates well the development of the industry.

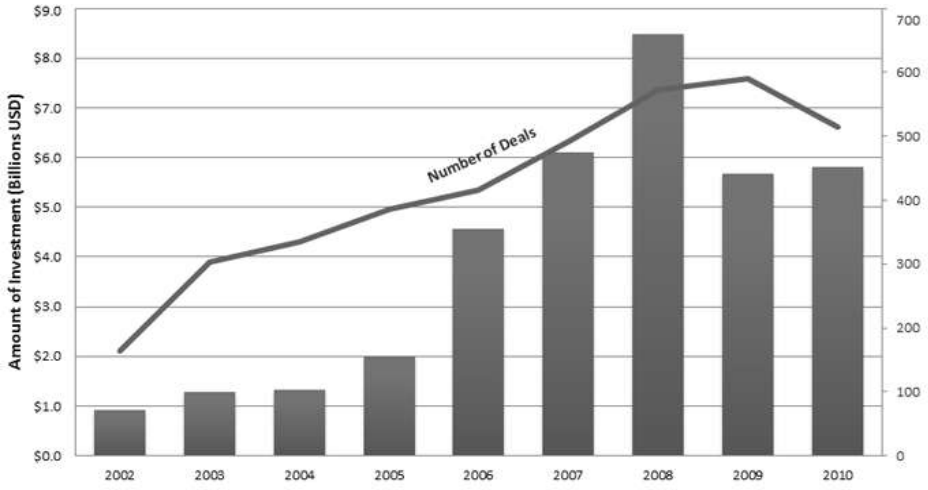

Figure 5 Global Cleantech Venture Capital Investment (Cleantech Group 2011b) [1]

In 2010, North America accounted for 68 percent of the total cleantech investments, while Europe and Israel accounted for 21 percent and Asia for 10 percent. During the second half of the year there was a noticeable increase in the share of investment taken by the Asia region. For example, China has emerged as a leading player in the global clean energy sector because of its strong wind, biomass and solar sector. Having built a strong manufacturing base and export markets, China is working now to meet domestic demand by installing substantial new clean energy-generating capacity to meet ambitious renewable energy targets. (Cleantech Group 2011b.)

Given that the total market for venture capital in the US is significantly larger in the EU, it is perhaps not surprising that the total cleantech venture capital market is bigger in North America than in the Europe. However, according to a comparison of different sources conducted by Cleantech Group, a larger share of venture capital in Europe is going to cleantech than is the

[1] This graph does not include venture investment in 4Q10. However, including the last quarter of 2010, cleantech venture investment was up by 28 percent compared to 2009 ($6.1 billion), making 2010 the second highest year for investment after 2008 ($8.8 billion).

case in North America. The large share of venture capital going into cleantech in Europe illustrates the strong position Europe has within the cleantech sector. (Cleantech Group 2011b.)

Given its rich tradition in both innovation and sustainability, Europe has potential to become a leader continent in clean energy technologies. However, it seems that venture capital financing is still more efficient in US, also in clean technology industry. According to several research papers, United States appears to have a markedly better developed market for VC, with Europe still significantly lagging behind (e.g. Hege et al. 2009). Although the recent years have witnessed significant convergence in funding levels, investment patterns and realized returns, Europe may still need a substantial increase in the amount of venture funds available to be able to better deliver green economic growth.

Venture capital investors in clean technologies in Europe and the US achieved excellent returns on their investments up to 2008. These exceptional returns were driven by the outstanding success of a small number of early investments in the solar sector. However, the clean energy sector, like all other areas, was affected by the financial crisis. Venture capital performance and venture exits dropped sharply in the second quarter of 2008. However, the level of activity is still high from a historical perspective, and the future of clean energy investing seems fairly bright. (Lerner 2010.) For example, according to VC survey made by Deloitte and NVCA (2010), venture capitalists believe cleantech sector is a growing industry that is worth investing in the future. 80% of the respondents were going to increase their investments in cleantech in the next five years. This is illustrated in the graph below.

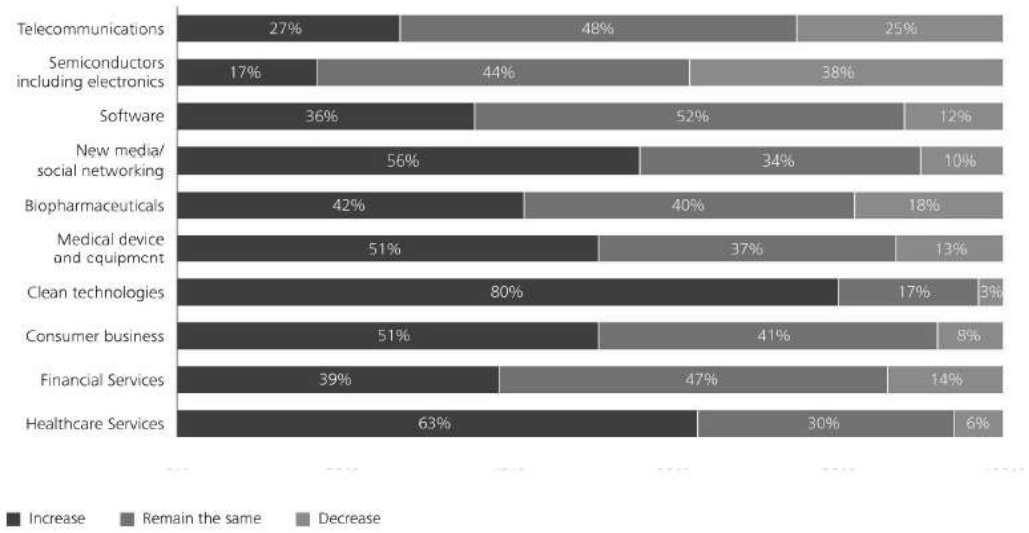

Figure 6 VC Survey: Investment by sector in the next five years (Deloitte 2010) [2]

4.2 Clean Energy Investments in Finland

According to the Finnish Cleantech Venture Report 2011, private investment activity in Finland has showed high growth. With a high share of renewables in energy production, long traditions in energy efficiency industry and strong government support for R&D, Finland is an ideal place for new clean energy innovations. In addition, Finland has one of the most stringent environmental laws in the world, which has given clean energy companies the motivation to innovate in order to meet the regulations most efficiently. Finland has committed to EU target to increase the use of renewable energy to 38% by 2020 which is among the highest in the EU. (Cleantech Finland 2011.)

The largest venture investment in the history of Nordic cleantech took place in Finland in 2008. A 120 million euro investment in WinWind was made by Masdar Cleantech Fund from Abu Dhabi. As to the technology areas that have rendered most investor interest in Finland from the

[2] 516 responses from nine countries: 47% from U.S. and 53% foreign countries. Survey conducted in the U.S., Canada, U.K., China, France, Germany, India, Brazil and Israel. Responses from large, mid-sized and small venture capital firms.

investor point of view, three stand out: energy efficiency, energy storage and advanced materials. (Nordic Cleantech Open 2011, 7.)

One of the significant features of the investment climate in Finland is strong collaboration between venture capital and public financiers. The need for more efficient cooperation of public and private operators is seen as a key factor in the creation of energy sector growth companies, the energy industry development, and economic development of Finland. Organisations such as Sitra, Tekes, Finnish Industry Investment and Veraventure are mandated to invest public funds as equity into companies from pre-seed to expansion. They have been involved in at least 50% of the venture capital private equity deals in Finnish cleantech companies over the last 4 years. Public venture capital agencies have an important role in sharing risks and supporting private venture capital investors in financing risky startup companies. (Nordic Cleantech Open 2011, 5.)

To boost the development of Finnish cleantech startups, a lot of new activities and funding instruments have been launcher recently, many of them administered by Tekes, the Finnish Funding Agency for Technology and Innovation. For example, Tekes has a new kind of cooperation between cooperation with private venture capitalists called VIGO, which is managed by the Finnish Ministry of Employment and the Economy. In the cleantech area Tekes' partner in VIGO funding is Cleantech Invest which was announced in 2010. The fund utilizes a set-up that enables grant funding from TEKES to the invested companies, and it will be used to invest in seed stage Finnish cleantech companies. (Nordic Cleantech Open 2011, 7.) For this thesis, I interviewed Tarja Teppo from Cleantech Invest to get a more profound picture of investing in the clean energy sector. Her views of investing in clean energy sector will be discussed in the next chapter.

Other major Finnish private clean energy venture capital companies are for example VNT Management and Ahlström Capital. The focus of the VNT Management's investments is on renewable and distributed energy generation and energy-saving technologies, especially in electrical and power electronics applications. Ahlström Capital focuses on early and growth stage cleantech companies across Scandinavia and the rest of Europe. (Nordic Cleantech Open 2011, 6.)

4.3 Financial Constraints in Clean Energy Sector

There are several risks and asymmetric information in clean energy investments, which may drive away investors. Hence, many clean energy companies find it difficult to obtain enough capital for the commercialization of their business. According to a survey of executives active in the cleantech sector by law firm Taylor Wessing, there is a growing early-stage funding gap for European companies, particularly in the biofuels, marine and green transportation sectors. Technology-mature and capital efficient sub-sectors such as solar, onshore wind and energy efficiency are attracting the majority of equity and debt while less advanced subsectors are finding it harder to obtain financing. (AltAssets 2010.)

According to the Grant Thornton International Business Report (IBR 2010), financial constraints are the most pressing concerns for businesses in the cleantech sector; more than one third cite a shortage of long-term finance, a shortage of working capital and the cost of finance as major constraints on expansion. These results show that cleantech companies face financial constraints more than all sectors average. (Grant Thornton 2010.)

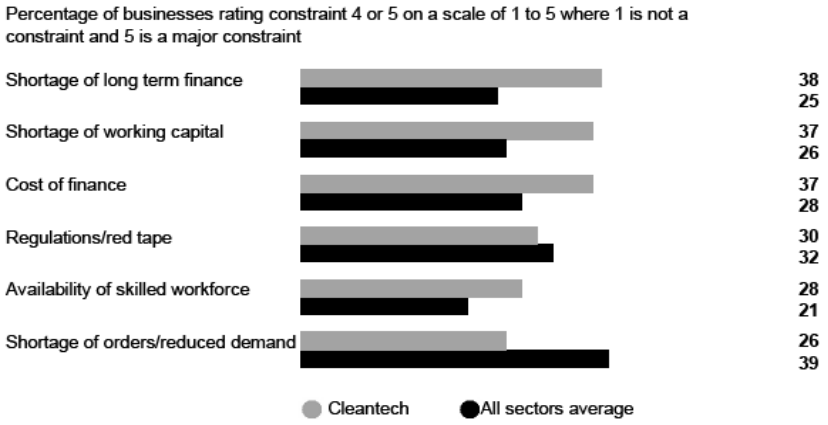

Figure 7 Constraints on expansion (Grant Thornton 2010) [3]

[3] IBR is a quarterly survey of the views of senior executives in privately held businesses (PHBs) all over the world. Launched in 1992 in nine European countries the report now surveys over 11,000 PHBs in 39 economies providing insights on the economic and commercial issues affecting a sector often described as the 'engine' of the world's economy.

What is also interesting, a shortage of orders/reduced demand is cited as the biggest constraint by businesses in all sectors (39 per cent) but by just 26 per cent of businesses in the cleantech sector. This result illustrates the increasing demand of cleantech and clean energy innovations. Although this survey included also other cleantech sectors than clean energy, such as green building construction services, these results can be used as a motive for finding out how financial constraints could be mitigated in the clean energy sector. More specific distribution of the participating countries and cleantech areas of all the respondents are shown in appendix I and II.

When interviewing Tarja Teppo from Cleantech Invest, she emphasized that many investors don't invest in risky early stage companies because it requires a lot of work to provide managerial and marketing support, recruit new skills, build networks and develop a strategy that could bring enough high commercial benefits. Therefore, clean energy companies are often saying they have no money while investors with money are saying there are not enough good projects. (Teppo 2011.) There are many small companies that have great engineering knowledge and excellent technology. However, the problem is that there should be more highly skilled entrepreneurs with business knowledge and viable business plans. In other words, energy entrepreneurs need private financing to turn their new technology into marketable products, but private financiers often want marketable products and a well-rounded business plan before they risk any funds.

The figure in the next page summarises why clean energy companies are often not so attractive investment targets. Clean energy startup companies should often have more business skills, stronger customer focus and a comprehensive business plan to be able to attract investors. Hence, it is not just about increasing venture capital syndication to be able to invest more in risky early stage phases. Entrepreneurs also need to put some effort to mitigate the financial constraints they face.

	Start-up Clean Energy Companies Frequently Have	Investors Want
People	Strong technical expertise; a desire to retain ownership and control	Well-rounded and experienced management team; including start-up experience
Product	Protected intellectual property position; technical benefits well defined; often still focused on technology and not on developing a marketable product	Protected intellectual property position; a clearly defined product or set of products; market drive and clear customer benefits well articulated
Strategy	Narrow technology focus with limited profitability horizon	Strong market focus with sustained high profitability and technology platforms, which allow for product and market diversification
Markets	Technology push; often oriented to attracting more sponsored R&D; competitive position not well defined	Market creation and technology pull; many identified customers (min. $100M/yr. Potential market opportunity) and poised for rapid growth; competition well understood
Financing	Inadequate justification and definition on amount of investment required or expected, return on investment (ROI) and exit strategy	Clearly defined plan for use of funds to grow business providing high ROI (40%) and a clear exit strategy (~5 yrs) described
Business Plan	Incomplete or nonexistent	A comprehensive and integrated picture of all of the above – to bring the technology to market

Table 1 Enterprise Development Gaps as Seen in Many Entrepreneurial Clean Energy Companies (Murphy et al. 2002)

4.4Sector-Specific Risks in Clean Energy Investing

4.4.1 Systematic and Unsystematic Risk

There are many different approaches to defining risk. In the finance literature, risk is usually defined as deviation from an expected result. Risks that investors face can be divided by two categories, *systematic and unsystematic risk.* While unsystematic risk means company-specific or industry-specific risk that can be mitigated through diversification, systematic risk or market risk is essentially dependent on macroeconomic factors such as inflation, interest rates and dynamics of the market. Thus, market risk cannot be mitigated through diversification. Venture capital investments in clean energy have significant *systematic risk*, which means that the returns to start-up investments are highly dependent on the state of the economy. This systematic risk arises from the fact that their expenditures are comprised of R&D, product development, and market research. Startups have often significant fixed costs, which makes their success contingent on the state of the economy. (Cumming 2004, 8.)

For venture capital investing specifically, Ruhnka and Young (1991) compiled a list of 37 different risks that occur on different stages of VC investing. For reasons of practicability, Wüstenhagen & Teppo summarize the risks clean energy investments face in five categories: market adoption risk, exit risk, technology risk, people risk, and regulatory risk. (Wüstenhagen & Teppo 2004.) These risks will be discussed next.

4.4.2 Market Adoption Risk

The success of VC investments ultimately depends on customers' decisions to prefer the entrepreneurial firm's products over existing products. Market adoption risk refers to the fact that demand for a new product is usually unknown in advance. An additional source of market adoption risk appears in business-to-business markets, where a small number of potential buyers can decide about the adoption of a new technology and act as gatekeepers for the venture to reach the final customer. (Wüstenhagen & Teppo 2004, 10.)

Sustainable energy technologies often generate the same *private benefit* for the end user as older, incumbent technology. In terms of the private added value, they compete directly with conventional energy sources. Whether a solar cell will be bought by a residential customer to displace the fixed line electricity in his house is less obvious, since he cannot tell the difference in the final product that comes out of the wall socket. In contradiction, for example a mobile phone is likely to be preferred by customers over fixed line telephony because it provides him with completely new, private benefits. (Wüstenhagen & Teppo 2004, 11.)

However, clean energy innovations create also *societal value*, which means that clean energy innovation delivers a positive externality, for example, a reduction of emissions. (Wüstenhagen & Teppo 2004, 6.) As these additional positive externalities from clean energy innovations are not included in the rewards for innovators, the level of investment in these innovations is judged to be even further below the social-optimal level than the level of innovation activity generally. With sustainability innovation being characterized by a strong societal value, rather than private value, regulation is a strong factor influencing demand.

Furthermore, unlike biotechnology or information communication technologies, renewable energy technologies are highly dependent on physical conditions to generate electricity. Once a particular drug is developed or mobile phone application conceived, those products can be sold globally. However, for example a solar technology which works in Texas does not necessarily work in United Kingdom. It can be said that the supply of alternative energy technologies is a *niche product* that must be sold into local markets by people who understand the local environmental conditions. Regional niches are emerging for specific technologies, such as wind technologies in Denmark. (Knight 2010.)

4.4.3 Technology Risk

Another form of risk associated with VC investments results from the fact that it is usually unknown in advance whether or not a new technology will ultimately work. Clean energy projects often involve high levels of technical complexity that can be hard to communicate with the outside investors. Quite often the technologies need further development and the market infrastructure has to mature before the companies can roll out their solutions. This creates extra uncertainty for the investors. Many venture capital investors are unwilling to take technology risk and consider these companies too early stage for private capital.

Technology risk is particularly important when it comes to technologies that are capital intensive to develop and have long lead times. According to a survey of executives active in the cleantech sector by law firm Taylor Wessing, projects that depend on technologies mature enough to generate stable cash flows, such as solar and onshore wind, will continue to attract debt and equity. However, developing projects or assets in the biofuels, marine and green transportation sub-sectors that rely on technologies under development are expected to prove much harder to finance. (AltAssets 2010.)

4.4.4 People Risk

The success of VC investments depends on the ability of entrepreneurs and venture managers to grow the company. Since most young innovative firms are owner-managed, the poor managerial

background of the founder could typically be an obstacle to a successful start-up or the expansion of a young innovative firm. High-growth companies constantly change, and that means constant changes in the challenges that their management faces. Many entrepreneurs have high technical and engineering skills but they may lack business skills. They may also pursue private benefits which decreases the profitability of venture capitalists' investment. As mentioned earlier, venture capital has lots of mechanisms, such as syndicating investments, that can help mitigating risks caused by asymmetric information.

4.4.5 Regulatory Risk and the Role of Government in Mitigating This Risk

The main source of regulatory risk is government regulation of the end market that the venture aims to serve. Many sectors are regulated by government in one form or another, but the energy sector is often portrayed as particularly strictly regulated. Regulatory risk in the energy sector takes different forms, including subsidies to incumbent forms of power generation based on coal and nuclear energy, traditional government ownership of many electric utilities and inconsistent policies. (Wüstenhagen & Teppo 2004, 15.)

According to Finnish energy sectors investors, the biggest challenges in business development relate to the predictability and pro-activeness of public policies fostering desired growth. (Hokkanen 2009, 5.) In addition, according to a survey of executives active in the cleantech sector by law firm Taylor Wessing, the most important driver for future investment is the removal of uncertainties related to national regulatory frameworks. (AltAssets 2010.)

Furthermore, according to the report made by Bloomerg New Energy Finance (2011), feed-in tariff cuts and subsidy revisions in all the world's major clean energy markets decreased the demand for clean energy. Feed-in tariffs are supply-side or "technology push" measures that require direct fiscal support by the government. (Knight 2010.) They have turned out to be very effective in fostering clean energy innovations. Wind and solar companies were affected the most by policy uncertainty and the austerity measures, such as feed-in tariff cuts, adopted by governments throughout Europe. (Bloomberg New Energy Finance 2011.)

Government support for renewable energy in particular can be seen not only as a risk, but also as an opportunity. The government does have the power to indirectly curb the effects of the recession on the clean technology venture capital market by implementing policies that make investments in the sector more attractive. As mentioned earlier, one particularity of technologies and services in the sustainable energy sector is that they create both private and societal added value. Venture capitalists, unlike governments, look for investments that create private rather than societal value. (Wüstenhagen & Teppo 2004, 6.) Thus, public support is often needed in clean energy investments. Given that clean energy technologies have not yet achieved the point at which alternative means of generating electricity is equal in cost or cheaper than grid power, government policy is critical in determining the prices of inputs and finished products.

There is a good rationale for policymakers to care about new ventures and venture capitalists – innovation is critical to growth, and new ventures can stimulate innovation. Ghosh and Nanda (2010) highlight the role of active involvement of government in enhancing and speeding up clean energy innovations. They note three areas where the government can make a significant contribution. The first area is through stable, predictable and long-term policy measures aimed at *stimulating demand* for clean energy. Removing uncertainty around policies reduces policy risk dramatically and makes it easier for the private capital markets to plan their investments accordingly. Furthermore, the government can *stimulate M&A activity through policies such as Feed-in-Tariffs (FITs).* Finally, the government can create *public-private partnership funds* that can help either with first commercial testing or as mechanisms that effectively compete with the incumbents. Creating this competition can help stimulate M&A activity in the sector and hence drive the innovation pipeline (Ghosh & Nanda 2010, 18-19).

Much of the concern stems from questions about whether the government is capable of selecting investments that will lead to the most profitable returns. Critics of governmental VC investment have argued that bureaucratic funding decisions may result in the subsidization of unviable enterprises. Lerner (2010) states that the greatest assistance to venture capital may be provided by government programs that seek to enhance the *demand* for these funds, rather than the supply of capital. For example, standards or regulations can change the demand for clean tech products. Similarly, efforts to make entrepreneurship more attractive through tax policy may have a

substantial impact on the amount of venture capital provided and the returns that these investments may yield. (Lerner 2010.) However, the problems of promoting entrepreneurship are complex and it is often unclear how proposed changes will interact with each other. Therefore, there are no easy answers or "instruction manual" that explains which changes will have the desired effects.

In conclusion, the success of venture investment in the clean energy sector depends heavily upon the kind of environment that governments develop for such investing. It is important to remember that an entire ecosystem of supporting technology and service providers will be fundamental to the growth of a healthy clean energy sector. Longer-term innovation by venture-backed startups will also depend critically on the ability of the innovation ecosystem to adapt to the different structural characteristics of the clean energy sector. According to Lerner (2010), *"The tight ecosystem of technical and business skills, public sector support, expertise, and connections are essential factors enhancing clean technology innovations. They increase the confidence of investors to put money behind ideas as well as the ability of entrepreneurs to sell their ideas into the marketplace."*

4.4.6 Exit Risk

One of the most important bottlenecks threatening innovations in energy production is the inability of VCs to exit their investments before they hit the valley of death. Industries such as biotechnology and communications networking faced a similar problem when they first emerged, but the problem was ultimately overcome by changes in the innovation ecosystem. (Ghosh & Nanda 2010, 19-20.) According to Ghosh and Nanda (2010), the clean energy industry today is where biotechnology used to be. The biotechnology industry took over 10-15 years to reach a point of institutionalization where pharmaceutical firms and VC backed startups each play their role in the innovation eco-system.

Incumbents in the oil and power sector face little end-user pressure to adopt new technologies, since the end-user in the energy market cannot distinguish electrons produced from coal, the sun or the wind - unless the government prices the cost of carbon appropriately. Incumbents in the

energy sector thus do not tend to feel as threatened by potential competition from these clean energy startups, given the market structure and regulatory environment in the sector. Incumbents are therefore not pressed to acquire startups in order to meet end-user demand. (Ghosh & Nanda 2010, 15-16.) With incumbent firms unwilling to buy these startups at pre-commercial stages, the time to exit for the typical clean energy startup can be much longer than the three to five year horizon that VCs typically target.

In addition, the time to build power plants and factories is inherently longer than a software sales cycle and can even take longer than the life of a VC fund. This can lead venture capitalists to withdraw from sectors where they are not certain that they will be able to either fund the project through the first commercial plant, or they are not sure if they can exit their investment at that stage. (Ghosh & Nanda 2010, 14.)

However, as clean energy market develops, and investors and incumbent companies understand the value of clean energy innovations, more successful venture capital investments are expected. Successful exits have already increased in clean energy sector. Cleantech M&A transactions from 2000 to 2009 have generated USD 57.5 billion of financing in 613 deals. According to Cleantech Group (2011b), the number of announced Cleantech M&A deals was the highest ever in 2009, which is an early indication for the recovery of this market. As can be seen from the graph below, global cleantech M&A transactions have grown annually by 23% over the past five years. Cleantech M&A volumes still represent less than 1.5% of global M&A volume. (Cleantech Group 2011b.)

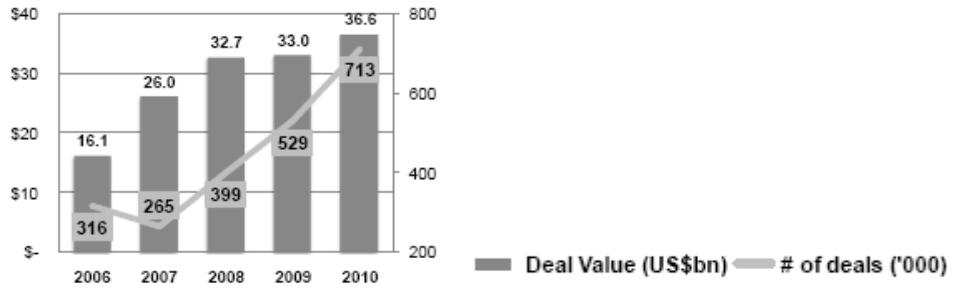

Figure 8 Global cleantech M&A activity (Cleantech Group 2011b)

In addition, the Cleantech IPO market has grown from 2000 to 2009 to a total of USD 35.3 billion in 274 deals. The majority of IPOs have been in energy generation. In the past two years, the IPO market was not a viable exit route due to the negative sentiment in the public market and lack of liquidity. However, as the economic environment begins to recover, the general IPO market is expected to grow. (SAM 2010, 26.)

5 SYNDICATION AS A TOOL TO MITIGATE FINANCIAL CONSTRAINTS IN CLEAN ENERGY SECTOR

As investments in clean energy often include remarkable risk and are often capital intensive, syndication could provide a solution for financial constraints that clean energy startups face. In this chapter, I will find out if increasing syndication could help alleviate financial constraints in following three phases of the venture capital investment process: the selection, the investment, and the exit. Since most of the research papers study the venture capital industry in general, all of the results cannot necessarily be applied to clean energy industry. However, these results should give some rationale for syndicating investments in clean energy sector.

Since venture capital is an American invention, and the United States is home to the largest venture capital industry by far, I will compare syndication practices in US and Europe and assess if European VC companies syndicate less efficiently than their US counterparts. I will examine if more efficient syndication of investments could mitigate financial constraints of clean energy startups in Europe. Finally, I will discuss about the benefits of cross-border syndication and syndication with corporate investors.

5.1 Motives for Syndicating Clean Energy Investments

5.1.1 Mitigating Capital Constraints of Clean Energy Investments

Clean energy investments can be categorized into two streams: *capital-intensive projects*, such as marine energy turbines, biofuels, geothermal and solar; and *efficiency technologies*, such as smart grid technology and software products focused on the home. (Fletcher 2010.) Energy efficiency investments are often more capital efficient and easier to exit and thus attract more venture capitalists. Especially more capital intensive projects can often find it difficult to get enough funding.

Furthermore, European VCs do not enjoy a large home base of institutional investors that fit the profile of long term partners for venture capital. Europe's large institutional investors, such as pension funds, asset managers, banks and insurers, often consider venture capital too small to justify allocating investment expertise or resources to this asset class. However, this is not only Europe's problem. The global venture capital performance has suffered in recent years, which has lead to lack of appetite from institutional investors across the globe, not just in Europe. (EVCA 2010.) Therefore, more active institutional investors with ability and willingness to take risks are needed. In addition, syndicating investments would allow a capital-constrained VC fund to invest in more projects, and could thus help mitigate financial constraints that early stage clean energy companies often face.

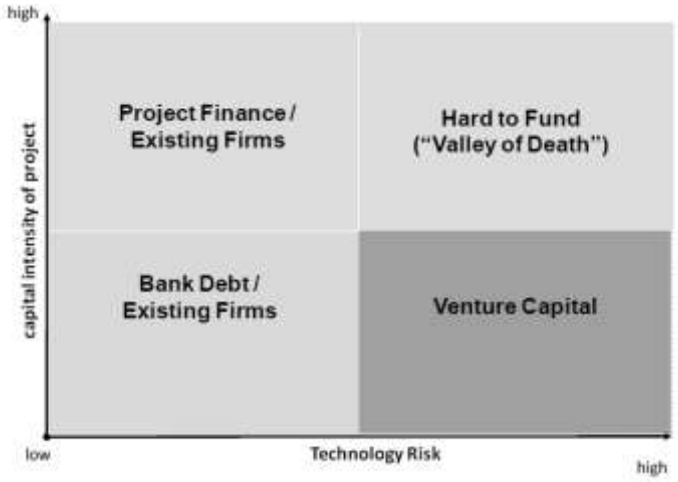

Figure 9 Venture Capital Investing Framework (Ghosh & Nanda 2010, 8)

As can be seen in the figure in the figure above, the "ideal" spot for venture capital investment is in the lower right hand box that is typified by high technology risk, but low capital intensity. VCs have often preferred investing in technologically risky projects with relatively low levels of capital investment. The fact that they need to make many investments to realize a few successes implies they typically invest under $10-15 million in equity per startup. Sectors such as IT and software that have relatively low levels of capital investment are ideal sectors for VCs. In those sectors, a syndicate of two to three investors can completely fund a startup through to IPO. These sectors also have shorter sales cycles that generate commercial viability quickly. A classic example is that of Google, that had an IPO 5 years after it received its first round of VC funding

and having raised about $40 million in venture capital. (Ghosh & Nanda 2010, 7.) While venture-funded web companies can create a marketable prototype in a matter of months, clean-tech companies can take years to develop products, such as solar panels and biofuels.

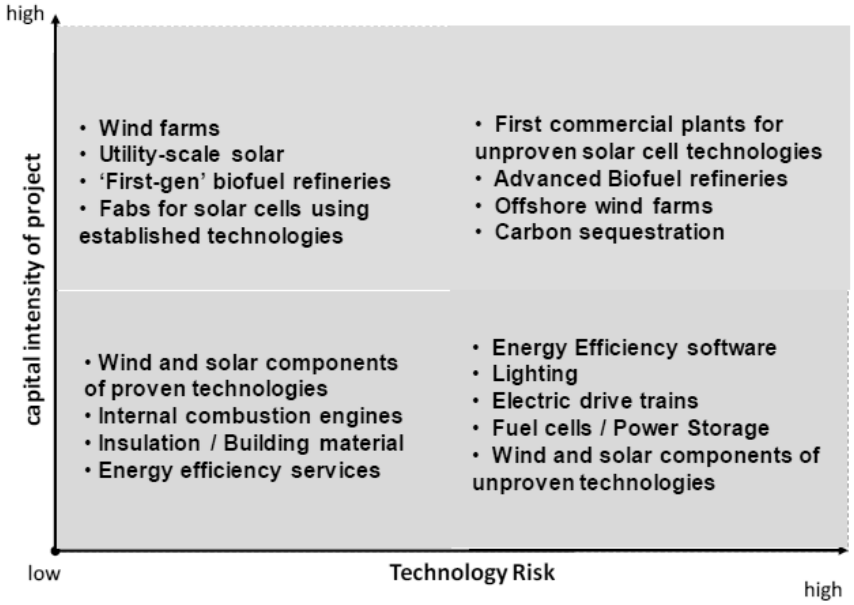

Figure 10 Sub Sectors within Clean Energy (Ghosh & Nanda 2010, 9)

This figure describes the clean energy investment landscape, mapped on to the venture capital framework outlined in the figure 9. The top left hand box includes the manufacture and deployment of more mature energy production technologies. The technology risk for these is minimal after the equipment has been commercially proven at scale, but these investments can be extremely expensive to finance. Debt investors are often willing to invest large sums of money once technologies have been tried and tested over a period of a few years. Over 50% of the new investment in clean technologies globally between 2007 and 2009 was from project finance of mature technologies such as wind turbines, solar panels, and first generation biofuel refineries. (Ghosh & Nanda 2010, 9.)

The bottom left hand box describes less capital intensive and less risky businesses, or the manufacture of components for existing technologies that are used for energy production. Several of these relate to incremental innovations being undertaken within existing companies.

These businesses do not face technology risk, and can easily raise bank debt to fund their operations. (Ghosh & Nanda 2010, 10.)

On the other hand, the technologies in the two right hand boxes typically are too technologically risky to attract debt finance. Even if the technology worked in the lab, it does not guarantee if it will work at scale. (Ghosh & Nanda 2010, 11.) Also, the large capital requirements of clean tech deals pose a unique financing challenge. If both the capital intensity and technology risks are high, new ventures may not succeed to obtain finance. Venture capitalists may be willing to take technology risk but do not have the funds under management to contribute equity for such a large deal.

This tension, described as the capital intensity problem, is a unique feature of the financing of clean technology innovations. There exists a significant financing gap for early commercial clean energy projects. Funding gap occurs when expensive new energy infrastructure is too capital intensive for the high-risk venture capital, but too risky for traditional debt providers, such as banks. (Jamison 2010, 5.) This is illustrated in the figure below.

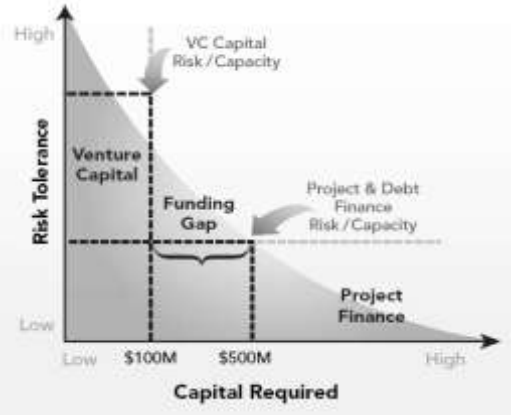

Figure 11 Capital Availability and Risk Tolerance (Jamison 2010)

According to Ghosh and Nanda (2010, 10) VCs are increasingly changing their focus towards only backing startups where the capital requirements are not so high. For example, the share of energy efficiency deals done by VCs rose from 24% in 2008 to 32% in 2009 while energy production investments fell from 30% to 18%, and investments in alternative fuels fell from 13% to 8%. (Ghosh & Nanda 2010 10.) However, the capital-intensive sub sector presents

opportunities for value realization. As the clean energy market matures a little, many investors can take a second look at some of the technologies that they previously considered too capital intensive.

According to Ghosh and Nanda (2010), enhancing startup innovations in energy production will require significantly *larger* funds than is typical for venture capital investors. The majority of venture capital investors in clean technology do not have dedicated funds for this sector. By syndicating investments, the venture capital investor can invest in larger number of portfolio companies and diversify away firm-specific risk (Bygrave 1987). Some deals may also simply be too large to be undertaken by a single VC who might not have enough funds. If the venture capital firm is too small relative to the project size, syndicating the deal may well be the only way to invest in that particular deal.

In conclusion, because of capital constraints that capital-intensive and risky projects face, venture capital investors may need to have far greater levels of syndication in order to sustain the level of investment required by this sector. However, navigating the valley of death cannot be resolved with only increasing syndication of investments. It also requires institutional investors willing to take risks, skillful and innovative entrepreneurs and an environment that supports innovative entrepreneurship. In addition, government support is often needed to make sure innovative ideas get enough funding to commercialize their business. The European Union also contributes to the financing of innovative small and medium sized enterprises via the "Entrepreneurship and Innovation" pillar of the European Competitiveness and Innovation Framework Programme (CIP), with a budget of €1.13 billion for the period 2007-2013. (Allison & Wilkinson 2010.)

5.1.2 Improving Exit Markets

According to Ghosh and Nanda (2010), a key aspect of the innovation ecosystem will be an active M&A market for clean energy startups. As mentioned earlier, improving exit markets for clean energy investments would encourage investors to invest more in clean energy sector and this way mitigate financial constraints that clean energy startups face.

Several studies examining syndication (e.g. Brander *et al.* 2002; Hochberg, Ljungvist & Lu 2007) have found it to be generally positively associated with the returns generated by the investments and the time to and probability of a successful exit. Furthermore, in their research, Seppä and Jääskeläinen (2003) state that the frequency of syndication enhances finding and evaluating new portfolio firms, and the large set of syndication partners strengthens the venture capitalists' ability to bring their portfolio companies public. A natural implication from previous studies is that when VC investors form a syndicate to co-invest in a project, syndicate members who have heterogeneous skills, information, industry expertise, and networks can provide a broad range of inputs for entrepreneurial firms and thus increase investments' value.

There is one study that supports the motivation of this thesis very well. In his research, Tian (2011) analyzes how VC syndication creates value for entrepreneurial firms and how value creation by VC syndicates differs from that of individual VC firms. This research paper provides evidence that VC syndicates *invest in riskier firms that otherwise might be unable to grow and mature*. VC syndication seems to investing significant amounts in younger firms, in earlier financing rounds, and in early stage firms. Furthermore, VC syndicates help firms *create greater product market value,* because VC syndicates are better able to understand and evaluate the technology of their entrepreneurial firms and nurture innovation. Although this research is not focused on clean energy investments, these results would support the hypothesis that syndication could increase the value of innovative early stage clean energy investments.

In addition, according to Tian (2011), entrepreneurial firms backed by VC syndicates have higher probabilities of successful exits, higher IPO market valuation, better post-IPO operating performance, and higher probability of post-IPO survival. In this research, both IPOs and acquisition are considered successful exit pathways in the existing literature, while liquidation is considered an unsuccessful exit pathway. The data for this research was obtained from the Thomson Venture Economics database for firms that received VC financing between 1980 and 2005. The data set contains 3,452 VC firms that invested in entrepreneurial firms between 1980 and 2005.

Tian (2011) indicates in his research that 30% of entrepreneurial firms in the sample period were backed by individual, *not syndicated*, VC firms. There is a rationale for why not all VCs want to syndicate. In the case of multiple VC investors, it can be difficult and time-consuming to deal with problematic entrepreneurial firms, such as renegotiating the investment agreement. These challenges increase management and monitoring costs and reduce the efficiency associated with a venture investment. Also, different types of VC investors may have different investment objectives and exit preferences, which might create conflicts among VC investors within a syndicate. (Tian 2011.)

5.1.3 Sharing Risks and Alleviating Problems Caused by Asymmetric Information

Clean technology firms heavily invest in innovations with uncertain and highly skewed returns. Informational asymmetries and their financial consequences can be severe in the clean technology market. Major clean technology projects have been historically avoided by investors due to high risks and uncertainties, length of the project and time of future returns. In addition, clean technology firms possess high levels of intangible assets, such as R&D investments and know-how, and very specialized tangible assets. Such assets usually have little liquidation value and hence, cannot be effectively used as collateral when borrowing. (Erzurumlu et al. 2010, 1-5.)

The degree of informational problems is likely to be less severe in markets with less innovation and diffusion uncertainties. For instance, wind energy firms employ a relatively mature production technology and spend little on product and process R&D. Wind turbines also have high collateral value due to low asset specialization and high market liquidity. Due to relatively low risks and high recovery value of the assets, such businesses often find it easier to finance their operations with bank loans. (Erzurumlu et al. 2010, 11.) Hence, financial constraints are usually not as severe in these companies.

Uncertainty is particularly high in the investments of those venture capitalists that invest in ventures with particularly high level of innovativeness, such as clean energy startups. According to Seppä and Jääskeläinen (2003), syndication attains significantly more efficiency gains when

there is much uncertainty. There is considerably more uncertainty present in ventures that are in an early stage of development than in ventures that are about to make an initial public offering. In addition, according to existing research, the younger and riskier the venture, the earlier the stage (Tian 2011, Dimov & Milanov 2009), and the larger the total size of the investment (Cumming 2006), the more likely the venture is to be syndicated. Also, ventures in areas of high technology are more often syndicated (Cumming 2006). These results again provide support for increasing syndication in early stage clean energy investments.

In addition, according to Seppä and Jääskeläinen (2003), having a diverse set of syndication partners is a potential success factor in venture capital investing especially in the case of early-stage investments. Early-stage investments typically require significantly more involvement in the day-to-day operations of the business from the venture capitalists. Syndication relationships can act as a vehicle to gather value-adding resources to improve the monitoring of portfolio companies. (Seppä & Jääskeläinen 2003.)

Table 2 summarizes the chapter 5.1 by collecting together the problems that cause financing constraints of clean energy companies and showing how syndication of venture capital investments can alleviate these problems.

VC Investment Phase	Problems Causing Financing Constraints of Clean Energy Companies	How Syndication Alleviates These Problems
Selection of the deal	Adverse selection & several risks inherent in clean energy investments (market risk, technology risk, regulatory risk, people risk, exit risk)	Enables better screening of investments in risky, uncertain and innovative industries (Casamatta & Haritchabalet 2007)
		VC syndicates invest in riskier firms that otherwise might be unable to grow and mature (Tian 2011)
	Too capital-intensive deals for investors	Syndicate partners can provide additional capital, and can thus decrease the financial commitment needed from the lead investor. This shares risk inherent in large investments. (Bygrave 1987.)
		First round syndicated investments tend to involve larger deal sizes than non-syndicated investments (Cumming 2006)
Investment process	Moral hazard	By syndicating investments, venture capital investors can gather value-adding resources to monitor portfolio companies better (Seppä & Jääskeläinen 2003)
Termination of the investment	Inadequate exit possibilities	Facilitating the networking of VCs extends the size of potential exit markets (Hochberg et al. 2007)
		Entrepreneurial firms backed by VC syndicates have higher probabilities of successful exits, higher IPO market valuation, better post-IPO operating performance, and higher probability of post-IPO survival (Tian 2011)

Table 2 How syndication alleviates financing constraints of clean energy companies

5.2 Comparison of Syndication Practices Between US and Europe

Previous research has shown that there are important differences between US and European VC industry practices. It has been shown empirically that American venture capitalists generate significantly higher value from their investments than their European counterparts. For example, calculations by Venture Economics indicate that from the beginning of the VC industry in Europe in the early 1980s until 2007, the average European VC fund had an annual return of minus 4 percent versus 16 percent for the average American VC fund. (Lerner 2009, 123.) Therefore, it is interesting to compare syndication practices between US and Europe and see if that could be one reason for more effective venture capital investing in US.

Recent years have witnessed significant convergence of Europe and US in funding levels, investment patterns and realized returns. However, there still seems to be differences in investment practices between Europe and US. Schwienbacher et al. (2008) suggest that there is lower venture capital investment performance in Europe because (1) the holding periods for investments in Europe seem to be longer, which may signal a reluctance to cut unpromising ventures, (2) European investors seem to use less of convertible securities which may indicate weaker control rights and less downside protection for the VCs, (3) management is replaced less frequently in Europe which may imply greater patience with managers who are not performing, (4) there is a more regional focus that may lead to missed opportunities elsewhere, and (5) European investors seem to syndicate less and in smaller syndicates which may imply that the benefits from syndication are not being fully exploited. (Schwienbacher et al. 2008.) In this thesis, I focus only on differences in syndication practices between Europe and US.

It appears that the benefits of syndication are derived from the syndication strategy, not from the use of syndication itself. That's why it's important to recognize that some strategies may lead to more profitable syndication, and other things such as geographical areas and investment sectors may also affect the success of syndication. For example, using data for a sample of 147 European VC-backed companies and a comparable sample of 234 American VC-backed companies for the period 1997-2003, Hege et al. (2009) found that one reason why European VC firms underperform their American peers US-based venture investors is that 1) they use syndication less effectively, as their syndicates do not grow over time, while their American counterparts do. According to Hege et al. (2009), the other reasons for why European funds underperform US funds is that 2) they use instruments of control and contingent funding less efficiently, 3) they do not increase the funding flow to good performers in contrast to the Americans, and 4) they are less specialized and include fewer corporate investors. 36% of VC-backed companies in the United States include a corporate investor in the syndicate at least one financing round, which is twice as many as in Europe. (Hege et al. 2009.)

The differences between syndication practices tend to be smaller between younger VC firms than between more established VC firms. This may signal that Europe is closing the gap in VC practice with America. Table 2 below provides summary statistics for syndication practices in

both the US and Europe. The first variable (SYNDICATION) represents the percentage of VC deals syndicated. The second variable (# syndicate partners) is the average syndicate size in which VCs were involved, including the respondent himself or herself. The third variable is the percentage of syndications that included only partners from the same country. The fourth variable represents the percentage of syndications that included partners from only outside the Europe (or US). Finally, the fifth variable gives the percentage of past syndications that involved at least one partner from the governmental sector. (Schwienbacher 2008.)

Variable	Europe		United States		Diff. mean	Diff. median
	mean	median	mean	median	p-value	p-value
SYNDICATION	54%	60%	80%	95%	0.00	0.00
# syndicate partners	2.7	3	4.5	4	0.00	0.00
Own country (or State) only	58%	60%	41%	50%	0.01	0.16
Outside Europe (or US) only	25%	10%	18%	10%	0.13	0.98
Governmental partner included	12%	0%	2%	0%	0.00	0.10

Table 3 Summary statistics for syndication of past deals (Schwienbacher 2008, 206)[4]

Table 3 illustrates that while US investors invest more frequently and in bigger syndicates, syndication with regional colleagues and governmental partners occurs significantly more often in Europe. (Schwienbacher 2008.) For example, in Finland, public venture capital agencies are important in financing risky startup companies and sharing risks with private venture capital investors.

In conclusion, more efficient syndication may thus be one reason why US venture capital investments generate higher value. However, we would need more evidence to show this causal relationship. Although there are more similarities in institutional factors and corporate culture between European countries than between Europe and US, Europe does not represent one

[4] The data set was assembled by way of sending questionnaires to VCs in the United States and in 6 European countries (Belgium, France, Germany, the Netherlands, Sweden and the United Kingdom) in 2001. The VC sample was drawn from the European Venture Capital Association (EVCA) and national VC member lists. In total, approximately 600 European and 600 VCs in the United States were contacted.

homogenous market. European companies have to deal with complexity of 27 different policies and programs. Syndication practices are not the same in every European country. In addition, the data used in these studies presented here has not been aggregated at industry level, such as clean energy, so more specific research on syndications in specifically clean energy investments would be needed.

In addition, besides differences in syndication, there are differences in other investment practices, such as the use of convertible securities. European venture capitalists use convertible securities less often than their US counterparts. Furthermore, there are *institutional differences* between US and Europe that may affect the value of venture capital investments. These institutional differences can be differences in *legislation, taxation and financial markets*. Some practitioners and academics believe that, compared to America, VC activity in Europe suffers as a result of higher taxes on capital gains and less personal protection in case of bankruptcy. (Bruton et al. 2005.) However, Hege et al. (2009, 29) find no evidence that the performance gap can be attributed to the difference in legal origin between Common Law in UK and Ireland and Civil Law in the rest of European countries or to the tax environment for venture financing. However, more research would be needed to be able to draw profound conclusions of this subject.

It has been argued that *exit possibilities* are better in US, where IPO markets are more developed. Despite many attempts to duplicate America's NASDAQ, Europe does not have a vibrant market where its young new companies can exit via IPOs. Given the weak public market for young companies in Europe, the primary avenue for their exit is a trade sale rather than an IPO. As mentioned earlier, there is compelling evidence that exits via trade sales are usually not as lucrative as exits via IPOs. (Oehler et al. 2007, 9.) Furthermore, there is *a strong entrepreneurial culture* in US which encourages people to start new companies.

It is important to acknowledge that there are institutional and cultural differences and differences in investment practices between Europe and US. However, in this thesis, I focus on examining differences in syndication practices and try to find arguments for syndicating investments nationally and globally. Based on the research comparing European and US

syndication practices, it could be suggested that European venture capitalists could *syndicate more* and probably *include a corporate investor in the syndicate*.

5.3 Syndicating with Corporate Investments

Traditionally, corporate involvement has tended to be seen most often in the later stages of development, when there is a measure of comfort that the product is likely to reach the market. However, corporate investors are increasingly making investments at an earlier stage. Major corporations, such as BASF, Boeing, GE, Honda, Intel, Norsk Hydro, Siemens and Unilever, make cleantech venture investments to meet their own strategic objectives. The corporates are thus addressing the cleantech funding gap. (Fletcher 2010.)

Corporate partnerships are becoming the best way to finance the development of capital intensive companies, such as solar energy companies. This type of corporate funding not only helps to provide necessary capital but it also provides solar companies with strategic relationships that help bring their products to market faster as well as market credibility. In addition, many solar companies are using these partnerships as a means to be acquired by larger companies who can better leverage their technology, rather than deal with the uncertain future of going public.

In their research, Maula et al. (2005) proposed that venture capital investment structures that combine the financial and management expertise of venture capital firms *and* the technology and commercial expertise of large corporations might offer optimal investment syndication for innovation. While independent venture capital funds (IVCs) are primarily concerned with the financial returns from their portfolio firms, CVCs emphasize other benefits that may arise from the investment, such as exposure to a pioneering technology and early establishment of alliances in the product markets. Through collaboration, VC firms can accrue additional technical and commercial expertise and build partnerships for exit through acquisition.

However, CVC firms may be disadvantageous in reducing information asymmetry due to new ventures' fears of expropriation by the investment parent firm with similar business lines. Also, when CVC funds do not produce substantial, immediate returns for their parent companies' strategic purposes, top management may decide to exit from the venture capital market (Dushnitsky & Lenox 2006.) Syndicating with other VC firms is one way CVCs can avoid this concern from start-ups.

5.4 Cross-Border Syndicating

5.4.1 Why Foreign Investors Are Needed in Europe

Given the shallower pool of venture capital in Europe compared to the US, one option for European investors could be to syndicate their clean energy investments more with their US and other foreign counterparts. As the figure 12 illustrates, European funds invest much less in aggregate than US funds. The much larger US venture capital industry has been credited with the emergence of whole new industries and such innovative corporate giants as Microsoft and Google. According to Knight (2010), US venture capitalists could have unique capabilities and resources, which could be worth exporting to European venture capital markets.

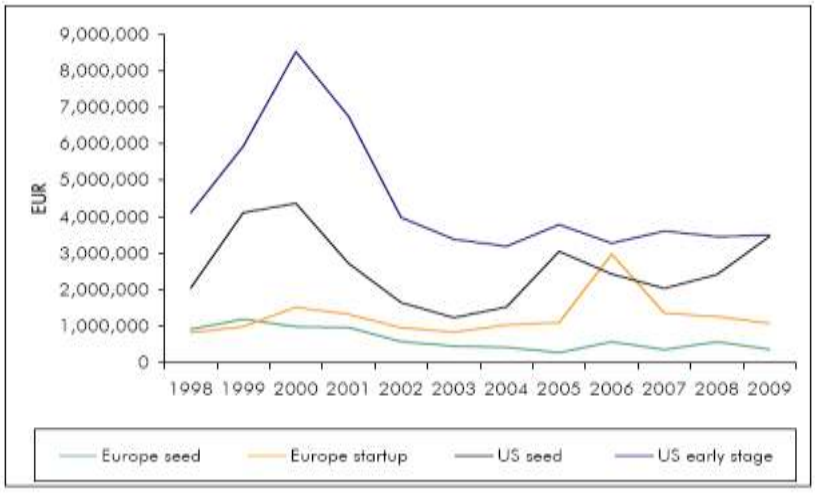

Figure 12 Average venture investment per investee company in US and Europe (EVCA 2010)

When interviewing Teppo (2011), she pointed out that foreign cleantech investors are needed in Finland. Furthermore, there is a clear pattern across the Nordic countries that foreign funds typically invest in larger ventures. While domestic funds have somewhat smaller investments than other Nordic funds, international funds clearly invest in more capital intensive projects. These risk lover investors are needed in Europe and in Finland to support capital intensive, risky clean energy investments. (Gjermund, Grünfeld & Espelien 2010.) Furthermore, there are clear advantages in *developing a more integrated Nordic venture capital market*. This would increase the likelihood of attracting international investors to the region.

Foreign venture capitalists can complement domestic venture capital supply and enhance innovations in a country. According to Maula and Mäkelä (2003) foreign investors can significantly aid the internationalization of their portfolio companies by helping them develop a global perspective to their business. Given the speed at which the economy is going global, successful VC investment demands an international approach, and deep understanding of markets and actors worldwide. The presence of foreign investors can also signal the quality and legitimacy of the venture.

Furthermore, Jääskeläinen and Maula (2005) stated that cross-border involvement by venture capital firms can influence exit behaviour. Using a large sample of European venture capital backed ventures and their exits, they suggest that the presence of foreign venture capitalists can reduce the informational problems related to the arrangement of exits through IPOs and trade sales in foreign markets, thus increasing the likelihood of such exits. The rationale behind this result lies in the fact that existing contacts of foreign venture capitalists can increase the diffusion of information among potential investors, thus enabling identification of potential exit opportunities.

However, geographical, institutional and cultural distances discourage cross-border investors, because it is harder to screen and monitor these investments. Different national, administrative, regulatory and tax rules can make cross-border investment difficult. The quality and development of the regulatory and legal framework are important factors that attract foreign venture capital (Dai, Jo & Kassicieh 2010). At present, there is no integrated European venture

capital market, and the regulatory situation varies widely from country to country and the market is fragmented along national lines. The EU is seeking to unify the venture capital market in order to provide innovative small businesses with easier cross-border access to financing. The Commission has committed itself to adoption of new rules, ensuring that by 2012 venture capital funds established in any Member State can invest freely throughout the EU. (European Commission 2011.) This should increase cross-border investments between EU countries, but not necessarily between Europe and US.

5.4.2 Why Cross-Border Venture Capitalists Should Syndicate with Local Investors

In their research, Tykvová & Schertler (2011) find out that the negative effects of geographical and institutional distances are more pronounced for stand-alone crossborder deals than for deals syndicated with a local VC. In addition, according to Knight (2010), a number of US cleantech investors approached mentioned that the nature of early stage technology deals requires proximity to local management. The presence of local venture capital investors with whom to partner in a syndicate may play an important role for foreign venture capitalist.

According to Maula & Mäkelä (2004), major effects of a local investor on an entrepreneurial venture arise from the local investor's ability to: (1) provide day-to-day operational support and business advice to the entrepreneurial team, which is important particularly for early-stage ventures, (2) advise the venture in issues related to local market and legal environment, (3) provide contacts in the local market and to cross-border investors, and (4) signal the quality of the venture. Maula & Mäkelä (2004) also point out that local venture capital investors usually play an important role in attracting cross-border venture capital investors. A cross-border venture capitalist may view the existence of a respected local venture capitalist as a positive signal certifying the quality of the venture.

Devigne et al. (2011) argue that domestic venture capital investors are better equipped than cross-border investors to overcome information asymmetries and to provide the resources relevant in the early development phase. Therefore, syndicating with local VC investors allow foreign VCs to invest in more risky local ventures. Local investors often have more information

about the operation of the local market, including access to deal flow, networks of contacts and familiarity with different legal requirements. Also, by being in close proximity, they may be more able to provide monitoring and value adding activities than distant foreign investors (Knight 2010). Hence, syndication with local venture capitalists reduces foreign venture capitalists' obstacles arising from lacking geographical and institutional proximity to the portfolio company. (Tykvová & Schertler 2011).

In comparison, the resources of a cross-border venture capital investor are especially valuable in a later phase when international expansion becomes more important. Compared with domestic venture capital investors, cross-border venture capital investors provide their portfolio companies with specific resources to grow and to develop internationally. Therefore, companies backed by a syndicate comprised of domestic *and* cross-border venture capital investors develop more strongly, both in the short and in the long run, than venture capitalists investing alone (Devigne et al. 2011.) Consequently, the entrepreneurial firms invested jointly by foreign and local VCs are more likely to successfully exit as IPOs. (Dai et al. 2010.) Overall, these results indicate that combining the expertise and resources of international venture capitalists and the superior local knowledge of local venture capitalists is important in obtaining successful outcomes.

However, syndication does not bring only benefits but may also cause some problems. The agency problems are aggravated as more participants with various information sets and different preferences are involved. Larger syndicates result in an increased incentive to engage in free-riding behavior. However, in their research, Tykvová and Schertler (2011) demonstrate that syndication partners' participation likelihoods decrease only when an *inexperienced* local VC leads the syndicate, but not when an experienced local VC is the lead. The local VC's experience moderates the discouraging impact of the geographical distance on participation likelihoods. Hence, *experienced and active local investors* are needed in Europe in order to attract cross-border venture capital.

6 CONCLUSIONS

6.1 Venture Capital Syndication Can Mitigate Financial Constraints in Clean Energy Sector

Especially early stage companies find it often difficult to get funding and are thus financially constrained. Venture capital is often needed to finance these companies. Although there is no clear evidence of venture capital's causal effect on innovations, venture capital can still contribute to the economy as a whole by mitigating problems caused by asymmetric information and promoting the development of high growth companies that create jobs and generate wealth.

Venture capitalists have many tools that can mitigate financial constraints caused by asymmetric information. These mechanisms include *screening, monitoring and staging investments, using convertible securities and syndicating investments*. In this thesis, I focused especially on syndication that can help *diversify and reduce portfolio risk, provide access to increased deal flows, enhance better deal selection and add value because of the complementary contributions of syndicate members* to the post-investment development of ventures. Consequently, according to several research papers, syndication could *increase the probability of a successful exit*. For example, in clean energy sector, more successful exits are needed, and increased syndication would be one solution for this problem.

Asymmetric information and different risks inherent in clean energy sector provide a good rationale for syndicating clean energy investments. Given that clean energy projects are often risky, and the potential returns do not necessarily compensate these risks, syndication seems to offer one solution to increase chances of successful exits. According to Casamatta et al. (2007), other things equal, the uncertainty of the portfolio firms, or of the industry where VCs invest in, should have an influence on the level of syndication of venture capitalists. In addition, several research papers state that syndicated venture capitalists invest in riskier and younger firms that otherwise might be unable to grow and mature. This result supports the view that syndication

pools information and reduces information asymmetries. Therefore, we could draw a conclusion that syndication is a useful investment practice in the clean energy sector.

6.2 More Efficient Syndication of Venture Capital Funds May Be Needed in Europe

Given its rich tradition in both innovation and sustainability, Europe has potential in becoming a clean energy hub. However, if Europe wants green growth, more venture capital is probably needed. Enhancing syndication could be one solution for this. Syndication seems to be less frequent in Europe than in US, and the average size of syndicates is smaller in Europe than in US. It should be noted that the recent years have witnessed significant convergence in funding levels, investment patterns and realized returns. However, based on several research papers, *venture capital syndication could be used more efficiently in Europe*, so that potentially successful innovations would have better possibilities to obtain funding they need. In addition, more *cross-border cooperation* and *syndication with corporate investors* is needed.

Although the U.S. is often considered the "model" venture capital system, there are in fact several generic economic, cultural and legal factors that enhance vibrant venture capital industries. Hence, increasing venture capital syndication and optimizing other investing strategies is not enough to mitigate financial constraints, enhance entrepreneurship and increase innovations in clean energy sector. Successful venture capital industries need for example *a well-established legal system with good investor protection* and *a stable regulatory and taxation system* that doesn't penalize start-ups and investors. In addition, *risk-tolerant institutional investors* and *a vibrant IPO market are needed*. Furthermore, innovations won't be created without *a tradition of entrepreneurship and risk-taking*, *a strong R&D culture* and *free labor market with strong engineering and business talent*. (Megginson 2001.)

6.3 Public Sector Is Needed to Enhance Attractive Investment Climate in Clean Energy Sector

Because clean energy investments create positive externalities, public support is often needed in clean energy investments. The greatest assistance to venture capital may be provided by government programs that seek to enhance the *demand* for these funds, rather than the supply of capital. This means that the most effective programs and policies seem to be those which lay the foundations for effective private investment. For example, *regulations and tax conditions* can change the demand for clean tech products. In addition, efforts to make entrepreneurship more attractive through tax policy may have a substantial impact on the amount of venture capital provided and the returns that these investments may yield. (Lerner 2010.)

Clean energy investments are often not providing large and rapid payoffs to early investors. Pushing companies to provide significant investor returns on the VC funding timelines may distort the venture's strategic decisions and long-term growth. In order to develop a well-functioning venture capital market for clean energy sector, it is necessary to continue *building bridges between public and private funding*. Venture capital funds that are capitalised by the combination of private and public money but are managed by professional venture capital managers could help alleviate the financial constraints of these companies.

All in all, despite the recent declines in investment, the macro-trends for clean energy venture capital are positive. The market for clean energy has already grown to a respectable size, and more growth can be expected, as long as there are enough innovative companies that get necessary funding and managerial support for successfully commercializing and internationalizing their business.

6.4 Further Research

Further research would be needed to study how different industries benefit from the syndication of investments. General research papers about syndication, that are not specialized in examining any specific industry, cannot reveal if there are some differencies between for example cleantech and biotechnology industries.

Some statistical evidence on whether differences for example in syndication practices between US and Europe are related to the differences in performance would also be needed. Furthermore, comparing VC syndication practices between Europe, US and Asia would be an interesting avenue for further research. Investigating similarities and potential differences in syndication motives and propensity might yield interesting insights. More profound research would also be needed on how economical cycles affect the efficiency of venture capital in alleviating asymmetric information and mitigating financial constraints for startups.

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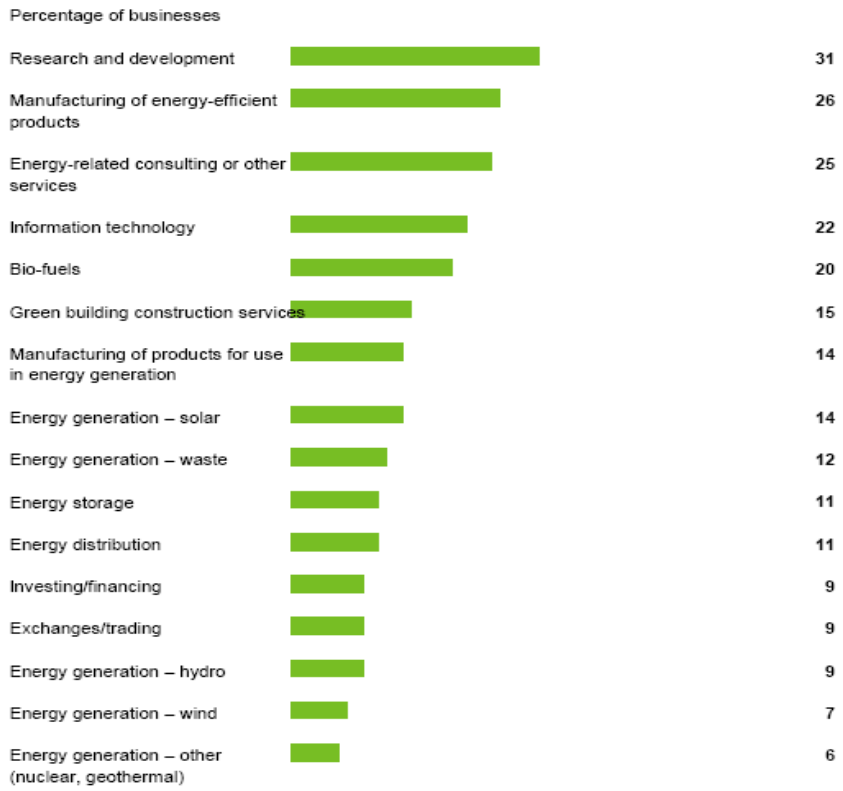
Tarja Tappo has been involved with renewable energy and other cleantech research and advisory projects for Nordic institutional and industrial investors as a co-founder of Cleantech Invest.

APPENDICES

APPENDIX I . Which areas of the sector are you involved in? Grant Thornton IBR 2010 respondents by cleantech sector



APPENDIX II. Participating economies in Grant Thornton IBR 2010 Survey (Grant Thornton IBR 2010)

APPENDIX III. Sustainable energy markets categorized by Bloomberg New Energy Finance

Bloomberg New Energy Finance specialises in five major markets - ***clean energy, energy smart technologies, carbon capture & storage, nuclear, and the global carbon markets:***

CLEAN ENERGY

Biofuels
Liquid transportation fuels including biodiesel and bioethanol. These can be derived from a range of biomass sources, including sugar cane, rape seed (canola), soybean oil or cellulose.

Biomass, solid waste and biogas
Production and consumption of solid and gaseous fuels derived from biomass. Solid biomass for the energy sector can include a number of specially-grown crops, such as elephant grass or coppiced willow, but it can also consist of crop residues such as straw. Bloomberg New Energy Finance includes in this sector processors of other waste matter for energy generation, such as sewage waste, chemical by-products and biogas produced from municipal waste, as their exploitation often involves the same technologies as grown-forpurpose biomass.

Geothermal
The geothermal sector covers technologies used to produce electricity from heat in deep subsurface geological formations. This heat can be extracted as part of a naturally occurring hydrothermal resource, or as an engineered geothermal system (EGS), which holds much potential but is still in early development stages. Exploration, drilling, and power plant technologies are all critical to geothermal resource development.

Small hydro (<50MW)
There may seem little new about hydroelectric power. Indeed at Bloomberg New Energy Finance we don't cover large-scale hydroelectric power projects. However, there are interesting developments in small-scale and low-head hydro power, and even very small scale hydro solutions. Hydro power is undergoing a renaissance and has a lot to contribute to the deployment of renewable energy globally.

Marine
The Marine sector covers all technologies relating to extraction of energy from the sea. Possibilities include waves and tide, either via tidal barrages or tidal flow generators. Note that exploitation of marine biomass would be categorised in biomass, rather than in this sector.

Solar
The Solar sector covers all technologies which capture energy directly from the sun. These include direct production of electricity using semiconductor-based photovoltaic (PV) materials, use of concentrated sunlight to heat fluid to drive power generation equipment (solar thermal electricity generation or STEG), and passive methods which use solar to replace fossil fuel energy, for example to heat water. The photovoltaic sector is the largest of these in terms of investment volume, while passive is the largest in terms of fuel saved and carbon dioxide emissions reduced globally. However, PV is expected to dramatically reduce costs through new technologies and increased manufacturing scale, and is expected to break into new areas of energy demand over the coming decades.

Wind
Wind is the renewable technology that has had the biggest impact on our energy usage patterns over the past decade. The next decade will see continued activity, particularly in developing countries and offshore. The Wind sector includes components and subassemblies for wind turbines as well as manufacturers of turbines themselves. A big part of this sector, however, consists of the various developers, generators, utilities and engineering firms that have sprung up to exploit opportunities to build wind farms around the world.

Services & support
The rapid growth of the clean energy industry will require the development of a complete sector of service companies dedicated to serving the needs of technology and equipment suppliers, owners of renewable energy and biofuels assets, and so on. In this sector Bloomberg New Energy Finance put providers of information and research specialised clean energy financial services companies, consultants and the like. In addition to these 14 sectors, which make up the clean energy industry itself, the Bloomberg New Energy Finance Intelligence includes details of other active and important organisations of two types: the general financial services industry, and the Governments, NGOs and policy-makers.

ENERGY SMART TECHNOLOGIES

Energy efficiency
This sector covers technologies and practices aimed at improving efficiency both on the supply side – in generation, transmission and distribution – and on the demand side, including the built environment and industry. From CHP and superconducting transmission to efficient lighting, building materials, industrial processes and HVAC, a range of technologies exist that can capture the low-hanging fruit of efficiency.

Digital energy
Digital energy encompasses a web of technologies and services that use information and communications technology to improve energy efficiency, security and reliability, starting with the smart power grid. The smart grid includes systems to balance supply and demand, automate grid monitoring and control, flatten peak consumption and communicate in real-time with consumers. Supply and demand data will flow between power producers and customers, and automated demandside management and virtual power plants will become reality.

Power storage
Many renewable energy and emerging energy technologies are either intermittent, or have response curves that are unable to follow the dynamic demands that will be put on them when deployed. Batteries and other energy storage technologies therefore become key enablers for any shift to these technologies. Within this sector we include compressed air, flywheels, capacitors and a range of battery technologies, including flow batteries.

Hydrogen and fuel cells
This sector covers the production, storage and direct applications of hydrogen as a fuel, as well as the associated market for fuel cells. Although they have been around for 150 years and their performance is not in doubt, the high manufacturing costs and infrastructure needs of fuel cells mean that they have yet to capture the mass market. A large number of companies and research initiatives are hoping to change that over the coming decade. We draw a distinction between the hydrogen industry and the fuel cell sector: fuel cells can burn a variety of hydrocarbon fuels, and hydrogen can be used by other systems, such as internal combustion engines.

Advanced transportation
Transport presently accounts for a quarter of world energy consumption. Advanced Transportation covers technologies that reduce the use of energy associated with all types of transportation. Key technologies include electric and hybrid vehicles, plug-in vehicle charge infrastructure, transportation-suitable fuel cells, and combustion efficiency technologies.

CARBON CAPTURE & STORAGE

CCS comprises technologies that directly capture, transport and store CO2 emissions from fossil-fuelled power and industrial facilities. The sector is still young but important technologies include pre-combustion, post-combustion, and oxy-combustion CO2 capture. The captured CO2 can be stored in deep subsurface geological formations, or utilised in enhanced oil recovery (EOR) or reacted with other compounds to produce marketable products -these efforts to reuse the CO2 is known as carbon capture usage and storage (CCUS)

NUCLEAR

Nuclear provides 70% of the carbon-free electricity generated in the world today. With global energy consumption projected to increase 160 percent by 2050, an expanding nuclear energy industry will provide the world's economies a cost-effective solution to base load electricity generation without large new emissions of carbon dioxide.

APPENDIX IV. Questions for the semi-structured interview with Tarja Teppo

Early stage companies often find it difficult to obtain funding. Is the problem the lack of funding or rather the lack of potential business ideas?

Would Finnish venture capital companies need to syndicate more to be able to better finance early stage clean energy companies?

Are there difficulties in exiting clean energy investments successfully? From your perspective, is it perhaps more difficult to exit clean energy investments than to exit investments in IT or biotechnology?

Do Finnish venture capital industry need more international investors?

What is the role of corporate/strategic investors in early stage clean energy investments?

What are the most important challenges and opportunities in the clean energy investing field in the future?