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How to escape the Valley of Death?

A case study of innovative energy technology projects in the European Union

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Abstract

Thousands of innovative energy technology projects are not able to obtain financing, specifically from private investors, between when they have demonstrated their technology works on a prototype scale and when they have reached a commercial scale and can enter the market. This is known as the Valley of Death (VoD). The literature provides a few reasons behind the VoD and mainly calls for considerable public intervention to solve it. The objective of this thesis is to expand this knowledge by actively searching for innovative energy technology projects stuck in the VoD in the European Union and understand which issues these innovators face. It is also to see if these issues can be parted and how to prioritise those most likely to be solved without considerable public intervention. Finally, it is to see which actions the various players should take to ease such issues.

To do so, the concept of investment community was introduced, which is made up of three relevant players: the innovator, the investor and a matching platform. The latter is an entity, public or private, that offers services to increase the successful matching between innovators and investors. By undertaking 65 interviews with innovators stuck in the VoD, innovators that made it on the market, investors and matching platforms, this thesis investigated the current situation, needs and tips for improvement for each player of the investment community.

This allowed to illustrate the characteristics of 28 innovative energy technology projects stuck in the VoD, such as their long time to positive cash flows, high capital intensity and high risk perception, among others. It made a categorisation of the issues causing the VoD possible, hence highlighting which are more likely to be solved. It lastly permitted to come up with four sets of recommendations to improve the investment community and ease as many issues as possible. The first is aimed at matching platforms and shows how to create an "ideal" matching platform. The second targets the innovator, and explains what the latter should do to become an "ideal" innovator. The third shows the innovator which investor it should "ideally" target. Finally, the fourth looks at improving the overarching ecosystem, through changes in regulation for example.

These four sets of recommendations illustrate what an investment community should look like to help energy technology innovators escape the Valley of Death in the European Union.

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1. Introduction

Innovators in Europe have a hard time accessing finance for their innovative technologies and putting them on the market (CEPA and ICL, 2017). The literature points at two principal problems causing this (Trinomics B.V., unpublished); the first being a purely financial problem: private investors are worried by the high risks and uncertain returns combined with innovative technologies, meaning the private finance flow given to innovators developing such projects stops in case public funds are retracted (IEA-RETD, 2014). The second is more of a practical problem, since there is a mismatch in the market between investors and innovators and they speak highly different languages (EIB, 2014). Because of these problems, innovative technology projects cannot access private finance once they have completed the research and development (R&D) stage, demonstrated their prototype works and need significant funds to scale up their operations and enter the market: this concept is known as the Valley of Death (VoD) (Wolfe *et al.,* 2014).

This is also true when it comes to innovative technology projects within the energy sphere (JRC, 2013). The strategy of the European Union (EU) is to create a regulatory environment for consumers, innovators and investors that is beneficial to all (EC, 2016a). At the same time, it has announced ambitious energy targets in the 2030 Climate and Energy Framework, which aims at a 40% domestic reduction in GHG emissions, a 27% share of consumed energy from renewable energy sources (RES) and a reduction of 27% in energy consumption (compared to 1990 levels) by 2030 (EC, 2014). To achieve this, measures such as the Energy Roadmap (EC, 2010), the Energy Union Package (EC, 2015a), and the Integrated Strategic Energy Technology (SET) Plan (EC, 2015b) were implemented, so as to transform the European Energy System with innovation at its core. Some of the priority actions mentioned to accelerate this transformation are for instance to maximise RES potential by developing high performance renewable technologies and their market integration through programmes such as the InnovFin Energy Demo Projects (EDP) and the European Fund for Strategic Investments (EFSI)[1] from the European Investment Bank (EIB); developing and strengthening energy efficient systems; research the commercial viability of Carbon Capture Storage and Use (CCSU); and increase the safety of nuclear energy.

While these measures support investments into innovative energy technologies from a public perspective, private financing is much less present. These technologies are seen as highly risky and capital intensive, meaning their viability is severely correlated to interest rates. In addition, the two major problems described above are exacerbated in the energy context; most innovative energy technology projects are aborted as soon as public finance stops, and energy innovators and private investors typically have difficulties in finding each other in the market, resulting in a mismatch (Martin and Scott, 2000). The consequence is that these energy projects are abandoned in the VoD (Auerswald and Branscomb, 2003), as detailed in chapter 2, the theory section.

Currently, there is extensive information gathered on innovative energy technologies; research is made on RES, energy efficiency, smart cities, carbon capture and use, storage… e.g. CMU (2014). As well as modes of financial investments, such as private equity, debt, loan, guarantee… e.g. BNEF (2016). The VoD concept and attempting to bridge it, especially via public policy instruments, has been researched as well, specifically in the USA (Murphy and Edwards, 2003; Weyant, 2011; Jenkins and Mansur, 2011). There is also existing knowledge on the type of financial investors that should finance a specific venture stage of an innovative technology project, as seen in Figure 1 below.

[1] See http://www.eib.org/products/blending/innovfin/ and http://www.eib.org/efsi/index.htm

Finally, there are studies showing the financial instruments that would be more suitable for first-of-a-kind and R&D phase innovative energy technology projects (Lepsa, 2015; EC, 2016b).

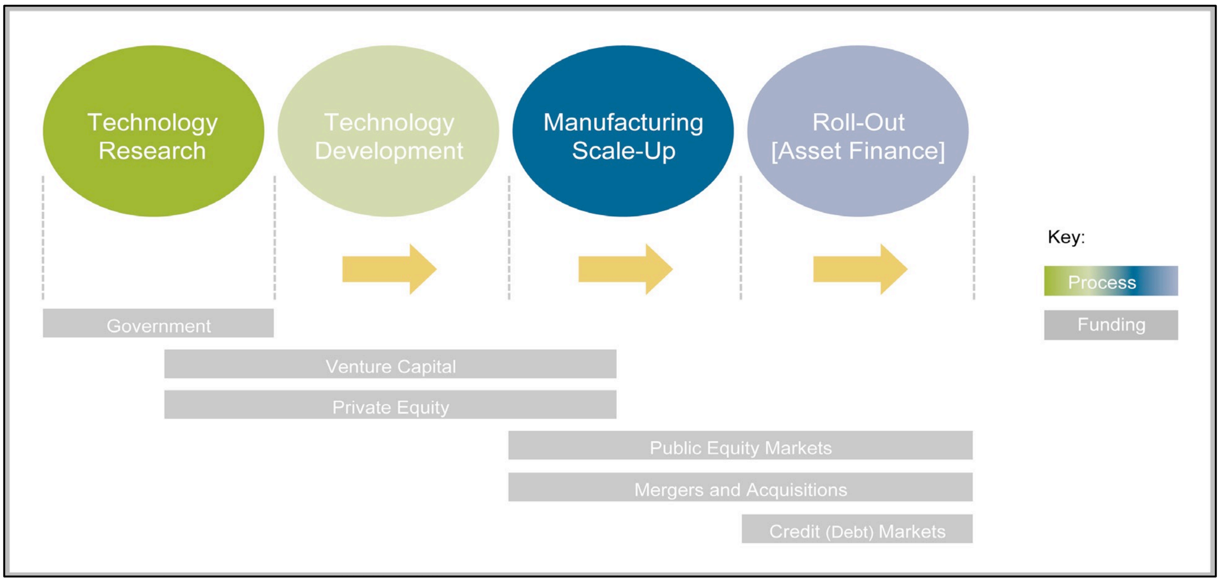

Figure 1: preferred investors for specific technology project stages. Source: FS UNEP (2015).

However, there is little knowledge on how to make sure that innovative energy technology projects that are currently stuck in the VoD due to lack of (private) financing can be further developed. Furthermore, as shown in chapter 2, the theory section, the problems causing the VoD seem to be under-researched. Specifically:

1. Few problems are mentioned, usually only the most obvious ones such as the high risks and low returns of innovative energy technology projects

To develop this point, there will be an active search for such projects that are stuck in the VoD in the EU today to understand why that is. The latter will also be asked to other players involved, such as private investors and innovators that successfully escaped the VoD, to increase the amount of problems known.

2. There is no proper categorisation of these problems. As aforementioned, the only distinction made is between a financial problem and a mismatch between innovators and investors

The objective is to separate the problems discovered in the research phase in two categories called intrinsic issues and transactional issues. Intrinsic issues are those that intrinsically make private investors decide not to invest in innovative energy technology projects, such as the high-risk perception. Transactional issues, such as the communication difficulties created by the innovator/investor mismatch, occur when private investors would potentially be interested to invest but end up not doing so. The mismatch is caused by both parties; innovators are not aware of the different financial possibilities; and investors find it hard to seek and assess potential projects. The latter is a lost opportunity; the availability of finance for innovative energy projects is rising, yet investors seem to compete for few similarly evaluated new technologies that appear suitable in terms of *inter alia* size and risk profile. In reality, there is a highly technologically and geographically diverse collection of innovators who cannot seem to find suitable financing even though their project is commercially viable (Trinomics B.V., unpublished).

3. It is unclear which of these problems are easier to solve

By separating the problems causing the VoD in intrinsic and transactional issues, the goal is to show that some issues are easier to solve than others. Realistically, intrinsic issues may never be solved or only through massive public support and regulation changes. Inversely, it might be possible to realistically ease transactional issues.

The objective is hence to fill these knowledge gaps and take a practical perspective while doing so. As outlined in the methods chapter, the relevant players will be interviewed directly to obtain the necessary information to fill these gaps. The relevant players are the investors and the innovators; but since the purpose is to show that transactional issues caused by the investor/innovator mismatch can be eased, there is a third relevant player: matching platforms. These offer services to help investors and innovators find each other, match, and therefore increase private investments into innovative energy technology projects.

In theory then, a matching platform can aid innovators escape the VoD by increasing their chance of receiving funding from investors. The platform can let them find each other independently, or it can actively try to match a specific project with one or more investors. Yet there is little knowledge and no existing research on matching platforms, so this gap will be filled as well. For clarification purposes, the term 'investment community' will henceforth be used to represent the agglomerate of the three relevant players: the investors, the innovators and the matching platforms, as represented in Figure 2 below.

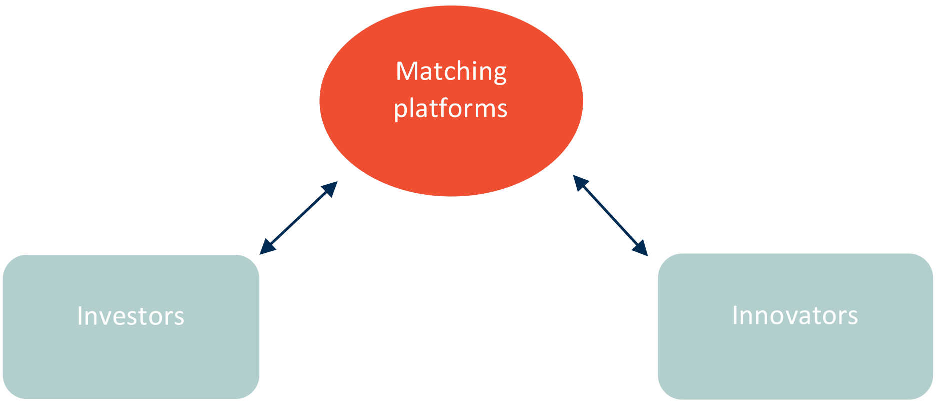

Figure 2: the three relevant players within an investment community. Source: own rendering.

Considering the aforementioned knowledge gaps, the following research questions will be answered:

Main research question: how should the investment community look like to help energy technology innovators escape the Valley of Death in the European Union?

Sub-research question 1: which innovative energy technology projects are currently stuck in the Valley of Death in the EU and why?

Sub-research question 2: how can intrinsic and transactional issues be parted and categorised?

By interpreting the results of the two research sub-questions, the aim is to answer the main research question and discuss what the investment community should look like. The objective is to give three sets of recommendations to create an "ideal" matching platform, an "ideal" innovator, make sure the latter knows which investor to target "ideally", and a final set of recommendations to improve the overarching ecosystem and spur desired regulation changes. Providing these findings could potentially allow energy innovators to solve their transactional issues, escape the VoD, contribute in increasing the potential of clean energy technologies in the EU and help the latter reach its ambitious energy targets. This could then give an idea of how a higher share of sustainable energy sources could be used, thus adding to the field of sustainable development.

2. Theory

The undertaken research regards the players of the investment community. The definition given of the latter was created specifically for this thesis and is therefore novel. Additionally, one of the players of the investment community, the matching platforms, have not been researched in the literature yet. There is however extensive information in the literature regarding the VoD. For a successful innovation to occur, there must be a situation where the "technology push" meets the "demand pull", yet in the energy sector this tends not to happen due to several barriers to innovation (Grubb*,* 2014). Many innovative energy technologies therefore stay trapped in the VoD.

2.1. Literature review of the Valley of Death

The VoD is a well-known concept described by Frank *et al* (1996) as "the situation in which a technology fails to reach the market because of an inability to advance from the technology's demonstration phase through the commercialization phase", hence where innovative projects "go to die because they lack the funding necessary to become a commercial product" (Heller and Peterson, 2016). In recent years, it has become a keystone within technology management discussions and made popular by articles such as the one written by Mills and Livingston (2005), or books like that of Markham and Mugge (2014). Intuitively, the Valley of Death is correlated to the image of Death Valley in Nevada, namely a barren landscape, investment-wise (Auerswald and Branscomb, 2003). A literature review on the concept of the VoD will now be presented, firstly by looking at it within the general innovation literature, then by exploring it from a strictly innovative energy technology point of view.

2.1.1. The Valley of Death within the general innovation literature

2.1.1.1. Explanation of the Valley of Death

Within an innovative technology venture, there is often uncertainty regarding the level of progress that can be achieved and at what expenses. Although markets have the power to pull innovative technologies onto commercialization, and private companies can push them to achieve the same, innovation is often stopped short by the VoD. The latter is a metaphor exemplifying that most innovative ideas had within the R&D phase do not make it to the commercialization phase, i.e. the market (Weyant, 2011). It is estimated that the public rate of return of expenditure in R&D of innovative technologies is double that of private R&D financing (Mansfield, 1996); this explains why most of the funding in innovative technologies at the initial stages of a technological venture, is made by public financing sources. The problem is that this public funding stops after the R&D stage, and is not picked up by any other type of financing extensively, hence creating the VoD. Indeed, "the innovation and diffusion of technology is a complex multidimensional process" (Weyant, 2011), and its "pathway to the market is murky" (Mohrman and Wagner, 2008). Ultimately then, the VoD is a gap between the development of technology and that of commercially viable products, meaning many innovative technology ideas never reach the market (Kirzner, 1997).

This has been well-known for decades; Bozeman (2000) points out that the US Congress stated "the process of commercializing intellectual property is very complex, highly risky, takes a long time, cost much more than you think it will, and usually fails" already back in 1985. It can easily take 10 years for an innovative technology to go from invention to a commercial product (Auerswald and Branscomb 2003). Similarly, it has also been clear for a long time that innovative technologies are crucial to the sustained growth of an economy. While incremental innovations are also necessary, true growth can only be achieved through the continuous introduction of radically innovative technologies which will disrupt the existing market and form new, better industries (Lucas, 1988).

The problematic of successfully putting innovative technologies on the market, due to the VoD, has been present in the literature since the 1980s, and developed on since then. As stated by Weitzman (1998), ''the ultimate limits to growth may lie not as much in our ability to generate new ideas, so much as in our ability to process an abundance of potentially new seed ideas into usable forms.'' As pointed out by Wolfe *et al.* (2014), the VoD has been studied extensively in the literature, and from varying perspectives, "such as economic and public policy (Kammen and Dove, 1997; Bozeman, 2000; Auerswald and Branscomb, 2003; Etzkowitz, 2006; Ford *et al*., 2007), business development and market adoption (Rogers, 1962; Marczewski, 1997; Markham, 2002; Wessner, 2005), and institutional practices (Casper, 2000; Barr *et al.,* 2009)."

From a point of view of general innovation policy literature, there has been a shift. Up to the 1990s there was an understanding that innovation was a linear process from research to market brought forward by technological push; in later years, innovation has emerged as an evolving, nonlinear and interactive process (Todtling and Trippl, 2005). This means there is a strict necessity for companies, research centres, public bodies and financial players to communicate and find a way to collaborate. It is now clear that policy must include the "organizational, financial, skilful and commercial aspects of innovation" (Hudson and Khazragui, 2013).

This point of view is also shared by the Organization for Economic Cooperation and Development (OECD) that believes a significant amount of innovation failure is due to little coordination and collaboration efforts between the different actors of the innovation process; finance issues often being one of the main culprits (OECD, 2010). Indeed, a study made for the House of Commons (2013) in the UK stated that private financing is being directed towards quicker returns and lower risk investments than innovative technology projects. For quite some time, there has also been a "chicken or egg" situation from a commercial point of view: investors and commercial partners (e.g. suppliers) often wait to see whether there is demonstrated demand on the market before investing in a specific innovative energy technology. Yet consumers wait to see the commercialized product to prove they would purchase it and hence demonstrate that demand (ten Cate *et al.* 1998).

Within the innovation process of an innovative technology venture from idea to market, the VoD is by far the most critical phase. It is the moment where the technology must withstand being put within an industrial framework, i.e. a solid business case for the technology must be made, future cash flows must be predicted, and the potential market of consumers and suppliers must be identified. The majority of innovative technology projects are not able to achieve this, meaning most innovative technologies do not make it to the market. As aforementioned, the main reason behind the VoD is the lack of private financing. The latter can partly be explained by the fact that there are two main categories of people involved, the innovators and the investors, which are highly different. Innovators and investors have different educations, ways of communicating, sources of information and expectations. This creates a mismatch between the two, which end up not being able to communicate or even trust each other, thus keeping the innovative technology project stuck in the VoD. Often, technology innovators come from outside the commercial sector, so they do not know how to communicate the potential uses of the technology and its applications on the market (Martin and Scott, 2000).

Another typical issue is the scarcity of small/medium scale private investors at the VoD stage, so between public and university R&D investments and larger private investments (institutional investors and commercial banks). These small/medium scale investors are business angels (wealthy private individuals), corporations investing in the equity of innovative start-ups in their field, and venture capital (VC) funds dedicated to high risk, earlier stage investments. However, while it is thought that VCs are the main source of investment at this stage, business angels and corporations usually exceed investments from VCs. The latter tend to wait until after the product development stage, optimally until there is positive cash flow (Auerswald and Branscomb, 2003). Another issue highlighted by these authors is the absence of infrastructure, such as the presence of suppliers of innovative materials, skilled people that understand the new technology, new distribution services, software; basically, all complementary factors needed for market acceptance to occur. There are also overarching external factors at play; for instance, the VoD is exacerbated for some innovative technologies while others (which will possibly not be economically competitive on the market), keep getting institutional support, due to "political self-seeking and technological over-optimism" (Cohen and Noll, 2002).

2.1.1.2. Recommendations in the general innovation literature to ease the Valley of Death

Markham (2002) suggests that the technology innovator who wants to cross the VoD must do several actions. These include:

- Determining whether the innovative technology has a potentially solid commercial value.
- If so, identifying a commercially viable product from it and writing a persuasive business case.
- Finding the necessary resources to exploit the potential of the product.
- Reducing risk to seek outside approval from entities such as investors, commercial partners and suppliers.
- Being influential during the approval stage of the technology and subsequent development and launch stages.

These are the minimal activities to be undertaken by the innovator if (s)he wants to stand a chance at crossing the VoD. Similarly, it is significant for the investor to have a good understanding of the technology, and for this, the British House of Commons suggested the government to make sure investors can access substantial information about technological developments to spark their interest in investing in them. One of these pieces of information could for instance be an extensive R&D scoreboard[2] given at regional or even municipal level (House of Commons, 2013).

Other suggestions to the government are to make a separate innovation policy for small and medium enterprises, as smaller companies face an unfavourable fiscal environment; to have a board reviewing the regulatory burdens on innovative technology companies; and to have a clear-cut strategy on which technology sectors it intends to fund, in order to increase confidence from private investors and leverage finance (ibid.). According to Weyant (2011), "complementary, non-market-based technology advancement policies" would also increase the innovation volume as well as the number of players that can produce and use these innovative technologies. These policies should not be seen as a potentially major public investment, but rather as a tool to create opportunities and leverage private financing. He suggests targeted research programs to grow the volume of potential innovative technology projects as well as programs to educate consumers and make sure more of these projects become financially viable through an easier route to market.

It is important to have both technology push policies at the beginning of the VoD, and technology pull policies at the end of it. This is key to try and reduce the gap created by the VoD (Auerswald and Branscomb, 2003). In order to push technological innovations towards commercialization, both financial incentives and recognitions through awards, promotions and accolades can be effective. This idea was brought forward by stakeholders involved and struggling with the VoD who gathered at a workshop organized by Wolfe *et al.* (2014).

[2] See http://iri.jrc.ec.europa.eu/scoreboard16.html

These also gave recommendations on how to help increase the volume of innovations that make in to the market, such as:

- Allowing scientists to collaborate with the industry to enhance intellectual exchange and expand the network of smaller companies, within the realm of fair competition
- Having places that allow project developers to use costly, specialized equipment to get information when it is urgently needed

Barr *et al.* (2009) put the emphasis on the point that innovative technology ventures need to be run by innovators who can communicate both with engineers and investors. The authors, who have fourteen years of experience in education of technology, came up with a course to teach at university to meet this point. This course, among other things, teaches both students with scientific and business backgrounds about the VoD, hence increasing the incidence of people that are prepared to cross it once they are in it.

2.1.2. The Valley of Death within the energy innovation literature

2.1.2.1. Explanation of the Valley of Death

It is widely recognised that it is of utmost importance to be part of the next wave of energy innovation (Atkinson *et al.,* 2009) and to be an energetically independent nation, in order to be untouched by the volatility of energy markets and for environmental reasons. However, this needed transformation of the energy sector is being slowed down by the high capital intensity of innovative technologies, high perceived risks, and barriers to scalability, among others (Atkinson *et al.,* 2011). While innovation could overcome these barriers, it is currently being cut short by the VoD: like general innovative technologies, innovative energy technologies also face an unavailability of financing from the private sector.

A substantial number of innovative energy technologies never make it to the market and can thus not compete with more mature technologies. This situation is exacerbated for start-ups and smaller entrepreneurial firms, which face issues of capital availability from day one. At each stage of the energy innovation process, there are several public and private actors and institutions, which “affect the development, deployment, maturation and price of new technologies” (Jenkins and Mansur, 2011). Specifically, their actions set the framework for the financing of innovative energy technologies and therefore see which company will pass to the next stage. Among others, these actors include investors, innovators, but also the national/supranational governments.

This creates the VoD (see Figure 3 below), which can arise as early as the proof of concept is made but usually becomes severe when the first working prototype is achieved. For each venture stage, there is then a typical private investor type that should in theory finance the innovator, going from the 3 Fs (Friends, Family and Founders) to private equity (e.g. institutional investors such as pension funds), project financing (e.g. commercial banks) and finally becoming a publicly listed company through an Initial Public Offering (IPO).

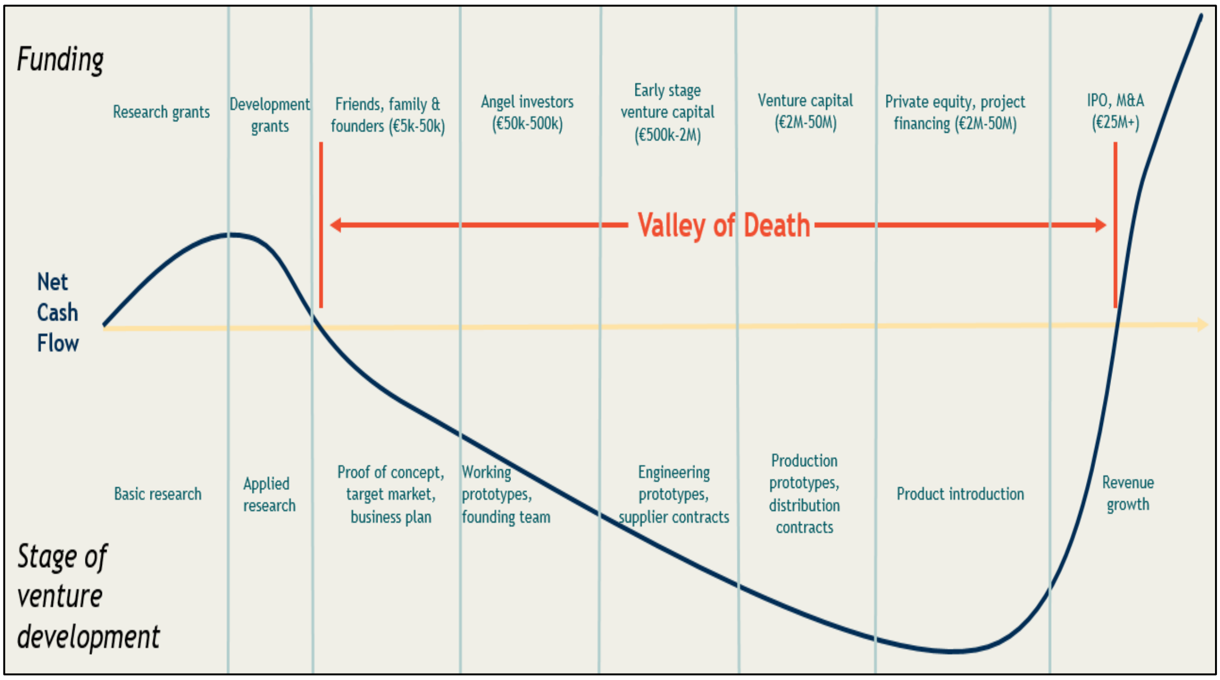

Figure 3: the Valley of Death in terms of investor types and technology venture stages, related to the innovator's net cash flow. Source: Own rendering.

Venture capital funds (VCs) have been seen in the past as the most important private investor to ensure innovative energy companies make the shift from public to private financing, jump the VoD and enter the market. Since 2005, VCs have indeed increased their investments in clean energy technologies. However, these are mature technologies, made by companies with an established business plan (Weyant, 2011), which has negative implications. Gompers and Lerner (2002) stated that "90% of new entrepreneurial ventures that do not attract VC financing will fail within the first three years".

Historically, VCs are used to handle advanced technological risks that come with innovative energy technologies, yet to offset higher risks they invest in numerous ventures, expecting only a few to result in high returns. Considering their extensive portfolio, VCs prefer less capital-intensive firms which yield returns on investment (ROI) in a short time period and can therefore be reinvested in other innovative energy ventures. The problem is that most innovative energy technologies are characterised by their high capital intensity and the extensive time frame needed to make it to the market. Indeed, a manufacturing plant needed to scale up an innovative energy technology to market level can require hundreds of millions of euros of investment, with the latter reaching the billion euro ballpark in case of carbon capture and storage (CCS) for instance.

VCs simply do not have the financing capabilities to fill the gap and bridge the VoD. The same goes for business angel investors. Only investors such as debt financing commercial banks and private equity institutional investors (pension funds, insurance funds, asset managers…) can provide such capital, but they seek lower risks and wait for the venture to have positive cash flow (see Table 1 below; Jenkins and Mastur, 2011). They also tend to have little in-house knowhow about innovative energy technology which hinders their willingness to invest in such ventures (FUNDETEC, 2008).

Table 1: illustration of the typical investors involved with technology ventures. Source: Jenkins and Mastur (2011).

PRIVATE SECTOR ACTORS IN THE ENERGY INNOVATION CYCLE	SEED FINANCING	ANGEL INVESTORS	VENTURE CAPITAL	DEBT FINANCING	PRIVATE EQUITY	UTILITIES
Typical Investment Amount	Small	Small	Small-medium	Any size	Any size	Large
Technology Financing Stage	R&D, Prototype	R&D, Prototype	Prototype, Commercial-ization	Commercial-ization, Deployment	Commercial-Ization, Deployment	Deployment
Expected Time for ROI	Long-term	Long-medium-term	Short-medium-term	Medium-long-term	Medium-long-term	Long-term
Risk Tolerance	High	High	High	Low	Low	Low

Even in times when there are good lending conditions, the larger debt financing players such as commercial banks are not structurally placed to make investments in innovative energy technologies, considering their specific location in the risk/reward spectrum. In fact, "no existing class of financing institutions is effectively positioned to address the particular risk/return category" that characterizes innovative energy technologies in the VoD. This was shown when there was little private financing of innovative energy technology ventures in 2008, even if interest rates were historically low and stocks historically high. One could argue then, that no set of private financial players can currently solve the situation, thus "the VoD challenge is one that the private sector will not address on its own" (BNEF, 2010).

There is a gap between the venture stage public money can finance up to and the venture stage VCs are willing to start investing in. This financing gap, and the subsequent VoD, particularly reaches innovative energy technologies that have demonstrated their concept but need a substantial input of capital to demonstrate their concept can also work on a commercial scale, along finding the right suppliers, customer base and commercial partners necessary to achieve this scaling up. To do this, extensive capital is required for commercial-scale manufacturing, production, and market launch operations. This is exacerbated by the fact that innovative energy technologies tend to be even more capital intensive than usual innovative technologies, which explains why so many innovative energy companies remain stuck in the VoD (Jenkins and Mastur, 2011).

The situation has reached its low point following the financial crisis, as renewable energy sources (RES) investments from banks, VCs and institutional investors in the EU fell dramatically. For mature energy technologies, this was reverted thanks to stimuli from the European Investment Bank (EIB) and national public promotional banks such as the German KfW (TaylorWessing, 2010), and today the market drives investments for mature RES such as solar energy and onshore wind considering their constant decrease in levelised cost of electricity (LCOE). However, this is not the case for innovative energy technologies (especially highly capital-intensive ones such as wave/tidal energy), where early-stage access to finance is a severe issue. Most investors want to invest at a later stage, and the difficulties in trying to cross the VoD are increasing. In addition to the usual high risk and capital intensity problems, other challenges faced by energy technology innovators are that investors are deterred by uncertainties over permitting licensing, securing a good power purchase agreement and finding capital to scale up the technology to the commercial phase (*ibid.*).

Usually, if a firm fails to commercialise a world-class innovative technology, it is because it failed to secure the necessary private financing due to incompatibilities between what the innovator offers and what the investor seeks (Murphy and Edwards, 2003). These gaps include things such as:

- The differences in values, requirements and goals of innovators and investors, with the former rather seeking technological innovation and the latter financial returns
- The long time frame a venture needs to enter positive cash flows
- The risk perception of private investors

The last point contains several aspects; these can range from the most common ones (such as financial, technological, completion and business risks) to less obvious ones, specific to innovative energy ventures, such as information asymmetries (the investors are worried that the innovator does not share everything it knows about its technology's potential in the market).

2.1.2.2. Recommendations in the energy **innovation** literature to ease the Valley of Death

To offset some of these risks, some actions can be taken (*ibid.*), such as:

- Reducing the information asymmetries between investors and innovators, such as the difficulties the two groups have in sharing viable financial and technological information the can both comprehend
- Seeking an acceleration in the focus shift of a venture from technological development to market introduction
- Developing innovative ways for public and private players to co-invest in a venture and thus further maximise the leveraging of private finance.

There is a need to increase the support for energy technology innovation significantly. This should be done by public institutions, to avoid any IP retention by private companies, although it must be made sure they are not subject to political influences. Finally, these institutions should receive unlimited, unbiased advising from the industry as well as the scientific community (Weyant, 2011). Both the investors and the innovators agree that the governments and their policies must play a crucial role. Firstly, by exacerbating the importance of innovative energy technology within its regulatory framework; then, by removing any ambiguity lying within support frameworks. Regulatory stability and clear, accessible incentives through public funding and grants are key (TaylorWessing, 2010).

2.1.3. The effect of public intervention

Public intervention appears to be the solution, according to the literature. If one were to leave it completely to the market, investments in innovation would be below the socially desirable level, due to challenges such as "limited appropriability, financial market failure, external benefits to the production of knowledge", among others (Martin and Scott, 2010). This explains why public funding is so important for innovative technology companies. Alongside funding, several policies can also be helpful, such as positive competition and tax policies and subsidies. Public support should be the basis to support the research that eventually turns into marketable products. There should be several institutions in the EU, like the National Institute of Standards and Technology in the USA, that bridge the public and private sectors, by showcasing innovative technologies to private investors and their potential place in the market (ibid.).

Overall, governments are responsible for a relatively small amount of total funding in innovative energy technology firms, but their importance is considered vital. They can help build partnerships between research institutes/universities and the industry, they can leverage private finance through financial instruments such as grants, they can support public educational establishments to grow the future base of innovators, and make the regulatory environment as optimal as possible for innovative companies (Auerswald and Branscomb, 2003). Governments can take are to subsidise the R&D phase of private firms, sponsor universities and research agencies, strengthen the protection of an innovative company's intellectual property, offer grants prizes, awards, and sponsor the demonstration of large-scale innovative projects (Reichman *et al.,* 2008).

At later stages, to speed up the diffusion of innovative technologies ready to enter the market, other policies that can be implemented comprise "technology standards, technology demonstrations and testimonials, information programs, and provision of lower-cost financing" (Weyant, 2011). Some authors believe the VoD can be solely addressed via effective public policy, as the right policies can commercialise a higher volume of innovative energy technologies, in turn creating more jobs and stimulating more competition in the economy. Without the necessary policies and public leverage, there will be not enough spontaneous interest from private finance to bring energy innovations on the market. Jenkins and Mastur (2011) for example, propose two such policies that could bridge the VoD in the USA[3].

While supply-side policies like those are vital, the European Commission (EC) has known for several years that these must be complemented by demand-side policies. The latter are "all public measures to induce innovations and/or speed up diffusion of innovations through increasing the demand for innovations, defining new functional requirement for products and services or better articulating demand" (Edler and Georghiou, 2007). Examples of such policies have been researched for decades; Geroski (1990) showed that public innovation procurement has a higher cost efficiency than R&D subsidies. Nonetheless, most innovation policies brought forward by the EC in the past decades have focused on the supply rather than the demand side (EC, 2009), so the latter should be focused on more to help bridge the VoD.

To sum up, most of the recommendations given in the literature for innovative energy technologies to escape the VoD focus on the public sector. Yet a lot is already being done with public funds to try and help innovative technology start-ups advance their ventures. Annex 1 shows a list of EU funded programs and institutions (e.g. the European Investment Bank[4]) that aim to do that through public direct investments and policy-based incentives.

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[3] Firstly, the authors suggest the Clean Energy Deployment Administration (CEDA) to provide the necessary public funding to bridge the VoD. CEDA is a governmental investment fund that would initially utilise public money and eventually become an "independent, not-for-profit, private sector investment fund". It would offer vital financial tools to reduce the VoD financing gap, ranging from loan guarantees, insurance products, bonds and debt financial instruments. Through this, the perceived financial risk would be smaller, hence attracting and leveraging private finance. Secondly, they suggest implementing the National Clean Energy Testbeds (N-CET) program. Rather than trying to solely reduce the financing gap, this program seeks to cut the "cost, time, and permitting challenges associated with innovative energy technology demonstration". It would do so by allowing innovative energy companies to use "pre-approved, monitored and grid-connected public lands" when the need to build projects to demonstrate their technology can work on the commercial scale. This would highly reduce the costs and time consumption typical of finding land, receive permitting licenses and build the necessary infrastructure needed for innovative energy demonstration projects.

[4] See http://www.eib.org/

While these play an important role, most EU and national funding currently works with grants, subsidizing a particular project through the use of public money. Several other EU funded programs use grants and a combination of other financial instruments to sustain energy innovation; some of these programs can be found in Annex 2, the most well-known being Horizon 2020[5]. In addition to programs that are already in place, research is continuously being funded by the EC to analyse new ways to improve the situation in the VoD, such as by using the Commercial Readiness index (CRI) framework to support policies aiming at accelerating the commercialisation of innovative RES (IEA-RETD, 2017). So public policy is indeed necessary, but one can argue it is not a panacea to solve the VoD on its own. Policy can help with facilitating some of the financial risks that hold back private investors, by providing specific support programmes and public funds as leverage for example. However, other criteria cause the low interest of private investors, such as business risks (unviable business plans, misinformation exchange between innovators and investors, mutual visibility).

To conclude, innovative energy technology projects often do not have too much difficulty receiving public funding, yet undergo a troublesome route when it comes to attracting private investors, which is what this thesis is based on. A recent study from ICF (2016) interviewed 35 energy innovators from several sectors (PV, CSP, wind energy, ocean energy, geothermal, biomass, storage, CCS, infrastructure[6]), which are at the stage of scaling up their demonstration projects on a commercial level, i.e. in the middle of the VoD. They confirm the literature findings, namely that the main problem behind the VoD is that energy technology innovators cannot attract enough capital from private investors, which is where the investment community could play a role.

2.2. The players within an investment community

Most of the recommendations given in the literature to solve the VoD point towards public intervention. However, coming back to the two categories of issues mentioned in the Introduction section, while public intervention is necessary to ease challenging issues (i.e. the intrinsic ones) faced by energy innovators, another set of issues (i.e. the transactional ones) could realistically be eased by improving the investment community. What is included in the scope of an investment community will now be discussed.

The concept of investment community is common; an extensive web search shows there are several entities that are regarded as an investment community:

- Investor groups; such as IIGCC (Institutional Investors Group on Climate Change), INCR (Investor Network on Climate Risk), LTIIA (Long Term Infrastructure Investors Association), LTIC (Long Term Investors Club), Initiative Carbon 2020, or PDC (Portfolio Decarbonisation Coalition)
- Business angel groups; such as EBAN (European Business Angel Network), BAE (Business Angels Europe), or Element 8
- VC and PE funds; such as BEV (Breakthrough Energy Ventures), SI Capital, Fidura, EarlyBird, or Cleantech Invest
- Public-private and policy advocacy working groups; such as EEFIG (Energy Efficiency Financial Institutions Group), US PREF (US Partenrship for Renewable Energy Finance), CEM (Clean Energy Ministerial), or GIIC (Green Infrastructure Investment Coalition)

[5] See http://ec.europa.eu/programmes/horizon2020/
[6] PV: photovoltaic, CSP: concentrated solar power, CCS: carbon capture and storage

- Databases; such as Impact Assets 50, or WIPO (World Intellectual Property Organization) Green

However, the given definition of an investment community (see Introduction) brings the scope down, as there must be a matching platform connecting innovators and investors, offering specific matchmaking services between the two groups. The examples given above thus cannot be regarded as compliant to the definition, so only investment communities that have a matching platform count.

2.2.1. Matching platforms

These exist in three forms:

1. Business accelerators: these tend to be publicly funded organisations that assist innovative start-ups by providing them with capital and contacts as well as by coaching and mentoring the innovators
2. Private matchmaking companies: these are for-profit firms that offer several services to innovators, such as showcasing them on an online database available to investors, or providing activities such as scouting for investors in foreign countries
3. Crowdfunding platforms (CFPs): these are the most recent type of matching platform; CFPs are still a growing industry, based on the idea that any individual can start investing in innovators presented on the platform, with sums as low as 20 euros.

These three types of matching platforms are the basis for the research made, and therefore the only types considered within the scope of this thesis.

2.2.2. Innovators

To understand which innovators are in scope, what an innovative energy technology project is must be illustrated.

2.2.2.1. Technology

The technologies that are considered in scope are all the (potential) pillars of a future clean energy system, so:

- Renewable energy sources (RES): including solar, wind, biofuel, hydro, tidal, ocean and geothermal energy as well as any novel renewable energy sources
- Energy smart technologies: including energy efficiency (EE), storage, electrified transport, fuel cells, hydrogen, carbon capture and storage/utilisation (CCSU) and smart grids.

Considering the extensive variability between these technologies, some will work better than others when forming an investment community. For example, most of the financing activity regarding EE is revolved around implementing existing mature technologies, rather than investing into new technologies. Consequently then, there are few investment communities based on innovative EE technologies.

2.2.2.2. Maturity

This thesis considers a project innovative if it has not entered the market/commercialisation phase yet. It must be mature enough to have entered the VoD, but not mature enough to have escaped it. This can be quantified by introducing the technology readiness levels (TRL). Within non-commercialised projects, TRLs are often used to define the maturity of a specific project. They range from 1 to 9, and were first introduced by NASA; Figure 4 below illustrates these 9 levels. As shown in the literature review, the VoD usually occurs when an innovator has demonstrated its prototype and needs to scale it up, until it is ready to introduce its technology on the market. Thus, since the innovators have to be stuck in the VoD to be in scope, they have to be between TRL 6 and 9[7].

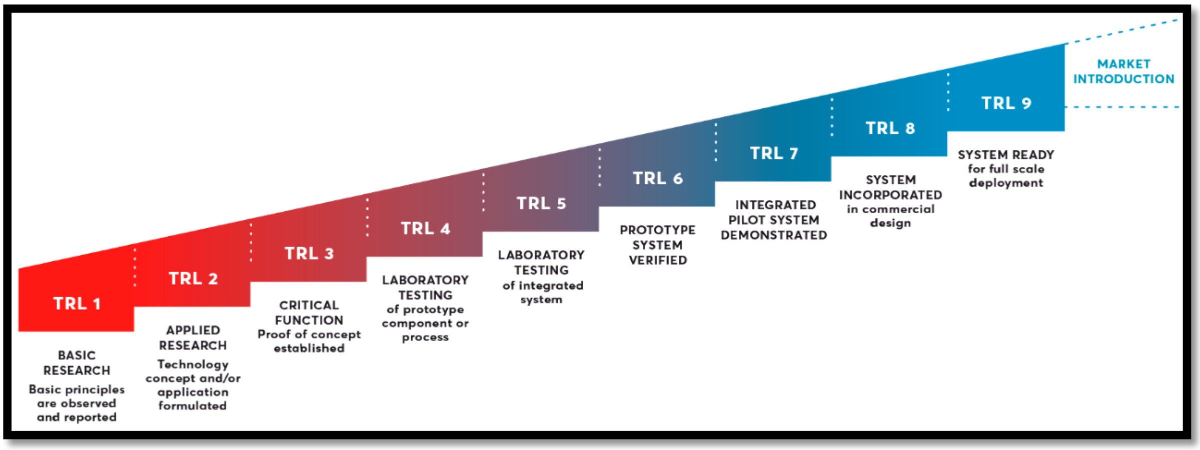

Figure 4: concise definition of the 9 TRLs. Source: BRIGAID (2016).

2.2.2.3. Other scoping criteria

Regarding the type of innovative technology project, it must be an energy project of a technological nature (either hardware or software), meaning that social or business model innovations will not be included. Within technological innovations, both product and process technological innovations are included[8].

In terms of geography, all innovators must be developing or have developed their innovative energy technology projects in the EU. This is also true for the other components of the investment community (matching platforms and investors)[9].

2.2.3. Investors

The final investment community player are investors. There are several types of investors that can be considered (see Table 2). Seeing that they all apparently invest in energy technologies currently stuck in the VoD (as shown in Figure 3, in the literature review), they can all be kept in scope. A more detailed explanation of the various investor types can be found in Annex 3 (specifically, the various types dealing with public funds can be seen). The investor scoping will be significantly brought down thanks to the findings during the research phase.

[7] An exception can be made if for example a TRL 4 or 5 innovator is very close to reaching TRL 6; whether they are in scope is decided on a case-by-case basis

[8] A product innovation is making an existing product more efficient, while process innovations make the manufacturing of said product more efficient.

[9] Exceptions ca be made on a case-by-case basis, e.g. a non-EU investor that invests in the EU can be considered in scope.

Table 2: description of the various investor types that could finance energy innovators. Source: own rendering[10].

Investor type	Description
Own resources, family and friends	Friends, family and founders who invest their personal capital
Business accelerators	Structures that invest a small amount of money in a large number of start-ups
Public funds	Entities that invest public money in various forms, such as grants
Business angels	Affluent individuals or families that provide capital to start-ups
Crowd funders	Individuals who provide capital via a crowdfunding platform
Venture capital funds	A type of private equity fund that provides capital to small, early stage, emerging firms with high-growth potential
Growth/expansion capital funds	A type of private equity fund that provides capital to fund the expansion of an established firm
Corporate investors	Large companies that invest in other firms, either directly or via a corporate venture capital fund
Commercial banks	Private commercial banks such as Deutsche Bank and BNP Paribas Fortis.
Institutional investors	A nonbank organisation that invests large quantities, such as pension funds and insurance companies

2.3. Theoretical framework

Knowing the players involved in the investment community, a few considerations must be made from the literature review presented in this Theory section:

- The literature confirms that the VoD is common and highly problematic within energy innovation.
- While it illustrates several issues the innovators face when trying to access finance, it does not seem to make any categorisation of said issues, such as distinguishing between intrinsic and transactional issues.
- Since there is no categorisation, it is not clear whether some issues are more likely to be solved than others.
- The issues illustrated are numerous, but intuitively, one would think there are many more.
- Furthermore, most issues mentioned (such as high capital intensity and high perceived risks), fall in the intrinsic issue category. The only real transactional issue mentioned is that there is an information asymmetry and miscommunication between innovators and investors, as these groups have a completely different background.

[10] Compiled on the basis of various sources, including AFME (2017), ICF (2016) and BNEF (2016).

- Most of the recommendations call for public intervention.
- There is no mention of an investment community, or specifically of matching platforms.

The research phase detailed in the following Methods section will focus on this last point. By undergoing first-hand research on the players involved in an investment community, namely matching platforms, innovators and investors, it will answer the reminder of the gaps listed above. This will be done by gathering a longlist of issues from the players, categorising them, prioritising those that are more likely to be solved and finally provide recommendations which do not require public intervention, but mostly actions from the players of the investment community themselves.

3. Methods

This section will illustrate the methodology that was put in place to answer the research question and sub-questions. The core of this methodology and main source of data are the interviews made with every component of the investment community.

3.1. Researching investment community players

3.1.1. Innovators stuck in the Valley of Death: answering the first research sub-question

To answer research sub-question 1, a list of innovative energy technology projects that is currently in the VoD in the EU was made[11]. These came from several sources:

1. Most came from the Cordis database[12], which contains the innovative energy projects funded under FP7 and H2020, the past and current research and innovation funding programmes in the EU. From the database, 704 projects were selected.
2. Through the European Energy Network[13], 43 national energy agencies were contacted. Additionally, 17 energy technology associations were contacted. These 60 contacts allowed to add another 45 innovative energy projects to the list.
3. Finally, by contacting the partners and searching in the network of the people involved in the project this thesis is based on, a further 27 projects were added to the list.

In total, the initial list of innovative energy technology projects stuck in the VoD contained 776 projects. These were then analysed in terms of the set scoping boundaries (e.g. TRL, geography) and on their innovativeness. This permitted to shrink the list to 280 projects, as the other 496 were deemed out of the scope of this thesis. An initial survey was sent to these 280 projects gathering more basic information (see Annex 4). The type of questions included in this survey and other survey characteristics such as how to approach the projects build on the research by Walonick (2010).

Out of 280 projects, the 72 who answered the first survey received a second, more detailed survey (see Annex 5), for which the methodology used was the same as for the first survey. However, while the first survey was sent as a Word document, the second was made on Excel for it to include more detailed questions whilst being user-friendly. It included five sheets, namely: project description, project information, project finance, financing obstacles and project risks. Finally, 28 innovative energy technology projects successfully filled the second survey and answered additional interview questions[14], thus creating the pool of projects currently stuck in the VoD in the EU; the description of each project can be found in Annex 6.

The information from each survey was put under Word format, thus creating 28 fiches illustrating the projects. These fiches were then used to compare and contrast the 28 projects; a quantitative analysis was made by looking at indicators such as geographical/technological coverage, time to positive cash flow and project risks. Once the geographical coverage was shown, the other quantitative indicators were analysed in terms of technology only, not geography. This was decided because all 28 projects wish to enter the market in several EU countries (if not all), so analysing other indicators according to the projects' current location would not include their future target

[11] This list was made with the help of London Economics, partners in the project this thesis is based on.
[12] See http://cordis.europa.eu/home_en.html
[13] See http://enr-network.org/
[14] A few innovators were contacted again in case some of the answers given were unclear

locations and hence skew the interpretation. One of these quantitative indicators were the financing sources the 28 projects asked finance from. These included all possible sources available, namely:

- IPOs/public equity: this occurs when an innovator undergoes a secondary or initial public offering (IPO), in which it becomes a publicly listed company, which investors can trade on the stock market
- Public debt: this is for instance a loan given out by a public entity such as a public bank, or bonds
- Banks: i.e. commercial and private banks
- Alternative equity: this is private equity, so includes any private equity funds such as VCs, corporations, institutional investors, etc.
- Alternative loan: this is private debt, so includes funds such as asset based lenders, hedge funds, private placements, etc. but also some VCs that specialize in debt
- Other: this is mainly represented by research grants and public money given by entities such as H2020, EU and national grants, local governmental support, etc. but also by a few private entities such as family, friends and business angels

3.1.2. Successful innovators, matching platforms and investors: answering the second research sub-question

3.1.2.1. Answering the second research sub-question

Alongside understanding why the 28 projects are currently stuck in the VoD, the interviews with these 28 innovators allowed to gather the issues they are currently facing and categorise them among intrinsic and transactional issues. These were further sub-categorised and are the basis of the remainder of the results interpretation. This was the sole work of the author, and was done by looking at the longlist of issues, aggregating the most similar ones together and then bringing down the scope. Eventually, there were several groups of circa 4-5 issues each, which allowed to name the various sub-categories based on their content. The same logic was then done to name the categories. This categorisation permitted to answer research sub-question 2. One should note that the various intrinsic and transactional issues arose from the 28 innovators stuck in the VoD, but also from the successful innovators that escaped the VoD, as well as from the matching platforms and the investors who work daily with innovators stuck in the VoD. These all had to be researched separately.

3.1.2.2. Researching successful innovators

A total of 41 energy innovators were pre-selected after an extensive web research (see Annex 7 for the full list). Some of the 41 innovators were also discovered after interviewing the board of advisors[15] that sat behind the project this thesis is based on. This allowed to create a longlist in Excel, where each innovator was separated according to the following categories, as shown in Table 3 below.

Table 3: illustration of the categories used to separate the innovators.

Technology type	Innovator type (name)	Project / Technology	Maturity level	Funding history / Investment size	Investor type	Geographical scope	Sources

[15] The name and workplace of the advisors interviewed can be found in Annex 8.

Initial information was gathered on their innovative energy technology project online, and they were asked to confirm their suitability to the study and whether they would be interested in participating. Eventually, 9 of the 41 innovators agreed to do a personal interview. These are all energy innovators that were successful at making it on the market[16].

3.1.2.3. Researching matching platforms

A total of 25 matching platforms were pre-selected after an extensive web research (see Annex 9 for the full list), of which 11 agreed to a personal interview, namely 5 business accelerators, 4 crowdfunding platforms and 2 private matchmaking companies[17]. In addition to the issues faced by innovators stuck in the VoD, the questions asked mostly regarded the services that the matching platforms offer to improve the matching between innovators and investors, such as "Which services are you specialised in?", "How do you contribute to creating matches?" and "Which additional services could be introduces to increase matchmaking success?". A longlist of services offered from all matching platforms types was made. These services were then categorised by matching platform type and their utility against existing issues faced by innovators stuck in the VoD was analysed.

3.1.2.4. Researching investors

A total of 33 investors were pre-selected after an extensive web research (see Annex 10 for the full list). Of the 33, 8 agreed to a personal interview, namely 5 VCs, 1 broker, 1 lawyer and 1 business angel. The main questions regarded which investors a TRL 6-9 energy innovator should target[18].

One should note that all components of the investment community (i.e. innovators, matching platforms and investors) that were interviewed also gave further information on each other and the overarching environment, such as things that make the others successful, challenges they face and recommendations on how to improve. Finally, some information was also gathered by attending relevant events[19].

3.2. Interpretation of the results: answering the main research question

To answer the main research question, the information gathered to answer the two sub-questions was used. Analysing the projects stuck in the VoD and interviewing all components of the investment community (i.e. innovators, investors, matching platforms) illustrated the intrinsic and transactional issues faced by innovators stuck in the VoD, the challenges hindering matching platforms and the difficulties behind targeting the correct investors.

[16] They are called 'innovators' throughout the thesis even though they are on the market and therefore above TRL 9, so outside of the aforementioned scoping boundaries of the innovator category. This is because the questions they answered regard the period when they were at a TRL 6-9 stage and what they did to escape the VoD, therefore making them in scope

[17] Many of these, considering their private structure, preferred not to share their information, hence why solely 2 were interviewed.

[18] Several corporations (e.g. Samsung, Engie, Bosch etc.) were contacted, but since they abide to stringent regulations and confidentiality measures, no corporate investor was available for an interview, or even an informal chat. Generally, the fact investors are private, for-profit entities explains why so few were available for an interview.

[19] Such as one on the finance market place of energy on the 18/01/17, one organised by SolarPower Europe on the 07/02/17, and one of the European Crowdfunding Network on the 16/02/17.

These negative factors were discussed one by one:

- Intrinsic issues were presented and an explanation was given showing why they cannot be dealt with within a master thesis.
- Transactional issues were presented as well; the services given by the matching platforms were then analysed to see which service eases which transactional issue(s), and hence which of the latter is not being taken care of by existing matching platform services. This was used to create an “ideal” matching platform.
- The challenges existing matching platforms face were presented, and recommendations on how to improve them were given.
- After having showed the issues energy innovators face, the factors successful innovators possess were presented and recommendations were given to create an “ideal” innovator
- The difficulties in targeting the right investors were presented and recommendations were given on which to target, “ideally”.
- A final set of recommendations was given to overcome overarching issues such as regulatory problems.

Every single result and result interpretation was the personal work and opinion of the author, so this research should in no way be considered as the only way for innovative energy technology projects stuck in the VoD in the EU to come out of it, but rather as a starting point upon which to build up with further research. For confidentiality reasons, while the list of innovators, investors and matching platforms can be found in the annexes, nowhere in the thesis will the name of the people interviewed be mentioned next to what they have said; instead, phrases like “a Swiss VC stated that…” will be used. The expression “the interviewees” will be used henceforth to represent the whole group of 65 innovators (including the 28 innovators stuck in the VoD), investors, matching platforms and others (e.g. advisors) that were interviewed during the research phase. Finally, unless stated otherwise in their titles, the figures and tables are the rendering of the author, based on own research and results.

4. Results

The results section will first look at the innovative energy technology projects stuck in the VoD through a quantitative analysis. Then, by adding the information gathered from the interviews of the successful innovators, the investors and the matching platforms, a qualitative analysis of the issues faced by energy innovators stuck in the VoD will be made.

4.1. Projects stuck in the Valley of Death in the European Union

To answer the first research sub-question, the first survey was sent to 280 projects[20], from which the final 28 projects stuck in the VoD came from. Several of these 280 projects were suggested by advisors or energy associations, meaning their choice was subjective. To have a non-skewed appreciation of the actual geographical/technological coverage of innovative energy projects stuck in the VoD, one should look at 180 of those 280 projects that were EU-funded under FP7 or H2020. The skewing should be minimised, as EU innovation funding is likely proportional to the finance needs for innovation in each country. Figure 5 below is a map of the EU, illustrating the geographical distribution of these 180 projects. Although there is a good geographical coverage (except Eastern Europe), some countries have many more projects stuck in the VoD than others, specifically Italy, Spain and Germany, compared to e.g. the Scandinavian countries.

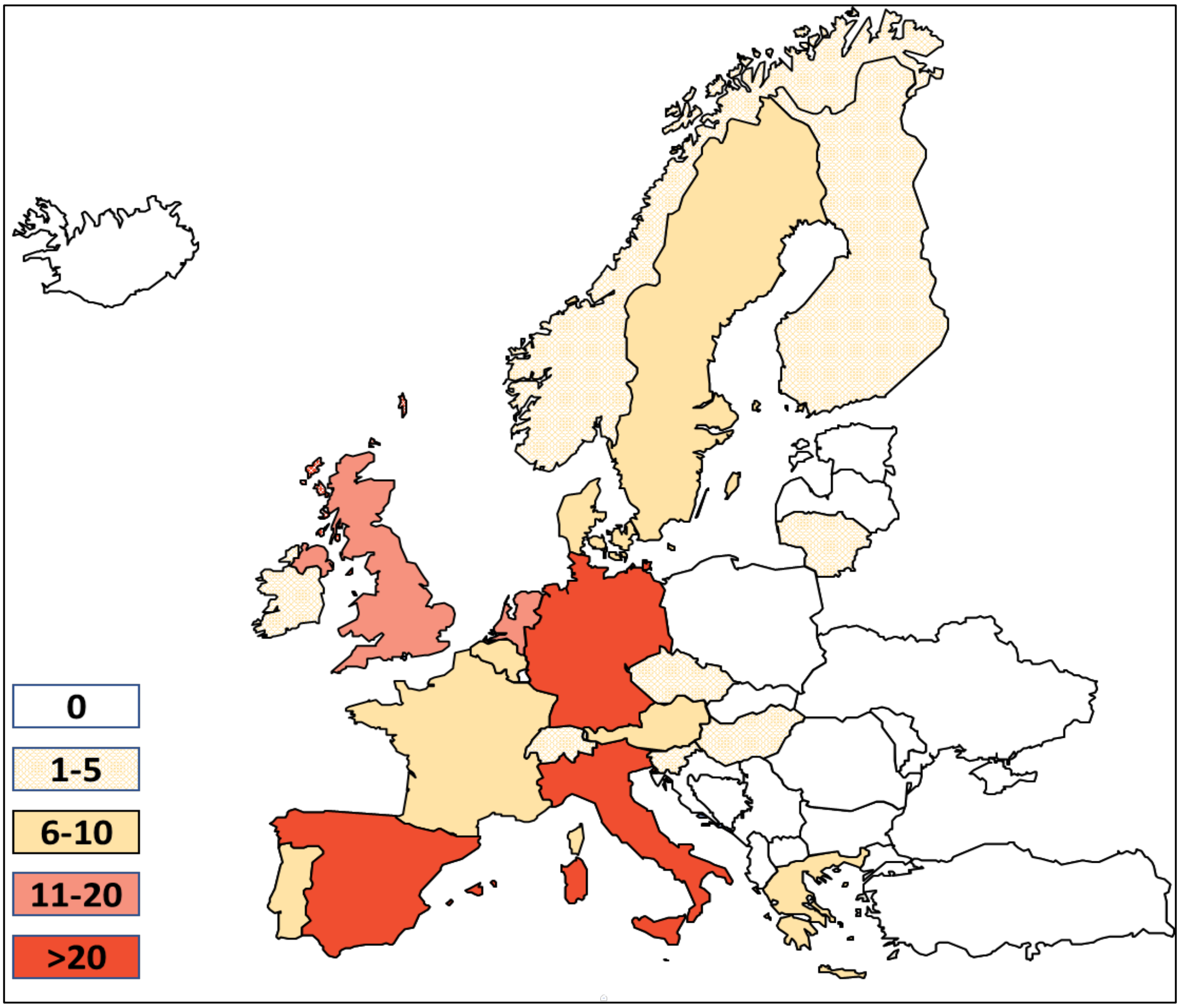

Figure 5: illustration of VoD hotspots in the EU, showing the number of projects per country.

[20] The geographical and technological distribution of the 280 projects can be seen in Annex 11.

In terms of technology, Table 4 below shows the technological categorisation of the 180 EU-funded projects.

Table 4: separation of the 180 EU-funded projects in 25 technology types.

Technology	# of projects
Solar Power (PV / CPV)	20
Energy Savings	19
Wind Power	18
Distribution System	17
Biogas/Biomass/Waste heat	12
Smart Cities	12
Industry	12
Biofuel	10
Carbon Capture Storage (CCS)	10
Solar (CSP)	10
Tidal Power	9
Wave Power	9
Storage	5
Solar (Other, e.g. cooling)	3
Geothermal	2
Other[21]	10
Total	**180**

Just as for the geography, there is also a good technological coverage, as the 180 projects stuck in the VoD make up 25 separate technology types. The technology types that have the highest number of projects that require financing come from mature industries such as solar and wind energy, meaning innovative technologies occur in all industries, regardless of maturity. The 28 projects that answered the second survey successfully will now be extensively analysed through several indicators.

[21] Other includes heat pumps, microalgae, TSO, CHP, polygeneration, solid waste recycling, non-RES generation, sewage sludge, leaks detection and power actuators.

4.1.1. Geography and technology

In terms of geography, Figure 6 below spreads the 28 projects stuck in the VoD throughout 15 countries.

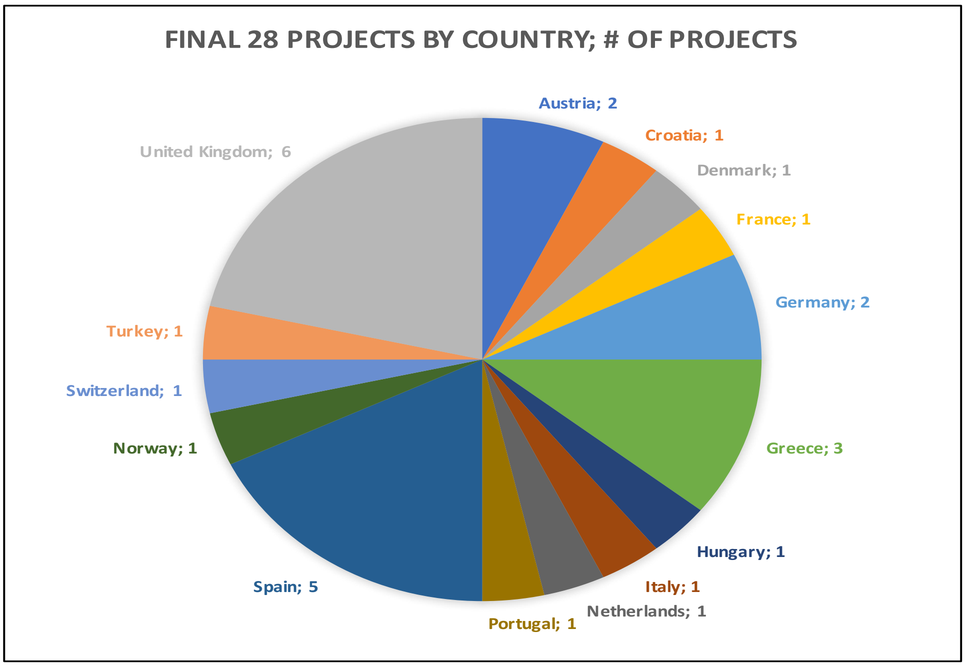

Figure 6: pie chart depicting the geographical coverage of the 28 projects.

There is a solid geographical coverage, ranging from West to East and South to North, showing the VoD is spread out within the whole of the EU. Several projects are based in Southern Europe, e.g. Spain, where there is a poor financial situation in general, exacerbated when it comes to innovative technologies. The overrepresentation of projects from the United Kingdom is explained by the fact that most of the wave and tidal energy projects are located there, and that these two technologies represent a large portion of projects stuck in the VoD, as described below.

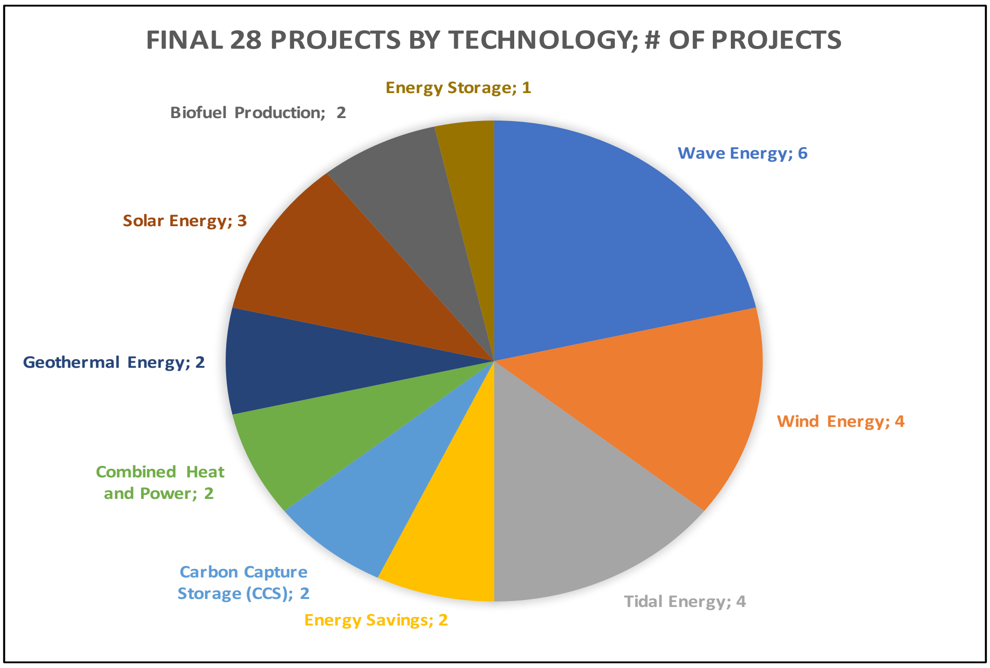

Figure 7: pie chart depicting the technological coverage of the 28 projects.

Figure 7 above separates the 28 projects within ten different technologies. The two most represented technologies are wave and tidal energy. These technologies and their industries are still extensively immature so more of these projects need financing compared to e.g. geothermal energy. Even when geothermal projects are innovative, since the technology has been active since the 1904 in Italy (Tiwari and Ghosal, 2005), they can rely on decades of industry track record, on established stakeholders, industrial partners and electricity distribution channels. Generally, there is a large variability of technologies being brought forward, which reflects the current political agendas in the EU.

4.1.2. TRL

This indicator looks at the TRL, i.e. the current stage of development of the innovative energy technology, with TRL 1 being the first stage and TRL 9 the last one, just before the technology is ready to enter the market. As aforementioned in previous chapters, TRL 6 to 9 is typically where the VoD is located. Figure 8 below shows that 26 out of the 28 projects stuck in the VoD are indeed either at TRL 6, 7, 8 or 9[22]. Furthermore, 23 out of the 28 projects are either TRL 6 or 7, i.e. the typical beginning of the VoD. This goes to show that the VoD is highly problematic from the very start and escaping it to enter the market is challenging.

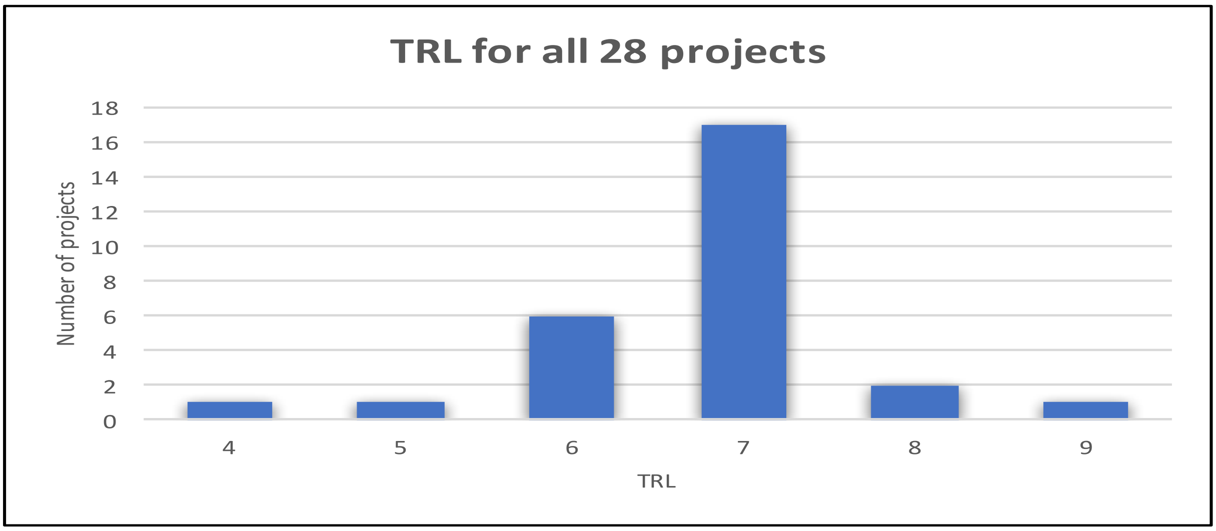

Figure 8: graph depicting the TRL of the 28 projects combined.

The TRL per technology was then analysed, as shown in Figure 9 below; where every technology is represented (with the number of projects in brackets), and an average of the TRL values of the projects within each technology was made. While most technologies share a TRL in the range of 6-7.5, the only outlier is energy savings, with an average TRL of 5. This is because there are two projects within energy savings, with one of them being the TRL 4 project mentioned in Figure 9. The low TRL value for energy savings should therefore be seen as an exception, and not as a characteristic of the specific technology type.

[22] The TRL 4 project and TRL 5 project were included as they are both very close to reaching higher TRLs and are indeed stuck in the VoD

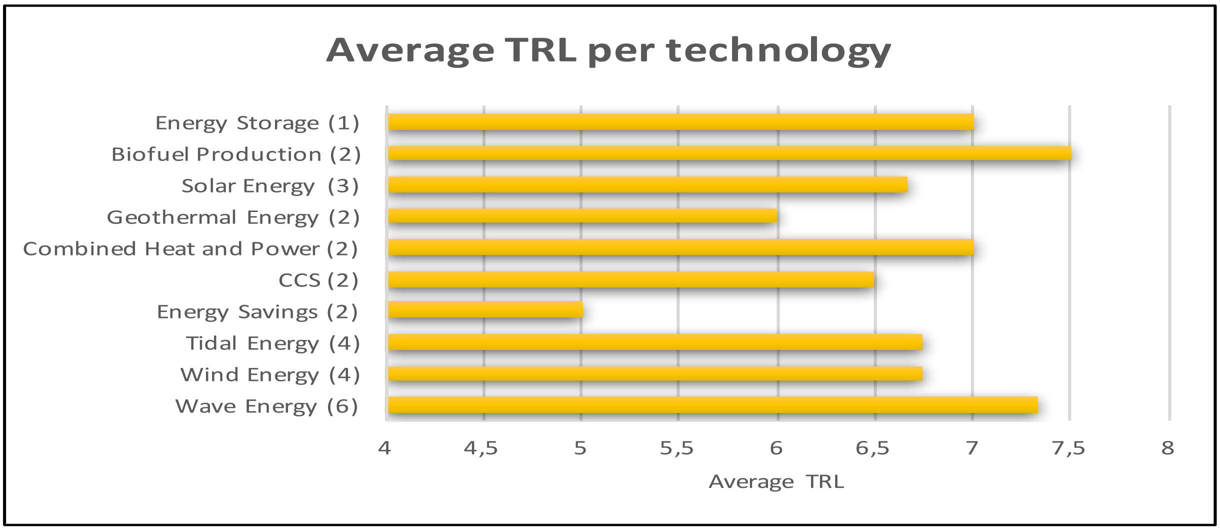

Figure 9: graph depicting the TRL of the 28 projects, per technology.

4.1.3. Time to market

This indicator is time to market, representing the number of predicted years it will take the 28 projects to be commercialised and enter the market. It is important to note that unlike the TRL indicator[23] this one is highly subjective and is based on each innovator's prediction, implying some might be fairly optimistic. As shown in Figure 10, the result is comparable to a bell shape graph, with the largest portion of projects expecting to enter the market in three years time.

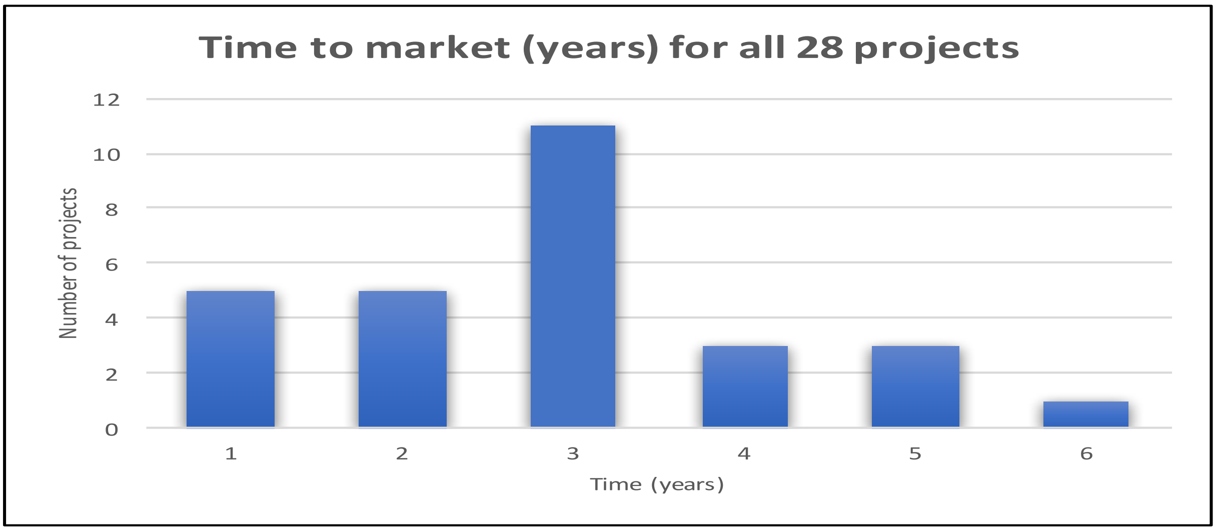

Figure 10: graph depicting the time to market of the 28 projects combined.

The time to market indicator was also analysed per technology, as shown in Figure 11 below. Most of the technologies share similar values that would take them 2 to 3 years to enter the market. On one extreme, the exceptions are energy savings and CCS, needing 4 years. For energy savings, this is explained by the aforementioned low TRL project; for CCS, by the fact that these are extremely large scale projects that carry a lot of implications, from a technological but also socio-economical point of view. On the other extreme, the exception is energy storage, which only requires one year. This is

[23] The various TRLs have clear, distinct boundaries and the innovator must be able to prove (s)he has indeed reached that level.

because there is only one storage project, which happens to be quite advanced, so it is not a technology type characteristic.

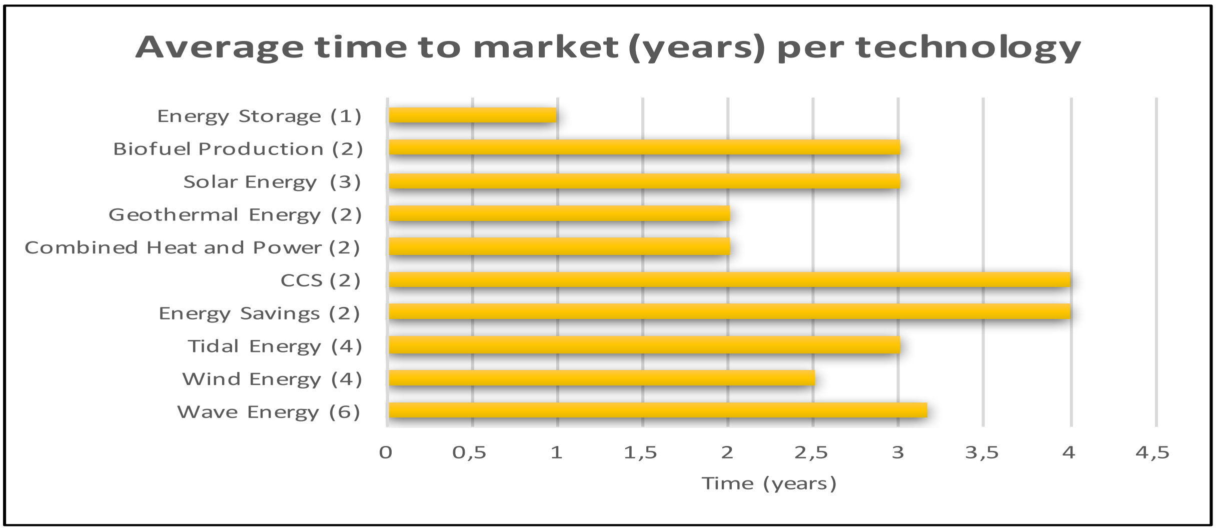

Figure 11: graph depicting the time to market of the 28 projects, per technology.

4.1.4. Time to positive cash flow

This indicator looks at how many years it will take the project to start making profits. Figure 12 shows the aggregate values for all 28 projects. This is based on 5 to 10-year cash flow analyses provided by each innovator, where the starting point is the beginning of the construction (e.g. for a geothermal project) or the production (e.g. for a project that wants to sell individual products) phase. The highest portion of projects expects to take 4 years to achieve positive cash flows, which is one year longer than the predicted 3 years to enter the market. For many of the projects then, positive cash flows occur in the first year of the operational phase, once they are commercialised. Generally, the fact time to market and positive cash flow are quite long is a testimony of the depth of the VoD.

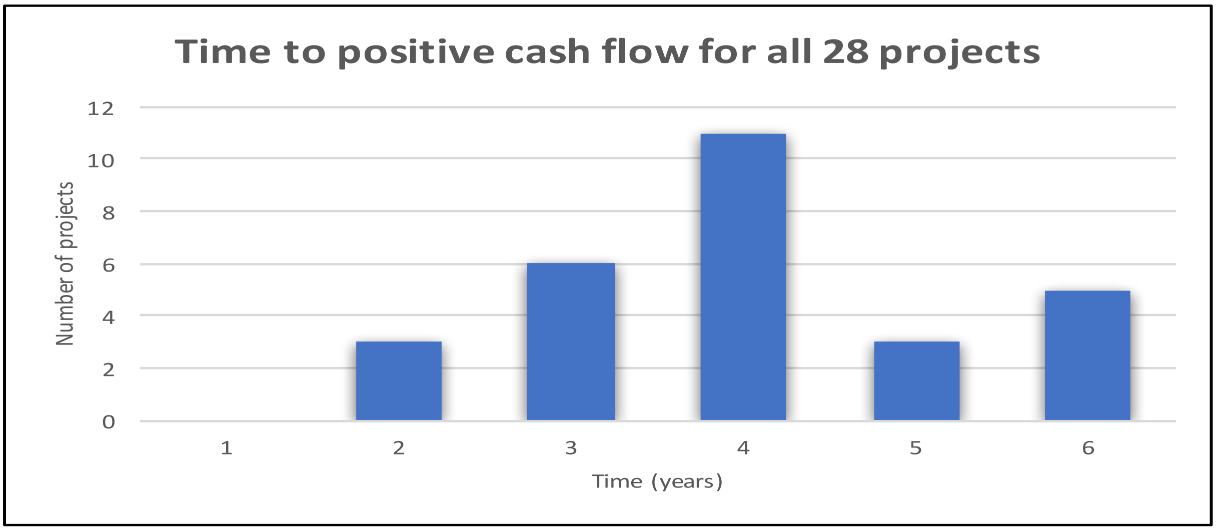

Figure 12: graph depicting the time to positive cash flow of the 28 projects combined.

This indicator was also looked at per technology, as shown in Figure 13 below. When comparing this graph with the average time to market per technology graph, one can note that several technologies (such as energy storage, biofuel production, CHP and tidal energy) follow the aforementioned pattern, i.e. the time to positive cash flow is about one year longer than the time to market. Other patterns are also existent; for instance, solar, geothermal and wind energy take two years longer, because of the very high capital intensity of such projects, meaning it takes longer to offset the initial costs. Energy savings take the same time, whereas CCS and wave energy take a few months less to have positive cash flows than to enter the market. One of the reasons for this is that some of the projects within these technologies plan to sell a small-scale product (to start making revenues and build up a customer base) before officially entering the market with a larger scale version.

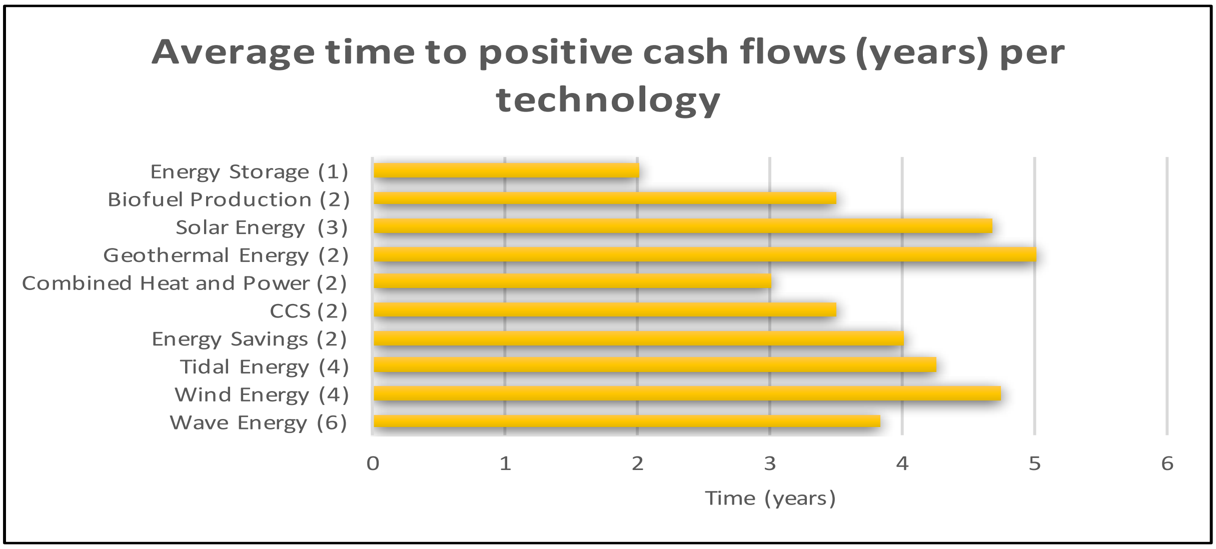

Figure 13: graph depicting the time to positive cash flow of the 28 projects, per technology.

4.1.5. Capital needed and capital secured

This indicator represents the capital needed (in millions of €[24]) by each project to complete the construction/production phase, i.e. the capital needed to be able to enter the market. Figure 14 below shows the aggregate capital needed by all 28 projects versus the capital they have obtained at this point. The result is that less than a third of the capital needed to enter the market has been secured thus far, with circa €600 millions still missing; showing the extent of the VoD. In addition, one project needs a further €3 millions to reach the construction/production phase, and five other projects will require an aggregate €16.6 millions after this phase before they can be operational. One should keep in mind that the innovators might have been optimistic when stating their capital needed figures.

[24] For projects from the UK, the currency was converted from pounds to euros using http://www.xe.com/currencyconverter/ with the currency rates of the week of the 10th of April 2017

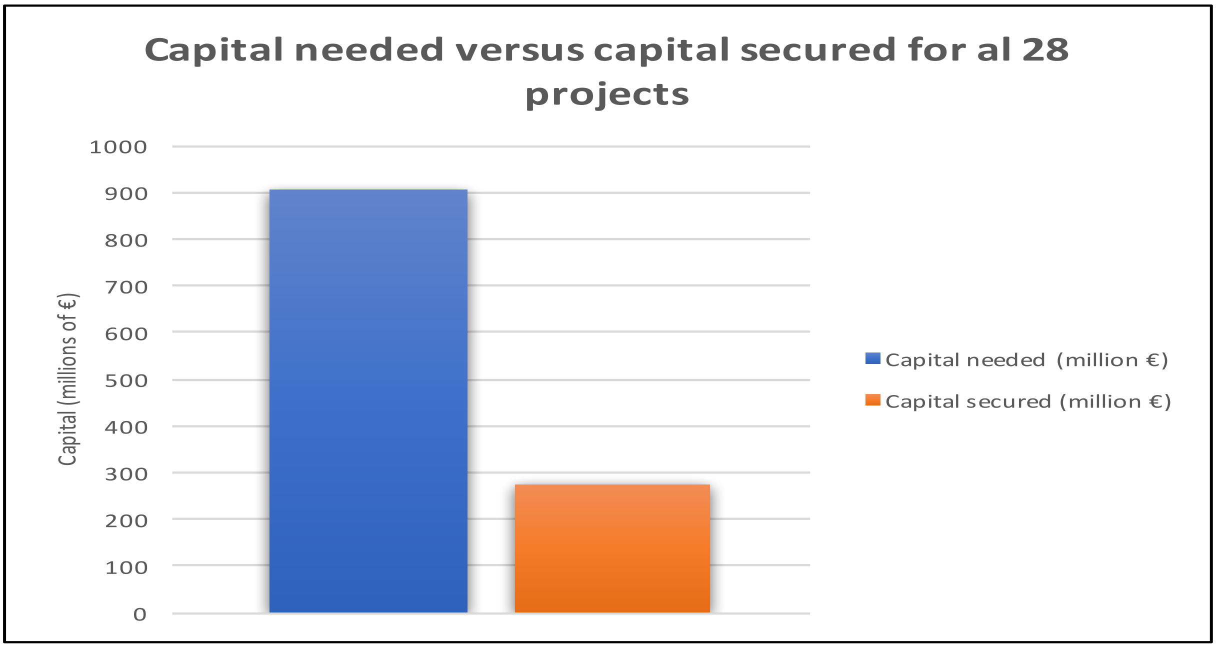

Figure 14: graph depicting the difference between capital needed and secured, for all 28 projects.

The 28 projects have been aggregated per technology until now, as within each technology type the different projects had comparable values. For this indicator, the values below are shown per project considering they are widely dissimilar, even within each technology type (see Figure 15). The 28 projects are ranked from highest to lowest amount of capital needed. The results are highly variable, with project 1 requiring €153.5 millions and project 28 requiring €1.5 millions.

The variability within technologies is also significant; such as wind energy, where project 8 needs €44 millions more than project 28. To this regard, one should note that CCS project 25 is quite far behind in terms of technological development, so that the capital needed value of €2 millions given by the innovator is only valid for a 20MW pilot plant. Retrofitting the same technology to a 600 MWe coal power plant would cost €669 millions. The fact that 9 of the 28 projects each need less than €5 million and yet are still stuck in the VoD goes to show the latter is present at all investment volumes.

Finally, most projects have a comparable ratio of capital needed versus secured; with some exceptions. Projects 7, 8 and 11 have no capital secured because the innovators have not started looking for it when the interviews took place; and project 3 has managed to secure in excess of €100 millions because it is developed by a multinational corporation with substantial own equity, which provided the necessary cash itself.

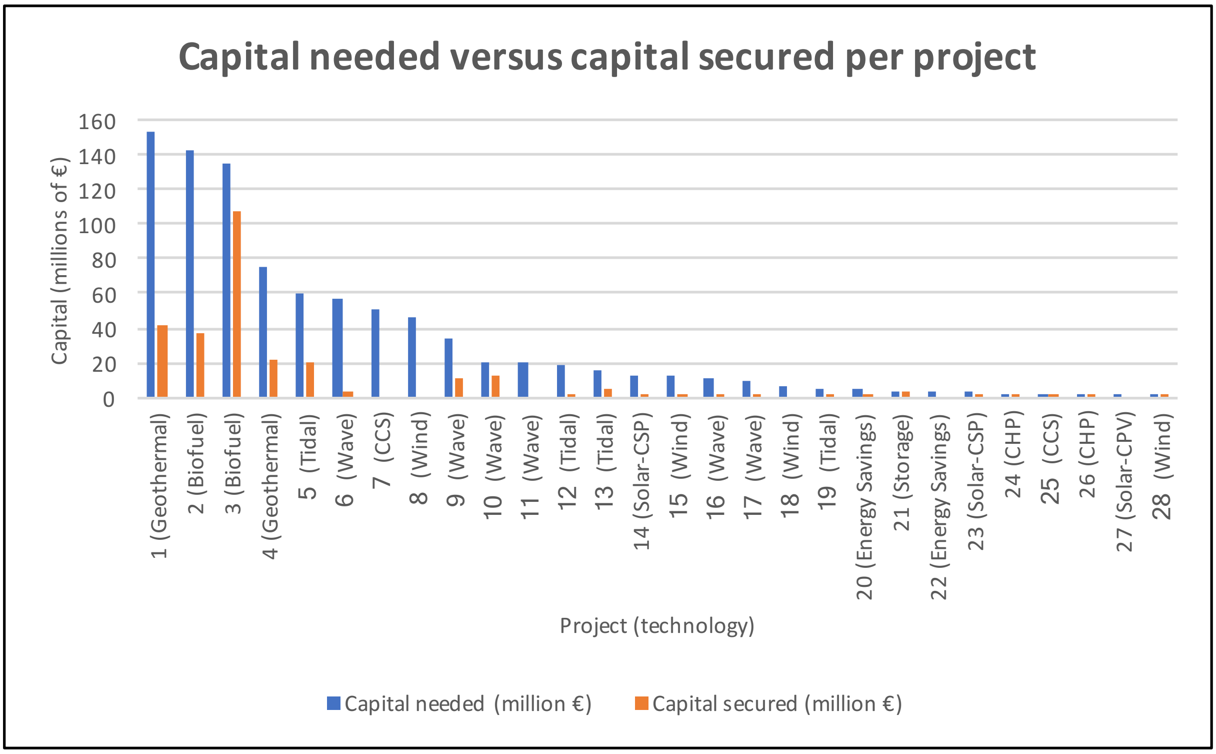

Figure 15: graph depicting the difference between capital needed and secured, per project.

4.1.6. Financing sources

This indicator analyses how many different types of financing sources the innovators asked capital to, from how many they successfully obtained it and how long it took to obtain an answer[25]. To simplify a categorisation of the answers by the innovators, they were asked to distinguish between six types of financing sources, as detailed in the Methods section. Figure 16 below shows how many months it took on average for all 28 innovators to know whether their financing request was accepted or not; the results are aggregated per financing type. There is one extreme outlier messing with the data: one solar energy project had to wait 81 months before it received an answer from a potential investor in the "Other" category. Nonetheless, the average stands, and the "Other" category is the one with the longest duration (regardless of the extreme outlier), since it is mainly composed of large European and national bodies offering research grants, which need to go through thousands of possible options and are not strictly for profit, so not as time pressured as private companies. "Alternative equity" investors take circa double the time than banks, mainly because the latter have strict regulations they must follow so they tend to refuse most innovative energy projects straight away.

The average duration for all financing types is almost 6 months; this might not seem like a long-time period, but it is for an innovator who urgently needs to find finance. This can partly explain the VoD. Having a response after 1 month would for instance enable the innovator to look for other investors while being backed up by a first investor, hence bringing a stronger business case forward.

[25] This data comes from 25 out of the 28 projects as 3 had not started looking for finance at the time of the interviews.

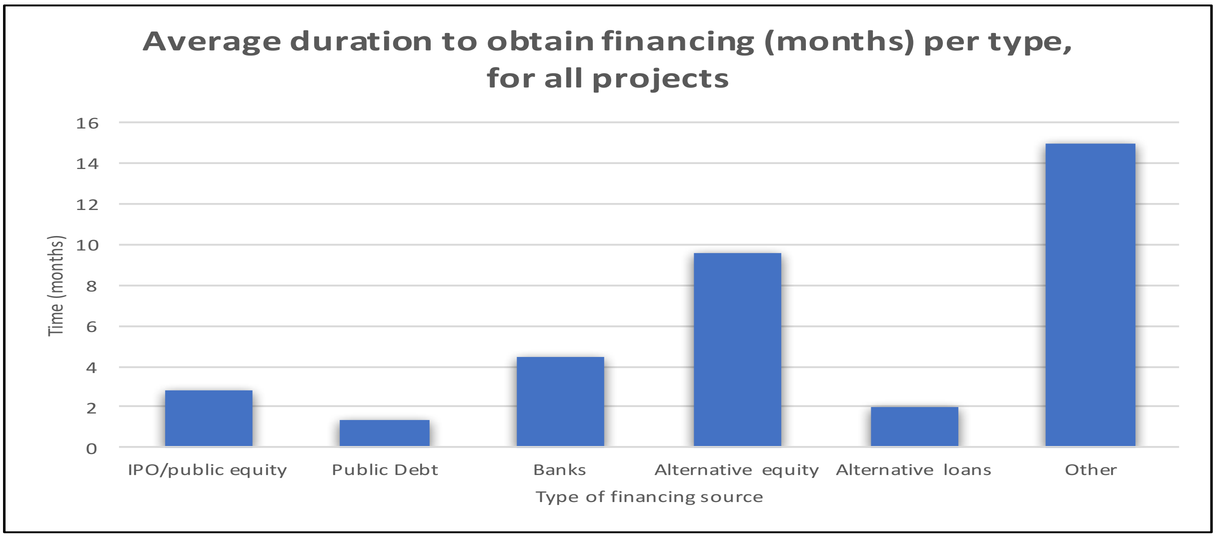

Figure 16: graph depicting the duration to obtain financing, for various investor types.

Knowing the duration, the other facet of this indicator was to analyse the aggregate number of financing sources the 28 innovators applied to, per financing type; and see from how many of those they received financing, as shown in Figure 17 below. The results do not contradict the current energy investing environment, described in the Theory section. The ratio of projects successful when asking finance form private banks and alternative loans is very small, which confirms that banks and for instance hedge funds are mostly not relevant for energy innovators stuck in the VoD. Also, public equity and debt are rarely applied to; in fact, these two financing types are usually not considered as relevant by the literature.

The two financing types most demanded by innovators are alternative equity and the others. This is because the "Other" category includes research grants, which provide vital capital for many innovators to survive the first months/years and have a good chance of being obtained (1/2.5 applications were successful). And because "Alternative equity" contains VCs, by far the most sought after type of investor. Nevertheless, the poor success ratio of 1/4.5 applications to VCs is one of the explanations behind the VoD. This confirms the idea mentioned in the theory chapter that VCs might not be as ideal as most innovators think. This opinion will be further elaborated on in later chapters.

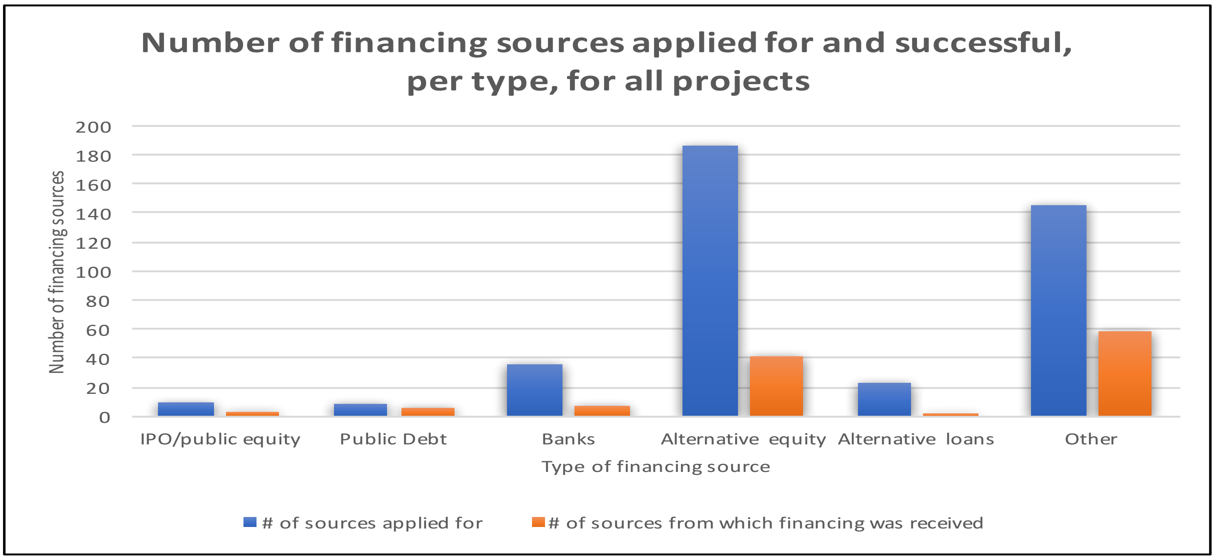

Figure 17: graph depicting the difference between sources applied for and successful applications.

4.1.7. Project risks

The 28 innovators were asked to state the risks their projects face, both during the construction/production phase as well as once the innovation enters the market, i.e. the operational phase. They were asked to rank them between low, medium and high risks. Since the actual risks described by the innovators will be one of the sources for the further data analysis in the following pages, this indicator simply looks at the aggregate number of risks, per phase and per level, for all 28 projects. This is shown in Figure 18 below; in both the construction/production and operational phases, a bell shape is formed, with the highest number of predicted risks being of medium level.

In the construction/production phase, there are 29 medium-level risks, meaning each project faces at least one such risk during this phase. Following this logic, more than half of the 28 projects will face at least one high-level risk in both phases. Overall, there are 110 aggregated predicted risks, for all levels and both phases. Considering this is only coming from 28 projects, and keeping in mind that some innovators might be quite optimistic, it is a significant amount. If the innovators themselves perceive such risks, the investors will likely perceive the same if not more, partly explaining why innovative energy technologies have such difficulty in accessing private finance.

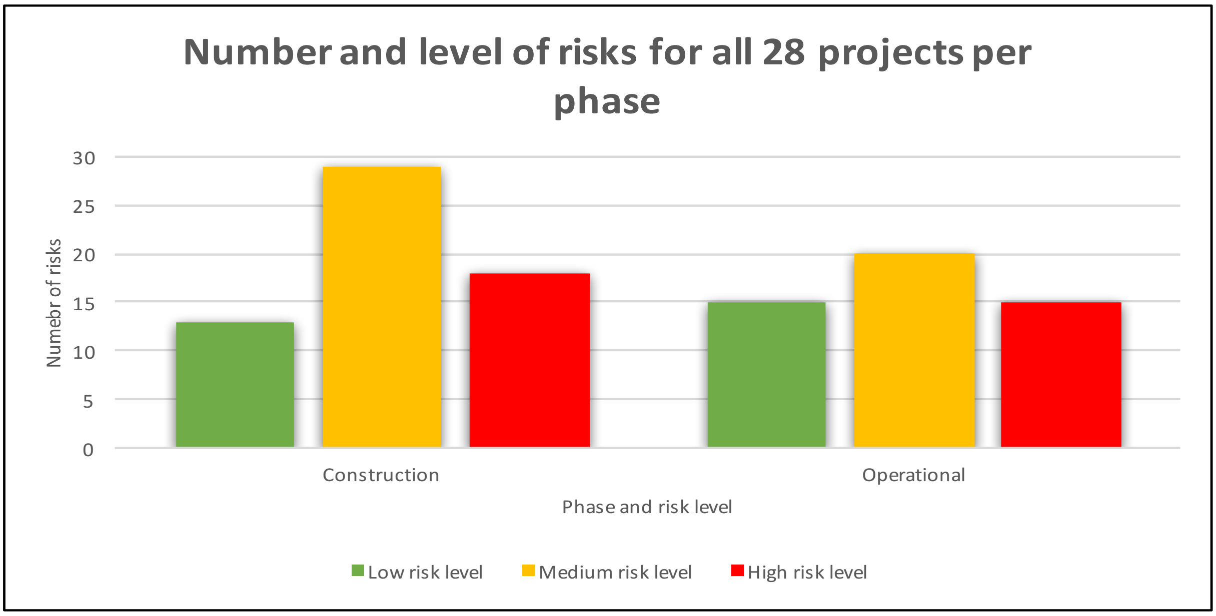

Figure 18: graph depicting the risk characteristics for all 28 projects combined.

Finally, this project risks indicator was also separated to show the results per technology, as shown in Figure 19 below. The technologies that represent more projects have a higher number of aggregate risks; nonetheless, some interpretations can be made, such as that wave and tidal energy are perceived as very risky even to the innovator themselves, confirming the opinions of many investors.

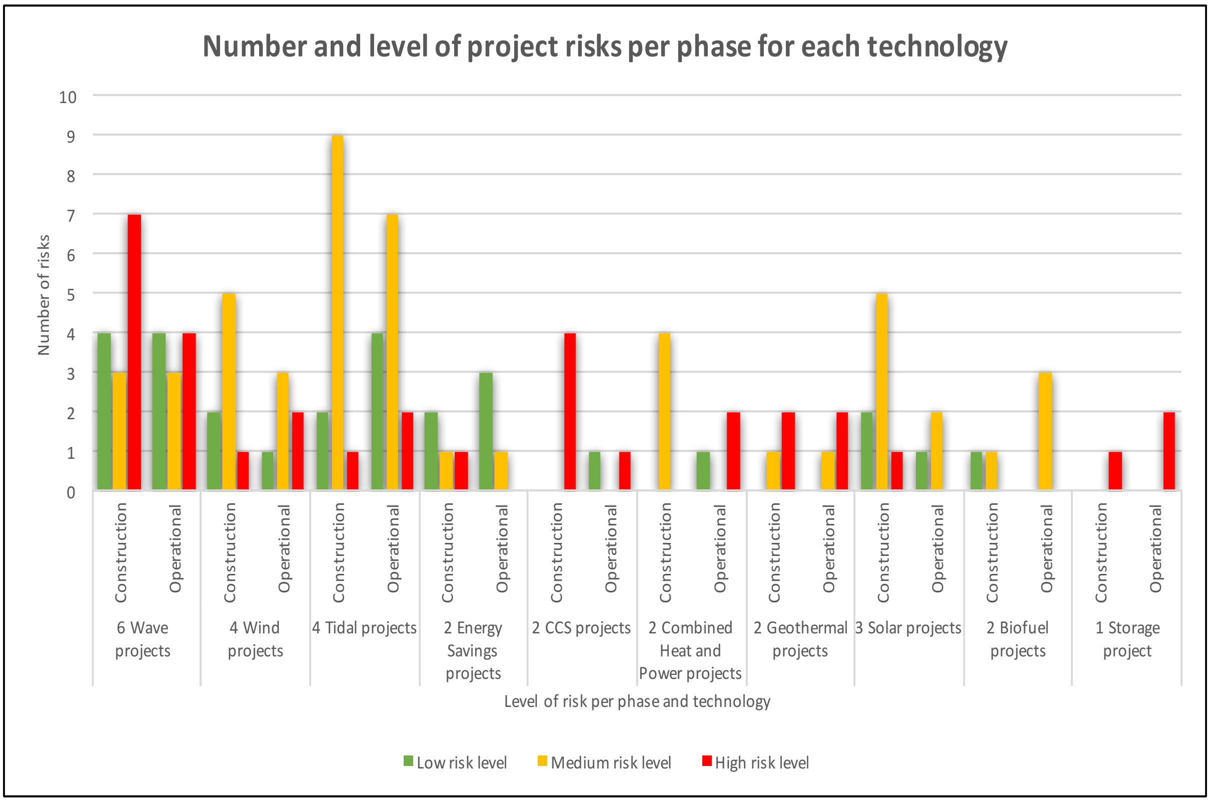

Figure 19: graph depicting the risk characteristics of the 28 projects, per technology.

4.1.8. Indicator summary

To sum up, although the 28 projects have great technological and geographical variability, they all suffer from similar problems. The analysed indicators explain why energy innovators struggle in attracting investments and why they are stuck in the VoD (see Table 5 below), answering the first research sub-question.

Table 5: summary of the analysed quantitative indicators.

Indicator	Typical status for innovative energy projects stuck in the VoD
TRL	Below TRL 9
Time to market	Long, circa 3 years
Time to positive cash flow	Long, circa 4 years
Capital intensity	Variable, but it can become very high
Time to obtain finance	Long, circa 6 months to have a yes/no answer from investors
Success rate with investors	Poor, circa 1/4.5 of investors successfully finance the innovator
Perceived risks	Several, at all venture phases and risk levels

4.1.9. Alternative solutions to further finance

The 28 innovators stuck in the VoD were also asked to state what they would do in case they will not be able to secure further capital, specifically private capital. One innovator replied he was confident they would be able to access further finance. Of the rest, two out of three gave three options:

- Those who plan to fall back on own equity. i.e. provide the capital themselves. This is not an option for the majority of innovative energy projects, it is only plausible for those led by large corporations.
- Those who plan to go back to public funding, and seeking grants. Yet considering the TRL stage of these projects, most public money would be out of scope for them as it is usually aimed at start-ups which just started their innovation route.
- Those who plan to reduce operation size, and try to focus on one component of the technology and bring that on the market.

However, 9 out of the 28 projects, so almost one out of three, stated they would have to close down the project. Being able to attract finance is necessary and failing to do so means these projects will remain stuck in the VoD and will eventually have to declare bankruptcy. There is a negative perception regarding the likelihood of being able to attract finance and therefore escape the VoD, which comes from the innovators themselves, i.e. the people that likely believe the most in these projects. The VoD is then not only known by the literature, it is a concrete concept, present in the real world.

4.2. Categorisation of intrinsic and transactional issues

Alongside the quantitative indicators, a qualitative analysis was also made, as there are many more reasons behind the VoD. The following section builds on the answers from the 28 innovators stuck in the VoD, as well as the interviews with innovators that successfully escaped the VoD and with investors, as outlined in the Methods section. It is also based on the notes taken at several events discussing finance within innovative energy and on relevant literature.

This resulted in a long list of 90 issues that cause energy innovators to have difficulty in accessing private finance. After analysing them, they were separated into intrinsic and transactional issues, in order to answer the second research sub-question.

4.2.1. Intrinsic issues

Intrinsic issues are the core cause explaining why energy innovators cannot access finance, specifically private finance, and thus why so many cannot escape the VoD. Figure 20 shows that four categories of intrinsic issues were created, each containing some sub-categories. This categorisation does not come from the literature, but was made by the author to best interpret the results at hand. The four categories will now be delved into, and the actual issues within each of their sub-category will be listed in the following figures. The listed issues for each sub-category will then be discussed in the bullet points below the figures. Most of these issues are direct quotes from the interviews, and other comments given by the interviewees will be cited in the text.

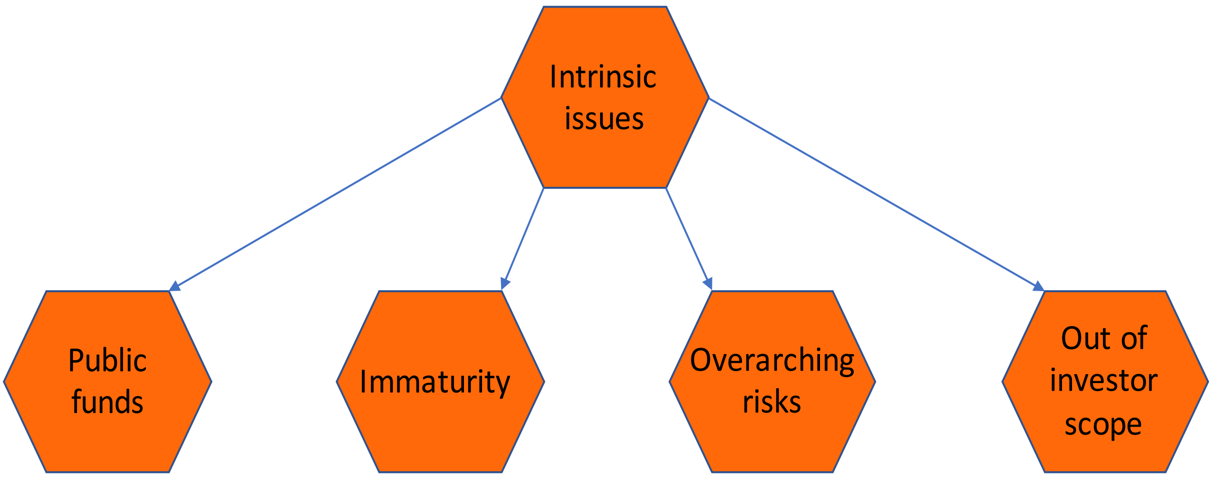

Figure 20: depiction of the four categories of intrinsic issues.

4.2.1.1. Category 1: Public funds

The first category of intrinsic issues is public funds, i.e. all the issues innovators face when trying to attract public finance as well as more overarching issues with public finance. This category contains three sub-categories. Figure 21 below depicts this, alongside the actual issues below each-sub-category. The issues are colour-coded yellow to dark red, which represents the severity of the issue. This severity is the result of the number of times each particular issue was mentioned during the interviews, in the literature, and at events that were attended; as shown in the scale in Figure 21.

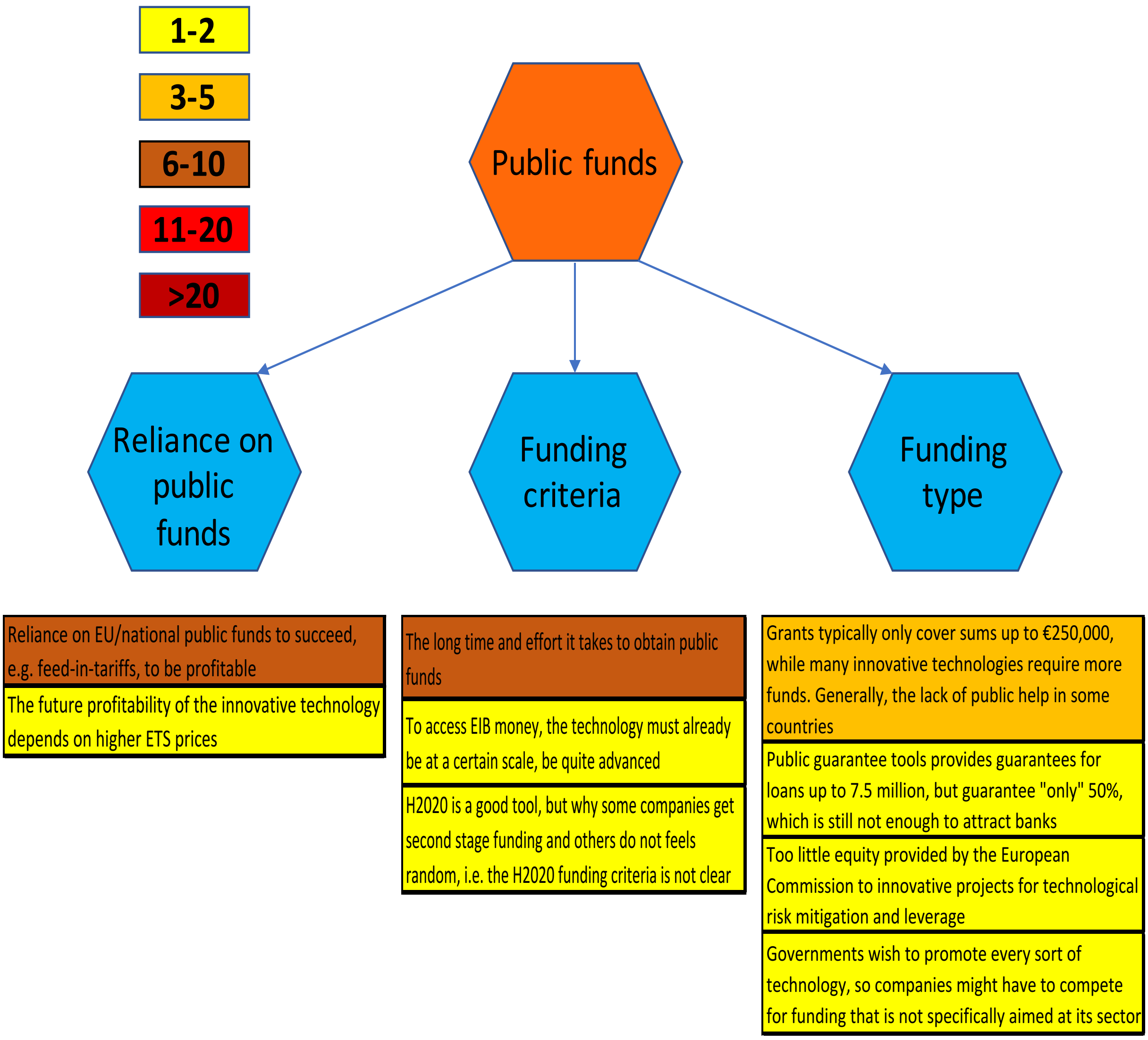

Figure 21: the public funds category and its three sub-categories, with the issues listed below each of the latter.

- Starting with the first sub-category, i.e. reliance on public funds, 7 interviewees believe too many innovative companies have to rely on public money to survive to the next venture stage, and to be able to succeed once operational. Most of those who mentioned this are developing immature technologies such as wave and tidal energy, showing that being part of an immature industry is more challenging for an innovator.
- As for the funding criteria sub-category, 8 interviewees believe that while public funds are very useful it takes too much time and effort to obtain them, exacerbating the VoD. Similarly, a Scottish business angel stated it is hard to get money from the European Investment Bank (EIB), and that a small innovator would have to stop their business just to have the time to apply for it. Finally, one should keep in mind public money is not necessarily always good; a law firm interviewed stated that the conditions for some UK grants were so stringent that innovators had to decline them.

- Although less severe, the funding type sub-category contains more issues. The main one, mentioned by 5 interviewees, is that grant money is not sufficient. A business angel stated that grants help small innovators survive, but are not enough to attract private investors at later stages; he sees these small grants as more of a regional industry catalysing factor, as most of the money spent will not amount to bring innovators on the market.

Generally, one should retain that public money should not be seen as the panacea to solve the VoD, at least not with the amount of currently available public funds. A German VC stated that for instance the German government allocated €2 billion along with the public bank KfW to support early stage innovators; while “that is very helpful, private investors are still necessary”. Yet it is problematic to find lead private investors, and often in investment rounds the public side is covered, but the private one is missing.

4.2.1.2. Category 2: Immaturity

The second category of intrinsic issues, depicted in Figure 22 below, is immaturity. This occurs when one of the stakeholders involved or the industry are not mature enough, resulting in the mismatch between what innovators offer and what investors want, and keeping the innovators in the VoD.

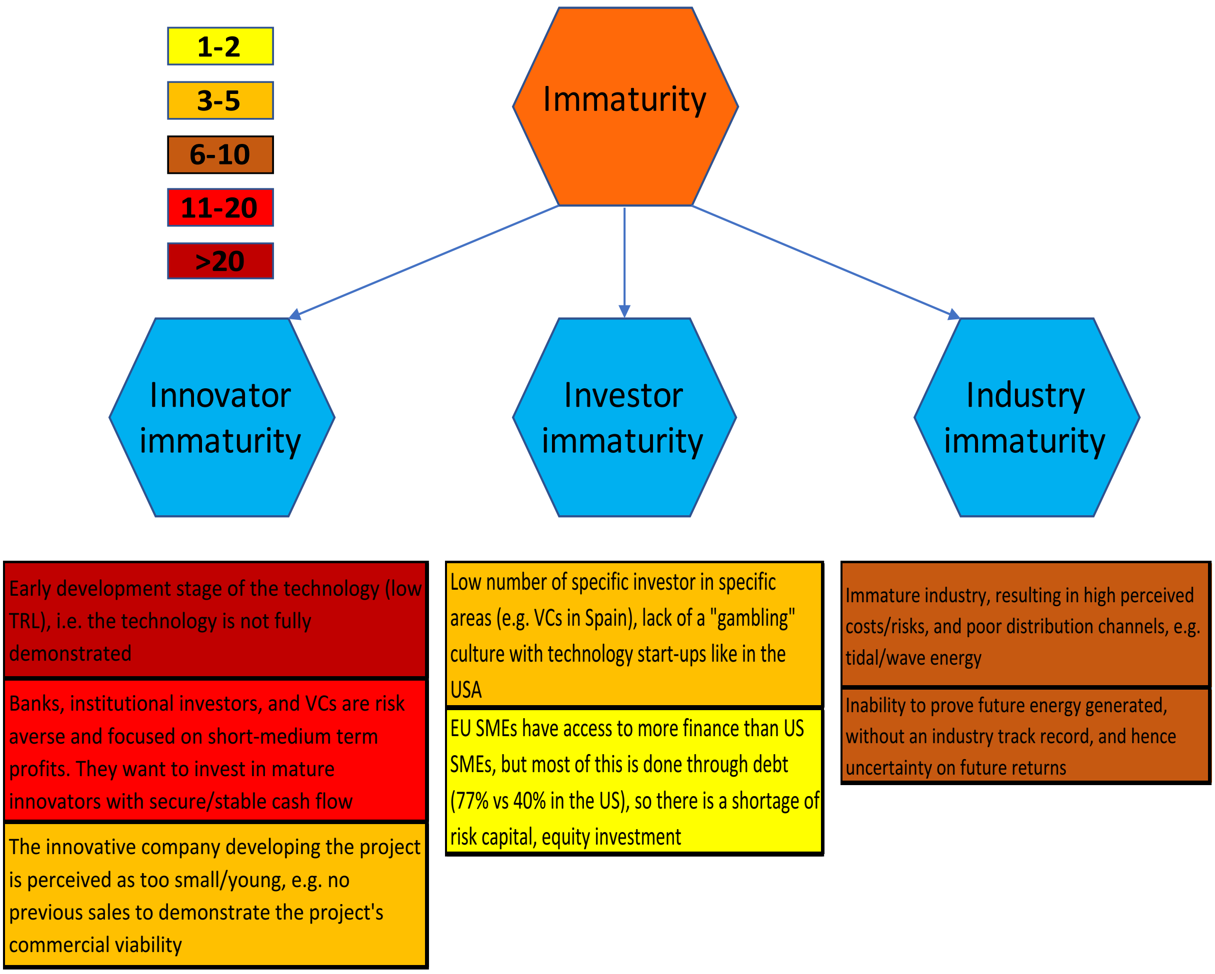

Figure 22: the immaturity category and its three sub-categories, with the issues listed below each of the latter.

- The first sub-category regards the innovator’s immaturity. The first issue is the most mentioned of all, via the literature and by 21 interviewees: the technology developed by the innovator is too early stage, so the investors are not interested. As stated by a British VC, while they used to invest in such early stage before the financial crisis, few investors will do so now as they want the technology to be almost on the market. Similarly, a German VC stated that between TRL 6-9 there is little private capital, especially when it is a high capital intensity technology.

The second issue, mentioned by 12 interviewees, is strictly correlated to the first. The innovator's immaturity means many type of investors, such as banks, institutional investors and also VCs will not invest; due to high perceived risks and negative cash flows. Specifically, banks are highly unsuitable; a British solar energy innovator that managed to raise €30 million said getting a bank loan would still be "extremely difficult and a bad idea" without a stable revenue stream.

- The second sub-category, i.e. investor immaturity, is seen as less important, although 3 interviewees do believe there is a different investing culture compared to the USA, much more risk-averse.
- Finally, the industry being immature is another cause behind poor private investments, as an immature industry such as that of wave and tidal energy is perceived as risky and without a structured supply chain[26]. Another 7 interviewees mentioned that an immature industry means there is no industry track record, making it more unattractive to investors. A French VC pointed out that it really is a question of a lack of track record and hence success stories, so that it is a weakness of the market, not of the innovators.

Immaturity, and specifically the innovator's and industry's immaturity are one of the core causes of the VoD, as these scare off private investors.

4.2.1.3. Category 3: Overarching risks

The third category of intrinsic issues, depicted in Figure 23 below, are overarching risks. In previous chapters, high perceived risks have already been mentioned a couple of times, and they are indeed one of the crucial causes of the VoD when it comes to innovative energy projects. This category delves into the four types of risk that illustrate why an energy innovator appears so unattractive to private investors.

[26] Nonetheless, a British VC advises to focus on tidal lagoon projects (such as at Swansea Bay), as it is essentially just a remodelling of hydroelectricity technology and thus perceived less risky.

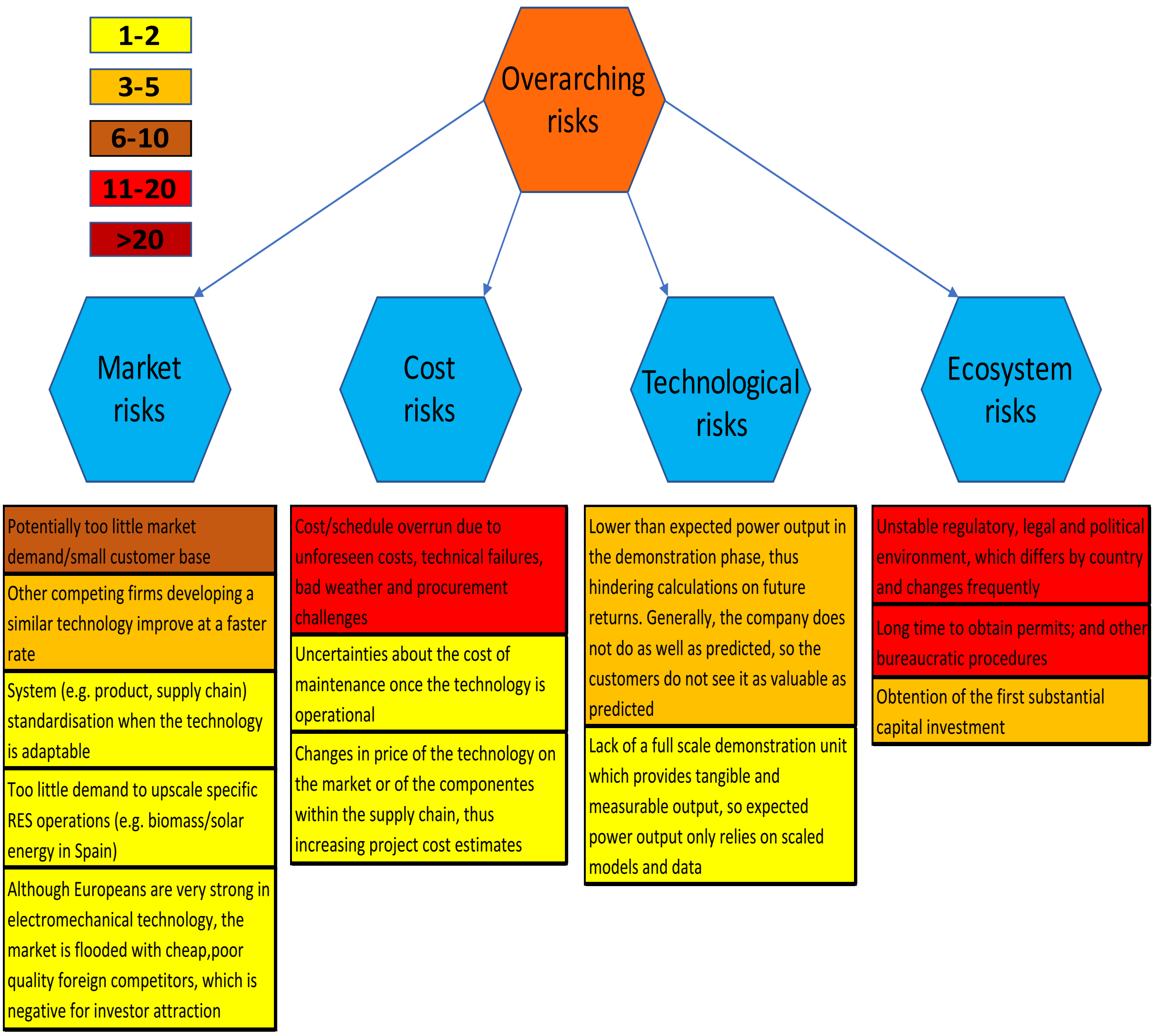

Figure 23: the overarching risks category and its four sub-categories, with the issues listed below each of the latter.

- Several market risks have been identified by the interviewees; 10 said the most severe one is the innovator not achieving enough sales once it enters the market.
  The fourth issue (too little demand for specific RES operations) is highly related to geography. The two innovators interviewed are both from Spain and they say there is a "dislike for technology" and that Spain's industrial leaders prefer to be followers in technology-based businesses. For solar energy, they state there is a negative industry perception and belief that "one can only surrender against the Chinese competitors".
- The main cost risk, mentioned by 17 interviewees, is not necessarily specific to energy, it can occur in all types of technological ventures. However, energy technologies can be highly complex so investors assume costs will always be higher than predicted.
- Another aspect investors fear is technological risks, namely that the technology will not work as well as predicted, which means worse cash flows and an increased difficulty in attracting customers, which in turn worsens the innovator's valuation.
- Overall, the most severe type of risk sub-category is what is called ecosystem risks, i.e. any risk that is not strictly related to the innovator, or the technology, but rather to the surrounding ecosystem the innovator works in. Indeed, 16 interviewees mentioned that the instability of the environment increases perceived risks significantly.

A clear example relates to the first intrinsic issues category, namely public funds, as many innovative energy innovators are reliant on public benefits to survive; so if the political agenda in the innovator's country suddenly changes after an election, and subsidies to clean energy are cut for instance, it could result in the innovator's bankruptcy. Additionally, 13 interviewees pointed out bureaucracy as an issue, especially due to the time and effort needed to make sure it gets done on time. This is exacerbated whenever an innovator aims to enter several target markets, as bureaucracy is specific to each country. Language then also becomes a barrier, and innovators have to spend time on aspects such as permitting and licensing, instead of developing the technology further or attracting investors.

There are therefore several types of risk related to innovative energy technologies which render the latter unappealing to a lot of investors; this is correlated to the last category of intrinsic issues, the investor's scope.

4.2.1.4. Category 4: Out of investor scope

This is the fourth and last category of intrinsic issues. It is interconnected with the immaturity and risk categories, as due to those, the innovator is perceived as too immature, too risky, and therefore not in the scope of the investor. Specifically, three aspects make an energy technology innovator out of scope for investors, as outlined in Figure 24 below.

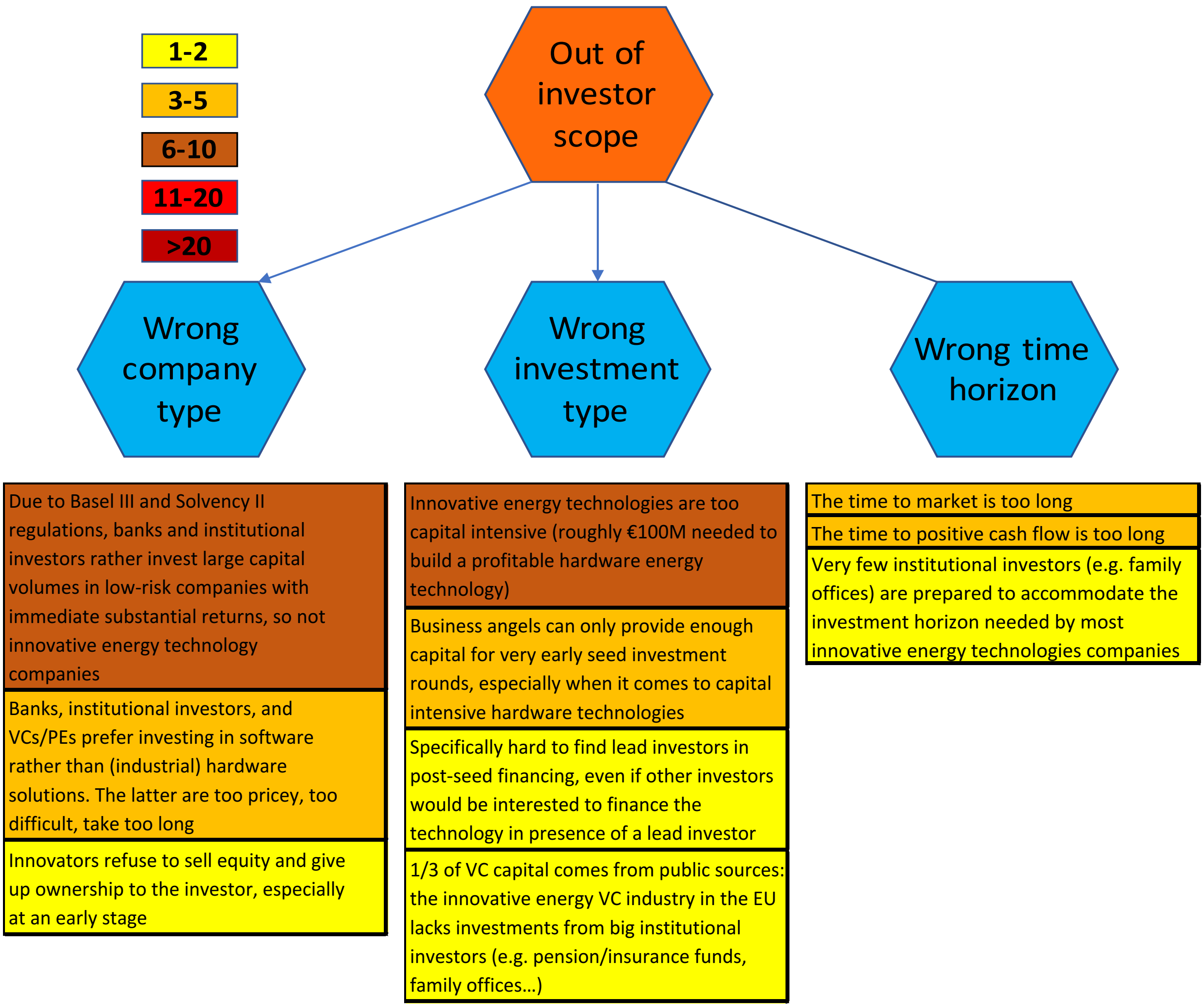

Figure 24: the out of investor scope category and its three sub-categories, with the issues listed below each of the latter.

- The first sub-category, i.e. wrong company type, means the innovator is developing a type of company which is unsuitable for the investor. Specifically, 6 interviewees mentioned the first issue, namely that following the regulations implemented to offset the global financial crisis[27], investors such as banks and institutional investors do not invest in companies that are not making a revenue and are high-risk. For instance, a British Bank stated they do not invest in companies younger than 2 years, yet a lot of innovators cannot make it that far without significant financing. This means that debt finance, i.e. loans, are rarely available, which is specifically challenging for capital intensive projects. Such projects are usually hardware technologies, which correlates to the second issue, namely that most investors are turning towards software rather than hardware innovators. A British hardware innovator that did succeed in obtaining finance stated it was very frustrating as "a lot of time was wasted for very little investment".
- Secondly, since the innovator is developing an unsuitable company for investors, the investment type is equally unsuitable. The main issue is that innovative energy technologies are too capital intensive; the only investors that could invest that much are banks or institutional investors, which were shown above to not be interested. For other investors, such as business angels, it is impossible to invest more than a million euros. The aforementioned British bank suggests linking innovators with several business angels, but they say there are very few of these angels in Europe: there is a lack of investing culture.
- Finally, the innovators do not enter in the right investment time horizon, which relates back to the quantitative analysis. This confirms that factors such as time to market and to positive cash flow are important to investors and are one of the causes behind the VoD.

These were the four categories of intrinsic issues; the root cause of these issues is that there is an intrinsic mismatch between what the innovators offer and what the investors want to finance. Intrinsic issues therefore include many of the main reasons behind the VoD. As showed by the severity scale, some are considered more important than others, such as the innovator's immaturity or the ecosystem risks. Intrinsic issues are usually those picked up by the literature and considered most urgent by scholars, as shown in the Theory section. However, considering the intrinsic nature of these issues, these are problems that could only be addressed through massive governmental intervention and public finance; making them out of the reach of a thesis. While these issues will not be further delved into, later sections will present different sets of recommendations (for innovators, for investors, for matching platforms and for the overarching environment), which could be useful to facilitate some of the above intrinsic issues.

4.2.2. Transactional issues

Intrinsic issues explain why innovators often cannot obtain financing from investors, specifically private ones. However, other times energy innovators could theoretically obtain financing from investors, but they still do not manage. This is because they face transactional issues, i.e. issues that could be eased by the players of the investment community themselves: the innovators, the investors and the matching platforms. This thesis will focus on transactional issues, as the recommendations that will be brought forward could realistically have a positive impact and diminish them.

[27] One of the regulations mentioned, Basel III, requires less risky investments, more liquidity and higher solvability.

Circa 45 transactional issues were found during the interviews, in the literature or by attending events, although most of them are direct quotes from the interviews. These have been separated into five categories, as depicted in Figure 25 below. The five categories are labelled A to E and the issues within each category are labelled for example A1, A2, A3… This is done as these labels will be used at a later stage.

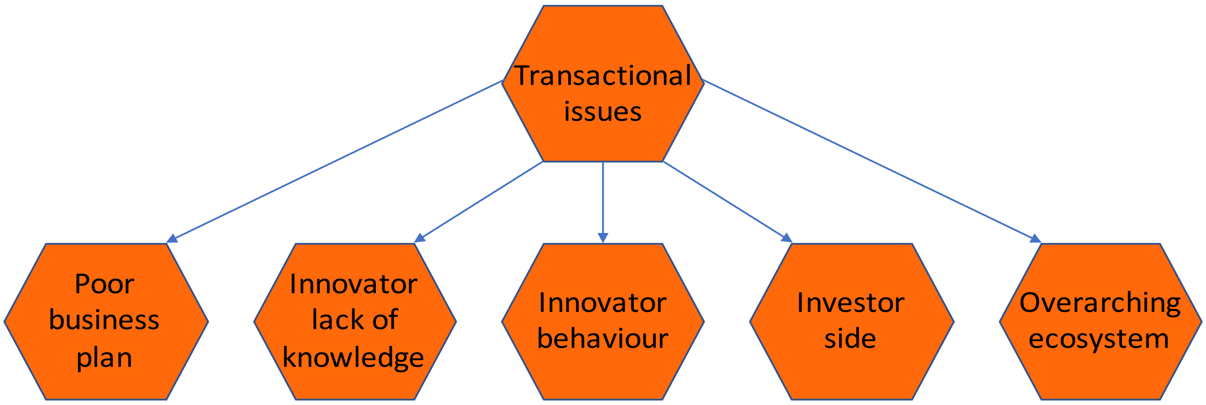

Figure 25: depiction of the five categories of transactional issues.

4.2.2.1. Category 1: Poor business plan

The first category of transactional issue is depicted in Figure 26 below. One of the reasons energy technology innovators do not obtain financing at times, is that their business plan is poor. The business plan is the media through which investors learn about the innovator for the first time; if it is not entirely convincing, economically and technically sound, well-written and presented, the investor will put it aside. The business plan is therefore crucial; deserving innovators might not receive financing because they do not know how to write a business plan.

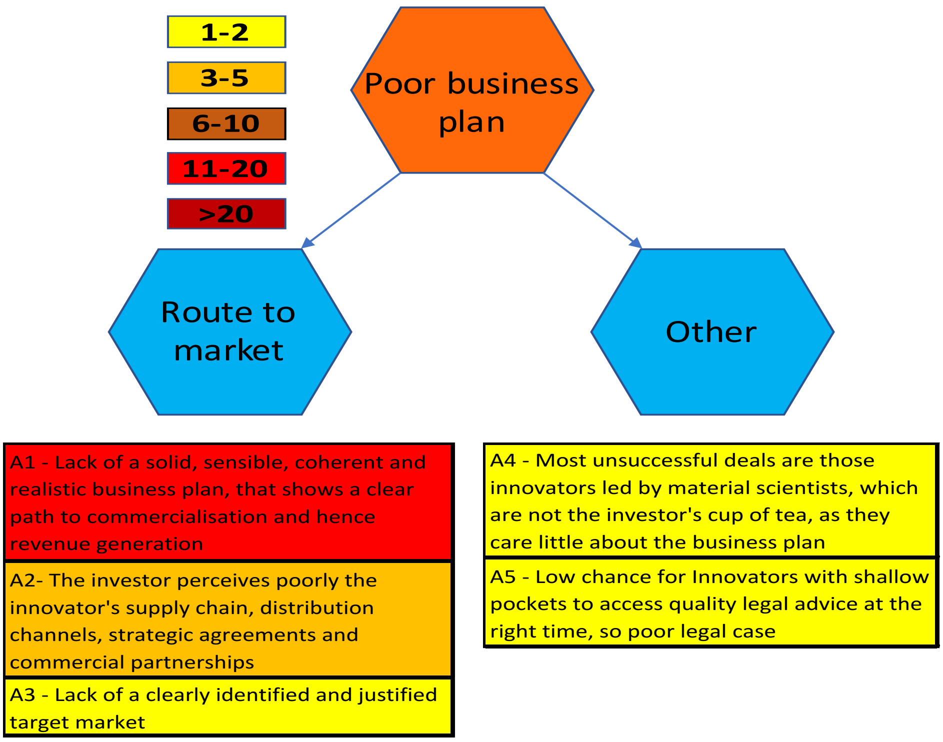

Figure 26: the poor business plan category and its two sub-categories, with the issues listed below each of the latter.

- The idea behind a business plan is to state the current economic and technical facets of the technology as well as how the innovator plans to develop its venture and enter the market. The first sub-category therefore reflects the issues with the innovator's planned route to market; as 12 interviewees confirm that many innovators lack the skills to write a good business plan.

  Specifically, another 5 interviewees mentioned the second issue, namely that the business plan illustrates poorly how the innovator plans to find suppliers, distributors, customers and other necessary players to enter the market. This results in the investors not financing them. Before the global financial crisis, this was less of an issue; an innovator gave the example of companies such as Wavestar Energy and Pelamis, which managed to attract tens of millions of euros of investments event though "their business case was a disaster".
- The other sub-category reflects two other issues. The first one concerns the make-up of the innovator team. The second looks at the business plan from a legal perspective. An interviewed British law firm stated that innovators with little money will have financial problems to meet the necessary legal requirements once a quality legal firm will analyse their case. They also state there are no shortcuts, as the innovator might choose not to patent the technology, but then have to rely on mutual confidentiality, which is risky.

A poorly prepared business plan is therefore a transactional issue which could be avoided to help more innovators get financing and ease the VoD. Other transactional issues arise from the innovator's side.

4.2.2.2. Category 2: Innovator lack of knowledge

The second category of transactional issues looks at the innovator's lack of knowledge, and how this creates issues when trying to attract finance (see Figure 27).

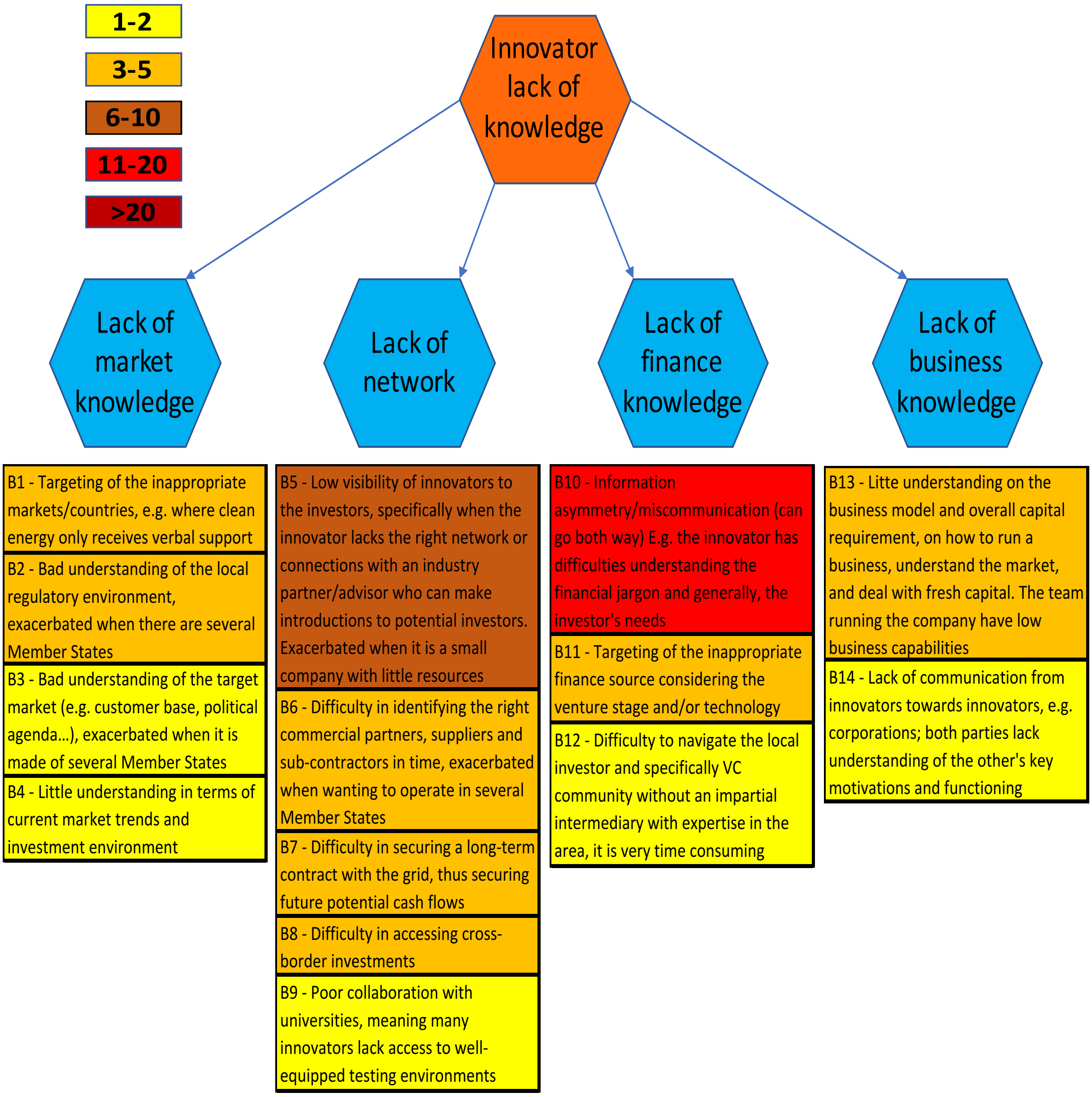

Figure 27: the innovator lack of knowledge category and its four sub-categories, with the issues listed below each of the latter.

- The first knowledge type the innovator lacks regards the market, as (s)he might be targeting a market with an unsuitable environment for innovative energy technology projects (B1), or it might be a suitable market, but (s)he does not understand it well enough to optimise the development of its technology (B3).
- The second type looks at the innovator's poor network and its lack of knowledge regarding the right contacts and partners. The first main issue, mentioned by 7 interviewees, is that without the right network and connections, the innovator has low visibility to investors, i.e. the innovator has trouble getting in the investors' radars.
  Other issues mentioned which are caused by a poor network include the difficulty in building commercial partnerships and distribution channels, or managing to access investors abroad.
- The third type regards the innovator's financial knowledge, which is considered too poor by many. 12 interviewees believe there is a miscommunication between investors and innovators, meaning the latter do not understand what the investor requires. This then results in several misunderstandings, low ability of working together, and a poor business

plan, among other problems. Additionally, having low knowledge on financial terms means the innovator does not necessarily know where to find the right investors, or which are the right investors for the TRL stage he is currently at. This results in a loss of time and effort, made much worse if the innovator is seeking investors in foreign countries, as the investment environment can differ a lot.

- The final type comes from a business perspective. It is not sufficient to find the ideal market, have a good network and know which investors to contact and how, if the innovator team does not know how to run a business. That will scare potential investors off, as there would be high levels of unnecessary risks involved.

The innovator must have significant knowledge on the market, on finance and business aspects, as well as have a good network. The number of issues and the times these were mentioned shows the importance of innovators having this knowledge. Without it, they will have a much harder time to obtain finance and their VoD will be exacerbated.

4.2.2.3. Category 3: Innovator behaviour

The way an innovator behaves is also important. During the interviews, it was clear that in addition to poor business plan writing skills and little knowledge, some innovators also suffer from undergoing sub-optimal behaviours (see Figure 28).

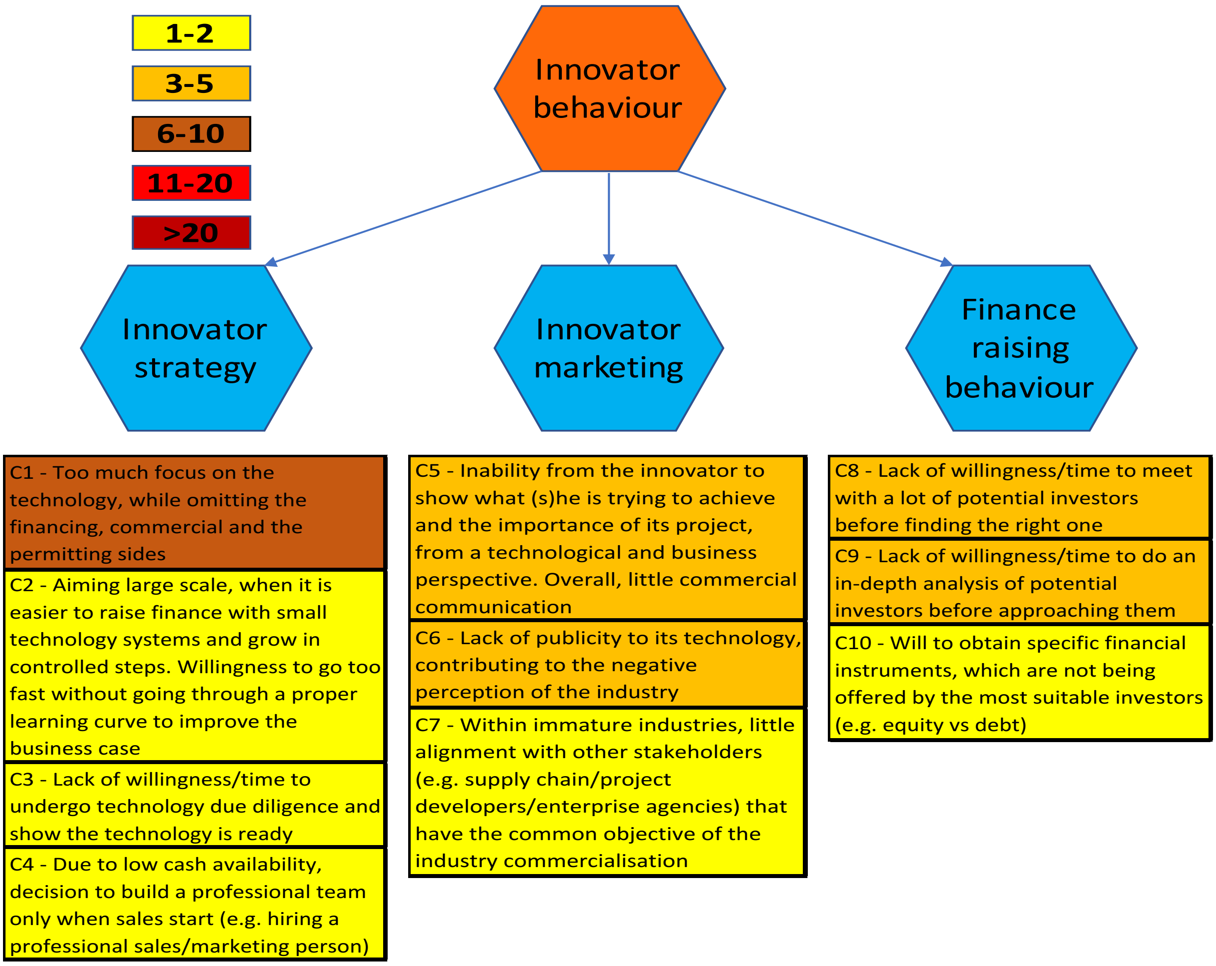

Figure 28: the innovator behaviour category and its three sub-categories, with the issues listed below each of the latter.

- The first type of wrong behaviour regards the strategy the innovator follows. The issue considered by far more severe, mentioned by 7 interviewees, is the way the innovators divide their time; too much of it goes towards developing the technology. Investors prefer to finance innovators who have a less developed technology but are more advanced on the legal aspects (such as permitting/licensing), and have done sound financial analyses and forecasts of their projects.
- The second misbehaviour by innovators is the way they market their technologies, with the main two issues relating to issue C1, namely that the innovator spends too much time on the technology and undergoes little commercial communication and does not publicise its project. These factors then exacerbate other aforementioned transactional issues such as the low visibility to investors or other potential commercial partners and customers.
- The final sub-category concerns the behaviours undertaken by innovators when trying to raise finance. Once again, this is a consequence of C1, as the innovators spend too little time trying to find, access and convince innovators to finance them. Innovators believe it will be easier to attract investors once the technology is market ready and therefore decide to spend its time developing it rather than meeting with investors. This point was specifically risen by small scale innovators, which own a SME. They stated that different investors require lots of information from the innovator, usually in a highly specific format, so a lot of time and effort goes into providing this information; and innovators cannot afford to "go down blind avenues where there is no real prospect of getting finance". Nevertheless, offsetting issue C9 would potentially help innovators avoid having to go down said blind avenues.

There are several transactional issues that surround the innovators; not only the fact that they produce (what are perceived as) poor business plans and have a lack of specific knowledge necessary to attract investors, but also that they have certain behaviours and routines which only exacerbate the other transactional issues and push them even further down the VoD.

4.2.2.4. Category 4: Investor side

Yet a transaction is made by two parties, and this category of issues shows the investor also suffers from a lack of specific knowledge and behaviours (see Figure 29).

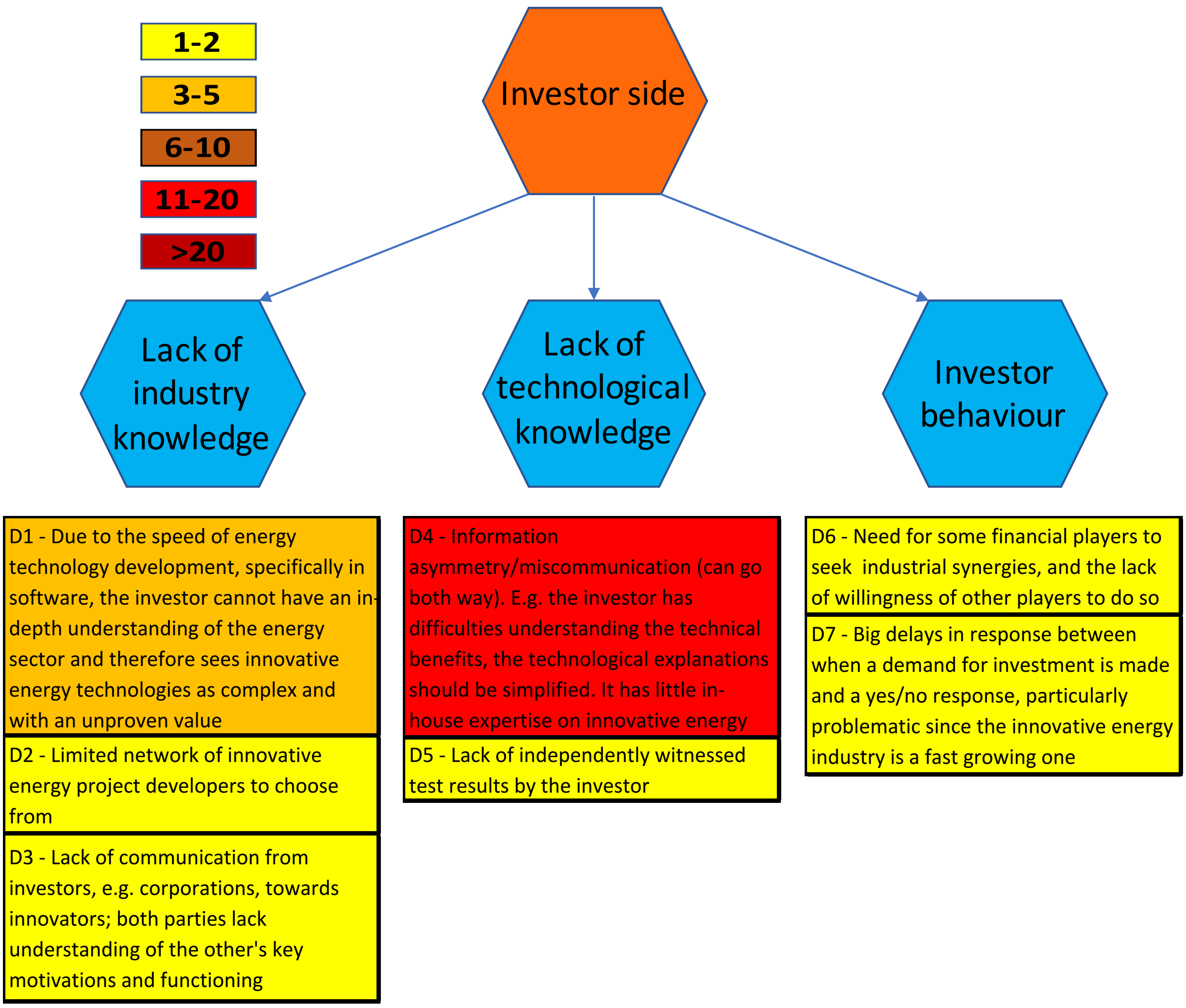

Figure 29: the investor side category and its three sub-categories, with the issues listed below each of the latter.

- The first sub-category concerns the investor's lack of knowledge of the clean energy industry; as 4 interviewees mentioned the first listed issue. This lack of knowledge then results in investors perceiving many innovative energy technology projects riskier than what they might actually be.
- That is exacerbated by the second sub-category, i.e. the lack of technological knowledge. This results in a miscommunication between the two parties, meaning the investor cannot fully appreciate the potential of the innovative energy technology and will thus prefer not to finance it. This was mentioned by 12 interviewees and is one of the most severe transactional issues.
- Finally, the investor holds certain behaviours which are deemed damaging to transactions, such as D7, the long response time. As with many of these transactional issues, these are mostly direct quotes from interviews, so subjectivity plays a role; furthermore, innovators will be more critical of investors and vice versa. Nonetheless, this likely does occur in certain transactions.

This concludes the transactional issues that see the two parties of the transaction, innovators and investors, as accountable. Most of the issues are directed towards innovators, but investors also play their role. Easing these transactional issues would therefore mean the transactions between the two parties would run smoother and help innovators escape the VoD.

4.2.2.5. Category 5: Overarching ecosystem

A few additional transactional issues exist, which are caused by the ecosystem investors and innovators work in. By looking at the colour coding, one should note that most of these ecosystem issues have only been mentioned once, with E1 being mentioned twice (see Figure 30). They are not considered as severe as the other transactional issues.

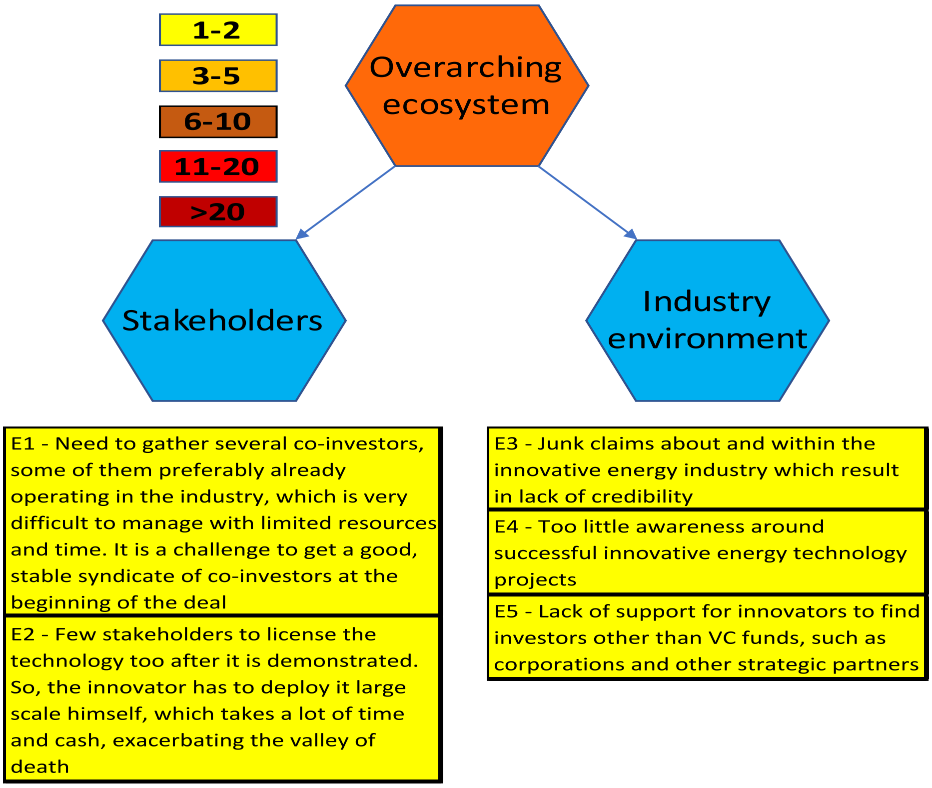

Figure 30: the overarching ecosystem category and its two sub-categories, with the issues listed below each of the latter.

- the first sub-category regards the other stakeholders involved in a transaction between an innovator and an investor. Considering the capital intensity of an innovative energy technology project, a single investor rarely backs up the innovator alone; this could only work for a large corporation. In most cases, there needs to be a syndicate, i.e. a conglomerate of different co-investors. Typically, there will be a mix of small-scale investors such as business angels and small VCs and large-scale investors such as large VCs, corporations, public entities and sometimes institutional investors.

  Yet a Swiss VC states that is not as easy as it sounds; they say often large public entities might change the person who oversees the investment and the new person has a different opinion, or a corporate co-investor will abruptly decide they do not want the investment in their portfolio anymore. This causes significant problems that have nothing to do with the innovator’s technology, knowledge or behaviour.

- The final sub-category of transactional issues are related to the overall industry environment, and include aspects such as little awareness of success stories, and an overall negative industry perception.

4.2.3. Categorisation summary

To sum up, the initial longlist of 90 issues that was made was divided into two big categories: intrinsic and transactional issues. The former includes four sub-categories: public funds, immaturity, overarching risks and out of investor scope. The latter includes five sub-categories: poor business plan, innovator lack of knowledge, innovator behaviour, investor side and overarching ecosystem. This categorisation is the answer to the second research sub-question, which alongside the answer to the first sub-question allows to tackle the main research question.

4.3. How the investment community should look like to escape the Valley of Death

4.3.1. Matching platforms

The transactional issues have been categorised and ranked by severity; these are issues that are much less present in the literature than intrinsic issues, yet they occur every day and could be tackled to help more innovators escape the VoD. Some are considered more severe than other, such as the innovator having a poor business plan, the miscommunication between innovators and investors, the low visibility from innovators to investors and the fact innovators spend too much time on the technology and not enough on trying to attract investors and partners. Transactional issues could be eased by improving the investment community, specifically though the use of a matching platform.

4.3.1.1. Matching platforms success factors

During the interviews, several success factors of matching platforms have been pointed out. These factors have therefore been sorted and are shown in Figure 31 below. The success factors have been divided into four key facets of a matching platform: the services it provides, its structure, its operations and the strategy it follows. The same colour scale applies as for the issues, only this time, since being pointed out is a positive thing, the more a factor is mentioned in the interviews, the better it is. One can see that the matching platform facets considered most important to its success are its operations and services. Considering there were several success factors mentioned, only those mentioned at least twice by the interviewees were kept; the others can be found in Annex 13.

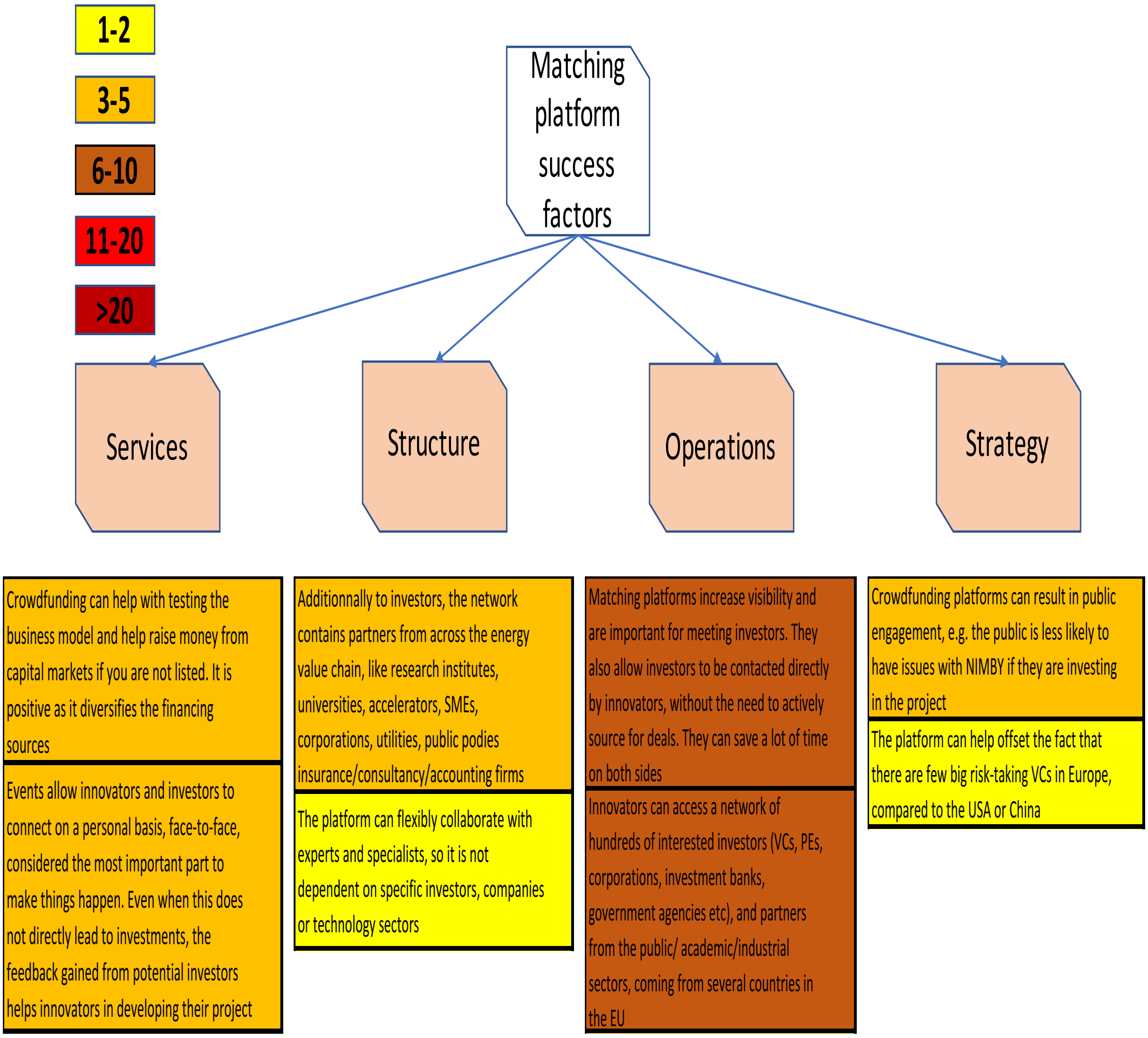

Figure 31: the success factors behind matching platforms.

- Matching platforms offer services to try and bring together innovators and investors. A type of matching platforms, crowdfunding platforms (CFPs), have been mentioned to offer successful services such as being able to raise money from capital markets without having to be publicly listed on a trading market. Secondly, matching platforms organise events, which allow innovators and investors to meet, get to know each other, and begin a personal relation, which is considered crucial by several investors interviewed. Another success factor mentioned is that platforms can assist innovators seek cross-border investments through a scouting service
- The structure of a matching platform is also important; one of the key success factors here is that a platform does not just put the innovator in contact with an investor, but also with supply chain partners, distribution channels partners, and overall a pool of experts and other stakeholders that can help the innovator reach its goals. This is key for an innovator with a poor network, which is one of the main transactional issues categories. For example, a concentrated solar power (CSP) innovator that was interviewed stated that being matched with an investor is not enough, as they also need to get in touch with a co-investor that specialises in CSP in the target market as well as with an IP specialist.

- The dark brown colour shows that the operations facet of the matching platform is considered as the most important success factor. Indeed, it combines the ideas taken from the services and structure categories. On the services hand, the emphasis is put on the fact that innovators become more visible to investors through the platform's operations, and can even get put in contact with them directly. On the structure hand, the idea that this aforementioned extensive network of relevant stakeholders can be accessed by the innovators, in various target markets. Another success factor mentioned within operations is that platforms coach innovators to improve their pitching and presentation skills.
- Finally, some think matching platforms can have a cultural impact; such as making investors take on more of a risk-taking behaviour like they do in the USA, through the promise of stable co-investor syndicates. This lack of gambling and risk-taking culture among European investors compared to American investors was one of the intrinsic issues. A Spanish PV innovator that was interviewed states that in his opinion, one can only solve the lack of private finance in innovative energy projects in the EU by changing the investment culture.
  Other success factors mentioned in the strategy facet of the platform is that the latter can build trusted relationships with investors via a track record of success stories; and that there is a continuous expansion of the investor and innovator network.

Out of all the interviewees, while several did not comment, 15 said they have never used matching platforms, and 14 said they use or have used them. The most common use is attending the matching/pitching/networking events organised by the platforms. Some say they have not met any interesting match there, but several say they have. For example, a Belgian smart grid innovator met its three principle investors thanks to a matching platform, and an Austrian biofuel production innovator made a pool of interested investors by attending matching events 2-5 times a year. Generally, the investors interviewed seem to attend such events regularly, especially VCs. The extreme case is a Finnish VC[28]. Only 5 of the 28 projects currently stuck in the VoD use or have used matching platforms. Additionally, all were asked whether they believed matching platforms could be a solution to obtain more private finance. Only 13 out of 28 innovators answered, yet 12/13 said yes.

4.3.1.2. Matching platforms services

Matching platforms could be a possible solution to ease transactional issues and help innovators escape the VoD. They have been shown to exist in three main types: business accelerators, private matchmaking companies and crowdfunding platforms (CFPs). As explained in the Methods chapter, 5 business accelerators, 4 CFPs and 2 private matchmaking companies were interviewed. This permitted to get an in depth understanding of which services they offer. These services have been separated per matching platform type, with some extra services that are both offered by business accelerators and private matchmaking companies.

All the services are shown in the figures below, starting with figure 32. To evaluate the extent to which matching platforms are currently able to address transactional issues on their own, each service has been analysed to see how many transactional issues it targets, if any. The more issues a service targets, the darker the shade of green it is characterised by. The colour scale is shown in figure 32; representing the number of transactional issues each specific service is targeting. The issues are coded, e.g. A2, following the coding given in the transactional issue categories (see Figures 26 to 30).

[28] This VC attends Cleantech Group's events, Cleantech Scandinavia venture events (1-3 per year), Nordic cleantech open events (semi-final camps, final pitching event), Fiban pitching events in Finland, STING in Stockholm, Climate-KIC pitching events, Ecosummit, Munich Network cleantech event, Slush (Finland and China), Energy venture Fair in Zurich

Type 1: Business accelerators

The first type of matching platforms looked at are business accelerators. The latter, depicted in Figure 32 below, offer 12 distinct services, with all but 3 partially targeting at least one transactional issue. The word partially is used to illustrate that a service is potentially helping ease out a specific transactional issue, albeit it is unlikely it can cover all aspects of said issue. There are three services targeting 3 or more transactional issues: services number 5,6, and 7. For example, service number 5 (called the Highway service, offered by KIC Innoenergy) aims to provide the innovator with an assessment of the target market; this helps partially ease, among others, transactional issue B3, namely that innovators have a bad understanding of the target market. This same logic was used for all the other services.

The fact that a service partially eases several transactional issues is undoubtedly a good indicator of its importance. However, as shown before, the issues are all ranked by severity; so a service that partially eases 3 transactional issues that have been only mentioned once each could be seen as less important than a service that partially eases only one transactional issue, that was mentioned several times. This is for instance the case of service 10 on the figure below, which offsets issue C1, mentioned 7 times by the interviewees.

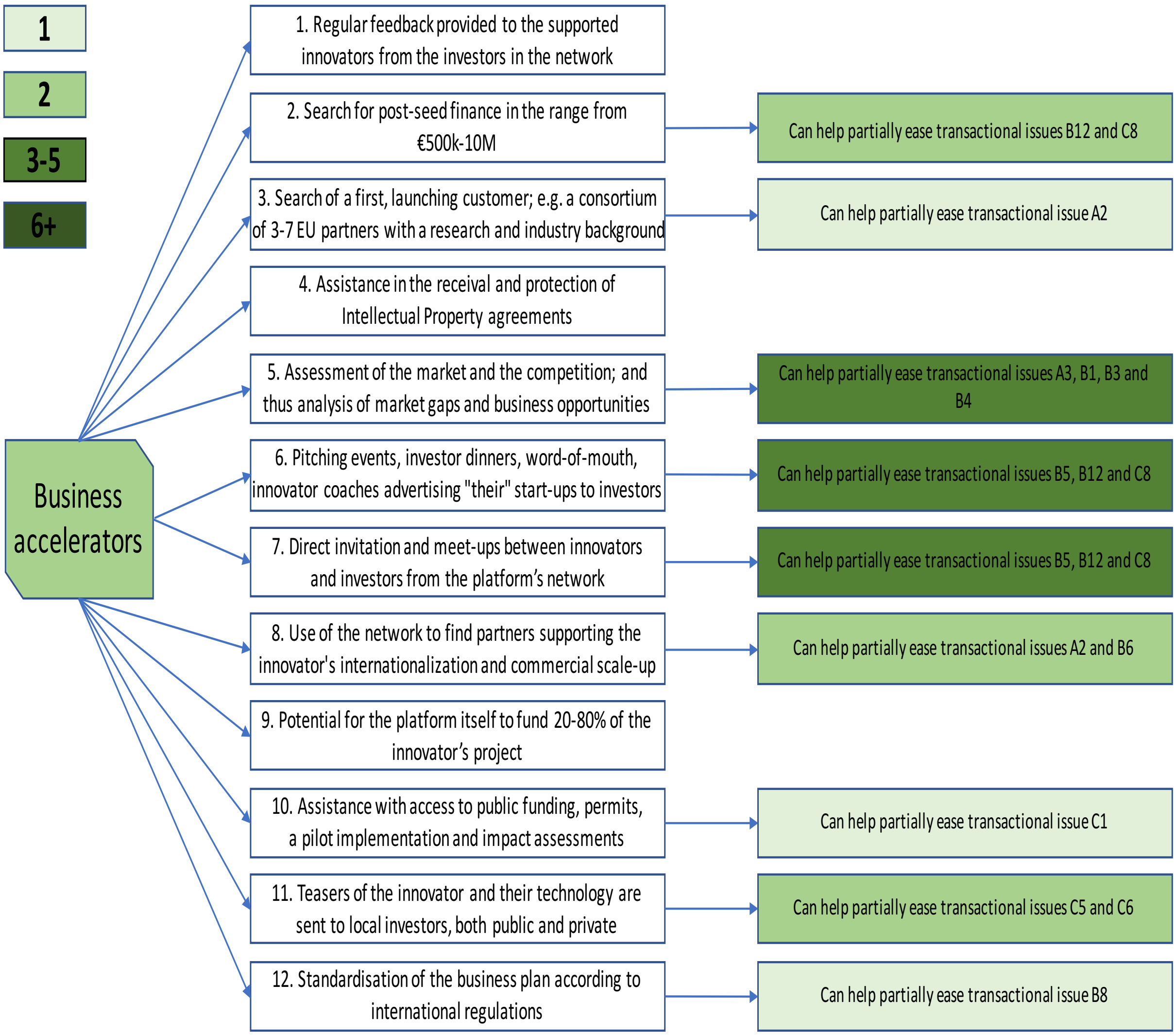

Figure 32: depiction of the services offered by business accelerators (middle column), and how these fare against the transactional issues (right column).

Business accelerators and private matchmaking companies

Figure 33 below shows the services that are currently being offered both by business accelerators and private matchmaking companies. Considering both platform types offer these services, it is unsurprising to see they all partially ease at least two transactional issues. Specifically, service number 14, which looks at improving the innovator's business plan, eases five transactional issues; the same goes for service number 19, which consists of small matching events. Finally, service number 18 partially eases six transactional issues, via a large matching event. The latter is offered by the business accelerator KIC Innoenergy, it is called the Business Booster event[29], and had 700 participants from 32 countries last year. Similarly, the private matchmaking company Cleantech Group organizes the Cleantech Forum[30], attended by 450 participants and is the largest gathering of VCs and corporate investors in Europe, there are usually 40% investors, 30% innovators and 30% government agencies.

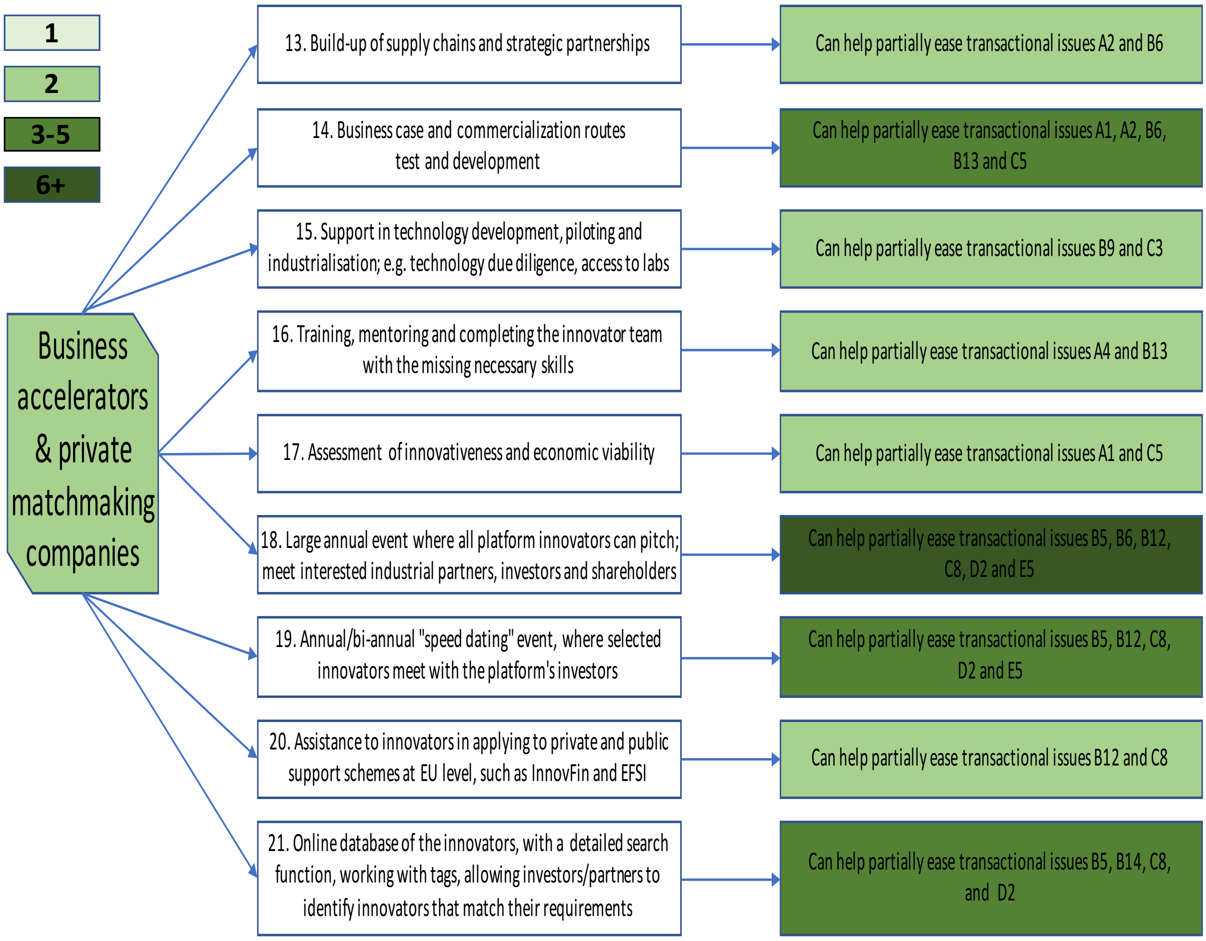

Figure 33: depiction of the services offered by both business accelerators and private matchmaking platforms (middle column), and how these fare against the transactional issues (right column).

Type 2: Private matchmaking companies

Figure 34 below shows the services that are currently being offered by private matchmaking companies only. All services but one partially ease at least a transactional issue, and the overall shade of green is darker than in the figures above, i.e. these services offset more transactional issues each. For instance, service number 28 (called the i3 platform, offered by the Cleantech Group)

[29] See http://tbb.innoenergy.com/
[30] See https://www.cleantech.com/events/

partially eases nine transactional issues, service number 31 partially eases 8, and service number 32 partially eases 7. While service number 31 is a type of online platform, the other services consist in doing an in depth-analysis of the investor for the innovator, and vice versa.

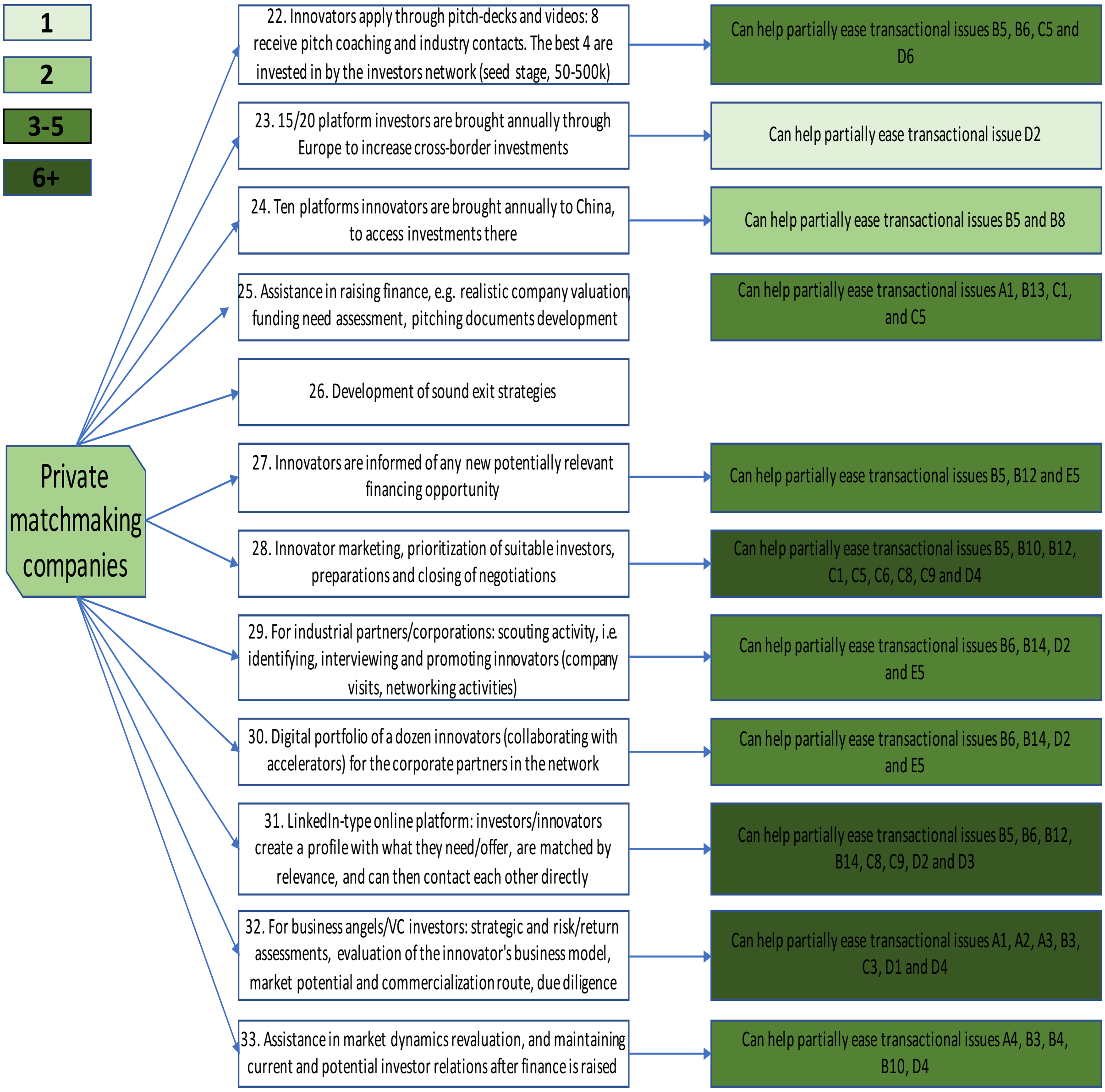

Figure 34: depiction of the services offered by private matchmaking platforms (middle column), and how these fare against the transactional issues (right column).

Type 3: Crowdfunding platforms

Finally, the last type are CFPs, as depicted in Figure 35 below. CFPs are different from the other two types of platforms, as they do not match innovators with typical investors such as business angels or VCs, but rather with thousands of individuals who usually only invest small sums of money. Considering the capital intensity of innovative energy technologies, this is possibly why CFPs offer much fewer services, which partially ease only three transactional issues. It would appear that an "ideal" matching platform would be a mix between a business accelerator and a private matchmaking company, rather than a CFP.

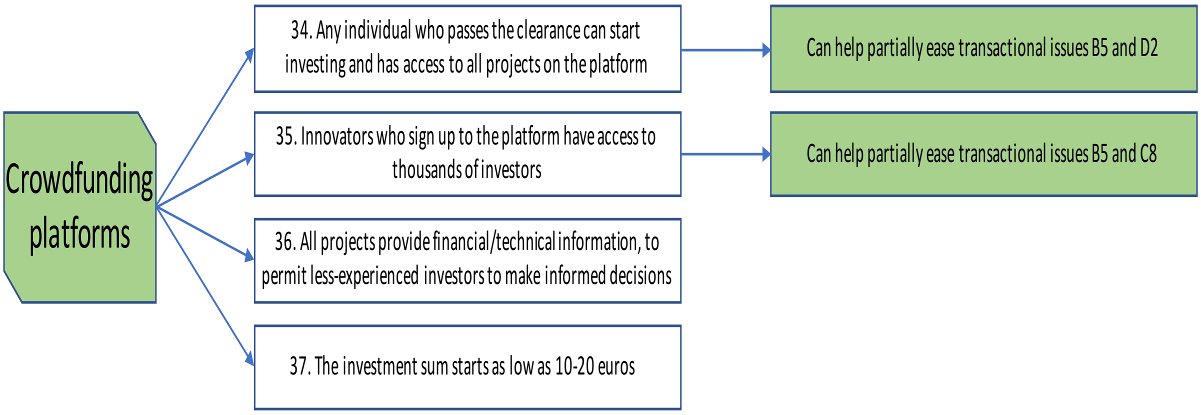

Figure 35: depiction of the services offered by crowdfunding platforms (middle column), and how these fare against the transactional issues (right column), with both issues partially easing two issues.

To sum up, by interviewing 11 matching platforms, a list of 37 services was made. Each service was then analysed against the 45 transactional issues that have been illustrated before. This permitted to see that 31 services are currently partially easing at least one of these transactional issues. The different shades of green also show most services help partially ease more than one issue at a time, with 4 services tackling more than 6 transactional issues each. These 4 services are:

- a large event where innovators can meet investors, partners and other relevant stakeholders
- aiding the innovator find, prioritize and negotiate with suitable investors
- an online platform where innovators/investors are matched by relevance
- an in-depth analysis of the innovator for the investor

These four services help partially ease the transactional issues that were mentioned the most and therefore considered most severe by the interviewees, namely the innovator having a poor business plan, the miscommunication between innovators and investors, the low visibility from innovators to investors and the fact innovators spend too much time on the technology and not enough on trying to attract investors and partners. These four services must then be the basis of an "ideal" matching platform. To create the latter, a final piece of information is needed, namely which transactional issues are not being partially eased by the currently existing services.

4.3.1.3. The "ideal" matching platform

Table 6 below shows all 45 transactional issues, listed with the aforementioned coding, e.g. A2.

Table 6: Representation of all 45 transactional issues. In green, those that are partially eased by currently existing matching platform services; in red those that are not.

A1 - Lack of a solid, sensible, coherent and realistic business plan, that shows a clear path to commercialisation and hence revenue generation	B7 - Difficulty in securing a long-term contract with the grid, thus securing future potential cash flows
A2- The investor perceives poorly the innovator's supply chain, distribution channels, strategic agreements and commercial partnerships	B8 - Difficulty in accessing cross-border investments
A3 - Lack of a clearly identified and justified target market	B9 - Poor collaboration with universities, meaning many innovators lack access to well-equipped testing environments
A4 - Most unsuccessful deals are those innovators led by material scientists, which are not the investor's cup of tea, as they care little about the business plan	B10 - Information asymmetry/miscommunication (can go both way) E.g. the innovator has difficulties understanding the financial jargon and generally, the investor's needs
A5 - Low chance for Innovators with shallow pockets to access quality legal advice at the right time, so poor legal case	B11 - Targeting of the inappropriate finance source considering the venture stage and/or technology
B1 - Targeting of the inappropriate markets/countries, e.g. where clean energy only receives verbal support	B12 - Difficulty to navigate the local investor and specifically VC community without an impartial intermediary with expertise in the area, it is very time consuming
B2 - Bad understanding of the local regulatory environment, exacerbated when there are several Member States	B13 - Little understanding on the business model and overall capital requirement, on how to run a business, understand the market, and deal with fresh capital. The team running the company have low business capabilities
B3 - Bad understanding of the target market (e.g. customer base, political agenda…), exacerbated when it is made of several Member States	B14 - Lack of communication from innovators towards investors, e.g. corporations; both parties lack understanding of the other's key motivations and functioning
B4 - Little understanding in terms of current market trends and investment environment	C1 - Too much focus on the technology, while omitting the financing, commercial and the permitting sides
B5 - Low visibility of innovators to the investors, specifically when the innovator lacks the right network or connections with an industry partner/advisor who can make introductions to potential investors. Exacerbated when it is a small company with little resources	C2 - Aiming large scale, when it is easier to raise finance with small technology systems and grow in controlled steps. Willingness to go too fast without going through a proper learning curve to improve the business case
B6 - Difficulty in identifying the right commercial partners, suppliers and sub-contractors in time, exacerbated when wanting to operate in several Member States	C3 - Lack of willingness/time to undergo technology due diligence and show the technology is ready

C4 - Due to low cash availability, decision to build a professional team only when sales start (e.g. hiring a professional sales/marketing person)	D4 - Information asymmetry/miscommunication (can go both way). E.g. the investor has difficulties understanding the technical benefits, the technological explanations should be simplified. It has little in-house expertise on innovative energy
C5 - Inability from the innovator to show what (s)he is trying to achieve and the importance of its project, from a technological and business perspective. Overall, little commercial communication	D5 - Lack of independently witnessed test results by the investor
C6 - Lack of publicity to its technology, contributing to the negative perception of the industry	D6 - Need for some financial players to seek industrial synergies, and the lack of willingness of other players to do so
C7 - Within immature industries, little alignment with other stakeholders (e.g. supply chain/project developers/enterprise agencies) that have the common objective of the industry commercialisation	D7 - Big delays in response between when a demand for investment is made and a yes/no response, particularly problematic since the innovative energy industry is a fast growing one
C8 - Lack of willingness/time to meet with a lot of potential investors before finding the right one	E1 - Need to gather several co-investors, some of them preferably already operating in the industry, which is very difficult to manage with limited resources and time. It is a challenge to get a good, stable syndicate of co-investors at the beginning of the deal
C9 - Lack of willingness/time to do an in-depth analysis of potential investors before approaching them	E2 - Few stakeholders to license the technology too after it is demonstrated. So, the innovator has to deploy it large scale himself, which takes a lot of time and cash, exacerbating the valley of death
C10 - Will to obtain specific financial instruments, which are not being offered by the most suitable investors (e.g. equity vs debt)	E3 - Junk claims about and within the innovative energy industry which result in lack of credibility
D1 - Due to the speed of energy technology development, specifically in software, the investor cannot have an in-depth understanding of the energy sector and therefore sees innovative energy technologies as complex and with an unproven value	E4 - Too little awareness around successful innovative energy technology projects
D2 - Limited network of innovative energy project developers to choose from	E5 - Lack of support for innovators to find investors other than VC funds, such as corporations and other strategic partners
D3 - Lack of communication from investors, e.g. corporations, towards innovators; both parties lack understanding of the other's key motivations and functioning	

Table 6 above shows that the currently existing matching platform services offset 31 out of 45 transactional issues. To build an “ideal” matching platform, one can then use the analysis that has been performed so far, starting with the currently existing matching platform services that partially ease several transactional issues. Considering each service shows the number of issues it can partially ease and that each transactional issue is ranked by severity, which services should be considered most important and therefore kept in the "ideal" platform, is up to personal interpretation. Realistically, a matching platform will have severe difficulties if it were to offer around 40 different services; the expertise, staff, equipment needed and the money it would cost makes it unviable. Yet it could offer around 20/25 services. Therefore, one option could be for example to:

- keep all currently existing services that partially ease at least three transactional issues (16 services: number 5, 6, 7, 14, 18, 19, 21, 22, 25, 27, 28, 29, 30, 31, 32 and 33)
- out of the remaining currently existing services, keep those that offset at least a transactional issue that has been mentioned six times or more (severity colour code dark brown and above) by the interviewees (5 services: number 10, 17, 24, 34 and 35)
- create new services to partially ease the transactional issues that are currently not met (see Table 6 above), and that have at least been mentioned three times by the interviewees (3 services, to offset issues B2, B7 and B11). For example, a panel of regulation experts could be part of the platform's network to ease issue B2; negotiation specialists that have contacts with local grid operators could help ease issue B7; and innovators could be taught which finance sources to target, considering their technology development stage, to help ease issue B11. The latter could happen via a course, or by producing a comprehensive guide, such as a Vademecum[31], to illustrate the point clearly and concisely, and mass distribute it.
  One could argue that these 3 services are less necessary than those of the second bullet point, since they partially ease transactional issues that have been only mentioned at least three times versus at least six times. However, these services are not currently offered, they are innovative and refreshing, and might give the "ideal" matching platform a competitive advantage versus the others. This would in turn attract the best innovators and investors and the business model of the "ideal" matching platform would, idyllically, be copied and spread through the market.

Since the build-up of this "ideal" matching platform was made by seeing how many transactional issues could be eased, the services that do not ease any have not been accounted for. Some however could be included, such as service number 4, regarding IP protection, which is important when it comes to intrinsic issues. Once again, this is up to personal interpretation. Nonetheless, considering the impact of a combination of the most important services, an "ideal" matching platform could help ease many transactional issues, hence increasing the amount of private finance invested in innovative energy technology projects and helping EU innovators escape the VoD.

To create the "ideal" matching platform, it seems one must simply keep the best currently existing services and add some new ones. However, as described above, the vast majority of these services are currently being offered either by business accelerators or by private matchmaking companies, which has two significant implications:

1. business accelerators tend to be solely focused on start-ups, which are generally of a low TRL; meaning that innovators that are at TRL 6-9, i.e. precisely those innovators that are stuck in the VoD, would not be able to apply for these services
2. private matchmaking companies are indeed private, meaning they are for profit firms; this signifies that the services they offer are considerably costly. Most energy technology innovators stuck in the VoD do not have enough capital to spend it on such services, or they have some capital but believe other aspects should be prioritised over such services.

[31] A basic structure of what such a Vademecum might look like can be seen in Annex 12.

To really create the "ideal" matching platform which would help innovators stuck in the VoD, the combination of services described above should not be offered by a business accelerator or a private matchmaking company. This does not make these two platform types redundant. When looking at their services, business accelerators can be considered as vital for the survival of many start-ups, and private matchmaking companies have a significant clientele of advanced innovators that can afford their fees. Nevertheless, when it comes to helping most innovators that are stuck in the VoD, the "ideal" matching platform should for example be a public or not-for-profit entity which does not focus on start-ups, but on innovators that are at TRL 6-9.

4.3.1.4. Matching platforms challenges and recommendations

For the matching platform to be "ideal", it is not enough that it has the most useful services and targets the correct innovators. The interviewees have identified several challenges with current matching platforms, as well as recommendations the matching platforms should abide to. Both the challenges and recommendations have been ranked following the same colour code as for the platform success factors, i.e. by the number of times they were mentioned by the interviewees. Considering there were many challenges and recommendations mentioned, only the most important ones will be discussed in the text. All the challenges can be found under schematic form in Annex 14 and the recommendations in Annex 15[32]. Both the challenges and recommendations have been divided in the same four facets as the platform success factors, namely services, structure, operations and strategy.

Challenges

- 7 interviewees mentioned 6 challenges in terms of the services offered, with matching events being the most criticised. For instance, it was said there are too few investors and too little investor diversification at events, that the latter are all similar, and that when it comes to potential industry partners, corporations tend to send people at events which have little "concrete business innovation decisional power".
- In terms of structure, CFPs were criticised by 3 interviewees as only 5% of their transactions are done via equity finance. Further 3 said it is problematic when a matching platform does not have a local network of investors and partners in the target market.
- The platform's operations received the most criticisms, which were mentioned by the most interviewees. The majority of it were directed towards CFPs; 6 interviewees said crowdfunding is not relevant to most innovative energy projects as these are often too complex to attract CFP investors, and 3 said that the due diligence before the project is put on the CFP is too long, that cross-border investments are very challenging and that 25% of all projects on CFPs go bankrupt[33].
- Finally, regarding the platforms' strategies, the main criticism is again directed towards CFPs, as the latter do not take any liability, which then falls on their (inexperienced) investors. For instance, a Swiss VC said it will not "go near an innovator that is crowdfunded", as there are potential legal issues, which are incompatible with VCs.

When looking at the challenges faced by matching platforms, according to the interviewees, a few conclusions can be drawn. Most importantly, that crowdfunding is not a suitable type of platform when it comes to innovative energy technologies. This goes to confirm what was decided when

[32] One should note that the recommendations are not necessarily related to the challenges. i.e. following the recommendations does not mean the challenges will be offset, they are simply extra recommendations the interviewees thought would be useful to make the matching platform even more "ideal".

[33] There are mostly mature energy projects on CFPs, so it is safe to assume the failure rate would be higher with more innovative projects.

building the "ideal" matching platform, as CFPs were also discarded then. Secondly, that platforms could be improved, for instance by making sure a diverse crowd of investors is present at matching events, by including local investors in their network, and by lengthening the support phase offered by platforms, specifically for hardware technologies.

Recommendations

- The services facet received the most recommendations, which were also the most mentioned. 13 interviewees suggest creating a matching service to facilitate contacts with corporate investors and strategic partners (e.g. energy suppliers, building companies), and specifically with the operational people within those companies.
  Additionally, matching events should have industry specialists, they should be technology focused and on a local scale. To make the matching event day as efficient as possible, the interviewees advise to copy the style of the Ecosummit[34] or the HGTF[35] event in Germany, both regarded as very valuable. HGTF, for example, invites 800 people; everyone gets the list of attendees in advance, and there is a matching tool, where one says to an innovator 'let's meet at table X at time Y', so lots of meetings can be pre-scheduled during the day. "It is very exhausting, but very efficient", said a German VC.
- In terms of structure, several recommendations were made by the CFPs to improve their industry, but this type of platform has been shown not to be relevant anymore. Other recommendations are to expand the platform into China, and hold an event there; or to have a third-party made platform rating and make sure platforms are as user-friendly as possible to avoid discouraging innovators/investors that lack time as it is.
- Recommendations were also made regarding the platform's operations, but all were only mentioned once, so are less urgent. However, an atypical one was suggested by a Dutch VC. Namely that it is better to match innovators with customers rather than have the platform give them money/training, as a customer base is more valuable. Instead of giving money to innovators, platforms should spend that money to help find a customer base, e.g. making sales calls. The matching should be between the innovator and the market; if there are no potential sales, there will be no investors.
- Finally, in terms of strategy, the relevant recommendations were also solely mentioned once, and include things such as increasing communication between innovators and corporations by organising roundtables, engaging with an advisor who can introduce the innovator to potential investors, and seeking investors in the target markets, as these can help the innovator find sales partners and customers there.

To sum up, most of the challenges faced by matching platforms can be avoided by not using a CFP type platform for the "ideal" platform. The latter could then maximise its possibilities of being "ideal" by following the recommendations listed above.

4.3.1.5. Matching platforms summary

Matching platforms have now been extensively researched. First, by discussing the platforms' success factors; then, by listing all currently existing matching platform services to see which partially ease one transactional issue or more, and which transactional issues are not eased at all. Using this knowledge and the severity ranking of the transactional issues, an "ideal" matching platform was proposed. Finally, the challenges the interviewees believe matching platforms are facing were considered, as well as some recommendations to improve these platforms in terms of

[34] See http://ecosummit.net/
[35] See https://high-tech-gruenderfonds.de/en/

their services, structure, operations and strategy. This "ideal" matching platform could be a way to ease transactional issues and help energy innovators escape the VoD. While this may be true, it is likely not enough. Innovators should not solely be part of the "ideal" matching platform, they should also make themselves "ideal", hence maximising the possibility of attracting private finance.

4.3.2. The "ideal" innovator

This section will first look at the success factors boasted by other innovators that successfully escaped the VoD and made it on the market.

4.3.2.1. Innovator success factors

Since several success factors were mentioned, only those mentioned at least twice are present in Figure 36 below, the remaining ones can be found in Annex 16. The colour code remains the same, i.e. it accounts for the number of times a specific factor has been mentioned by the interviewees.

Figure 36: depiction of the factors that made innovators successfully escape the VoD, in terms of their network, operations, strategy and investor targeting.

- The factor category that made innovators most successful in escaping the VoD is a good network. This first category contains the most success factors, which have also been mentioned significantly, starting with the first factor: cooperating with universities increases the chances of being successful. A British PV innovator stated their “cooperation with Oxford University was vital”, and that the university’s VC fund even financed them. Additionally, a Swiss VC said ¼ of their investments started as university research projects, so they keep good relations with universities.
  The third factor says the innovative management team should have industry experience and an extensive network. The same British innovator said most of the initial €10M raised from private finance was through the management’s personal contacts, since they hired someone who had these contacts. He thinks doing that could be a good bargain for several innovators, as “the trust via contacts is very important".
  The fourth factor illustrates the importance of cooperating with corporations and corporate investors. A Belgian smart grid innovator, for instance, entered in strategic cooperation with ABB Benelux. He said they considered cooperation with other industry partners as well (e.g. ENGI, EDF, Schneider, Siemens) but perceived ABB to be the most appropriate partner due to the strategic fit of the innovator towards the multinational’s portfolio.
- The way an innovator operates can also increase its success chances, so the people running the business must work well together. A French VC stated that the first thing investors look at is the innovator team; only if it stands out, “which is rare”, will they look at the technology. Additionally, a Finnish VC said that for unsuccessful innovators it often boils down to internal conflicts in the management team. If these conflicts go on for a while, the investor loses its trust. They said “it is usually not a technological issue, but more of a human issue”. Similarly, a German VC stated that unsuccessful innovators usually have fights within the management team, making the latter split up.
  The second and third factor express the importance of building a customer base and showing the innovative technology is marketable. This can also be done in foreign target countries by working with local industry associations.
- An innovator’s strategy is also important for its success. Innovators should aim to attend as many matching/networking events as possible, which goes to confirm the utility matching platforms can have in easing the VoD. One should note that before attending these events, the innovators must know how to pitch. A Finnish VC said It all boils down to how well the innovator can pitch his project: “the investor must believe in the person and his story”. If the investor is not convinced in 5 minutes, a customer would probably not be convinced either, making the innovator unattractive to the investor.
- Finally, successful innovators target the right investors. One option is for example to start local, only look for international investors after. Another factor that was mentioned was the importance of starting with public funding in order to attract private investors.

Innovators which successfully escaped the VoD have some factors in common, such as cooperating with universities, having a good network of investors and commercial partners, having a management team that works well together, and participating in many matching/pitching events. Innovators currently stuck in the VoD should therefore try to make as many as possible of these success factors theirs.

4.3.2.2. Innovator recommendations

There are also several recommendations (given by successful innovators, as well as investors and matching platforms) that innovators could follow to maximise their chances of attracting private finance and get a better chance to escape the VoD themselves. These were very numerous, so they were separated into seven categories, of which four are the same as for the innovator success factors, as shown in Figure 37 below. Only those mentioned twice or more will be discussed in the text, alongside further comments made by the interviewees. The list of all recommendations given can be found under table form in Annex 17.

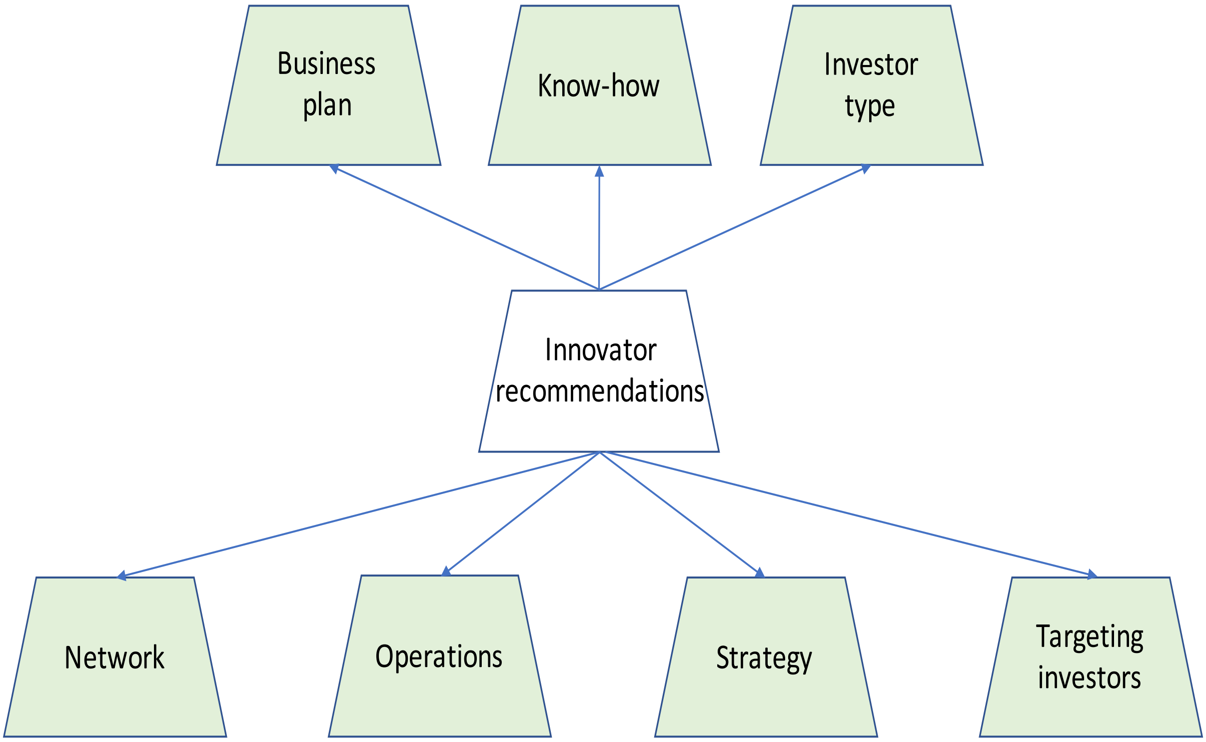

Figure 37: depiction of the seven categories of recommendations given to innovators stuck in the VoD.

- The first recommendations given to innovators regard the business plan, such as boosting their visibility by participating to awards[36]. Also, the innovator should predict the investors' doubts and deliver a clever low risk route to market. Finally, s(he) should have a clear plan of how much ownership (s)he is willing to give up and how to use the capital received by the investor.
- Secondly, recommendations regarding the innovator's know-how. For example, it is vital for the CEO, CFO and COO[37] to have good presentation/negotiating skills, and for the technology to have certain benefits with regards to current technological, socioeconomic and political trends. Finally, innovators must not give up, knowing that things will always cost more and take longer than expected.

[36] Not everyone agrees; a Finnish VC stated that when innovators "get a lot of awards, you wonder if they just spend their time seeking awards, rather than making sales calls".
[37] Chief Executive Officer, Chief Financial Officer and Chief Operating Officer

- Thirdly, recommendations on the most suitable type of investor, such as seeking one that will support the innovator's internationalisation, and has a network in China[38] and/or the USA. As well as looking for corporate investors, and the European Investment bank (EIB[39]).
- Fourthly, the innovator's network. The most mentioned recommendation is that innovators should try to build a consortium with supply chain partners and investors[40]. Also, they should find customers as early as possible and a lawyer with experience in TRL 6-9 financing. There is no need to hire expensive, international law firms, a small lawyer that knows about company-to-company contracts and national law is fine[41].
- Then the recommendations regarding the innovator's operations followed. These included things such as getting several good patents, looking for someone with business know-how if the innovator has little, and "work well". For example, if the innovator takes too long to answer the investor's email, it leaves a bad impression[42], as that shows how they would work with customers.
- Strategy recommendations were next, like EU grants usually being faster and more competent than national grants, seeking finance through capital markets, and starting fundraising activities with potential customers early, as these could become investors/partners as well.
- Finally, recommendation on targeting investors were made. The main one is to have a clear, transparent and to the point communication strategy when approaching investors. Also, innovators should study the investor, know what they usually invest in and why; most importantly, they should not give up, as one must talk to hundreds of investors for one to accept[43].

All these categories had a similar amount of recommendations, and were mentioned a similar amount of times by the interviewees (as can be seen in Annex 17). The only recommendation that was mentioned more than 3 times was the first within the targeting investors category, i.e. innovators having good communication strategies and skills. For example, a Swiss VC stated that when it comes to approaching the investor, calling takes too much time. Innovators should send an e-mail with a PowerPoint presentation of the technology and company; joining a detailed business plan is often too much and not necessary, "what drives the investor nuts is receiving decks that do not convey what the innovator does". Also, they should not just come by and make a pitch, that would take too much time and be inefficient.

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[38] A Swiss VC believes "internationalisation is a must for energy technologies". Similarly, a French VC said that since €100M are needed to build a profitable hardware clean energy firm, and only €20M are usually found from open investors in Europe, they then go to China to seek investors for the remaining. They also said most companies do not even find the initial €20M investment in Europe. The most recent one is Heliatech in Germany, and that was "already very surprising".

[39] Receiving a loan from the latter could even facilitate getting a loan from a commercial bank, said a Finnish VC. However, an Estonian ultra-capacitor innovator warns getting an EIB is in no way guaranteed and they are even more demanding with the business case than private investors.

[40] A Scottish business angel said "it is better to have founding partners, rather than a founding CEO".

[41] In case money is short, a Danish wave energy innovator said some lawyers will work on credit if "you promise you are about to get an investment on board".

[42] A Scottish business angel said that VCs, specifically, "tend to not be very patient, and although mutual faith is critic, it can unravel very quickly" and that "once the relation between the VC and the management team breaks down, it is very hard to repair"

[43] As confirmation, an Estonian innovator said that "the best way to ensure investments is have as many meetings/networking events as possible, and talk to as many potential investors as possible"

If the innovator were to manage to make the success factors that were discussed earlier his/hers and follow as many of these recommendations as possible, (s)he would become an "ideal" innovator, reduce the incidence of transactional issues (and possibly some intrinsic issues as well), thus attracting more private investors and having a better chance of escaping the VoD. To draw a conclusion on the previous chapters, an illustration has been given of what an "ideal" matching platform and innovator could look like. There is one last group present within the investment community, namely the investor.

4.3.3. Targeting the "ideal" investors

As mentioned in the Methods section, several investors were interviewed, yet it is not realistic to discuss an "ideal" investor, since every type of investor interviewed might state they are the optimal type. However, one can look at which type of investor the innovator should aim to target, "ideally". This is done keeping in mind that the innovator is developing an energy technology project and is at TRL 6-9. In the Theory section, the different types of investors and how they typically relate to the VoD have been described in detail. The relevance of each investor type for TRL 6-9 innovators, i.e. those that are usually stuck in the VoD, is now considered. Table 7 below shows each type of investor: they have been ordered by the typical investment size, and then their suitability towards financing TRL 6-9 innovators was analysed in the literature[44]. The ones in red do not typically finance TRL 6-9 innovators, the ones in yellow do but are problematic; and the ones in green typically focus on TRL 6-9.

Table 7: representation of the various type of investors, their typical investment size and whether they invest in TRL6-9 energy innovators. Source: own rendering[45]

Investor type	Typical innovator maturity	Typical investment size
Own resources, founders family and friends (3Fs)	Only TRL <6	€20K - 100K
Business accelerators	Only TRL <6	€10K - 150K
Public funds, e.g. grants	Only TRL <6	€10K - 250K
Business angels	All TRLs	€50K – 1M
Crowdfunding	All TRLs	€20K – 5M[46]
Growth/expansion capital funds	Only TRL >9	€1M – 5M
Venture capital funds	TRL 6-9 and above	€300K – 10M
Corporate investors	TRL 6-9 and above	€20m - €100M
Commercial banks	Only TRL >9	€20m - €100M
Institutional investors	Only TRL >9	> €25M

[44] One of the sources used to create Table 7, a study made by AFME (2017), goes into detail explaining the main barriers each investor type faces when financing low TRL innovators and also proposes some solutions.
[45] Compiled on the basis of various sources: AFME (2017), ICF (2016) and BNEF (2016).
[46] One should note that the €5M figure is only true in the UK, as each country has a maximum amount CFPs can raise per project. Germany, for instance, is maxed at €1.5M.

While investors such as the 3Fs, business accelerators and public funds are key at the early stages of a technology project for survival, and as leverage to attract private capital (as stated in the Theory section), TRL 6-9 innovators are out of their financing scope. One should note that while public entities will likely not finance TRL 6-9 innovators directly through grants for example, other instruments could be targeted by the innovators, such as debt finance by public banks (e.g. KfW) or guarantees, made to leverage private finance.

As for crowdfunding, although they do typically also finance TRL 6-9 innovators, it has been shown that CFPs undergo too many severe challenges; coupling those with a low investment size makes crowdfunding unsuitable for TRL 6-9 innovative energy technologies. Growth capital funds, commercial banks and institutional investors (e.g. pension/insurance funds) are marked red as they invest in innovators that are essentially on the market, so above TRL 9, and that have a positive cash flow. This was pointed out in the intrinsic issues section, and was also confirmed through interviews made with two experts sitting on the advisory board of the project this thesis is based on.

Indeed, Ms Lada Strelnikova, asset manager at Deutsche Bank, stated “commercial banks will never finance small-scale, immature innovative energy projects”, as they are only interested in scaling up existing mature risk-less technologies. In another interview, Mr Ulf Clerwall, who works for Axis Alternatives, stated the banking sector is “mentally depressed”, and that the regulatory environment must change to increase conventional investments in small-scale innovative energy projects. A similar situation occurs when looking at institutional investors. Ms Strelnikova believes they do not invest in TRL 6-9 energy innovators as they seek larger returns (around 7%), meaning clean energy investments (of any sort, not necessarily innovative) only account for a very small share of institutional investors’ assets under management. This is because they have a conservative and prudent attitude and they are bound to stringent regulations. The same goes for growth capital funds, albeit at a smaller investment scale.

It appears that the type of investors a TRL 6-9 energy technology innovator is stuck in the VoD should target are: business angels, VCs and corporate investors. As shown in Table 7, business angels invest at all technology development stages, including TRL 6-9. However, business angels, being private individuals, will typically invest relatively small amounts, rarely surpassing €1M per investment. Indeed, an interviewed Scottish business angel stated they “usually look at being a very small minority investor”. So although they are suitable and should be targeted, they must be seen as a co-investor in a syndicate, as they are not able to sustain the investment required by energy innovators on their own. One remains with VCs and corporate investors as leading investors. As shown in the section discussing the recommendations made to innovators, both VCs and corporate investors were seen as the two most suitable investor types. While this is the case, they might be less ideal than usually depicted as explained below.

4.3.3.1. Venture Capital funds

VCs appear to be ideal in every way, they invest substantial amounts (with IDInvest, the biggest VC in continental Europe, which soars up to €10M per investment), and they say they also invest in TRL 6-9 innovative energy projects, as they are willing to take on higher risks than other investor types. However, there is evidence to show they are less ideal than previously hoped for. A recent study (ICF, 2016) examined the investor’s interest to finance innovative energy technology projects; 80 organisations were interviewed, including 16 VCs. These 80 financial players invested €2 billion in 87 TRL 7-8 energy projects.

When talking to the VCs, a few considerations were made:

- VCs will demand significant ownership in return for an investment, and with it, managerial control; something energy innovators try to avoid. They also seek high returns (20-30%) and they tend to be small and scarce. For these reasons, their interest in innovative energy technologies is not very common today.
- There has been a severe decline in recent years in the interest of VCs to fund energy innovators (VC investments plummeted by 83% between 2012 and 2013), and several VCs stopped this kind of investments all together. The main internal reasons are previous bad experiences with TRL 7-8 energy projects; a higher attraction towards other, capital-light sectors; changes in investment strategies (rather look at energy efficiency than energy generation for example); poor financial returns; low in-house expertise; and a limited network of project developers. The main external reasons are the capital intensity of innovative energy technology projects, the extensive time to market, and the overall lack of interest from other financial players for co-investments, such as banks and institutional investors.

Several of these internal and external reasons have been mentioned within the intrinsic and transactional issues sections, meaning the thesis interviewees would tend to agree with the ICF (2016) study VCs interviewed. To give an example, the CFO of a British PV innovator was interviewed for this research, and stated it is currently very hard to find VCs willing to provide funding at TRL 6-9. Indeed, VCs will typically only consider investing once the innovator is making revenue, and favor software over hardware. Although many VCs claim to invest in innovative energy technology projects, the CFO said it appears they "only do so rarely and whilst the excuses for turning down a technology can be anything from being 'too early' to 'too late', one is never entirely sure of the underlying reason as sometimes the excuses appear inconsistent/hollow". It would seem that VCs are not actually as interested in innovative energy technologies as many believe. As part of the thesis research, several investors were interviewed, including 6 VCs, and they confirm this fact to some extent:

- Three VCs stated it is highly complex to only focus on clean energy investments, so their portfolio usually comprises below 20% of energy related projects. Another VC, from the Netherlands, had a 100% clean energy portfolio, and they had to shut down operations in 2016, and said "it is better to have circa 20% of clean energy related projects, otherwise you cannot sustain it".
- Four VCs stated that their investment sweet spot is when the innovator can show product market and sales, alongside a customer base to scale up the business; i.e. likely not a TRL 6-9 energy innovator

Although VCs are in theory a suitable investor in innovative energy technology projects and they held this role in the past (with many believing it is still the case), there are several indications they are not as ideal as previously thought. This does mean VCs should no longer be targeted, as many still do invest. It means the innovators have to be more patient and spend more time and effort to find those that do.

4.3.3.2. Corporate investors

The third most suitable investor type are corporate investors. The same ICF (2016) study interviewed 25 corporate investors (utility and energy companies mainly) and drew the following conclusions. While VCs are less inclined to invest in innovative (hardware) energy technologies in general, corporate investors are more open. They are more likely to take higher risks than other investors and have high investment capabilities per project (€20-100m), so they should be a primary target for new EC policy to boost investments in innovative energy technologies. Corporations are more keen because they have a long-term strategy (in excess of 10 years) and are more concerned with revenue and regulatory risks rather than technology and completion risks. Overall, corporations are the ones with the greatest proclivity to invest in innovative energy technology projects in the EU.

This is a positive view of corporate investors, and some interviewees of this thesis confirm this:

- A British PV innovator was financed by the corporation Statoil, as "they are starting to look at renewable energy to remain in business in 30 years"; so innovators can aim for those corporations that have it in their strategy to invest in innovative energy.
- A Finnish VC stated that if the innovator still needs 2-3 years before the technology is market ready (which is the case for many TRL 6-9 innovators), they should seek corporate investors, as they are the only ones who can take on that much risk.
- A Swedish private matchmaking platform stated that corporations have the best combination of relevant industry insight and investment horizon. They also believe, alongside a German hydroelectricity innovator, that one must seek them, especially when developing a hardware energy technology, as they have capital, technical know-how and an extensive industry network.
- A French VC stated that although they are investing less than before, "partnerships with corporates are essential".

On the other side, other interviewees disagreed:

- The same British PV innovator that was financed by Statoil said that it is indeed rare to be successful with corporations, it is a question of having the right technology at the right time; they were rejected by 30 corporations before obtaining finance. They also said that as long as their technology was not fully proven, trying to attract corporate investors was "completely useless".
- A Swiss VC stated corporate investors usually seek to buy stakes in companies that at least break-even, so many innovative energy innovators at TRL 6-9 are likely out of scope.
- A German hydroelectricity innovator said that they were unable to attract any corporation despite having been financed already by a public seed investor, a public development bank, two business angels, and one VC.
- A Finnish VC stated that at any networking/pitching event they attend, half the investors are corporate investors, but when one looks at the amount of deals they make, "it is not that impressive". While she does see many advantages in TRL 6-9 innovators getting involved with the activities of a corporation, they must be careful when accepting finance in terms of equity, i.e. ownership. This is because corporations are known to 'digest' small innovators, meaning an innovator "could shoot itself in its own foot if it gets money from the wrong corporation".

While there are contrasting views regarding corporate investors, their multiple advantages make them a potentially ideal investor, so TRL 6-9 energy innovators should continue targeting them.

4.3.3.3. Is there an "ideal" investor to target?

To draw a conclusion on investors, one could say that the 'right' investors (i.e. those who want to invest such as business angels) do not have enough capital, and those that have enough capital (e.g. banks) are the 'wrong' investors. Still, it appears TRL 6-9 energy innovators have three main investor types to target, namely business angels, VCs and corporate investors. Although they all invest in TRL 6-9 innovative energy technologies, each one also has its pitfalls. Nonetheless, innovators should target these three investor types, as they remain their best chances to obtain private finance.

Considering their shortages, researchers are seeking alternatives; for instance in a working paper first published a year ago (Gaddy *et al.*, 2016). Here, the historical decline of investments made by VCs in innovative energy is illustrated, mainly caused by the fact they lost immense sums of money in such investments between 2006 and 2011[47]. This means that currently, most VCs do not want to invest in clean energy. Nonetheless, the authors believe that by following the commitments stated out in the Paris Climate Change Summit[48], and by avoiding the mistakes made by VCs a few years back; a new, more diverse set of investors would be able to finance the new generation of clean energy innovators. This set of investors includes players such as:

- The Breakthrough Energy Venture, founded by Bill Gates and other billionaires, who aim to provide more "patient" capital to energy innovators that seek to achieve "fundamental science breakthroughs", meaning returns on investment will not be as urgent as for other investors.
- Institutional investors; Gaddy *et al.* (2016) believe that these have the right capital and investment horizon and do not invest now because they are "inexperienced technology investors". They say that a network of institutional investors recently pledged circa €4 billion to upscale clean technology innovators worldwide, and that if a positive track record of investments arose, more institutional investors would become interested.
- Regional partnerships between innovators and corporations being supported by the local governments.
- Manufacturing sites, funded by the government, which would allow innovators to learn the necessary skills and know-how to up-scale its manufacturing facilities.
- University laboratories, i.e. allowing innovators to use lab facilities and resources.

The ideas brought forward by the MIT, alongside what is already been discussed about investors could be represented in the aforementioned Vademecum (see Annex 12), i.e. a guide that explains in detail which investor to target at which technology venture development stage and how. This could be a useful feature to decrease the confusion among innovators and make sure several transactional issues which are related to the financial and business lack of knowledge of innovators are reduced, increasing their chances of escaping the VoD. As stated previously, this Vademecum could be made by the "ideal" matching platform and distributed to the innovators when they become part of said platform.

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[47] Two VCs interviewed explained this also happened in Europe. That period was known as cleantech 1.0 (companies founded between 2005 and 2010), which terminated once the market crashed and numerous investors lost their money. Cleantech 2.0 then started in 2010, focusing on more diversified sectors, such as energy efficiency and circular economy, and yet still received a lot fewer investments than cleantech 1.0. Recently cleantech 3.0 has started, which focuses on software, and is undoubtedly more attractive to investors. Generally, the lack of capital in clean energy that started with the financial crisis persists today.

[48] One should note the paper came out mid-2016, so the situation might change, at least for the USA, considering President Trump's will to pull out its country from the Paris agreement.

4.3.4. Overarching recommendations

So far, to answer the main research question, this thesis has shown how an "ideal" matching platform could be formed to ease most of the transactional issues between innovators and investors, it showed how platforms today face challenges and gave recommendations on how to improve them. It showed how an innovator could become "ideal" for an investor by stating factors of successful innovators that made it to the market and recommendations innovators should follow. Finally, it gave recommendations on which investors to target.

These three sets of matching platform, innovator and investor recommendations have the potential to improve the investment community and help innovators escape the VoD in the EU. There is a last set of recommendations that overarch the investment community, namely recommendations the interviewees mentioned to improve the ecosystem (i.e. where innovators, investors and platforms work) as well as changes in regulations. Considering these have only been mentioned by one interviewee at a time, some will be discussed below, but the schematic representation of all these recommendations can be found in Annex 18.

Regarding recommendations that improve the ecosystem, examples are that:

- The EU should put greater effort into explaining, marketing and – if possible – simplifying the application processes of its public funding schemes.
- Students who do technical studies and research institutes employees should also learn the basics of business, and entrepreneurship[49].
- An equity investing culture should be born in the EU, like in the USA.

As for recommendations regarding changes in regulation:

- One should know that the problem for innovators is that there are different legislations, fiscal barriers and languages among member states. To improve the VoD for innovators who target several market countries, one would need a large, homogenous, internal EU market. The European Commission aims to achieve this with the Capital Markets Union (CMU)[50], and by setting up a group of experts to see how to increase finance to clean energy.
- Several tax related recommendations were made, such as tax releases for business angels who invest in low TRL innovators, and allowing investors to deduct capital from their tax base in case the capital invested in innovative energy is lost, as it currently occurs in the USA.

4.4. Best practice example and summary

Knowing the information illustrated in the above chapters, one could come up with an example of best practice innovator, i.e. which TRL 6-9 energy innovator would be most likely to attract private finance and therefore escape the VoD in the EU?

[49] For example, Tekes has a program for students/professors to pitch their innovation. If it is approved, they can apply for Tekes funding. See https://www.tekes.fi/en/

[50] This was pointed out during the AFME event, where the EC was present and introduced the CMU. However, others replied that the main problems faced by innovators include things such as accountancy, insolvency, taxation, and financial literacy. So while the CMU is good, it is not clear that it would help with these problems, as they are on a national scale. See https://ec.europa.eu/info/business-economy-euro/growth-and-investment/capital-markets-union_en

The innovator would have to fulfil several aspects:

- In terms of technology, most investors prefer software over hardware, so (s)he should be developing an innovative energy software technology. This in turn would result in lower capital intensity and lower perceived risks. If it is within hardware, the quantitative indicators seem to indicate biofuel would be the most attractive to investors.
- The project should be at high TRL and be within less than 2 years of entering the market (otherwise only corporations could sustain them).
- It should have been successful at receiving public funds, such as grants, when it was at lower TRLs, as these can be a guarantee to leverage private finance.
- It should have an extensive network of commercial and supply chain partners, as well as universities and advisors. If not, it should hire someone who has and integrate them in the management team.
- It should have sound legal representation.
- It should build a customer base[51], through e.g. signing letters of intent.
- It should target a market with good regulation/overarching ecosystem for energy innovators, with the interviewees indicating Germany as a good example.

Most importantly, this innovator should try to follow the recommendations given in this section and become an "ideal" innovator, it should try and target the "ideal" investor and it should become part of the "ideal" matching platform. To sum up, these sets of recommendations could help innovators come as close as possible to being in an "ideal" situation, thus reducing many issues they currently face, especially transactional issues, and have a better chance at escaping the VoD. These sets of recommendations are the basis of what an investment community should look like and the answer to the main research question.

[51] This is for example what Tesla did with its first model, the Tesla Roadster, before it was known to the general public

5. Discussion

5.1. Research limitations

A few comments must be made regarding the results presented and the thesis overall. Firstly, there are several limitations within the research phase:

- 65 interviews were made: 28 with innovators currently stuck in the VoD, 11 with matching platforms, 9 with innovators that successfully made it on the market, 9 with those sitting on the board of advisors for the project this thesis is based on, and 8 with investors. For several of the groups interviewed then (e.g. the investors), the sample is small and cannot be considered complete.
- The robustness and validity of part of the research is hindered by the fact that it is based on a sample of 28 projects.
- A few limitations target the quantitative indicators used to analyse the 28 projects. Firstly, the geographical coverage is not necessarily a true representation of where most innovative energy technology projects are currently stuck in the EU. For example, some countries in Eastern Europe might not be represented because they never managed to attract EU public funding under FP7 and H2020. Or the fact that the Nordic countries have fewer projects stuck than Italy or Spain could be explained by the general economic disparities between North and South. Or if Germany has several could be because they are more innovative than most countries and will therefore proportionally have more projects stuck in the VoD.
- Similarly, for the technological coverage, some type of innovators might simply be more keen at answering surveys than others and their technology type is thus more represented.
- One should note that there were several differences between the technological distribution of the 28 final projects, versus that of the 180 projects shown in the map, where solar power and energy savings were the two most represented. That is also related to how willing the various innovators were to answer the surveys and the interview questions.
- The small sample of 28 innovators stuck in the VoD also meant that the intrinsic/transactional issues (and therefore the resulting interpretations) could not realistically be separated per technology, and therefore represented all innovative energy technologies.
- The four sets of recommendations given to answer the main research question are based on these 65 interviews. Considering the highly subjective nature of interviews, one must keep in mind that not every person interviewed necessarily gave the most objective answer. For this reason, it is important to keep a critical mind on the various statements and answers given by the interviewees.
- Similarly, every single result interpretation, ranging from the categorisation of the intrinsic/transactional issues, to the utility of the matching platform services, and finally to the various sets of recommendations, has been the personal work of the author and is therefore subjective as well.
- One must also be critical with the various sets of recommendations; these are general, and do not account for technology differences, or for the fact that every country in the EU has different regulations, political agendas, institutions and investor environments.

5.2. Contributions to literature

Nevertheless, while this research is characterised by some limitations, it has also some theoretical implications. As pointed out in the Theory section, the literature illustrated few issues causing the VoD, and these issues were not categorised, so it was unclear which are more likely to be solved. This thesis' value added is therefore to have found an extensive longlist of issues causing the VoD, to have ranked and separated them in various categories and sub-categories, and to have shown which ones (i.e. the transactional ones) can be solved easier. Regarding how to solve the issues causing the VoD, most of the authors in the literature called for public intervention. Thus, this work contributed by taking a new approach and talking directly to the relevant players, the investor and innovators, to collect their point of view.

Furthermore, it introduced the idea of using matching platforms and creating investment communities. The sets of recommendations given are aimed directly at the various players of the investment community (the innovators, the investors and the matching platforms), which have rarely been the aim of the recommendations in the literature. To give a concrete example, today most matching platforms such as business accelerators will tend to support an innovator for circa a year. By looking at the indicators of the 28 projects stuck in the VoD, this would mean 23 of them would see their support end before they are able to enter the market, hindering the positive effects of matching platforms. It could then be suggested to extend the support period beyond the first year if the project is worthy.

5.3. Further research

To conclude, this thesis tried to look at the topic of the VoD from a different perspective by stating that it might be caused by two types of issues, of which the transactional ones could be eased more realistically; and it gave four sets of recommendations on how to do this. Due to time constraints, there were a lot of aspects that could not be considered, and these sets of recommendations should be in no way seen as the only way to help energy technology innovators escape the VoD in the EU, but rather as a first glimpse into the research of more realistic, alternative ways to do so (without having to rely on massive public intervention).

Further research is necessary, such as:

- Putting some of the recommendations given into action and see if they work in the real world.
- Replicating a similar research with a larger, statistically significant sample; this would in turn allow to deliver sets of recommendations for the innovators, investors and matching platforms per innovative technology type, and/or per country.
- Doing the opposite, i.e. focusing on a smaller sample and diving into each project at great depth, which could result in highly specific yet important findings.
- Delving deeper into matching platforms and seeing if innovative energy projects that make use of the latter appear to escape the VoD more easily.
- Confirming whether the maturity of the industry plays a significant role, as aforementioned in the Results section. One could assume that more mature industries are better equipped to help innovative technology projects escape the VoD. If that is the case, one could see which characteristics of a mature industry are important to escape the VoD and see if they can be transposed to less mature industries.

Finally, one could wonder whether considering all clean energy technologies as equal is optimal. Within this thesis, all energy technologies were included in the scope and the sets of recommendations given aim to help all energy innovators escape from the VoD. Similarly, public funds are pointed towards all different types of energy technologies, also those that are less mature than others, such as tidal and wave energy. However, within renewable energy technologies (RET), one could wonder why to bother with other technologies other than solar energy (and wind energy since it is now a very mature industry), when looking at Figure 38 below.

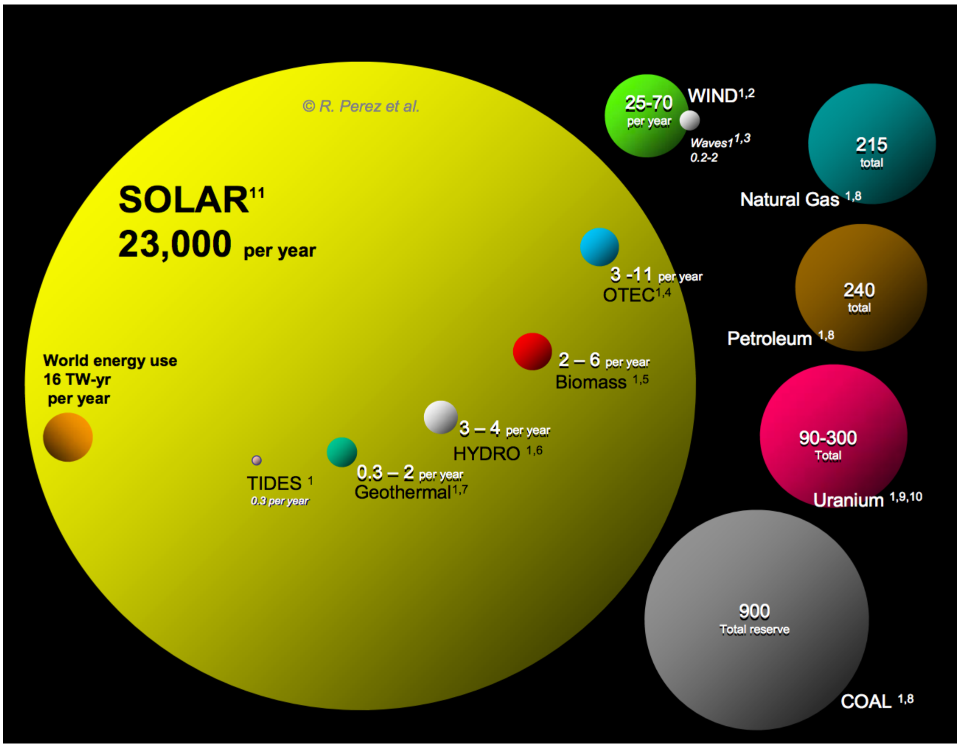

Figure 38: Comparing finite and renewable planetary energy reserves (Terawattyears), with yearly potential shown for the renewables. Source: Perez and Perez (2009).

The potential of solar energy is so extensive compared to other RETs (e.g. tidal, geothermal, hydro…), that with its industry now being mature as well as cost-efficient, it could seem unproductive to use so much public money and effort into other RETs. This thought is exacerbated when looking for example at how much smaller the potential of wave and tidal energy is, especially considering this thesis has shown no private investor is interested in financing such technology projects. This question has been pointed out for several years (MacKay, 2008).

RETs are not enough to successfully implement a new energy system on their own, as these have to be complemented by various other technologies. During an interview made with Trinomics B.V. in November 2016, a professor at Lappeenranta University of Technology (Finland) said these other technologies could be for instance energy storage, demand/response, smart grids, energy efficiency and power to X (when the sectors that cannot be electrified will need to be decarbonised).

As food for thought/further research then, one could argue that it would make more sense to only direct public funds towards the technologies that have a higher probability of carrying out the energy transition, and thus try to leverage private finance and help escape the VoD only the innovators developing these technologies. This argument is not stating some technologies are worthier of financing than others. Taking the example of tidal and wave energy, their potential might be significant enough in some countries, and countries with low potential might still justify financing tidal and wave energy because they are well embedded in the network of countries that do have high potential. Nevertheless, further research could be made on a national (if not local scale), to see if it is the best choice to direct public funding to all types of innovative energy technologies, or if a specific combination of these could make more sense considering the local characteristics of, among others, the market, regulations and energy potentials.

6. Conclusion

The aim of this thesis was to answer the main research question and illustrate what an investment community should look like to help energy technology innovators escape the Valley of Death in the European Union. To do this, two sub-questions had to be answered. The first permitted to gain an understanding of the kind of innovative energy technology projects that are stuck in the VoD. The second involved undertaking 65 interviews with the stakeholders involved in an investment community, i.e. innovators, investors and matching platforms; allowing to categorise the causes behind innovative energy technology projects being stuck in the VoD.

The two main categories were the intrinsic and the transactional issues, and the latter were shown to be more likely to be solved. These were therefore focused on, and the services offered by currently existing matching platforms were analysed to see how they fare in offsetting the transactional issues. The resulting evaluation permitted to show which currently existing services should be kept, and which should be added, thus improving the current matching platform. This partly answered the main research question, which read as follows:

How should the investment community look like to help energy technology innovators escape the Valley of Death in the European Union?

By using the knowledge gathered during the research phase and interpreting the results, this thesis gave four sets of recommendations to help ease the transactional issues, which in turn could facilitate some of the intrinsic issues as well. The first set of recommendations was aimed at the matching platforms, and how to improve them to offset more transactional issues and be more attractive to investors and innovators. The second set of recommendations targeted the innovators, to help them solve other aspects which cannot solely be met by the services of a matching platform. The third set of recommendations was also pointed at the innovators, but came from the investor interviews and reflected their perspective. The final set of recommendations regarded the overarching environment, aimed at for instance public institutions and governments.

These sets of recommendations allow an “ideal” innovator to be part of an “ideal” matching platform, target the investors in an “ideal” manner and be in an “ideal” ecosystem while doing so. They are the basis of what the investment community should look like in order to ease the issues causing the low amount of private finance that EU energy innovators secure, and therefore help innovative energy technology projects escape the Valley of Death in the European Union.

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8. Annexes

All annexes have been made by the author. If the sources used to make these annexes were different than those mentioned in the text, it will be specified.

8.1. Annex 1 – General EU programs

Examples of past and present EU funded programs to sustain energy innovation. Source: own rendering using data found on the programmes' websites

Funding programme	Funding period	Available EU budget	Approximate Annual Budget for Energy
European Fund for Strategic Investment (EFSI)[52]	2015-2018	EUR 16 billion EU guarantee and EUR 5 billion EIB capital	EUR 5 billion
European Structural and Investment Funds (ESIF)[53]	2014-2020	EUR 454 billion	No split available
European Regional Development Fund (ERDF)[54]	2014 - 2020	EUR 196 billion	No split available
Cohesion Fund (CF)[55]	2014 - 2020	EUR 63.4 billion (of which EUR 10 billion to CEF - transport)	No split available
European Energy Programme for Recovery (EEPR)[56]	2009-2015	EUR 3.98 billion	No split available
European Investment Bank[57]	Ongoing	EUR 7.5 billion/year in energy (based on 2014)	EUR 7.5 billion

[52] See http://www.eib.org/efsi/
[53] See https://ec.europa.eu/info/funding-tenders/european-structural-and-investment-funds
[54] See http://ec.europa.eu/regional_policy/en/funding/erdf/
[55] See http://ec.europa.eu/regional_policy/en/funding/cohesion-fund/
[56] See http://ec.europa.eu/energy/eepr/projects/
[57] See http://www.eib.org/

8.2. Annex 2 – Grant-offering EU programs

Examples of past and present EU funded programs, to sustain energy innovation. These programs offer(ed) grants, the most common type of public funding. Source: own rendering using data found on the programmes' websites

Funding programme	Funding period	Available EU budget	Approximate Annual Budget for Energy
Horizon 2020[58]	2014 - 2020	EUR 80 billion	No split available
Secure, Clean and Efficient Energy[59]	2014 - 2020	EUR 5.9 billion	EUR 700 million
Project Development Assistance (PDA)/ELENA[60]	Ongoing	EUR 80 million (2014-2017)	EUR 20 million
NER300[61]	2012, 2013	EUR 2.1 billion	No split available

[58] See http://ec.europa.eu/programmes/horizon2020/
[59] See http://ec.europa.eu/programmes/horizon2020/en/h2020-section/secure-clean-and-efficient-energy
[60] See http://www.eib.org/products/advising/elena/index.htm
[61] See https://ec.europa.eu/clima/policies/lowcarbon/ner300_en

8.3. Annex 3 – Finance sources

Detailed overview of the various finance sources. Source: Own rendering using data from Trinomics B.V. (unpublished)

Finance source type	Investor description	Typical technology stage they invest in	Mainly targeted innovator size	Investment presence in the clean energy sector
Public finance source				
NPA: National Public Administration (e.g. business accelerators)	National, regional, local governments, as well as public agencies of each individual member state.	Usually in the initial stage of a technology, such as R&D, through public direct investments, policy-based incentives, grants and public-private partnerships.	Both SMEs and large enterprises, but mostly SMEs.	NPAs represent a significant amount of the total financial flows to decarbonisation investments. They directly invest in EE in the transport and buildings sectors and support the development of EE in industry, as well as R&D for non-established, innovative RES and EE technologies.
National Promotional Banks	Banks that are fully or mostly owned by public governments, which also provide strategic direction and are often involved in the selection of board members.	Usually in the initial stage of a technology, such as R&D, through promotional funds via commercial banks (second-tier lending) or by lending directly to end-customers (first-tier lending).	Both SMEs and large enterprises, but mostly SMEs.	Most public promotional banks use a mix of commercial-rate and concessional debt to provide finance for RES and EE investments.
EU interventions (e.g. European business acclerator)	Similar to the role of NPAs on a EU level, EU interventions include finance provided via the EU budget.	Usually in the initial stage of a technology, such as R&D, through funding programmes, grants, public-private partnerships etc.	Both SMEs and large enterprises, but mostly SMEs.	Existing EU funds and programmes that can finance RES and/or EE investments include for example Horizon 2020, the EIB, and the European Structural and Investment Funds (ESIF).
EU Public Finance Institutions (PFIs)	EU PFIs work closely together and in a similar manner to their national counter-parts: the NPBs.	Usually in the initial stage of a technology, such as R&D, through a combination of commercial-rate and concessional debt, as well as guarantees, bonds and public-private partnerships.	Both SMEs and large enterprises, but mostly SMEs.	PFIs play an important role in catalysing and mobilising private investment in RES and EE. Major PFIs include for instance the EIB and the European Bank for Reconstruction and Development (EBRD).
Private finance source				
Commercial banks	These are national private commercial banks such as Deutsche Bank and BNP Paribas Fortis.	Usually at a later stage, once the technology is proven, fit to enter the market and has reached financial closure.	Mostly large enterprises.	They are an important finance source, but they invest in established technologies, such as solar and wind (mostly onshore).

Institutional investors	Institutional investors comprise asset owners and investment managers, such as insurance/pension funds and family offices.	Usually at a later stage, once the technology is proven, fit to enter the market and has reached financial closure.	Mostly large enterprises.	Institutional investments in European RES projects has been increasing steeply over the past 10 years, but only in established technologies from large firms. Clean energy investment only accounts for a very small share of institutional investors' assets under management.
Venture Capital/ Private equity (e.g. growth capital funds)	VCs tend to be owned by highly wealthy individuals or are a small part of the portfolio of large institutional investors, like pension funds and insurance companies.	Usually at an early middle to late stage, between angel investors and commercial banks, through debt and equity financing.	Mostly SMEs.	VC/PE funds invest money in the equity of companies developing innovative energy technologies. In theory also at early stages, but this does not actually happen very often. Plus, the overall investment capacity compared to banks, for example, is minimal.
Business angels	These tend to be highly wealthy individuals.	Usually at an early to middle stage, between public funding and VC/PE, through debt and equity financing.	Mostly SMEs.	Angel investments tend to be directed towards the initial stages of a innovative technology project where risk is high. In Europe, these are heavily complemented by direct and indirect government support.
Own finance sources				
Corporations	These comprise large European utilities such as E.ON and EDF.	This can occur throughout the entirety of the technology lifecycle, through the own equity of large, established companies, so through self-financing.	Large enterprises.	Large European utilities are an important source of equity finance for RES projects; in particular at the development and pre-construction stage. In 2014, nine of the largest European utilities invested a total of US$11.9 billion in renewable energy.
Small End-Users (e.g. family and friends)	These include households, small cooperatives as well as entities such as crowdfunding platforms (CFPs) gathering hundreds of individuals to invest in a clean energy project.	Usually at an early to middle stage, until VC kicks in; especially in the case of own equity by family and friends. Other alternative finance sources such as CFPs can also invest in later stages.	Mostly SMEs.	Small-end users also use their own equity and are an important potential source of finance for innovative energy technology projects. They have already unlocked vast amounts of money, in particular for energy efficiency measures in buildings and transport, as well as established RES.

8.4. Annex 4 – First survey

The questions included in the first survey sent out to potential projects stuck in the VoD. To avoid using too much space, the formatting has been simplified to only include the questions, and not e.g. the multiple choice boxes.

1. Please enter your project identifier. You can find this in the email that was sent to you with the link to this survey. If you have not been given a project identifier, please enter the name of your project.

2. If selected, are you happy to be contacted again by us to gain a more in-depth understanding of your project (initially via another survey)? In particular, are you happy to provide financial information of your project and discuss potential project risks with us?

3. Please provide us with your preferred contact email address below.

4. Please provide us with your preferred contact telephone number below.

5. Please provide a short description of your project.

6. Are you receiving H2020 or FP7 funding?

7. When was the start date of your project?

8. What is the end date of your project?

9. Which energy sector is your project active in?

10. In which EU country(ies) could the project be implemented on a commercial basis?

Please Note: We understand that this information may be commercially sensitive. We will not disclose this information outside our project team without prior agreement.

11. What is the minimum size of external investment you need to be fully operational (i.e. operating on a commercial scale)? Please provide your answer in Euros.

12. How much, if anything, of this target investment size have you raised so far? Please provide your answer in Euros.

13. Which stage of development is your project currently in? If you are unsure which box to tick, please tick the one that fits closest and provide further details in the comments box below.

14. At which TRL-Level on the NASA scale of technology readiness is your project at? If you are unsure which box to tick, please tick the one that fits closest and provide further details in the comments box below. Source of scale: Technopolis et al. (2014), evaluation of the impacts of projects funded under the 6th and 7th EU Framework Programme for RD&D in the area of non-nuclear energy.

15. By when do you expect the project to be ready to operate on a commercial basis?

16. How easy is it to increase the production capacity of your project? (1 = very easy, 5 = not scalable at all) For example, if you are developing a generator, how easy it is to increase the capacity this generator produces?

17. How easy is it to replicate your project? (1 = very easy, 5 = very hard to replicate (only one unit feasible/possible)) For example, if you are building a generator, how easy will it be to build and take live a second and third generator?

Thank you very much for your time, you are nearly at the end of this survey. As the survey is still in the design stage, we would greatly appreciate if you could take a moment to tell us about your experience with this survey.

18. Were the questions in this survey easy to understand and made sense?

19. Did you experience any problems with the survey?

20. Do you have any additional comments in relation to this survey?

8.5. Annex 5 – Second survey

The second survey is composed of five Excel sheets, as stated in the Methods chapter. For simplification purposes, only the fourth sheet is shown below to illustrate the type of questions asked and the formatting proposed

IV. Financing Obstacles

Information

In this section we are interested to learn more about your experience in obtaining financing for your project.
In particular, if you have faced obstacles trying to obtain finance, we would like to understand the reasons for this as well as any lessons you have learned from this experience.

Obstacles in Obtaining Project Financing

What obstacles have you faced in obtaining finance for your project?

How many potential investors have you been in contact with to raise finance?

What type of investors have you been in contact with to raise finance (e.g. banks, venture capital firms, government agencies, etc.)?

How many of these investors ultimately decided not to invest in / finance your project? (E.g. Of the X investors we contacted, we were unsuccessful in securing finance from Y investors)

How long have you been trying to obtain further finance for your project?

What were the reasons why these investors did not invest in / finance your project?

What are your options if you do not obtain any further finance for your project?

What lessons did you learn from the experience of trying to obtain finance? In particular, what would you not do again / what recommendations would you give other project teams trying to obtain finance?

8.6. Annex 6 – List of the 28 projects stuck in the VoD

Description of the 28 projects stuck in the VoD in the EU.

Project Name	**Bresaer (Solarwall)**	**CarbonOrO**	**CLEAG**	**Current2Current**
Project Description				
Company overview	This project is backed by a consortium of 16 entities, including private companies, research institutes and service providers.	CarbonOrO is a small-sized Dutch company.	CLEAG is a SME founded in 2003 in Switzerland.	The company was founded in 2007 in Scotland.
Technology	Energy savings technology for buildings: an envelope for building refurbishment, combining solar thermal air, PV, insulation panels, dynamic windows, all within adaptable metallic structures.	CCS: absorbs CO2 in an energy efficient way (it operates at temperatures of 70 degrees Celsius, rather than 120, like other technologies), using a bespoke amine solution. One can the use the absorbed CO2 to make biomethane from	Advanced geothermal ICC (Internalization of Carbon Compounds): it uses the hot water as well as the combustible gases dissolved in the hot water for energy production. The CO2 from the combustion is captured at a rate of 98% and reinjected.	Tidal Energy: the technology diverts a horizontal flow of water to a vertical flow, exhausting through a vertical axis turbine, which drives a generator and produces electricity.
Project location	Turkey	Netherlands	Croatia	United Kingdom

Project Name	**Deep Green**	**Digespo**	**Direct Drive TT**	**Ecowindwater**
Project Description				
Company overview	Minesto AB, developing Deep Green, is a Swedish company of circa 50 employees, and a spin-off of Saab. It is publicly listed, with 4500	The project is being developed by a consortium of 7 entities, including research institutes, universities and private companies.	The project is led by Nova Innovation, founded in 2010 in Scotland. They made the world's first operational grid-	Greek SME founded in 2007.
Technology	Tidal Energy: unique technology that cost-effectively generates energy from low-velocity tidal and ocean currents, thanks to a kite assembly, which moves in a similar manner to a wind kite, and travels 10 times faster than the current	Solar CSP: low visual impact technology that generates heat at medium temperatures (up to 300 degrees Celsius), can also be used for residential sites.	Tidal energy: this technology is the first direct drive tidal turbine that is reliable and economically viable, improving the reliability and lowering the lifetime cost of tidal energy.	Wind and Solar energy: an ecological multiuse autonomous floating platform that combines wind and solar energy to desanilate sea water, providing portable water for islands and remote areas.
Project location	United Kingdom	Italy	United Kingdom	Greece

Project Name	EGS Hungary	ELISA	HEAT-R	HELIOVIS AG
Project Description				
Company overview	EU-FIRE, the company developing the project was founded in Hungary in 2001, and opened a separate division focusing on geothermal	Esteyco, leading the ELISA project, was founded in 1970 in Spain.	AEInnova, developin the HEAT-R technology, is a small company of 14 employees founded in 2014.	Company founded in 2009 in Vienna.
Technology	Geothermal energy: development of an Enhanced Geothermal System (EGS) reservoir and building of a geothermal power plant. EGS can satisfy base load electricity demand.	Offshore wind energy: the first bottom-fixed gravity-based structure (GBS) offshore wind turbine installed without the use of scarce and costly heavy-lift vessels, thanks to an autolift telescopic tower. In deep water (35m+), cost reduction can exceed	Combined heat and power: thermoelectric devices that recover waste heat from the industry and convert it to electricity. The latter can be used directly or returned to the grid. The devices are modular, scalable and highly flexible, in terms of heat	Solar energy, CSP: an inflatable solar concentrator made of plastic films. It has a temperature range between 150 and 400 degrees C, very high modularity and scalability. Over its lifetime, the technology can provide 55% cost
Project location	Hungary	Spain	Spain	Production and R&D in Austria. Demonstration project in the United

Project Name	LOVE	Oceanlinx Group	Prometheus-5	REPHLECT
Project Description				
Company overview	The project is implemented by a consortium of 7 partners, including universities, research institutes, corporations	Small Australian company that has operated for 19 years, with sister companies in the USA and Europe.	Helbio, the company developing the project, is a university spin-off created in 2001. It is a small Greek company of 10 employees.	BSQ Solar, the company developing the project, is a Spanish SME founded in 2009.
Technology	Energy savings (industry): aim is to improve the energy efficiency in process industry, by converting currently unused low temperature heat into electricity. The new thermally driven heat pumps should outperform current	Wave Energy: an oscillating water column (OWC), a patented bi-directional turbine and a generator produce electricity. As the water enters the column in waves, it compresses and decompresses the air inside, thus turning the turbine and	Combined heat and power: can either work as a stand-alone power system or as CHP. It is an innovative way to achieve CHP using hydrogen and fuel cells.	Solar Energy: high concentration PV, and alternative to rooftop PV installations. It consists of a generator and a sun-tracker mounted on a high pole, so it can be mounted anywhere. It can have four times more energy surface density than
Project location	Switzerland	France	Greece	Spain

Project Name	Resen Waves	SCARLET	SEESWIND	Sunliquid
Project Description				
Company overview	Company founded in Denmark in 2010.	Project led by a consortium of two universities, one research institute and eight companies.	Baiwind SL, the company behind the project, is a Spanish SME founded in 2009.	The project is developed by Clariant, a Swiss group founded in 1995, comprising of 140 companies and 17442 employees.
Technology	Wave Energy: simple and cost-effective wave energy buoy concept, commercialised in small scale 5kW modules. It converts the horizontal and vertical wave action into electric power with a direct mechanical to electric drive.	CCS: project aim is to realise the full-scale integration of Calcium Carbonate Looping (CCL), a highly efficient post-combustion CO_2 capture technology using limestone based sorbents. CCL can be used in power and inductrial plants.	Wind Energy: a set of modular 'plug and play' windmills aiming at the small wind market. It covers the full range of windes, and in particular soft and medium wind speeds of less than 4m/s. It is also very silent, so aims to supply houses, communities or	Biofuel production: a climate friendly process for the production of sustainable biofuels and bio-based chemicals from biomass.
Project location	Denmark	Germany	Spain	Eastern Europe

Project Name	Tidal Energy Converter	TILOS	Triblade	Wave Dragon
Project Description				
Company overview	Scotrenewable, the company developing the project, is a Scottish company comprising 25 employees.	The project is developed by a consortium of 13 players, such as universities, research institutes, and	Winfoor, developing the triblade, is a spinoff of Lund University founded in 2007.	Wave Dragon is a Danish company that started its R&D phase on their technology back in 1987.
Technology	Tidal Energy: a floating tidal stream platform with two turbines mounted on a floating hull platform just under the surface. This low cost structure comprises well understood technologies with a simplified and cost effective installation and	Energy storage: project that aims to demonstrate the optimal integration of local scale energy storage in a fully-operated, smart island micro grid that will communicate with the main electricity grid. The storage will take place thanks to NaNiCl2	Wind energy: innovative technology for large scale wind turbine rotor blades. The 3-in-1 triblade aims to reduce blade weight by up to 80% and increase blade length by up to 50%, while reducing production costs.	Wave energy: a large floating reservoir with a doubly-curved ramp in front. The reservoir gathers the water that overtops the ramp, which then drains back to sea through a number of low-head hydro turbines located in the reservoir.
Project location	United Kingdom	Greece	Sweden	Denmark

Project Name	Wave Roller	Waves4Power	WECI	Winddiesel
Project Description				
Company overview	AW Energy Oy, developing the technology, is a Finnish company founded in 2002.	A SME founded in 2012 in the UK.	A SME founded in 2008 in Spain.	Güssing Energy Technologies leads the project in a consortium that also entails universities, research institutes and companies.
Technology	Wave energy: a hinged panel, anchored on the seabed generates electricity from nearshore ocean wave energy. The waves move the panel, this kinetic energy being converted to electricity and trasnferred to an on-shore transformer station via a subsea cable.	Wave energy: a buoy that converts the energy of waves into electrical energy. As waves rise and fall within the buoy, a piston, placed in a tube within the buoy and connected to a hydraulic conversion system, is moved, creating a gigantic pump and thus generating electricity.	Wave energy: technology based on a floating point absorber with a direct drive linear generator power take off. This is cheaper than comparable solutions and is able to maximise energy capture.	Biofuel production: premium fuel that is produced by converting excess power from wind and photovoltaic (PV) power plants into high quality fuels though a Biomass to Liquid (BtL)-process. It will be cheaper and of a better quality than conventional diesel.
Project location	Portugal	UK	Spain	Austria

8.7. Annex 7 - List of innovators

Pre-selection list of innovators; in green the ones that were interviewed

Company name	Technology	Country
Aurelia Turbines	New small gas turbine technology providing best ever efficiencies	Finland
Smart Hydro Power	Smart river turbines producing a maximum amount of electrical power with the kinetic energy of flowing waters	Germany
Enervalis	Operating systems / SaaS middleware for support of smart micro grids, EVs, singel intelligent buildings, and other energy services.	Belgium
Ngenic	Smart thermostat that can be remotely controlled via smartphone (Similar to german Tado)	Sweden
Naked Energy	Hybrid electricity and heat solar panel: Hybrid solar panel generates electricity and heat (PVT panel) by drawing heat away from PV module, thus optimising its power output and simultaneously producing thermal energy	UK
MINERVE	Co-electrolyser of steam and CO_2	France
Heliatech	Heliafilm is a flexible solar film less than 1mm thick that is produced as a roll-to-roll process. It's flexible, light, transparent, ultra-light. Currently the most efficient organic solar cell on the market (13%).	Germany, but looking to expand globally
Ferroamp	Smart grid inverter integrating PV and storage in a local DC Microgrid	Sweden, but looking to expand globally
GulPlug	Energy sensor to enhance the connectivity and energy efficiency of industrial machines	France
O-Flexx	Technology based on thermo-electric effects (Seebeck-Effekt, Peltier-Effekt und Thomson-Effekt) enabling two-way conversion between power and heat	Germany
Tado	Smart thermostat that can be remotely controlled via smartphone	Germany
Ubitricity	Smart and sportable charging plugs (one per vehicle) enabling charging without dedicated charging stations (i.e. from streetlamps etc.)	Germany
PENLIB	A new generation of lithium-ion polymer batteries by developing new battery components	France
Eyecular	StratiFlex product to improve thermal stratification in hot water tanks, thus improving heat storage efficiency	Denmark
EOLOS	Wind measuring floating platform	Spain
HyCUBE	Three innovative solutions for hydrogen storage systems	France
VERBIO Vereinigte BioEnergie AG	Biomethane production from straw: First-of-a-kind straw-to-biomethane plant based on company's own mono straw fermentation technology. Production of transport fuel from local farming residues:	Germany

ROMO Wind	iSpin - wind turbine module for data collection enabling wind data analysis, prediction, optimisation. Danish Technological University (DTU)	Denmark / Switzerland
Fuel Cell Energy	Direct Fuel Cell (DFC) are based on carbonate fuel cell technology, meaning electricity can be generated directly from fuel through internal reforming, more efficiently and polluting less than a standard natural gas power plant	USA, with affiliations in Europe and Asia
Exasun	The Black Roof, essentially a similar idea to the Tesla rooftiles, loses normal tiles and substitutes them with black solar panels that have a higher efficiency thanks to metal wrap-through cells and flexfoil interconnections. Also doable for windows, facades	Netherlands
OneShore	The company's own-developed OneAnalyser diagnostic tool is first used to monitor and analyse the consumer's energy demand, enabling better design and optimisation of solar-diesel combo system	Germany
Torresol Energy	Concentrated solar power plant via solar tower and thermal storage able to provide electricity generation over 15 hrs of absence of solar radiation. Nominal power 17.5 MW, expected yearly yieald 100 MWh	Spain
Gencell (Global	High efficiency energy solutions (CHP and Power) based on state-of-the-art fuel cell technology, back-up and off-grid applications	Germany / Global
Energyworx	Data management platform for energy utilities based on big data and machine learning	NL / USA
Seatower	Low-cost foundations for 6MW+ offshore wind turbines	Norway / Global
Efergy	The Efergy Ego allows to monitor every appliance in the house via mobile, tablet or laptop to analyse its consumption and boost its efficiency	USA, EU, Oceania
Turbulent	New micro hydropower plant design enabling a more compact turbine, reducing size, costs and environmental impact, enabling decentralised application and making it the first profitable micro turbine in the world	Belgium
Againity	Organic-Rankine-Cycle technology for conversion of low-grade heat into electricity	Sweden
Aquion Energy	The Aspen batteries use acqueous hybrid ion technology to store electricity in a safe, efficient and non polluting way	USA
BioCube Corporation	The BioCube produces biodiesel from energy efficient feedstocks that do not feature in the food chain, with a possibility of zero carbon emissions. It can be brought anywhere to sustain the energy independence of poorer communities	Canadian company, distributed in North America, Asia, Africa and Oceania
Calmac	The IceBank stores thermal energy in the sense that it produces ice during the night when electricity is cheaper, and delivers it as cold ventilation during the day when it is most needed	American company, product sold globally

AltaRock Energy	Thermally-degradable zonal isolation materials (TDZIM) makes multiple zone geothermal reservoirs a reality and exacerbates the effectiveness of Enhanced Geothermal Systems (EGS)	USA
View Glass	View Glass is a type of glass that reacts to outside conditions, at day and night, by changing how tinted it is. In the summer, less sunlight enters the building, there is ventilation efficiency increase. The optimal amount of daylight always comes in, thus reducinh lighting consumption. Overall, circa 20% reduction on annual electricity consumption	USA
Skeleton Tech	Company developing ultracapacitors, a pioneer in the field	Estonia
Sonnenbatterie	Home, behind-the-meter energy storage system based on lithium iron phosphate batteries	Germany
Powervault	Various battery-based behind-the-meter energy storage systems	UK
Nexeon	Various behind-the-meter energy storage systems based on their silicon anodes lithium-ion batteries	UK
AW Energy	The WaveRoller converts ocean waves into electricity. Global potential of 500GW	A Finnish company, with projects in Portugal, France, the UK, Ireland and Chile
E-BUS BATTERY	Novel modular battery system	Poland
Oxford PV	Perovskite solar cells. Put a perovskite layer on top of c-Si layer to improve PV efficiency	UK company, perovskite solar cells will be produced in Germany
Arol	Biogas pretreatment system	France

8.8. Annex 8 – List of advisors

The people that sat on the board of advisors for the project this thesis is based on, and that were interviewed

Advisor	Workplace
Oliver Gajda	Eurocrowd
Diletta Giuliani	Climatebonds Initiative
Ulf Clerwall	Axis Alternative/ ALLISS
Connor Riffle and Floriane De Boer	Carbon Disclosure Project (CDP)
Lada Strelnikova	Deutsche Bank
Anna Lehmann	Climate Policy Advisory
Jessica Brown (CPI)	Climate Policy Initiative
Guillaume Taylor	Quadia

8.9. Annex 9 - List of matching platforms

Pre-selection list of matching platforms, separated by type; in green the ones that were interviewed

Crowdfunding platforms
Abundance Investment
Greencrowd
Wiseed
Enerfip
Lendosphere
GreenVesting
Lumo
Bettervest
MicroVentures
Crowdcube
European crowdfunding networks such as Crowdfundres, Citizenergy and Crowdfunding4innovation
(Private) matchmaking companies
ETEQ Venture
Ventures4Growth
Blumorpho
Broadscale
E-nable+
Cleantech Group
EIPP (European Investment Project Portal)
Business accelerators
Climate-KIC
KIC InnoEnergy
LACI (Los Angeles Cleantech Incubator)
CET (Clean Energy Trust)
Dublin Business Innovation Centre (BIC)
Secure Chain
European Investment Advisory Hub

8.10. Annex 10 – List of investors

Pre-selection list of investors, separated by type; in green the ones that were interviewed

Private Equity & Venture Capital
Cleantech Invest
eCapital
UP Invest
FirstFloor Capital
Dynamic Ventures Corporation
MTI Ventures
Longwall Venture Partners LLP
Zouk Capital
Doen Foundation
Yellow and Blue
Emerald Ventures
Idinvest
Business accelerator
Green Campus Innovation
Public Bank
KfW
Sächsische AufbauBank
EIB
Private Bank
Swedbank AS
Corporation
Samsung investment fund
Bosch investment fund
Statoil
Harju Elekter
Innogy (RWE Group) Venture Capital fund
Siemens Venture Capital fund
Eneco corporate Equity Fund
Investment and equity management firms
Continuum capital
Parkwalk
OSEM
Meridiam
Business angel
Simon Joseffson
Andrew Morton
Broker
Capillary Oy
Lawyer
Eversheds
Technology transfer
EMPA

8.11. Annex 11 – Geographical/technological coverage of the 280 first survey projects

Country	# of projects
Spain	52
United Kingdom	32
Italy	27
Germany	25
Austria	22
Netherlands	18
France	13
Denmark	11
Sweden	10
Greece, Portugal	9
Belgium	8
Finland, Ireland, Norway	7
Switzerland	5
USA	3
Cyprus, Estonia, Hungary, Slovenia	2
Australia, Brazil, Coratia, Czech Republic, Liechtenstein, Lithuania, Poland	1
Total	**280**

Technology	# of projects
Solar Power (PV / CPV)	25
Wind Power	24
Smart Cities	24
Storage	24
Other	22
Tidal Power	20
Distribution System	19
Energy Savings	19
Biofuel	19
Carbon Capture Storage (CCS)	17
Biogas/Biomass/Waste heat	17
Wave Power	17
Solar (CSP)	15
Industry	12
Geothermal	7
Solar (Other, e.g. cooling)	3
Total	**280**

8.12. Annex 12 - Vademecum

Below is an example of what the table of contents of the guide could be, i.e. a simple 8-step guide from where the innovator currently is to exiting (when the investors sell their shares).

Vademecum

From company inception to success: A guide for innovators in the energy sector

FIRST STEP: KNOW YOURSELF AND UNDERSTAND YOUR NEEDS (INTERNAL ASSESSMENT)

SECOND STEP: DO IT YOURSELF OR ASK FOR HELP? (EXTERNAL ASSESSMENT)

THIRD STEP: BUSINESS PLANNING

FOURTH STEP: UNDERSTANDING THE FINANCING ENVIRONMENT

FIFTH STEP: APPROACHING INVESTORS

SIXTH STEP: NEGOTIATING, DOCUMENTING AND VALUING

SEVENTH STEP: CLOSING AND POST-CLOSING: COMMUNICATION, GOVERNANCE AND NEXT STEPS

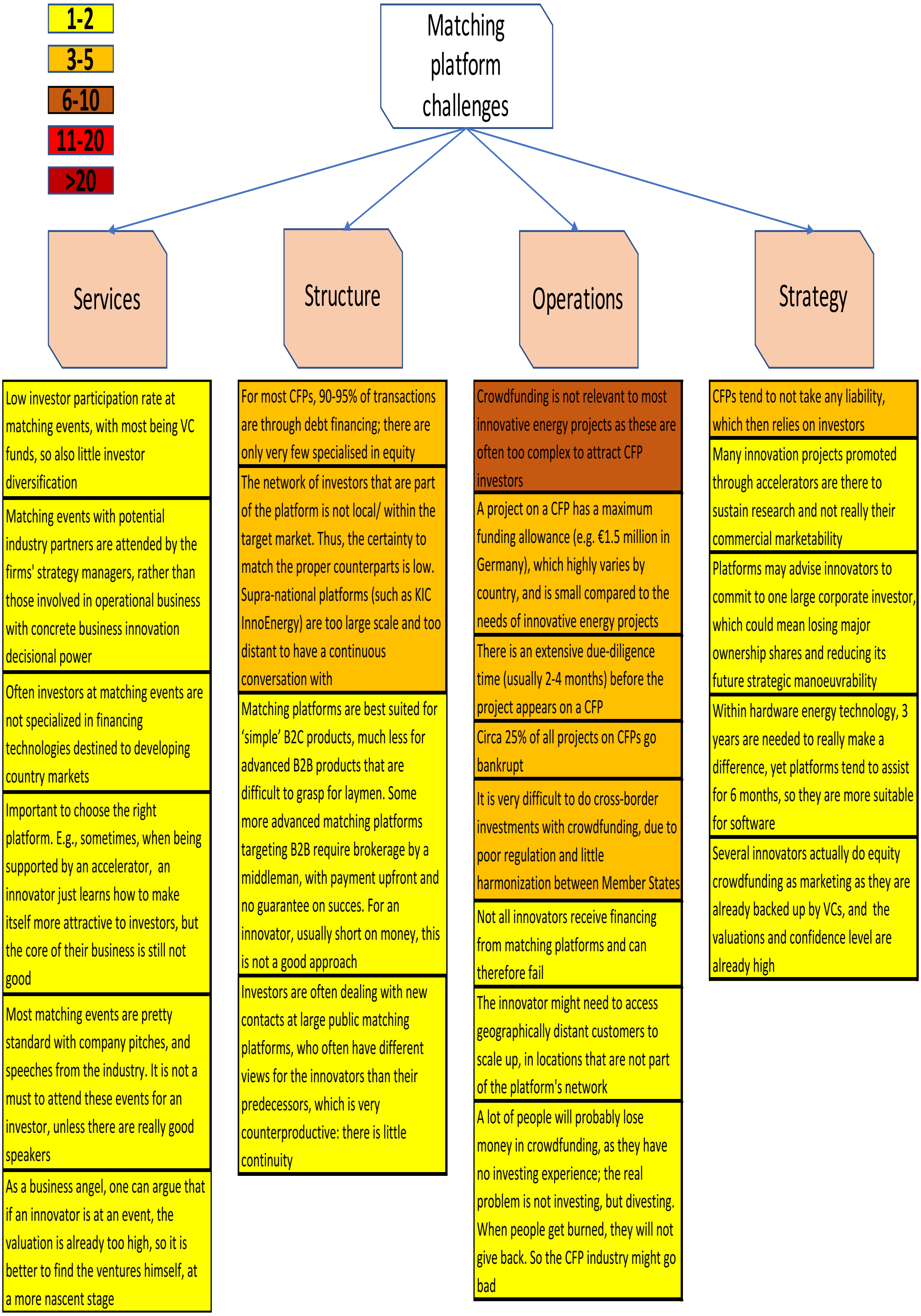
EIGHTH STEP: EXITING

8.13. Annex 13 - Additional matching platforms success factors

Below are the additional success factors of matching platforms pointed out during the interviews. As for the main ones outlined in the thesis, these are separated in four main categories and follow the same colour code, i.e. they are all yellow, as they have been mentioned only by one interviewee.

Services	Structure
A platform can help investors do cross-border investments through a scouting service for example	Having a public entity as part of the platform helps ease the risk evaluation of projects for bank loans
What makes a matching event successful for the investor is the quality of the innovators attending and the structure: events that have speed dating between investors and innovators that are well organized work the best	The EU can provide annual financial support, local governments be core partners and help shape the platform and make financial contributions
The investment culture in the EU should be improved, by getting individuals interested as well. That is where CFPs can help	The platform is registered as a public charity, which enables it to invest into earlier-stage technology than other platforms, and have lower return requirements than private investors
Operations	**Strategy**
Platforms can teach innovators how to pitch, present themselves... Some platforms have been really good. HTGF/KIC Innoenergy have been in contact with investors to improve themselves and are now very well integrated in the VC community.	A platform, by creating transparency around methods and processes, and building a track record of success stories, can build trusted relationships with investors
The platform asks for feedback from their clients to see where they can improve as a matching platform	The investor/innovator networks is expanded constantly through online searches, monitoring investments being made, monitoring awards, and networking events
The platform can re-invest all returns into sustaining and co-investing in new innovators	Platforms can reach agreements with investor associations, e.g. KIC Innoenergy with the European Business Angels Network (EBAN) to promote their investment in innovative energy

8.14. Annex 14 – Challenges faced by matching platforms



8.15. Annex 15 – Recommendations for matching platforms

- 1-2
- 3-5
- 6-10
- 11-20
- >20

Matching platform recommendations

Services

- At events, there should be a diverse crowd of investors ; e.g. since VCs are shifting their focus away from hardware energy technologies, putting a strong focus on VCs for matching events is unwise
- A matching service to facilitate contact with corporate partners and strategic partners (e.g. energy suppliers, building companies), and specifically with the operational people within those companies, should be created
- Events sould be kept small and with a focus on specific technologies/industries. Localized events are likely more successful than cross-regional/cross-sectoral ones
- The best events are those where the innovator can pitch and talk to the investors directly, and are technology focused. Through these, the innovator can also get invited to pitch at other events outside their home country
- It is very important to use the event day as efficiently as possible, like HTGF Germany or Ecosummit
- Industry events are better compared to general business accelerator events for example; having industry specialists is valuable. The hit rate is much higher at industry events. Local money could be easier to get access to though at a local accelerator event, as they would have to invest in local companies, but their added value in growing the business is much less

Structure

- Crowdfunding platforms must have a winding down policy to appear more secure to investors
- To improve transparency issues with crowdfuning platforms, one should have standardised KPIs and ratings on each platform
- To improve crossborder activities, there could be partnerships among national CFPs so a French CFP with a French project can propose it to Dutch investors through a Dutch CFP
- The platform should be expanded into Asia, specifically China, and hold an annual matching event there with local investors
- The matching platform should be of easy access and user-friendly, to avoid discouraging innovators/investors who already lack time
- A platform rating – verified by a third party – should be established regarding for example the number of successful deals the platforms' events achieve

Operations

- Once it will be implemented, take advantage of the one-stop advisory facility to orient potential innovators and investors within the various financing public instruments
- The above facility should also include a strategic advisor role that has knowledge of the market and understands the innovator's financial needs, thus allowing the innovator to focus more on finding a customer base and worry less about financing
- When it comes to matching online profiles of investors and innovators in the database, the platform should improve their algorithms to create the best matches
- The platform should help innovators target the right investors, let it be in the database, at events or through other services
- As an investor, having consultants do the talking is no good, as one never knows how good the technology actually is; it is better to have the innovator talking
- It is better to match innovators with customers rather than have the platform give them money/training. A customer base is more valuable than an innovator that was trained by consultants to pitch a great business plan. After, the VC, attracted by the customer base, can aid the innovator through finance, contacts, and growing their network

Strategy

- Member States should implement clearcut regulations that are also compatible with the EU legisaltion on crowdfunding to allow crossborder investments
- Roundtables between innovators and corporations should be made to increase communication between them, as they often lack understanding of the other's key motivations and functioning
- Matchings should be sought with investors active in the target markets, in order to help find sales partners and customers there
- If you have the right technology, but not the right network, you must engage with an industry partner, an advisor who can make introductions for you to potential investors
- Better for a platform to focus on B2C rather than B2B products
- Platforms should invite local public authorities to discuss the ease of regulations

8.16. Annex 16 – Successful innovators characteristics

Additional success factors held by innovators who made it on the market; the usual colour code applies, meaning the following recommendations were mentioned by one or two interviewees

Network
Due diligence time can be shortened if the innovator is known by the investor through personal connections
Operations
Important to work with industry associations in target countries to build a network, partnerships and customer base
It is very helpful to lay down the risk for the supply chain stakeholders in change of a long-term commitment in their supply; the innovator can manage to do this by convincing the supply chain players that there is a market opportunity
Strategy
The business model and value proposition must be flexible to accommodate market demand and feedback from partners
Engaging with external consultants, albeit not attracting further investments, can allow the management team to refine its investor-relation competencies and "learn the tricks"
Targeting investors
Public funding is crucial, it increases the innovator's liquidity, and reduces perceived risks. Receiving support from KIC InnoEnergy or the EU SME instrument can be a decisive factor to obtain further funding, private as well as from other players such as the EIB
Innovators must be able to show investors that there is a clear path to market and that the commercial strategy is robust
Mostly family offices and business angels should be targeted, only move to VCs and other investors once the product is demonstrated

8.17. Annex 17 – Recommendations for innovators

Recommendations for innovators to be more successful; the usual colour code applies, meaning the following recommendations were mentioned by one or two interviewees (in yellow), or between three and five times (in orange)

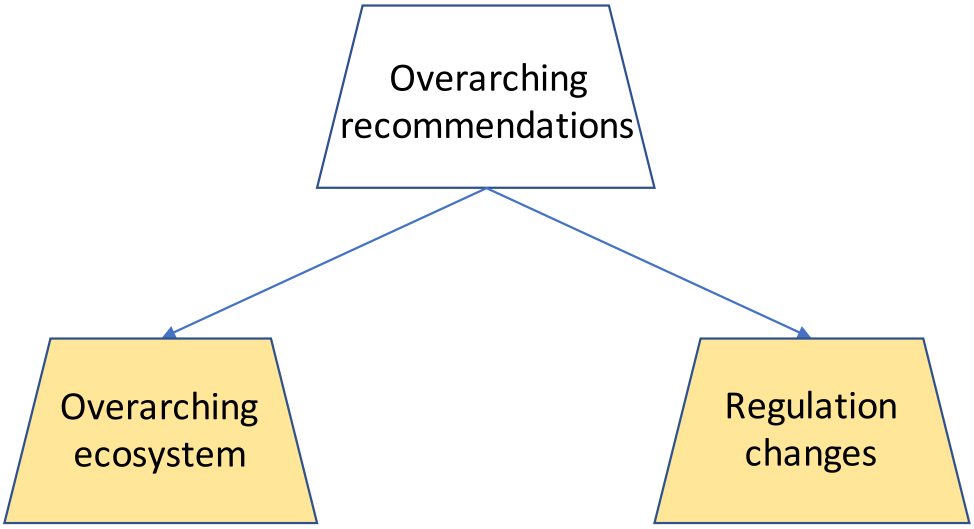
Business plan
Must have a socially and economically convincing business case, supported by various activities to boost visibility (awards, cooperation with NGOs, foundations and governments in the target markets). The case should comply to the investor's needs and the current energy trends, in addition to a sound technological innovation
Innovators must focus on their network, try to understand all risk factors for investors and deliver stability, efficiency, a potential commercial route, and a clever low risk route to market. Essentially a solid business plan. You have to be credible, honest, transparent
At each investment round, it is important to convey simple messages like: 'at this point we were able to raise X million euros. Since then the next milestones/deliverables have been reached in the development of the technology and the business. This justifies an uplift of Y million eurosf
The innovator should have a clear plan of how much ownership it is willing to give up and how to use the fresh capital input
Know-how
The competence of the CEO, CFO, COO is key for fundraising. Skills to be learned include presentation and negotiation. These can only be learned with time, through trial and error, optimally while being supported through cooperation with fundraising professionals or experienced managers
The technology should have certain benefits in regard to current technological, socioeconomic and political trends. The innovator should have a good understanding of the market
The innovator team should have good knowledge of project financing, all aspects related to pre-commercialization and entering the market. They should also have knowledge on marketing, communication, business and finance. Important to know the fundamentals of product design, financial modelling. They must understand how to get a supply chain going, especially in other target countries
Must not give up, knowing that things will always cost more and take longer than expected
When the investors come in, the innovator should be able to tell them who the potential venture buyers could be in a couple of years
Investor type
Should seek an investor who will support the innovator's internationalization to seek investments outside Europe, by f.e. having offices in the USA/China. An investor that will find partners there to seek further funding and develop in the market
Must target investors that understand the renewable energy market/industry. That know it takes a long time to make money, like wind energy which only recently became attractive commercially. Investors should have an investment horizon of approximately 10 years. 5 to 7 years can be fine in some cases as well
Corporate investors may represent the most attractive combination of relevant industry insights and investment horizon for innovators
Should seek corporate investors when dealing with capital intensive hardware technology; they have capital, technical know-how and industry insight
Obtaining an EIB loan could have a positive impact on obtaining other bank loans

Network
Innovators should have support in identifying concrete sales opportunities and partners with the same strategic interests prior to market introduction. An innovator should try to get a consortium going, partner with supply chain stakeholders and investors
Innovators must be more market-driven, reach out to potential customers before the product is ready, get market feedback, find customers willing to take part in piloting projects, secure letters of intent
It is important to note that the large investors can gang up against the firm's management or against each other and be powerful but if they are chosen successfully they can be complementary and very helpful, also for the next financing rounds
If the innovators are first-time entrepreneurs, they should collaborate with a lawyer that has experience in early stage funding, it is "warmly" suggested
In terms of lawyers, small lawyers should be sufficient. No need for expensive, international, specialised firms for a 2-3 million investment. They do need to know about company-to-company contracts and national law
Operations
The innovator should try to have as many good patents as possible. They should have a good knowledge of the market to anticipate requirements and build them in good property rights
It makes no difference to the investor if there is an outside advisor supporting the innovator for financing. The critical item for them is the team behind the venture, they always try to work directly with the team
If the innovators have no business experience, they should look for a person who supports them with it. If they are not open to it, the investor will pull out
Important to focus on the first customer base and get their feedback
Innovators must grasp that it is also important to show how they are to work with. If they are slow in responding to emails, it leaves a bad impression, also for how they would deal with customers. Trust between parties gets built up during the DD process
Strategy
H2020 is a very good programme, there is significant money. Since there is a 5% success rate of people who apply to H2020 to get money, their business plan evaluation is solid. Generally, EU grants are faster and more competent than national grants. Use public programs as much as possible to have innovator's risk reduced. also useful in other ways. E.g. to establish contacts
If the innovator gets the possibility to sell the venture, better to hire someone to take care of the deal, in order for the innovator to focus on managing the company. There are several examples where companies went downhill because the founder was focused on selling instead of developing the business
Seek to find funding through capital markets, it does not necessarily take longer. You can get financed without ever needing to ask VCs
Must be careful to go to family offices, big VCs too early, as they will want a big chunk of the company at a very low price. Better to wait until the company has reached some value
It is advisable to not wait until it is too late to start focusing the fundraising activities on (potential) customers, as these can also become potential investors and partners
Targeting investors
Communication strategy with the investor should be simple, transparent, and "to the point". The main messages should be understandable. The business case should show there is a gap in the market and how the technology wants to fill it. This has to happen on a quantitative level (business plan, calculations, etc.) but also on a personal level through face to face communication that has to show the passion and credibility of the innovator. A clear communication of the goals of each party is essential

Innovators must target their investors, do their homework to know what they usually invest in and why. And not give up, one has to talk to hundreds of investors for one to accept
It is important to choose the interested investors with the closest linkages to the company, technology-wise and geographically, as they will be more involved and help expand the network
Securing funds from big investors like corporations, family offices, institutional investors is difficult. It is a combination of luck and a good fit with the strategic criteria of these investors. So the innovator must do their homework, find the right ones
Innovator needs to have something out there, e.g. first product, prototype, etc. when seeking VCs. So if the innovator is 2-3 years before the first product comes out, that is a risk that only corporate investors can take, so should seek them

8.18. Annex 18 – Overarching recommendations

The usual colour code applies, meaning the following recommendations were mentioned by one or two interviewees



Overarching ecosystem

- Loans of significant volume (above 10 million euros) and decent interest rates (4-5%) should be made available to innovators
- Public EU money is essential but the EU should put greater effort into explaining, marketing and – if possible – simplifying the application processes of its schemes
- The InnovFin SME Guarantee facility could raise the guarantee provided up to 100% to increase incentives for commercial banks, and overall be expanded by lowering the threshold for eligible projects
- When students do technical studies, they should also learn the basics of business, and entrepreneurship. Universities should do this, but also research institutes for example
- An equity funding culture must be born, there is a current bias against equity in the EU

Regulation changes

- The problem for innovators is there are different legislations, fiscal barriers, languages etc… among member states. The digitalisation of a single market is ok, but most importantly, one needs a large, homogenous, internal EU market. The European Commission aims to achieve this with the CMU. They also set up a group of experts to see how to increase green finance
- A favourable tax regime for investors should be established whenever returns are re-invested in new ventures
- There should be tax releases for private individuals who invest in start-ups
- Member states should allow investors to deduct capital from their tax base in case the capital invested in innovative energy is lost. This currently happens in the USA
- Public authorities should introduce procurement policies that are more decisively oriented towards clean technologies