ERASMUS UNIVERSITY ROTTERDAM
ERASMUS SCHOOL OF ECONOMICS
Economics & Business
Master of Financial Economics

Green is Good

Does a renewable energy program lower the cost of debt for listed EU companies?

Author:	Dex Jan Loek Holman
Student number:	414473
Thesis Supervisor:	R. Huisman
First Reader:	V. Stet
Date:	24/07/2020

Abstract

Global initiatives to spare the planet of the negative effects of fossil fuels have led to an unprecedented momentum for leaving the fossil fuel age behind and embracing renewable energy. ‘Going Green’ has over the past few decades grown from being an idyllic dream into a recurring mantra and present-day reality across the world. While governments and non-profit organizations have championed green energy adoption, corporate organizations are at the forefront of helping to achieve global targets and continue to come under the spotlight. Over the last decade, renewable energy adoption has been growing at a record pace among companies with big corporations leading the green revolution. This study takes a unique approach by setting out to examine if the broad adoption of renewable energy joining the RE100, an initiative where companies commit to 100% renewable energy, has benefitted corporate organizations by lowering their cost of debt. To test if renewable energy adoption lowers the cost of debt, a sample of 209 listed European companies are drawn in the 2014-2018 period and a fixed effect analysis is conducted on the extracted panel dataset. The same sample is used to test whether joining the RE100 lowers the cost of debt or acts as a moderator which strengthens the effect on the relationship on renewable energy and the cost of debt. This study finds significant evidence that the adoption of renewable energy for listed European companies on average lowers their cost of debt, suggesting that increasing the renewable energy, on average, reduces the cost of debt for European listed companies in the period 2014 till 2018. However, there is no significant evidence that joining the RE100, and therefore committing to 100% renewable energy, will lower the cost of debt or strengthens the significant negative relationship between renewable energy usage and the cost of debt. The findings are robust for industry and country specific influences. This study acknowledges the fact that these results do not imply that increasing the renewable energy share directly will reduce the cost of debt for companies in a strict time period, but suggests the that on average increasing the renewable energy share of a company will reduce its cost of debt. Overall, the findings of this paper provide managers of companies an additional reason to adopt a renewable energy program.

Preface

I hope that this paper brings increased understanding of corporate sourcing of renewables and will incentivize managers of companies to make the renewable transition. Moving to renewable energy sources will reduce a company's environmental impact. By reducing our environmental footprint, we will leave a better world for the next generation.

During my internship at a subsidiary of General Electric, called LM Wind Power, I was first introduced to the world of renewable energy. This world has attracted me ever since and I am certain that one day the world will be better off through renewable energy sourcing. However, this research showed me some downsides of the current renewable energy market, as I now fully understand how the world of renewable energy works, I also see the big flaws and mistakes that are being made by regulators and companies. Since my initial proposal was more orientated towards investigating the guarantees of origins market, I was, and still am, astonished by the way corporates "green wash" through procuring oversupplied unbundled renewable energy certificates (guarantees of origin) and brokers are earning loads of money. In my believes, the EU has to reform the current rules in order to fight this "green washing" of big corporates. By allowing companies to compensate their ("dirty") grey energy through unbundled GOs they keep an untransparent and inefficient market for GOs in place, which very much looks like brokers are in it for greed and not for the green. As these brokers are getting rich of selling oversupplied GOs from the Nordic states, big corporations are advocating their reduction of environmental impact through renewable energy to investors and other stakeholders. This untransparent market, where brokers are earning the big bucks and there is no value added to the renewable energy production made me think a lot about the movie Wall Street and the famous sentence "greed is good". For this reason, the title of my thesis is "Green is Good", suggesting that companies should focus on "real" sourcing methods of renewable energy, which add value to the market, such as PPAs and self-generation instead of the GOs.

Fortunately, there are enough examples of companies which source renewable energy through more production adding methods such as PPAs and self-generation. Unfortunately, this study cannot distinguish between companies that procure GOs and companies that use PPAs and self-generation to source renewable energy. This might be interesting for future research.

As this thesis and my time at the Erasmus University has come to an end, I would like to thank three people. First of all, I would like to thank my mom and dad, who kind of pushed me towards Rotterdam to go and study at the Erasmus University. Thanks to that push, I have gained a lot of knowledge and had an amazing time in Rotterdam as a student. Second, I would like to thank Ronald Huisman, who supported me through the process of thesis writing. I think, I could not have wished for a better supervisor. Thanks, in particular for your understanding for my situation the past months and Zoom conversations about the stock market, surfing, holidays and the renewable energy market. It would be nice to meet in person one day.

Table of Contents

1 Introduction

Over the last few decades, governments, and private organizations around most of the developed world have invested more frequently in research on sustainability projects, including renewable energy (BNEF, 2020). Advances in research have led to huge cuts in the cost of renewable energy and helped to fuel large-scale adoption of green energy across the world, rendering fossil fuels increasingly obsolete. At the forefront of the adoption of renewable energy across the globe are corporate organizations that often are at the fore of the consumption of fossil fuels. Latest figures from Bloomberg reveal that businesses across the world have signed up to buy 8.6GW of clean energy in 2020 alone, up from 7.2GW over the same period in 2019, suggesting the market is set to comfortably exceed the 2018 total of 13.6GW, which was itself a record (Bloomberg, 2020).

While the renewable energy adoption market continues to be dominated by US companies which accounted for 69% of capacity, or 5.95GW, an important driver to easing capital constraints for E.U. companies that consume non-renewable energy has been the rapidly decreasing cost of renewable energy production. With rapid technological development decreasing the cost of electricity generation from renewable sources, (average capital costs have decreased by 80% for solar and 50% for onshore - wind power), these renewable energy sources have become the cheapest sources of new power generation in many parts of the world including Europe (IRENA, 2019). Additionally, renewable long-term energy contracts, or so-called power purchasing agreements, now provide an opportunity to hedge against future price volatility, helping to guard against electricity price volatility which is expected to rise by 43% over the next decade (Carbon Trust, 2017). By signing long term renewable energy contracts directly with renewable energy producers, companies can hedge against this volatility in electricity prices. Moreover, companies that make an early commitment to renewables and develop an understanding of the financing mechanisms of renewables will gain a competitive advantage (Eccles & Klimenko, 2019).

In summary, companies can decrease their costs and electricity price volatility risk by using electricity from renewable sources.

While a decrease in the cost of renewable energy has helped to cut company overhead costs and aided the adoption of renewable energy at an unprecedented scale, other benefits are observed to have also accrued to companies adopting renewable energy options. Governments and financial lending institutions across the world and in the EU especially, have over time introduced a litany of financial and non-financial incentives to encourage the adoption of green energy. Aside from these direct tangible benefits from governments and lenders, companies also face a significant backlash from both the public and shareholders when perceived to not be doing enough to 'save the planet'. While studies in the past have adopted various approaches to measuring these accruing benefits especially by showing the effects of CSR performance on the cost of debt, this study to the best of our knowledge, is the first to focus solely on the renewable energy strategy of companies and its effect on the cost of debt in EU companies.

In the following sections, we delve further into the subject by introducing the relevant literature and the research questions to be discussed. The concepts of corporate renewable energy usage, green initiative memberships, cost of debt, and their relationships are elaborated on. From existing literature, hypotheses are formed to answer the research question. The research design of the paper is explained and more specifically, the data collection, target sample, research methods, and used models are discussed. In the fifth chapter, the results of the research are elaborated and tested for their robustness. Finally, a conclusion is drawn on the results and recommendations are given for further research.

1.1. Drivers of renewable energy on Access to capital – European Union

Within the European trade zone, the main public actor to stimulate renewable energy is the European Union and its member states. An important driver to easing access to capital for E.U. companies that consume high volumes of renewable energy is the increasing legally binding renewable energy targets and regulation for E.U. member states. By 2050 the E.U. aims to have a zero-emission energy supply and therefore become the first continent supplied by 100% renewable energy (European Commission, 2010).

Besides EU-wide targets and policies, member states also prepare their national energy plans to increase their share of renewables. Consequently, municipalities promote renewable energy by selecting only companies that can meet renewable energy criteria for their tenders (Dutch Government, 2018). To stimulate renewable energy production and consumption, the European Union introduced the following three initiatives that eased access to capital for E.U. companies:

a) In 2010 the European Union created an investment fund, the 'Marguerite' to ease access to capital for capital-intensive renewable energy infrastructure investments of E.U. companies. This fund grants E.U. companies, active in the renewable energy industry, access to equity and debt. The target equity financing volume of the fund is €1.5 billion. Simultaneously, the fund gives companies access to €5 billion of debt capital to finance their projects. (European Investment Bank, 2010)

b) In 2001, Germany became the first member of the European Union to introduce an economic policy, called the Feed-in Tariff. The goal of this policy was to ease access to capital for the discovery and exploitation of renewable energy sources. This policy allows E.U. member states to guarantee E.U. companies cost-based prices of renewable energy with subsidies. These subsidies consist of long-term contracts (15-20 years) which paid in proportion of the resources and capital expended to produce renewable energy. EU member states introduced this feed-in tariff system at different times. (Banja et al., 2017)

c) In 2001 the European Union introduced a certificate system, so-called Guarantees of Origin (G.O.). The goal of these certificates is to ease access to capital for renewable energy producers. These certificates allowed renewable energy producers to claim the renewable source of their produced MWh which could then be sold to electricity retailers, businesses, or brokers – additional to selling renewable energy itself. These certificates have enabled E.U. companies to offset their carbon footprint from their power consumption. (European Commission, 2019)

The E.U. and member states through these sets of policies and others continue to set ambitious renewable energy targets that cannot be reached by public investments alone (European Commission, 2019). To accomplish these ambitious targets, private actors, need to step into renewable energy sourcing, and with large companies such as Google, Apple, and Siemens already fuelling their daily operations with energy from renewable sources, there's optimism as regards broad renewable energy adoption (BNEF, 2020).

1.2. Drivers of renewable energy on Access to capital – EU companies

Within the European trade zone, the main private actors to stimulate renewable energy adoption are institutional investors, banks, and private investors. An important driver to the adoption of renewable energy initiatives and by implication, the ease of access to capital for E.U. companies is the increasing attention to corporate social responsibility. Over the past decade, corporate social responsibility (hereafter CSR) has gained importance in the E.U. region Stakeholders of companies, such as customers, employees, and suppliers, expect companies to have a positive social impact and not harm the environment. Consequently, companies now use their resources to support environmental, social, and governance activities with companies that perform better on CSR, experiencing easier access to capital. On the equity side, a survey conducted by the Harvard Business Review found that environmental, social, and governance activities (ESG) are considered very important by executives of the most prominent global institutional investing firms. Especially for long term investments, ESG factors are taken into account when making investment decisions (Eccles & Klimenko, 2019). Investors believe that ESG commitments of firms can improve returns or reduce risk (PwC, 2015). Institutional investors, such as pension funds, move towards a more responsible investment strategy because of the demand of their clients to put more importance into ESG factors (KPMG, 2018). As a result, environmental, social, and governance (ESG) and CSR activities play an essential role for companies to attract individual and institutional investors. This increasingly booming market for socially responsible investing in Europe and the U.S. is putting pressure on firms to make ESG activities a priority. In other words, companies that lack long-term plans and vision for a sustainable future are regarded as losers by investors in the long run (Lemke & Lins, 2013). Hence, companies putting resources and efforts into CSR and ESG activities will experience more accessible access to equity capital.

On the side of debt, banks are taking CSR performance and activities into account when determining interest rates for companies. Hence, companies with higher CSR performance can borrow money cheaper and experience lower interest rates (Goss & Robert, 2011). A new phenomenon in debt financing is the rise of sustainable linked loans; loans with interest rates determined by sustainability key performance indicators. Hence, if the sustainability KPIs are reached, a company can pay a lower interest rate over its loan. Sustainability linked loans reached a total of $71.3 billion at the end of the third quarter of 2019 and have doubled relative to 2018. These loans are expected to gain more momentum in the near future and become a standard. (Reuters, 2019)

Besides these loans, companies also issue Green Bonds to fund their sustainable operations. The main difference is that with Green Bonds, the proceedings of the bond has to be invested in sustainable projects. In contrast, sustainability linked loans can be used for all kinds of operations as long as the predetermined sustainability targets are met.

The improvement of a company's CSR performance is the foremost reason to source renewable electricity. Companies expect to gain a competitive advantage over their peers by increasing their CSR performance. An increase in the demand for products or services is expected due to the competitive advantage created by renewable electricity resourcing (European Commission, 2019). This rise in demand for renewable electricity sourcing by corporates is now driving renewable in the E.U. Companies all around the world are making commitments to fuel their operations with electricity from renewable sources. To give strength to their commitments, companies now randomly adopt renewable energy initiatives.

To summarize, CSR activities and performance improves access to capital for companies. Since renewable energy sourcing is an essential CSR and ESG activity, this paper hypothesizes that a company's renewable energy strategy improves access to debt capital as well. Because of the magnitude and rise of the sustainable debt market, this paper focusses on the effects of a companies' renewable energy strategy on the cost of debt.

Aside from examining the impact of renewable energy usage by European companies on their cost of debt, this paper will additionally investigate whether committing to a renewable "green" initiative strengthens the impact on the cost of debt. The consumption of renewable energy and committing to a renewable electricity initiative is part of the renewable energy strategy of companies. Therefore, the research question of this paper is:

Does a renewable energy programs lowers the cost of debt for listed European companies?

By answering this research question, the study tries to enhance the knowledge of CSR activities and in specific the adaption of renewable energy sourcing of companies. To the best of my knowledge, this is the first paper that analyses quantitively the impact of renewable energy sourcing by companies’ access to capital metrics. The results of this paper can help managers of companies understand the additional benefits of using renewable energy, besides reducing their environmental impact. Furthermore, the results can help to show the incremental benefit of joining an initiative stimulating renewable energy, such as the RE100. Additionally, this paper contributes by combining two concepts of renewable energy strategy: committing to initiatives and renewable energy usage.

2 Theory and hypotheses development

This section elaborates on the prior knowledge and literature on corporate renewable energy, renewable energy initiatives, and their effects on the cost of debt.

2.1. Corporate renewable energy program

A corporate renewable energy program is the implementation and framework that companies follow for the integration of renewable energy into their operations. Renewable energy is energy generated from renewable sources, such as wind, solar, hydropower, biomass, and geothermal. An efficient and effective renewable energy program includes a well-defined renewable sourcing strategy and a precise target setting (Vlahoplus and Quanlan, 2018).

Below, the most critical drivers for companies to implement a renewable energy program are discussed.
First, companies implement renewable energy to improve their corporate social responsibility (CSR), sustainability, and reputation. A company's CSR strategy is defined by its environmental, social, and governance (ESG) activities and targets. An effective and efficient CSR strategy will result in a higher reputation for a company (Gazzola, 2014). Many CSR strategies contain renewable energy sourcing targets to reduce their environmental impact, hence reduce their carbon footprint. Furthermore, increasing attention and support for renewable energy by governments has made renewable energy relatively easy and cheap to achieve company sustainability goals (Deloitte, 2019).

Secondly, consumers and employees put more attention to corporate social responsibility measurements taken by companies (KPMG, 2018). For example, research by consulting firm Global Tolerance (2015) showed that half of the workforce (42%) consider the impact of their company's activities on the environment when making job decisions. The research surveyed more than 2,000 UK citizens who said they prioritized the impact of their activities on the world over salary. These results are mainly driven by citizens born between 1981 and 1996, so-called millennials (Global Tolerance, 2015). People's evolving attention on the impact of their activities on the world when making job decisions can also be seen in their behavior as customers. Nowadays, customers put more attention to the impact on the world companies make before doing business with them or buying their products (KPMG, 2018).

Investors consider companies' ESG and CSR activities when making investment decisions. As part of a fund for sustainable investing strategy, they monitor the ESG activities of companies, such as renewable energy sourcing (McKinsey & Company, 2019). A survey published in the Harvard Business Review interviewed 70 senior executives at 43 global institutional investment firms showed that ESG and CSR are a top priority for institutional investors (Eccles & Klimenko, 2019). This growing prioritization of ESG and CSR might be explained by the pressure from shareholders of these institutional investor funds.

Thirdly, companies implement a renewable energy program to reduce their costs. Over the past decade, renewable energy generation technologies experienced a rapid decline in costs. Especially large companies might profit from this reduction of costs through on-site installations and procurement of PPAs. Furthermore, large companies can hedge against future electricity price volatility through the procurement of PPAs. PPA's and on-site generation are considered an expensive option for companies and only cost-efficient when a company is energy intensive. Therefore, smaller companies, which are non-energy intensive, tend to choose "Green Offers" and unbundled GOs (IRENA, 2018). In contrast with the cost savings a company can experience when setting long term renewable energy contracts with producers and on-site generation, "green offers" and unbundled GOs increases the cost for a company. The "green offers" are often sold at a premium by electricity retailers. This might be explained by the fact that electricity retailers have to buy GOs with their electricity to make the green claim. In short, at this moment in time, the argument of cost reduction only holds for large energy-intensive companies. In contrast, the European Commission survey reported that energy-intensive companies emphasize that renewable energy sourcing so far does not reduce the costs (European Commission, 2018).

Finally, diversification of energy sources is a driver for companies to implement a renewable energy program. Companies are diversifying their energy mix to increase their resilience and energy reliability (European Commission, 2018). Since fossil fuels are running up, and prices tend to fluctuate over time, companies now seek for renewable alternatives to reduce their future energy supply risks (McKinsey & Company, 2019). By sourcing renewable electricity, companies feel they are ensuring the security of their future energy supply (IRENA, 2018).

To summarize, CSR and sustainability performance and reputation (reduction of carbon emissions), cost reduction, diversification of energy mix portfolio and marketing opportunities are the drivers for companies to integrate renewable energy into their business operations.

CSR and sustainability targets are considered the number one driver for companies to implement a renewable energy program.

A recent online survey conducted by the European commission questioned 68 European companies on various renewable energy-related topics. The sample consisted of large and small-medium enterprises (SMEs) and included non-energy intensive and energy-intensive companies. Of the 68 respondents, 42 respondents sourced renewable energy, ten respondents planned to source renewable energy, and 16 respondents did not source renewable energy or plan to do so. The majority of companies in the samples were non-members of the RE100 initiative. The main finding of the survey was that companies prioritize their CSR strategy when deciding on the implementation of a renewable energy program. The explanation is that a sound CSR strategy will increase the value of existing and potential shareholders, due to increasing attention for environmental sustainability of shareholders. Furthermore, they report that other stakeholders, such as suppliers and customers often require companies to use renewable electricity to comply with their green supply chain. Thus, suppliers and customers put pressure on companies to use renewable energy to comply with their sustainability targets. (European Commission, 2019). Consistent with the findings of the European Commission, a survey conducted by the RE100 initiative found that managers join the RE100 initiative and source renewable energy to manage their greenhouse gas emissions and in this way improve their CSR reputation. Managers are putting more attention on reducing their carbon footprint to meet CSR and sustainability targets (RE100 report, 2018). The use of renewable energy sourcing to reduce carbon emissions is a commonly used instrument, especially for energy-intensive firms. Moreover, companies fear future regulations imposed by governments. For example, various member states already imposed carbon taxes on companies. As a result, companies have to pay for their carbon emission or risk a penalty. Therefore, companies seek to manage their carbon emissions to prevent future carbon taxes or fines (PwC, 2018). Furthermore, the survey results found that managers value customer expectation (RE100 report, 2018). However, considering that the sample employed for the survey consisted of only RE100 member firms, we wish to point out that these results might be biased.

To summarize, companies reduce their carbon footprint to reach their CSR and sustainability targets by sourcing renewable energy. Therefore, the management of carbon footprint and improvement of CSR performance are the primary reasons for companies to source renewable energy.

2.1.1. Renewable sourcing strategy

The renewable energy sourcing strategy is defined by the mix of instruments a company uses to source renewable energy. Companies may choose different instruments, depending on their CSR and sustainability strategies and goals. The options for E.U. listed companies to source renewable electricity are discussed below.

Firstly, the self-generation of renewable electricity is used to source renewable energy. Companies install solar photovoltaic (P.V.) or wind turbines for their power demand. This method is most frequently used by energy-intensive companies (RE-Source, 2020).

Secondly, renewable power purchase agreements (PPAs) are used to source renewable energy. Companies set long term clean energy contracts with renewable energy producers. The two forms of PPAs are virtual and physical PPAs. Virtual PPAs are contracts In the past five years, the worldwide corporate PPA volume increased by more than 770% indicating growing and widespread acceptance of renewable energy. Despite this growing acceptance of renewable energy as indicated by the growing number of PPA's Europe still lacks the right energy infrastructure required to push corporate PPAs to desirable levels. The low-level of adoption in the EU is indicated in the fact that only 18% of the global corporate PPA market is accounted for by Europe (BNEF, 2018).

Thirdly, unbundled Guarantees of Origin are used to source renewable energy by European companies. Unbundled GOs do not require upfront capital investments and enable corporations to meet their sustainability targets. The use of unbundled certificates is estimated to decrease by 10% each year, while PPAs and on-site generation will increase steadily through 2030. The reason for this is that corporate sourcing through unbundled GOs adds an extra cost for every MWh of electricity consumed by the firm. (BNEF, 2017) Furthermore, unbundled GOs are purchased by companies equal to their consumed electricity. This way corporates can claim their electricity as green and offset their scope 2 emissions. Scope 2 emissions are carbon emissions from the production of power (European Commission, 2018). Corporations are therefore still able to have non-renewable energy contracts but offset this carbon emission with unbundled GOs. Corporations procure these unbundled GOs from traders or brokers. These traders and brokers procure the GOs directly from renewable energy producers or G.O. portfolio companies, applying a fee or premium over the price (Oslo Economics, 2017).

Finally, renewable energy offers are used by companies to source renewable energy. Renewable energy offers are subscription-based energy contracts by power retailers. Often,

these offers are sold at a premium because of the willingness to pay for green products by companies (RE-Source, 2020).
To summarize, companies use self-generation, power purchase agreements, unbundled GOs and renewable energy offers to source renewable energy to meet their sustainability targets.

Moreover, companies tend to diversify their sourcing methods to reduce their procurement risk (European Commission, 2019). According to the international renewable energy agency (IRENA), self-generation is the most common instrument used by companies to renewably source electricity comprising 35% of total instruments followed by unbundled GOs (28%), renewable PPAs (25%) and renewable energy offers (7%) (IRENA, 2018). Consistent with the findings of the survey conducted by the IRENA, the survey conducted by the European Commission report that companies favour reducing their risk by not focusing on one option of renewable electricity sourcing. Therefore, companies seek to diversify their renewable energy mix and reduce their procurement risk (European Commission, 2019). Corporations use these various methods of renewable electricity sourcing depending on their size, leadership engagement, risk profile, and CSR strategies (RE-Source,2020). Yonge and Dominy (2012) conducted a global energy mix survey and questioned executives involved in corporate energy strategy at 100 energy-intensive companies with revenues exceeding 1 billion USD. They reported that 40% of the company's assessed had energy costs exceeded 50 million USD, while 27% had cost over 100 million USD. Therefore, the key driver, to choose between the various instruments, is the cost of energy (77%). Furthermore, reliability of the energy supply is an essential factor of companies when determining their energy mix (31%), followed by carbon emissions (23%), regulatory compliance (15%), and energy price volatility (10%). Although this research dates back to 2012, this paper argues that its findings are still relevant to current realities of large companies. For companies where energy expenditures were less than 5% of its total operational costs, the so-called non-energy intensive companies, the most common sourcing method are unbundled certificates. On the other hand, energy-intensive companies, which are companies with energy expenses exceeding 15% of the operational costs of self-generation, PPAs are the most common method of sourcing renewable electricity. Specifically, the materials sector has a strong preference for self-generation and PPAs. The extra costs, which are attributed to the procurement of certificates, might explain this sourcing decision (IRENA, 2018).

2.1.2. Renewable energy initiatives

Renewable energy initiatives stimulate corporate renewable energy sourcing and are an essential driver for the demand for renewable energy. Corporate renewable energy initiatives are promoting and supporting firms to source their electricity from renewable sources to reduce environmental impact and to offset their carbon emissions.

As a result of the importance of CSR, companies set sustainability targets and use environmental initiatives to communicate their message and targets to consumers, shareholders, and other stakeholders. Therefore, environmental initiative membership increases the reputation of companies. When looking specifically at renewable energy initiatives, companies are required to set renewable energy sourcing targets, focused on increasing the renewable energy consumption of companies to reduce their Scope 2 emissions. Member states of the E.U. are already known for setting renewable energy consumption targets and with support of these initiatives' companies are following this targeted approach (Scott Madden, 2018).

The leading renewable electricity initiative is the RE100 initiative led by The Climate Group and the Carbon Disclosure Project**,** founded in 2004. The RE100 initiative consists of influential companies that are publicly committed to 100% renewable electricity. These companies have the goal to reduce their carbon footprint from electricity usage to zero. Therefore, the RE100 brings together these companies to increase the demand and supply of electricity generated from renewable sources. As of March 2020, globally, 223 companies committed to adopting 100% renewable energy by joining the RE100 initiative (The Climate Group, 2020). A report by the RE100 (2018) states that committing to 100% renewable energy will create a competitive advantage over peers. Furthermore, they state that companies committed to the RE100 initiative are leaders in their sector. To become a RE100 member, a company needs to be influential, have a clear renewable energy strategy, significant electricity consumption, and have to approve to 100% renewable energy by 2050, but preferably sooner. There are no restrictions on the renewable energy sourcing methods used by companies. Therefore, RE100 companies use on-site self-generation, PPAs, unbundled certificates, and green offers. RE100 members are obliged to disclose their renewable electricity consumption, renewable energy sourcing instruments, and strategy (RE100, 2020).

2.2. Renewable energy program and cost of debt

In this section, the literature on the effects of renewable energy programs and their drivers on the cost of debt is discussed. As described earlier CSR and carbon emission management are the main drivers for managers to implement renewable energy programs. First, we review previous studies on the effects on the cost of debt of the leading renewable energy drivers, as well as CSR and sustainability performance of corporate organisations. Secondly, we will review a few studies on the effects of corporate renewable energy usage are discussed.

Earlier studies investigated the relationship between the cost of debt and corporate social responsibility activities or performance. These studies hypothesized that stakeholder theory explains the relationship between the cost of debt and levels of CSR. Stakeholder theory theorizes that companies should not only act in the interest of shareholders but in the interest of all stakeholders; such as suppliers, employees, and customers. By acting in the interest of all stakeholders, companies can create a competitive advantage over companies that only focus on their shareholders (Freeman, 1984; Jones, 1995). The engagement with stakeholders' results in a decrease in information asymmetry, and therefore reduces a firm's risk (Cooper & Uzun, 2015). Therefore, earlier studies showed that companies with better CSR performance experience a lower cost of debt.

For example, Goss & Roberts (2011) find that firms with the worst corporate social responsibility scores pay a higher amount on their bank debt. Bad performing CSR companies pay between 7 and 18 basis points more on their bank debts compared to companies with higher CSR scores. The reason for this higher rate is that banks perceive CSR concerns as a risk factor. In line with Goss & Roberts (2011), Cooper and Uzun (2015) find that excellent CSR performance of U.S. firms leads to lower cost of debt, as a proxy for the cost of debt yield spreads and yield to maturity on corporate bonds in the period from 2006 till 2013 are used. Manufacturing firms experience a more substantial reduction in yield spreads and yield to maturity as a result of excellent CSR performance. Therefore, they support the view that lenders perceive good CSR performing companies as less risky.

Studies conducted on European firms reported similar evidence of the effects of CSR performance on the cost of debt. For example, Eliwa et al. (2019) found that European firms with a high ESG performance experience a lower cost of debt. Moreover, they find that ESG disclosure has a moderating effect on the relationship between CSR performance and the cost of debt. Furthermore, they find that ESG disclosure alone also significantly lowers the cost of debt, arguing that lenders fail to distinguish between ESG disclosure and performance. For both measurements of cost of debt, interest expense divided by interest-bearing debt, and credit ratings provided by Fitch, they found significant results. Using the same measurements for the cost of debt, La Rosa et al. (2018) found similar results on the effect of CSR performance on a company's cost of debt. Furthermore, they find that firms with better CSR performance experience a higher leverage allowance by lenders. These findings confirm the view that lenders perceive CSR performance as a risk-reducing indicator.

In contrast with the findings of the studies elaborated above, Magnanelli and Izzo (2016) reported that CSR performance does not affect the cost of debt. Magnanelli and Izzo (2016) used a sample of companies active worldwide in the period between 2005 and 2009. This contrast in results with similar studies might be explained by the different proxies used by Magnanelli and Izzo (2016). Hence, they used the interest expense of a company divided by the interest-bearing debt of a given year. Furthermore, the lack of significant results of an effect of CSR performance on the cost of debt might be explained by the period. Hence, this thesis argues that more recently, the importance of CSR for stakeholders is significantly more than from 2005 till 2009. Therefore, it is expected that the results would be more significant if the study were conducted within a more recent time frame.

To summarize, an abundance of studies found that CSR performance negatively affects the cost of debt of companies. Furthermore, studies argue that disclosure of CSR activities has a moderating effect on the relationship of CSR performance and the cost of debt. Some studies even state that CSR disclosure on its own affects the cost of debt, arguing that lenders are short-sighted and look at disclosure and not at performance when determining the cost of debt.

More specifically on corporate environmental activities, Bauer and Hann (2010) analyzed the effect of environmental concerns on the cost of debt and found, consistently with the findings on CSR performance, that companies with more environmental significantly have a higher cost of debt. They argue that companies' cost of debt and default risk are affected by environmental misconduct. Bauer and Hann (2010) use data from corporate bonds to determine the cost of debt and credit ratings. More specifically, they measure the cost of debt with the bond spread, bond ratings, and long-term issuer ratings. By examining a sample of 582 public U.S. companies between 1995 and 2006, they find that companies active in practices that positively contribute to the environment are associated with a lower cost of debt. Furthermore, they report that companies with environmental concerns experience lower credit ratings and a higher bond spread. Next to the relationship of ESG performance and disclosure and the cost of debt, Eliwa et al. (2019) analyze the specific effect of environmental performance and disclosure on the cost of debt of European companies. The results of the study show that environmental performance and disclosure, independently, significantly lowers the cost of debt. In contrast with their view that ESG disclosure has a moderating effect on the relationship of ESG performance and the cost of debt, for environmental performance and disclosure, they not only view disclosure as a moderating variable but independently analyse its effects. Environmental disclosure and performance have a more significant effect on the cost of debt than social and governance performance and disclosure. The study also concludes that the renewable energy share of a company is an essential factor in calculating its environmental performance.

The reduction of carbon emissions is essential for companies to reach their sustainability targets and therefore is a crucial environmental issue for companies. Furthermore, targets and support schemes implemented by the European Union and its member states induce companies to take a more proactive approach to source carbon-neutral energy sources. Therefore, companies are now sourcing renewable energy to reduce their carbon footprint and avoid potential penalties in the future. Some studies also analyzed the effects of a company's carbon emission on the cost of debt (Jung, Herbohn and Clarkson, 2018; Kleimeier and Viehs, 2018). Renewable energy sourcing is an instrument used by companies to reduce their Scope 2 carbon emission; therefore, it is interesting to look at the effects of carbon emissions on the cost of debt. A similar study conducted by Jung et al., (2018) finds that Australian companies that are more exposed to carbon-related risk experience a higher cost of debt. Therefore, they argue that banks ask for higher interest rates. Hence carbon-related risk companies receive a carbon penalty by banks. The carbon-related risk is measured as the willingness of companies to respond to a voluntary questionnaire by the Carbon Disclosure Project (CDP). This measurement for carbon-related risk is called into question by this paper, because companies might not have received the survey in good order. The penalty, given by banks for carbon-related risk, can be mitigated by providing evidence that the company is aware of their carbon-related risks. The time frame used for this study is from 2009 till 2013 and was only focused on Australian companies. Kleimeier & Viehs (2016), finds that companies disclosing their carbon emissions to the Carbon Disclosure Project experience a lower cost of debt, measured as the logarithm on the interest spread on loans. A dummy variable is used, which sets equal to one when a company discloses carbon emissions to the CDP and zero whenever a company does not disclose its carbon emissions. Furthermore, they look at emission levels of companies and find that companies with higher Scope 2 carbon emissions pay a significantly higher interest rate on their bank loans. Likewise, an increase of scope one emissions by companies significantly increases the interest rate paid on their bank loans. The effects on the cost of debt are higher for scope two emissions than scope one emissions. Hence, companies with higher emissions from electricity generation experience a higher cost of debt.

This thesis argues that companies that do not source renewable energy are considered more exposed to carbon-related risk and therefore experience a higher cost of debt, in line with the findings of Jung et al. (2018). To my knowledge, only two studies analysed the effects of corporate renewable energy usage on the cost of debt (Fonseka, Rajapakse & Richardson, 2019; Chava, 2014). Fonseka, Rajapakse, and Richardson (2019) find that Chinese energy firms involved in renewable energy generation experience a lower cost of debt than energy firms that generate energy from fossil sources. By examining a sample of 514 listed over the period 2008-2014, they report that energy type disclosure of solar and wind power firms decreases their cost of debt. The explanation is given by the fact that disclosure of energy type will lower the level of information asymmetry and therefore lower the credit risk. The proxy used for the cost of debt is the effective interest rate, measured by interest expenditure divided by the debt outstanding for a given year. These findings might suggest that companies that use less-pollutant energy products (e.g., wind and solar) can borrow money from banks at a lower cost than companies that use more-pollutant energy (e.g. coal) These findings are consistent with reports of Bloomberg New Energy Finance which state that renewable energy companies on average have a lower cost of debt than oil and gas companies (BNEF, 2019). Chava (2014) investigates the effects of environmental strengths and concerns on the cost of debt. For environmental strengths, they include two dummy variables: a clean energy variable and an environmental communication variable. The clean energy variable equals one if a company has taken action to reduce its environmental impact through the sourcing of renewable energy. The environmental communication variable equals one if a company publishes a member of a voluntary environmental initiative. The results of the effects on these two variables on the cost of debt are not significant. An explanation of the results might be due to the period, as the sample period is 1992 till 2007. Hence, during this period in time, corporate renewable energy was considered necessary for companies. Furthermore, from 2010 on, we see a significant increase in demand for renewable energy by companies, and in the sample period of the paper by Chava (2014) only a little demand is present.

To summarize, companies with a high CSR performance experience a lower cost of debt while companies with less environmental concerns experience a lower cost of debt. Additionally, companies that reduce their carbon emissions have a lower cost of debt. Since renewable energy sourcing of companies will increase the CSR performance, reduce the environmental concerns, and reduce the carbon footprint, these findings imply that companies who source renewable energy also experience a lower cost of debt. Consistent with this view, the first hypothesis is developed.

H_0: Sourcing renewable energy lowered the cost of debt for European listed companies in the period between 2014 and 2018
H_a: Sourcing renewable energy did not lower the cost of debt for European listed companies in the period between 2014 and 2018

As the cost of capital is calculated from the cost of debt and the cost of debt, this paper argues that, if the results show that renewable energy usage lowers the cost of debt, ceteris paribus this will mean that renewable energy usage will increase a firm's value.

2.3. Renewable energy initiative memberships and cost of debt

By joining a green initiative, companies will increase their stock performance. Fisher-Vanden and Thorburn (2009) found that companies announcing the membership of Ceres, an initiative for environmental commitments, experience an abnormally high return in the days after the announcement. More specifically on the RE100, renewable energy initiative, Bisel (2019) conducted an event study of the effect of a RE100 membership announcement on a company's stock return. The researcher hypothesizes that the decision of a company to utilize renewable energy will increase the stock returns for consumer-based companies. This is explained by the fact that consumers attribute more value to the utilization of renewable energy of companies. Therefore, it is expected that the relationship is weaker for non-consumer-based companies. Furthermore, the researcher expects a more robust reaction when the RE100 membership is announced at a major climate convention. Additionally, a weaker relationship between the announcement of a RE100 membership and stock returns is expected for energy-intensive companies. The explanation given is the higher costs associated with a renewable energy transition. Using a matched difference-in-differences (DID) model, the announcement effect on stock returns are significantly positive for consumer-based industries. In contrast, a negatively insignificant announcement effect is found in non-consumer companies. When looking at industries, the research finds a positive announcement effect on consumer services, healthcare, and manufacturing industries. However, an adverse effect is found for oil and gas companies. This might be explained by the fact that oil and gas companies are among the worst carbon emitters (World Bank, 2020). Therefore, a RE100 commitment might be seen as an act to increase its reputation and not reduce their environmental impact, so-called greenwashing.

Additionally, joining a renewable energy initiative will increase a company's firm performance. A study conducted by the RE100 initiative and consulting firm Capgemini (2018) reported that companies committing to the RE100 initiative performed better than non-members. The company's performances were measured by the net profit margin and the EBIT margin. The researchers of RE100 and Capgemini found that RE100 members significantly performed better on both performance indicators than their non-member peers. Therefore, they state that committing to 100% renewable energy will create a competitive advantage. Furthermore, they state that the results show that companies committed to the RE100 initiative are leaders in their sector. Companies that perform better will have easier access to debt capital and a lower cost of debt. Consequently, it is expected that joining the RE100 will decrease the company's cost of debt.

Moreover, companies commit to an initiative to communicate their renewable energy strategy with stakeholders (Chava, 2014). Excellent communication and a clear strategy will increase a company's reputation and therefore, its access to debt capital (Eliwa et al., 2019). Most environmental initiatives oblige companies to disclose their environmental practices. As discussed earlier, disclosure of ESG has a moderating effect on the relationship of ESG performance and the cost of debt. Eliwa et al. (2019) showed that ESG disclosure not only has a moderating effect but independently affects the cost of debt as well. The explanation is given by the fact that public disclosure of ESG activities will reduce the information asymmetry with stakeholders, such as creditors. Reduction of information asymmetry will increase transparency and reduce agency costs of debt (Moerman, 2005). The disclosure of environmental practices gives lenders the ability to perform environmental risk assessments on companies and determine the interest rates accordingly.

H_0: Membership of the RE100 initiative lowered the cost of debt for European listed companies in the period 2014 till 2018

H_a: Membership of the RE100 initiative did not lower the cost of debt for European listed companies in the period 2014 till 2018

This paper follows the view that disclosure of information will reduce information asymmetry, hence reduce the firm and credit risk. Since member companies of the RE100 are obliged to disclose their energy information, it is expected that RE100 companies experience an increase in transparency towards stakeholders. Furthermore, this paper aligns with the view that companies use environmental initiatives to signal their sustainability strategy to their stakeholders. Therefore, stakeholders are more aware of the sustainability strategy of RE100 member companies than non-member companies. This will result that a company's disclosure of renewable energy usage has a moderating effect on the relationship between renewable energy usage and the cost of debt. A third hypothesis is formed according to this view.

H_0: Membership of the RE100 initiative has a moderating effect on the relationship between the cost of debt and corporate renewable energy usage of European listed companies
H_a: Membership of the RE100 initiative does not have a moderating effect on the relationship between the cost of debt and corporate renewable energy usage of European listed companies

3 Research Design

3.1. Data and sample

To test the four hypotheses elaborated in the previous section, a unique 5-year annual data set of 209 listed European firms for the five-year period of 2014 till 2018 is constructed. This study focusses on the relatively short time frame of five years because of the lack of qualitative historical data on renewable energy usage of companies. ESG disclosure has gained popularity in the past years and many companies did not disclose their renewable energy usage at an earlier moment in time. Consistent with Eliwa et al. (2019) and La Rosa et al. (2017) this study excludes and real firms active in the financial and real estate sector from the sample, due to their different purpose of debt financing, which can influence the results. Based on prior studies, companies from Norway and Switzerland are included in the data, based on their similarities with European Union member states and in an effort to increase the sample size. The data used for this research is gathered from multiple data sources, creating a unique dataset. First, the renewable energy usage of European listed companies, measured as the renewable energy consumption divided by the total energy consumption, is gathered from one of the largest databases on ESG performances of companies, the Thomson Reuters Asset4 database and the Bloomberg database on ESG. Asset4 covers more than 10.000 companies worldwide reporting on more than 250 key indicators on ESG performance. After filtering out companies that did not have data points on all years a set of 121 companies is left from the Asset 4 database. By adding data from the Bloomberg terminal on renewable energy usage of European listed companies, and controlling for duplicate companies, 64 companies were added to the dataset. If two data points on renewable energy usage of companies were missing, the data were retrieved from annual reports if available. By searching through annual sustainability reports of RE100 member companies and other large listed European companies, 24 companies where added to the dataset. The renewable energy usage data is checked for consistency with annual reports and sustainability reports. To summarize, the dataset consists of 209 European listed companies with renewable energy usage data collected from the Asset4 database, the Bloomberg terminal and annual sustainability reports for the period 2014 till 2018.

Second, Factiva and the website of the RE100 initiative are used to investigate which companies of our sample are members of the RE100 initiative and therefore commit publicly to 100% renewable energy usage. A total of 110 European companies are members of the

RE100 initiative. In our sample, 27 companies are members of the RE100 initiative, which is 12,92% of the total sample.

Third, the Datastream database is used to retrieve annual financial information on the 209 companies of the sample. The industry composition of the sample is shown in table 1. The majority, 62 companies, of the sample is active in the industrials industry. The majority of the RE100 companies in the sample are active in the consumer staples industry.

To summarize, the procedure described before has led to a database containing 209 listed companies from 19 European countries, which can be found in table 1B. In table 1 the distribution of industries of the companies included in the sample can be found. The sample consists of companies from 9 different industries. Most of the companies in the sample are active in the industrial industry. The smallest number of companies in the sample are active in the Energy sector. The period for the sample is from 2014 till 2018.

Table 1A: Industry Composition Sample

ICB Industry Name	N	Companies	Percent	N (*RE100*)
Basic Materials	165	33	15,79	10
Consumer Discretionary	160	32	15,31	15
Consumer Staples	140	28	13,4	29
Energy	20	4	1,91	5
Health Care	75	15	7,18	7
Industrials	310	62	29,67	10
Technology	40	8	3,83	5
Telecommunications	100	20	9,57	24
Utilities	35	7	3,35	0
Total	1045	209	100	105

Table 1B: country composition sample

Country	N	Companies	Percent	N (*RE100*)
Austria	25	5	2.39	0
Belgium	40	8	3.83	12
Denmark	30	6	2.87	11
Finland	80	16	7.66	0
France	115	23	11.00	1
Germany	135	27	12.92	12
Greece	10	2	0.96	0

Hungary	5	1	0.48	0
Ireland	25	5	2.39	5
Italy	70	14	6.70	0
Luxembourg	10	2	0.96	0
Netherlands	80	16	7.66	17
Norway	5	1	0.48	0
Poland	5	1	0.48	0
Portugal	25	5	2.39	0
Spain	55	11	5.26	2
Sweden	105	21	10.05	5
Switzerland	70	14	6.70	15
United Kingdom	155	31	14.83	25
Total	1045	209	100	105

3.2. Measurement of variables

Data regressions are sensitive to outliers and influence points. Therefore, the distribution of all the variables are tested for outliers and influence points. To test for outliers and influence points this thesis used histograms and boxplots. This study used a histogram to inspect the distribution of the variable and to which degree there was a symmetrical distribution. The boxplot is used to inspect the distribution of the variable for extreme values. If a value is more than 1.5 IQR from the median the boxplot will indicate it as an extreme value. In addition, after the inspection via the histogram and boxplot, the skewness and kurtosis of the variable were inspected. The logarithmic functions of variables is used if a variable is extremely right-skewed. Another method used to control for outliers and influence points in this paper is Winsorizing the variable. Winsorizing is the transformation of a variable, by mitigating the extreme values in the dataset. The choice of the degree of Winsorization depends on the boxplot of the variable. Winsorizing will mitigate the effect of potential outliers on the results (Reifman & Keyton, 2010). The variables used in this study are described in the section below or in table A1 of the appendix.

3.2.1. Dependent variable - *Cost of debt*

The proxy used for *cost of debt* in this paper is a company's interest expense in year *t* divided by the interest-bearing debt in year *t*. This proxy is in line with earlier research investigating the relationship between ESG performance and the cost of debt (Magnanelli and Izzo, 2016;

La Rosa et al., 2018; Eliwa et al., 2019). The *cost of debt* is the money a company has to pay to cover for their debts, these expenses are made to bondholders or banks or other financial lenders. To deal with outliers and skewness in the dataset, the logarithmic function of the original cost of debt variable is taken, and the variable is Winsorized at the 3% and 98% level.

3.2.2. Measurement variables

The first measurement variable used in this paper is *renewable energy*, measured as the logarithmic function of the total energy consumed from primary renewable energy sources divided by the total energy consumption of a firm for any given year. The logarithmic function of the raw renewable energy variable is taken to deal with skewness of the variable in the dataset.

The second measurement variable *RE100* is a dummy variable which equals 1 whenever a company is a member of the RE100 initiative and zero whenever a company is not a member for any given year.

The final measurement variable, *RenEn*RE100* is the interaction term between renewable energy usage and membership of the RE100 renewable energy initiative. This variable is created to analyse the potential moderating effect of joining the RE100 initiative and committing to 100% renewable energy on the relationship between the *renewable energy* share and the *cost of debt*.

3.2.3. Control variables

To control for other effects on the cost of debt several control variables are included in the model. The control variables are included based on a significant effect on the cost of debt in prior studies. So, consistent with existing literature on the cost of debt, the control variables are the *firm Size*, *leverage*, *profitability*, *tangibility*, and *growth* (Bauer & Hann, 2010; Goss & Robert, 2010; Jung et al., 2014; Chava, 2014; Cooper & Uzun, 2015; Kleimeier & Viehs, 2016; Magnanelli & Izzo, 2016; Fonseka et al. , 2018; Eliwa et al. , 2019; De La Rosa et al., 2017; Jung et al., 2014).

The *size* variable is measured as the natural logarithm of total assets in year *t*. Firm size (*Size*) is expected to be negatively associated with the cost of debt. The *leverage* variable is the ratio of total debt to total assets in year *t*. *Leverage* is expected to have a positive relationship with the *cost of debt*. Higher leverage increases the cost of debt due to an increase in the probability of bankruptcy or default risk of a company. To deal with outliers in the dataset, the *leverage* variable is Winsorized at the 7% and 100% level. For the *profitability* variable, a firm's return on assets is used, measured as the earnings before interests and taxes divided by total assets. A negative relationship is expected between *profitability* (*ROA*) and the cost of debt. Firms with higher *profitability* are more likely to have excess free cash flow and hence the ability to meet debt obligations. To deal with outliers in the dataset, the *profitability* variable is Winsorized at 2% and 95% level. To control for the effect on the cost of debt by the *tangibility* of a company's assets, measured by the logarithmic function of the total value of PPE (property, plant, and equipment) divided by total assets of a given year *t*, is included in the model. The effect of having tangible assets is expected to be negative with the cost of debt. Tangible assets can be used as collateral by borrowers and hence reduce the probability of default, resulting in a lower cost of debt. To deal with outliers in the dataset, the *tangibility* variable is Winsorized at the 1% level. The *growth* prospects of a firm are expected to have a negative relationship with the cost of debt. To control for this effect the market to book ratios of companies are included in the model. The market to book ratio is a firm's market capitalization divided the book value of shareholders equity of a given year *t*. A higher market to book ratio, implying higher growth prospects, will give a signal that a firm has a higher chance of meeting debt obligations and hence reduce the probability of default, resulting in a lower cost of debt. To deal with outliers in the dataset, the *growth* variable is Winsorized at 2% and 94% level. To control for the effect on the cost of debt by the *liquidity* of a company's assets, measured by the logarithmic function of a firm's current assets divided by the current liabilities of a given year *t*, is included in the model. The effect of having a high level of liquidity is expected to be negative with the cost of debt. Liquid assets can be sold more quickly by a company when it is in distress and therefore high liquid companies can pay the debt obligations easier, resulting in a lower cost of debt. To deal with outliers in the dataset, the *liquidity* variable is Winsorized at the 1% and 99% level. To control for *industry* effects on the cost of debt an industry dummy variable is included in the model. The industry dummy variable is based on the ICB classification codes, established by the European Union. As a final step, a dummy variable to control for *country* effects is included in the model.

3.3. Regression model

In this paper, the relationship between the renewable energy share of companies on the cost of debt is examined. Furthermore, the relationship between a membership of the RE100 renewable energy initiative and the cost of debt is examined. At last, the moderating effect of a RE100 membership on the relationship between the renewable energy share and the cost of debt is examined. First, this paper looks at the effect of a company's renewable energy usage level on the cost of debt in the period 2014 to 2018 (H_1). Secondly, the effect of a company's commitment to 100% renewable energy, by publicly joining the RE100 initiative, on a company's cost of debt is investigated (H_2). Lastly, the moderating effect of joining the RE100 renewable energy initiative on the relationship of renewable energy usage and the cost of debt is investigated (H_3). The hypotheses are all tested using the specified model 1. To test hypotheses 1, 2, and 3, panel data is used with a time-varying element *t* and a cross-sectional element i.

$$(1)\quad Cost\ of\ Debt_{i,t} = \alpha_i + \beta_1 Renewable\ Energy_{i,t} + \beta_2 RE100_{i,t} + \beta_3 RenEn_{i,t} * RE100_{i,t} + \delta X_{i,t} + \nu_{i,t}$$

Cost of Debt	Cost of debt, measured as the logarithmic function of the interest expense divided by the average of the interest-bearing debt for a given year *t*
Renewable Energy	renewable energy share, measured as the logarithmic function of renewable energy usage divided by the total energy consumption for a given year *t*
RE100	renewable energy initiative variable, a dummy variable set equal to one whenever a company is member of the RE100 initiative, and zero if a company is not a member of the RE100 for year *t*
*RenEn*RE100*	Moderating variable renewable energy share multiplied by the RE100 dummy
$X_{i,t}$	Matrix of control variables

Within the context of our model, *H1* predicts a negative coefficient on the renewable energy variable, suggesting that companies with a higher renewable energy usage experience a lower cost of debt in 2018. This is consistent with the view that firms with more environmental activities and fewer carbon emissions experience a lower cost of debt, as elaborated on in our literature review. Consistent with that view, *H2* predicts a negative coefficient, suggesting that membership of the RE100 initiative and committing to 100% renewable energy alone will reduce the cost of debt for a company. *H3* predicts a negative coefficient on the interaction variable, *RenEn*RE100*. Suggesting that committing to the RE100 initiative will strengthen the lowering effect on the cost of debt of renewable energy usage of companies. This is consistent with the view that companies that are members of the RE100 initiative use initiatives to signal their environmental activities to lenders and other stakeholders. Figure 1 shows a conceptual framework of the hypotheses that are being examined to answer the research question.

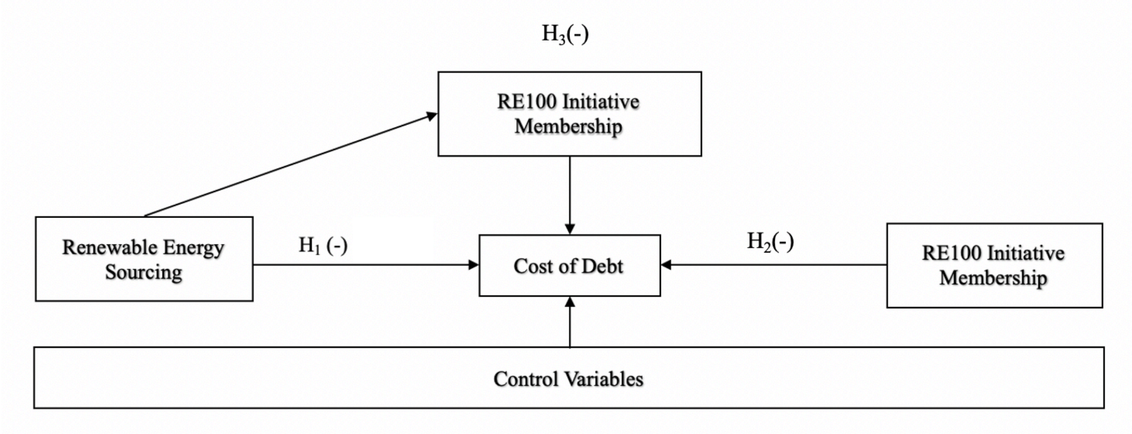

Figure 1: conceptual model

To test the hypotheses, the assumptions for a multiple linear regression must be met.
The assumptions for a multiple linear regression are normality, linearity without autocorrelation, multicollinearity, or heteroskedasticity (Bolin et al., 2014). If these assumptions are not met, your estimates will have larger variance and results will be biased, inconsistent, and inefficient. The normality and linearity assumptions are met after taking logarithmic functions of the variables and controlling for outliers. Autocorrelation between the variables is tested by performing the Woolridge-test for panel data. The VIF (Variance Inflation Factor) test is used to check for multicollinearity for every regression. The Breusch-Pagan test is used to check for heteroskedasticity for every regression.

4 Results

In this section, the descriptive statistics, Pearson correlation coefficients, and three tests are presented to examine the relationship between renewable energy programs and the cost of debt of listed European companies. The results will reject or accept the hypotheses formulated in chapter two.

4.1. Descriptive statistics

In table 2 the descriptive statistics from the variables used in this paper are given. The number of observations for the five-year period and 209 firms used for this research is 1,045. Next to the number of observations the mean, standard deviation, minimum and maximum value are given. Panel A shows the descriptive statistics of the variables unadjusted for their distribution and skewness. Panel B shows the descriptive statistics adjusted for their distribution and skewness. The adjustments of the variables are described in the data section of this paper. According to the raw data (Panel A), the average renewable energy share is 0.21 and the standard deviation is 0.23. The mean of RE100 is 0.10 and the standard deviation is 0.30. The mean of the liquidity ratio is 0.95 and the standard deviation is 0.62. The mean of tangibility is 0.27 and the standard deviation is 0.19. The mean of growth is 2.65 and the standard deviation is 31.64. The mean of profitability is 0.05 and the standard deviation is 0.07. The mean of the leverage is 0.27 and the standard deviation is 0.160. The mean of the size of a firm is 7.15 and the standard deviation is 0.63. According to the adjusted variables (Panel B), the average renewable energy share is 0.17 and the standard deviation is 0.18. The mean of RE100 is 0.10 and the standard deviation is 0.30. The mean of the logarithmic function of the liquidity ratio is -0.18 and the standard deviation is 0.48. The mean of the logarithmic function of tangibility is -1.65 and the standard deviation is 0.93. The mean growth is 2.9 and the standard deviation is 2.2. The mean profitability is 0.05 and the standard deviation is 0.05. The mean of the logarithmic function of leverage is -1.5 and the standard deviation is 0.65. The mean of the size of a firm is 7.15 and the standard deviation is 0.627.

Table 2: Descriptive statistics

Panel A: Summary Statistics – raw variables

	(1)	(2)	(3)	(4)	(5)

VARIABLES	N	mean	sd	min	Max
Cost of debt*	1,045	0.0481	0.0763	0.000176	1.262
Renewable energy*	1,045	0.209	0.233	0	1
RE100*	1,045	0.100	0.301	0	1
Liquidity*	1,045	0.954	0.620	0.110	9.190
Tangibility*	1,045	0.268	0.191	0.00589	0.899
Growth*	1,045	2.645	31.64	-964.2	225.9
Profitability*	1,045	0.0540	0.0733	-0.820	0.715
Leverage*	1,045	0.265	0.160	0.00112	1.280
Size*	1,045	7.153	0.627	5.586	9.082
Number of companies	209	209	209	209	209

* raw unadjusted variable

Panel B: Summary Statistics – adjusted variables

	(1)	(2)	(3)	(4)	(5)
VARIABLES	N	mean	sd	min	max
Cost of debt	1,045	-3.352	0.617	-4.864	-1.658
Renewable energy	1,045	0.173	0.177	0	0.693
RE100	1,045	0.100	0.301	0	1
Liquidity	1,045	-0.182	0.478	-1.470	1.095
Tangibility	1,045	-1.653	0.930	-4.238	-0.107
Growth	1,045	2.926	2.174	-2.737	7.974
Leverage	1,045	-1.499	0.646	-2.976	0.247
Profitability	1,045	0.0525	0.0480	-0.0682	0.161
Size	1,045	7.153	0.627	5.586	9.082
Number of companies	209	209	209	209	209

4.2. Pearson correlation coefficient

Table 3: Matrix of correlations

Pearson correlations between COD, renewable energy percentage, RE100 membership and control variables.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1) Cost of debt	1								
(2) Renewable energy	-0.1428*	1							
(3) RE100	-0.1165*	0.4256*	1						
(4) Liquidity	-0.0161	-0.0196	-0.0679*	1					
(5) Tangibility	0.0989*	0.0330	0.0346	-0.1097*	1				
(6) Growth	-0.1225*	0.1107*	0.2079*	0.0910*	-0.1742*	1			
(7) Profitability	-0.1171*	0.1566*	0.1677*	0.2483*	-0.0298	0.5536*	1		
(8) Leverage	-0.1373*	-0.0643*	-0.0110	-0.2541*	0.0950*	-0.2496*	-0.3723*	1	
(9) Size	-0.0160	-0.0129	0.1348*	-0.1603*	-0.0259	-0.1184*	-0.1404*	0.1514*	1

Table 3 shows the correlation between the adjusted variables. The matrix of correlations indicates the associations between the variables used for this research. Table 3 shows a negative correlation (-0.143) between the cost of debt and the renewable energy share of companies and a negative correlation (-0.117) between the cost of debt and the commitment to 100% renewable energy use. Both correlations have statistical significance at the 5% level.

4.3. Regression results

In this section, the results are elaborated in order to reject or accept the hypotheses and answer the research question.

4.3.2. Hypotheses 1,2, and 3

To test the first and second hypotheses we employ a panel dataset to investigate the effects of the renewable energy share of companies and the RE100 membership on the cost of debt of companies. Hypotheses three investigates whether a RE100 membership has a moderating effect on the relationship of the renewable energy share and the cost of debt. In these hypotheses, the main objective was to investigate the broad effect of adopting renewable energy sources on cost of debt in European listed firms. The property of a panel data regression is that the same firm is investigated multiple times, which can be considered as a repeating measurement. With this repeated measurement problems such as autocorrelation can become a problem. The advantage of panel data is that there is an ability to control for an unobserved variable. This unobserved variable can be a source of a bias in an OLS regression. Therefore, a panel data regression is used. To determine if a random-effects model is sufficient a Hausman test is performed. The Hausman test showed a chi-square of 127.94 and a p-value of 0.000. This indicates that a random-effects model is inefficient because there is a structural difference in the estimates. Therefore, a fixed-effects model is used in this analysis. To mitigate potential heteroskedasticity, the standard errors of the estimated coefficients are adjusted for firm-level clustering and heteroskedasticity.

Table 4 reports results for the fixed effects panel data regression analysis. Based on the R-squared, each model contributed to the explanatory power of *renewable energy* on the cost of debt. According to Ringle et al. (2015), a VIF value higher than 5 indicates multicollinearity in the regression. Therefore, the VIF values for the regressions in table 4 indicate there is no existence of multicollinearity.

The first model regresses the control variables on the cost of debt. The findings of the model (1) suggest that only *Leverage* (*B*= - 0.477, *p*<0.01) and *Size* (*B*= -1.339, *p*<0.01) have a significant negative effect on the cost of debt. However, the findings of the model (1) suggests that liquidity, tangibility, growth, and profitability do not have a significant effect on the cost of debt.

In the second model, the renewable energy variable is included. The results of model (2) suggest that *renewable energy* has a strong negative significant effect on the cost of debt at the 1% significance level (*B*= - 0.774, *p*<0.01). These results of the regression confirm the second hypothesis suggesting that an increase of the renewable energy share will decrease the cost of debt for listed European companies between 2014 and 2018. Controlling only for renewable energy in our model, the impact is statistically significant and indicates that an increase in renewable energy use decreases the cost of debt when all other effects held constant.

In model (3), the RE100 variable is included in the regression. The results of the model (3) indicate that joining the RE100 initiative alone does not significantly affect the cost of debt of European listed companies. Thus, the third hypothesis is rejected indicating that committing to 100% renewable energy alone is not enough to lower the cost of debt.

In model (4), both the *renewable energy* variable and the *RE100* variable are included in the model. The *renewable energy* share of companies still has a negative significant effect on the cost of debt (*B*= - 0.823, *p*<0.01) and the p-value for RE100 reduces from 0.794 (model 3) to 0.253 (model 4), however still not has a significant effect on the cost of debt. Therefore, the third hypothesis is still rejected, suggesting that a RE100 membership alone does not affect the cost of debt.

Model (5) includes the intersect variable *RenEn*RE100* in testing hypothesis 4. According to model (5), the *RenEn*RE100* does not have a significant effect on the cost of debt. This result suggests that being a member of the RE100 does not have a moderating effect on the relationship between the renewable energy share of a company and its cost of debt. Therefore, the last hypothesis is rejected.

Models (4) and (5), validate the conclusions from the model (2) and (3). In model (4) and (5), renewable energy usage has statistically significant impacts on the cost of debt and the RE100 membership does not have a significant effect. In comparison with the model 2, the estimated coefficient is slightly increased, and an increase in renewable energy usage decreases the cost of debt significantly.

Table 4: regression results

VARIABLES	(1) model 1	(2) model 2	(3) model 3	(4) model 4	(5) model 5
Renewable Energy		-0.774***		-0.823***	-0.834***
		(0.272)		(0.271)	(0.282)
RE100			0.023	0.102	0.077
			(0.088)	(0.089)	(0.125)
ReneEn *RE100					0.072
					(0.298)
Liquidity	-0.025	-0.030	-0.025	-0.030	-0.030
	(0.073)	(0.073)	(0.073)	(0.073)	(0.073)
Tangibility	0.171	0.154	0.173	0.159	0.159
	(0.109)	(0.117)	(0.110)	(0.119)	(0.119)
Leverage	-0.477***	-0.480***	-0.478***	-0.481***	-0.482***
	(0.096)	(0.096)	(0.096)	(0.096)	(0.096)
Size	-1.339***	-1.251***	-1.341***	-1.256***	-1.257***
	(0.263)	(0.272)	(0.264)	(0.272)	(0.272)
Growth	-0.006	-0.008	-0.007	-0.008	-0.008
	(0.016)	(0.015)	(0.016)	(0.015)	(0.015)
Profitability	-0.467	-0.277	-0.472	-0.287	-0.289
	(0.464)	(0.464)	(0.466)	(0.463)	(0.464)
Constant	5.830***	5.295***	5.848***	5.344***	5.344***
	(1.887)	(1.915)	(1.894)	(1.916)	(1.918)
Observations	1,045	1,045	1,045	1,045	1,045
R-squared	0.227	0.245	0.227	0.247	0.247
VIF	1.27	1.24	1.26	1.29	2.23
Number of companies	209	209	209	209	209
Industry fixed effects	YES	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

4.3.3 Control Variables

With regards our control variables, *firm Size, leverage, profitability, tangibility, liquidity* and *growth,* the results show that all the variables except *tangibility,* have negative relationships with the dependent variable, *cost of debt*. While the negative relationships between the dependent variable, *Cost of Debt* and *liquidity, firm size, profitability* and *growth* follow the earlier stated expectation, its relationship with leverage (negative) and tangibility (positive) run contrary to the expectations.

The result of the regression suggests that increases in firm leverage led to a decline in cost of debt. Although this finding runs contrary to expectations that higher leverage increases the cost of debt due to an increase in the probability of bankruptcy or default risk of companies, this relationship is attributed to the nature of leverage incurred by these firms which might have improved their credit worthiness before lenders. Firms that might have incurred additional leverage by investing on renewable energy or through diversifying their investment base to embrace more sustainable energy or income sources would receive favour from lenders and therefore, lead to negative relationships between *cost of debt* and *leverage*. Given the high industrial nature of firms in the dataset and the increased shift towards sustainable energy sources over the period covered by this study, this unexpected relationship is therefore attributed to this more favourable disposition of lenders to firms embracing sustainable energy and investment options.

Also contrary to the expectations is the relationship between the dependent variable, *cost of debt* and *tangibility*. Our result indicates a positive relationship between cost of debt and tangibility i.e., as tangible assets grew over the period covered, cost of debt also increased. While this runs contrary to expectations as tangibility is expected to reduce the probability of default thereby resulting in lower cost of debt, the nature of acquired assets is a key determinant of the disposition of lenders to tangibility. If firms are seen to have too many non-sustainable, depreciating, and unrenewable tangible assets lenders would be averse to these firms thereby increasing their cost of debt.

The rest of our control variables, *liquidity, firm size, profitability* and *growth* interacted as expected with the dependent variable as they were all seen to have possessed negative relationships with the cost of debt as theorized in this paper.

4.4 Robustness checks

In this section, the robustness of the results showed in table 4 is tested. The robustness of the results is tested in two ways. First, the biggest country in the sample is omitted. Secondly, the biggest ICB industry is omitted from the sample.

4.4.1. Country robustness test

Approximately 30% of the sample consists of the two biggest counties. This could lead to biased results since they might be driven by only these countries. To make sure of the negative relationship between the renewable energy share of a company and its cost of debt, the two biggest countries; the United Kingdom and Sweden are omitted from the sample. After omitting the U.K. and Sweden from the sample 151 samples are and 755 observations are left in the sample.

According to the results in table 5, *renewable energy* still has a negative significant effect on the cost of debt (*B*= -1.148*, p*<0.01. The effect of renewable energy on the cost of debt is stronger when Germany and the UK are omitted, but the general conclusions are not affected much. Consistent with the findings of table 4 *RE100* and *RenEn*RE100* have an insignificant effect on the cost of debt. However, the findings of this robustness show that RE100 has an insignificant negative effect. This switch from positive to negative is explained by the high number of RE100 members active in the U.K. and Sweden. Consistent with *renewable energy*, the control variables follow the same signs and significance levels as the estimated models showed in table 4, indicating the robustness of the estimated models.

Table 5: robustness regression results - country

VARIABLES	(1) model 1
Renewable Energy	-1.148***
	(0.342)
RE100	-0.025
	(0.000)
RenEn*RE100	0.134
	(0.402)
Liquidity	0.013
	(0.088)
Tangibility	0.130
	(0.142)
Leverage	-0.394***
	(0.110)
Size	-1.481***
	(0.337)
Growth	-0.006
	(0.023)
Profitability	-0.231
	(0.630)
Constant	7.063***
	(2.402)
Observations	755
Number of companies	151
R-squared	0.253
Industry fixed effects	YES
Year fixed effects	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

4.4.2. Industry robustness test

Approximately 30% of the sample consists of companies active in the industrial sector. This could lead to biased results since they might be driven by Industrial companies. To make sure of the negative relationship between the renewable energy share of a company and its cost of debt, Industrial companies are omitted from the sample. After omitting the industrial companies from the sample 147 companies and 735 observations are left in the sample.

According to the results in table 6, *renewable energy* still has a negative significant effect on the cost of debt (*B*= -0.854*, p*<0.01). The effect of renewable energy on the cost of debt is slightly stronger when industrial companies are omitted, but the general conclusions are not affected much. In line with the findings of table 4, *RE100* and *RenEn*RE100* follow the same sign and are not significant. Consistent with *renewable energy*, the control variables follow the same signs and significance levels as the estimated models, indicating the results are robust for the influence of companies active in the industrial sector.

Table 6: robustness regression results - industry

VARIABLES	(1) model 1
Renewable Energy	-0.854***
	(0.316)
RE100	0.077
	(0.136)
RenEn*RE100	0.056
	(0.329)
Liquidity	-0.019
	(0.074)
Tangibility	0.069
	(0.134)
Leverage	-0.473***
	(0.111)
Size	-1.326***
	(0.306)
Growth	0.010
	(0.012)

Profitability	-0.012
	(0.494)
Constant	5.691***
	(2.175)
Observations	735
Number of companies	147
R-squared	0.257
Industry fixed effects	YES
Year fixed effects	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

5 Discussion

5.1. Discussion

Implications of this study are focused on business managers, who sometimes do not understand the value of renewable energy usage for their companies. Therefore, this study tries to emphasize the importance of sourcing renewable energy for businesses. The findings of our work underline various findings from other researchers. Our findings are in line with that by Jung et al., (2018) who concluded that companies that fail to reduce its carbon emission by embracing renewable energy sources face higher risks and higher cost of capital. By showing proof of this phenomenon in Europe, our study lends further credence to the work of Jung et al. (2018). Contrary with Fonseka et al., (2019) who conducted a study on Chinese companies, where they found that disclosing renewable energy information improved companies' access to capital, this work found evidence in Europe that membership of RE100 which require disclosure of renewable energy information, does not significantly affect cost of debt among European companies.

Furthermore, this study in light of its findings recommends that business managers source for "real" renewable energy. Many companies source "fake" renewable energy by buying green certificates to compensate for their carbon emissions and grey energy consumption. As this way of compensation is allowed by regulatory authorities, such as the EU, it does not support the cause of reducing the environmental impact of the company if the certificates are procured from oversupplied renewable energy countries. Therefore, this paper recommends managers to source their renewable energy through PPAs or self-generation.

5.2. Limitations & future research

First, the data available does not differentiate between direct corporate renewable energy sourcing, which is sourced directly from renewable sources and the procurement of renewable energy certificates. Therefore, this paper cannot say if the companies who claim to use renewable energy compensate by procuring renewable certificates of oversupplied Nordic hydro or really contribute to additional renewable energy production. For further research it would be interesting to see if the effect of renewable energy on the cost of debt differs between renewable energy sourcing methods or renewable energy source used. However, current secondary data does not differentiate between the sourcing method (self-generation, PPAs, unbundled certificates) of corporate renewable energy.

Second, due to the lack of data on the renewable energy share of companies in the European Union a small sample is used for this research. Over time more companies are disclosing their renewable energy share in their sustainability reports. For the period used for our research, only 209 companies in the EU disclose their renewable energy share. It is expected that in the future more companies will disclose their renewable energy share and methods, due to the gaining importance of environmental practices of companies. Therefore, research on the effects of renewable energy sourcing on a company's capital structure, and in specific the cost of debt, is expected to have more explanatory power, due to more data availability. Research at a later moment in time will be valuable to contribute to the current energy finance literature. In our sample some industries and countries only consist of a small number of companies; therefore, the explanatory power for these countries and industries is low. Thus, it is important for business owners active in these industries and countries to take these results as indicative results and not make drastic decisions in business operation before researching if these results hold for their business.

Third, the results of this study do not suggest that increasing or decreasing the renewable energy share will directly reduce the cost of debt. This paper does states that on average the findings suggest that companies with increased renewable energy experience a lower cost of debt. Therefore, it is not possible to give a moment in time when the effect of increasing or decreasing the renewable energy will be visible for managers. Thus, for future research it would be interesting to use a dynamical model to conclude whether it is possible to suggest the causal effect on increasing the renewable energy share on the cost of debt in the next year.

At last, future researchers should include other geographical locations to draw conclusions worldwide and analyze differences. By doing so, different regulatory measurements and their effects on business metrics can be analyzed.

6 Conclusion

This study tries to answer the question of whether a company's renewable energy program affects its cost of debt for listed European companies. To answer the research question three hypotheses are formed. First the relationship between the company's renewable energy share and the cost of debt is analyzed. Second, the effect of the commitment of a company to 100% renewable energy, by joining the RE100 initiative on its cost of debt is analyzed. Third, the moderating effect of a RE100 membership on the relationship between the share of renewable energy and the cost of debt is analyzed. To test the three hypotheses this study employed a panel dataset for the period between 2014 till 2018. This study finds that renewable energy by European listed companies had a strong negative and significant effect on their cost of debt. The findings suggest that an increase of these companies' renewable energy share would decrease their cost of debt over time, and therefore accepting hypothesis one. Also, our study result showed that joining the RE100 initiative alone did not significantly affect the cost of debt for companies therefore a mere committal to adopting 100% renewable energy alone is not enough to lower cost of debt for European listed companies. Therefore, hypothesis two is rejected. Finally, and in the same vein, our study found that RE100 membership does not have a moderating effect on the relationship between the renewable energy of European listed companies and their cost of debt in the period between 2014 and 2018. Therefore, hypothesis three is rejected. With regards the control variables employed in our study, only *leverage* and *size* were found to have significant negative effects on cost of debt. While liquidity, tangibility, growth, and profitability we're seen to not have a significant effect on cost of debt. This study to the best of knowledge is the first to wholly focus on the renewable energy strategy of companies and their effects on the cost of debt. Other studies showed the effects of CSR performance or carbon emissions on the cost of debt, but no other study focusses on the relationship between a company's renewable energy share or strategy and the cost of debt. Based on the findings of this study, this study contributes to the energy finance literature, lenders and managers of European listed companies, who now have proof that adoption of renewable energy benefits the company cost of debt.

7 Appendix

Table A1: Variables description

Variable	Description	Measurement	Source
Cost of debt	Interest Expense$_t$ divided by the firm's total interest-bearing debt $_t$	Interest expense	Datastream
renewable energy	Company's percentage of primary renewable energy usage (renewable energy consumption /total energy consumption)	% Renewable Energy	Asset4 Bloomberg Annual Reports
RE100	Equals 1 if a company is member of the RE100 renewable energy initiative and 0 if a company is not a member.	RE100 membership	RE100-website Factiva
RenEn*RE100	Interaction variable multiplying RenEn with RE100 membership		
Size	Natural logarithm of a firm's Total Assets	Total Assets	Datastream
Leverage	Interest Bearing Debt$_t$ / Total Assets$_t$	Interest bearing debt	Datastream
Profitability	Net Income$_t$ / Total Assets$_t$	EBIT	Datastream
Tangibility	PPE$_t$ / Total Assets$_t$	PPE	Datastream
Growth	Natural logarithm of a firm's Market value of Equity$_t$ divided by its Book Value of Equity$_t$	M/B	Datastream
Liquidity	Natural logarithm of a firm's current assets divided by its current liabilities	Total Assets Current Debt	Datastream
Industry	Categorial variable based on the ICB-codes sector classifications.		Datastream
Country	Categorial variable based on the country in which the company is active		Datastream

Table A2: Descriptive statistics per country

	Cost of debt		Renewable energy		
Country	Mean	Std. Dev.	Mean	Std. Dev.	Freq.
Austria	0,046	0,018	0.26	0.23	25
Belgium	0,035	0,020	0.28	0.26	40
Denmark	0,038	0,025	0.33	0.29	30
Finland	0,039	0,019	0.23	0.20	80
France	0,032	0,018	0.15	0.16	115
Germany	0,048	0,029	0.17	0.25	135
Greece	0,061	0,023	0.03	0.04	10
Hungary	0,056	0,003	0.46	0.22	5
Ireland	0,048	0,032	0.19	0.19	25
Italy	0,041	0,017	0.09	0.13	70
Luxembourg	0,076	0,026	0.17	0.18	10
Netherlands	0,041	0,016	0.31	0.29	80
Norway	0,036	0,007	0.16	0.20	5
Poland	0,043	0,005	0.43	0.16	5

Portugal	0,022	0,015	0.28	0.27	25
Spain	0,052	0,030	0.20	0.22	55
Sweden	0,031	0,017	0.27	0.23	105
Switzerland	0,035	0,025	0.15	0.17	70
United Kingdom	0,042	0,014	0.20	0.25	155
Total	0,040	0,022	0.21	0.23	1,045

Table A3: Descriptive statistics per industry

	Cost of debt		Renewable energy		
ICB Industry Name	Mean	Std. Dev.	Mean	Std. Dev.	Freq.
Basic Materials	0,046	0,038	0,180	0,190	165
Consumer Discretioniaries	0,068	0,147	0,270	0,250	160
Consumer Staples	0,038	0,021	0,220	0,240	140
Energy	0,047	0,025	0,220	0,270	20
Health Care	0,042	0,037	0,170	0,220	75
Industrials	0,051	0,082	0,140	0,170	310
Technology	0,022	0,018	0,330	0,310	40
Telecommunications	0,042	0,018	0,360	0,290	100
Utilities	0,042	0,008	0,110	0,160	35
Total	0,048	0,076	0,210	0,230	1,045

8 References

Anton, S. G., & Nucu, A. E. A. (2020). The effect of financial development on renewable energy consumption. A panel data approach. Renewable Energy, 147, 330-338.

Bauer, R., & Hann, D. (2010). Corporate environmental management and credit risk. Available at SSRN 1660470.

Bolin, J. H. (2014). Hayes, Andrew F. (2013). Introduction to Mediation, Moderation, and Conditional Process Analysis: A Regression-Based Approach. New York, NY: The Guilford Press. Journal of Educational Measurement, 51(3), 335-337.

Brander, M., Gillenwater, M., & Ascui, F. (2018). Creative accounting: A critical perspective on the market-based method for reporting purchased electricity (scope 2) emissions. Energy Policy, 112, 29-33.

Brown, P. (2013). European Union wind and solar electricity policies: overview and considerations.

Chava, S. (2014). Environmental externalities and cost of capital. Management Science, 60(9), 2223-2247.

Cheng, B., Ioannou, I., & Serafeim, G. (2014). Corporate social responsibility and access to finance. Strategic management journal, 35(1), 1-23

Cooper, E. W., & Uzun, H. (2015). Corporate Social Responsibility and the Cost of Debt. Journal of Accounting & Finance (2158-3625), 15(8).

Deloitte. (2019). 2019 renewable energy industry outlook.

Eccles, R. G., Ioannou, I., & Serafeim, G. (2014). The impact of corporate sustainability on organizational processes and performance. Management Science, 60(11), 2835-2857.

Eccles, R., Klimenko, S. (2019). The Investor Revolution. Harvard Business Review.

El Ghoul, S., Guedhami, O., Kwok, C. C. Y., & Mishra, D. R. (2011). Does corporate social responsibility affect the cost of capital? Journal of Banking & Finance, 35(9), 2388–2406.

Eliwa, Y., Aboud, A., & Saleh, A. (2019). ESG practices and the cost of debt: Evidence from EU countries. Critical Perspectives on Accounting, 102097.

European Commission. (2019). Competitiveness of corporate sourcing of renewable energy

European Investment Bank. (2018). FAQ available on the Marquerite Fund. Retrieved from: https://www.eib.org/en/press/news/2020-european-fund-for-energy-climate-change-and-infrastructure-marguerite-fund

Fd.nl. (2018). Green electricity from the Netherlands is the most expensive in Europe. Retrieved from https://fd.nl/ondernemen/1267043/gewilde-groene-nederlandse-stroom-duurst-in-europa#

Fisher-Vanden, K., & Thorburn, K. S. (2011). Voluntary corporate environmental initiatives and shareholder wealth. Journal of Environmental Economics and management, 62(3), 430-445.

Fonseka, M., Rajapakse, T., & Richardson, G. (2019). The effect of environmental information disclosure and energy product type on the cost of debt: Evidence from energy firms in China. Pacific-Basin Finance Journal, 54, 159-182.

Freeman, R. E., Harrison, J. S., Wicks, A. C., Parmar, B., & de Colle, S. (2010). Stakeholder Theory. The state of the art

Gazzola, P. (2014). Corporate social responsibility and companies' reputation. Network Intelligence Studies, 2(03), 74-84.

Goss, A., & Roberts, G. S. (2011). The impact of corporate social responsibility on the cost of bank loans. Journal of Banking and Finance, 35(7), 1794–1810.

Hsiao, J. I. (2018). Blockchain for corporate renewable energy procurement-potential for verification of renewable energy certificates. US-China L. Rev., 15, 75.

https://home.kpmg/xx/en/home/insights/2018/04/new-drivers-of-the-renewable-energy-transition.html

Hutchinson, C. (1992). Corporate strategy and the environment. Long Range Planning, 25(4), 9-21.

IEA. (2019). World Energy Investment.

IRENA. (2018). Renewable power generation costs in 2018.

IRENA. (2018). Renewable power generation costs in 2018.

Izzo, M. F., & Magnanelli, B. S. (2012). Does it pay or does firm pay? The relation between CSR performance and the cost of debt. The Relation between CSR Performance and the Cost of Debt (January 16, 2012).

Jansen, J. (2017). Does the EU renewable energy sector still need a guarantee of origin market?. CEPS Policy Insights, (2017-27).

Jones, T.M. (1995). Instrumental stakeholder theory: A synthesis of ethics and economics. Academy of Management Review, 20, 404-437

Jung, J., Herbohn, K., & Clarkson, P. (2018). Carbon risk, carbon risk awareness and the cost of debt financing. Journal of Business Ethics, 150(4), 1151-1171

Kleimeier, S., & Viehs, M. (2018). Carbon disclosure, emission levels, and the cost of debt. Emission Levels, and the Cost of Debt (January 7, 2018).

KPMG. (2018). New drivers of the renewable energy transition. Retrieved from

La Rosa, F., Liberatore, G., Mazzi, F., & Terzani, S. (2018). The impact of corporate social performance on the cost of debt and access to debt financing for listed European non-financial firms. European Management Journal, 36(4), 519-529.

Lund, H. (2007). Renewable energy strategies for sustainable development. Energy, 32(6), 912-919.

Magnanelli, B., Izzo, M. (2017). Corporate social performance and cost of debt: The relationship. Social Responsibility Journal 13: 250-265.

McKinsey & Company. (2019). Fueling the energy transition: Opportunities for financial institutions.

Moerman, R. W. (2005, December). The impact of information asymmetry on debt pricing and maturity. In Seminar Paper, December.

Mouilleron, M. (2018). Impact of the Guarantees of Origin on investments in renewable energy in the Netherlands (Master's thesis, Norwegian University of Life Sciences, Ås).

NRDC. (2018). Paris Climate Agreement: Everything You Need to Know. Retrieved from: https://www.nrdc.org/stories/paris-climate-agreement-everything-you-need-know

O’Connor, S., McElfish, J., & Reynolds, L. (2019). Corporate Renewable Energy Goals: What Does “100% Renewable” Really Mean? Environmental Law Reporter: News & Analysis, 49(7), 36–57.

Oslo Economics. (2017). Analysis of the trade in Guarantees of Origin.

Philibert, C. (2017). Renewable energy for industry. Paris: International Energy Agency.

Porter, M. E. (1989). From competitive advantage to corporate strategy. In Readings in strategic management (pp. 234-255). Palgrave, London.

Ralston, B. (2008). How to develop a customized corporate energy strategy. Strategy & Leadership, 36(2), 30-39.

RE-Source (2020). Introduction to Corporate Sourcing of Renewable Electricity in Europe. Retrieved from: http://resource-platform.eu/files/toolkit/RE-Source-introduction-to-corporate-sourcing.pdf

Reuters. (2017). Dutch will miss 2020 green energy, climate targets: report. Retrieved from https://www.reuters.com/article/us-netherlands-climatechange/dutch-will-miss-2020-green-energy-climate-targets-report-idUSKBN1CO2EV

Reuters. (2019). Growth in sustainability-linked loans boosts ESG ratings firms. Retrieved from: https://www.reuters.com/article/growth-in-sustainability-linked-loans-bo/growth-in-sustainability-linked-loans-boosts-esg-ratings-firms-idUSL2N27615Y

Scott Maden. (2018). Powering On: Four Factors to Energize a Corporate Renewable Energy Program. Retrieved from: https://www.scottmadden.com/wp-content/uploads/2018/09/ScottMadden_Powering_On_Four_Factors_to_Energize_a_Corporate_Renewable_Energy_Program_2018_Nov.pdf

Tantau, A., Chinie, A., & Carlea, F. (2015). Corporate entrepreneurship and innovation in the renewable energy field. Procedia Economics and Finance, 22, 353-362.

Ye, K., Zhang, R. (2011). Do lenders value corporate social responsibility? Evidence from China. Journal of Business Ethics 104: 197-206.