Network for Studies on Pensions, Aging and Retirement

NETSPAR ACADEMIC SERIES

The Importance of Materiality in Carbon Emissions Screening Examined on Risk and Return in the Utilities Sector

Max Dufaure de Lajarte

MSc 08/2021-014

Maastricht University

MASTER THESIS

THE IMPORTANCE OF MATERIALITY IN CARBON EMISSIONS SCREENING EXAMINED ON RISK AND RETURN IN THE UTILITIES SECTOR

by

Maximilien Peter Roger Dufaure de Lajarte

I6141144

Maastricht University, School of Business and Economics
MSc International Business – specialization Sustainable Finance
Regular Master Thesis
Maastricht, August 10, 2021

Thesis supervisor: Dr. Paul Smeets
Authors Mail: m.dufauredelajarte@student.maastrichtuniversity.nl

Abstract

This thesis contributes to the understanding of the industry-specific materiality of carbon emissions and its impact on portfolio performances. The results of this study are important for investors because in past academic papers, a (financial) carbon emissions premium has been identified (Bolton & Kacperczyk, 2019; Garvey et al., 2018; In et al., 2019), but this premium could vary depending on the industry. The portfolio and regression analysis examine returns of portfolio screening strategy, which consists of a 25% best in class threshold, based on MSCI's Environmental, Social, and Governance (ESG) and carbon emissions ratings obtained from the FactSet database. The results show that there is no major difference in financial performance between the screened portfolios and their unscreened counterparts. The findings implicate that non socially responsible investors do not have an incentive to screen for ESG or carbon emissions ratings, as they are not financially rewarded for it. However, the carbon emissions portfolios minimally outperformed in the portfolio analysis (cumulative return, average return, Jensen's alpha, and Sharpe ratio), which could indicate that the carbon emissions issue is on the verge of becoming material. Therefore, future research could focus on the date and the intensity of the upcoming carbon emissions materialization, taking industry-specific materiality into account.

Table of Contents

List of Abbreviations

ESG Environmental, Social, Governance

MSCI Morgan Stanley Capital International

SASB Sustainability Accounting Standards Board

Introduction

In recent years the Environmental, Social, and Governance (ESG) factors have gained much attention. This can be seen in the increase in spending on ESG data, which has grown from 200 million dollars in 2014 up to (expected) 745 million dollars in 2020 (Pierron, 2019). The majority of global institutional investors now include ESG factors in their investment strategy (FTSE Russell, 2018). This trend is mainly due to the increasing number of academic papers which promote the knowledge on ESG screening having a positive impact on financial performance (Eccles & Klimenko, 2019). With the article of Khan et al. (2016) a new element has entered the field of ESG investing: materiality.

While ESG materiality often refers to the 'importance' or 'impactfulness' of ESG factors on financial performance on an overall, global, and industry-wide basis, Khan et al. (2016) define individual ESG factors to be material or not, depending on the industry. They find that "that firms with good ratings on material sustainability issues significantly outperform firms with poor ratings on these issues. In contrast, firms with good ratings on immaterial sustainability issues do not significantly outperform firms with poor ratings on the same issues." (Khan et al., 2016). This more nuanced approach towards materiality is further developed by Steinbarth (2018) and van Heijningen (2019), who significantly improve the financial performance of portfolios by screening companies for a few but material ESG factors.

The nonprofit organization *Sustainability Accounting Standards Board* (SASB) has become the main entity to assess materiality. The SASB developed a materiality map in which it presents sector and industry-specific material sustainability-related business issues, and draws a clear line between material and generic ESG issues for each sector and industry. One of its 26 sustainability-related business issues is greenhouse gas emissions, of which carbon emissions make up the most important part.

Carbon emissions are one of the most important pollutants released in masses through human activity since the industrial revolution and have become a key driver of climate change. There are several ways through which a company's carbon emissions can impact its financial performance. The most important one is government regulations. The majority of governments have recognized the threat climate change is to humanity and have pledged in the 2015 Paris Agreement to reduce their carbon emissions. Their key tools are regulations through which governments impose on domestic companies to reduce their carbon emissions. But there are also other ways through which carbon emissions can impact financial performance. Climate change has become a major topic discussed on various public media, which has led to an increase in public attention and consumer sensitivity towards the issue of carbon emissions. Investors, therefore, must account for more risk factors, as companies could perform worse due to their non-adaptiveness to government regulations and public opinions. This could at best mean that investors do not receive any return on their investment anymore; at worst, assets lose (the entirety) of their value and leaves the investor stranded. To compensate for this risk exposure, investors do demand a return premium (Bolton & Kacperczyk, 2019), which can become costly for firms. In contrast, companies that look ahead and prepare for risks stemming from carbon emissions regulations and opinions could gain a strategic advantage as a carbon emissions issue leader, as they face lower risk from regulations and are publicly better perceived. Even if carbon emissions issue leaders have equal returns to their industry peers, their lower risk properties could lead to higher risk-adjusted returns (In et al., 2019), which is interesting for investors.

Following the aforementioned definition of Khan et al. (2016) on materiality, all companies should be impacted by the carbon emissions issue differently, depending on their industry. The oil and gas, air transport, and electric utilities industries should be more impacted by the carbon emissions issue than the financial service and entertainment industries, as their (oil and gas, air transport, and electric utilities industries) companies are prone to emit higher amounts of carbon emissions and have greater difficulties in reducing them without reducing business activity. Firms; from industries where carbon emissions are a material issue; that have managed to cut a large amount of their carbon emissions should have a strategic advantage as they avoid external costs, e.g. stemming from governmental regulations. Industry laggers, in contrast, should have difficulties catching up with the leaders, as the laggers face external and improvement costs simultaneously. This should further stress carbon emissions' impact on a company's risk and return characteristics, which should be important to investors.

While many academic articles have discussed the effect of ESG and carbon emissions screening on portfolio performance (Bolton & Kacperczyk, 2019; Cohen et al., 1997; Derwall et al., 2005; Eccles et al., 2016; Garvey et al., 2018; Ghoul et al., 2021; In et al., 2019; Nagy et al., 2016; NN Investment Partners & European Centre for Corporate Engagement, 2016; RobecoSAM SI Research & Development and Robeco Quantitative Strategies, 2014; Trinks & Scholtens, 2017), few have covered the topic of materiality on an industry and company level (Consolandi et al., 2020; Khan et al., 2016; Steinbarth, 2018; van Heijningen, 2019) focusing on a multiple number of ESG issues. No paper has jet covered industry-specific carbon emissions materiality, i.e. how much does the impact of the carbon emissions issue on risk and return change between an industry portfolio where carbon emissions are a non-material issue and an industry portfolio where carbon emissions are a material issue? Could industry-specific carbon emissions materiality lead to better or worse performing portfolios?

To better understand this topic, this thesis discusses the following main question: Between ESG and carbon emissions, which screening method provided the best portfolio with the highest financial performance, and could this performance be attributed to materiality?

The research of this paper is based on two stock universes, one being the utilities sector and the other being the electric utilities industry. According to the SASB's materiality map, carbon emissions are a minor material issue for the utilities sector, because it consists of a broad range of electric, water and gas utility companies which each face different material issues. For the electric utilities, however, carbon emissions are a major material issue. Therefore, in the portfolio analysis, the measured risk-return contrast between the two stock universes' portfolios should provide an indication of the presence of materiality and the extent of its impact on portfolios' risk and return. Furthermore, regression analysis should provide knowledge on the significance of the portfolio analysis results and further insights into the relationship between ESG or carbon emissions ratings and financial return.

The data of this research is downloaded from the FactSet website, from which monthly closing prices and semesterly ESG and carbon emissions ratings from the companies of the two stock universes are retrieved. The research covers the period of May 2013 to April 2021, which allows obtaining insights into the portfolios' performances during the covid crisis.

In the pages that follow, the literature gap that this thesis attempts to fill is explained in greater detail, covering current academic articles on ESG, environmental and carbon emissions screening, as well as the state of knowledge on materiality, according to Khan et al. (2016). Then the data and methodology approach are presented in detail on their structure, advantages, and weaknesses. The results chapter shows no major performance difference between the screening methods in the portfolio analysis, and the regression analysis finds only non-significant relations between ESG or carbon emissions ratings and financial return. Therefore, in the discussion and conclusion chapters, it is argued that the carbon emissions issue has not yet materialized, but soon could be.

Literature

This chapter discusses academic articles which analyse the three main components of this thesis: ESG and environmental screening, and materiality. The first two sections focus on findings related to ESG and environmental factors in the field of finance, after which the link to materiality, and its importance for an efficient implementation of the aforementioned factors, are reviewed. In the concluding section, the gap carbon emissions screening and materiality is identified, and the research questions of this paper are defined.

ESG screening

When it comes to ESG screening, the findings of academic articles differ. Several articles conclude that stocks (Ashwin Kumar et al., 2016; Clark et al., 2014; Eccles et al., 2014; Friede et al., 2015; Morgan Stanley, 2015; Velte, 2017) and portfolios (Eccles et al., 2016; Nagy et al., 2016; NN Investment Partners & European Centre for Corporate Engagement, 2016; RobecoSAM SI Research & Development and Robeco Quantitative Strategies, 2014) when including ESG criteria did outperform their traditional counterparts. For stocks, this would appear through higher returns (Eccles et al., 2014; Morgan Stanley, 2015; Velte, 2017) and/or lower risk (Ashwin Kumar et al., 2016; Eccles et al., 2014; Morgan Stanley, 2015). In addition to that, Eccles et al. (2014) mention that high sustainability companies exhibit higher stakeholder engagement, more long-term orientation, and higher measurement and disclosure of non-financial information. Investors could therefore benefit from incorporating ESG scores in their portfolio strategy, as it would ease the identification process of well-performing stocks. This can be of advantage in emerging markets that are defined by restricted information accessibility. This is highlighted by the NN Investment Partners & European Centre for Corporate Engagement (2016) report that found high ESG portfolios to outperform their ESG lagging portfolio in emerging markets. In developed markets, results are more ambiguous. Based on 2000 companies from the developed markets, RobecoSAM (2014) develops for each industry a sustainability leader portfolio, with the 20% most sustainable companies, and a sustainability lagger portfolio, with the 20% most unsustainable companies, and concludes that the sustainability leader portfolio proved to be the most efficient in each industry. Eccles et al. (2016) confirm RobecoSAM's (2014) finding when using a developed market portfolio with a 10% best in class threshold, but when applying a 25% best in class threshold, the portfolio underperforms through slightly lower return than the unscreened portfolio.

This is further underlined by (Ghoul et al., 2021), who obtained opposing results in their recent research, for which they decomposed mutual fund portfolios into socially responsible (green) and non-socially responsible (brown) parts. They found that the socially responsible part demonstrated lower raw return, lower risk-adjusted return, and a lower Sharpe ratio. The magnitude of these underperformances is, however, limited. Trinks & Scholtens (2017) go a step further by arguing that screening out controversial stocks may reduce financial performance. In their paper, they conclude that controversial stocks generally provide higher risk-adjusted returns, which could be explained by investors demanding compensation for their exposure to ESG related risks. This could explain the underperformance of Eccles et al.'s (2016) 25% best in class threshold portfolio, as too many controversial but well-performing companies are excluded.

Looking at two meta-studies from Clark et al. (2014) and Friede et al. (2015) the overarching conclusions appear clearly. Reviewing more than 200 studies, Clark et al. (2014) obtain a positive correlation between good sustainability practices and economic performance for both companies and investors: "88% of reviewed sources find that companies with robust sustainability practices demonstrate better operational performance, which ultimately translates into cashflows. […] 80% of the reviewed studies demonstrate that prudent sustainability practices have a positive influence on investment performance" (Clark et al., 2014). Friede et al. (2015), who analyse about 2200 studies dating back to the 1970ies, find similar results, with "roughly 90% of studies find a nonnegative ESG–CFP relation. More importantly, the large majority of studies reports positive findings" (Friede et al., 2015). To conclude, as shown above, the opinions and findings of many academic researchers differ upon the financial performance of ESG screening. When looking at the meta-studies, it is, however, clear that most of the papers identify positive results between ESG screening and financial performance.

Environmental screening

Here again, the findings of academic research differ strongly, also because, contrary to governance or social factors, the way environmental factors can impact financial performance is more intangible and related to external norms created through regulations, media attention, industry standards, customer sensitivity, etc. as described by Flammer (2013). This intangibility may also be the reason why Velte's (2017) findings describe environmental factors to have a weaker impact than governance factors on companies' financial performance.

When evaluating the relationship between environmental and financial performance, two academic articles based on portfolio analysis should be considered. The older one written by Cohen et al. (1995) compares two portfolios, the "environmental leaders" against the "environmental laggers", and concludes that the "environmental leaders" portfolio either similarly performed or outperformed its counterpart over the 1987 - 1990 period. The categorization of a firm being a leader or a lagger is based on environmental performance data consisting of nine different measures ranging from the volume of toxic chemical release to the number of oil spills. The more recent piece of research written by Derwall et al. (2005), also develops two portfolios, a high eco-efficient, and a low eco-efficient, based on Innovest Strategic Value Advisors' corporate eco-efficiency scores. They conclude that the high eco-efficient portfolio produced significantly higher average returns than its counterpart over the 1995 - 2003 period. Investors should monitor the environmental score of their investments over time as norms change. When investments lead ahead of environmental norms, it creates an additional return and exhibits lower risk stemming from news on environmental issues, which Flammer (2013) describes as using environmental CSR as a resource. When investments, however, lag behind environmental norms, negative environmental news becomes more harmful and catching up more difficult, as common eco-friendly initiatives are less rewarded.

And how do firms generally perform when screened solely by carbon efficiency? As this is a key factor, this thesis focuses on. To answer this question In et al. (2019) developed a carbon efficient-minus-inefficient (EMI) portfolio based on 736 US public firms over the period of 2005 to 2015, in which carbon efficiency was defined as revenue-adjusted greenhouse gas (GHG) emissions at firm level. Their results are that carbon-efficient firms tend to be those with lower book-to-market ratios, higher free cash flows and cash holdings, higher coverage ratios, lower leverage ratios, higher dividend payout ratios, and because the EMI portfolio produces a large positive cumulative return after 2009, the authors suggest that carbon-efficient firms outperform carbon-inefficient firms in the stock market. Environmental efficiency should be considered as "a cost-saving and risk-mitigation instrument and source of market competitiveness in a rapidly changing world and climate" (In et al., 2019). A similar study by Garvey et al. 2018 also supports the notion that portfolios that rank stocks by emission intensity produce positive alpha. Both studies, however, have an important weakness, as lined out by Bolton & Kacperczyk (2019): They do not control for industry, firm characteristics, and known risk factors.

Bolton & Kacperczyk (2019) find, in contrast, different results. Using a standard cross-sectional analysis, they search whether carbon emissions affect cross-sectional US stock returns. For comparability reasons, they also measure carbon emissions by emission intensity like In et al. (2019) and Garvey et al. (2018), but also by the total level of emissions and the year-by-year change in emissions. This allows for more nuanced results. Their main conclusion is that carbon emissions positively affect stock returns when controlling for the total level of, and the year-by-year change in emissions. But no relation could be established to emissions intensity, used in the studies of In et al. (2019) and Garvey et al. (2018). The authors argue that as carbon intensity is a ratio, "it is likely to be a noisier metric of carbon risk exposure" (Bolton & Kacperczyk, 2019). They also find that the carbon premium has only materialized recently, most probably with the Paris Agreement in 2015, which is in line with the explanation that "investors are already demanding compensation for their exposure to carbon emission risk" (Bolton & Kacperczyk, 2019). This is further emphasized by Krueger et al.'s (2020) survey results: While institutional investors do believe carbon risks to be a material risk, they do not believe that this risk is generally under-priced. In some sectors although, such as the oil or electric utilities sector, equities are thought to be overvalued and not fully reflecting the risks from climate change. Investors, however, believe these overvaluations not to be very large.

To conclude, at first sight disinvesting from stocks with low or decreasing environmental scores, and investing in stocks with high or increasing ones, initially appeared to be an ideal addition to every investor's portfolio strategy. A recent study has, however, pulled attention to an emerging carbon price premium. Screening controversial, carbon-emitting companies out could therefore lead to underperforming portfolios.

Materiality

Materiality is an element that has recently entered the field of ESG investing. The nonprofit organization *Sustainability Accounting Standards Board* (SASB) has become the main entity to assess materiality, and many researchers base their findings on SASB's data (Consolandi et al., 2020; Credit Suisse, 2016; Grewal et al., 2021; Khan et al., 2016; Steinbarth, 2018). SASB develops a framework in which it classifies ESG issues and provides, most notably through its materiality map, knowledge about which issues are material to which economic sectors or industries.

The first academic study to prove the importance of materiality was conducted by Khan et al. (2016). Using a sample of 2307 companies, they find that companies that focus on having good ratings on material ESG issues, all while neglecting immaterial issues, "significantly outperform firms with poor ratings on these issues and those that perform well on both material and immaterial issues" (Khan et al., 2016). This shows that for a company identifying material ESG issues is essential, as it should avoid wasteful spending on issues that do not provide any return and could enhance investments in those issues that contribute to the company's financial performance.

Further, more recent studies have been made, supporting the importance of materiality in ESG screening. Using ESG data from RobecoSAM in combination with a large sample of international companies from the years 2005 to 2017, van Heijningen (2019) finds that screening portfolios for average material ESG scores provided significantly higher excess returns and that an accurate understanding of a firm's material ESG performance does improve the predictability of financial returns. To continue, Consolandi et al. (2020) focus on the nuances of materiality, as it is said in their article's title "how material is a material issue?". Using the classifications of materiality provided by SASB on a large sample of US companies from January 2008 to July 2019, Consolandi et al. (2020) determine "the equity premium of listed companies is better explained by the concentration of material issues (i.e., the Gini index) than by the ESG momentum" (Consolandi et al., 2020). Their conclusion is that covering fewer material issues but financially more important ones is rewarded by the market. Steinbarth (2018) further emphasizes that not all ESG issues are equal. Based on SASB's framework, she determines that "less than 25% of data items in traditional ESG scores are considered material for two-thirds of all securities in the Russell Global Large Cap Index universe" (Steinbarth, 2018). Based on issues that are part of 'traditional' ESG scores from Sustainalytics and selected for their materiality characteristics defined by SASB, Steinbarth (2018) develops the Russell Investments ESG scores, with which she obtaines significant portfolio performance improvements.

To recapitulate, all research papers clearly show that materiality is an essential element of ESG investing, as it tells investors to concentrate on a few but material issues which determine the success of an investment. Focussing on non-material issues should not only be considered as a waste of time and money but could also lead to misleading results and, therefore, to underperforming portfolios.

Literature gap and research questions

As presented above, many studies have participated in the debate about the financial performance of ESG, environmental or carbon emissions screened portfolios, and have come to conflicting conclusions. In contrast, the role of materiality in those screenings appears to be clear, as all major academic findings pinpoint to the same positive results. This may, however, also be due to the recency of this subject, as still few academic papers have been written about materiality, and in the future new ones with contradicting findings could emerge.

While there has been much research in ESG, and trimming ESG scores down to their material components, none has verified in greater detail the materiality of carbon emissions per se. Aforementioned articles covering carbon emissions screening have analysed this issue on a global scale and have not paid attention to different industries' and sectors' financial performances, which should vary according to materiality. Till now, the SASB is the main entity that defines carbon emissions as material for industries such as air and road transport, meat and agriculture, electric utilities, etc. While it does state that these assumptions of materiality are based on academic research, it does not publicly show its research, nor does it refer to publicly available sources.

In the context of global warming, understanding carbon emissions' materiality should be of utmost interest to investors as investments could get stranded (Krueger et al., 2020) due to upcoming carbon emission regulations and other external norms as described by Flammer (2013). Following this logic, sustainable firms should show adaptability to new environmental standards and a capability to implement new technologies, should they belong to industries that are exposed to carbon emissions' risk. Investors also should develop an understanding of which industries are the most exposed to carbon emissions risk and pay attention to the carbon emissions performance of their investments to maintain a sustainable portfolio.

How would such a carbon emissions screened portfolio perform compared to one screened by 'traditional' ESG scores, especially when including the element of materiality? Would a carbon emissions screened portfolio outperform in a universe in which it is considered to be material?

These are the main questions that will be discussed in this thesis. To answer them, the two screening criteria, ESG and carbon emissions, are applied to two stock universes, the utilities sector and the electric utilities industries, using a 25% best in threshold. Additionally, for benchmarking purposes, two non-screened portfolios representing each stock universe are made. The choice of using the utilities sector and the electric utilities industry is linked to SASB's materiality map. It identifies carbon emissions to be a material issue for the electric utilities industry, which isn't the case for the water and gas utilities. For the utilities sector carbon emissions is, therefore, a material issue among others.

Should ESG and carbon emissions screened portfolios perform worse than their unscreened counterparts, then this could indicate that the controversial stocks, which are screened out, are providing higher returns, as investors demand compensation for the higher amounts of risk they take (Bolton & Kacperczyk, 2019). Should carbon emissions portfolio underperform more than the ESG portfolio in the electric industry universe, then this could indicate that firms with low carbon emissions ratings, which are screened out, are providing much higher returns, as investors want to be compensated, not for a generic, but for a material risk.

Should ESG and carbon emissions screened portfolios outperform their unscreened counterparts, then this could underline that for a company doing well on intangible factors does impact financial performance positively. This may not necessarily be due to higher returns, but rather due to lower risk exposure, which leads to higher risk-adjusted returns, as described in Eccles et al. (2016). Should the carbon emissions portfolio outperform the ESG portfolio in the electric industry universe, then this could be due to materiality. Should the ESG portfolio outperform in one of the stock universes, then this could indicate that the ESG score is composed of a concentration of material ESG criteria, as described by Consolandi et al. (2020).

Should all portfolios perform similarly, then a relation between the screening methods, materiality, and financial performance cannot be determined. The factors may be too intangible to have an impact on a firm's, and therefore on a portfolio's, performance. Another reason could be that the carbon emissions issue has not yet become material for the electric utilities sector. And the ESG score could be composed of too many unmaterial, generic criteria.

Data

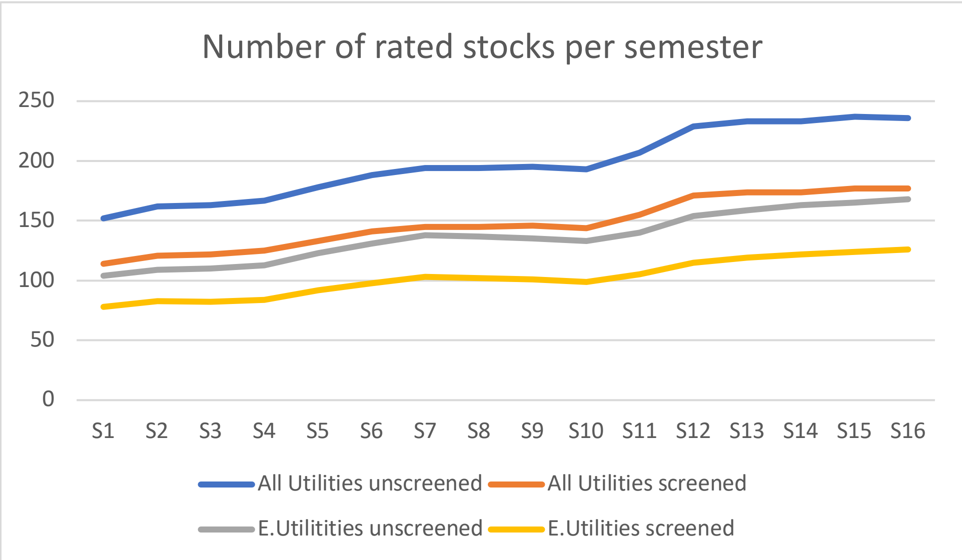
As mentioned in the literature chapter, the data about materiality is based on SASB's materiality map. Initially, this choice was out of pure practicality, as the map is publicly available, well categorizes ESG issues, and clearly presents which issues are material to which industries, which allows the viewer to easily understand the bigger picture. Credit Suisse (2016), which compares SASB's framework to MSCI's; which is SASB's biggest concurrent in the field of sustainability materiality; finds that SASB's framework outperformed MSCI's by 27.8 percentage points providing higher portfolio performance, which further strengthened the choice of using SASB's materiality map.

For the two stock universes, global data from May 2013 to April 2021 is retrieved from the FactSet webpage. While the utilities sector universe is based solely on FactSet's RBICS Utilities, the electric utilities industry universe is based on a multitude of datasets (Appendix1), which is due to FactSet not offering one single dataset for all industries belonging to the electric utilities industry. While most datasets are named quite forwardly, such as 'International Electric Utilities' and 'Alternative Power Generation', other are less precise, containing the term 'Wholesale Power'. Wholesale power refers to producing and selling large amounts of energy products in bulk, may it be electricity, gas, steam, etc. (Chen, 2021). The FactSet RBICS matrix, however, defines wholesale power as "companies which generate and or sell electricity to other utilities and/or to large industrial customers" (see the first slide of the excel docs), and does not mention other energy products. Furthermore, the dataset 'Other Electric and Natural Gas Utilities' is excluded, as these companies provide a mixture of utility services.

To maintain a good overview over the data, the datasets are broken down into semesters, starting either on the 1st of May or 1st of November. Next to standard variables, such as companies' names or the stock exchange they are traded on, each semester dataset contains valuable non-financial and financial variables. Non-financial variables are ESG and carbon emissions ratings, the exchange region, and the industry, while financial variables are the closing prices of the first day of the semester followed by monthly closing prices at the end of each month, and annual dividends.

The ESG and carbon emissions ratings are provided by MSCI. The ESG ratings are ranked from AAA, being the best, to CCC, being the worst. The ranking describes a company's performance in the most significant ESG risk and opportunities important in its industry compared to its peers. This shows that MSCI has already adapted to the new element of materiality and has actively chosen to exclude generic, non-industry-specific ESG issues in its ranking. The ESG screening could therefore provide better performing portfolios if MSCI managed to concentrate on the correct material issues. The carbon emissions ratings are ranked similarly from 10, being an industry leader, to 0, being an industry lagger. The carbon emissions rankings are relative to the standards and performance of a company's industry peers. But following the definition of materiality, being a leader in the water or gas utilities should not be valued as much as being a leader in the electric utilities, as companies do not face the same risks or opportunities. A carbon emissions screened portfolio should shine in the electric utilities universe, as it can only pick from companies for which carbon emissions are material, while in the utilities sector, it can pick between various carbon emission leaders, but not all may lead in an issue that is material to them.

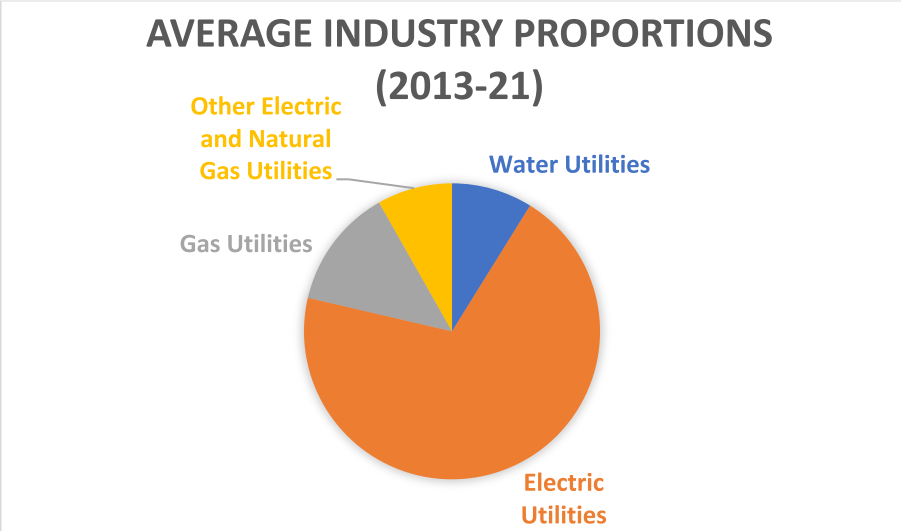
With the ESG and carbon emissions ratings also arises a major limitation in the data: Only a few companies have one. Just to give an example: For May 2013, FactSet's RBICS Utilities contains 2424 stocks. Only 152 are ESG and carbon emissions rated, a mere 6.27%. In the pre-2013 period, a sharp drop-off in rated stock is noticeable. Till 2021 the number rises to 237, representing 9.78% of all utilities stocks. This is in line with Pierron (2019), who finds that investing in ESG has increased substantially from $200 million in 2014 to an expected $745 million in 2020. The electric utilities database has even fewer rated stocks, as can be seen in the chart below (Appendix2*).



*After having cleaned out stocks with incomplete data.

Due to the screening process, this can lead to semesters in which the electric utilities portfolio contains less than 100 stocks, which is especially persistent in the 2013 to 2016 period. This could pose problems as the analysis could lead to meaningless results. Further, a limited number of stocks (4) have to be eliminated for the entire study period as they would trade for 0€, and 11 have to be eliminated for when over the semester the closing prices became unavailable. Last of both is due to the lack of knowledge of what happened to those firms. They may have filed bankruptcy or may have gone private, two outcomes that financially have two very different consequences for investors.

Another weakness in the data could arise from the proportions between electric, water, and gas utilities in the utilities sector datasets. Over the study period, on average electric utilities made up 69,79% of the utilities sector, followed by gas utilities with 13,15% and water utilities with 8,84%. Companies that offer a mix of electric and gas utilities make up 8,21% (Appendix3)



This could become problematic as the utilities sector dataset could potentially not differ enough from the electric utilities dataset, and therefore obtain very similar results. Therefore, before analysing the results in the following chapters, the industry proportions made through the screening processes will be looked upon. This is done to assure that, in the worst case, the electric utilities do not completely replace the other utilities. In the best case, the other utilities gain a little in terrain.

As global data is being used for this analysis, a further variable is added to the datasets, containing the geographical location of the companies. Before presenting the results, it will be interesting to know how the screening methods impact the regional diversification of the portfolios. Furthermore, this allows to make two important indexes: A global market index and a global risk-free index. Instead of using one standard common index, like the S&P500, which would only be representative of the US, this would allow to create a global market index. By using a multitude of MSCI's market indexes (MSCI North America (990200), MSCI EM Latin America (892000), MSCI Europe (990500), MSCI FM Africa (MS136617), MSCI EM Asia (899700), MSCI Pacific (990800), MSCI Europe & Middle East (999902)) retrieved from FactSet's database, it is possible to construct a market index that represents the geographical proportions of the stock universes, on a monthly basis. For example, the utilities sector universe consists in the month of May 2013 to 46,71% of stocks from North America, to 9,87% of stocks from South America, etc. Hence the global market index consists to 46,71% of MSCI North America, to 9,87% of MSCI South America, etc. Same is applied to the global risk-free index, using ten-year government bonds from major economies (North America: 10Y US Gov. Bond Yields, South America: 10Y Mexico Gov. Bond Yields, Europe: 10Y EU Area Gov. Bond Yields, Africa: 10Y South Africa Gov. Bond Yields, Asia: 10Y South Korea Gov. Bond Yields, Pacific: 10Y Australia Gov. Bond Yields, Middle East: 10Y Israel Gov. Bond Yields) which represent their respective region. The choice of a specific bond depends on the data availability and on the return rate, as these should not be too high nor too low, as to be representative of the broader geographical area. This is especially difficult for Asia, as no data is available for China, Japan's risk-free rate is too low to be representative of most emerging countries, and India's risk-free rate is too high for most developed countries. The final choice falls on South Korea, as it has a well in between risk-free rate (following the Goldilocks principle). The data is retrieved from the Federal Reserve Economics Data webpage.

Finally, for the Carhart 4 factor model, the monthly data of the Fama French 3 factors and Carhart's momentum factor is downloaded from the MBA Fama French website. The data represents the developed market (North America, Europe, Japan, Asia, and Pacific), which is the best option as there is no global data, but it is far from being the optimal explanatory data, considering that the stock universes consist to a certain amount of emerging market companies. Another limit is that according to Griffin (2002), Fama and French's developed market factors provide an inferior explanation of time-series variation in stock returns than the country-specific ones. Hence, both weaknesses may lead to insignificant or misleading results.

Methodology

Regression analysis and portfolio analysis are two common quantitative methods to evaluate the relationship between ESG/environmental and financial performance. However, In et al. (2019) identify two important issues with the regression analysis approach: Firstly, due to inconsistent environmental performance data, it can be difficult to obtain a significantly large sample. Secondly, determining causality in the observed correlation remains complicated as other factors could explain the regression analysis' result.

Therefore, the initial choice for the methodological approach of this master thesis was based on portfolio analysis, using Eccles et al. (2016) as guidance for the development of this thesis' methodology and result interpretation. Six portfolios are developed, 3 representing the utilities sector as a whole and the other 3 representing the electric utilities in specific. For the utilities sector, as for the electric utilities industry, one portfolio (the All-(Electric-)Utilities portfolio) includes all stocks available for this analysis of the respective sector or industry, while the other two portfolios are screened respectively using either ESG or carbon emissions ratings.

Two common ESG strategies are the ESG 'Tilt' strategy, which consists of "overweigh[ing] stocks with higher ESG ratings" (Nagy et al., 2016), and the ESG 'Momentum' strategy, which consists of "overweight[ing] stocks that have improved their ESG rating over recent time periods" (Nagy et al., 2016). Following Eccles et al.'s (2016) approach, a best-in-class threshold of 25% (the bottom 25% are excluded) is applied to the ESG and carbon emissions screened portfolios, which are sorted according to the Tilt strategy.

The investment universes are rebalanced twice a year (on the 1st of May and on the 1st of November), and for practicality, they are assumed to be the starting point for fund managers to do their stock selection based on present ESG and carbon emission indicators. The stock universes are hence divided into semesters, as already mentioned in the Data chapter. Within a semester, the stocks will be fix, as the hypothetical portfolio managers will only rebalance their portfolio every six months. Between the semesters, the stock universe will vary, as more companies are being ESG and carbon rated, from which the portfolio managers thus can pick from, and at the same time, other companies go private or bankrupt and henceforth disappear.

In order to compare the performance of the portfolios, they all start with 1000€ on the 1st of May 2013. With this capital, a fraction of the market is bought. The market differs as different screening methods are applied. With the investable capital, equal fractions from each stock are bought. In the case of the carbon emissions screened electric utilities portfolio, the fraction is ~0,81, as the carbon emissions screened market is ~1230,81€ worth, and in the case of the unscreened electric utilities portfolio the fraction is ~0,58, as the unscreened marked is worth ~1701,54€ worth. Over the next month, market value will grow or shrink, which will determine if the portfolio's value grows or shrinks, and the fraction translates the market value into the portfolio's value. For example: The carbon emissions screened electric utilities portfolio has a fraction of ~0,81. The carbon emissions screened market falls from ~1230,81€ to ~1167,24€, which means that the portfolio also falls from 1000€ to 948,35€ (=1167,24€ * 0,81). This works well, as there has been a stock selection at the beginning of the semester, and the study follows the value evolution of these stocks on a monthly basis.

Annual dividends are spread equally over the year, as to incorporate them in the study, but without adding unnecessary return volatility. They are reinvested monthly, and together with the main investment capital, which means that a new fraction must be calculated every month, now based on the market value at the end of the month (31 of May) (look at Appendix4 for better understanding). This cycle is repeated throughout the semester.

In the next semester, after the screening and overweighing of the stock universe following the Tilt strategy, the remaining amount from the previous semester is reinvested on the 1st of November (and later again on the 1st of May), similarly to the initial 1000€.

The returns on the investment are calculated at the end of each month, which allows to monitor the portfolios' performances over the study time. Several portfolio performance measurements are applied to obtain a well-founded understanding of their risk and return properties.

1st Cumulative return

"A cumulative return on an investment is the aggregate amount that the investment has gained or lost over time, independent of the amount of time involved." (Chen & Scott, 2020)

$$\frac{(Current\ Portfolio\ Value) - (Initial\ Portfolio\ Value)}{(Initial\ Portfolio\ Value)}$$

It allows to obtain a first, basic view of the portfolios' performances, which may, however, be misleading. The portfolio with the highest return may seem at first sight to be financially the most attractive, but as this measurement does not include risk factors, it may also be the riskiest one. Another weakness is that it only provides a momentary result, meaning that this measure does not describe well the assets return performance during the entirety of the study period. A portfolio may just have gained recently tremendous value, like the GameStop stock, and be on an extreme high, and may fall right after the study period ends. Therefore, the average return performance is more interesting, as it provides a better understanding of how a portfolio performed during the study period.

2nd Average Return

As this study covers portfolio performance, the geographic mean is used to calculate the average return. It provides a more accurate measurement of portfolio return than the arithmetic mean, especially when returns are volatile, as it considers compounding effects, which smooths the average. Furthermore, the geometric mean "is most appropriate for series that exhibit serial correlation—this is especially true for investment portfolios" (Hayes & James, 2020).

$$\mu\text{geometric} = [(1 + R1)(1 + R2) \dots (1 + Rn)]^{1/n} - 1$$

Where R1, R2, …, Rn are the returns of a portfolio. While the average return provides a better estimate of the return performance than the cumulative return, it may still be misleading, as it does not include risk characteristics.

3rd Correlation

Correlation is an interesting statistic as it allows to measure the degree to which the portfolios move in relation to each other and to the market. It provides a good overview of how the screening methods change a portfolio's return characteristics, thus enables the identification of diversification benefits stemming from the screening methods.

$$r = \frac{n \times (\sum(X, Y) - (\sum(X) \times \sum(Y)))}{\sqrt{(n \times \sum(X^2) - \sum(X)^2) \times (n \times \sum(Y^2) - \sum(Y)^2)}}$$

Where r = Correlation coefficient; n = Number of observations; X = Sum of all X values; Y = Sum of all Y values; X,Y = Sum of each X value multiplied with its corresponding Y value. The correlation is, however, not computed manually but by using the correlation function of excel's data analysis function.

4th Standard Deviation

This statistic measures the dispersion of a portfolio's return relative to its average return. A higher standard deviation indicates a higher dispersion from the mean return, which signifies that a portfolio exhibits higher risk characteristics. But the standard deviation isn't flawless, as its value can be impacted by outliers and extreme values. Even if these are positive abnormal returns, which is in the investor's favour, the standard deviation counts them as additional risk.

$$Standard\ Deviation = \sqrt{\frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n-1}}$$

Where x_i = Value of the i^{th} point in the data; $\bar{x}$ = The mean value of the data set; n = The number of observations. In the excel document, the standard deviation is calculated using the STDEV.S (for sample) formula. The sample version is used, as the data consists of a time limited, 2013-2021, dataset, and therefore does not cover the entire population, or time.

5th Maximum Drawdown

Eccles et al. (2016) describe maximum drawdown to be "[t]he maximum difference between a portfolio's cumulative return at any day and its previous maximum cumulative return" (Eccles et al., 2016). As this analysis is based on monthly data, it may be less precise. It allows, however, to obtain a further viewpoint on the portfolios' riskiness, and may be related to a certain event, such as the financial crisis 2008 or the covid pandemic, and could indicate the portfolios' performances during a major negative event.

$$MDD = \frac{Trough\ Value - Peak\ Value}{Peak\ Value}$$

6th Sharpe ratio

The Sharpe ratio puts the return of the portfolio into relation to its risk.

$$Sharpe\ ratio = \frac{R_p - R_f}{\sigma_p}$$

Where R_p = return of the portfolio; R_f = risk-free rate; σ_p = standard deviation of the portfolio. Subtracting the risk-free rate from the mean return enables to isolate the profits associated with risk-taking activities. For this, the first entry of the global risk-free rate (look up Data Chapter) is used. The reason for using only the first entry over a study time average is that it simulates the choice an investor has at the 1st of May between investing into a near riskless 10 year government bond or into the study's risky portfolios. By dividing the result by the standard deviation, the risk characteristics are included in the measurement. As this study uses monthly returns the volatility may be lower than when using daily returns, and therefore the Sharpe ratio may be smoothed out.

7th Beta

The beta coefficient measures the volatility of a portfolio compared to the systematic risk stemming from the overall market and hence describes the changes in returns of a portfolio relative to the swings in the market. The utilities sector is known to have low betas, which means that they are, in theory, less volatile than the market, which can be useful for investors (Kenton & Westfall, 2021).

$$\beta = \frac{Covariance(R_e, R_m)}{Variance(R_m)}$$

Where R_e = the return on an individual stock; R_m = the return on the overall market; Covariance = how changes in a stock's return are related to changes in the markets returns; Variance = how far the market's data points spread out from their average value. In the excel document, the beta coefficient is calculated using the slope formula, defining the global market index as the independent (x) variable and the returns of the portfolios as the dependent (y) variable.

8th Jensen's alpha

Contrary to standard alpha, which only refers to above benchmark returns, Jensen's alpha also includes a risk-adjusted component, which is based on the beta coefficient. It allows to check if the same conclusions as from the Sharpe ratio can be made.

$$\alpha = R(i) - (R(f) + \beta x\ (R(m) - R(f)))$$

Where R(i) = the realized return of the portfolio or investment; R(m) = the realized return of the appropriate market index; R(f) = the risk-free rate of return for the time period; β = the beta of the portfolio of investment with respect to the chosen market index. Similarly, as with the Sharpe ratio, the risk-free rate is set on the global risk-free rate's first entry.

9th CVAR95

The conditional value at risk (CVAR) method is used to define a portfolio's tail risk because it gives an average expected loss rather than a wide range of potential losses provided by the value at risk (VAR) method. It describes the "expected monthly return in the worst 5% of months" (Eccles et al., 2016), and is a further method to identify the risk characteristics of the portfolios.

$$CVaR = \frac{1}{1-c}\int_{-1}^{VaR} xp(x)dx$$

Where p(x)dx = the probability density of getting a return with value 'x'; c = the cut-off point on the distribution where the analyst sets the VaR breakpoint; VaR = the agreed-upon VaR level.

As discussed in the next chapter, the results from the portfolio analysis are many times very similar for all three screening methods. As the size of the impact of these often-small differences is difficult to determine, several regression analyses are done to determine the significance between different screening methods and portfolio performance. This is contrary to the initial choice of only including portfolio analysis, and the alteration was taken late in the development of the thesis paper. Hence the data, which is structured in a way to fit optimally to portfolio analysis, exhibits a major weakness in turn for the regression analysis: Semesterly ESG and carbon emissions ratings. Even though the returns are reported monthly, the portfolio's ratings are reported on a semesterly basis, as the stock selection takes place at the beginning of each semester. The study time consists of 16 semesters, which represents few entries to analyse for a regression analysis, which ideally should consist of a very high number of points. This could lead to insignificant results and low explanatory power.

1st Carhart four-factor model

The Carhart four-factor model captures the risk and return characteristics of four elementary equity investment strategies:

- The market factor, which consists of investing in high versus low market sensitivity stocks. The factor is composed of the value-weighted average return of major stock exchanges.
- The small minus big factor, which consists of investing in small versus large market capitalization stocks. The factor is calculated by taking the return of a portfolio of small-cap stocks minus the return of a portfolio of large-cap stocks.
- The high minus low factor, which consist of investing in value stocks (stocks with a high ratio of book to market value) versus growth stocks (stocks with a low ratio of book to market value). The factor is calculated by taking the return of a portfolio of value stocks minus the return of a portfolio of growth stocks.
- The momentum factor, which consists of investing in momentum stocks (stocks that outperformed in the recent past) versus contrarian stocks (stocks that underperformed in the recent past.

$$R_P - R_F = \alpha_p + \beta_M(R_M - R_F) + \beta_S R_S + \beta_H R_H + \beta_O R_O$$

Where $R_P - R_F$ = Portfolio excess return; $R_M - R_F$ = Market factor return; R_S = Size factor return; R_H = HML factor return; R_O = Momentum factor return; α_p = Portfolio risk-adjusted return; β_M = Portfolio market beta; β_S = Portfolio size beta; β_H = Portfolio HML beta; β_O = Portfolio momentum beta.

In the excel document, the regression is done through the data analysis regression function.

"[T]he betas of a portfolio are measures of the extent to which the portfolio return varies with the factor returns" (Heatter et al., 2009). For example, a momentum factor return impacts a portfolio with a momentum beta of 0.6 twice as much as once with a momentum beta of 0.3. It can therefore highlight a portfolio's risk characteristics, based on its excess volatility, and describe a portfolio's composition. For example: a positive high minus low beta could indicate that the portfolio much consists of value stocks, or at least of stocks that perform similar to value stocks.

Furthermore, it allows to compare the portfolio analysis' market beta risk and alpha return results to those from the regression analysis.

Using the residuals from the regressions, the idiosyncratic risk is calculated for each portfolio. Contrary to the market beta, which describes a portfolio's volatility, and therefore risk, stemming from the market, the idiosyncratic risk describes the risk that is related to the stocks of a portfolio. It is calculated using the standard deviation of the residuals.

2nd Tilt and momentum regression analysis

In this regression, correlations between semesterly ESG or carbon emissions ratings, the independent variables, and portfolio returns, the dependent variable, are searched for. The ratings are formed following the two strategies mentioned at the beginning of this chapter: ESG Tilt and ESG Momentum (Nagy et al., 2016). To ensure that any outperformance of the portfolios does not result from additional risk, the semester returns are in form of Jensen's alpha. While Tilt analysis focuses on 'how are ratings correlated with monthly returns', the Momentum analysis focuses on 'how are changes in ratings correlated with changes in monthly return'.

To enlarge the sample, the semester ratings and returns of both the screened and unscreened portfolios are put together in one dataset, for ESG and carbon emissions rating, respectively. Hence in the Tilt analysis, the datasets contain 32 points (=16semesters * 2). In the Momentum analysis, the datasets contain 30 points, as the momentum strategy consists of the change in ratings, and therefore the first entries of the screened and unscreened portfolios fall away.

Results

This chapter is divided into four sections: Industry and country proportions, return, risk, and risk-adjusted returns. Each section presents portfolio and regression analysis results, and if possible, compares them.

Industry and country proportions

	Water	Electric	Gas	Mixed Electric and Gas
ESG	6,23%	69,10%	14,65%	10,02%
CO2	7,07%	72,03%	12,86%	8,04%
All Utilities	8,84%	69,79%	13,15%	8,21%

All portfolios of the utilities stock universe have very similar proportions among the three industries. The highest deviation is in the electric industries, where the carbon emissions screened portfolio contains 2,92% more electric industry stocks than the ESG screened one. Therefore, should there be any outperformance, it should not be due to industry characteristics. In the later analysis the similarity between the two stock universes could lead to very similar results of in same screening methods.

Utilities Sector

	North America	South America	West Europe	East Europe	Africa	Asia	Pacific	Mid East
ESG	40,77%	9,89%	19,39%	2,80%	0,00%	21,77%	5,33%	0,05%
CO2	39,14%	10,77%	17,68%	2,70%	0,00%	24,19%	4,88%	0,64%
All Utilities	42,08%	8,57%	14,88%	3,13%	0,00%	26,50%	4,35%	0,48%

Electric Utilities

	North America	South America	West Europe	East Europe	Africa	Asia	Pacific	Mid East
ESG	37,85%	11,27%	19,65%	2,76%	0,00%	21,74%	6,73%	0,00%
CO2	39,25%	11,93%	18,87%	2,49%	0,00%	21,43%	5,89%	0,15%
All Electric Utilities	39,74%	9,67%	14,70%	3,45%	0,00%	26,82%	5,51%	0,11%

When looking at the geographical distribution some clear trends can be identified once the screening methods are applied. The strongest trends are the investment into Western Europe, which is up to 4,95% more than in the All (Electric) Utilities, and the disinvestment from Asia, which is up to 5,39% less than in the All (Electric) Utilities. This indicates that the stock universes have a lot of high ranked companies coming from Western Europe, and a lot of low ranked ones coming from Asia. It does not indicate that these companies provide a higher return, and the relation between ESG or carbon emission ratings and financial return is discussed in the next chapter, based on the results of the following three sections.

Return

Cumulative return

	Utilities Sector	Electric Utilities
ESG	123,21%	129%
CO2	129,60%	128,91%
All (Electric) Utilities	119,70%	125,52%

To begin with, all portfolios appear to have performed very well, as they more than doubled their initial investment value within 8 years. Looking at the results, one could easily be tricked into thinking that the unscreened All (Electric) Utilities portfolios had the worst return performance in both stock universes, while the screened portfolios provided some 3.39 to 9.90 percent more return, 5,07% on average, a relative small difference when spread over the study period of 8 years.

Average return (using the geometric mean)

	Utilities Sector		Electric Utilities	
	Monthly	Annually	Monthly	Annually
ESG	0,80%	9,95%	0,86%	10,69%
CO2	0,88%	10,95%	0,88%	10,91%
All (Electric) Utilities	0,84%	10,39%	0,85%	10,62%

The average return provides a different picture of the portfolios' return performances, in that the ESG screened portfolios perform slightly worse or similar as the All (Electric) Utilities. Returns differ very little, with monthly returns ranging from 0,80% to 0,88%, which leaves doubt if any portfolio really outperformed another one. On average, both stock universes appear to have performed similarly.

Tilt and momentum regression analysis

	Utilities Sector		Electric Utilities	
	Adjusted R Square	Coefficient	Adjusted R Square	Coefficient
ESG Tilt	0,0382	-0,0361	0,0185	-0,02912
CO2 Tilt	0,0160	-0,0144	-0,0094	-0,00949
ESG Mom	0,0380	89,67	-0,0044	-91,72
CO2 Mom	-0,0221	13,85	-0,0300	-171,54

***α=0.01; **α=0.05; *α=0.1

The regression analyses did not identify any significant relationship between the two ESG strategies and portfolio performance. The adjusted R squares are very low, or even negative, which indicates that in the Tilt strategy ratings have no (near zero) explanatory power on portfolios' semester returns, and that in the Momentum strategy changes in ratings have very no explanatory power on portfolios' changes in returns.

To conclude, no clear performance differences originating from the screening methods could be identified in the portfolio analysis, nor could a relation between ESG or carbon emissions ratings and financial returns be established.

Risk

Standard Deviation

	Utilities Sector		Electric Utilities	
	Monthly	Annually	Monthly	Annually
ESG	3,58%	12,40%	3,72%	12,88%
CO2	3,67%	12,71%	3,80%	13,16%
All (Electric) Utilities	3,71%	12,85%	3,85%	13,33%

The results for the standard deviation are very similar across all portfolios. In the electric utilities universe, the results are slightly higher which may be due to fewer stocks as compared to the utilities sector, and therefore lower diversification potential. This is however contrasted by the fact that the ESG and carbon screened portfolios have, through their screening process, fewer stocks than the All (Electric) Utilities portfolio but still exhibit lower standard deviation.

Correlation

Utilities Sector

	ESG	*CO2*	*All In*	*Global market index*
ESG	1			
CO2	0,986346	1		
All (Electric) Utilities	0,87657	0,87966	1	
Global market index	0,5223	0,502308	0,534489	1

Electric Utilities

	ESG	*CO2*	*All In*	*Global market index*
ESG	1			
CO2	0,993917	1		
All (Electric) Utilities	0,869477	0,867354	1	
Global market index	0,492859	0,45543	0,514455	1

Within the utilities sector and electric utilities stock universes all portfolios are highly correlated to each other, with the screened portfolios showing the highest correlations to each other. All portfolios have a correlation to the global market index that is lower than one, which indicates that they exhibit lower volatility than the market, and therefore are interesting diversification opportunities for investors who search to reduce their portfolio volatility. The utilities sector is known to have lower volatility than the market as their stock tend to move more slowly than market averages (Kenton & Westfall, 2021). The screening methods further decreased portfolios' market volatility, but only up to a maximum of 0.0591, and on average by 0.0312.

Beta

	Utilities Sector	**Electric Utilities**
ESG	0,494932	0,480864
CO2	0,487845	0,454123
All (Electric) Utilities	0,525035	0,519493

The market betas are calculated using risk-free excess return, while the correlations are based on the portfolios' and global market index's raw return. The beta results are similar to the results from the correlation. It underlines again that the All (Electric) Utilities is the most exposed to market volatility, while the carbon emissions screened portfolio is the least exposed. This linearity could be due to the similarity of the two stock universes.

Carhart four-factor model

	Utilities Sector		**Electric Utilities**		
	Adjusted R Square	Market Factor	Adjusted R Square	Market Factor	Small m Big Factor
ESG	0,11759	0,38333***	0,11612	0,39488***	-0,42270*
CO2	0,10905	0,37809***	0,13094	0,36236***	-0,47304*
All (Electric) Utilities	0,10630	0,36597***	0,10373	0,39636***	-

***α=0.01; **α=0.05; *α=0.1

In the Carhart four-factor model, only the market beta is significant in both stock universes, and the small minus big factor is significant for the electric utilities only. The adjusted R square is low, ranging from 0,104 to 0,131, which indicates that the market factor and the small minus big factor don't have much explanatory power on the portfolios' return performances. In other words, the (low) return volatility is due to other factors.

Contrary to the previous market beta results, the Carhart four-factor model's market factor does not show a clear linearity between screening and lower volatility. In the utilities sector the all utilities portfolio has the lowest volatility, while in the electric utilities industry it is the carbon emissions screened portfolio. The differences are however small again, and the low volatility is most probably due to industry characteristics.

In the electric utilities the small minus big factor is significant at an alpha of 0.1 for both screened portfolios. Fama and French developed the small minus big factor arguing that smaller companies outmatch larger companies in market capitalization return. The negative coefficients indicate that the screened electric utilities portfolios consist most probably of larger companies, and that in times where smaller companies excel, the portfolios will perform less well, while in times where big companies excel, the portfolios will outperform (Heatter et al., 2009).

Idiosyncratic risk – based on Carhart four-factor model residuals

	Utilities Sector	Electric Utilities
ESG	0,032729	0,034030
CO2	0,033186	0,035239
All (Electric) Utilities	0,034147	0,035479

The idiosyncratic risk for itself is difficult to evaluate, and the results should only be used for comparability. The results are low and very similar, with the ESG screened portfolios showing the lowest risk compared to the All (Electric) Utilities, and the electric utilities universe exhibiting slightly higher overall idiosyncratic risk than the utilities sector universe.

Maximum Drawdown (all in April-March 2020)

	Utilities Sector	Electric Utilities
ESG	-418,28€	-433,49€
CO2	-432,35€	-423,43€
All (Electric) Utilities	-416,52€	-439,12€
Global market index	-352,98€	-344,05€

The worst performing period of all portfolios is during the beginning of the covid pandemic. The electric utilities portfolio performed on average 9,63 € worse. Both stock universes, however, performed worse than the global market index. This is surprising, as the utilities sector provides products of first necessity, which even during a crisis should usually be consumed in normal amounts, and that previous results showed that both stock universes had a lower volatility than the market.

CVaR95

	Utilities Sector	Electric Utilities
ESG	-7,55%	-8,39%
CO2	-7,61%	-8,24%
All (Electric) Utilities	-6,10%	-9,03%

Here again very similar results are obtained. In the utilities sector the screened portfolios show a higher CVaR95 risk, in the electric utilities in contrast they show the lowest. The biggest difference is in the stock universe risk averages, as the electric utilities exhibit 1,47% more CVaR95 risk than the utilities sector.

Risk adjusted returns

Sharpe Ratio

	Utilities Sector	Electric Utilities
ESG	0,593381	0,624051
CO2	0,657041	0,626916
All (Electric) Utilities	0,606423	0,597521

Jensen's Alpha

	Utilities Sector	Electric Utilities
ESG	3,22%	4,07%
CO2	4,28%	4,50%
All (Electric) Utilities	3,41%	3,68%

Both Sharpe ratio and Jensen's Alpha show the same picture: The carbon emissions screened portfolios have the best risk-adjusted returns, while the ESG portfolio performs worst in the utility sector and all electric utilities portfolio performs worst in the electric utilities. Here the differences are small again with the carbon emissions screening method leading by 0.87% and 0.82% (Jensen's Alpha) compared to the unscreened portfolio.

Alpha from Carhart four-factor model

	Utilities Sector		Electric Utilities	
	Adjusted R Square	Alpha	Adjusted R Square	Alpha
ESG	0,11759	0,00475	0,11612	0,00487
CO2	0,10905	0,00490	0,13094	0,00534
All (Electric) Utilities	0,10630	0,00603	0,10373	0,00549

***α=0.01; **α=0.05; *α=0.1

The Carhart four-factor model does not identify any outperformance, as the alpha value (intercept) is not significant. It puts the validity of the portfolio analysis' alpha value into question.

Overall, in the portfolio analysis the results are mixed and do not differ enough between the portfolios to identify strong tendencies to outperformance. When looking at the cumulative return, average return, Jensen's alpha and Sharpe ratio, then a small trend can be found in which the ESG screened portfolio slightly underperforms in the all utilities stock universe and carbon emissions screened portfolio performs slightly better than its unscreened counterpart in both stock universes. The regression analysis results are mostly non-significant and show low explanatory power. Where they are significant, they conflict with the portfolio analysis' results. No portfolio has shown large under or overperformances to the other ones, and the overall conclusion is that the screening methods have no high impact.

Discussion

The discussion chapter begins with an evaluation of the findings on portfolios' performances. Based on these, implications on the presence of materiality are elaborated. After having answered the main research question, the limitations and weaknesses of the overall research design are presented, and recommendations for further research are stated.

Referring back to the main research question of this paper, one has to ask: Which screening method provides the best portfolio with the highest financial performance in each stock universe, and could this performance be attributed to materiality?

The results chapter did not identify any major differences in the risk and return characteristics between the portfolios. This contradicts the findings mentioned in the literature chapter, where authors detected positive portfolio performance from either ESG or carbon leaders (Cohen et al., 1997; Derwall et al., 2005; Eccles et al., 2016; Garvey et al., 2018; In et al., 2019; Nagy et al., 2016; NN Investment Partners & European Centre for Corporate Engagement, 2016; RobecoSAM SI Research & Development and Robeco Quantitative Strategies, 2014) or from laggers (Bolton & Kacperczyk, 2019; Trinks & Scholtens, 2017) for different reasons. In order to align with one of these two trends, the screened portfolios would have either needed to outperform their unscreened counterparts, hence supporting the notion that leader portfolios outperform, or underperform to their unscreened counterparts, hence supporting the notion that lagger portfolios outperform, as through the 25% best in class screening the portfolios excluded the either under or overperforming lagger companies. But as all portfolios of the same stock universe performed similarly, this paper cannot conclude that ESG or carbon emissions leaders or laggers make a portfolio perform better. Ghoul et al. (2021) find that socially responsible portfolios provide diversification benefits, which also isn't the case in this paper, as the screened portfolios are highly correlated with the unscreened ones.

Furthermore, the portfolios' performances appear to be driven by other factors, such as the industry, market, and composition. This can be seen through the average performance differences between the utilities sector and electric utilities industry portfolios, and the Carhart four-factor models' significant market and size (small minus big) betas.

Solely based on the conclusions of the first part of the discussion chapter, one could doubt that ESG and carbon emissions screening could impact portfolio performance. But what role could materiality play in these results? As mentioned in the materiality section in the literature chapter, ESG issues must be material to a company's industry to create financial outperformance.

In the data chapter is mentioned that a company's MSCI ESG score is based on its performances in the issues that are the most significant to its industry. This means that MSCI already included the element of materiality in its ESG scores. According to Consolandi et al. (2020) and Steinbarth (2018), the ESG premium is best explained through a few but material issues; hence the ESG screened portfolios had good opportunities to be the best-performing ones in both stock universes. But as the ESG screened portfolios never outperformed their unscreened counterparts, serious doubt could be drawn on MSCI picking the right issues to include in their ratings or simply picking too many generic ones, which then outweigh the material ones. At the same time, should MSCI indeed have picked material issues for its ESG ratings, then the concept of materiality in itself could be put into question.

Carbon emissions, conversely, is a single issue, and as it did not produce any major difference in portfolio performance, one can argue that it is not a material issue for the utilities sector, and more importantly, for the electric utilities. This contrasts with SASB's materiality map, which defines carbon emissions to be material for the electric utilities. But seen that in some measurements from the portfolio analysis (cumulative return, average return, Jensen's alpha, and Sharpe ratio), the carbon emissions screened portfolios performed better by a small margin, could indicate that it is on its way of becoming material, as external factors such as governmental regulations become more stringent. This is in line with Bolton & Kacperczyk (2019), who find carbon emissions to have become material only recently in 2017.

Overall, this research provides findings which contrast with those of other academic articles, creating a picture of lacking impact of ESG and carbon emissions screening, which also puts the notion of materiality into question. This should demotivate investors to apply ESG and carbon emissions screening when composing their portfolios, as these processes demand additional resources. ESG ratings must be bought or developed, and then applied, but as there is no financial premium, nor other benefits such as diversification properties, non-socially responsible investors are most likely to save these expenditures.

But the lack of outperformance could also be due to the research approach of this thesis. The first weakness and major difference from other academic articles is that this thesis is based on monthly returns and semesterly ESG and carbon ratings.

The problem with monthly returns is that it flattens out a portfolio's return volatility and thus reduces the risk that can be measured through portfolio analysis. Eccles et al.'s (2016) paper did not find any increases in return through ESG screening but significant reductions in risk, leading to increased risk-adjusted returns. Eccles et al. (2016) uses daily returns through which risk can be measured more precisely. The thesis lacks this level of precision, which might be the reason for the lack of major performance differences between the portfolios.

Semester-based portfolios are ideal for the portfolio analysis, but not for the regression analysis, as per portfolio only 16 points between ESG or carbon emissions ratings and portfolio performance are available. For comparison, Khan et al. (2016) had 2396 points between ESG scores and companies' performances for their regression analysis. The amount of data might be the reason why Khan et al. (2016) have been able to do a more precise analysis, with significant results regarding materiality. This thesis' tilt and momentum regression contained only 32 and 30 points, which are probably too few to do a well-founded regression analysis.

Furthermore, both stock universes are limited by the number of ESG and carbon rated stocks. This leads, for example, to the screened electric utilities portfolio containing less than 100 stocks for the first half of the study period, which might not be representative of the real electric utilities industry. This is a problem also identified by In et al. (2019) who find that empirical findings on the relationship between financial and environmental performance can vary between studies, because unlike financial performance indicators, ESG performance still has varying definitions and lacks standardization across companies, which further complicates access to large samples for portfolio analysis.

Another weakness may stem from the ESG and carbon emissions ratings themselves. Bolton & Kacperczyk (2019) could only identify a relationship between carbon emissions and financial performance when measuring carbon emissions by the total level of and the year by year change in emissions, while carbon intensity as in In et al. (2019) lead to insignificant results. This could also be the case for the ESG and carbon emissions ratings used in this thesis, as they are based on companies' performances relative to those of their industry peers. They, therefore, resemble more a 'relative' variable, such as carbon intensity, and less an 'absolute' variable, such as the total level of carbon emissions, which could lead to insignificant results as in Bolton & Kacperczyk (2019).

A final weakness in this research is the data used for the Carhart four-factor model. As mentioned in the data chapter, the developed markets data for the model is not fully representative of the stock universes applied in this thesis. Furthermore, Griffin (2002) finds that Fama and French's developed market factors provide an inferior explanation of time-series variation in stock returns than the country-specific ones. Other academic articles received significant results because they could use country-specific (four-factor) data which reflect the analysed stock universe much better, such as in Edmans (2011) who uses US specific four-factor data for his '100 Best Companies to Work For in America'. Therefore, better fitting data in the four-factor model could lead to more significant results in this thesis.

Self-criticism is important in each study, as it allows to evaluate the validity of the findings. As presented in the previous sections of this chapter, the thesis has several weaknesses and might therefore have received insignificant results, a problem which future research should avoid. Research through portfolio analysis should use daily return datasets, as to correctly assess the portfolios risk and return properties. Research through regression analysis should also be based on data which is more frequent than semesterly ESG or carbon ratings and returns. When applying the Carhart four-factor model it may be more interesting to use a country specific sample, as, aforementioned, it provides more significant results (Griffin, 2002). For example, one could regress a US sample of firms on the US four-factor dataset from the Fama and French website. If future research wants to focus on one country in specific, then the problem of low numbers of ESG and carbon ranked companies could arise. However, this could be bypassed by not solely focussing on one specific sector or industry, but by combining several industries where carbon emissions are considered to be a material issue.

Future research could also focus on the efficiency of different carbon emissions metrics, such as total level of carbon emissions, year to year change in carbon emissions, carbon emissions intensity relative to their revenue, output or size, etc, to further build out Bolton & Kacperczyk, (2019) work. It would allow for a better understanding of how to apply these metrics in different analysis approaches, in order to achieve significant results.

The change in carbon emissions materiality should be closely monitored, as the threat of global warming obtains more attention by the governments and the greater public. The findings of this thesis do not indicate any materiality of carbon emissions for specific industries, such as the electric utilities industry, nor for a broader section of the market, such as the utilities sector, however this could change soon. Future research could focus on when and how much carbon emissions materializes over the next years. They should respect the aforementioned weaknesses and use a multiple of carbon emissions metrics to ensure that these changes are precisely measured. The emergence of carbon emissions materiality for certain industries can be measured through portfolio analysis, as certain industry portfolios may outperform others due to materiality. It can also be measured through regression analysis, by identifying a correlation between carbon emissions metrics and financial performance. While this should be doable on company level, it might be more difficult to do on a portfolio level, as portfolios first must be composed, and after their overall carbon emissions ranking/metric has to be put into relation with their financial performance. Finally, future research should focus on industry specific emergence of carbon emissions materiality, as in this thesis, and not on the global emergence of carbon emissions materiality, because it allows for more nuanced knowledge of this topic.

Conclusion

According to Khan et al. (2016), the materiality of ESG issues varies across industries, and with it its financial impact. Later academic papers show that focussing on a few, but specific material issues is rewarded financially (Steinbarth, 2018; van Heijningen, 2019). While previous academic articles cover the emergence of carbon emissions on a global scale (Bolton & Kacperczyk, 2019; Garvey et al., 2018; In et al., 2019), this thesis searches for the industry-specific emergence of carbon emissions materiality. It, therefore, tries to evaluate the impact of carbon emissions screening based on portfolios' performances in two stock universes that have different exposures to carbon emissions materiality according to the SASB. The main idea is that carbon emissions screening will lead to outperformance in the stock universe, where carbon emissions are considered to be a specific material issue. In contrast, it would not create any or limited financial premium in a stock universe where carbon emissions are considered to be a generic or minor material issue.

The two stock universes used in the research are the utilities sector and the electric utilities industry. The SASB clearly defines carbon emissions to be material in both stock universes, but while it is specifically material to the electric utilities industry, it is a minor material issue to the utilities sector, as the utilities sector consists of water, gas, and electric utilities which each bring their own individual material issues with them.

The portfolios are composed using a 25% best in class threshold, based on MSCI's ESG or carbon emissions ratings, and are compared to unscreened portfolios, to benchmark. Both ratings are developed based on a company's ESG or carbon emissions performance relative to its industry peers. MSCI states that the ESG ratings are based on selected issues that are important in a company's industry. This means that MSCI already incorporated materiality into its ESG ratings. Therefore, the ESG screened portfolio has good chances to become the best performing one, according to the authors mentioned in the introduction of this chapter (Steinbarth, 2018; van Heijningen, 2019).

As shown in the results chapter, no major performance difference could be identified between the portfolios. For the ESG screened portfolios, this could be due to ESG having no impact on financial performance, which would challenge the findings of past academic articles (Clark et al., 2014; Eccles et al., 2016; Friede et al., 2015; Ghoul et al., 2021; Nagy et al., 2016; NN Investment Partners & European Centre for Corporate Engagement, 2016; RobecoSAM SI Research & Development and Robeco Quantitative Strategies, 2014; Trinks & Scholtens, 2017). But it could also be due to MSCI picking generic ESG issues which do not provide any additional financial return. The results of the carbon emissions screened portfolios indicate that the carbon emissions issue hasn't become yet a material one in the electric utility sector in specific and in the utility sector at large. This is in contrast to the findings of Bolton & Kacperczyk (2019), Garvey et al. (2018), and In et al. (2019), who find that carbon emissions do have an impact on financial performance. As the carbon emissions portfolios minimally outperform in the portfolio analysis (cumulative return, average return, Jensen's alpha and Sharpe ratio), it could indicate that carbon emissions are on the verge of becoming material.

The research design contains several weaknesses, which may have led to the lack of difference in portfolios' performances. These are due on the frequency of the data, the lack of specific Carhart four-factor data, the lack of ESG and carbon emissions rated companies and the way the ratings are composed.

The findings implicate that non socially responsible investors do not have an incentive to screen for ESG or carbon emissions ratings, as they are not financially rewarded for it. This is further accentuated through the costs of acquiring ESG and carbon emissions data and applying these in the stock selection. But as climate change progresses, the carbon emissions issue could soon become material. It is most likely that the most polluting industries will be the most impacted by governmental regulations, public opinions, etc., and therefore could face higher risks in financial downturn, which will also hurt investors.

Future research could focus on the date and the intensity of carbon emissions materialization. The intensity could also be analysed at industry level, to better understand the element of industry specific materiality, as individual industries are expected to be impacted at different intensities. Furthermore, research on carbon emissions metrics and ratings could be done, as to expand the knowledge on carbon emissions metrics and ratings that do have an impact on financial performance, and in contrast those that don't.

Reference List

Ashwin Kumar, N. C., Smith, C., Badis, L., Wang, N., Ambrosy, P., & Tavares, R. (2016). ESG factors and risk-adjusted performance: a new quantitative model. *Journal of Sustainable Finance and Investment*, *6*(4). https://doi.org/10.1080/20430795.2016.1234909

Bolton, P., & Kacperczyk, M. T. (2019). Do Investors Care about Carbon Risk? *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.3398441

Chen, J. (2021). *Wholesale Energy*. Investopedia. https://www.investopedia.com/terms/w/wholesale-energy.asp

Chen, J., & Scott, G. (2020). *Cumulative Return Definition*. Investopedia . https://www.investopedia.com/terms/c/cumulativereturn.asp

Clark, G. L., Feiner, A., & Viehs, M. (2014). From the Stockholder to the Stakeholder: How Sustainability Can Drive Financial Outperformance. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.2508281

Cohen, M. A., Fenn, S. A., & Konar, S. (1997). "Environmental and Financial Performance: are they related?", Discussion Paper, Vanderbilt University. *Igarss*, *1997*(May).

Consolandi, C., Eccles, R. G., & Gabbi, G. (2020). How material is a material issue? Stock returns and the financial relevance and financial intensity of ESG materiality. *Journal of Sustainable Finance and Investment*. https://doi.org/10.1080/20430795.2020.1824889

Credit Suisse. (2016). *ESG-Alpha: I am a Material Girl*. /research-doc.credit%02suisse.com/docView?language=ENG&format=PDF&source_id=em&document_id=1063708251&serialid=XvWD6b%0AqS%2FTuZiGA4o89ILWBIIhTx9Ss5Rsa%2FgSoBaEc%3D&cspId=&toolbar=1

Derwall, J., Guenster, N., Bauer, R., & Koedijk, K. (2005). The eco-efficiency premium puzzle. *Financial Analysts Journal*, *61*(2). https://doi.org/10.2469/faj.v61.n2.2716

Eccles, R. G., Ioannou, I., & Serafeim, G. (2014). The impact of corporate sustainability on organizational processes and performance. *Management Science*. https://doi.org/10.1287/mnsc.2014.1984

Eccles, R. G., & Klimenko, S. (2019). The investor revolution -Shareholders Are Getting Serious About Sustainability. *Harvard Business Review*, *2019*(May-June).

Eccles, R. G., Verheyden, T., & Feiner, A. (2016). ESG for All? The Impact of ESG Screening on Return, Risk, and Diversification. In *SSRN*. https://doi.org/10.1111/jacf.12174

Edmans, A. (2011). Does the stock market fully value intangibles? Employee satisfaction and equity prices. *Journal of Financial Economics*, *101*(3). https://doi.org/10.1016/j.jfineco.2011.03.021

Flammer, C. (2013). Corporate social responsibility and shareholder reaction: The environmental awareness of investors. *Academy of Management Journal*, *56*(3). https://doi.org/10.5465/amj.2011.0744

Friede, G., Busch, T., & Bassen, A. (2015). ESG and financial performance: aggregated evidence from more than 2000 empirical studies. *Journal of Sustainable Finance and Investment*, *5*(4). https://doi.org/10.1080/20430795.2015.1118917

FTSE Russell. (2018). *Smart beta: 2018 global survey findings from asset owners*. https://investmentnews.co.nz/wp-content/uploads/Smartbeta18.pdf %0D

Garvey, G., Iyer, M., & Nash, J. (2018). Carbon footprint and productivity : does the "E" in ESG capture efficiency as well as environment? *Journal of Investment Management*, *16*(1), 59–69.

Ghoul, S. El, Karoui, A., Patel, S., & Ramani, S. (2021). *The Green and Brown Performances of Mutual Fund Portfolios*.

Grewal, J., Hauptmann, C., & Serafeim, G. (2021). Material Sustainability Information and Stock Price Informativeness. *Journal of Business Ethics*, *171*(3). https://doi.org/10.1007/s10551-020-04451-2

Griffin, J. M. (2002). Are the Fama and French Factors Global or Country Specific? In *Review of Financial Studies* (Vol. 15, Issue 3). https://doi.org/10.1093/rfs/15.3.783

Hayes, A., & James, M. (2020). *Geometric Mean Definition*. Investopedia . https://www.investopedia.com/terms/g/geometricmean.asp

Heatter, C., Gabriel, C., & Wang, Y. (2009). *A Four-Factor Performance Attribution Model for Equity Portfolio*. https://www.emaproducts.com/Video/EMA - A Four-Factor Attribution Model.pdf

In, S. Y., Park, K. Y., & Monk, A. (2019). Is "Being Green" Rewarded in the Market? An Empirical Investigation of Decarbonization Risk and Stock Returns. *Stanford Global Projects Center Working Paper*.

Kenton, W., & Westfall, P. (2021). *Beta Definition: Meaning, Formula, & Calculation*. Investopedia . https://www.investopedia.com/terms/b/beta.asp

Khan, M., Serafeim, G., & Yoon, A. (2016). Corporate sustainability: First evidence on materiality. In *Accounting Review*. https://doi.org/10.2308/accr-51383

Krueger, P., Sautner, Z., & Starks, L. T. (2020). The importance of climate risks for institutional investors. In *Review of Financial Studies* (Vol. 33, Issue 3). https://doi.org/10.1093/rfs/hhz137

Morgan Stanley. (2015). *Sustainable reality: understanding the performance of sustainable investment strategies.*

Nagy, Z., Kassam, A., & Lee, L.-E. (2016). Can ESG Add Alpha? An Analysis of ESG Tilt and Momentum Strategies . *The Journal of Investing*, *25*(2). https://doi.org/10.3905/joi.2016.25.2.113

NN Investment Partners, & European Centre for Corporate Engagement. (2016). *The materiality of ESG factors for emerging markets equity investment decisions: Academic evidence*.

Pierron, A. (2019). ESG Data: Mainstream Consumption, Bigger Spending. *Opimas*.

RobecoSAM SI Research & Development and Robeco Quantitative Strategies. (2014). Alpha from Sustainability. In *RobecoSAM White Paper*.

Steinbarth, E. (2018). Materiality Matters: Targeting the ESG Issues that Impact Performance. *Russell Investments*.

Trinks, P. J., & Scholtens, B. (2017). The Opportunity Cost of Negative Screening in Socially Responsible Investing. *Journal of Business Ethics*, *140*(2). https://doi.org/10.1007/s10551-015-2684-3

van Heijningen, K. (2019). The impact of ESG factor materiality on stock performance of firms. *Erasmus Platform for Sustainable Value Creation Working Paper*.

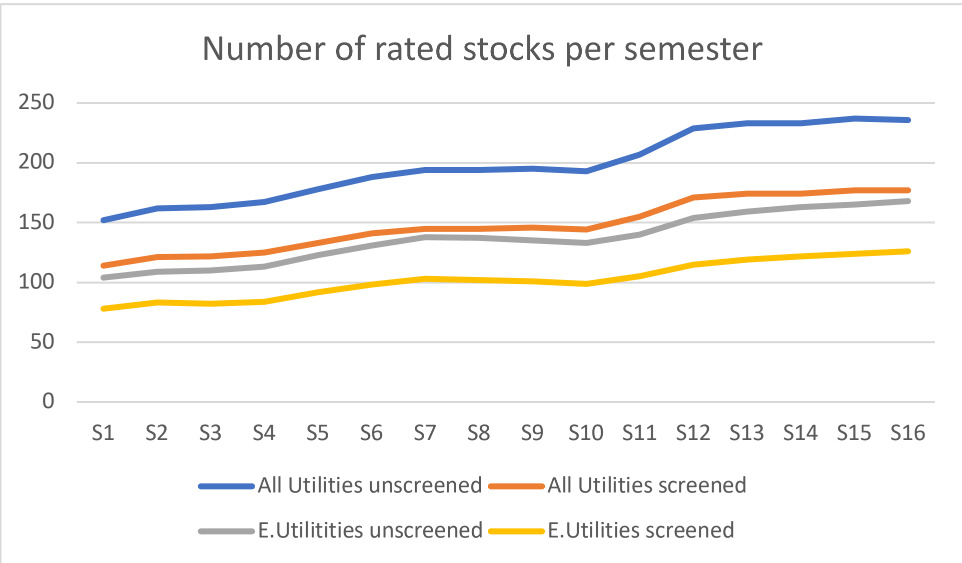
Velte, P. (2017). Does ESG performance have an impact on financial performance? Evidence from Germany. *Journal of Global Responsibility*, *8*(2). https://doi.org/10.1108/jgr-11-2016-0029

Appendices

Appendix1: Datasets composing the electric utilities universe

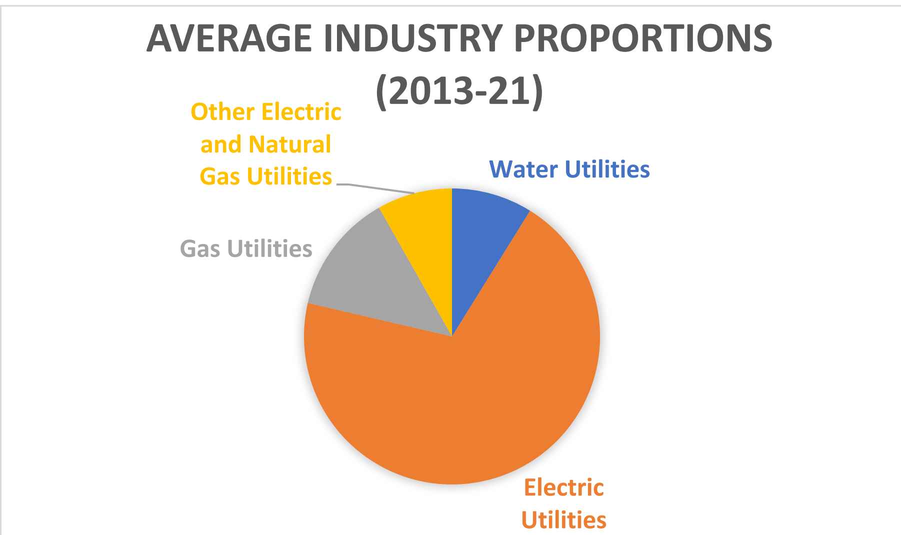
Ref	Inc/Exc	Criteria	Category	Formula	Passed
L2	Include	Alternative Power Generation (4760) (Industry)	Fac... > Util... > Alternative Power Generatio...	PUBLIC:FIN=4760	299
L9	Include	Electric Power Generation, Transmission, Control and Distribution (2211) (Industry)	N...>...> ...> Electric Power Generation, Tra...	PUBLIC:CA_NAICS_IND_CODE=2211	454
L10	Include	Americas Wholesale Power (Industry)	FactSet Re... >...> Energ...> Americas Wh...	PUBLIC:FR_RBICS_NUM_CURR(INDGRP)='(	70
L11	Include	Asia/Pacific Wholesale Power (Industry)	FactSet Re...>...> Ener... > Asia/Pacific W...	PUBLIC:FR_RBICS_NUM_CURR(INDGRP)='(	300
L12	Include	Other International Wholesale Power (Industry)	FactSet R...>...> Ener...> Other Internation...	PUBLIC:FR_RBICS_NUM_CURR(INDGRP)='(	204
L15	Include	Multinational Wholesale Power (Industry)	FactSet Re...>...> Ener... > Multinational ...	PUBLIC:FR_RBICS_NUM_CURR(INDGRP)='(	64
L16	Include	United States Wholesale Power (Industry)	FactSet R... >...> Ener... > United States ...	PUBLIC:FR_RBICS_NUM_CURR(INDGRP)='(	394
L17	Include	International Electric Utilities (Industry)	FactSet Re... >...> Electri...> International ...	PUBLIC:FR_RBICS_NUM_CURR(IND)='6510'	319
L18	Include	Other United States Electric Utilities (Industry)	FactSet R... >...> Elect...> Other United St...	PUBLIC:FR_RBICS_NUM_CURR(IND)='6510'	15
L19	Include	United States Regional Electric Utilities (Industry)	FactSet ... >...> Elec... > United States Re...	PUBLIC:FR_RBICS_NUM_CURR(IND)='6510'	113

Appendix2: Number of rated stocks per semester*



*After having cleaned out stocks with incomplete data.

Appendix3: Average industry proportions in the utilities sector over the 2013 – 2021 period



Appendix4: First semester of the carbon emissions screened electric utilities portfolio

					CO2 Portfolio		
	Assets Value (pre-Fraction)	Fraction	Assets Value (post-Fraction)	Dividends (monthly) (post-Fraction)	Available Capital for Re-investment (Assets Value Appreciation or Depreciation + Dividends)	Raw Return (Assets Value Appreciation or Depreciation + Dividends)	Return on Investment
31/05/2013	1.167,24	0,812475778	948,351092	3,034960239	951,3860522	-48,61	-4,86%
30/06/2013	1.160,7	0,815075904	946,036511	3,04467287	949,0811839	-2,30	-0,24%
31/07/2013	1.168,2	0,8176991	955,2435799	3,054471681	958,2980516	9,22	0,97%
31/08/2013	1.115,1	0,820313762	914,6953113	3,064238611	917,7595499	-40,54	-4,23%
30/09/2013	1.120,9	0,823061821	922,5841222	3,074503841	925,6586261	7,90	0,86%
31/10/2013	1.152,5	0,825804668	951,736221	3,0847496	954,8209706	29,16	3,15%
Number of Stocks		Investable		Dividends (pre-Fraction)			
78		1.230,81		per annum 13 (pre-Fraction)			
				44,83			
		Fraction		Monthly 13 (pre-Fraction)			
		0,812475778		3,7354470			
		Available Capital					
		1000,00					

(from the Master Thesis Data E.Utilities excel doc., slide EU S1 CO2)