Fossil fuel divestment strategies: Financial and carbon related consequences

Hunt, Chelsie & Weber, Olaf (accepted), Fossil fuel divestment strategies: Financial and carbon related consequences, Organization & Environment. Copyright © [2018] (SAGE Publications). Reprinted by permission of SAGE Publications.

oweber@uwaterloo.ca

Abstract

Fossil fuel divestment is discussed controversially with regard to its financial consequences and its effect on decarbonizing the economy. Theory and empirical studies suggest arguments for both, financial underperformance and outperformance of divestment. Therefore, our first research objective is to understand the financial effect of divestment. The second objective is to analyze the influence of divestment strategies on the carbon intensity of portfolios. Empirically, our analysis is based on the Canadian stock index TSX 260 for the time between 2011 and 2015. The results of the study suggest higher risk-adjusted returns and lower carbon intensity of the divestment strategies compared to the benchmark. We conclude that divestment is not only an ethical investment approach, but that it is able to address financial risks caused by climate change and, at the same time, is able to reduce the carbon exposure of investment portfolios.

Introduction

According to the Intergovernmental Panel on Climate Change (IPCC), no more than one-fifth of the current proven fossil fuel reserves can be burned to mitigate climate change (McGlade & Ekins, 2015; Meinshausen et al., 2009). Consequently, fossil fuel divestment is seen as a potential activity to achieve this goal (Gillan & Starks, 2000; Guay, Doh, & Sinclair, 2004). In response, a number of well-known institutional investors started reducing their investment in the fossil fuel industry (Mooney, 2017) because of both, ethical (Clark & Monk, 2010) and financial (Rubin, 2016) reasons. They are afraid of reduced returns caused by stranded assets (Ansar, Caldecott, & Tilbury, 2014; Green & Newman, 2017) occurring through the devaluation of fossil fuel assets that cannot be burned without exceeding the 2°C goal. Furthermore ethically motivated investors divest, to reduce the carbon[1] footprint of their portfolios (Frankel, Shakdwipee, & Nishikawa, 2015; Scipioni, Manzardo, Mazzi, & Mastrobuono, 2012). Other investors divest to influence the fossil fuel industry to reduce their carbon emissions (Arabella Advisors, 2015; Dawkins, 2016).

Though climate change related investment risks and divestment are discussed intensively in public and in the investment community, analyses of carbon related financial risks did not find significant entrance into the academic research (Diaz-Rainey, Robertson, & Wilson, 2017). With regard to the effect of divestment in other fields, for instance, activities that addressed the South-African apartheid regime, a number of studies exist suggesting mixed results with regard to financial and social impacts (Arnold & Hammond, 1994; Gosiger, 1986; Grossman & Sharpe, 1986; Kaempfer, Lehman, & Lowenberg, 1987; Lansing & Kuruvilla, 1988; Lytle & Joy, 1996;

[1] In this study the term carbon stands for carbon equivalents (CO_2e). CO_2e expresses the impact of different greenhouse gases relative to the impact of CO_2.

Montgomery & Thomas, 1988; Rudd, 1979). Though some similarities between the anti-apartheid divestment movement and the fossil fuel divestment movement exist (Hunt, Weber, & Dordi, 2017), results from the first cannot just be transferred to the latter, mainly because fossil fuel divestment can be driven by both, ethical and financial reasons.

Research on the financial effects of fossil fuel divestment is sparse with the exception of a few recent studies by Henriques and Sadorsky (2017) who found that fossil fuel divestment increased the financial returns for investors and by A. Trinks, Scholtens, Mulder, and Dam (2018) who suggest that divestment portfolios are not negatively affected by the exclusion of fossil fuel stocks.

To further contribute to the knowledge about fossil fuel divestment, our first research question addresses financial consequences of divestment. We analyze, whether fossil fuel divestment leads to lower returns of investment portfolios because of a reduction of the number of investable constituents based on exclusion, whether divestment increases financial returns because of the exclusion of assets that could be stranded or are at risk with regard to climate regulations, or whether divestment does not have any effects on financial returns.

Though some studies on the carbon intensity of mutual investment funds have been conducted based on industry analyses (Koellner, Suh, Weber, Moser, & Scholz, 2007; Koellner, Weber, Fenchel, & Scholz, 2004), studies about carbon footprints (Wackernagel et al., 1999) of divestments strategies are sparse because former divestment strategies, for instance addressing the tobacco industry or the South African Apartheid regime, rather addressed social than environmental issues. Furthermore, Ritchie & Dowlatabadi (2015), for instance, suggest that divestment conducted by institutional investors does only have a small effect on the carbon footprint of their portfolios. Consequently, it is hard to argue that divestment contributes to climate change mitigation, if the carbon footprint of the divestment strategy does only change marginally. Therefore, our second question is to which extent different fossil fuel divestment strategies decrease the carbon intensity of a portfolio. Answering the second question will extend the knowledge about the carbon intensity of different types of divestment portfolios (Weber, 2014) and contributes to the literature about the carbon related impact of different divestment strategies.

This study analyzes the effects of different divestment and re-investment strategies on both, the financial return and the carbon intensity of the Canadian stock index TSX 260 between beginning of 2011 and August 31, 2015. The Canadian stock index has been selected because it incorporates a high number of fossil fuel related industries with global outreach, such as oil, natural gas, and mining. Different divestment and re-investment strategies have been analyzed using Carhart's Four-Factor Model (Carhart, 1997) and through the assessment of the carbon intensity of different portfolios.

The results of the study suggest that divestment from the fossil fuel sector increases the risk-adjusted financial returns though it limits the investment universe. This result is in-line with recent studies analyzing the US market (Henriques & Sadorsky, 2017; A. Trinks et al., 2018). We conclude that investments in the fossil fuel sector are at risk because of climate change risks that have been priced by financial markets. Furthermore, we find that re-investment into the Canadian low-carbon industry creates lower financial returns compared to re-investment according to industry weights. Finally, our results suggest that the divestment portfolios have a significant lower carbon intensity than the conventional benchmark, and that divesting from both, the energy industry and utilities decreases the carbon intensity most (see also Ritchie & Dowlatabadi, 2014).

This paper contributes to the academic literature on the financial and carbon related effect of fossil fuel divestment on financial returns. The results demonstrate that divestment is not only an ethical strategy but that it helps to manage current and future financial risks arising from climate change, such as stranded assets. With regard to the effects of different divestment strategies on the carbon intensity of portfolios, we conclude that stricter divestment strategies, excluding more fossil fuel stocks, results in higher risk-adjusted returns and lower carbon intensity than divestment approaches excluding less stocks. Furthermore, we conclude that the correlation between the carbon exposure of the portfolio and the risk-adjusted financial return demonstrates that divestment can be in-line with fiduciary duty (Waitzer & Sarro, 2012), an aspect that is important for institutional investors. Finally, we contribute to theory by broadening the discussion about the financial performance of sin stocks through the inclusion of fossil fuel stocks. We conclude that the Canadian financial market is characterized by high social norms that reduce the financial performance of fossil fuel stocks (see also Fauver & McDonald, 2014).

Literature Review

There are many studies that analyze the performance of socially responsible investing (SRI) compared with conventional investments (see Friede, Busch, & Bassen, 2015 for an overview). These studies report mixed results. Some of them suggest that SRI performs similar to conventional investment (Barnett & Salomon, 2003; Chegut, Schenk, & Scholtens, 2011; Louche, 2001) because the applied environmental, social, and governance criteria correlate with financial criteria or because the use of environmental, social and governance (ESG) criteria does not decrease the variance of the investment universe. Other studies argue, based on a portfolio theory perspective (Markowitz, 1952), that SRI has a lower financial performance than conventional investments because of a reduction of the investment universe. Another group of studies argues that costs of SRI are higher because of the need to analyze additional non-financial criteria (Bessembinder, 2016; Chong, Her, & Phillips, 2006). A third group of studies suggests that SRI has a higher financial performance than conventional investments because of a positive correlation between CSR and CFP (Lin, Chang, & Dang, 2015; Wang, Dou, & Jia, 2015), social norms (Fauver & McDonald, 2014), and because of a lower volatility of SRI portfolios (Becchetti, Ciciretti, & Giovannelli, 2013; Nofsinger & Varma, 2014).

One theoretical explanation for SRI having a higher financial performance than conventional investments is based on the assumption that corporate social performance (CSP) is correlated with financial performance. Consequently, investing in stocks of firms with high CSP leads to higher financial performance. Waddock and Graves (1997) used good management theory and argue that higher CSP increases stakeholder relations and consequently increases financial performance with relatively low costs (Moskowitz, 1972), and addresses long-term risks and volatility (Renneboog, ter Horst, & Zhang, 2008).

Social norms are the second theoretical concept explaining that SRI has a higher performance than conventional investment. Research on the influence of social norms on ethical and sin stocks delivers theoretical arguments for both, outperformance and underperformance of SRI. In markets with higher social norms, so-called sin stocks underperform while they outperform their conventional peers in markets with low social norms (Durand, Koh, & Limkriangkrai, 2013; Fauver & McDonald, 2014; Hong & Kacperczyk, 2009). Liston (2016), however, argues that investor sentiment is another important driver for the outperformance of sin stocks. Thus, fossil fuel stocks are expected to underperform in market with high social norms regarding climate change.

Theoretical arguments for a lower performance of SRI are mainly based on portfolio theory (Markowitz, 1952). Often, these studies hypothesize that SRI portfolios have a lower risk-return ratio since they exclude investments from the investible universe because of non-financial reasons. Such an exclusion contradicts modern portfolio theory stating that mean-variance efficient portfolios are not achievable under this condition (Geczy, Stambaugh, & Levin, 2005; Gregory & Whittaker, 2012; Tippet, 2001) if financial and ethical criteria are not correlated.

While the studies mentioned above address SRI in general, this study focuses on divestment and particularly fossil fuel divestment. In contrast to other SRI strategies, divestment is a pure exclusionary strategy, rejecting investments in stocks that are connected with controversial political regimes, such as the South-African apartheid regime (Kaempfer et al., 1987), or belong to a controversial sector, such as the fossil fuel industry.

Hence, fossil fuel divestment addresses the impact of carbon intensive fossil fuel production on climate change (Ekwurzel et al., 2017), and consequently advocates divestment from the fossil fuel industry (Ritchie & Dowlatabadi, 2014). Since the NGO 350.org launched their climate campaign in 2012, hundreds of institutions, including universities, faith organizations, pension plans and foundations, have committed to divesting from fossil fuels (Howard, 2015). Well-known institutional investors, such as the Rockefeller Foundation, the Norway Pension Fund, the New York City pension funds (Eltman, 2018), and other institutional investors announced that they divest from coal and the fossil fuel sector (Arabella Advisors, 2015; Cripps, 2014), to balance their financial and moral responsibility (Sievänen, Rita, & Scholtens, 2017).

With regard to financial consequences of divestment, many studies analyzed the anti-apartheid divestment movement and how divestment from South African stocks influenced portfolios risks (Rudd, 1979). Posnikoff (1997), for instance, found that US firms, announcing divestment from South Africa, experienced an increase in their share price. Grossman and Sharpe (1986) suggested that excluding South African stock decreased the financial performance of a portfolio but that the increase of small stocks caused by divestment balanced the decrease. The question remains, however, whether results from the South African anti-apartheid divestment campaign can be applied to fossil fuel divestment.

While excluding investments is the main method used by divestment campaigns, it can be combined with other methods, such as positive selection of alternative stocks. For example, more than 150 foundations are signatories of the so-called DivestInvest movement, having pledged to divest and re-invest 5 percent of their holdings in renewable energy investments (http://divestinvest.org/philanthropy/signatories/). The DivestInvest movement, combines exclusionary strategies with investment strategies in renewable energy industries or other climate solutions. The movement's intention is to shift capital flows away from high carbon emitting industries and to accelerate the transition to a global economy fueled by renewable energy.

Financially, advocates of the divestment campaign state that divesting might be a way to avoid financial losses resulting from the potential burst of the carbon bubble and due to stranded assets (Ansar et al., 2014). This hypothesis is supported by newer academic studies. Henriques and Sadorsky (2017), for instance, found that divesting from fossil fuel and investing in clean energy increased financial returns because of the higher performance of clean energy stocks.

Finally, another study argues that divesting from fossil fuels does not harm financial returns because fossil fuel stocks do not outperform other stocks on a risk-adjusted basis and that they do not contribute to diversification (A. Trinks et al., 2018). In contrast to the first two studies, Bessembinder (2016) argues that the costs of using additional criteria to exclude certain industries from the investment universe are higher than for conventional investments and therefore, also the financial returns are lower. Finally, opportunity costs have been identified for SRI that exclusively applies exclusion as non-financial decision criteria (P. J. Trinks &

Scholtens, 2015).

Both, empiric studies and theory suggest arguments for higher and lower financial returns of fossil fuel divestment compared to conventional investment. Therefore, our first research objective is to understand the financial effect of different divestment strategies. Consequently, our fist research question is whether different divestment strategies have an impact on the financial performance of investment portfolios.

Next to the financial consequences of divestment, many ethically driven investors divest because they strive to reduce the carbon footprint of their investments. With regard to this explicit effort to contribute to climate change mitigation, a recent report lists direct and indirect impacts of divestment (Ansar et al., 2014). The authors find that direct impacts on fossil fuel companies are rather limited because the maximal capital that can be divested in the industry is rather small and conventional investors will take the opportunity and invest into the industry. Changes in market norms caused by leading investors, however, might have a broader impact, because the market will follow the lead investors.

A further impact, mentioned by Ansar et al. (2014), is the stigmatization of the industry. Stigmatization might lead to more restrictive legislation, depreciation of the value of fossil fuel resources, and to efforts of fossil fuel companies to increase their environmental performance in order to dilute stigmatization. An Australian study even concludes that divestment and divestment announcements will lead to greater action on climate change on policy and organizational levels (Linnenluecke, Meath, Rekker, Sidhu, & Smith, 2015). Other studies describe divestment as a form of private governance that might lead to the economic and political change that is needed to address climate change (Ayling & Gunningham, 2017).

To assess the carbon intensity of portfolios, including divestment portfolios, carbon footprinting can be applied (Wackernagel & Rees, 1997). The method has been used, for example, to disclose a company's annual equivalent carbon emissions output under the European emission trading scheme. Consequently, investors also use carbon footprinting to assess the carbon intensity of their investment portfolios.

Based on carbon footprinting, studies analyzed the financed emissions of banks and found that they make them vulnerable to reputation issues (Collins, 2012). Another analysis suggests that SRI mutual funds have a lower carbon footprint than conventional funds because they tend to invest into industries with lower carbon emissions (Koellner et al., 2007; Koellner et al., 2004). Applying a carbon intensity calculator on an endowment fund, however, found that fossil fuel divestment that takes risk-return into account did reduce the carbon intensity of the portfolio less than expected because of mandated investment strategies and the economic structure of the financial market (Ritchie & Dowlatabadi, 2014). Therefore, the second objective of this study is to analyze the carbon intensity of various fossil fuel divestment portfolios to understand whether different fossil fuel divestment strategies vary with regard to their impacts on the carbon intensity of a portfolio and whether there is a correlation between the carbon intensity of divestment strategies and their financial performance. Together with the results for the first research question on financial returns, results for the second research question will contribute to carbon related financial decision making that is based on both, financial and climate related effects.

Methods and sample

The study analyses the Canadian financial market because it is a market with a high fossil fuel sector and high carbon emitting industries ratio. Studies argue that in Canada, because of the dependency on fossil fuel, divestment would not be possible without being exposed to higher risk (Ritchie & Dowlatabadi, 2015). Other studies on SRI in Canada, however, proposed a positive correlation between CSP and financial performance for Canadian firms (Makni, Francoeur, & Bellavance, 2009), but did not suggest significant differences in the financial performance of responsible investment funds and conventional funds (Bauer, Derwall, & Otten, 2007). Weber (2016), however, found that Canadian funds that are less exposed to climate risks outperform their competitors with higher climate risk exposure and Rubin suggests that fossil fuel divestment will increases financial returns in Canada (Rubin, 2016).

In-line with a recent study by A. Trinks et al. (2018), we compared expected and actual risk-adjusted returns of different investment strategies using Carhart's four factor model. Furthermore, we analyzed the carbon intensity – Scope 1 and Scope 2 carbon equivalent emissions divided by sales - of different divestment strategies in-line with other studies addressing corporate carbon emissions (Canadell et al., 2007; Roberts & Grimes, 1997; Tang & Luo, 2014).

The following sections start with describing the methods for the financial analysis. Second, our methods to calculate the carbon intensity of the different investment strategies will be explained. Third, we describe our divestment and re-investment methods. Finally, we present our sample.

Calculation of expected returns

We used Carhart's four factor model Carhart (1997) to evaluate the financial performance of divestment portfolios by relating excess returns to systematic risk factors (risk premium), and individual risk factors, such as size, book-to-market, and momentum (see Equation 1).

Equation 1: Carhart's four factor model (Carhart, 1997)

$$r_{it} = \alpha + \beta_{RMRF}RMRF * \beta_{SML}SML + \beta_{HMB} * HMB + \beta_{MOM} * MOM + + e_{it}$$

$$t = 1,2,\ldots,T$$

where

r_{it} = the return on a portfolio in excess of the one-month T-bill return

RMRF = excess return on a market proxy (market return less one-month T-bill return)

SMB = size effect (small cap minus large cap)

HML = book to market effect (value minus growth)

MOM = momentum effect (outperformer vs underperformer)

In-line with Bauer et al. (2007), we defined the groups for the risk factors as following. The small cap portfolio contains the bottom 20 percent securities ranked by their total market capitalization; the large cap portfolio is the remaining stocks within the benchmark universe. The value stock portfolio consists of the top 30 percent of securities ranked by their book to market ratio. The growth stock portfolio entails the remaining securities. The outperformer portfolio consists of the top 30 percent of securities ranked by the past 12-month momentum while the underperformer portfolio contains the remaining securities. The 12-month momentum is the percentage change of the month end price 12 months back to the most current month end price. Finally, excess return is calculated by the difference between the return of a one-month US Treasury Bill from the return of the security. The four factor model has been calculated using OLS regression. To analyze the robustness of the results we conducted bootstrapping with 50 replications and used a robust regression model for estimating the standard errors using the Huber-White sandwich estimator (Freedman, 2006).

Carbon intensity

Carbon intensity is a wide-spread method used in academic studies to evaluate carbon emissions compared with macroeconomic and financial indicators. Macroeconomic studies calculate carbon intensity as carbon emissions per Gross World Product (Canadell et al., 2007) and per Gross Domestic Product (GDP) (Roberts & Grimes, 1997). Another study combined carbon emissions, GDP growth, and human wellbeing to calculate the carbon intensity of human-wellbeing (CIWB) (Jorgenson, 2014).

On a microeconomic level, carbon intensity has been calculated for companies, industries, and equity funds as a relative measure instead of absolute carbon emissions (Hoffmann & Busch, 2008) to assess Scope 1 and Scope 2 CO_2e emissions per financial unit. Although some studies used cash-flow or financial market indicators, many studies use sales as the financial denominator to evaluate corporate carbon intensity because it considers cradle-to-gate value creation (Busch, 2010; Hoffmann & Busch, 2008). Furthermore, carbon intensity based on sales as the financial denominator is comparable across companies and industries (Tang & Luo, 2014), and has been used in 8 of 20 studies that used accounting indicators referenced in a review study (Busch & Lewandowski, 2017).

The method results in the average carbon intensity of the benchmark and each divestment strategy (Equation 2).

Equation 2: Portfolio Carbon Intensity:

$$\left(\frac{Constitutents'\ Carbon\ Emissions}{Constituents\ Sales}\right) * b$$

Where b = industry weight

For the healthcare industry, however, we used the total CO_2e emissions divided by economic activity in $million (Carnegie Mellon University Green Design Institute, 2018) for two reasons. Firstly, members of the Canadian healthcare sector did not submit any carbon related data to CDP or Bloomberg. Secondly, the sector includes public entities, such as hospitals that do not use sales as their main financial indicator. The approach is in-line with other studies analyzing the carbon intensity of the healthcare sector (Chung & Meltzer, 2009; Eckelman & Sherman, 2016) and of other industries (Hendrickson, Horvath, Joshi, & Lave, 1998; Suh, 2005).

To test for biases because of missing carbon data we conducted a logit regression with the availability of carbon data – categorized in yes and no- as dependent variable and the variables used in Carhart's four factor model (see Equation 1) as well as the GIC sectors. The only variable that has a significant impact on the availability of carbon data is market capitalization ($p < .0001$), indicating a higher likelihood for bigger firms to report their carbon data. Other financial indicators, such as book-to market ratio and momentum as well as the industry do not have an impact on carbon reporting.

Finally, we analyzed the differences on carbon emissions between the years. The difference between the year with the lowest emissions (2015) and the year with the highest emissions (2011) is 21.8 percent. The difference can be explained by an increasing carbon efficiency and by the reduction of the production in the fossil fuel industry.

Divestment and Re-investment Approach

Using the S&P TSX Composite Index (S&P TSX) as the starting universe, the study applied six divestment strategies based on GICS classifications. Consequently, we created six portfolios by divesting in different ways from fossil fuel related industries. The divestment strategies were:

1. *Coal:* Divestment from companies of the sub-industry Coal and Consumable Fuels (GICS: 10102050).

2. *Coal & Energy Equipment and Services (CEES):* Divestment from companies of the sub-industries Coal and Consumable Fuels (GICS: 10102050), Energy Equipment and Services (GICS: 101010).
3. *Coal & Carbon Underground 200 (CCU200):* Divestment from companies of the sub-industry Coal and Consumable Fuels (GICS: 10102050) and Canadian companies listed on the Carbon Underground's Top 2015 List (www.fossilfreeindexes.com), a list of the biggest carbon emitters.
4. *Coal & Oil, Gas and Consumable Fuels (COGCF):* Divestment from the companies of the subindustries Coal and Consumable Fuels (GICS: 10102050) and Oil, Gas and Consumable Fuels (GICS: 101020).
5. *Energy Sector (ES):* Divestment from the energy sector (GICS: 1010), excluding companies of the Renewable Electricity subindustry (GICS: 55105020).
6. *Energy + Utilities (EU):* Divestment from the companies from the energy and utilities sectors (GICS: 1010, 5510), excluding companies of the Renewable Electricity subindustry (GICS: 55105020).

The divestment strategies are based on common strategies that are applied by representatives of the divestment movement and mainly address the fossil fuel energy sector and utilities as the supplier of fossil fuels (Alexeyev et al., 2016; Fossil Free Indexes, 2017; Geddes, Goldberg, Tymoczko, & Branch, 2014). The strategy starts with divesting from the energy sub-industry with the highest carbon emissions (sub-industry Coal and Consumable Fuels) and includes energy sub-industries according to their carbon emissions in a descending order and finally divests from utilities.

Funds from the divested stocks were re-invested in two ways. The first approach re-invested the divested funds into the remaining constituents within the portfolio according to their weight. The objective of this approach was to follow a pure divestment approach to understand the active return related to the act of divesting without re-investing in green stocks. The divested portfolios were constructed in the same manner as the S&P/TSX universe. Therefore, the weight of any constituent in the divested portfolios could still be calculated as the stocks' float market capitalization outstanding divided by the summed float market capitalization of the portfolio.

While excluding stocks is the main method used by divestment campaigns, it can be combined with other methods, such as positive selection. As discussed above, the DivestInvest movement, for example, combines exclusionary strategies with investment strategies in renewable energy industries or other climate solutions (www.divest-invest.org). Hence, DivestInvest re-invests into companies whose core business is the development of green technologies and sustainable infrastructure solutions. In our study, the divested capital has been invested in the S&P/TSX Renewable Energy and Clean Tech Index issued by Sustainalytics (http://us.spindices.com/indices/equity/sp-tsx-renewable-energy-and-clean-technology-index).

The results for the re-investment into all industries presented below demonstrate that comprehensive divestment strategies that divest from a number of fossil fuel sub-industries increase financial returns and Sharpe ratios. Therefore, we did not analyze the green re-investment approach for all six strategies. Rather, it was helpful to analyze three strategies to understand the financial trade-offs between re-investment in all industries vs using the DivestInvest approach that re-invests into the green industry. Therefore, only the 2nd, 3rd and 5th divestment strategy was analyzed for the DivestInvest approach.

Sample

The period used was five years, between January 1, 2011 and August 31, 2015. It was selected to avoid biases due to the 2008 financial crisis and the availability of data for carbon related information of the index' stocks. The S&P/TSX Composite index was chosen as the investible universe because it is the broadest index to reflect the overall Canadian equity universe with approximately 70 percent of all market capitalization.

Data sources were Fundata (see Hunt, 2016) and Wharton Research Data Services (WRDS) for financial information. Furthermore, we used data from CDP, Bloomberg Inc., and the Carnegie Mellon IOLCA database (Carnegie Mellon University Green Design Institute, 2018) for carbon related information.

Results

First, we present the descriptive statistics of the divestment portfolios' financial indicators, followed by the results of Carhart's Four Factor model. Furthermore, statistics for the carbon footprint associated with divestment are presented.

Descriptive statistics for financials

This section presents the results of the descriptive statistics of the benchmark and the divestment portfolios addressing the first research question about differences between the benchmark and the divestment strategies with regard to financial returns.

The sector weights of the benchmark and the different divestment portfolios are presented in Table 1. The divested funds from the energy sector have been distributed evenly over all remaining sectors. For instance, the weight reduction of 8.3 percent of the CCU200 portfolio has been evenly distributed to all remaining shares in the portfolio.

About here Table 1.

The descriptive statistics of the financial indicators of the S&P TSX Composite Index and the different divestment portfolios are presented in Table 2. The S&P/TSX Composite portfolio is used as the benchmark in this analysis.

Insert Table 2.

As presented in Table 2, the total return of the divestment portfolios (12.35 to 21.28 percent) is higher than for the benchmark (11.30 percent). The same holds for the annualized return (2.36 percent for the benchmark vs 2.57 to 4.32 percent for the divestment portfolios). Furthermore, the annualized risk varies between 9.05 and 10.10 percent compared to the annualized risk of the benchmark of 9.91 percent. In addition, the Sharpe ratio increases with the amount of divested shares with a low of .23 for the benchmark and Sharpe ratios between .25 and .47 for the divestment portfolios. The annualized active return, calculated as the difference between the annualized divestment portfolio return and the annualized benchmark return, is positive for all divestment portfolios. The annualized active risk of the divestment portfolios, however, is also positive, indicating a higher variance of the divestment portfolios' returns compared to the benchmark. The information ratio, calculated by the active return of a divestment portfolio compared to the benchmark index divided by the standard deviation of the active return, also suggests positive values between .45 and .89 for the divestment portfolios.

Obviously, the number of constituents of the divestment portfolios is smaller than of the benchmark portfolio. Furthermore, as described above, the weight of the energy sector decreases with the divestment strategies 1 to 6 and is lower than the benchmark for all divestment strategies. Finally, the lower number of constituents of the divestment portfolios increases the average weight distribution per constituent.

Figure 1 presents cumulative returns of the benchmark and the divestment portfolios for distributed re-investment. It suggests that the difference between the benchmark and the divestment portfolios increases over time.

Insert Figure 1.

After having re-invested the divested capital into all constituents and industries within each portfolio (see Table 1), the second approach re-invested the divested funds into green economy securities to analyze whether re-investing the divested capital into securities that directly support the growth of the green economy is financially competitive. Table 3 presents the descriptive return statistics for the divestment strategies with re-investment into the S&P TSX Renewable Energy and Clean Technology Index (Green Index) for the CEES, CE200, and EU strategies. The data suggests that clean technology re-investment strategies create higher total returns, annualized returns, and a higher Sharpe ratio if divestments have been conducted based on the strategies CCU200 (subindustry Coal and Consumable Fuels and Canadian companies listed on the Carbon Underground Top 200) and based on EU (energy and utilities, but not renewable electricity). The weaker investment strategy, which only divests from coal and energy equipment and services, did not create higher returns than the benchmark if re-invested into green stocks. However, the annualized risk of all DivestInvest strategies (8.40 to 9.18 percent) was lower than the risk of the benchmark (9.91 percent).

Insert Table 3.

As shown in the cumulative returns graph (Figure 2), the Green Index underperformed the benchmark and the DivestInvest portfolios. Therefore, any significant investment within this index decreases the returns of the divestment portfolios. However, as suggested by the results above, divesting from Canadian firms within the Carbon Underground 200 and re-investing into the Green Index was a more beneficial strategy than completely divesting from the energy sector and re-investing into the Green Index.

Insert Figure 2.

Results of Carhart's Four Factor Model

In order to address our first research question whether divestment changes the financial returns of portfolios, we used Carhart's Four Factor Model to analyze the financial performance of the benchmark and the various divestment portfolios. As r^2 and the p-values suggest, the model is able to predict the expected returns of the divestment portfolios (see Table 4). Robustness tests using bootstrapping and robust regression suggest the same results for r^2 and the same significance level as the OLS regression and did not result in different expected returns.
The risk premium coefficient of the portfolios ranged from .81 to .98. These results demonstrate that one factor (risk premium) predicted most of the variance of the expected returns within this period and sample set. Risk premium is the coefficient representing systematic risk whereas the other three coefficients represent the idiosyncratic risks. Hence, the returns of the portfolios are mainly driven by systematic (market) risk while the idiosyncratic (stock specific) risk is less influential.

Because a well-diversified portfolio helps to eliminate idiosyncratic risk, and given that these portfolios are quite large, the smallest being the EU portfolio comprising of 175 stocks, these results are not surprising. Nonetheless, the result demonstrates that an investor remains well diversified within the market, even after divesting the entire energy sector, and that investors are being compensated for the systematic risk.

Furthermore, alpha was positive for the divested portfolios (A, B,C) and negative for the divested portfolios that re-invested in the green index (D, E, F) , indicating that the abnormal excess returns are positive for the divestment strategies with weighted re-investment and negative for the strategies with re-investment into the green index.

Insert Table 4.

Carbon intensity of the divestment strategies

This section presents the results for the second research question, whether the benchmark and the divestment portfolios have different carbon intensities. We present the sector weights, the carbon intensity of the sectors, and the weighted carbon intensity calculated by multiplying the sector weights with their carbon intensity in Table 5. The average carbon intensity of the benchmark portfolio over five-years has been 64.44 t CO_2e/$million. The standard error of the average increased by 1.19 percent using bootstrapping with 50 iterations compared to standard mean calculation. The carbon intensity of the different strategies is .2 and .7 percent smaller for Coal and CEES respectively, and drops to 60.68 t CO_2e/$million for CCU200 compared to 64.44 t CO_2e/$million for the benchmark. The biggest reduction, however, is achieved through the additional divestment from the utilities sector in the EU portfolio (14.79 t CO2e/ $million).

Insert Table 5.

Figure 3 presents the differences between the carbon intensity of the benchmark portfolio and the divestment portfolios. Though the carbon intensity of the divestment portfolio is smaller than for the benchmark, the biggest change is caused by divesting from both, the energy sector and utilities (77 percent). The remaining divestment strategies decreased the carbon intensity between .17 percent for Coal and 17.54 percent for the ES portfolio. Redistribution of energy divestments to other industries, however, increases the weight of utilities that have a high carbon intensity.

Insert Figure 3.

Discussion & conclusion

This study analyzes the financial and carbon related effects of divestment. The results suggest that different divestment strategies including re-investing in green industries increases the risk-adjusted returns compared to the benchmark and decreases the carbon intensity of the portfolios. Furthermore, we find that stricter divestment approaches, excluding more fossil fuel related stocks, have higher risk-adjusted returns and a lower carbon intensity than less strict approaches.

The results contribute to the knowledge about the connection between fossil fuel divestment strategies and risk-adjusted financial returns. Earlier studies on divestment rather addressed one divestment strategy, such as divesting from the fossil fuel sector (Henriques & Sadorsky, 2017; A. Trinks et al., 2018) and did not differentiate between different divestment strategies. This study, however, uses different investment and re-investment strategies and compares them with regard to their risk-adjusted financial returns. Furthermore, we also analyze the carbon intensity of the different strategies including the connection between carbon intensity and risk-adjusted financial returns. Finally, the study contributes to the knowledge about divesting in a markets with high exposure to high carbon emitting industries, such as the Canadian market.

In contrast to theoretical expectations based on portfolio theory (Markowitz, 1952), we conclude that divestment increases risk-adjusted returns, because it rather reduces the ratio of risky stocks instead of the diversity of the Canadian stock index. This can be explained by the market pricing the risk of stranded assets and increasing climate change related regulations, such as cap-and-trade mechanisms as systematic risks for the fossil fuel industry (Ansar et al., 2014; Battiston, Mandel, Monasterolo, Schuetze, & Visentin, 2017; Rubin, 2016). Consequently, being a member of the fossil fuel industry is correlated with higher financial risks.

Furthermore, the results of this study contribute to the knowledge about the acceptance of a social norm – in this case the need to address climate change – by the Canadian financial market. Since research on sin stock performance suggests that sin stocks underperform in markets with higher social norms (Durand et al., 2013; Fauver & McDonald, 2014; Hong & Kacperczyk, 2009), our results contribute to theory by demonstrating that the influence of social norms related to climate change contributes to the underperformance of fossil fuel stocks in the Canadian market.

Hence, with regard to our first research question about financial consequences of divestment the study contributes to the literature by suggesting that divestment has not only an ethical component but can be a way to increase the risk-adjusted performance of a portfolio. Furthermore, according to our results, fossil fuel divestment does not only address issues of the future, such as stranded assets (Ansar et al., 2014; Diaz-Rainey et al., 2017), but is a way to manage current financial risks connected with climate change. It seems that investment strategies based on climate risk assumptions are rewarded by the financial market.

Furthermore, we found that re-investing the divested funds into the remaining industries resulted in higher financial returns than re-investing into a green industry index. This finding might be a Canadian phenomenon. In contrast to other countries (Henriques & Sadorsky, 2017), analyses of the Canadian green technology industry found that because of a long period without any significant environmental regulations and climate change policies, until recently, green technology firms have not been performing in a way that qualifies them as alternative investment to the fossil fuel sector (Bak, 2017; Weber, 2016). Future research, however, is needed to analyze whether this will change with the introduction of a stricter climate change policy, such as carbon cap-and-trade mechanisms in Canada.

With regard to our second research question, we find that divestment decreased the carbon intensity between .2 and 77 percent. Though other studies could show that the carbon intensity of SRI funds is smaller than of their conventional peers (Koellner et al., 2007), we are able to quantify the reduction for a variety of divestment strategies. The most significant change in carbon intensity has been achieved through divesting from both, the energy and the utilities industry. Divesting only from a small group of fossil fuel related industries, such as coal and consumable fuels, has only a small impact on the carbon intensity because the portfolio weight of such high emitters is relatively small. The finding of a limited impact of divestment on the carbon intensity of divestment portfolios of institutional investors by Ritchie and Dowlatabadi (2015) can be explained with limited divestment options for institutional investors who have to follow certain investment criteria that do not enable them to divest from whole industries. This study, however, demonstrates that divestment strategies exist that are able to reduce the carbon exposure and the carbon intensity of financial portfolios significantly if investors follow a rather strong divestment approach that excludes the fossil fuel related industry including utilities.

In addition, the results of this study suggest that even in markets with a high fossil fuel industry ratio, such as the Canadian financial market, divestment can be conducted successfully. This result is in contrast to the argument that in relatively small markets with strong industry concentration, divestment results in financial losses compared to the benchmark because of the lack of options to diversify. Since our analysis focuses on risk-adjusted returns, it seems that the fossil fuel sector does not contribute to diversification even in a concentrated market (see also A. Trinks et al., 2018).

Furthermore, we conclude that the discussion about financial returns and divestment should less focus on possible financial losses of divestment but rather on financial losses of not divesting from fossil fuels and related utilities that are exposed to climate change risks. According to our results, fossil fuel divestment makes sense from a financial point of view even without any ethical justification.

Finally, from a managerial point of view, we suggest that fossil fuel divestment is in-line with fiduciary duty (Richardson, 2011, 2013; Waitzer & Sarro, 2012). Based on our results, we conclude that fossil fuel divestment can be conducted without harming financial returns and the ethical divestment strategy contributes to higher financial returns according to the results of the four-factor model (Carhart, 1997).

Future research is needed to understand the effects of divestment and carbon footprinting strategies during different time periods and for different markets. Additionally, financial research often neglects the effects of national or regional regulations and policies on financial markets, and therefore, comparing studies across further markets would be interesting. Finally, a weakness of the current study is caused by the uncertainty of carbon data. Reliable data on corporate carbon emissions is still scarcely available because its reporting is not mandatory, and the allocation of industry related carbon emissions to financiers is still unclear. Hence, future research is needed to focus on better assessing and modeling the carbon footprint of portfolios.

References

Alexeyev, J., Braman, S., Cane, H., Connolly, L., Di Rosa, L., Elivo, R., . . . Singh, H. (2016). *The carbon undergorund 2016*. Port Washington, NY: Fossil Free Indexes.

Ansar, A., Caldecott, B., & Tilbury, J. (2014). *Stranded assets and the fossil fuel divestment campaign: what does divestment mean for the valuation of fossil fuel assets?* Oxford, UK: Smith School of Enterprise and the Environment, University of Oxford.

Arabella Advisors. (2015). *Measuring the Growth of the Global Fossil Fuel Divestment and Clean Energy Investment Movement*. Washington, DC: Arabella Advisors.

Arnold, P., & Hammond, T. (1994). The role of accounting in ideological conflict: lessons from the South African divestment movement. *Accounting, Organizations and Society, 19*(2), 111-126.

Ayling, J., & Gunningham, N. (2017). Non-state governance and climate policy: the fossil fuel divestment movement. *Climate Policy, 17*(2), 131-149.

Bak, C. (2017). *Generating Growth from Innovation for the Low-carbon Economy: Exploring Safeguards in Finance and Regulation*. Waterloo, ON: Centre for International Governance Innovation (CIGI).

Barnett, M. L., & Salomon, R. M. (2003). Throwing a curve at socially responsible investing research: A new pitch at an old debate. *Organization & Environment, 16*(3), 381-389.

Battiston, S., Mandel, A., Monasterolo, I., Schuetze, F., & Visentin, G. (2017). A climate stress-test of the financial system. *Nature Climate Change, advance online publication*. doi:10.1038/nclimate3255

Bauer, R., Derwall, J., & Otten, R. (2007). The Ethical Mutual Fund Performance Debate: New Evidence from Canada. *Journal of Business Ethics, 70*(2), 111-124. doi:10.1007/s10551-006-9099-0

Becchetti, L., Ciciretti, R., & Giovannelli, A. (2013). Corporate social responsibility and earnings forecasting unbiasedness. *J Bank Finan, 37*(9), 3654-3668. doi:http://dx.doi.org/10.1016/j.jbankfin.2013.05.026

Bessembinder, H. (2016). *Frictional Costs of Fossil Fuel Divestment*. Retrieved from https://ssrn.com/abstract=2789878

Busch, T. (2010). Corporate Carbon Performance Indicators Revisited. *Journal of Industrial Ecology, 14*(3), 374-377. doi:10.1111/j.1530-9290.2010.00239.x

Busch, T., & Lewandowski, S. (2017). Corporate Carbon and Financial Performance: A Meta-analysis. *Journal of Industrial Ecology*, n/a-n/a. doi:10.1111/jiec.12591

Canadell, J. G., Le Quéré, C., Raupach, M. R., Field, C. B., Buitenhuis, E. T., Ciais, P., . . . Marland, G. (2007). Contributions to accelerating atmospheric CO2 growth from economic activity, carbon intensity, and efficiency of natural sinks. *Proceedings of the National Academy of Sciences, 104*(47), 18866-18870. doi:10.1073/pnas.0702737104

Carhart, M. M. (1997). On Persistence in Mutual Fund Performance. *J Finan, 52*(1), 57-82.

Carnegie Mellon University Green Design Institute. (2018). *Economic Input-Output Life Cycle Assessment (EIO-LCA) Canada 2002 (105 sectors) Producer model [Internet]*. Retrieved from: http://www.eiolca.net/

Chegut, A., Schenk, H., & Scholtens, B. (2011). Assessing SRI fund performance research: Best practices in empirical analysis. *Sustainable Development, 19*(2), 77-94. doi:10.1002/sd.509

Chong, J., Her, M., & Phillips, G. M. (2006). To sin or not to sin? Now that's the question. *Journal of Asset Management, 6*(6), 406-417. doi:10.1057/palgrave.jam.2240191

Chung, J. W., & Meltzer, D. O. (2009). Estimate of the carbon footprint of the US health care sector. *JAMA, 302*(18), 1970-1972.

Clark, G. L., & Monk, A. (2010). The Norwegian Government Pension Fund: Ethics over Efficiency. *Rotman International Journal of Pension Management, 3*(1), 14-19. doi:10.3138/rijpm.3.1.14

Collins, B. (2012). *Bankrolling Climate Disruption: The Impacts of the Banking Sector's Financed Emissions*. San Francisco, CA; Nijmegen, The Netherlands: Rainforest Action Network, Banktrack.

Cripps, P. (2014, February 5, 2014). $1.8bn coalition divest from fossil fuels, reinvest in clean-tech. *Environmental Finance.* Retrieved from www.environmentalfinance.com

Dawkins, C. E. (2016). Elevating the Role of Divestment in Socially Responsible Investing. *Journal of Business Ethics*, 1-14.

Diaz-Rainey, I., Robertson, B., & Wilson, C. (2017). Stranded research? Leading finance journals are silent on climate change. *Climatic Change, 143*(1), 243-260. doi:10.1007/s10584-017-1985-1

Durand, R. B., Koh, S., & Limkriangkrai, M. (2013). Saints versus Sinners. Does morality matter? *Journal of International Financial Markets, Institutions and Money, 24*, 166-183. doi:https://doi.org/10.1016/j.intfin.2012.12.002

Eckelman, M. J., & Sherman, J. (2016). Environmental impacts of the US health care system and effects on public health. *PLoS ONE, 11*(6), 1-14.

Ekwurzel, B., Boneham, J., Dalton, M. W., Heede, R., Mera, R. J., Allen, M. R., & Frumhoff, P. C. (2017). The rise in global atmospheric CO2, surface temperature, and sea level from emissions traced to major carbon producers. *Climatic Change*. doi:10.1007/s10584-017-1978-0

Eltman, F. (2018). NYC sues, divests from oil firms over climate change. Retrieved from http://abcnews.go.com/Technology/wireStory/nyc-taking-steps-divest-pension-funds-fossil-fuels-52252377

Fauver, L., & McDonald, M. B. (2014). International variation in sin stocks and its effects on equity valuation. *Journal of Corporate Finance, 25*, 173-187. doi:https://doi.org/10.1016/j.jcorpfin.2013.11.017

Fossil Free Indexes. (2017). *The Carbon Underground*. Port Washington, NY: Fossil Free Indexes.

Frankel, K., Shakdwipee, M., & Nishikawa, L. (2015). *Carbon Footprinting 101: A Practical Guide to Understanding and Applying Carbon Metrics*. New York: MSCI.

Freedman, D. A. (2006). On The So-Called "Huber Sandwich Estimator" and "Robust Standard Errors". *The American Statistician, 60*(4), 299-302. doi:10.1198/000313006X152207

Friede, G., Busch, T., & Bassen, A. (2015). ESG and financial performance: aggregated evidence from more than 2000 empirical studies. *Journal of Sustainable Finance & Investment, 5*(4), 210-233. doi:10.1080/20430795.2015.1118917

Geczy, C. C., Stambaugh, R. F., & Levin, D. (2005). Investing in Socially Responsible Mutual Funds. *SSRN eLibrary*. doi:10.2139/ssrn.416380

Geddes, P., Goldberg, L., Tymoczko, R., & Branch, M. (2014). *Building a carbon free equity portfolio*. Retrieved from Sausalito, CA:

https://www.aperiogroup.com/system/files/documents/aperio_group_-_building_a_carbon-free_equity_portfolio.pdf

Gillan, S. L., & Starks, L. T. (2000). Corporate governance proposals and shareholder activism: The role of institutional investors. *Journal of Financial Economics, 57*(2), 275-305.

Gosiger, M. C. (1986). Strategies for Divestment from United States Companies and Financial Institutions Doing Business with or in South Africa. *Human Rights Quarterly, 8*, 517. doi:10.2307/762275

Green, J., & Newman, P. (2017). Disruptive innovation, stranded assets and forecasting: the rise and rise of renewable energy. *Journal of Sustainable Finance & Investment, 7*(2), 169-187. doi:10.1080/20430795.2016.1265410

Gregory, A., & Whittaker, J. (2012). Exploring the Valuation of Corporate Social Responsibility—A Comparison of Research Methods. *Journal of Business Ethics, 116*(1), 1-20. doi:10.1007/s10551-012-1465-5

Grossman, B., & Sharpe, W. (1986). Financial Implications of South Africa Divestment. *Financial Analysts Journal, 42*, 15-29.

Guay, T., Doh, J. P., & Sinclair, G. (2004). Non-Governmental Organizations, Shareholder Activism, and Socially Responsible Investments: Ethical, Strategic, and Governance Implications. *Journal of Business Ethics, 52*(1), 125-139. doi:10.1023/b:busi.0000033112.11461.69

Hendrickson, C., Horvath, A., Joshi, S., & Lave, L. (1998). Peer reviewed: economic input–output models for environmental life-cycle assessment. *Environmental Science & Technology, 32*(7), 184A-191A.

Henriques, I., & Sadorsky, P. (2017). Investor implications of divesting from fossil fuels. *Global Finance Journal*. doi:https://doi.org/10.1016/j.gfj.2017.10.004

Hoffmann, V. H., & Busch, T. (2008). Corporate Carbon Performance Indicators. *Journal of Industrial Ecology*, *12*(4), 505-520. doi:10.1111/j.1530-9290.2008.00066.x

Hong, H., & Kacperczyk, M. (2009). The price of sin: The effects of social norms on markets. *Journal of Financial Economics*, *93*(1), 15-36. doi:https://doi.org/10.1016/j.jfineco.2008.09.001

Howard, E. (2015, May 19). The rise and rise of the fossil fuel divestment movement. *The Guardian*. Retrieved from https://www.theguardian.com/environment/2015/may/19/the-rise-and-rise-of-the-fossil-fuel-divestment-movement

Hunt, C. (2016). *Divesting and Re-investing into a Greener Future for Canada.* (Master in Environmental Studies Master's thesis), University of Waterloo, Waterloo, ON. Retrieved from http://hdl.handle.net/10012/10598

Hunt, C., Weber, O., & Dordi, T. (2017). A comparative analysis of the anti-Apartheid and fossil fuel divestment campaigns. *Journal of Sustainable Finance & Investment, 7*(1), 64-81. doi:10.1080/20430795.2016.1202641

Jorgenson, A. K. (2014). Economic development and the carbon intensity of human well-being. *Nature Climate Change*, *4*(3), 186.

Kaempfer, W. H., Lehman, J. A., & Lowenberg, A. D. (1987). Divestment, Investment Sanctions, and Disinvestment: An Evaluation of Anti-Apartheid Policy Instruments. *International Organization, 41*(3), 457-473.

Koellner, T., Suh, S., Weber, O., Moser, C., & Scholz, R. W. (2007). Environmental Impacts of Conventional and Sustainable Investment Funds Compared Using Input-Output Life-Cycle Assessment. *Journal of Industrial Ecology, 11*(3), 41-60.

Koellner, T., Weber, O., Fenchel, M., & Scholz, R. W. (2004). Principles for Sustainability Rating of Investment Funds. *Business Strategy and the Environment, 14*(1), 54-70.

Lansing, P., & Kuruvilla, S. (1988). Business divestment in South Africa: In who's best interest? *Journal of Business Ethics, 7*, 561–574.

Lin, C.-S., Chang, R.-Y., & Dang, V. (2015). An Integrated Model to Explain How Corporate Social Responsibility Affects Corporate Financial Performance. *Sustainability, 7*(7), 8292-8311.

Linnenluecke, M., K. , Meath, C., Rekker, S., Sidhu, B., K. , & Smith, T. (2015). Divestment from fossil fuel companies: Confluence between policy and strategic viewpoints. *Australian Journal of Management, 40*(3), 478-487. doi:10.1177/0312896215569794

Liston, D. P. (2016). Sin stock returns and investor sentiment. *The Quarterly Review of Economics and FInance, 59*, 63-70. doi:https://doi.org/10.1016/j.qref.2015.08.004

Louche, C. (2001). The corporate environmental performance - financial performance link: Implications for ethical investments. In J. J. Bouma, M. Jeucken, & L. Klinkers (Eds.), *Sustainable Banking. The greening of finance.* (pp. 187-200). Sheffield: Greenleaf.

Lytle, L. C., & Joy, O. M. (1996). The stock market impact of social pressure- the south african divestment case. *The Quarterly Review of Economics and FInance, 36*(4), 507-527.

Makni, R., Francoeur, C., & Bellavance, F. (2009). Causality Between Corporate Social Performance and Financial Performance: Evidence from Canadian Firms. *Journal of Business Ethics, 89*, 409-422.

Markowitz, H. (1952). Portfolio Selection. *The Journal of Finance, 7*(1), 77-91.

McGlade, C., & Ekins, P. (2015). The geographical distribution of fossil fuels unused when limiting global warming to 2 [deg]C. *Nature, 517*(7533), 187-190. doi:10.1038/nature14016

Meinshausen, M., Meinshausen, N., Hare, W., Raper, S. C., Frieler, K., Knutti, R., . . . Allen, M. R. (2009). Greenhouse-gas emission targets for limiting global warming to 2 C. *Nature, 458*(7242), 1158-1162.

Montgomery, C. A., & Thomas, A. R. (1988). Divestment: Motives and Gains. *Strategic Management Journal, 9*(1), 93-97. doi:10.2307/2486004

Mooney, A. (2017, April 28). Growing number of pension funds divest from fossil fuels. *Financial Times*.

Moskowitz, M. (1972). Choosing socially responsible stocks. *Business and Society Review, 1*(1), 71-75.

Nofsinger, J., & Varma, A. (2014). Socially responsible funds and market crises. *J Bank Finan, 48*, 180-193.

Posnikoff, J. F. (1997). Disinvestment from South Africa: they did well by doing good. *Contemporary Economic Policy, 15*(1), 76-86. doi:10.1111/j.1465-7287.1997.tb00456.x

Renneboog, L., ter Horst, J., & Zhang, C. (2008). The price of ethics and stakeholder governance: The performance of socially responsible mutual funds. *Journal of Corporate Finance, 14*, 302-322.

Richardson, B. J. (2011). From fiduciary duties to fiduciary relationships for socially responsible investing: responding to the will of beneficiaries. *Journal of Sustainable Finance & Investment, 1*(1), 5-19. doi:10.3763/jsfi.2010.0002

Richardson, B. J. (2013). Fiduciary responsibility in retail funds: clarifying the prospects for SRI. *Journal of Sustainable Finance & Investment, 3*(1), 1-16. doi:10.1080/20430795.2012.751349

Ritchie, J., & Dowlatabadi, H. (2014). Understanding the shadow impacts of investment and divestment decisions: Adapting economic input–output models to calculate biophysical factors of financial returns. *Ecological Economics, 106*(0), 132-140. doi:http://dx.doi.org/10.1016/j.ecolecon.2014.07.005

Ritchie, J., & Dowlatabadi, H. (2015). Divest from the carbon bubble? Reviewing the implications and limitations of fossil fuel divestment for institutional investors. *Rev. Econ. Financ, 5*, 59-80.

Roberts, J. T., & Grimes, P. E. (1997). Carbon intensity and economic development 1962–1991: A brief exploration of the environmental Kuznets curve. *World Development, 25*(2), 191-198. doi:https://doi.org/10.1016/S0305-750X(96)00104-0

Rubin, J. (2016). The Case for Divesting from Fossil Fuels in Canada. In. Waterloo, ON: CIGI.

Rudd, A. (1979). Divestment of South African Equities: How Risky? *The Journal of Portfolio Management, 5*(3), 5-10.

Scipioni, A., Manzardo, A., Mazzi, A., & Mastrobuono, M. (2012). Monitoring the carbon footprint of products: a methodological proposal. *Journal of Cleaner Production, 36*(0), 94-101. doi:http://dx.doi.org/10.1016/j.jclepro.2012.04.021

Sievänen, R., Rita, H., & Scholtens, B. (2017). European Pension Funds and Sustainable Development: Trade-Offs between Finance and Responsibility. *Business Strategy and the Environment, 26*(7), 912-926. doi:10.1002/bse.1954

Suh, S. (2005). Developing a sectoral environmental database for input–output analysis: the comprehensive environmental data archive of the US. *Economic Systems Research, 17*(4), 449-469. doi:10.1080/09535310500284326

Tang, Q., & Luo, L. (2014). Carbon management systems and carbon mitigation. *Australian Accounting Review, 24*(1), 84-98.

Tippet, J. (2001). Performance of Australia's Ethical Funds. *Australian Economic Review, 34*(2), 170-178. doi:10.1111/1467-8462.00186

Trinks, A., Scholtens, B., Mulder, M., & Dam, L. (2018). Fossil Fuel Divestment and Portfolio Performance. *Ecological Economics, 146*, 740-748. doi:https://doi.org/10.1016/j.ecolecon.2017.11.036

Trinks, P. J., & Scholtens, B. (2015). The Opportunity Cost of Negative Screening in Socially Responsible Investing. *Journal of Business Ethics*, 1-16. doi:10.1007/s10551-015-2684-3

Wackernagel, M., Onisto, L., Bello, P., Callejas Linares, A., Susana López Falfán, I., Méndez García, J., . . . Guadalupe Suárez Guerrero, M. (1999). National natural capital accounting with the ecological footprint concept. *Ecological Economics, 29*(3), 375-390. doi:http://dx.doi.org/10.1016/S0921-8009(98)90063-5

Wackernagel, M., & Rees, W. E. (1997). Perceptual and structural barriers to investing in natural capital: Economics from an ecological footprint perspective. *Ecological Economics, 20*(1), 3-24. doi:http://dx.doi.org/10.1016/S0921-8009(96)00077-8

Waddock, S. A., & Graves, S. B. (1997). The corporate social performance - financial performance link. *Strategic Management Journal, 18*(4), 303-319. doi:10.1002/(sici)1097-0266(199704)18:4<303::aid-smj869>3.0.co;2-g

Waitzer, E. J., & Sarro, D. (2012). The public fiduciary: Emerging themes in Canadian fiduciary law for pension trustees. *Canadian Bar Review*, *91*, 163.

Wang, Q., Dou, J., & Jia, S. (2015). A Meta-Analytic Review of Corporate Social Responsibility and Corporate Financial Performance. *Business & Society*, *55*(8), 1083-1121. doi:10.1177/0007650315584317

Weber, O. (2014). The financial sector's impact on sustainable development. *Journal of Sustainable Finance & Investment*, *4*(1), 1-8. doi:10.1080/20430795.2014.887345

Weber, O. (2016, January 20). Digging into the Eco-Fund Ratings. *Corporate Knights.* Retrieved from http://www.corporateknights.com/reports/2016-eco-fund-rating/digging-into-the-eco-fund-ratings-14530788/

Appendix A:

List of Canadian companies within the Carbon Underground 200 (www.fossilfreeindexes.com)

Oil, Gas, and Coal Companies
Canadian Natural Resources
Imperial Oil
Cenovus Energy
Husky Energy
Crescent Point Energy
Suncor Energy
Pacific Rubiales Petroleum
Penn West Petroleum
ARC Resources
Canadian Oil Sands
Tourmaline Oil
Enerplus
Peyto E&D
Encana
Teck Resources
Capital Power
MEG Energy
Mitsui & Co.

Prophecy Coal	
Total	

Figure 1: Cumulative returns of S&P TSX and the divestment portfolios for distributed re-investment

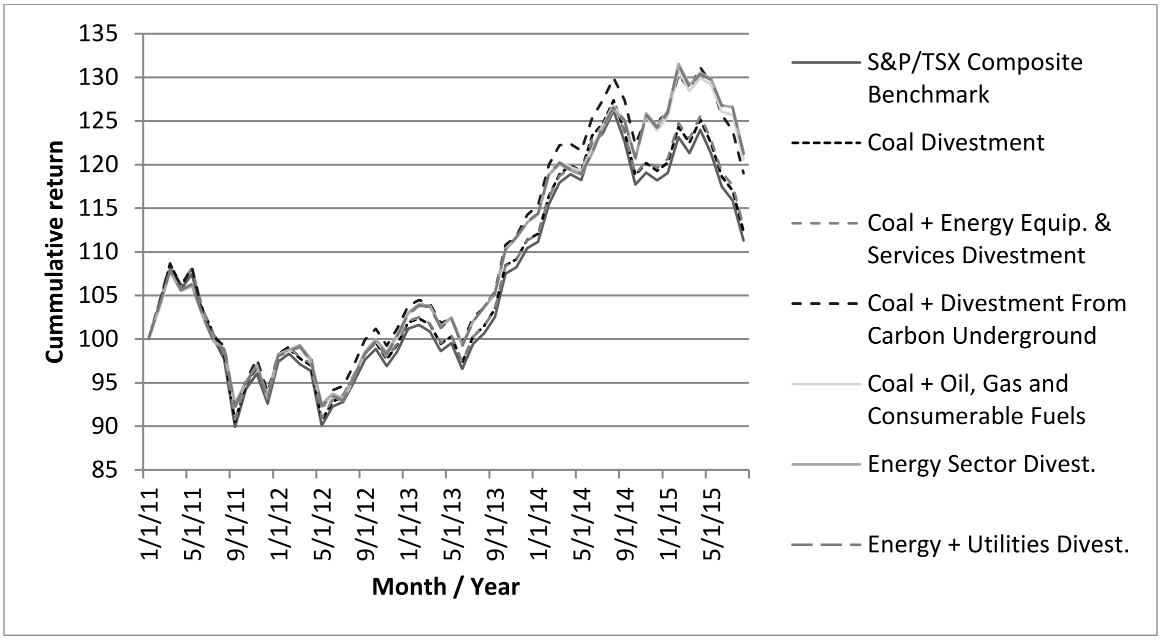

Figure 2: Cumulative returns for the divestment portfolios with green economy re-investment

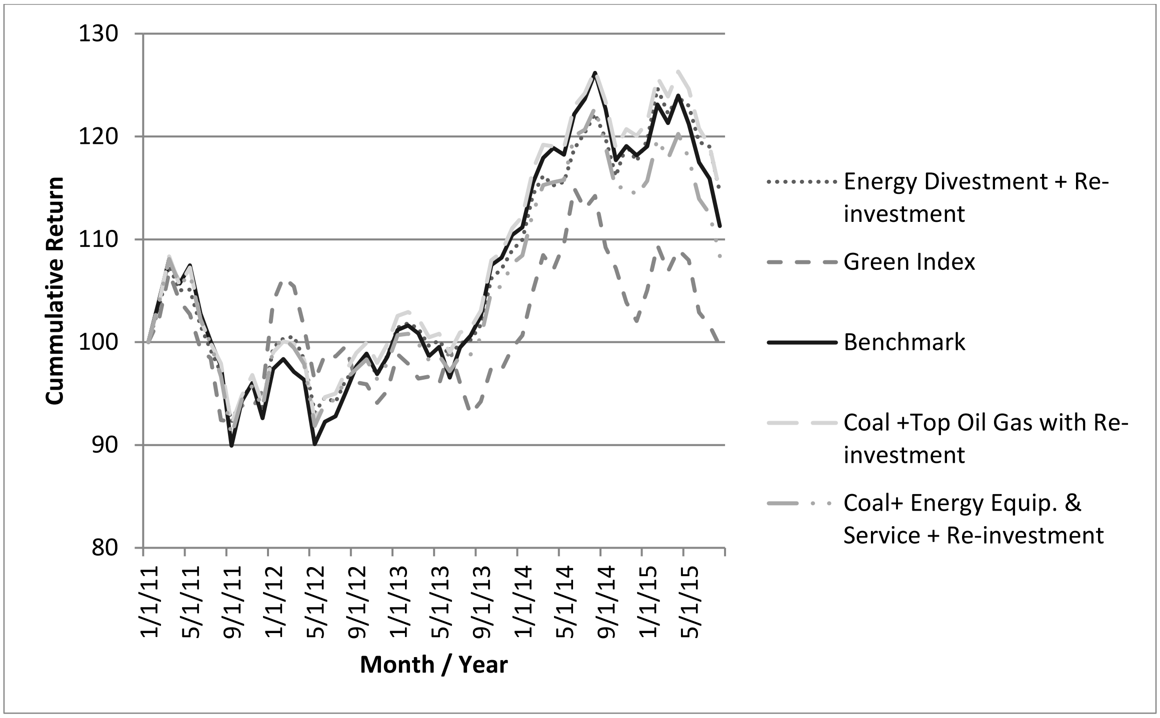

Figure 3: Carbon intensity of the benchmark and the divestment portfolios

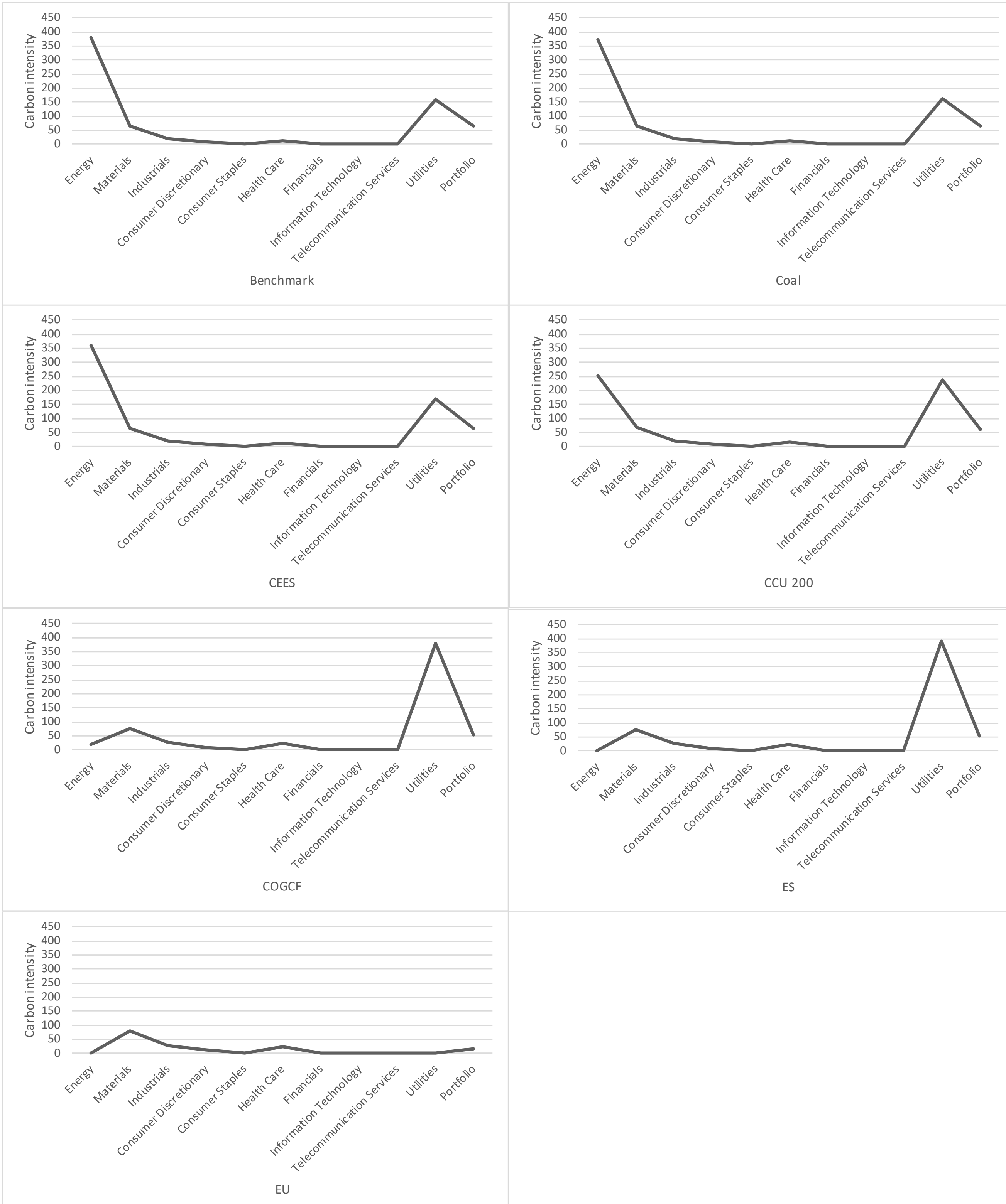

Table 1: Sector weights of the benchmark and the divestment portfolios

Sectors	Bench-mark	Coal	CEES	CCU200	COGCF	ES	EU
Energy	24.8%	24.4%	23.7%	16.5%	1.2%	0.0%	0.0%
Materials	15.1%	15.1%	15.2%	16.0%	17.7%	17.8%	18.5%
Industrials	8.4%	8.4%	8.5%	9.3%	11.0%	11.1%	11.7%
Consumer Discretionary	5.3%	5.4%	5.5%	6.3%	8.0%	8.1%	8.6%
Consumer Staples	2.8%	2.9%	3.0%	3.8%	5.5%	5.6%	6.1%
Health Care	2.9%	3.0%	3.1%	3.9%	5.6%	5.7%	6.2%
Financials	32.3%	32.4%	32.4%	33.2%	34.9%	35.1%	35.8%
Information Technology	1.7%	1.8%	1.8%	2.6%	4.3%	4.5%	5.0%
Telecommunication Services	4.7%	4.7%	4.8%	5.6%	7.3%	7.4%	8.0%
Utilities	1.9%	2.0%	2.0%	2.8%	4.5%	4.7%	0.0%

Table 2: Descriptive statistics of the S&P TSX Composite Benchmark and the divestment portfolios between January 1, 2011 and August 15, 2015

Index Statistics	S&P TSX	Coal	CEES	CCU200	COGCF	ES	EU
Total Return	11.30%	12.35%	12.89%	19.01%	20.56%	21.40%	21.28%
Annualized Return[1]	2.36%	2.57%	2.68%	3.87%	4.16%	4.32%	4.30%
Annualized Risk[2]	9.91%	10.10%	9.89%	9.69%	9.12%	9.05%	9.19%
Sharpe Ratio[3]	0.23	0.25	0.27	0.39	0.45	0.47	0.46
Annualized Active Return[4]	0	0.20%	0.31%	1.48%	1.76%	1.92%	1.90%
Annualized Active Risk[5]	0	0.44%	.37%	1.66%	3.04%	3.26%	3.21%
Information Ratio		0.45	0.85	0.89	0.58	0.59	0.59
Average # of Constituents/ Month	244	242	231	225	193	182	175
Weight of Energy Sector	24.80%	24.43%	23.70%	16.50%	1.24%	0	0
Avg. Weight Dist. Increase/ Stock[7]	0	1.013	1.021	1.203	1.351	1.351	1.386

[1]The annualized return is based on the geometric average. Dividends, management fees, and transaction costs were not included.

[2]Annualized risk is calculated on the on-price returns using monthly values and is the annualized standard deviation of monthly returns.

[3] Sharpe ratio does not include risk free rate

[4]Annualized active return = Annual Portfolio Return Ann. Benchmark Return –

[5]Annualized active risk is the annualized standard deviation of the active monthly returns.

[7]The average weight distribution increase for 01/31/2011. Each stock varies throughout the period due to the relative weight of the divestment portfolio against the index

Table 3: Financial return statistics for divestment and re-investment strategies

Statistics	S&P/TSX Composite	CEES (re-invest)	CCU200 (re-invest)	EU (re-invest)
Total Return	11.30%	8.37%	14.67%	14.60%
Annualized Return	2.32%	1.77%	3.03%	3.02%
Annualized Risk	9.91%	9.18%	9.15%	8.40%
Sharpe Ratio	0.23	0.19	0.33	0.36
Annualized Active Return	0	0.55%	0.71%	0.70%
Annualized Active Risk	0	2.23%	1.97%	3.45%
Information Ratio		0.25	0.36	0.203
Correlation (Sub Index vs. Green Index)		0.742	0.540	0.500

Table 4:Results of Carhart's Four Factor Model for the divestment portfolios

Portfolio	R^2	Risk Prem.	SML	HML	MOM	Alpha	P-value
CEES	.9988	.9889	-.0013	.001	.0009	.0002	<.001
CCU 200	.9744	.9629	-.001	-.012	-.0021	.0018	<.001
ES	.9134	.8941	-.0072	-.0287	.0076	.0015	<.001
CEES (green)	.9612	.8929	-.0027	-.0073	-.0046	-.0098	<.001
CCU 200 (green)	.9669	.8987	-.0022	-.0064	-.0045	-.0002	<.001
ES (green)	.8967	.8134	-.0072	-.0171	.0018	-.0009	<.001

"green" indicates re-investment in S&P/TSX Renewable Energy and Clean Tech Index

R^2 of bootstrapping and robust regression are the same as for OLS regression

Table 5: Carbon intensity of the benchmark and the divestment portfolios

Sectors	Indicator	Benchmark	Coal	CEES	CCU200	COGCF	ES	EU
Energy	Sector weight	24.76%	24.40%	23.68%	16.47%	1.20%	0.00%	0.00%
	Carbon intensity	1528	1528	1528	1528	1528	1528	1528
	Weighted carbon intensity	378.33	372.89	361.88	251.74	18.32	0	0
Materials	Sector weight	15.07%	15.13%	15.21%	16.01%	17.71%	17.84%	18.46%
	Carbon intensity	430	430	430	430	430	430	430
	Weighted carbon intensity	64.80	65.05	65.39	68.83	76.13	76.73	79.38
Industrials	Sector weight	8.37%	8.42%	8.50%	9.30%	11.00%	11.14%	11.71%
	Carbon intensity	232	232	232	232	232	232	232
	Weighted carbon intensity	19.42	19.54	19.73	21.58	25.52	25.84	27.17
Consumer Discretionary	Sector weight	5.33%	5.38%	5.46%	6.26%	7.96%	8.09%	8.65%
	Carbon intensity	128	128	128	128	128	128	128
	Weighted carbon intensity	6.82	6.88	6.99	8.01	10.18	10.36	11.07
Consumer Staples	Sector weight	2.85%	2.89%	2.97%	3.77%	5.47%	5.61%	6.15%
	Carbon intensity	27	27	27	27	27	27	27
	Weighted carbon intensity	0.77	0.78	0.80	1.02	1.48	1.51	1.66

Health Care	Sector weight	2.93%	2.97%	3.05%	3.85%	5.55%	5.69%	6.23%
	Carbon intensity	400	400	400	400	400	400	400
	Weighted carbon intensity	11.71	11.89	12.21	15.41	22.20	22.76	24.91
Financials	Sector weight	32.29%	32.37%	32.45%	33.25%	34.95%	35.08%	35.81%
	Carbon intensity	4	4	4	4	4	4	4
	Weighted carbon intensity	1.29	1.29	1.30	1.33	1.40	1.40	1.43
Information Technology	Sector weight	1.71%	1.75%	1.83%	2.63%	4.33%	4.47%	5.00%
	Carbon intensity	11	11	11	11	11	11	11
	Weighted carbon intensity	0.19	0.19	0.20	0.29	0.48	0.49	0.55
Telecommunication Services	Sector weight	4.68%	4.73%	4.81%	5.61%	7.31%	7.44%	7.99%
	Carbon intensity	22	22	22	22	22	22	22
	Weighted carbon intensity	1.03	1.04	1.06	1.23	1.61	1.64	1.76
Utilities	Sector weight	1.92%	1.96%	2.04%	2.84%	4.54%	4.68%	0.00%
	Carbon intensity	8354	8354	8354	8354	8354	8354	8354
	Weighted carbon intensity	160.05	163.74	170.43	237.33	379.11	390.64	0.00
Portfolio	Average carbon intensity	64.44	64.33	64.00	60.68	53.64	53.14	14.79