Norwegian School of Economics
Bergen, Spring 2021

Does fossil fuel divestment contribute to the clean energy transition?

An event study on fossil fuel divestment announcements

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Master Thesis, Economics and Business Administration

Major: Financial Economics

NORWEGIAN SCHOOL OF ECONOMICS

Acknowledgements

This thesis is written as a part of our Master of Science in Business Administration at the Norwegian School of Economics (NHH) and concludes two years of studies on Financial Economics. Although the circumstances of our studies were altered during the COVID-19 pandemic, we are grateful for the collaboration and support from our colleagues and professors at NHH who provided us with the partnership and tools to maximize our learning.

We would like to extend our gratitude to our supervisor Dr. Darya Yuferova for her valuable guidance and critique throughout the writing process.

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Abstract

This thesis aims to assess whether fossil fuel divestment announcements of institutions have a financial impact on the energy transition, by utilizing event study methodology to measure abnormal returns and trading volume of the top hundred global fossil fuel and renewable energy stocks with the highest market capitalization at the date of fossil fuel divestment announcements from 2014 through 2019.

While our findings do not yield significant abnormal returns for fossil fuel stocks for the sample from 2014 through 2019, we do find significant abnormal returns in events prior to 2016, suggesting that investors reacted to announcements in the earlier years of the divestment movement and do not find the recent announcements to provide significantly new information. We do not find significant abnormal returns for renewable energy stocks, both during the sample from 2014 through 2019, and in the sample prior to 2016.

In terms of trading volume, the findings yield significant cumulative average abnormal volume (CAAV) for both fossil fuel and renewable energy stocks during the event windows, which are defined as a subset of days before, after, and on the announcement day (day zero). Fossil fuel stocks experience positive CAAV during the short [0:3 days], long [0:10 days], and full event windows [-3:10 days], and renewable energy stocks experience negative CAAV during the long and full windows.

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1. Introduction

Over the past decade, growing awareness around climate change and the environmental impacts of the fossil fuel industry have sparked a shift to renewable energy and a divestment campaign against fossil fuels, resulting in financial and educational institutions, governments and other entities committing to divest. The importance of this transition has been recognized at an international level, and in 2021 the UN Secretary-General stated: "To achieve net zero emissions by 2050, we need an urgent transition from fossil fuels to renewable energy," and requested a strong commitment from all governments to end fossil fuel subsidies and construction of coal-fired power plants (UN, 2021). This request was followed shortly by the International Energy Agency's 2021 roadmap to net zero emissions by 2050 report, which recommended no new investment in new fossil fuel supply projects starting immediately (IEA, 2021). This report prompted international debate, with Japan and Australia indicating they will continue investing in fossil fuel regardless, and two of Norway's political parties expressing skepticism over the findings (Financial Times, 2021).

This transition from fossil fuels to renewable energy is reflected in financial markets. In 2020, investment in the energy transition[1] reached $501 billion, an increase of 113% from 2010 (Bloomberg, 2021). New investment in renewable energy made up a significant portion of this growth, with a global increase of 44% over the same period (Bloomberg, 2021). Additionally, the MSCI World ex Fossil Fuels Index, which eliminates exposure to fossil fuel reserves, outperformed the MSCI World Index in eight out of ten years from 2011 through 2020 (MSCI, 2021), and a 2020 study found that renewable power stocks were less volatile and provided higher returns than fossil fuels (IEA and CCFI, 2020), even outperforming oil in 2020[2] despite the COVID-19 pandemic (Bloomberg, 2021).

Although the fossil fuel divestment movement is widely supported as a driver of change, some argue that divestment has little to no effect on fossil fuel stocks and recommend a strategy of active engagement and new investment in clean energy instead. This paper contributes to this debate by examining whether fossil fuel divestment has a financial impact on the energy

[1] Investment in the energy transition includes investment in renewable energy, hydrogen, carbon capture and storage (CCS), energy storage, electrified transport, and electrified heat (Bloomberg, 2021).

[2] Clean energy shares measured by the WilderHill New Energy Global Innovation Index (NEX) gained 142% in 2020, while oil shares measured by the NYSE Arca Oil Index fell 38% (Bloomberg, 2021).

transition, by utilizing event study methodology to measure abnormal returns and trading volume of the top hundred global fossil fuel and renewable energy stocks with the highest market capitalization at the date of divestment announcements from 2014 through 2019. Based on the efficient market hypothesis, the public divestment announcements should be incorporated in stock prices within days of announcements, and we expect to find abnormal returns and trading volume within the event study window.

Existing studies have measured the impact of divestment on the fossil fuel industry, such as a study by Dordi (2016) which measures abnormal returns of fossil fuel stocks in relation to divestment related events, and a paper by Cojoianu et al (2020) which measures the effect of fossil fuel divestment commitments on the flow of capital into the oil and gas sector. However, there is limited research on the spillover effects that fossil fuel divestment may have on the renewable energy industry. In the case of fossil fuel divestment announcements, the spillover effect could be triggered by information spillover and portfolio rebalancing, and we are therefore interested in expanding the study to include the renewable energy stocks.

We also identify a lack of existing literature on the impacts of fossil fuel divestment announcements on trading volume. Based on Karpoff's (1986) theory of trading volume and Beaver's (1968) definitions of informational content, if a divestment announcement has informational content, it could have the potential to change investor expectations and actions, which could then affect trading volume. This paper therefore aims to expand upon existing literature and fill in the gaps around spillover to renewable energy as well as potential abnormal trading volume around divestment announcement events.

In this study, the analysis on abnormal returns finds that there are no statistically significant abnormal returns for fossil fuel or renewable energy stocks around fossil fuel divestment announcements. This result differs from the findings by Dordi (2016), who finds statistically significant abnormal returns for the fossil fuel industry in relation to fossil fuel divestment related events. However, this difference can be explained by the differences in event type, time range, event selection, and the sample of stocks used in the studies. Many of the significant results in the 2016 study are divestment campaigns or endorsements, whereas this study only considers the divestment announcements of institutions and excludes endorsements and campaigns. This suggests that the campaign and endorsements, or the global divestment movement itself, could be the drivers of the negative impacts on the fossil fuel industry rather than the individual pledges to divest.

We further conduct robustness checks to identify the differences in results, which find that conducting the analysis on events that occur prior to 2016 as done by Dordi (2016) does in fact yield significant negative returns for fossil fuel stocks. This change in significance over time can be interpreted through signaling theory, which could suggest that the first few years of the divestment movement provided new information and served as a signal to investors who adjusted their portfolios accordingly, and therefore did not react as significantly to the events in later years. However, conducting the analysis on events prior to 2016 still does not yield significant results for renewable energy stocks, and we still do not find spillover effects on the renewable energy industry.

In contrast to abnormal returns, we find significant cumulative average abnormal trading volumes for both fossil fuel and renewable energy stocks during event windows, which are defined as a subset of days before, on and after the announcement day, which we consider as day zero. Fossil fuel stocks experience positive cumulative abnormal trading volume in the short [0:3 days], long [0:10 days], and full [-3:10 days] event windows, with statistical significance at the 5% level in the short window and at the 1% level in the long and full windows. Renewable energy stocks, however, experience negative cumulative average abnormal trading volume during the long and full windows, with statistical significance at the 1% level. The difference in significance between abnormal returns and abnormal trading volume could be explained by Beaver (1968), which suggests that there are heterogeneous risk preferences among investors, resulting in just a subset of investors finding the information in divestment announcements to be valuable enough to adjust their portfolios.

The structure of this paper begins with an overview of theoretical framework, including an introduction to the discourse around the divestment movement itself. This is followed by the presentation of our hypotheses, an explanation of event study methodology and the model and methods used in this analysis, and the process of event selection and data collection. The next section presents the empirical findings and results, along with our interpretation of results and robustness checks. Finally, we present the conclusion, as well as the limitations of this paper and recommendations for future studies.

2. Theoretical Framework

2.1 Divestment as a form of activism

The action of divestment aims to create change by withdrawing capital from companies or industries engaged in certain activities (Ansar and Caldecott, 2016), and in the past divestment campaigns have targeted industries such as tobacco, munitions, adult services, gambling, and South Africa during the apartheid (Ansar and Caldecott, 2016).

The divestment campaign against South Africa's apartheid began in the 1970s, leading pension funds, churches, and university endowments such as Harvard's to divest from banks and companies connected to South Africa (Teoh, 1999). However, a 1999 study found that despite this campaign, the valuation of US firms with South African operations were not significantly affected by pension fund divestment, shareholder pressure or legislative sanctions (Teoh et al., 1999).

Another campaign launched in 1987 against tobacco, targeting academic institutions, legislatures and investment boards, and eventually led to Harvard University's divestment of almost $58 million USD in 1990 (Teoh et al., 1999). The movement was pushed by ethics and social policy, but also by doubts in the fiscal policy of investing in tobacco as the industry faced increasing regulation (Wander, 2007), similar to the case for fossil fuel divestment today. This socially responsible investment movement was identified as a contributing factor to the weakening share prices of tobacco stocks (Wander, 2007).

The fossil fuel divestment campaign emerged in 2008, led by the US NGO 350.org. It grew faster and wider than other divestment campaigns (Ansar and Caldecott, 2016), and by 2021 350.org listed 1,312 institutions committed to divest, with a total value of over $14.56 trillion USD (Fossil Free, n.d.). Notable divestments include the Rockefeller Brothers Fund, Norway's Government Pension Fund Global, New York City, and the Republic of Ireland, each controlling up to trillions in holdings.

2.2 Divestment versus engagement

While the fossil fuel divestment movement is widely praised as a catalyst for change, some prominent investors are skeptical to its effectiveness. In 2019, Microsoft co-founder Bill Gates was quoted saying: "Divestment, to date, probably has reduced about zero tonnes of emissions. It's not like you've capital-starved [the] people making steel and gasoline. I don't know the mechanism of action where divestment [keeps] emissions [from] going up every year" (Edgecliffe-Johnson and Nauman, 2019). Rather than divest, he argues, investors should instead fund innovations that reduce greenhouse gas emissions (Edgecliffe-Johnson and Nauman, 2019).

Similarly, Bill McNabb, the 2016 chief executive of asset manager Vanguard, criticized the fossil fuel divestment movement by saying it would "take something that was public and transparent and make it private and opaque, and a wealth creation vehicle for a small group of individuals" (Foley, 2016). He stated that considering there was no impact to the income or balance sheet of the company facing divestment, it is more effective to continue investing and engage with the company as a shareholder (Foley, 2016).

This perspective is supported by a report by the European Council on Foreign Relations, which suggests that divestment from fossil fuels is likely to have only a limited effect on equity or debt, and that even the maximum possible divestment from university endowments and public pension funds is unlikely to have a major effect on stock prices (Ansar and Caldecott, 2016). The findings also suggest that although coal-related firms listed on major stock exchanges appear to be affected, the direct impact on the oil and gas sector is likely minor, as alternative investors are easy to find (Ansar and Caldecott, 2016).

Furthermore, a Temple University study supports the case for investment and engagement, finding that after successful corporate social responsibility engagements on environmental and social issues, there was an improvement in accounting performance and governance of the companies that were engaged (Dimson et al., 2015). The probability of the success of the engagements increases if the firm engaged has reputational concerns (Dimson et al., 2015), which is relevant for the fossil fuel companies facing reputational risks as public awareness around the divestment campaign increases over time.

Another issue with fossil fuel divestment is that even if institutions commit, there is no guarantee that all capital will be divested. For example, BlackRock announced divestment from coal in January 2020, but only from companies with over 25% of revenue from thermal coal, and did not divest if clients did not explicitly choose to exclude coal. This strategy meant that even a year after committing to divest, BlackRock still held USD $85bn in coal companies (Jolly, 2021).

On the other hand, the argument in favor of divestment can be supported by its effect on the coal industry, which is less liquid with fewer traders and higher transaction costs (Ansar and Caldecott, 2016). A 2016 study found that the share prices of coal companies fell significantly since the announcement of divestments, with the Dow Jones Total Market Coal Sector Index down 76% from 2010 to 2015, compared to the 69% growth in the Dow Jones Industrial Average. Findings also showed that the campaign is likely to have led to more accurate pricing of climate risk (Ansar and Caldecott, 2016). Reputational risk is a type of transitional climate risk, so the potential for being boycotted and receiving unfavorable media attention could be incorporated into investment decisions.

Beyond the financial perspective, activists argue that the campaign creates change by removing the “social license to operate” (Edgecliffe-Johnson and Nauman, 2019). This sentiment has been echoed by investors such as the Rockefeller Brothers Fund, which was originally established with revenue from oil but has since committed to divest from fossil fuels. Justin Rockefeller of the fund addressed this in 2016, acknowledging that although the decision to divest was partly symbolic, the symbolism still mattered (Foley, 2016).

2.3 Efficient Market Hypothesis

The primary role of capital markets is the allocation of funds. To ensure that capital flows to where it can create the most value, it is important that market prices of securities reflect all information available about the value of the security. Fama (1970) defines a market where prices fully reflect all available information as an efficient market, entailing that whenever new information that is relevant for the security prices arises, it should quickly and correctly be incorporated in the price. Therefore, no trading strategies based on already available information can be used to obtain excess returns as this information should already be incorporated in the price. The efficient market hypothesis relies on three assumptions. First, markets are liquid and there are no transaction costs. Second, information is available and free for market participants. Third, market participants interpret new information similarly and act rationally.

Fama (1970) distinguishes between three forms of market efficiency. The weak form of market efficiency solely incorporates information about historical prices and returns. This means that trading strategies such as technical analysis where one looks at price patterns cannot yield excess returns. The weak form of efficiency builds on the random walk literature, where a series of prices change randomly from previous prices. The logic behind the theory is that if information is immediately reflected in stock prices, tomorrow's news will only be reflected in tomorrow's price changes and will be independent of today's price changes. By definition, news is unpredictable, and thus, price changes must also be random and unpredictable (Malkiel, 2003).

Semi-strong form of market efficiency also incorporates other information that might be relevant for the price of a security such as earnings announcements, stock splits, and other relevant information found in annual reports. The strongest form of market efficiency is concerned with whether certain individuals have monopolistic access to information that is relevant for the price of a security but not available to the public (Fama, 1970).

As divestment announcements are public information, this study assumes that markets are efficient in the semi-strong form. If investors value the information embedded in these announcements, it should, according to the efficient market hypothesis, be incorporated in stock prices within days of the announcement. However, if certain individuals are aware of the divestments before the announcement and choose to trade on this information, there could be abnormal returns prior to the announcement.

2.4 Information asymmetry and Signaling Theory

Spence (1973) was the first to introduce signaling theory and used the labor market to explain the theory in his original formulation. In a hiring process, the employer knows less about the quality of the candidate than the candidate in question. Therefore, candidates obtain education to reduce information asymmetries and signal their quality to potential employers. Stiglitz (2002) defines information asymmetries as a situation in which two parties have different levels of knowledge. In financial markets most information is available for the public, but some information is only available for a subset of investors. When this is the case, information asymmetries arise.

According to Stiglitz (2000), there are two types of information where asymmetries play an important part:

1. Information about quality, and
2. Information about intent.

In divestment announcements, quality could refer to the ability of the signaler (the divesting fund) to reach out to the public with their news, and the signaler’s ability to fulfill the needs of the receiver of the signal. In this setting, the second type of information asymmetries can be split in two. First, the funds signal their view on fossil fuel stocks and their stand in the energy transition. Second, it could also be viewed as a way of lowering information asymmetries in the way of releasing information about the excluded firm’s behavior. Furthermore, for a signal to be effective it needs to be observable, so the public must be able to observe the signal that the funds are sending. If it is not observed by the public, the signal will have less effect (Connelly et al., 2011).

2.5 A theory of Trading Volume

Karpoff (1986) based his theory of trading volume on the idea that investors are heterogenous, and that they idiosyncratically and periodically revise their demand prices. Information affects trading volume in two distinct ways and the theory provides a rationale for whether one can infer that an event contains information valued by investors.

Before explaining Karpoff's theory further, a definition of informational content will be provided. Beaver (1968) provides two definitions of informational content:

1. The information provided changes the expectations of the outcome of an event.

2. The information provided changes the expectations, and the change in expectations are large enough to change the decision-maker's actions.

By the first definition, a divestment announcement has informational content if it changes investor's beliefs of the probability distributions of future returns. In turn, this leads to a change in the equilibrium value of the current market price. By the second definition, a divestment announcement has informational content if it leads to changes in the holdings of a stock in an investor's portfolio. This change can happen through selling parts, or the entire portion of shares held or by buying more shares of the firm in question. Thus, both in the event of "good" and "bad" information, it is likely that the trading volume around these events will differ from normal trading volumes.

Going back to Karpoff, information affects trading volume in two different ways. Abnormally high trading volumes can arise from heterogeneous reactions amongst investors. However, this does not necessarily mean that investors disagree on how to interpret the information. It can reflect consensus amongst investors about the new information if their initial beliefs were different. Furthermore, new information can affect trading volume both positively and negatively. First, if the new demand price of potential buyers (non-owners) exceeds the new demand price of potential sellers (current owners), trading volume is expected to increase. Second, if the new demand price of potential buyers is lower than that of the potential sellers, trading volume is expected to decrease as a result of the new information (Karpoff, 1986).

Research on this area has shown that the abnormal trading volume related to an event are somewhat persistent over time. There are three ways one could interpret this. First, not all investors receive the information at the same time. This implies that some investors adjust their portfolios based on "old news". Second, certain investors might not be able to buy or sell as much as they want initially and must do their trades gradually. This could be explained by transaction costs or limits on size of trades. Finally, investors are affected by uncertainty and make mistakes, which are then corrected at a later time (Karpoff, 1986).

2.6 Alternative theories explaining abnormal returns and volume

In addition to the three main theories presented above, the following section will introduce theories and hypotheses that can help to explain abnormal returns and trading volume around the announcement date.

Sustainability and the Cost of Capital

According to the dividend discount model, the stock price is equal to future dividends, discounted at an appropriate discount rate to reflect the risk of the dividends. Research shows that firms with significant environmental concerns pay a higher credit spread on their loans than those firms that have policies in place to mitigate environmental risk. It is also shown that firms that operate more sustainably in the environmental dimension have a lower cost of equity through a reduced beta (Clark, Feiner, and Viehs, 2015). Therefore, if the credit and equity markets perceive divestment announcement as signals of high risk for the excluded firms, stock prices might decrease due to a higher discount rate.

The Liquidity Hypothesis

Studies show a strong negative correlation between the bid-ask spread and trading volume (Amihud & Mendelson, 1986). Thus, a high bid-ask spread limits the liquidity of a stock and then in turn also the price efficiency. A portion of the bid-ask spread is connected to information asymmetries between investors, and the spread increases when investors perceive information differently (Coller & Yohn, 1997). The liquidity hypothesis proposes that public announcements lower information asymmetries in a market. Lower asymmetries lead to lower bid-ask spreads and higher trading volume (Cheung & Roca, 2013).

Sustainability redundancy and sustainability taste

Cheung and Roca (2013) propose two hypotheses that can explain the abnormal returns and trading volume for ESG indices: the sustainability redundancy hypothesis, and the sustainability taste hypothesis. The former builds on traditional portfolio theory in which investors base their portfolio holdings solely on risk-adjusted returns. In this case, sustainable activities may be costly and reduce shareholders returns. The latter focuses on the extra utility added for investors that value sustainability. On top of the return received from holding the shares, additional utility is derived from holding shares in firms that operate sustainably. Thus, when firms are excluded from fund holdings, share prices should fall.

Downward sloping demand curve and price pressure hypothesis

Several important propositions in finance rely on horizontal demand curves for a firm's equity. This implies that investors can buy and sell shares without significantly affecting the stock price. If this holds, divestment announcements should not be accompanied by a decrease in stock prices. However, several studies have found that this may not be true, and that large block sales leads to a decrease in stock prices, which means that the demand curve is downward sloping (Shleifer, 1986).

According to the price pressure hypothesis this effect increases with the size of the block trade. The hypothesis explains this by the fact that when there are large trades, the share price must fall to induce investors to trade (Scholes, 1972).

Attention and information flow

Andrei and Hasler (2015) state that stocks that investors pay low attention to underreact to new information, while buying pressure and abrupt price reactions characterize stocks that investors pay high attention to. It is reasonable to believe that investors pay more attention to stocks that are covered by analysts, and that stocks with a high number of analysts covering them have stronger reactions to new information. Andrade, Bian and Burch (2013) show that the greater number of analysts covering a stock, the higher the rate of information flow in the market. Higher rate of information flow lowers information asymmetries and increases price and volume reactions.

Institutional holdings

Boehmer and Kelley (2009) argue that stocks with a higher percentage of institutional ownership are priced more efficiently. One natural explanation could be that institutional investors trade more frequently than individual investors, and therefore move their holdings to where it can create the most value when new information arrives. Furthermore, Sias (1996) finds that because institutional investors trade in larger volumes, stocks held by institutions tend to be associated with higher volatility. Trueman (1998) explains this by an increased probability of herding behaviour amongst institutional investors. One of the reasons for this behaviour is that the performance relative to other institutional investors are important. Thus, institutional investors may be inclined to act in response to other institutional investors' actions in order to not fall behind. This may lead to larger price movements, increased volatility, and higher trading volume.

2.7 Previous studies on divestments and ESG-based exclusions

As responsible investing has become a growing area of interest, the following studies have researched divestment events, inclusion in sustainable indices, and sustainable preferences of investors.

First, a study by Dordi (2016) measured the impact of divestment related events from 2012-2015, which include divestment pledges, endorsements, and campaigns, on the top 200 fossil fuel firms ranked by potential carbon emissions of their reported reserves. This effect was then compared to the effect of other events related to the carbon budget and stranded assets. The study uses both single-day and multi-day event windows and finds statistically significant negative abnormal returns for both. This shows that the markets do react to divestment announcements, not only on the day of the announcement but also in the days following the announcement, resulting in underperformance for the fossil-fuel firms through the post-event window. However, it should be noted that this effect is only found in multi-day event windows of five days or shorter, and events with overlapping event windows are included in the study. Furthermore, the study finds that divestment announcements and events related to the carbon budget and stranded assets have the same negative effect on share prices.

In another paper, Cojoianu et. al (2020) measured the effect of fossil fuel divestment commitments on the flow of capital into the oil and gas sector across 33 countries from 2000 to 2015. The study finds significantly lower capital flows to oil and gas companies as a result of divestment commitments. However, this effect is highly influenced by the specific country’s regulatory context, and the effect is diminished in countries that heavily subsidize fossil fuels.

Kappou and Oikonomou (2016) investigated the effect on financial and operational performance of firms being added to or removed from the MSCI KLD 400, a well-known social stock index. Although this study is done on an index rather than a specific fund’s investment portfolio, the signaling effect to the market is similar, and their findings are also relevant for this study. They did not find statistically significant results for stocks added to the index, but did find significant negative abnormal returns for stocks being excluded from the index. The study also finds that trading volume is significantly higher after exclusion, and that operational performance deteriorated after exclusion.

A paper by Bolton and Kaperczyk (2020) studied whether investors care about carbon risk by analyzing whether carbon emissions affected a cross-section of US stock returns. Their results find that there is a correlation between exclusionary screening by institutional investors and direct emission intensity (total emissions to sales), but only within in the oil and gas, utilities, and motor industries. This correlation is only found on scope 1 emissions, which are the direct emissions from production, and findings show that institutional investors had significantly smaller holdings in companies with high scope 1 emissions intensity. This relationship between divestment and emission intensity is not found to be significant in industries outside of oil and gas, utilities, and motor industries (Bolton and Kacperczyk, 2020).

Bassen, Kaspereit and Buchholz (2020) measured the effect of Blackrock's announcement of divesting from thermal coal. Their final sample of firms consisted of 318 firms along the coal supply chain. Most of the firms included in the study did not experience any abnormal returns, however, the study does yield negative abnormal returns for the largest coal mining firms, and finds that this effect was strongest for firms headquartered in the US.

Finally, a paper by Choi, Gao, and Jiang (2020) studied financial performance in relation to attention to global warming, by looking at events of abnormally high local temperatures and Google search volume related to climate change. In cases with abnormally high temperatures, Google search volume related to climate change increased, and carbon intensive firms underperformed firms with low carbon emissions in the financial markets. The study further finds that returns were unlikely to be due to changes in fundamentals, and that retail investors, rather than institutional investors, were the actors who were selling the firms. This has implications for our study, considering that the media attention surrounding each fossil fuel divestment announcement has the potential to increase the awareness of individual investors and thus affect returns of carbon-intensive fossil fuel firms.

3. Hypotheses

This thesis aims to capture the effect that fossil fuel divestment announcements have on both fossil fuel and renewable energy stocks. Our study is based on the belief that there is an energy transition from fossil fuels to renewable energy, and that divestment announcements accelerate this transition by affecting the returns of both fossil fuel and renewable energy stocks. According to the efficient market hypothesis the effects of the divestment announcements should be priced immediately when the market becomes aware of the new information. As these announcements are public information, the effects should be incorporated in stock prices immediately after the announcement. These beliefs are captured in the following hypotheses:

Hypothesis 1: Fossil fuel divestment announcements yield significant negative abnormal returns for fossil fuels firms.

Hypothesis 1 builds on the assumption that divestment announcements contain informational content valued by investors. According to signaling theory, divestment announcements provide investors with new information and information asymmetries are reduced. Furthermore, this hypothesis builds on the assumption that investors view divestment announcements as information concerning increased risk surrounding the excluded stocks. Consequently, investors will divest from the excluded stocks, creating a price pressure that reduces stock prices. Reduced stock prices are also in line with the theory of sustainability and the cost of capital, in which increased risk leads to a higher cost of capital, and in turn reduces the stock price.

Hypothesis 2: Fossil fuel divestment announcements yield significant positive abnormal returns for renewable energy firms.

This hypothesis is built on the assumption that divestment announcements have a spillover effect. When investors sell their holdings in fossil fuels, they may reallocate their money to the renewable energy industry. Furthermore, depending on how investors perceive the information a divestment announcement contains, the signaling theory may be relevant. Investors may perceive these announcements as a shift towards a future where fossil fuel is gradually phased out and the renewable energy sector grows stronger. Thus, to be a part of this shift, investors may be inclined to reduce their holdings in fossil fuel stocks and increase their holdings in renewable energy stocks, which in turn increases the price of renewable energy stocks.

Hypothesis 3: Divestment announcements yield a significant positive effect on abnormal trading volume for fossil fuel stocks.

Hypothesis 4: Divestment announcements yield a significant positive effect on abnormal trading volume for renewable energy stocks.

Hypotheses 3 and 4 are supported by Karpoff's theory of trading volume. Divestment announcements provide new information to the stock markets, which is valued by investors. These hypotheses build on the assumption that divestment announcements change investor expectations of future returns, and furthermore change their expectations enough to affect their behavior, leading to abnormal trading volume surrounding the announcement date. Hypotheses 3 and 4 are also supported by the liquidity hypothesis. The announcement lowers information asymmetries between investors, increases the liquidity of the stock, and in turn yields higher trading volumes.

Hypothesis 5: There is information leakage prior to the divestment announcement.

Hypothesis 5 builds on the assumption that the efficient market hypothesis of semi-strong form does not hold. This implies that certain investors acquire and trade on information before the information is available to the public. If this hypothesis holds, abnormal returns and trading volume will be present before the announcement day.

4. Event study methodology

The following section covers the event study methodology applied to test our hypotheses regarding abnormal returns and volume of fossil fuel and renewable energy stocks around fossil fuel divestment announcements. Event studies are often used to test the efficient market hypothesis and measure the relationship between an event and the return of securities. The test is conducted to identify abnormal returns relating to a specific event around a specified time, referred to as the event window (Kritzman, 1994).

In the beginning, most event studies conducted were only done in one country due to the strong assumption that there was a lack of integration between financial markets globally. However, due to international trade and foreign direct investment, financial literature in 1970s identified correlations between international financial markets, and found that international stock market movements were a major factor affecting domestic stock returns. Although this is well known in today's markets, there are certain complicating aspects one must have in mind when conducting a multi-country event study. First, an appropriate market portfolio must be chosen for the different regions included in the study. Second, the risk of confounding events is higher and must be accounted for. Third, there is a lack of synchronism in the market data between the regions (Park, 2004). These aspects and how to control for them will be discussed further in this part of the study.

According to MacKinlay (1997), the steps in an event study are as follows:

1. Define the event window.
2. Estimate the normal return using an appropriate return model and estimation window.
3. Estimate abnormal returns/volume.
4. Test the statistical significance of abnormal returns and abnormal volume.

4.1 Event window

Defining the event window is one of the most crucial parts of an event study. The event window must be long enough to ensure that the whole effect of the event is captured, but it must also be short enough to exclude confounding events. Another issue with long event windows is that it reduces the power of the t-statistic and can lead to false conclusions about the significance of the event (McWilliams, et al, 1997).

If the efficient market hypothesis were to hold, the effect on share prices should be seen immediately. However, even if the event is an announcement given on a specific date it is typical to set the event window length to more than one day, as this allows the analysis to capture abnormal returns around the day of the event (MacKinlay, 1997). Furthermore, including 3 days prior to the event in the event window allows the analysis to capture potential effects of information leakage, which is a breach of the efficient market hypothesis of the semi-strong form.

Table 1: Event windows

Interval	**Length**
Pre-event window	[-3:-1]
Short window	[0:3]
Long window	[0:10]
Full window	[-3:10]

Note: Table 1 describes the length of the different event windows. 0 denotes the event day. A negative number indicates number of days prior to the event day.

This study will include four event windows. The pre-event window is designed to capture abnormal returns due to information leakage. To isolate the effect surrounding the actual day of announcement, a short window is applied. The long window is applied to capture long-term effects of announcements, excluding any effects of potential information leakage prior to announcement. Finally, the full event window should capture all abnormal returns due to divestment announcements.

4.2 Estimation window

After defining an event window, an estimation window must be defined. It is most common to use the period prior to the event. MacKinlay (1997) suggests a period of 120 trading days prior to the event as a proxy for the length of the estimation window, however, other windows are also common. For the estimation period not to be influenced by any effects of the event, it is crucial that the event period itself is not included in the estimation window. If the data in the estimation window is tainted by return data in the event window, the abnormal return would be biased. Therefore, a hold-out-period should be included between the estimation window and the event window (Lynch & Mendenhall, 1997).

It is also important to identify confounding events, which are separate events that could influence the results of the study. These events can be controlled by excluding firms with confounding events, grouping firms with the same confounding events, excluding firms on the day of the confounding event, or taking the financial impact of the confounding event into account during the estimation of the abnormal returns (Park, 2004).

As Park (2004) points out, multi-country event studies add complexity to the choice of the appropriate estimation window, as there is a higher chance of country-specific events influencing the estimation window. Optimally, researchers should investigate every country to check if such events have occurred during the period. However, this is a very time-consuming task for event studies covering a large number of countries. As an alternative, Park (2004) suggests employing a longer estimation period to reduce the potential effect these events can have. By doing this, unusual market movements due to country-specific events will only affect small portion of the estimation period.

To reduce effects of country-specific events, this study will use an estimation window of 250 trading days prior to the event. Furthermore, to prevent against biased results, a hold-out period of 21 trading days is also included.

Table 2: Event study timeline

	Estimation window	**Hold-out period**	**Event window**
T	T = [-274:-25]	T = [-24:-4]	T = [-3:10]
Trading days	250	21	14

Note: Table 2 describes the length of the estimation window, hold-out period, and event window. 0 denotes the event day. A negative number indicates number of days prior to the event day.

4.3 Estimation of normal returns

There are a number of approaches to calculate the normal return of a given security. These approaches can be grouped into statistical and economic models. Economic models rely on both statistical assumptions and economic arguments, while statistical models only rely on statistical assumptions. MacKinlay (1997) presents four models to estimate normal returns. First, the constant mean return model assumes that the normal return of a stock is the mean return of that stock, and further assumes that the mean return is constant over time. Second, the market model relates the return of a security to the return of a given market portfolio, assuming the relationship between the return of the security and the return of the market is linear. Third, factor models aim to reduce the variance of abnormal returns by explaining more of the variation in the normal return. Finally, the capital asset pricing model (CAPM) is an equilibrium theory where the expected return of an asset depends on the risk-free rate, the assets covariance with, and the expected return of the market portfolio.

Park (2004) emphasizes the importance of taking domestic factors such as exchange rates, inflation and GDP-growth into account when conducting a multi-country event study. Thus, arguments for using a factor model where these factors are accounted for could be made. However, data availability tends to limit the effect of these factors in event studies where daily data is used, as most economic data are only available on a monthly basis. Thus, there would be no volatility in these factors during the event window when daily returns are used and the event window only spans over a few days. Although other factor models such as the FF3 or FF5 could be used, the observations in this study are the 100 largest fossil fuel and renewable energy stocks measured by market capitalization at the time of the announcement. Thus, the added complexity of these models will not provide more accurate results, but would rather be biased to the SMB-factor (small minus big firms). The market model is preferable compared to the constant mean model because the variance of abnormal returns related to the market variance is reduced using the market model (MacKinlay, 1997). A problem with the CAPM is that the output of the model is sensitive to restrictions and that those restrictions are questionable. As this can be avoided by using the Market model, this study will use the Market model to measure normal returns.

4.3.1 The Market Model

The market model relates the return of a stock to the return of a chosen market portfolio and assumes that there is a linear relationship between the two. The model builds on the assumption that security returns are normally distributed.

$$R_{it} = \alpha_{it} + \beta_{it} * R_{mkt} + \varepsilon_i \qquad (5.1)$$

R_i and R_{mkt} represent the rate of return for the security and for the chosen market portfolio on day t. α_i and β_i represent the intercept (alpha) and the security's exposure to systematic risk. Lastly, ε represents the error term and has expected value of zero.

The parameters in the market model are estimated using the estimation window sample with an ordinary least squares regression (OLS). The estimated parameters, stock and market index returns are then used to measure the abnormal returns during the event window. The market model controls for market movements and for the risk of the stock (beta) during the event window (Binder, 1998).

In order to control for geographical differences, regional market indices are used as a proxy for market return. As the stocks included in this study are the 100 largest fossil fuel and renewable energy stocks measured by market capitalization at the time of the events, the indices used are all mid to large capitalization indices. The following four indices are used:

Table 3: Market indices

Region	Index	Currency	Market Cap	Constituents
North America	MSCI North America Index	USD	Mid and large cap	709
South America	MSCI Emerging Markets Latin America Index	USD	Mid and large cap	103
Asia Pacific	MSCI AC Asia Pacific Index	USD	Mid and large cap	1 544
Europe	MSCI Europe Index	USD	Mid and large cap	432

Note: Table 3 shows the chosen market indices for the different regions.

4.4 Abnormal returns

After computing the normal return using the market model, the abnormal return can be measured. The abnormal return is the actual stock return minus the normal stock return in the event window. The formula for measuring abnormal returns is as follows:

$$AR_{it} = R_{it} - \hat{\alpha}_i - \hat{\beta}_i R_{mkt} \quad (5.2)$$

$\widehat{\alpha_\iota}$ and $\widehat{\beta_\iota}$ represent the estimated alpha and beta over the estimation period.

To draw overall inferences of the event in question, the abnormal returns must be aggregated. The aggregation is done through two dimensions, across securities and through time (MacKinlay, 1997).

4.4.1 Aggregation across securities

Daily abnormal returns are calculated for each individual security using the formula above. Then, daily abnormal returns are aggregated and averaged by the number N securities for each day of the event window, yielding daily average abnormal returns (AAR). AAR is calculated as follows:

$$AAR_t = \frac{1}{N}\sum_{i=1}^{N} AR_{it} \quad (5.3)$$

4.4.2 Aggregation across securities and through time

After aggregating abnormal returns across securities, the aggregation through time can be calculated. When aggregating through time, the cumulative abnormal returns (CAR) are found for each individual security, and the cumulative average abnormal return (CAAR) is found for all securities combined. CAR and CAAR are the sum of returns of a given time period (MacKinlay, 1997). Thus, for this study's short event window, the CAR of a given security will be the sum of the abnormal returns of day 0 to day 3. CAR and CAAR are calculated as follows:

$$CAR_i = \sum_{t=T_1}^{T_2} AR_{it} \quad (5.4)$$

$$CAAR = \sum_{t=T_1}^{T_2} AAR_t \quad (5.5)$$

Where T_1 and T_2 represent the first and last day of the event window, respectively. After computing the CAAR, the next step is to perform a test for statistical significance.

4.4.3 Significance testing

To test the significance of AAR and CAAR we must compute the variance for each stock in the sample. The conditional variance consists of two components: the disturbance variance, and additional variance due to sampling error in beta and alpha. The sampling error leads to serial correlation even though the true disturbances are not dependent through time. However, by increasing the estimation window, this part of the equation approaches zero and the sampling error vanishes (MacKinlay, 1997). Thus, by choosing a longer estimation window it is reasonable to assume that this problem is avoided. The variance for each stock is computed as follows:

$$\sigma^2(AR_{it}) = \sigma^2_{\varepsilon_i} + \frac{1}{L_1}\left[1 + \frac{(R_{mkt} - \hat{\mu}_{mkt})^2}{\hat{\sigma}^2_{mkt}}\right] \tag{5.6}$$

However, by employing a long estimation window the second part of the equation can be removed and the variance for each stock is:

$$\sigma^2(AR_{it}) = \sigma^2_{\varepsilon i} \tag{5.7}$$

Next, after computing the variance for each stock, the sample variance for AAR is computed:

$$\sigma^2(AAR_t) = \frac{1}{N^2}\sum_{i=1}^{N} \sigma^2_{\varepsilon i} \tag{5.8}$$

Finally, a two-tailed t-test is applied to test the significance of the CAARs over the different event window periods. L represents the length of the event window.

$$t(CAAR) = \frac{CAAR}{\sqrt{\sigma^2_{AAR} * L}} \tag{5.9}$$

The same formula is applied when calculating the significance of AAR. As L represents the length of the event window and AAR represents average abnormal returns per day in the event window, L equals 1 and the formula becomes:

$$t(AAR_t) = \frac{AAR}{\sqrt{\sigma^2_{AAR}}} \tag{5.10}$$

4.5 Abnormal trading volume

This study will also measure whether divestment announcements result in abnormal trading volume. The trading volume metric is measured as the number of shares traded on a given day, divided by the number of shares outstanding.

This is done so that the results will not be affected by the fact that some firms have a higher number of shares outstanding than others (Beaver, 1968).

$$V_{it} = \ln\left(\frac{n_{it}}{S_{it}} * 100\right) \tag{5.11}$$

n_{it} denotes number of shares traded for securtiy i at time t, and S_{it} denotes the number of outstanding shares for security i at time t. According to Chae (2005), trading volume can be highly non-normal. To correct for this, trading volume is log-transformed.

To estimate the abnormal trading volume, the study relies on a mean-adjusted model. Formula 5.12 shows the mean-adjusted model.

$$AV = V_{i,t} - \overline{V_{\iota,t}} \tag{5.12}$$

Where V_{it} represents the trading volume metric for stock i at time t and $\bar{V}_{it}$ represents the mean trading volume in the estimation period and is calculated as follows:

$$\overline{V_{\iota,t}} = \frac{1}{T}\sum_{T=t_0}^{T_1} V_{i,t} \tag{5.13}$$

T denotes the number of days in the estimation period. The same estimation window as for abnormal returns is applied for abnormal volume, namely 250 trading days. As with abnormal returns, abnormal trading volume must be aggregated across securities and through time. Formula 5.14 shows the calculation of daily average abnormal trading volume (AAV).

$$AAV_t = \frac{1}{N}\sum_{i=1}^{N} AV_{it} \tag{5.14}$$

We further calculate the cumulative average abnormal volume (CAAV) following the same method as Chae (2005). Summing AAV over the days in the different event windows yields cumulative abnormal trading volume. Calculations are shown in formula 5.15.

$$CAAV = \sum_{t=T_1}^{T_2} AAV_t \tag{5.15}$$

To test for statistical significance, the standard deviation of average abnormal trading volume must be calculated. The calculation is shown in formula 5.16.

$$\sigma AV = \sqrt{\frac{1}{T}\sum_{T=t_0}^{T_1}(AV_t - \overline{AV_t})^2} \tag{5.16}$$

Lastly, the calculation of the T-stat is shown in formula 5.17.

$$t_{AV,t} = \frac{\overline{AV_t}}{\sigma AV} \tag{5.17}$$

4.6 Cross-sectional analysis

To further extend our study, we perform a cross-sectional analysis. Theoretical insights can result from examining the relationship between the cumulative abnormal volume and characteristics specific for the stocks included in the study. According to MacKinlay (1997), a cross-sectional analysis is particularly useful when several hypotheses explaining abnormal volume exists.

The regression consists of seven independent variables and three dummy variables. Free float and bid-ask spread are included to account for liquidity. Return on assets, debt to assets, the price to book ratio, and number of analysts covering the stock are included to account for firm-specific characteristics. Finally, dummy variables representing the region of the stock exchange that the stock is listed on are included in the regression to test for any effects the regions may have on the cumulative abnormal volume.

The following regressions are used in the cross-sectional analysis.

$$\begin{aligned} CAV = \alpha + \delta_1 Fossil\ fuel + \beta_1 Free\ float + \beta_2 Bid\ ask\ spread \\ + \beta_3 Institutional\ investors + \beta_4 Return\ on\ assets + \beta_5 Debt\ to\ assets \\ + \beta_6 Price\ to\ book + \beta_7 Analysts + u \end{aligned}$$

$$\begin{aligned} CAV_{Fixed\ Effects} \\ = \delta_1 Fossil\ fuel + \beta_1 Free\ float + \beta_2 Bid\ ask\ spread \\ + \beta_3 Institutional\ investors + \beta_4 Return\ on\ assets + \beta_5 Debt\ to\ assets \\ + \beta_6 Price\ to\ book + \beta_7 Analysts + \delta_2 North\ America + \delta_3 Asia\ Oceania \\ + \delta_4 Europe + u \end{aligned}$$

5. Data

5.1 Event selection

Identifying divestment events

This study consists of 15 individual divestment announcement events from 2014 to 2019. By the beginning of 2021, the Fossil Free campaign had listed 1,312 institutions that committed to divest from fossil fuels (Fossil Free, n.d.), so it is necessary to narrow down the events to a sample of quality events for this study. In order to select the events, we first set a window of time beginning in 2014, as the fossil fuel campaign had gained international traction and began to grow quickly at this point. Due to the COVID-19 pandemic, events during and after December 2019 have been excluded, so the end date is set to 30th November 2019. To identify the individual events, the Lexis Nexis database was used to gather newspaper articles, newswires and press releases containing the keywords 'fossil fuel divest' that were published between 1st January 2014 and 30th November 2019. The news sources were then narrowed to The Guardian and Financial Times due to the Financial Times' strong reputation for reporting on business matters, and the Guardian's history of covering the fossil fuel divestment campaign. This resulted in the identification of 32 divestment announcement events.

Exclusion criteria

These events are further filtered by removing those where external confounding events fall within the event window, events where the event windows overlap with each other, events with simultaneous pledges to invest in renewable or green technology, and those with a lack of information.

To identify confounding events, the LexisNexis database is again used to compile events related to the fossil fuel divestment campaign and the shift to renewable energy. We identified seven confounding events that could have an impact on the fossil fuel and renewable energy companies' returns, as they include commitments or targets related to at least one of the industries. These confounding events are presented in appendix 1. This step excluded one event which included the 2014 UN Climate Summit in its event window. As mentioned previously, we also considered the entire COVID-19 pandemic as a confounding event, so all events after 30th November, 2019 are excluded.

Next, we consider divestment events themselves to be confounding when their event windows overlap with each other. We therefore eliminate the events with overlapping event windows, as we cannot separate their individual effects. This step eliminated the divestment announcements of an additional 12 institutions.

We further excluded the divestment events of three institutions due to their simultaneous pledges to invest in renewable energy alongside the divestment, as this study aims to identify whether fossil fuel divestment has an effect on fossil fuel stocks and whether there are observable spillover effects on renewable energy stocks, and the addition of a simultaneous pledge to invest in renewable energy could affect the results. Finally, one event was excluded due to a lack of relevance, as the institution that committed to divest did not actually hold investments in fossil fuels at that time. All excluded events can be found in appendix 2.

After the full selection and exclusion process, we are left with 15 events on which the study is conducted, presented in appendix 3. Each event consists of an institution's announcement to divest from at least one type of fossil fuel.

5.2 Data collection and processing

Data Collection

Data on fossil fuel and renewable energy firms is retrieved from Refinitiv Eikon, and the data processing and empirical analysis of the study is done in R. To identify the 100 largest firms in the fossil fuel and renewable energy sectors at the date of each divestment announcement event, the “screener” function in Eikon is used, and the firms’ market caps are calculated by multiplying the shares outstanding by the share price at the event date. The full list of the fossil fuel and renewable energy stocks used in this study and the breakdown by region can be found in appendix 15, 16, 17, and 18.

When retrieving the returns and volume for each of the top fossil fuel and renewable energy firms, we use daily data in order to identify abnormal returns or trading volume on each specific day during the event window. Daily historical stock prices (close prices), trading volume, and market index prices are collected in datastream through Refinitiv Eikon for 274 days prior to the event through 10 days after the event.

$$r_{i,t} = \frac{P_{i,t}}{P_{i,t-1}} - 1 \qquad (6.1)$$

$$V_{it} = \left(\frac{n_{it}}{S_{it}} * 100\right) \qquad (6.2)$$

According to Morse (1984), daily returns are preferred in all event studies, apart from cases where there is uncertainty about the actual date of the event. The use of daily returns is also supported by MacKinlay (1997) who states that studies employing daily data experience increased significant results.

Data Processing:

In a multi-country event study, there will be a lack of synchronism in stock market trading data between countries. Between Asian and European countries there is a difference of about 5 or 6 hours, and there is also the same difference between European and American countries. This means that there is a 12-hour difference between Asian and American countries. To adjust for the time difference, Asian and Australian stocks are lagged by 1 day as suggested by Park

(2004). It is important to note that this depends on where the stocks are trading, not where their operations or headquarters are.

During the data cleaning process, observations with missing data on returns and trading volume are removed from the sample. Throughout this paper we refer to the sample as the top 100 fossil fuel and renewable energy stocks at the time of each divestment announcement, but the exact number of observations for each divestment vary slightly due to this processing step. The final number of observations for fossil fuels and renewable energy stocks is shown in table 4. Initial sample, exclusions, and the final sample for fossil fuel and renewable energy stocks separately can be found in appendix 4 and 5.

Table 4: Final sample

Date	Institution	Initial sample	Exclusions	Final sample
07.05.2014	Stanford University	200	15	185
07.10.2014	Australian Local Government Super	200	15	185
23.11.2014	KLP	200	12	188
19.01.2015	Nordea	200	12	188
05.02.2015	Norwegian Government Pension Fund Global	200	12	188
02.03.2015	City of Oslo	200	10	190
08.07.2015	University of Warwick	200	14	186
10.09.2015	University of California	200	11	189
01.04.2016	Saudi Arabia	200	12	188
13.12.2016	Southwark council pension fund	200	15	185
15.05.2017	BMO Global Asset Management	200	11	189
05.02.2018	Edinburgh University	200	9	191
12.07.2018	Republic of Ireland	200	12	188
09.03.2019	Norwegian Government Pension Fund Global	200	13	187
07.05.2019	KLP	200	17	183
	Total	**3 000**	**190**	**2 810**

Note: Table 4 displays the date of the divestment announcement, the divesting institution, and the quantity of the sample of the top fossil fuel and renewable energy stocks by market cap at the date of the announcement (this number does not represent the institutions' holdings in fossil fuel or renewable energy stocks). Each event starts with 200 initial stocks. The exclusions column presents the number of stocks removed due to missing data, and the final sample column presents the number of stocks on which the analysis is conducted.

To treat for outliers in the estimation window, the data is winsorized at the 1st and 99th percentiles, as these outliers could affect the results of the regression used to calculate abnormal returns during the event window. Additionally, the returns and trading volume are log transformed. As suggested by Henderson (1990), although log transformation does not seem to be an important consideration in event studies, there is still reason to use log transformed returns as this step improves the normality of the return distribution. The returns are log transformed using the following formula (Henderson, 1990):

$$r_{i,t} = \ln(1 + r_{i,t}) \tag{6.3}$$

where R_{it} = continuously compounded return on security i in period t.

We also log transform trading volume, as a paper by Ajinkya & Jain (1989) states that the natural log transformed volume can improve the normality of the distribution (Ajinkya & Jan, 1989).

$$V_{it} = \ln(1 + V_{it}) \tag{6.4}$$

Appendix 6, 7, 8, and 9 present the distributions of returns and volume for fossil fuel and renewable energy stocks. As the figures display a bell curve shape we can infer that the normality assumption holds. Table 5 shows a summary of the data used in this study.

Table 5: Summary Statistics

Statistic	Min	Pctl(25)	Median	Mean	Pctl(75)	Max	St. Dev.
CAR (FF)	-0.416	-0.048	-0.012	-0.012	0.025	0.308	0.067
CAR (RE)	-1.395	-0.069	-0.009	-0.008	0.054	1.976	0.142
CAV (FF)	-1.568	-0.208	0.042	0.392	0.861	3.441	1.206
CAV (RE)	-6.218	-1.677	-0.114	-0.169	0.881	6.721	3.078
Free float (FF)	0.108	0.357	0.826	0.683	0.994	0.999	0.332
Free Float (RE)	0.239	0.418	0.629	0.628	0.827	1	0.243
Institutional Investor (FF)	0.017	0.135	0.378	0.439	0.749	0.956	0.325
Institutional Investor (RE)	0	0.019	0.192	0.274	0.479	0.82	0.271
ROA (FF)	-0.049	0.017	0.044	0.044	0.075	0.126	0.045
ROA (RE)	-0.533	-0.06	0.012	-0.041	0.053	0.161	0.173
D/A (FF)	0.063	0.167	0.242	0.27	0.363	0.542	0.135
D/A (RE)	0	0.072	0.234	2.782	0.418	817.199	40.325
P/B (FF)	0.56	1.079	1.589	2.129	2.535	7.105	1.606
P/B (RE)	0	0.946	1.819	5.925	3.363	1,016.27	42.779

Note: Table 5 presents summary statistics for the sample of the top 100 fossil fuel and top 100 renewable energy stocks, as ranked by market cap, at the date of each divestment announcement. CAR FF, CAR RE, CAF FF, and CAV RE are calculated for the long event window. Free float represents the percentage of the firm's tradable shares, and institutional investor represents the percentage of shares held by institutions.

6. Empirical findings and results

The following section displays our empirical findings and interpretation of results. We first present findings on abnormal returns. As we do not find significant abnormal returns for fossil fuel stocks or renewable energy stocks separately, we present the difference in cumulative average abnormal returns (CAAR) in section 6.1 to analyze whether the impact of divestment announcements differs significantly between the two industries. Average abnormal return (AAR) and CAAR for fossil fuel and renewable energy stocks with their respective T-stat can be found in appendix 10, 11, 12, and 13.

Second, we present the findings on cumulative average abnormal volume CAAV. As CAAV is statistically significant for both fossil fuel and renewable energy stocks, this is presented separately for both industries. Finally, we present the findings of the cross-sectional analysis, followed by the interpretation of the results and robustness checks.

6.1 Abnormal returns

We do not find significant abnormal returns for fossil fuel stocks or renewable energy stocks on a daily basis nor when looking at the defined event windows. Hypothesis 1 states that divestment announcements should yield significant negative abnormal returns for fossil fuel stocks. As our results do not support this, hypothesis 1 is rejected. Furthermore, hypothesis 2 builds on the assumption that the divestment announcements should have a spillover effect on renewable energy stocks, and states that we should see significant positive abnormal return for renewable energy stocks. Our results do not support this and hypothesis 2 is rejected.

We further compare the difference in CAAR between fossil fuels and renewable energy to identify whether there is a stronger negative reaction in fossil fuels compared to renewable energy. As we do not find any significant differences in CAAR between the two industries, as presented in Table 6, we again cannot say that fossil fuel divestment announcements have a spillover effect on the abnormal returns of the renewable energy industry.

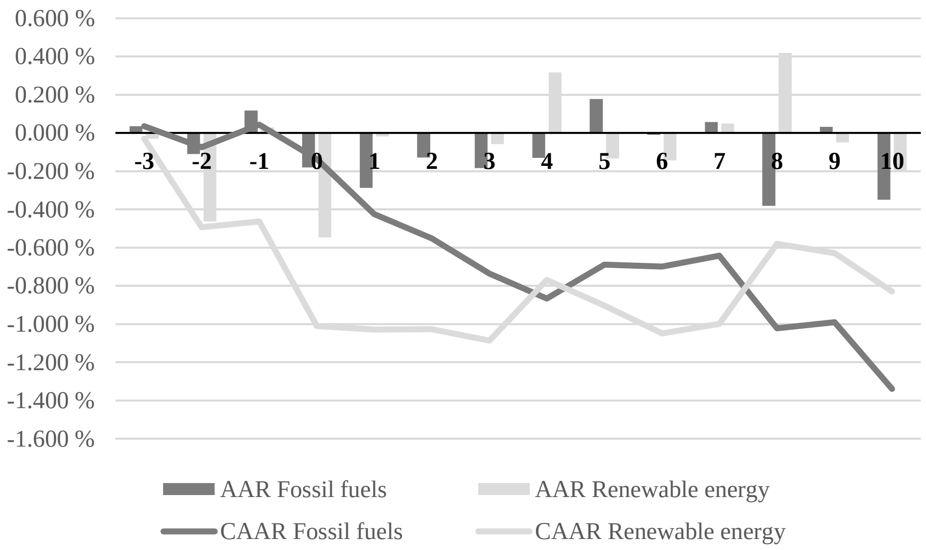
Table 6: Comparison of CAAR for fossil fuel and renewable energy stocks

Event window	CAAR FF	CAAR RE	Difference	T-stat
Pre-event	0.043 %	-0.464 %	0.507 %	1.375
Short window	-0.780 %	-0.623 %	-0.157 %	-0.369
Long window	-1.383 %	-0.365 %	-1.017 %	-1.441
Full window	-1.339 %	-0.829 %	-0.510 %	-0.641

*Note: Table 6 displays the difference in CAAR for fossil fuel stocks and renewable energy stocks. The T-stat represents the significance of the difference in CAAR. Significance levels: *p<0.10, **p<0.05, ***p<0.01.*

Figure 1 presents AAR and the development in CAAR for fossil fuel and renewable energy stocks over the full event window. Renewable energy stocks experience considerable declines in return two days prior to the event and on the event day. Fossil fuel stocks experience a stable decline in returns from one day before the announcement to four days after. On day eight after the announcement fossil fuel stocks continue to decline, whilst renewable energy stocks experience positive abnormal returns.

Figure 1: AAR and CAAR over the full event window



Note: Figure 1 presents the average abnormal returns and cumulative average abnormal returns for fossil fuel and renewable energy stocks during the full event window.

6.2 Abnormal trading volume

The following section presents the analysis of abnormal trading volume for both fossil fuel and renewable energy stocks around fossil fuel divestment announcements. We first calculate the CAAV for fossil fuel and renewable energy stocks following the methodology used by Chae (2005), presented in the table below. Fossil fuel stocks experience significant positive abnormal volume as a result of divestment announcements, while renewable energy stocks experience significant negative abnormal volume.

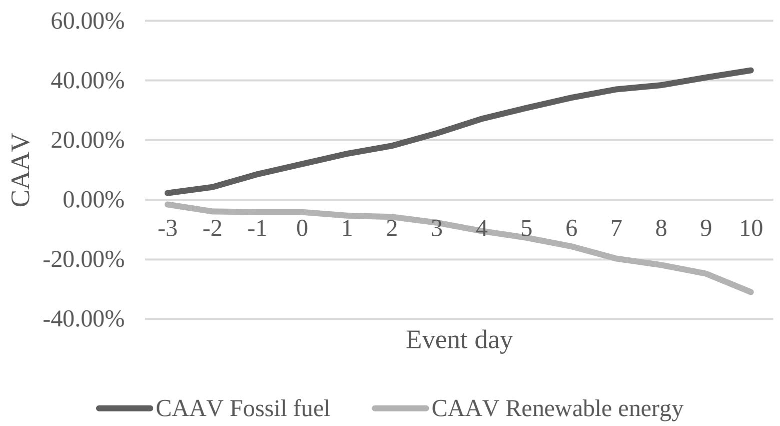
Table 7: CAAV **-** Fossil fuels and renewable energy

	Fossil fuels		Renewable energy	
Event window	**CAAV (%)**	**T-stat**	**CAAV (%)**	**T-stat**
Pre-event	8.54 %	1.555	-2.54 %	-0.697
Short window	**13.75 %**	**2.169****	-6.31 %	-1.500
Long window	**34.85 %**	**3.314*****	**-26.84 %**	**-3.849*****
Full window	**43.38 %**	**3.657*****	**-29.38 %**	**-3.735*****

*Note: Table 7 displays the CAAV for fossil fuel and renewable energy stocks. Significance levels: *p<0.10, **p<0.05, ***p<0.01.*

Hypothesis 3 states that divestment announcements should yield positive abnormal volume for fossil fuel stocks. We find positive CAAV in our short-, long-, and full window, and our findings are statistically significant at the 5% level for the short window and at the 1% level for the long and full windows. As a result, hypothesis 3 is not rejected. Hypothesis 4 states that divestment announcements should yield positive abnormal volume for renewable energy stocks. As we find negative CAAV in our long- and full window and our findings are statistically significant at the 5% and 1% level, respectively, hypothesis 4 is rejected.

Figure 2: CAAV over the full event window

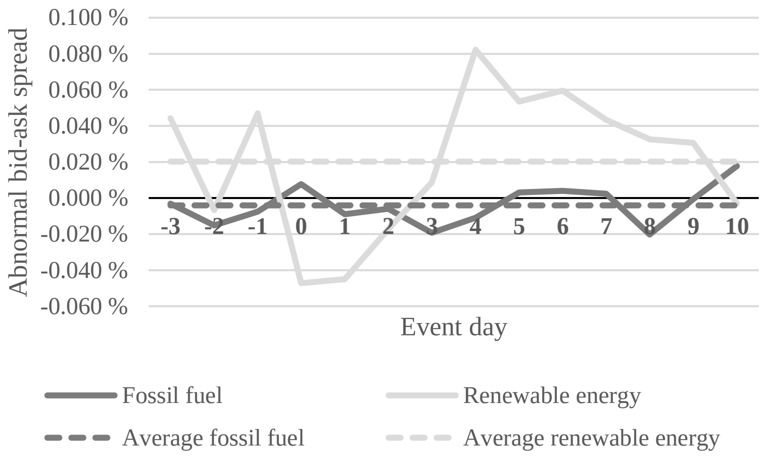


Note: Figure 2 presents the CAAV for fossil fuel and renewable energy stocks over the full event window.

Figure 2 presents the development in CAAV for fossil fuel and renewable energy stocks over the full event window. As seen from the figure, CAAV moves in the opposite direction for the two industries.

One possible explanation for the negative CAAV found for renewable energy stocks could be an abnormally high bid-ask spread over the event window. Figure 3 displays the abnormal bid-ask spread for fossil fuel and renewable energy stocks over the event window. As illustrated by the graph, the average bid-ask spread for renewable energy stocks is higher than for fossil fuel stocks. Although we do not find statistically significant results for abnormal bid-ask spread for fossil fuel or renewable energy stocks, the direction displayed in figure 3 could be a possible factor in explaining the difference in CAAV, as renewable energy stocks seem to display higher abnormal bid-ask spreads from day three to day nine after fossil fuel divestment announcement events.

Figure 3:Abnormal bid-ask spread over the full event window



Note: Figure 3 presents the abnormal bid-ask spread and the average abnormal bid-ask spread for fossil fuel and renewable energy stocks over the full event window.

Based on our findings for both abnormal returns and abnormal volume, we can now assess hypothesis 5, which states that there is information leakage prior to the divestment announcements. The study yields no statistically significant abnormal returns or abnormal volume on the days before the event for fossil fuel stocks nor for renewable energy stocks, and therefore hypothesis 5 is rejected.

Finally, we conduct a cross-sectional analysis to see cumulative abnormal volume (CAV) is affected by liquidity measures, percentage of institutional investors, firm-specific characteristics, and the region. To control for regional fixed effects, we add regional dummy variables to the model in regression 2. The results are presented below in Table 8.

Table 8: Cross-sectional analysis - CAV

	1	**2**
Fossil Fuel	0.382***	0.532***
	(0.1337)	(0.1732)
Free Float	0.050	0.257
	(0.2343)	(0.2194)
Spread	-0.032	-0.048
	(0.0428)	(0.0380)
Institutional Investor	0.262	0.655***
	(0.2459)	(0.2521)
ROA	1.440*	1.256*
	(0.8295)	(0.7367)
D/A	0.814**	0.783**
	(0.3858)	(0.3574)
P/B	0.072**	0.073**
	(0.0322)	(0.0294)
Analysts	0.012**	0.009
	(0.0051)	(0.0075)
North America		-0.210
		(0.3741)
Asia Oceania		0.385
		(0.3472)
Europe		0.312
		(0.3599)
Constant	-0.739***	-1.188***
	(0.1995)	(0.3662)
Observations	2,642	2,642
Adjusted R2	0.021	0.024

*Note: Table 8 presents the cross-sectional analysis of cumulative abnormal volume for the full sample of fossil fuel and renewable energy stocks. Regression 1 does not control for regional fixed effects, while regression 2 does. Fossil fuel is a dummy for the type of energy, free float represents the percentage of tradable shares, institutional investor represents the firm's percentage of institutional investors for the firm, and analysts represent the number of analysts covering the stock. Significance levels: *p<0.10, **p<0.05, ***p<0.01.*

Regression 1, which does not include regional controls, explains 2.1% of the variation in CAV. When adding regional controls in regression 2, the model explains 2.4% of the variation in CAV. We will focus on regression 2, as it includes the additional regional controls. First, the results show that the coefficient for fossil fuels is positive and significant at the 1% level, which helps to support our findings regarding CAAV. Next, we find that the percent of institutional investors for a firm is positively correlated with CAV and significant at the 1% level. This could be explained by the Sias (1996), who notes that institutional investors trade more frequently and in larger volumes. Finally, the firm specific traits which include return on assets, debt to assets, and price to book, are all positively correlated to CAV. Although regression 2 only explains 2.4% of the variation in CAV, which means it has low explanatory power, several of the coefficients are statistically significant and can help to explain some of the drivers behind abnormal trading volume.

6.3 Interpretation of results

This study yields no significant results concerning abnormal returns and hypotheses 1 and 2 are rejected. However, we do find significant results concerning abnormal trading volume. Based on these results, we do not reject hypothesis 3, but reject hypothesis 4 due to negative abnormal volume. Finally, as we do not observe abnormal results for returns or volume in the pre-event window, hypothesis 5 is rejected. Our hypotheses build on the theories presented in the theoretical framework in section 2 and rely on the following assumptions:

- Market efficiency of semi-strong form.
- Asymmetric information exists in financial markets.
- Divestment announcements include information valued by investors.
- Divestment announcements have spillover effects.
- The demand curve is downward sloping.
- New information increases trading volume.

This study relies on the assumption that markets are efficient in the semi-strong form, entailing that new information should be incorporated quickly and correctly in stock prices when made public. Thus, the effect on stock prices should be reflected within a short period of time if investors value the information provided in divestment announcements. Furthermore, the efficient market hypothesis builds on the assumptions of no transaction costs and assumes investors are rational and interpret information the same way. We identify two plausible explanations for the lack of significant results. First, investors are already aware of the information divestment announcements contain, and thus, the information is already incorporated in stock prices. Second, there is a possibility that investors view the information differently and the stocks' equilibrium price is not changed.

According to the signaling theory, divestment announcements could be seen as means to lower information asymmetries in the markets. The lack of significant results in our study might be explained by the fact that investors became aware of the ongoing divestment campaign over time, and therefore the more recent announcements did not entail strong signals. For example, KLP has slowly been lowering its threshold of coal investments, and new divestment announcements could therefore have been anticipated by investors. Furthermore, the lack of results might be explained by low quality of the signalers. Firms who have given signals in the past about shifting to renewable energy or being sustainable without following through (greenwashing) may have less valuable signals in events such as divestment announcements. For example, in April 2016 Saudi Arabia announced that they would sell state oil assets (Macalister, 2016). However, as of 2021 the Saudi Arabian government is still the largest owner (98.18%) of the world's largest integrated oil and gas company, Saudi Aramco.

This study relies on the assumption that divestment announcements contain valuable information for investors. However, this assumption might be too strong, and the information provided might only be valued by a subset of investors. Beaver (1968) provides two definitions of informational content. First, a divestment announcement has informational content if investors' expectations of the stock's future performance is changed. Second, the change in expectations must be large enough to change investor holdings. This means that even if divestment announcements have enough informational content to change investors' expectations, it may not change the expectations of enough investors to affect stock prices.

Furthermore, Beaver (1968) provides an explanation for why we observe abnormal trading volume but not abnormal returns. If investors interpret the information in divestment announcements differently, it can take some time before they agree on a new equilibrium price, and during this period volume increases. If one assumes homogeneous risk preferences among investors, there would be a price reaction and no volume reaction after the announcement until a new equilibrium price is reached. Beaver (1968) further explains abnormal returns as changes in expectations for all investors, whilst abnormal volume can appear when new information only changes the expectations for a subset of investors. Thus, significant abnormal volume and the lack of abnormal returns can be explained by heterogeneous risk preferences amongst investors. As a result, only a subset of investors find the information provided in divestment announcements valuable enough to change their portfolio holdings.

Karpoff (1986) states that trading volume is somewhat persistent over time. The reasons for this could be that not all investors receive the information at the same time, investors are not able to trade as much as they want right away and must do their trades gradually, or that investors make mistakes and then correct them later. These three reasons could explain why we do not find significant results when looking at daily trading volume, and do find statistically significant cumulative average abnormal volume.

The belief that the demand curve is downward sloping entails that large block trades in theory should lead to a decrease in stock prices because investors must accept a lower price in order to sell their holdings. By contrast, if the demand curve is horizontal, investors should be able to buy and sell stocks without any significant impact on stock prices. This study does not yield any results that can confirm or deny the existence of a downward sloping demand curve.

Cheung and Roca (2013) studied the effect that being added to or deleted from a sustainability index had on the stock prices. One of their findings was that stocks being included in sustainability indices in Asia experienced negative returns. This led to their hypothesis of sustainability redundancy in Asia. Interestingly, our analysis yields some similar results. On the day of the divestment announcement the abnormal return of renewable energy stocks located in Asia is negative 0.972% and statistically significant at the 10% level. However, this observation was only made for one day and when looking at the cumulative abnormal returns there were no significant results. These findings are presented in Appendix 14.

The next assumption this study relies on is that divestment announcements have a spillover effect, entailing that when the announcements of divestment from fossil fuels stocks are made one might see a shift in investor holdings to renewable energy stocks. The fact that this does not seem to be the case in this study could be explained by the possibility that investors with a strong sustainability focus are already positioned in renewable energy stocks, and thus, the announcements do not lead to any additional shift in investor holdings.

According to Karpoff (1986), volume decreases if the demand price of potential sellers (current owners of the stock) is higher than the demand price of the potential buyers (non-owners). This can explain why we find significant negative abnormal trading volume for renewable energy after the divestment announcement. Investors who already own renewable energy stocks may view divestment announcements as a sign that the market will shift to a more sustainable future, while potential buyers may not view the information provided in the same way. As such, divestment announcements do not change investors' initial beliefs, and instead may cause further divergence between investors. This could also explain why we do not find significant abnormal returns for renewable energy stocks.

6.4 Robustness check

6.4.1 Comparison to Dordi (2016)

As mentioned in the literature review, a study by Dordi (2016) conducted a similar analysis on the impacts of divestment related events on the fossil fuel industry and found that the announcements of fossil-fuel divestment did have a statistically significant negative impact on the share price of fossil fuel firms. As we find that there is no statistically significant impact on the returns of fossil fuel firms, we identify the following key differences between our studies and conduct robustness checks that can help to explain the differences in our findings.

1. **Event type:** Dordi (2016) includes not only the divestment pledges of institutions, but also endorsements and campaigns related to divestment, for example the 2014 endorsement by Ban Ki-moon. As our study aims to specifically measure the impact of divestment pledges of institutions, we did not include endorsements or campaigns, and considered Ban Ki-moon's endorsement to be a confounding event.
2. **Time range:** Dordi's study was conducted in 2016, so there are no divestment related events included after 2015. As our study is conducted in 2021, we use a wider time range and include events up until the end of 2019, when the COVID-19 pandemic began.
3. **Event selection:** When selecting events for our study, we excluded divestment events with overlapping event windows to avoid the effect of confounding events, so events that fall within –3:10 days of each other were removed from our study. However, Dordi (2016) included events with overlapping event windows, with some events occurring just two to three days apart.

4. **Sample of firms:** The sample in Dordi's study consists of the top 200 fossil fuel firms, ranked by the potential carbon emissions content of their reported reserves, while we used the top 100 fossil fuel companies ranked by market cap. However, Dordi (2016) notes that the largest corporations account for the largest share of potential production and emissions, so this may not be the largest driver of the differences between our results.
5. **Market index:** When calculating abnormal returns, Dordi (2016) uses the MSCI all-country world index. However, in this study we separate the companies by region and use the respective regional market indices to control for geographical differences. The market in our study is therefore represented by the MSCI North America Index, MSCI Emerging Markets Latin America Index, MSCI AC Asia Pacific Index, or the MSCI Europe Index.

The five points listed above can help to explain why Dordi (2016) finds significant negative impacts on fossil fuel firms while we do not. After closer examination and the conducting robustness checks presented in table 9, we identify the event type, time range, and event selection to be the main drivers of the significant negative CAAR results for fossil fuels in Dordi's study. First, an examination of their results shows that around half of the significant results stem from events which are not institutional divestment pledges. As we did not include these types of events, this could suggest that the campaigns and endorsements, or the global movement itself, is the driver of the impacts on the fossil fuel movement rather than the individual firms pledging to divest.

Second, the time range of divestment events is another factor that can change the significance of the results. As Dordi included events up until 2015, we tested our analysis using only events up until the end of 2015 and found significant negative CAAR in the fossil fuel industry, presented in Table 9. This suggests that events in the earlier years of the fossil fuel divestment movement had a greater impact than those occurring in the later years. This could be interpreted using signaling theory and information asymmetries. Specifically, Stiglitz (2000) identifies information about intent as a type of information where asymmetries play an important part. In this case, the start of the fossil fuel divestment movement may have signaled to investors that many major institutions around the world had the intention to divest from fossil fuels, and with this knowledge the investors may have adjusted their portfolios accordingly. In the later years, the divestment campaigns may have already been happening for long enough that the newer divestment events did not provide significantly new information to investors, who were already aware of this movement and had reacted in the earlier years. This is illustrated in Table 9, which presents significant negative CAAR for fossil fuel stocks in the short, long, and full windows if we exclude events after 2015 as done by Dordi (2016).

Finally, we tested for the difference in event selection by narrowing down our sample to only include the events that our study has in common with Dordi (2016), which again are all prior to 2016. This results in significant negative CAAR for fossil fuel firms in the short, long, and full event windows.

Table 9: CAAR for fossil fuels - Comparison to Dordi (2016)

	Events before 2016		**Events included by Dordi**	
Event window	**CAAR (%)**	**T-stat**	**CAAR (%)**	**T-stat**
Pre-event	-0.038 %	-0.055	0.470 %	0.480
Short window	**-1.391 %**	**-1.753***	**-2.045 %**	**-1.811***
Long window	**-3.041 %**	**-2.310****	**-4.013 %**	**-2.142****
Full window	**-3.078 %**	**-2.073****	**-3.543 %**	**-1.677***

*Note: Table 9 displays the CAAR for fossil fuel stocks using only events before 2016, and only events included by Dordi (2016). Significance levels: *p<0.10, **p<0.05, ***p<0.01.*

We then conducted the same two robustness checks for renewable energy stocks, by narrowing down the sample to events prior to 2016 and further to those in common with Dordi (2016). However, we still do not find significant results for renewable energy firms in either case. These findings are presented in table 10.

Table 10: CAAR for renewable energy - Comparison to Dordi (2016)

	Events before 2016		**Events included by Dordi**	
Event window	**CAAR (%)**	**T-stat**	**CAAR (%)**	**T-stat**
Pre-event	-0.663 %	-0.650	-0.495 %	-0.313
Short window	-0.600 %	-0.509	-1.538 %	-0.842
Long window	-0.172 %	-0.088	-3.673 %	-1.213
Full window	-0.835 %	-0.379	-4.168 %	-1.220

*Note: Table 10 displays the CAAR for renewable energy stocks using only events before 2016, and only events included by Dordi (2016). Significance levels: *p<0.10, **p<0.05, ***p<0.01.*

As shown above, even in the earlier time frame of the divestment movement in which fossil fuel stocks experience significant negative abnormal returns, we still do not find any significant cumulative average abnormal returns for renewable energy companies.

6.4.2 Abnormal trading volume and google search volume

Finally, we conduct a third robustness check by measuring attention to fossil fuels versus renewable energy around the divestment announcements. This check is based on a study by Choi, Gao and Jiang (2020), which found that in events of abnormally high local temperature, attention to climate change as proxied by Google search volume increases, and in financial markets, stocks of carbon-intensive firms underperform those with low carbon emissions.

Using historical Google Trends data extracted in R, we measure the abnormal search volume for the search terms: "fossil fuel divestment", "fossil fuel", "energy transition", and "renewable energy" around the fossil fuel divestment announcements in our study. This results in positive significant abnormal search volume for the search term "fossil fuel" on the day of divestment announcements and one day after. However, we still do not find any significant results for renewable energy. The results can help to support the findings of positive cumulative average abnormal trading volume for fossil fuels, and do not provide additional insights for renewable energy. It can also help to support the findings of significant negative cumulative average abnormal returns for fossil fuel stocks and no significant effects on renewable energy stocks prior to 2016.

Table 11: Abnormal Google search volume by keyword

	Fossil fuel divestment		Energy transition	
Event day	**Abnormal search volume**	**T-stat**	**Abnormal search volume**	**T-stat**
-1	-1.158	-0.505	9.158	1.101
0	-2.158	-0.942	-2.842	-0.342
1	-0.158	-0.069	11.158	1.342

	Fossil fuel		Renewable energy	
Event day	**Abnormal search volume**	**T-stat**	**Abnormal search volume**	**T-stat**
-1	-10.053	-0.449	50.053	0.758
0	**71.947**	**3.214*****	94.053	1.424
1	**40.947**	**1.829***	75.053	1.136

*Note: Table 11 displays the abnormal Google search volume for the keywords "fossil fuel divestment", "energy transition", "fossil fuel", and "renewable energy" on the event day and one day before and after, as well as their respective T-statistics. Significance levels: *p<0.10, **p<0.05, ***p<0.01.*

6.4.3 Potential overlapping

Some of the events included in the analysis are potentially overlapping in their estimation period. This means that there is a risk of over-/underestimating the abnormal returns depending on the stock's reaction to the earlier events. According to Park (2004) this can be solved by employing a long estimation window and/or excluding potentially overlapping events. Therefore, this study utilizes an estimation window of 250 trading days to reduce these potential problems. Furthermore, we tested the analysis with exclusions of the events with overlapping estimation periods and found that this did not significantly change the results. Therefore, we are confident that the results accurately present the impact of divestment announcements in the time period and sample chosen for this study.

7. Conclusion and limitations

7.1 Conclusion

This thesis assessed whether fossil fuel divestment announcements of institutions truly have a financial impact on the energy transition, and utilized event study methodology to measure the abnormal returns and trading volume of the top hundred global fossil fuel and renewable energy stocks with the highest market capitalization at the date of divestment announcements from 2014 through 2019.

We do not find any statistically significant cumulative average abnormal return for fossil fuel or renewable energy firms during the event windows, so we reject both hypothesis 1 and 2, which state that fossil fuel divestment announcements yield significant negative abnormal returns for fossil fuel stocks and positive abnormal returns for renewable energy stocks, respectively. It is interesting to note that the abnormal returns are significant when excluding events after 2015. We interpret this through signaling theory, which could suggest that the growth of the fossil fuel movement over the first few years signaled to investors that institutions would have future intentions to divest. Therefore, in the years after 2015 investors may have already been aware of the movement and had reacted accordingly, so the newer divestment announcements did not provide significantly new information.

We find significant positive cumulative abnormal volume for fossil fuel stocks in the short, long, and full windows, and significant negative cumulative abnormal volume for renewable energy stocks in the long and full windows. Therefore, we cannot reject hypothesis 3, which states that divestment announcements yield a significant positive effect on abnormal trading volume for fossil fuel stocks, and reject hypothesis 4, which states that divestment announcements yield a significant positive effect on abnormal trading volume for renewable energy stocks. The negative effect on trading volume for renewable energy stocks could suggest that investors are heterogeneous and interpret the divestment announcements differently.

Finally, we do not find any statistically significant abnormal returns or volume during the pre-event window, so we reject hypothesis 5, which states that there is information leakage prior to the divestment announcement.

In closing, although the results do not show a significant negative impact on the returns of fossil fuel and renewable energy stocks, this study contributes to the fossil fuel divestment debate by analyzing the effect on renewable energy and trading volume. As the world continues to transition to a net zero energy system, we can expect the fossil fuel divestment movement to continue to evolve, and recommend future studies in this area of interest.

7.2 Limitations

When considering the results of this event study analysis, several limitations should be taken into account. First, each divestment announcement event is unique to the institution making the announcement, and therefore the divestment criteria, type of fossil fuel excluded, size of divestment, and the timeline vary across events. For example, although some divestment announcements stated the criteria for divestment, such as companies with a certain percentage of revenue that is attributed to a type of fossil fuel, most announcements did not specify the exact criteria for divestment.

Additionally, the divesting institutions themselves may have different levels of credibility. If firms have made announcements in the past and not followed through, or if they have been known to engage in greenwashing by making their firm seem more sustainable than it truly is, investors may not react as strongly to their divestment announcements. Greenwashing has been found to negatively affect consumers' 'green trust' (Chen and Chang, 2012), which suggests that some firms' announcements on divesting could be trusted less by the market.

Finally, the indices used for the market returns cover broad regions, such as Asia Pacific and Europe. These regional indices may not capture the country level impacts that firms may experience.

7.3 Suggestions for future research

As the IEA's 2021 report suggests, the world must transition from fossil fuels to renewable energy in order to meet the international targets set on climate change. Fossil fuel divestment is therefore a relevant topic for further studies to provide more evidence in the debate surrounding the topic. First, as we find a difference in significance between the early and later years of the divestment campaign, it would be of interest to conduct this event study again after another five years to expand the time frame further and examine whether the significance changes.

Additionally, our study measures the impacts of fossil fuel divestment on the top hundred fossil fuel and renewable energy firms by market capitalization. It would be interesting to conduct a similar study on the fossil fuel and renewable energy firms that are held by the divesting institution and would be excluded as a result of the announcement, as this could provide an understanding of direct impacts rather than the industry impacts.

Finally, although individual fossil fuel divestment announcements may not have a significant financial impact, they could help to raise awareness around climate change and energy transition issues. A study on this topic could be done in a similar manner to Darwin, Gao, and Jiang (2020), who find that in abnormally warm weather events, attention to climate change as proxied by Google search volume increases, and stocks of carbon intensive firms underperform those with low carbon emissions. As many investors state that divestment is meaningful through its symbolism, it would be interesting to further assess whether fossil fuel divestment events measurably increase attention to these environmental issues.

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9. Appendix

Appendix 1: Confounding events

Date	Confounding Event
23.09.2014	UN Climate Summit
24.10.2014	EU agrees to a 40% greenhouse gas cut by 2030 and a target for at least 27% share renewable energy
04.11.2014	Ban Ki-moon endorses fossil fuel divestment
12.11.2014	US-China emissions deal
14.12.2014	Lima Accord
14.03.2015	UN backs fossil fuel divestment campaign
25.06.2015	Bill Gates commits to invest USD $2bn in breakthrough renewable energy projects
12.12.2015	COP21: Paris Agreement
04.11.2016	Paris Agreement entered into force

Note: Appendix 1 presents the confounding events identified in the study and their respective dates.

1. **23 September 2014:** The 2014 UN Climate Summit was held with a purpose to serve as a precursor to the 2015 Paris agreement, advocating for countries to focus on cutting emissions (UNFCCC, 2014-c).

2. **10 October 2014**: The European Council endorsed a binding target of at least a 40% domestic reduction in greenhouse gases and a 27% share of renewable energy consumed in the EU by 2030 (UNFCCC, 2014-b).

3. **4 November 2014**: UN Secretary General Ban Ki-moon asked companies to reduce fossil fuel investments at a press conference and stated, "I have been urging companies like pension funds or insurance companies to reduce their investments in coal and a fossil-fuel based economy to move to renewable sources of energy" (UNFCCC, 2014-a).

4. **12 November 2014:** A landmark deal between the US and China to reduce emissions was announced. As part of this deal, China set a target to increase the share of non-fossil fuel energy consumption to around 20% by 2030 (Safi, et al., 2014).

5. **14 December 2014:** The Lima Accord was created as an agreement between 190 nations to reduce the use of oil, gas and coal. The accord did not set legally binding

requirements, but the nations were expected to create their own plans on policies to cut emissions (Davenport, 2014).

6. **14 March 2015:** The Guardian broke the news that the UN supported the fossil fuel campaign, citing a quote by the spokesman for the UN Framework Convention on Climate Change, who said that divestment sent a signal to companies that the current situation of burning fossil fuels cannot continue (Carrington, 2015).

7. **30 June 2015:** Bill Gates announced that he would double his investments in green technologies to USD $2bn over the period of 2015 to 2020, including renewable energy technologies. He simultaneously called for governments to increase their investments in R&D for renewable energy technologies (Adams and Thornhill, 2015).

8. **12 December 2015:** The Paris Agreement was adopted at COP 21 by 196 Parties, which aimed to limit global warming to well below 2°C. Countries agreed to take action to reduce greenhouse gas emissions (UNFCCC, n.d.).

9. **4 November 2016:** The Paris Agreement entered into force (UNFCCC, n.d.).

Appendix 2: Excluded events

Date	Excluded Institution
11.07.2014	World Council of Churches
22.09.2014	Rockefeller Brothers Fund
24.03.2015	Syracuse University
01.04.2015	Guardian Media Group
24.04.2015	SOAS University of London
30.04.2015	Church of England
13.05.2015	London School of Hygiene and Tropical Medicine
14.05.2015	University of Washington
19.05.2015	University of Oxford
22.05.2015	University of Hawai'i
23.05.2015	AXA
27.05.2015	Norwegian Government Pension Fund Global
12.12.2017	AXA
10.01.2018	New York City
21.01.2018	Lloyd's of London
31.02.2018	Generali
12.06.2019	Norwegian Government Pension Fund Global

Note: Appendix 2 presents the events that were excluded from the study during

Appendix 3: Final sample of divestment announcement events (Values denoted in USD)

Date	Institution	Fund Value	Divestment	Fossil Fuel Type	Divestment Criteria
07.05.2014	Stanford University	18.70 B	NA	Coal mining	Coal mining as a principal business
07.10.2014	Australian Local Government Super	7.46 B	23.32 MM	Coal mining or coal fired electricity generation	Over 1/3 revenue from coal mining or coal-fired electricity generation
23.11.2014	KLP	70.00 B	73.73 MM	Coal	More than 50% revenue from coal
18.01.2015	Nordea	264.57 B	116.04 MM	Coal mining	Large and sustained exposure to thermal coal mining
05.02.2015	Norwegian Government Pension Fund Global	850.00 B	NA	Coal	NA
02.03.2015	City of Oslo	NA	7.00 MM	Coal	NA
08.07.2015	University of Warwick	0.02 B	1.56 MM	Coal, oil, gas	NA
10.09.2015	University of California	98.00 B	200.00 MM	Coal, oil sands	NA
01.04.2016	Saudi Arabia	NA	2000000.00 MM	Petroleum	NA
13.12.2016	Southwark council pension fund	1.52 B	NA	All fossil fuels	NA
15.05.2017	BMO Global Asset Management	1.93 B	25.79 MM	All fossil fuels	All companies with fossil fuel reserves
05.02.2018	Edinburgh University	1.40 B	8.79 MM	Coal, oil, gas	NA
12.07.2018	Republic of Ireland	9.13 B	342.24 MM	Coal, oil, peat, gas	20% or more revenue from exploration, extraction or refinement of fossil fuels
09.03.2019	Norwegian Government Pension Fund Global	1000.00 B	7500.00 MM	Oil, gas	NA
07.05.2019	KLP	80.00 B	365.98 MM	Coal	More than 5% revenue from coal-based activities

Note: Appendix 3 shows the included events, size of divesting fund, divestment amount, which type of fossil fuel the institution divested from and their divestment criteria.

Appendix 4: Final sample - Fossil fuel stocks

Date	Institution	Initial sample	Exclusions	Final sample
07.05.2014	Stanford University	100	4	96
07.10.2014	Australian Local Government Super	100	5	95
23.11.2014	KLP	100	2	98
18.01.2015	Nordea	100	3	97
05.02.2015	Norwegian Government Pension Fund Global	100	3	97
02.03.2015	City of Oslo	100	2	98
08.07.2015	University of Warwick	100	1	99
10.09.2015	University of California	100	1	99
01.04.2016	Saudi Arabia	100	1	99
13.12.2016	Southwark council pension fund	100	4	96
15.05.2017	BMO Global Asset Management	100	3	97
05.02.2018	Edinburgh University	100	3	97
12.07.2018	Republic of Ireland	100	2	98
09.03.2019	Norwegian Government Pension Fund Global	100	1	99
07.05.2019	KLP	100	1	99
	Total	**1500**	**36**	**1464**

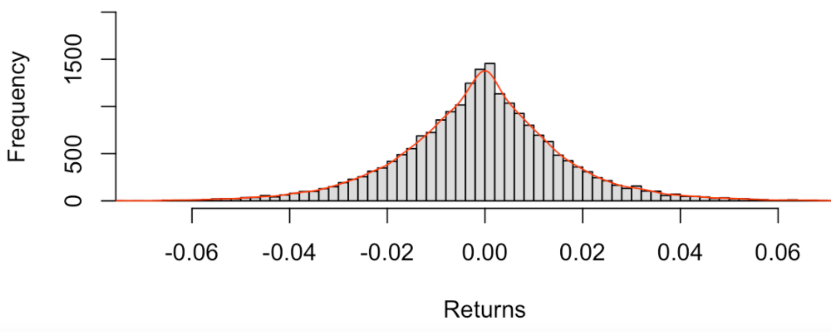
Note: Appendix 4 displays the date of the divestment announcement, the divesting institution, and the quantity of the sample of the top fossil fuel and renewable energy companies by market cap at the date of the announcement. Each event starts with 100 initial stocks. The exclusions column presents the number of observations removed due to missing data, and the final sample column presents the number of stocks that the analysis is conducted on.

Appendix 5: Final sample - Renewable energy stocks

Date	Institution	Initial sample	Exclusions	Final sample
07.05.2014	Stanford University	100	11	89
07.10.2014	Australian Local Government Super	100	10	90
23.11.2014	KLP	100	10	90
18.01.2015	Nordea	100	9	91
05.02.2015	Norwegian Government Pension Fund Global	100	9	91
02.03.2015	City of Oslo	100	8	92
08.07.2015	University of Warwick	100	13	87
10.09.2015	University of California	100	10	90
01.04.2016	Saudi Arabia	100	11	89
13.12.2016	Southwark council pension fund	100	11	89
15.05.2017	BMO Global Asset Management	100	8	92
05.02.2018	Edinburgh University	100	6	94
12.07.2018	Republic of Ireland	100	10	90
09.03.2019	Norwegian Government Pension Fund Global	100	12	88
07.05.2019	KLP	100	16	84
	Total	**1500**	**154**	**1346**

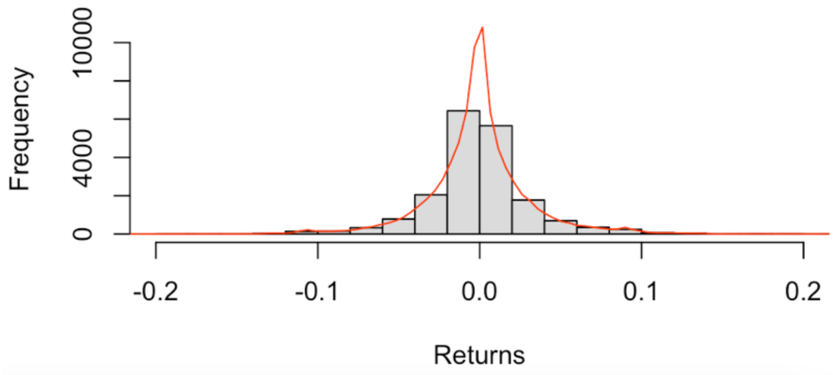
Note: Appendix 5 displays the date of the divestment announcement, the divesting institution, and the quantity of the sample of the top fossil fuel and renewable energy companies by market cap at the date of the announcement. Each event starts with 100 initial stocks. The exclusions column presents the number of observations removed due to missing data, and the final sample column presents the number of stocks that the analysis is conducted on.

Appendix 6: Histogram fossil fuel returns



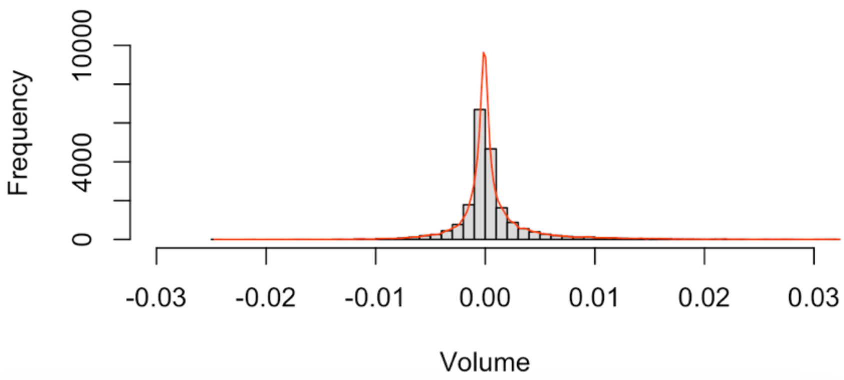
Note: Appendix 6 shows the distribution of abnormal returns for fossil fuel stocks.

Appendix 7: Histogram renewable energy returns



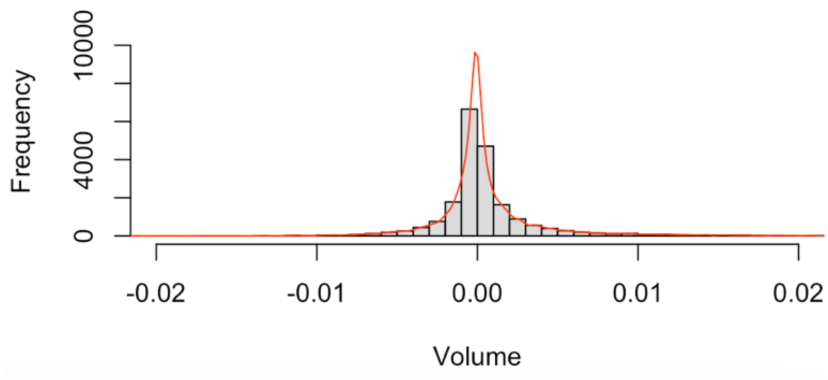
Note: Appendix 7 shows the distribution of abnormal returns for renewable energy stocks.

Appendix 8: Histogram fossil fuel volume



Note: Appendix 8 shows the distribution of abnormal trading volume for fossil fuel stocks.

Appendix 9: Histogram renewable energy volume



Note: Appendix 9 shows the distribution of abnormal trading volume for renewable energy stocks.

Appendix 10: AAR - Fossil fuel stocks

Event day	AAR (%)	T-stat
-3	0.042 %	0.152
-2	-0.136 %	-0.489
-1	0.138 %	0.494
0	-0.173 %	-0.623
1	-0.293 %	-1.054
2	-0.106 %	-0.379
3	-0.126 %	-0.452
4	-0.153 %	-0.549
5	0.160 %	0.575
6	-0.006 %	-0.023
7	0.086 %	0.310
8	-0.359 %	-1.289
9	0.030 %	0.109
10	-0.323 %	-1.158

*Note: Appendix 10 presents the average abnormal return (AAR) for fossil fuel stocks and their respective T-statistic. Significance levels: *p<0.10, **p<0.05, ***p<0.01.*

Appendix 11: AAR - Renewable energy stocks

Event day	AAR (%)	T-stat
-3	0.000 %	-0.001
-2	-0.467 %	-1.185
-1	0.031 %	0.078
0	-0.631 %	-1.603
1	0.000 %	0.001
2	0.020 %	0.051
3	0.039 %	0.098
4	0.324 %	0.822
5	-0.124 %	-0.316
6	-0.205 %	-0.521
7	0.062 %	0.158
8	0.380 %	0.964
9	-0.049 %	-0.124
10	-0.225 %	-0.571

*Note: Appendix 11 presents the average abnormal return for renewable energy stocks and their respective T-statistic. Significance levels: *p<0.10, **p<0.05, ***p<0.01.*

Appendix 12: CAAR - Fossil fuel stocks

Event window	CAAR (%)	T-stat
Pre-event	0.043 %	0.089
Short window	-0.701 %	-1.258
Long window	-1.269 %	-1.374
Full window	-1.226 %	-1.177

*Note: Appendix 12 presents the cumulative average abnormal return for fossil fuel stocks and their respective T-statistic Significance levels: *p<0.10, **p<0.05, ***p<0.01.*

Appendix 13: CAAR - Renewable energy stocks

Event window	CAAR (%)	T-stat
Pre-event	-0.436 %	-0.640
Short window	-0.572 %	-0.727
Long window	-0.410 %	-0.314
Full window	-0.847 %	-0.574

*Note: Appendix 13 presents the cumulative average abnormal return for renewable energy stocks and their respective T-statistic. Significance levels: *p<0.10, **p<0.05, ***p<0.01.*

Appendix 14: AAR - Renewable energy stocks aggregated by region

Event day	North America		Asia/Oceania		Europe	
	AAR	T-stat	AAR	T-stat	AAR	T-stat
-3	0.183 %	0.228	-0.149 %	-0.296	0.234 %	0.240
-2	-1.013 %	-1.263	-0.308 %	-0.610	-0.055 %	-0.057
-1	0.123 %	0.153	0.025 %	0.050	-0.073 %	-0.075
0	-0.145 %	-0.180	**-0.972 %**	**-1,926***	-0.177 %	-0.182
1	-0.500 %	-0.623	0.195 %	0.387	0.176 %	0.181
2	-0.183 %	-0.228	0.129 %	0.255	-0.054 %	-0.056
3	-0.116 %	-0.145	0.235 %	0.467	-0.428 %	-0.439
4	0.670 %	0.835	0.294 %	0.583	-0.226 %	-0.231
5	-0.295 %	-0.368	0.016 %	0.032	-0.343 %	-0.352
6	0.023 %	0.028	-0.333 %	-0.660	-0.108 %	-0.110
7	-0.702 %	-0.875	0.323 %	0.640	0.499 %	0.512
8	0.043 %	0.053	0.621 %	1.231	0.081 %	0.083
9	-0.476 %	-0.594	0.020 %	0.039	0.517 %	0.530
10	-0.633 %	-0.789	-0.087 %	-0.173	0.007 %	0.007

*Note: Appendix 14 presents the average abnormal return of renewable energy stocks during the full event window of three days prior to the event through ten days after the event, aggregated by the region of the exchange the stocks are listed on. Significance levels: *p<0.10, **p<0.05, ***p<0.01.*

Appendix 15: Fossil fuel stocks by region

Region	Number of stocks	%
North America	708	48 %
Asia/Oceania	370	25 %
Europe	320	22 %
South America	66	5 %
Total	**1464**	**100 %**

Note: Appendix 16 presents the number of fossil fuel stocks included in the sample by the region of the stock exchange they are listed in, as well as the respective percentages of stocks in the sample listed in each region.

Appendix 16: Renewable energy stocks by region

Region	Number of stocks	%
Asia/Oceania	759	56 %
North America	383	28 %
Europe	204	15 %
South America	0	0 %
Total	**1346**	**100 %**

Note: Appendix 16 presents the number of renewable energy stocks included in the sample by the region of the stock exchange they are listed in, as well as the respective percentages of stocks in the sample listed in each region.

Appendix 17: Fossil fuel stocks included in the study

Stock	Frequency	% of events
Exxon Mobil Corp	15	100 %
Royal Dutch Shell PLC	15	100 %
PetroChina Co Ltd	15	100 %
Chevron Corp	15	100 %
Total SE	15	100 %
BP PLC	15	100 %
Schlumberger NV	15	100 %
China Petroleum & Chemical Corp	15	100 %
Eni SpA	15	100 %
Equinor ASA	15	100 %
Petroleo Brasileiro SA Petrobras	15	100 %
ConocoPhillips	15	100 %
Gazprom PAO	15	100 %
Ecopetrol SA	15	100 %
CNOOC Ltd	15	100 %
Occidental Petroleum Corp	15	100 %
NK Rosneft' PAO	15	100 %
Enterprise Products Partners LP	15	100 %
Glencore PLC	15	100 %
EOG Resources Inc	15	100 %
Suncor Energy Inc	15	100 %
Halliburton Co	15	100 %
China Shenhua Energy Co Ltd	15	100 %
Reliance Industries Ltd	15	100 %
Oil and Natural Gas Corporation Ltd	15	100 %
Phillips 66	15	100 %
Canadian Natural Resources Ltd	15	100 %
NK Lukoil PAO	15	100 %
Imperial Oil Ltd	15	100 %
Enbridge Inc	15	100 %
Kinder Morgan Inc	15	100 %
TC Energy Corp	15	100 %
APA Corp (US)	15	100 %
Coal India Ltd	15	100 %
Repsol SA	15	100 %
Woodside Petroleum Ltd	15	100 %
Nov Inc	15	100 %
Novatek PAO	15	100 %
Williams Companies Inc	15	100 %
Valero Energy Corp	15	100 %
PTT PCL	15	100 %

Devon Energy Corp	15	100 %
Energy Transfer LP	15	100 %
Pioneer Natural Resources Co	15	100 %
Surgutneftegaz PAO	15	100 %
Tenaris SA	15	100 %
Marathon Petroleum Corp	15	100 %
Marathon Oil Corp	15	100 %
Formosa Petrochemical Corp	15	100 %
Hess Corp	15	100 %
Continental Resources Inc	15	100 %
Plains All American Pipeline LP	15	100 %
Baker Hughes Co	15	100 %
PTT Exploration and Production PCL	15	100 %
Gazprom Neft' PAO	15	100 %
Magellan Midstream Partners LP	15	100 %
Snam SpA	15	100 %
Empresas Copec SA	15	100 %
OMV AG	15	100 %
Galp Energia SGPS SA	15	100 %
Tatneft' PAO	15	100 %
Cabot Oil & Gas Corp	15	100 %
Cheniere Energy Inc	15	100 %
Pembina Pipeline Corp	15	100 %
Eneos Holdings Inc	15	100 %
Indian Oil Corporation Ltd	15	100 %
Cheniere Energy Partners LP	15	100 %
Oil Search Ltd	15	100 %
Cenovus Energy Inc	14	93 %
Inpex Corp	14	93 %
ONEOK Inc	14	93 %
SK Innovation Co Ltd	14	93 %
Icahn Enterprises LP	14	93 %
Western Midstream Partners LP	14	93 %
China Coal Energy Co Ltd	14	93 %
Polskie Gornictwo Naftowe i Gazownictwo SA	14	93 %
Cimarex Energy Co	13	87 %
SK Holdings Co Ltd	13	87 %
Plains GP Holdings LP	12	80 %
YPF SA	12	80 %
China Oilfield Services Ltd	12	80 %
Yanzhou Coal Mining Co Ltd	12	80 %
Bharat Petroleum Corporation Ltd	12	80 %
Sinopec Shanghai Petrochemical Co Ltd	12	80 %
Ovintiv Inc	11	73 %

HollyFrontier Corp	11	73 %
Shaanxi Coal Industry Co Ltd	10	67 %
Crescent Point Energy Corp	9	60 %
Inter Pipeline Ltd	9	60 %
S-Oil Corp	9	60 %
Polski Koncern Naftowy Orlen SA	9	60 %
Antero Resources Corp	8	53 %
Range Resources Corp	8	53 %
Oil and Gas Development Co Ltd	8	53 %
Helmerich and Payne Inc	8	53 %
Neste Oyj	8	53 %
Southwestern Energy Co	7	47 %
Murphy Oil Corp	7	47 %
Ultrapar Participacoes SA	7	47 %
DCC PLC	7	47 %
MPLX LP	7	47 %
Santos Ltd	6	40 %
ANK Bashneft' PAO	5	33 %
Enagas SA	5	33 %
Targa Resources Corp	5	33 %
Diamondback Energy Inc	5	33 %
Valaris PLC	4	27 %
Ampol Ltd	4	27 %
Aker BP ASA	4	27 %
Transocean Ltd	3	20 %
Tullow Oil PLC	3	20 %
Saipem SpA	3	20 %
Tourmaline Oil Corp	3	20 %
EQT Corp	3	20 %
Koninklijke Vopak NV	3	20 %
TechnipFMC PLC	3	20 %
United Tractors Tbk PT	3	20 %
Lundin Energy AB	3	20 %
ARC Resources Ltd	2	13 %
Petronas Dagangan Bhd	2	13 %
Offshore Oil Engineering Co Ltd	2	13 %
Hindustan Petroleum Corp Ltd	2	13 %
Abu Dhabi National Oil Company for Distribution PJSC	2	13 %
Idemitsu Kosan Co Ltd	2	13 %
San Miguel Corp	2	13 %
Petrovietnam Gas Joint Stock Corp	2	13 %
Sinopec Oilfield Service Corp	2	13 %
Enable Midstream Partners LP	1	7 %
Core Laboratories NV	1	7 %

Whiting Petroleum Corp	1	7 %
Yantai Jereh Oilfield Services Group Co Ltd	1	7 %
SUNDANCE ENERGY INC (US)	1	7 %
Antarchile SA	1	7 %
MOL Magyar Olajes Gazipari Nyrt	1	7 %
Petrobras Distribuidora SA	1	7 %

Note: Appendix 17 presents the fossil fuel stocks included in the study. The frequency represents the number of times the respective stock is included in the sample of the top 100 fossil fuel firms, as ranked by market cap, at the date of a divestment announcement. The percentage of events represents the percent of divestment announcement events in this study in which this stock is included in the sample.

Appendix 18: Renewable energy stocks included in the study

Stock	**Frequency**	**% of events**
Vestas Wind Systems A/S	15	100 %
Daqo New Energy Corp	15	100 %
First Solar Inc	15	100 %
GCL-Poly Energy Holdings Ltd	15	100 %
Xinjiang Goldwind Science & Technology Co Ltd	15	100 %
JinkoSolar Holding Co Ltd	15	100 %
Hanwha Solutions Corp	15	100 %
SunPower Corp	15	100 %
Guodian Technology & Environment Group Corp Ltd	15	100 %
Sungrow Power Supply Co Ltd	15	100 %
Nanfang Ventilator Co Ltd	15	100 %
Canadian Solar Inc	15	100 %
China High Speed Transmission Equipment Group Co Ltd	15	100 %
Gigasolar Materials Corp	15	100 %
Tongwei Co Ltd	15	100 %
Xiangtan Electric Manufacturing Co Ltd	15	100 %
United Renewable Energy Co Ltd	15	100 %
Titan Wind Energy Suzhou Co Ltd	15	100 %
Solareast Holdings Co Ltd	15	100 %
EGing Photovoltaic Technology Co Ltd	15	100 %
Risen Energy Co Ltd	15	100 %
Green Plains Inc	15	100 %
Jiangsu SINOJIT Wind Energy Technology Co Ltd	15	100 %
Shenzhen Topraysolar Co Ltd	15	100 %
Huayi Electric Co Ltd	15	100 %
Shanghai Taisheng Wind Power Equipment Co Ltd	15	100 %
Plug Power Inc	15	100 %
Zhejiang Sunflower Great Health Limited Liability Company	15	100 %

North Electro-Optic Co Ltd	15	100 %
Jiangsu Akcome Science & Technology Co Ltd	15	100 %
CropEnergies AG	15	100 %
FutureFuel Corp	15	100 %
Sanix Inc	15	100 %
Changzhou Almaden Co Ltd	15	100 %
Guangzhou Devotion Thermal Technology Co Ltd	15	100 %
REX American Resources Corp	15	100 %
Suzlon Energy Ltd	15	100 %
Renewable Energy Group Inc	15	100 %
GCL System Integration Technology Co Ltd	15	100 %
Siemens Gamesa Renewable Energy SA	15	100 %
Fuelcell Energy Inc	15	100 %
Kenergy Scientific Inc	15	100 %
ABCO Energy Inc	15	100 %
Qingdao Zhongzi Zhongcheng Group Co Ltd	15	100 %
Velocys PLC	15	100 %
Roxas Holdings Inc	15	100 %
Cardinal Ethanol LLC	15	100 %
Unison Co Ltd	15	100 %
ForceField Energy Inc	15	100 %
Ceres Power Holdings PLC	15	100 %
Ballard Power Systems Inc	14	93 %
JA Solar Technology Co Ltd	14	93 %
Alto Ingredients Inc	14	93 %
Tainergy Tech Co Ltd	14	93 %
Broadwind Inc	14	93 %
S-Energy Co Ltd	14	93 %
Gevo Inc	14	93 %
Ujaas Energy Ltd	14	93 %
Ameresco Inc	13	87 %
Verbio Vereinigte Bioenergie AG	13	87 %
Danen Technology Corp	13	87 %
algoWatt SpA	13	87 %
West Holdings Corp	12	80 %
Silex Systems Ltd	12	80 %
Power Financial Group Ltd	12	80 %
SolarWindow Technologies Inc	12	80 %
SFC Energy AG	12	80 %
Global Bioenergies SA	12	80 %
BBHC Inc	12	80 %
China Geothermal Industry Development Group Ltd	11	73 %
Shinsung E&G Co Ltd	11	73 %
Central Development Holdings Ltd	11	73 %

JC Chemical Corp Ltd	11	73 %
Granite Falls Energy LLC	11	73 %
Enphase Energy Inc	10	67 %
Solargiga Energy Holdings Ltd	10	67 %
Tonking New Energy Group Holdings Ltd	10	67 %
Northern Growers LLC	10	67 %
Longitech Smart Energy Holding Ltd	9	60 %
Thai Agro Energy PCL	9	60 %
AFC Energy PLC	8	53 %
Propellus Inc	8	53 %
Red Trail Energy LLC	8	53 %
Heron Lake BioEnergy LLC	8	53 %
SIMEC Atlantis Energy Ltd	8	53 %
Deinove SA	7	47 %
Kirin Group Holdings Ltd	7	47 %
Daehan Green Power Corp	7	47 %
Vergnet SA	7	47 %
Solartron PCL	6	40 %
Zhongde Waste Technology AG	6	40 %
Aemetis Inc	6	40 %
Indosolar Ltd	6	40 %
Jinlei Technology Co Ltd	6	40 %
Inox Wind Ltd	6	40 %
Senvion SA	6	40 %
Engie Eps SA	6	40 %
Shenwu Energy Saving Co Ltd	5	33 %
Highwater Ethanol LLC	5	33 %
Ideal Power Inc	5	33 %
Kingbostrike Ltd	5	33 %
Sunrun Inc	5	33 %
Green Energy Group Ltd	5	33 %
Grenergy Renovables SA	5	33 %
Real Goods Solar Inc	4	27 %
Quantum Materials Corp	4	27 %
TPI Composites Inc	4	27 %
Sif Holding NV	4	27 %
Qingdao Tianneng Heavy Industries Co Ltd	4	27 %
Martifer SGPS SA	3	20 %
Surana Solar Ltd	3	20 %
Nel ASA	3	20 %
ABO-Group Environment NV	3	20 %
Anji Technology Co Ltd	3	20 %
Swedish Stirling AB	3	20 %
iSun Inc	3	20 %

MDI Energia SA	3	20 %
First National Energy Corp	3	20 %
Tarsier Ltd	2	13 %
ITM Power PLC	2	13 %
Ener-Core Inc	2	13 %
Xinyi Solar Holdings Ltd	2	13 %
Aqua Power Systems Inc	2	13 %
NanoFlex Power Corp	2	13 %
CS Wind Corp	2	13 %
Sino Bioenergy Corp	2	13 %
ABO Wind AG	2	13 %
SPI Energy Co Ltd	2	13 %
JiangSu Zhenjiang NewEnergy Equipment Co Ltd	2	13 %
Pinnacle Renewable Energy Inc	2	13 %
Sino United Worldwide Consolidated Ltd	2	13 %
Advance Materials Corp	1	7 %
Abalance Corp	1	7 %
Solaredge Technologies Inc	1	7 %
Global Green Chemicals PCL	1	7 %
KOALA Financial Group Ltd	1	7 %
Technovative Group Inc	1	7 %
SolTech Energy Sweden AB	1	7 %
Sky Energy Indonesia Tbk PT	1	7 %
Cortus Energy AB	1	7 %
China Network Media Inc	1	7 %
Sunworks Inc	1	7 %

Note: Appendix 18 presents the renewable energy stocks included in the study. The frequency represents the number of times the respective stock is included in the sample of the top 100 renewable energy firms, as ranked by market cap, at the date of a divestment announcement. The percentage of events represents the percent of divestment announcement events in this study in which this stock is included in the sample.