International Journal of Financial Management
12 (1) 2022, 11-22
http://publishingindia.com/ijfm/

Submitted: 26 September, 2021
Accepted: 15 November, 2021

Climate Risk and Financial Performance of Energy Companies – A Cross-Country Analysis

Amitava Mondal*, Somnath Bauri**

Abstract

Climate change imposes greater physical, transitional, as well as regulatory risks, on the firm's financial and operational activities. However, while evaluating the performance of the firms, the traditional financial performance indicators do not incorporate climate risk. Without integrating climate risk in the traditional performance indicators, the firms may be misleading the investors and other stakeholders by claiming higher achievement and better performance. Hence, this paper has tried to examine the firm's performance after integrating climate risk with the traditional financial indicators. Our results provide evidence that climate risk significantly affects the financial performance of firms. More specifically, energy companies from developing countries are more exposed to climate risk, than those located in developed countries. The study also revealed that companies from the developed countries have generated a higher amount of revenue and profit, but they (except Australia) are not able to transfer the company's methods of working to lower emissions production.

Keywords: Climate Risk, Integrated Ratios, Financial Performance, Energy Industry

Introduction

Climate risk is an emerging and dominant global phenomenon; it poses various challenges to achieving sustainability and to humankind. In the past few decades, the global climate system has experienced significant changes across the world, as revealed by the increasing frequency, intensity, and impacts of extreme weather events. Excessive exploitation and consumption of fossil fuel for the rapid development of industrialisation and urbanisation are mainly responsible for the excessive greenhouse gas (GHG) emissions. Among the heat-trapping greenhouse gases, carbon dioxide emissions are considered to be responsible for global warming and climate change (Ozturk & Acaravci, 2010; Rahman & Kashem, 2017). Researchers also found a positive relationship between energy consumption, especially fossil fuel consumption, economic growth, and carbon dioxide emissions (for instance, Vidyarthi, H. (2013); Mirza & Kanwal, 2017; Khan et al., 2020). For sustainable economic growth and to mitigate climate change-related risks, people around the world have tried to transform our economy to a low-carbon dependent and advanced economy. For a significant decrease in the carbon dioxide emissions, an intergovernmental agreement (Paris Agreement, 2015) has been adopted by the countries. The implementation of such an agreement imposes regulatory risks on energy companies. Thus, the transition imposes a wide range of threats on the existing carbon-intensive energy producers and related energy enterprises.

Climate risk could affect the economic performance of the firms by increasing the operating costs significantly. This effect on the businesses varies from sector to sector, based on their exposure to climate risk (Nikolaou et al., 2015). Berkman et al. (2021) point out that "An increasing number of extreme weather events have imposed large costs on affected companies and industries". However, among all the sectors, the energy sector is one of the most vulnerable and directly connected to climate risk, as it is likely to be affected by climate-related physical, transitional, as well as policy, risks. The energy sector not only accelerated the frequency and severity of the climate risk by emitting excessive amounts of carbon dioxide, but this sector is also facing great challenges from climate change. The consumption of coal, oil, and natural gases is responsible for 35% of global greenhouse gas (GHG) emissions in 2010 (IPCC, 2014). The transition to a lower-

* Associate Professor, Department of Commerce, Sidho-Kanho-Birsha University, Purulia, West Bengal, India.
Email: amitavakalna@gmail.com
** Research Scholar, Sidho-Kanho-Birsha University, West Bengal, India.

carbon economy needs capital-intensive investment and construction advance infrastructure by the existing carbon-intensive energy companies (Engels et al., 2020). Moyo et al. (2015) found a strong correlation between high climate-change risks and lower return on equity (ROE). A weak correlation was found between high climate-change opportunities and higher ROE. These challenges also disrupt the operational, as well as the financial, stability of the firms.

Investors and other stakeholders across the world consider climate risk to be a very serious issue. Hence, for taking more informed decisions, they have placed pressure on the corporates to disclose more transparent and decision-useful climate change-related information. This disclosure leads to the creation of reputational climate risk in the companies. Some researchers have also explored that climate risk disclosure could potentially increase the performance of the firms (Alsaifi et al., 2019). For the enhancement of legitimacy in the market, companies are also disclosing climate change-related data in their integrated reports, sustainability reports, as well as in ESG reposts. Climate risk could adversely affect the performance of the firms. Climate risks have to be taken into account to know the actual and more accurate performance of the firms. The traditional performance indicator (e.g. ROE, ROA) of the firms may fail to represent the actual firm performance.

Hence, this paper has tried to systematically analyse the performance of the sample companies after incorporating climate risk. The rest of the paper is presented as follows: the next section covers the literature review and research gap, whereas section 3 describes the objectives of the study, section 4 describes the methodology and data, section 5 reports the empirical results and discussions, and the final section concludes the paper.

Literature Review

'United Nations Framework Convention on Climate Change' (UNFCCC, 2007) revealed that climate change has been observed as one of the factors that adversely affect a firm's operational activities. Similarly, the European Commission 2020 also identified that climate change may lead to changes in our economic systems. According to a report of the U.S. Department of Energy (2013), "three major trends most relevant to climate risk are increasing air and water temperatures, decreasing water availability in some regions and seasons & increasing intensity and frequency of storm events, flooding and sea-level rise". In the changing climate scenario, the energy industry has been recognised as responsible for a large amount of carbon dioxide emissions, and at the same time, this industry is also vulnerable to climate risk. Cruz and Krausmann (2013) found that climate change imposes a wide range of physical threats to the oil and gas sector. They revealed that the intensity and frequency of this emerging risk depend on the location that is exposed to the risk. They found that this sector, located especially in 'low-lying coastal areas and areas exposed to extreme weather events', is the most vulnerable to this risk. They also suggested that this sector should take this emerging risk very seriously and also take appropriate measures to adapt or mitigate the negative consequences of this risk. Jianfei et al. (2014) found that Chinese energy provider enterprises had experienced dual pressure from climate change as well as from energy crises. They found that sustainable energy supply that did not affect the environment had become one of the most significant issues faced by China. They revealed that the top five power generation groups in China made several efforts to transition to a low-carbon economy during the 11th Five-Year Plan period.

Dahl and Flottum (2019) investigated how the energy companies think about climate change and how they have integrated it with their overall business strategy. For this purpose, they have selected three major energy companies, namely Canadian Suncor Energy, Norwegian Statoil, and French Total. They have found that French Total presented climate change as a 'responsibility' in their recent disclosures, and Canadian Suncor Energy presented climate change as a 'business risk'; on the other hand, this is represented as a 'business opportunity' by Norwegian Statoil. In certain countries, due to climate change, the dependency on particularly energy sources have changed. For instance, Boadi and Owusu (2017) have found, in the case of Ghana, that climate change-related variability in rainfall and El Nino-Southern Oscillation (ENSO) will create a huge problem in the power generation sector; they have also suggested that for sustainable energy supply, Ghana should decentralise from current hydropower to alternate energy resources. Lisperguer and Cuba (2008) found that climate risk increasingly alters the availability of natural energy resources and changes the operational performance of the energy production systems. They concluded that climate risk further changes the quality

and timing of renewable resources extraction potential. In this situation, if the stakeholders are not aware of this emerging risk, then the availability and affordability of energy for the Caribbean are at great risk.

Gerlak et al. (2018) found "significant emphasis on the identification of potential climate change impacts and opportunities for adaption, but less attention paid to the assessment of risk, stakeholder engagement, and cross-sectoral collaboration in climate risk management". Abreu et al. (2021) investigated the factors that influence the Canadian oil and gas sector to adopt climate change-tackling decisions. They found that external pressures from the government, suppliers, customers, and competitors could increase the likelihood of adopting a low-carbon strategy by the firms. They further revealed that investors and employees may be less committed to adopting climate change strategies compared to others stakeholders. They found that media and corporate sustainability reporting were not influencing firms to adopt low-carbon strategies, whereas firm's performance perceptions about this emerging risk play a vital role in influencing the adoption of climate change-tackling strategies. Engels et al. (2020) found that the conventional energy companies are facing an emerging risk related to the implementation of a new low-carbon energy evaluation system on their profitability and long-term survival. They highlighted the important question associated with climate risk on the energy companies: "how do these companies take wide-ranging investment decisions and convince investors that they will be able to generate a sustainable return on investment in a rapidly changing business world". They suggested that through the transition from fossil fuel-based to decarbonise-based energy generation strategy, the companies could make their businesses sustainable in the long run. Some researchers had explored the relationship between climate change and financial performance; for instance, Delmas et al. (2015) investigated the relationship between environmental and financial performance for 1,095 US corporations. They found that a decrease in GHG emissions leads to a positive effect on the financial performance of the sample companies for the period 2004 to 2008. They also found that the decrease in GHG emissions has a negative effect on return on assets (ROA). They concluded that reduction in GHG emission is recognised as profitable in the long-term perspective.

Nakao et al. (2007) found that environmental performance has a positive effect on the firm's financial performance, in the case of Japanese firms. They also found that improvement of the firm's environmental performance leads to an increase in the firm's long-term intangible assets. Climate risk can substantially impact the financial performance and financial policies of the firm. For example, Huang et al. (2017) investigated the impact of climate risk on a firm's financial report. They used the Climate Risk Index (CRI) score, published by 'Germanwatch' (2014), as the climate risk variable, whereas firms' financial performance is represented by return on assets (ROA), and cash flow from operations (CFO) is used for the present study. They found a negative relationship between climate risk and a firm's financial performance. Companies that are more exposed to climate risk tend to hold more liquidity (cash) to build more resilience to the threats of climate risk. More climate risk-exposed firms are expected to have long-term loans rather than short-term, and tend to distribute lower amounts of cash dividends. Sun et al. (2020) found that climate risk has both positive and negative impacts on the financial performance of Chinese mining companies. Therefore, these companies should take into consideration this emerging risk while planning and implementing future production activities and construction of infrastructure. They also suggested that for availing future competitive benefits and to sustain profitability, the companies should actively reduce GHG emissions. They suggested that for the reduction of climate change-related reputational risk and to improve brand value, these companies should also disclose climate change-related information to the investors and other stakeholders. Arnell et al. (2021) stated, "In the absence of explicit adaptation, risks will increase across the whole of the UK, but at different rates and from different starting values in different regions". They also revealed that a reduction in GHG emissions will lead to reducing the climate risks in the long run.

Research Gap

Previous studies had tried to explore a different dimension of climate risk in the energy sector. Few studies have also tried to explore the relationship between environmental and financial performance. However, the existing financial performance indicators are not incorporating the climate risk in their traditional computation of corporate financial performance; due to this, the traditional financial statements fail to provide a clear and accurate picture of the actual financial position of the company. As per our best knowledge, no studies have been found that incorporate

the integrated ratio approach to examine the relationship between climate risk and financial performance of the energy companies. Thus, the present study focuses on incorporating climate risk in the analysis of the financial performance of the selected companies.

Objectives

- To examine the relationship between climate risks and the financial performance of the sample companies.
- To compare the financial performance of the selected companies after incorporating climate risk.

Methodology and Data

Selection criteria of the sample companies for the study: We have considered the energy sector for our study. According to the 'Climate Change: Implication for the Energy Sector' report by the University of Cambridge (2014), the energy sector is not only responsible for increasing GHG emissions, but is also one of the sectors most exposed and vulnerable to climate risk. We have selected five companies from five different countries, namely BHB Billiton (Australia), Sinopec (China), BP & P.L.C (UK), Chevron (USA), and NTPC (India), to understand the climate change-related risk more clearly and from a broader perspective.

Financial information has been collected from the sample company's annual reports, whereas the climate change-related data have been collected from the respected company's ESG report/sustainability report/climate change report/integrated report.

To meet the objectives successfully, we adopt an integrated ratio approach. The integrated ratio approach helps us understand how climate risk affects the financial performance of a company. Here, the proxy variable of climate risk is CO2e emission by the companies, i.e. scope 1 and scope 2 emissions.

Here, we consider the following integrated ratios to achieve our objectives successfully:

Carbon Intensity
Formula: Carbon Intensity = (CO2 Scope 1 + Scope 2) / Revenue
Unit: CO2e
Explanation: How much CO2e a company emits per revenue.

BlackRock's Efficiency Improvement
Formula: BlackRock's Efficiency Improvement = $\{(\text{Carbon Intensity})_{t-1} - \text{Carbon Intensity})_t\}$ * Return on Equity
Unit: CO2e
Explanation: Carbon Intensity development by return in percentage. A positive outcome indicates it has been possible to reduce carbon per activity and gain a return on investors' capital. This is a low-carbon transition ratio, showing the integrated profitability of being able to transfer the company's methods of working to lower emission production, and at the same time, generate revenue and profit. However, note, if both the Carbon Intensity development and the return on equity are negative, then the result will be invalid.

Return on CO2e
Formula: Return on CO2e = {Profit/Loss for the Period / (CO2 Scope 1 + Scope 2)} * 100
Unit: Monetary Unit
Explanation: How much profit is earned per emitted CO2e

Cash Flow from CO2e
Formula: Return on CO2e = {CFFO / (CO2 Scope 1 + Scope 2)}
Unit: Monetary Unit
Explanation: The company's cash flow from operations per emitted CO2e

Empirical Analysis and Interpretations

In this section, we discuss the relationship between climate risk and financial performance. Integrated ratios bring financial data and non-financial data (climate risk) together in such a way that one can compare climate risk and performance of the company with another company. Here, first we incorporate the climate risk in the traditional system of computing financial performance of the sample companies as follows:

Selected Integrated Ratio Analysis for BHB Billiton (Australia)

Here, we have analysed the financial performance of BHB Billiton, after incorporating climate risk, with the

help of integrated ratio approach. The environmental and financial data are as follows:

Environmental Data

- *Scope 1 Emission*: 9.7 million tonnes CO2e and 10.6 million tonnes CO2e for 2019 and 2018, respectively.
- *Scope 2 Emission:* 5.0 million tonnes CO2e and 5.9 million tonnes CO2e for 2019 and 2018, respectively.

Financial Data

- *Revenue from Operating Activities:* 44,288 million USD and 43,129 million USD for 2019 and 2018, respectively.
- *Profit after Taxation:* 9,185 million USD and 4,823 million USD for 2019 and 2018, respectively.
- *Opening Shareholders' Equity:* 55,592 million USD and *Closing Shareholder's Equity:* 47,240 million USD for 2019.
- *Cash Flow from Operating Activities:* 17,871 million USD and 18,461 million USD for 2019 and 2018, respectively.

Table 1: Calculation of Integrated Ratios for 2019

Integrated Ratios	*BHB Billiton (Australia)*
(Carbon Intensity)t = (9.7 + 5.0) million tonnes CO2e / 44,288 million USD Unit: million tonnes CO2e	0.000331918
(Carbon Intensity)t-1 = (10.6 + 5.9) / 43,129 million USD Unit: million tonnes CO2e	0.000382573
BlackRock's Efficiency Improvement = {(0.000382573 − 0.000331918) million tonnes CO2e} * 17.864089 Unit: million tonnes CO2e	0.000904905
Return on CO2e = {9,185 million USD / (9.7 + 5.0) million tonnes CO2e Unit: million USD	624.829932
Cash Flow from CO2e = 17,871 million USD / (9.7 + 5.0) million tonnes CO2e Unit: million USD	1215.714286

Interpretation

Table 1 shows that, in the case of BHP, (Carbon Intensity) t: 0.0003319184 CO2e, which implies that for earning 1 million USD of revenue, the company emits 0.0003319184 million tonnes of CO2e in 2019. In 2018, BHP emitted 0.000382573 million tonnes of CO2e for earning 1 million USD revenue. As the outcome of BlackRock's Efficiency Improvement is positive, it can be concluded that it has been possible to reduce carbon per activity and gain a return on investor's capital. This is a low-carbon transition ratio, showing the integrated profitability of being able to transfer the company's methods of working to lower emission production, and at the same time, generate revenue and profit. By emitting 1 million tonnes of CO2e, the company has earned 624.82 million USD of profit. It also earned 1215.71 million USD cash flow from operations by emitting per millions of CO2e.

**Note:
Calculation of Return on Equity:
= Net profit / Average shareholders' equity * 100
= 17.864089%
Average shareholders' equity (million USD)
= (Opening shareholders' equity + Closing shareholders' equity) / 2
= 51,416

Selected Integrated Ratio Analysis for Sinopec (China)

Environmental Data

- Scope 1 emission: 125.68 million tonnes CO2e and 128.57 million tonnes CO2e for 2019 and 2018, respectively.
- Scope 2 emission: 45.01 million tonnes CO2e and 42.95 million tonnes CO2e for 2019 and 2018, respectively.

Financial Data

- *Revenue from Operating Activities*: 4,42,268 million USD and 4,35,361 USD million for 2019 and 2018, respectively.
- *Profit after Taxation*: 10,754 million USD and 12,090 million USD for 2019 and 2018, respectively.
- *Opening Shareholders' Equity:* 1,06,949 million USD and *Closing Shareholder's Equity:* 1,10,060 million USD for 2019.

- *Cash Flow from Operating Activities:* 22,875 million USD and 26,834 million USD for 2019 and 2018, respectively.

Table 2: Calculation of Integrated Ratios for 2019

Name of the Company / Integrated Ratios	*Sinopec (China)*
(Carbon Intensity)t = (125.68 + 45.01) million tonnes CO2e / 442268 million USD Unit: million tonnes CO2e	0.000385942
(Carbon Intensity)t-1 = (128.57 + 42.95) million tonnes CO2e / 435361 million USD Unit: million tonnes CO2e	0.000393972
BlackRock's Efficiency Improvement = (0.000393972 − 0.000385942) * 9.910720788 Unit: million tonnes CO2e	0.000959794
Return on CO2e = 10754 million USD / (125.68 + 45.01) million tonnes CO2e Unit: million USD	63.00310504
Cash Flow from CO2e = 22875 million USD / (125.68 + 45.01) million tonnes CO2e Unit: million USD	134.0148808

Interpretation

Table 2 shows that, in the case of Sinopec, (Carbon Intensity)t = 0.000385942 M. CO2e reveals that for earning 1 million USD of revenue, the company has emitted 0.000385942 million tonnes of CO2e in 2019, whereas in 2018, Sinopec has emitted 0.000393972 million tonnes of CO2e. As the outcome of BlackRock's Efficiency Improvement is positive, it can be concluded that the company has been able to reduce carbon per activity and gain a return on investors' capital. This is a low-carbon transition ratio, showing the integrated profitability of being able to transfer the company's methods of working to lower emission production, and at the same time, generate revenue and profit. Return on CO2e implies that by emitting 1 million tonnes of CO2e, the company earned 63.00310504 million USD in FY 2019. The fourth integrated ratio has revealed that the company's cash flow from operations per emitted CO2e M is 134.0148808 million USD.

**Note:

Calculation of Return on Equity

= Net profit / Average shareholders' equity * 100
= 10,754 / 1,08,505 * 100
= 9.910720788%
Average shareholders' equity (million USD)
= (Opening shareholders' equity + Closing shareholders' equity) / 2
= 2,17,010 / 2
= 1,08,505

Selected Integrated Ratio Analysis for BP & P.L.C (UK)

Environmental Data

- *Scope 1 Emission:* 49.2 million tonnes CO2e and 48.8 million tonnes CO2e for 2019 and 2018, respectively.
- *Scope 2 Emission:* 5.2 million tonnes CO2e and 5.4 million tonnes CO2e for 2019 and 2018, respectively.

Financial Data

- *Revenue from Operating Activities:* 2,78,397 million USD and 2,98,756 million USD for 2019 and 2018, respectively.
- *Profit after Taxation*: 4,026 million USD and 9,383 million USD for 2019 and 2018, respectively.
- *Opening Shareholders' Equity:* 99,444 million USD and *Closing Shareholder's Equity:* 98,412 million USD for 2019.
- *Cash Flow from Operating Activities:* 25,770 million USD and 22,873 million USD for 2019 and 2018, respectively.

Table 3: Calculation of Integrated Ratios for 2019

Name of the Company / Integrated Ratios	*BP & P.L.C (UK)*
(Carbon Intensity)t = (49.2 + 5.2) million tonnes CO2e / 2,78,397 million USD Unit: CO2e M	0.000195404
(Carbon Intensity)t-1 = (48.8 + 5.4) million tonnes CO2e / 2,98,756 million USD Unit: CO2e M	0.000181419
BlackRock's Efficiency Improvement = {(0.000181419 − 0.000195404) million tonnes CO2e} * 4.069626395 million USD Unit: million tonnes CO2e	−0.0000569137

Name of the Company / Integrated Ratios	*BP & P.L.C (UK)*
Return on CO2e = (4,026 million USD / (49.2 + 5.2) million tonnes CO2e) Unit: million USD	74.00735294
Cash Flow from CO2e = 25,770 million USD / (49.2 + 5.2) million tonnes CO2e Unit: million USD	473.7132353

Interpretation

Table 3 shows that, in the case of BP & P.L.C, (Carbon Intensity)t: 0.000195404 CO2eM, which implies that for earning 1 USDM of revenue, the company emitted 0.0003319184 million tonnes of CO2e in 2019, whereas in 2018, BP & P.L.C emitted 0.000382573 million tonnes of CO2e. As the outcome of BlackRock's Efficiency Improvement is negative, it can be concluded that it has not been possible to reduce carbon per activity and gain a return on investor's capital. This is a low-carbon transition ratio, showing the integrated profitability of not being able to transfer the company's methods of working to lower emission production, and at the same time, generate revenue and profit. Table 3 also shows that the company has earned 74.00735294 million USD of profit per emitted million tonnes of CO2e, whereas the company has generated 473.7132353 million USD cash flow from operations per emitted CO2e.

**Note:
Calculation of Return on equity:
= Net profit / Average shareholders' equity * 100
= 4.069626395%
Average shareholders' equity (USDM)
= (Opening shareholders' equity + Closing shareholders' equity) / 2
= 98928

Selected Integrated Ratio Analysis for Chevron Corporation (USA)

Environmental Data

- *Scope 1 Emission:* 55 million tonnes CO2e and 59 million tonnes CO2e for 2019 and 2018, respectively.
- *Scope 2 Emission:* 2 million tonnes CO2e and 3 million tonnes CO2 for 2019 and 2018, respectively.

Financial Data

- *Revenue from Operating Activities:* 1,39,865 million USD and 1,58,902 million USD for 2019 and 2018, respectively.
- *Profit after Taxation:* 2,924 million USD and 14,824 million USD for 2019 and 2018, respectively.
- *Opening Shareholders' Equity:* 1,54,554 million USD and *Closing Shareholder's Equity:* 1,44,213 million USD for 2019.
- *Cash Flow from Operating Activities:* 27,314 million USD and 30,618 million USD for 2019 and 2018, respectively.

Table 4: Calculation of Integrated Ratios for 2019

Name of the Company / Integrated Ratios	*Chevron Corporation (USA)*
(Carbon Intensity)t = (55 + 2) million tonnes CO2e / 1,39,865 million USD Unit: CO2e	0.000407536
(Carbon Intensity)t-1 = (59 + 3) million tonnes CO2e / 1,58,902 million USD Unit: CO2e	0.000390178
BlackRock's Efficiency Improvement = {(0.000390178 − 0.000407536) million tonnes CO2e} * 1.957378158 Unit: CO2e	−0.000033976
Return on CO2e = {2,924 million USD / (55 + 2) million tonnes CO2e} Unit: million USD	51.29824561
Cash Flow from CO2e = 27,314 / (55 + 2) million tonnes CO2e Unit: million USD	479.1929825

Interpretation

Table 4 shows that, in the case of Chevron Corporation, (Carbon Intensity)t: 0.000407536 CO2e M implies that for earning 1 million USD of revenue, the company emitted 0.000407536 million tonnes of CO2e in 2019, whereas in 2018, Chevron Corporation emitted 0.000390178 million tonnes of CO2e. The outcome of BlackRock's Efficiency Improvement is negative, which is why it can be concluded that it has been challenging to reduce carbon per activity and gain a return on investors' capital. This

is a low-carbon transition ratio, showing the integrated profitability of not being able to transfer the company's methods of working to lower emission production, and at the same time, generate revenue and profit. Table 4 also shows that the company has earned 51.29824561 million USD of profit per emitted million tonnes of CO2e whereas, the company has generated 479.1929825 million USD cash flow from operations per emitted CO2e.

**Note: Calculation of Return on equity:
= Net profit / Average shareholders' equity * 100
= 1.957378158%
Average shareholders' equity (USDM)
= (Opening shareholders' equity + Closing shareholders' equity) / 2
= 149383.5

Selected Integrated Ratio Analysis for NTPC (India)

Environmental Data

- *Scope 1 Emission:* 264.406 million tonnes CO2e and 255.185 million tonnes CO2e for 2019 and 2018, respectively.
- *Scope 2 Emission*: 0.02559425 million tonnes CO2e and 0.02743027 million tonnes CO2e for 2019 and 2018, respectively.

Financial Data

- *Revenue from Operating Activities:* 1,293.65 million USD and 1,195.46 million USD for 2019 and 2018, respectively.
- *Profit after Taxation:* 168.32 million USD and 148.17 million USD for 2019 and 2018, respectively.
- *Opening Shareholders' Equity:* 1,483.55 million USD and *Closing Shareholder's Equity:* 1,576.28 million USD for 2019.
- *Cash Flow from Operating Activities:* 229.64 million USD and 275.75 million USD for 2019 and 2018, respectively.

Table 5: Calculation of Integrated Ratios for 2019

Name of the Company / Integrated Ratios	*NTPC (India)*
(Carbon Intensity)t = (265 + 0.025647597) million tonnes CO2e / 1293.65 million USD Unit: million tonnes CO2e	0.204866577
(Carbon Intensity)t-1 = (256 + 0.027487445) million tonnes CO2e / 1195.46 million USD Unit: million tonnes CO2e	0.214166503
BlackRock's Efficiency Improvement = (0.214166503 − 0.204866577) million tonnes CO2e * 129.5466047 million USD Unit: million tonnes CO2e	1.204773837
Return on CO2e = 168.32 million USD / (265 + 0.025647597) million tonnes CO2e Unit: million USD	0.635108343
Cash Flow from CO2e = 229.64 million USD / (265 + 0.025647597) million tonnes CO2e Unit: million USD	0.866482177

Interpretation

Table 5 shows that, in the case of NTPC, (Carbon Intensity) t: 0.204866577, which implies that for earning 1 million USD of revenue, the company emitted 0.204866577 million tonnes of CO2e in 2019, whereas in 2018, NTPC emitted 0.214166503 million tonnes of CO2e. The outcome of BlackRock's Efficiency Improvement is positive, which is why it can be concluded that it has been possible to reduce carbon per activity and gain a return on investors' capital. This is a low-carbon transition ratio, showing the integrated profitability of being able to transfer the company's methods of working to lower emission production, and at the same time, generate revenue and profit. Table 5 also shows that the company has earned 0.635108343 million USD of profit per emitted million tonnes of CO2e, whereas the company generated 0.866482177 million USD of cash flow from operations per emitted CO2e.

**Note: Calculation of Return on equity:
= Net profit / Average shareholders' equity * 100
= 11.00174597%
Average shareholders' equity (million USD)
= (Opening shareholders' equity + Closing shareholders' equity) / 2
= 1,530

Table 6: Summary of the Integrated Ratios – Comparative Analysis of the Selected Integrated Ratio of the Sample Companies

Calculation of Selected Integrated Ratios for 2019					
	BHP Billiton (Australia)	*Sinopec (China)*	*BP & P.L.C (UK)*	*Chevron Corporation (USA)*	*NTPC (India)*
(Carbon Intensity)t Formula: Carbon Intensity = (CO2e Scope 1 + Scope 2) / Revenue Unit: CO2e	0.000331918	0.000385942	0.000195404	0.000407536	0.20486658
Carbon Intensity for (t-1) Formula: Carbon Intensity = (CO2e Scope 1 + Scope 2) / Revenue Unit: CO2e	0.000382573	0.000393972	0.000181419	0.000390178	0.2141665
BlackRock's Efficiency Improvement = {(Carbon Intensity)t-1 − (Carbon Intensity)t} * Return on Equity	0.000904903	0.00007958	−0.00005691	−0.000033976	0.10231542
Return on CO2e = (Profit/Loss for the Period / (CO2e Scope 1 + Scope 2)) Unit: (million USD)	624.829932	63.00310504	74.00735294	51.29824561	0.63510834
Cash Flow from CO2e = CFFO / (CO2e Scope 1 + Scope 2) Unit: (million USD)	1215.714286	134.0148808	473.7132353	479.1929825	0.86648218

Interpretation

Table 6 shows a comparative analysis between the sample companies. Here, the lowest (Carbon Intensity)t for FY2019 is 0.000331918 million tonnes of CO2e in the case of Australia, whereas the highest (Carbon Intensity) t for FY2019 is 0.20486658 million tonnes of CO2e in the case of India. Australia has earned 1 million USD by emitting 0.000331918 million tonnes of CO2e; however, compared to Australia, India has earned 1 million USD by emitting 0.20486658 million tonnes of CO2e. In the case of BP & P.L.C (UK) and Chevron Corporation (USA), the BlackRock's Efficiency Improvement is negative, so they are not able to reduce carbon per activity and gain a return on investors' capital. The rest of the companies, BHB Billiton (Australia), Sinopec (China), and NTPC (India), are showing positive BlackRock's Efficiency Improvement, so it has been possible to reduce carbon per activity and gain a return on investors' capital. The highest return on CO2e for FY2019 is 624.829932 million USD per million tonnes of CO2e in the case of Australia, whereas the lowest return on CO2e for FY2019 is 0.63510834 million USD per million tonnes of CO2e emission in the case of India. The highest cash flow from CO2e for FY2019 is 1215.714286 million USD per million tonnes of CO2e in the case of Australia, whereas the lowest cash flow from CO2e for FY2019 is 0.86648218 million USD per million tonnes of CO2e emission in the case of India.

Table 7: For the Calculation of the Modern Financial Indicators (Selected Integrated Ratios), we have Calculated the following Traditional Indicator (Return on Equity)

	BHP Billiton (Australia)	*Sinopec (China)*	*BP & P.L.C (UK)*	*Chevron Corporation (USA)*	*NTPC (India)*
Calculation of Return on equity: Net profit / Average shareholders' equity * 100	17.864089	9.910720788	4.069626395	1.957378158	11.001746
Average shareholders' equity (million USD) = (Opening shareholders' equity + Closing shareholders' equity) / 2	51416	1,08,505	98928	149383.5	1,530

Discussion of Results

We have considered five energy companies for the present study and we observed that the companies are aware of climate risk. The selected companies have disclosed climate risk-related data through their annual reporting practices. Except BP & P.L.C (UK) and NTPC (India), the rest of the companies have been able to reduce their scope 1 CO2e emissions for 2019, compared to the previous year. We have also observed that among the five sample companies, NTPC has emitted the highest amount of scope 1 CO2e, Sinopec is the second-largest emitter, and Whereas Chevron Corporation (USA) and BP & P.L.C (UK) hold the third and fourth position in emitting scope 1 CO2e, respectively. BHB Billiton is the least scope 1 CO2e emitter in FY 2019. It is also interesting that NTPC (India) emits the lowest amount of scope 2 CO2e and Sinopec (China) emits the highest amount of scope 1 CO2e in the study period.

Based on the above interpretations, the following conclusions have been drawn:

- Except BP & P.L.C (UK) & Chevron Corporation (USA), the rest of the companies are able to reduce their Carbon Intensity compared to the previous year (2018); among the five sample companies, BHB Billiton (Australia) has the least Carbon Intensity, whereas NTPC (India) has the highest Carbon Intensity for the study period.
- Among the five sample companies, BHB Billiton (Australia), Sinopec (China), and NTPC (India) have a positive BlackRock's Efficiency Improvement, which implies that these companies are able to gain a return on investor's capital with the reduction of carbon per activity. However, in the case of BP & P.L.C (UK) and Chevron Corporation (USA), it has been not possible to reduce carbon per activity and gain a return on investor's capital.
- BHP Billiton not only successfully reduced its Carbon Intensity, it has been able to earn the highest amount profit per CO2e emission. On the other hand, both BP & P.L.C (UK) and Chevron Corporation (USA) are not able to reduce Carbon Intensity, but have earned a higher amount of profit, compared to Sinopec (China) and NTPC (India).
- The highest cash flow per CO2e emission is earned by BHP (Australia). Chevron Corporation (USA) is at the second position in earning cash flow per CO2e emission, compared to the other three companies. However, BlackRock's Efficiency Improvement ratio is negative, which means Chevron Corporation (USA) is able to generate a comparative profit per emitting CO2e, as well as generating a comparatively high amount of cash flow from per emitted CO2e, but it is not able to manage both, i.e., reduction in CO2 emission per activity and gain a return on investor's capital. The same inferences could be drawn for BP & P.L.C (UK). On the other hand, Sinopec (China) has successfully reduced its Carbon Intensity, but its Cash flow from CO2e is comparatively lower and though NTPC (India) has successfully reduced its Carbon Intensity, it has the lowest cash flow from CO2e for the study period.

If we considered the return on equity (ROE) to examine the performance of the sample firms, Sinopec (China) and NTPC (India) performed very well. However, when we incorporate climate risk with the traditional indicators, we have found almost the opposite. The overall performance of BHB Billiton (Australia) is best, compared to the other sample companies, as it has not only the highest amount of return from CO2e, cash flow from CO2e, and positive BlackRock's Efficiency Improvement, it also successfully reduced its Carbon Intensity. BP & P.L.C (UK) and Chevron Corporation (USA) are successfully able to earn profit from the activity and cash flow from per CO2 emission; however, both the companies are not able to reduce carbon per activity and gain a return on investor's capital at the same time. On the other hand, both Sinopec (China) and NTPC (India) have a positive BlackRock's Efficiency Improvement, but lower amounts of return from CO2e and cash flow from CO2e in 2019.

Conclusions

This article has tried to explore the impact of climate risk on the financial performance of energy companies. This is an emerging area of research, as the financial and capital market has not yet fully understood the impact of climate risk on the performance of the firms, at least not immediately. Our work contributes to a growing literature in the area of research, by aiming to incorporate the climate risk in evaluating the performance of the energy companies with the help of the integrated ratio approach. Compared to the traditional performance indicators, the integrated ratios represent a more accurate performance

of the companies, as these new and modern performance indicators have integrated climate risk in evaluating the performance of the firms. This study has selected five energy companies from five different countries (including three developed and two developing countries) as samples for this research. We provide evidence that in the developing countries the energy companies are facing more climate risk, compared to the energy companies located in the developed countries. More specifically, in earning a unit of revenue, the energy companies from the developing countries emitted a higher amount of scope 1 and scope 2 greenhouse gases, than the energy companies from developed countries. The results also revealed that though the energy companies from the developed countries (except Australia) have generated a higher amount of revenue and profit, they are not able to transfer the company's methods of working towards lower emissions production. Though the performance of energy companies in developing counties was comparatively lower than the companies located in the developed countries, they are able to reduce carbon per activity and gain a return on the investor's capital.

References

Abreu, M. C. S. de, Webb, K., Araújo, F. S. M., & Cavalcante, J. P. L. (2021). From "business as usual" to tackling climate change: Exploring factors affecting low-carbon decision-making in the Canadian oil and gas sector. *Energy Policy, 148,* 111932. doi:https://doi.org/10.1016/j.enpol.2020.111932

Alsaifi, K., Elnahass, M., & Salama, A. (2019). Carbon disclosure and financial performance: UK environmental policy. *Business Strategy and the Environment, 29*(2), 711-726. doi:https://doi.org/10.1002/bse.2426

Arnell, N. W., Kay, A. L., Freeman, A., Rudd, A. C., & Lowe, J. A. (2021). Changing climate risk in the UK: A multi-sectoral analysis using policy-relevant indicators. *Climate Risk Management, 31*, 100265. doi:https://doi.org/10.1016/j.crm.2020.100265

Berkman, H., Jona, J., & Soderstrom, N. S. (2021, 25 March). Firm-specific climate risk and market valuation. Retrieved from https://ssrn.com/abstract=2775552 or doi:http://dx.doi.org/10.2139/ssrn.2775552

Boadi, S. A., & Owusu, K. (2017). Impact of climate change and variability on hydropower in Ghana. *African Geographical Review*. doi:10.1080/19376812.2017.1284598

Contreras-Lisperguer R., & Cuba de, K. (2008). *The potential impact of climate change on the energy sector in the Caribbean region.* Organization of American States.

Cruz, A. M., & Krausmann, E. (2013). Vulnerability of the oil and gas sector to climate change and extreme weather events. *Climatic Change*, *121,* 41-53. doi:https://doi.org/10.1007/s10584-013-0891-4

Dahl, T., & Flottum, K. (2019). Climate change as a corporate strategy issue: A disclosure analysis of three climate reports from the energy sector. *Corporate Communications: An International Journal*, *24*(3), 499-514. doi:https://doi.org/10.1108/CCIJ-08-2018-0088

Delmas, M. A., Nairn-Birch, N., & Lim, J. (2015). Dynamics of environmental and financial performance. *Organization & Environment, 28*(4), 374-393. doi:https://doi.org/10.1177/1086026615620238

Engels, P. D. A., Kunkis, M., & Altstaedt, S. (2020). A new energy world in the making: Imaginary business futures in a dramatically changing world of decarbonized energy production. *Energy Research & Social Science, 60,* 101321. doi:https://doi.org/10.1016/j.erss.2019.101321

Gerlak, A. K., Weston, K., McMahan, B., Murray, R. L., & Mills-Novoa, M. (2018). Climate risk management and the electricity sector. *Climate Risk Management*, *19,* 12-22. doi:https://doi.org/10.1016/j.crm.2017.12.003

Huang, H. H., Kerstein, J., & Wang, C. (2017). The impact of climate risk on firm performance and financing choices: An international comparison. *Journal of International Business Studies, 49*(5), 633-656. doi:https://doi.org/10.1057/s41267-017-0125-5

Jianfei, S., Song, X., Ming, Z., Yi, W., Yuejin, W., Xiaoli, L., & Zhijie, W. (2014). Low-carbon development strategies for the top five power generation groups during China's 12th Five-Year Plan period. *Renewable and Sustainable Energy Reviews, 34,* 350-360. doi:https://doi.org/10.1016/j.rser.2014.03.029

Khan, M. K., Khan, M. I., & Rehan, M. (2020). The relationship between energy consumption, economic growth and carbon dioxide emissions in Pakistan. *Financial Innovation*, *6*(1). doi:https:doi.org/10.1186/s40854-019-0162-0

Mirza, F. M., & Kanwal, A. (2017). Energy consumption, carbon emissions and economic growth in Pakistan: Dynamic causality analysis. *Renewable and Sustainable Energy Reviews, 72*, 1233-1240. doi:https://doi.org/10.1016/j.rser.2016.10.081

Moyo, M., & Wingard, H. C. (2015). An assessment of the impact of climate change on the performance of South African companies. *Journal of Governance and Regulation, 4*(2), 49-62. Retrieved from https://virtusinterpress.org/IMG/pdf/10-22495_jgr_v4_i2_p5.pdf

Nakao, Y., Amano, A., Matsumura, K., Genba, K., & Nakano, M. (2007). Relationship between environmental performance and financial performance: An empirical analysis of Japanese corporations. *Business Strategy and the Environment, 16,* 106-118. doi:https//doi.org/10.1002/bse.476

Nikolaou, I., Evangelinos, K., & Leal Filho, W. (2015). A system dynamic approach for exploring the effects of climate change risks on firms' economic performance. *Journal of Cleaner Production, 103,* 499-506. doi:http://dx.doi.org/10.1016/j.jclepro.2014.09.086

Ozturk, I., & Acaravci, A. (2010). CO2 emissions, energy consumption and economic growth in Turkey. *Renewable and Sustainable Energy Reviews, 14*(9), 3220-3225. doi:https://doi.org/10.1016/j.rser.2010.07.005

Rahman, M. M., & Kashem, M. A. (2017). Carbon emissions, energy consumption and industrial growth in Bangladesh: Empirical evidence from ARDL cointegration and Granger causality analysis. *Energy Policy, 110,* 600-608. doi:https://doi.org/10.1016/j.enpol.2017.09.006

Sun, Y., Yang, Y., Huang, N., & Zou, X. (2020). The impacts of climate change risks on financial performance of mining industry: Evidence from listed companies in China. *Resources Policy, 69,* 101828. doi:https://doi.org/10.1016/j.resourpol.2020.101828

U.S. Energy Sector Vulnerability to Climate Change and Extreme Weather. (2013). U.S. Department of Energy.

Vidyarthi, H. (2013). Energy consumption, carbon emissions and economic growth in India. *World Journal of Science, Technology and Sustainable Development, 10*(4), 278-287.