Green Energy Consumption and Stock Performance: Evidence from the German Market

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Abstract

This study investigates the impact of green energy consumption on stock performance within the German market, focusing on companies listed in the DAX40 index. Against the backdrop of a global shift towards sustainability and the increasing integration of Environmental, Social and Governance (ESG) factors in investment decisions, our research aims to provide empirical evidence on the relationship between green energy consumption and financial performance. Employing a comprehensive analysis approach, we utilize the Sharpe Ratio and paired samples t-test to assess our hypothesis. The study employs daily data aggregated into yearly values to facilitate analysis, with preprocessing techniques applied to ensure data quality and consistency. The selected timeframe for our quantitative exercise is 2014-2022. While the majority of companies did not exhibit statistically significant relationships, certain exceptions, such as Deutsche Bank, Symrise and Sartorius, showcased significant associations, highlighting sector-specific dynamics. These results underscore the complex interplay between environmental considerations and financial performance, offering valuable insights for investors and decision-makers. Our findings contribute to the ongoing discourse on responsible investing by providing empirical evidence on the relationship between green energy consumption and stock performance within the German market. By employing robust statistical techniques and focusing on a specific market context, the study offers unique insights into the implications of sustainable practices on corporate financial performance. The paper will try to answer the following research question: Can the high level of green energy usage impact the performance of the largest companies in Germany?

Keywords

Stock Performance, Green Energy, Sharpe Ratio, ESG

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Introduction

In recent years, the global shift towards sustainable practices and the transition to a green economy have become paramount concerns across various sectors. As companies increasingly recognize the importance of Environmental, Social and Governance (ESG) factors in their operations, investors and rating agencies are also paying closer attention to these metrics when evaluating the performance and sustainability of companies. One crucial aspect of ESG criteria is the adoption and utilization of green energy sources, which not only contribute to environmental preservation but also potentially influence financial performance. (Castro et al., 2021)

In the current context, where the primary focus is on investing in and transitioning to a more sustainable economic environment, many companies are striving to improve their ESG scores. Consequently, many are attempting to reduce energy consumption from unsustainable sources and modify their business plans to incorporate as much green energy as possible into their approach to business.

The present paper will try to answer the following research question: Can the high level of green energy usage impact the performance of the largest companies in Germany? The subject is still in its early stages, as reporting on energy consumption and the source of energy used is in its infancy.

To address this gap in the literature, we propose a comprehensive analysis that combines financial and environmental data to assess the influence of green energy consumption on stock performance (Cortez et al, 2022). Our study will employ the Sharpe Ratio (Sharpe, 1966), a widely used measure of risk-adjusted return, to evaluate the performance of stocks within the DAX40 index.

Our paper will contribute to the existing literature by providing empirical evidence on the relationship between green energy consumption and stock performance, specifically within the German market approach.

1. Literature review

The importance of sustainable investments has garnered increasing attention globally, with investors seeking to align financial goals with environmental considerations. In this context, understanding the relationship between green energy and stock performance becomes imperative.

Firstly, Küçükoğlu and Pınar (2015) explore the influence of green innovation on company performance, emphasizing its positive effects on environmental performance and competitive advantage. Their findings underscore the significance of green innovation activities, particularly in enhancing environmental sustainability and market competitiveness. In addition, Castro et al. (2021) investigate the impact of environmental performance on firms' stock prices, considering the context of renewable energy policies and green technologies. Their study suggests that environmental performance is valued by investors, with green patents and foreign trade contributing positively to the relationship between environmental performance and market values. Also, Cortez et al. (2022) investigate the environmental and financial performance of investments in energy firms. Their findings indicate that green energy portfolios generally outperform the market, with green energy firms demonstrating better environmental performance compared to non-green counterparts. In addition, Cortez et al. (2022) suggest a positive correlation between green energy investments and financial returns.

Moreover, Bauer et al. (2022) provide international evidence on the performance of green and brown stocks, highlighting the generally higher returns of green stocks across the G7 economies. The paper contributes to the ongoing debate on the relative pricing of climate-friendly versus less climate-friendly companies. On the other hand, Borghesi et al. (2022) analyze the impact of European green policy announcements on sectoral stock returns. The results of the paper suggest positive sentiment effects on both green and brown sectors following green policy-related announcements, with larger benefits observed among more sustainable portfolios. Anderloni and Tanda (2017) evaluate the determinants of short and long term performance of green energy companies. Evidence shows that green companies have a lower underpricing, which nevertheless disappears after few days of trading and when controlling for underpricing determinants. In the long run, performances of green and non-green are similar and empirical results show that the traditional risk factors explain return dynamics.

Karakostas (2023) emphasizes the role of macroeconomic conditions as determinants of stock market performance, highlighting the influence of international political and economic factors on stock exchange operations. The paper underscores the broader economic context within which stock market dynamics unfold. In the view of the German market, Nerlinger (2020) evaluates the sustainability and financial performance of the DAX 50 ESG index, shedding light on its effectiveness as a benchmark for German sustainable investments. Their analysis reveals mixed results, suggesting that while the index promotes sustainability, its financial performance may be comparatively weaker, potentially influencing investor perceptions and decisions.

2. Research methodology

The collected data underwent preprocessing to ensure quality and consistency. The timeframe of the study is 1 January 2014 – 31 December 2022. All the data were obtained from the Datastream by Refinitv. Daily data were transformed into yearly aggregates to facilitate analysis. Cleaning and normalization procedures were applied to address missing values, outliers, and inconsistencies in the datasets. From the initial 40 stocks, 29 stocks were retained for analysis due to data availability constraints.

The primary tools utilized for data manipulation, analysis and visualization are Python programming language libraries: pandas, numpy, matplotlib, and scipy. These libraries provide robust functionalities for managing extensive datasets, conducting mathematical operations, generating visual representations, and performing statistical analysis.

The Sharpe ratio was developed by Sharpe W. (1966) and became a cornerstone measure in finance for assessing the risk-adjusted returns of investment portfolios. Over the years, numerous studies have explored various aspects of the Sharpe ratio: its applications, limitations, and enhancements. In the realm of investment analysis, the Sharpe ratio serves as a vital measure for evaluating risk-adjusted returns. Ledoit and Wolf (2008) propose a robust method for testing differences in Sharpe ratios between investment strategies, particularly useful when returns deviate from normality or exhibit time series characteristics. This approach offers improved finite sample performance compared to existing methods, providing researchers with a reliable tool for comparing investment strategies.

For our study, we employ statistical tests such as the paired t-test and assess metrics like the Sharpe ratio to evaluate investment strategies and interventions. The paired t-test is commonly employed for assessing a consistent discrepancy between two sets of data. However, issues may arise when applying it to analyze dissimilarities of other natures. For instance, consider a scenario where y measurements consistently surpass x measurements at lower values, while the opposite holds true at higher values (Linnet, 1999). Moreover, various challenges exist in these methodologies, prompting scholars to propose alternative approaches for more robust analysis.

$$Sharpe\ ratio = \frac{Rp - Rf}{\sigma p}$$

(1)

where:

Rp = Return of the portofolio
Rf = Risk-free rate
σp = Standard Deviation of the portofolio

In Figure 1, the evolution of the performance of companies included in the DAX40 index after data cleaning is highlighted. It can be observed that the average performance of the companies included in the index has generally been positive, with only the years 2016 and 2022 showing negative values. The sudden decrease in 2022 can be explained by the onset of the conflict in Ukraine. The highest positive value was recorded in 2021, as a result of the reopening of the economy following the 2020 Covid-19 lockdown.
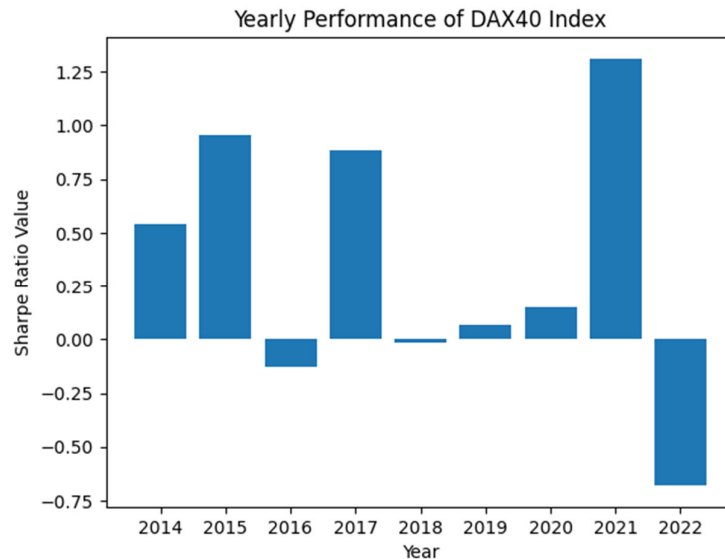

Figure no. 1. Yearly Performance of DAX40 Index
Source: Author's own research results – extracted from DataStream by Refinitiv

Figure 2 shows the evolution of the green energy consumption percentage of the companies included in the DAX40 index. It can be observed that the average green energy consumption has increases by more than 10 points in only 3 years. Some entities registered significant increases in the ratio of green energy. For

example: "Deutsche Telekom" registered a significant increase starting with the year 2020. Thus, from a green energy consumption ratio of 52%, it reached 92% in 2021.
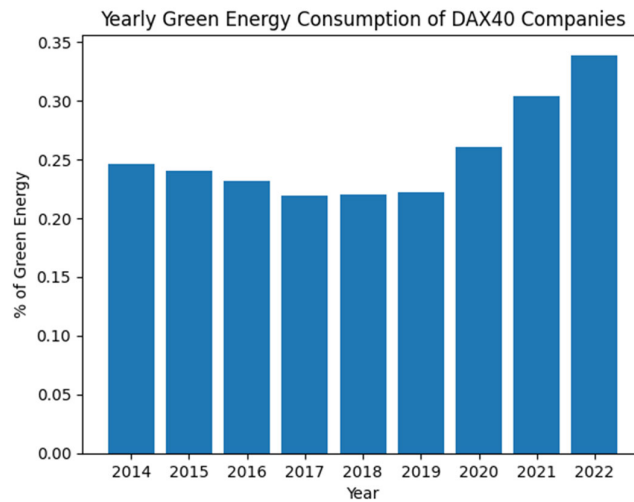

Figure no. 2. Yearly Green Energy Consumption of DAX40 Companies
Source: Author's own research results – extracted from DataStream by Refinitiv

3. Results

We conducted a paired samples t-test to investigate the potential relationship between the performance of stocks and the ratio of green energy consumption across a diverse range of companies. The t-statistic and corresponding p-values for each company are presented in Table 1.

Table no. 1. Results of Paired T-Test

No.	Company	T-statistic	P-value	No.	Company	T-statistic	P-value
1	SAP	-1.525.167	0.165727	16	HEIDELBERG MA-TERIALS	-0.460381	0.657498
2	SIEMENS	0.080449	0.937856	17	MERCK KGAA	2.057.482	0.073647
3	DEUTSCHE TEL-EKOM	-0.094587	0.926969	18	SIEMENS ENERGY N	-1.263.296	0.242054
4	ALLIANZ	0.288541	0.780268	19	CONTINENTAL	-0.601902	0.563904
5	MERCEDES-BENZ GROUP	-0.028978	0.977592	20	COVESTRO	0.605586	0.561572
6	DEUTSCHE POST	0.940029	0.374715	21	FRESENIUS	0.037160	0.971268
7	MUENCHENER RUCK	1.582.460	0.152202	22	ZALANDO	-1.772.185	0.114305
8	SIEMENS HEALTHINEERS	0.202029	0.844937	23	BRENNTAG	0.975622	0.357826
9	BASF	-0.979569	0.355989	24	SYMRISE	2.767.317	0.024398
10	DEUTSCHE BANK	-2.311.838	0.049547	25	QIAGEN	1.925.687	0.090320
11	INFINEON TECH-NOLOGIES	2.193.601	0.059586	26	AIRBUS (FRA)	1.457.900	0.182977
12	BAYER	-0.679090	0.516242	27	VOLKSWAGEN PREF.	-0.634663	0.543367
13	E ON N	-0.787780	0.453532	28	HENKEL PREFER-ENCE	-0.405488	0.695747
14	VONOVIA	0.001525	0.998821	29	SARTORIUS SHS.PREF.	2.469.726	0.038727
15	RHEINMETALL	1.649.249	0.137707				

Source: Author's own research results – extracted from DataStream by Refinitiv

Among the companies analyzed, only Deutsche Bank, Symrise and Sartorius SHS.PREF exhibited statistically significant relationships between stock performance and green energy consumption.

Deutsche Bank demonstrated a significant negative relationship ($t = -2.312$, $p = 0.050$), suggesting that an increase in the ratio of green energy consumption was associated with a decrease in stock performance. This finding may indicate potential challenges or uncertainties faced by financial institutions regarding the integration of sustainable practices into their operations. Symrise showed a significant positive relationship ($t = 2.767$, $p = 0.024$), indicating that higher green energy consumption was associated with improved stock performance. This result aligns with the growing recognition of the importance of sustainability and environmentally responsible practices in the consumer goods industry. Sartorius SHS.PREF also exhibited a significant positive relationship ($t = 2.470$, $p = 0.039$), further highlighting the potential benefits of embracing green energy practices in enhancing stock performance within the biotechnology and pharmaceutical sectors.

For the remaining companies, no significant relationships were found between stock performance and green energy consumption. However, it's worth noting that while these results did not reach statistical significance, they still provide valuable insights into the complex interplay between environmental factors and financial performance within various sectors.

These findings contribute to the ongoing discourse on the integration of ESG factors into investment decision-making processes. They underscore the need for further research and analysis to fully understand the implications of sustainable practices on corporate financial performance and shareholder value.

Conclusions

In conclusion, this study addresses the pressing need to understand the intricate relationship between green energy consumption and stock performance, especially within the German market landscape. Against the backdrop of a global shift towards sustainability and the increasing recognition of ESG factors in investment decisions, our research provides valuable empirical insights.

Through the utilization of the Sharpe Ratio and a paired samples t-test, we investigated whether companies' adoption of green energy practices influences their stock performance within the DAX40 index. While the majority of analyzed companies did not exhibit statistically significant relationships between green energy consumption and stock performance, notable exceptions emerged, shedding light on sector-specific dynamics.

The negative relationship observed in Deutsche Bank suggests potential challenges or uncertainties in integrating sustainable practices into financial operations, reflecting broader complexities within the financial sector. Conversely, the positive relationships demonstrated by Symrise and Sartorius SHS.PREF highlight the potential benefits of embracing green energy within the consumer goods and biotechnology/pharmaceutical sectors, respectively.

Moving forward, there are several key points for future research and improvement in methodology. Firstly, given the evolving nature of sustainable practices and reporting standards, continued data collection and analysis will be essential to capture longitudinal trends accurately. Additionally, expanding the scope of analysis to include a broader range of environmental, social, and governance factors could provide a more comprehensive understanding of their impact on stock performance.

In sum, this study contributes to the ongoing discourse on responsible investing and underscores the importance of further research to inform decision-making processes and drive positive environmental and financial outcomes. By continuing to explore the complex interplay between sustainability and financial performance, we can pave the way towards a more resilient and sustainable economic future.

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