УДК 628.3+336.761
JEL Classification O16, Q53, P48
DOI https://doi.org/10.33146/2307-9878-2024-2(104)-79-84

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Relationship between Wastewater Quality and Corporate Stock Price

Abstract. *Almost all industrial players handle wastewater treatment in one way or another by themselves, no matter the industry or company's size. Some companies have wastewater treatment plants, and others are considering investments for construction or modernisation. Occasionally, industrial wastewater is discharged to a municipal wastewater treatment plant; however, it must sometimes be pre-treated. Corporate wastewater quality is imperative for environmental responsibility, corporate legitimacy and financial performance. This paper examines the relationship between the reduction of hydrocarbon content of offshore and onshore wastewater and the stock price presented in TotalEnergies. The data on hydrocarbon content reduction in offshore and onshore wastewater discharge was collected from the TotalEnergies 2022 Sustainability and Climate Progress Report. In addition, the data on TotalEnergy's stock price was collected from the FusionMedia online stock price index. Data was analysed quantitatively through the application of a graphical approach. Findings from the graphical analysis of data depict two important dimensions of the stock value effect. Firstly, the results show a corresponding relationship between the reduction in the hydrocarbon content of wastewater and an increase in the stock price value of TotalEnergies. Secondly, the results show that the increase in stock price value continues even beyond the times of hydrocarbon reduction, which shows that investors compensate the company for its previously good performance in hydrocarbon reduction. This legitimacy-ingrained performance shows that hydrocarbon reduction protects the company's value even during uncertainties and/or hindrances in wastewater quality. Based on this finding, the paper develops an inductive hypothesis, opening a new research agenda. The findings are of practical significance for industrial hydrocarbon content reduction and the attraction of short- and long-term financial value to the industry.*

Keywords: *stock price, wastewater quality, corporate legitimacy, hydrocarbon content, offshore and onshore wastewater.*

Suggested Citation
Ngwakwe, C. C. (2024). Relationship between Wastewater Quality and Corporate Stock Price. *Oblik i finansi*, 2(104), 79-84. https://doi.org/10.33146/2307-9878-2024-2(104)-79-84

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Зв'язок між якістю стічних вод і ціною корпоративних акцій

Анотація. *Майже всі промислові гравці так чи інакше займаються очищенням стічних вод самостійно, незалежно від галузі чи розміру компанії. Деякі компанії мають власні очисні споруди, а інші розглядають інвестиції для їхнього будівництва чи модернізації. Іноді промислові стічні води скидаються в міські очисні споруди; однак іноді їх все ж потрібно попередньо обробити. Якість корпоративних стічних вод є обов'язковою індикатором екологічної відповідальності, корпоративної легітимності та фінансових показників. У цьому дослідженні розглядається взаємозв'язок між зменшенням вмісту вуглеводнів у морських і берегових стічних водах і курсом акцій, представленим у TotalEnergies. Дані про зниження вмісту вуглеводнів у морських і берегових скидах стічних вод були зібрані зі звіту TotalEnergies 2022 про сталий розвиток і клімат. Крім того, дані про курс акцій TotalEnergy були зібрані з онлайн-індексу цін на акції FusionMedia. Для кількісного аналізу даних використано графічний метод. Результати графічного аналізу даних відображають два важливі аспекти ефекту вартості акцій. По-перше, результати демонструють відповідний зв'язок між зменшенням вмісту вуглеводнів у стічних водах та підвищенням вартості акцій TotalEnergies. По-друге, результати доводять, що зростання вартості акцій продовжується навіть після періоду скорочення викидів вуглеводнів, що свідчить про те, що інвестори компенсують компанії її попередні хороші показники у скороченні вуглеводнів. Ця ефективність, заснована на легітимності, свідчить, що*

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скорочення викидів вуглеводнів захищає цінність компанії навіть під час невизначеності та/або перешкод в якості стічних вод. На основі цього висновку розроблено індуктивну гіпотезу, яка визначає нові напрямки для подальших досліджень. Отримані результати мають практичне значення для зниження вмісту вуглеводнів у стічних водах промисловості та залучення коротко- та довгострокових фінансових інвестицій у галузь.

Ключові слова: *ціна акцій, якість стічних вод, корпоративна легітимність, вміст вуглеводнів, морські та берегові стічні води.*

INTRODUCTION

The increasing advocacy for sustainable economic growth and development places the corporation at centre stage among other stakeholders in the global effort to balance the environmental impact of corporate operations with the economic objective of the business (Vyas & Cannon, 2008). Water pollution reduction is critical in advocating for environmental sustainability and climate change adaptation. Therefore, aside from legal or policy mandates for corporate efforts for environmental sustainability through a reduction in water pollution, the corporation has a role in climate advocacy as part of its core business strategy for environmental responsibility. Although greenhouse gas has often been the most common song rhyme regarding environmental sustainability, reducing water pollution is essential for fostering ecological conservation. Zolfaghari et al. (2022) emphasise that large-scale flow back and produced water (FPW) extraction during hydraulic fracturing (HF) is a major environmental problem associated with the extraction of hydrocarbons from non-traditional, low-permeability rock formations. For oil and gas companies, controlling FPW costs is essential when deciding how to handle FPW (either by treatment, disposal, recycling, or reuse).

Today, numerous studies are devoted to the impact of environmental management on financial results. In the domain of waste management and firm performance, prior research has likewise focussed on the impact of waste management on financial performance, with regression analysis being the dominant data analysis technique for the analysis time series, cross-sectional data, panel data or a combination of these. However, more is needed in prior environmental management accounting literature on the effect of wastewater hydrocarbon content on stock price. Hence, this paper pursues a related objective with prior research but with a slightly different objective and analytical technique slant. Accordingly, this paper aims to use a graphical technique to examine the effect of the hydrocarbon content of offshore and onshore wastewater on stock price. The author seeks to show the effect on stock price within periods of positive reduction in hydrocarbon content and the period of increasing hydrocarbon content. The resultant observation and analysis result would culminate in an inductive proposition for further extended research.

LITERATURE REVIEW

To investigate the relationship between corporate water disclosure and the financial success of thirty firms listed on the Johannesburg Stock Exchange (JSE) during four years, from 2017 to 2021, Nyahuna and Doorasamy (2023) carried out a thorough investigation and used a longitudinal technique in conjunction with a quantitative research methodology. The study's findings demonstrated a significant positive correlation between major financial performance metrics, such as return on assets, net profit margin, and earnings per share, and corporate water disclosure.

According to Porter's hypothesis, financial performance may even be improved by more stringent restrictions. A study by Rassier and Earnhart (2010) aimed to offer empirical support for this contentious Porter hypothesis impact. The influence of Clean Water Act regulations, particularly the allowed wastewater discharge limitations, on publicly traded companies' anticipated financial performance in the chemical manufacturing industries was investigated using panel data analysis. Tighter permissible discharge restrictions have been found to lower Tobin's q, a gauge of anticipated future financial performance (Rassier & Earnhart, 2010). Put another way, stricter Clean Water Act regulations jeopardize these companies projected financial performance. Moreover, Tobin's q was dissected into its component parts-market value and replacement costs (Rassier & Earnhart, 2010). They found that lower allowed discharge limits lead to lower market value and replacement costs through independent estimates of each component. However, the effect on market value is greater, indicating that investors may need to reevaluate their assumptions about future profits' discounted value when considering the Clean Water Act's regulatory reforms.

Corporate environmental management advocacy has recently moved beyond mere compliance to quality considerations, as quality can boost financial value. Hence, in their research on the intersection between environmental management and quality management, Molina-Azorín et al. (2009) find that it is impossible to overstate the effect that environmental management (EM) and quality management (QM) have on business performance. Because of their commonalities, these two approaches are becoming increasingly popular among organizations and are frequently used in tandem. As a result, research and application in the combination of QM and EM have gained significant traction. A complete QM-EM system (QEM), in which QM and EM no longer function independently, can be built to reach the maximum degree of integration. It is vital to determine the essential characteristics for assessing these management approaches and their effect on performance (Molina-Azorín et al., 2009). This is consistent with other findings, which opine that companies implementing innovative practices in response to recycling and waste management regulations and resource efficiency standards tend to experience increased profit margins (Rennings & Rammer, 2011).

In another corporate waste management and financial performance analysis, Bartolacci et al. (2018) investigated the relationship between business financial performance and their adherence to environmentally sound policies, particularly about separate garbage collection. Over four years (2012-2015), data from 45 Italian companies were analyzed for the study. Financial success was assessed using return on assets, while separate garbage collection rates and collection per capita indicated strong environmental practices. The study's conclusions demonstrated a significant and positive correlation between these variables.

Molina-Azorín et al. (2009) examined existing quantitative research studies that explore the connection between financial success and environmental management as part of their literature study. They found thirty-two related research, all looking at financial performance indicators, environmental variables, statistical analyses, and important conclusions. Most of the research indicated that corporate environmental management had a beneficial effect on financial success, notwithstanding the wide range of outcomes. The results also examined various businesses, sectors, and nations. Molina-Azorín et al. (2009) also found that regression analysis is the most often used method in research that seeks a linkage between environmental management and financial performance. In addition, their research revealed that some studies used environmental management factors while others concentrated on environmental performance variables.

Gull et al. (2022) investigated the impact of waste management on businesses' financial performance. By examining information from public companies in 41 nations between 2002 and 2019, the researchers found a significant inverse (and positive) relationship between business production of waste (and recycling) and financial performance. Furthermore, their channel analysis demonstrated that the structure of the industry, operating costs, ESG performance-based remuneration, the Paris Climate Agreement, and the global financial crisis all affected this link. As a result, the study's conclusions suggest that businesses can profit from environmental activities.

Given the abundance of mixed findings in the prior research regarding environmental management and corporate financial performance, Albertini (2013) embarked on a meta-analytical review to answer the perplexing question of whether environmental management actually contributes to enhancing the financial performance of companies. In order to identify plausible modifiers that could have impacted the conflicting results thus far reported, Albertini (2013) reviews previous research. Albertini (2013) establishes a favourable association between financial performance and environmental performance through a meta-analysis of 52 studies undertaken over 35 years. Furthermore, the moderator analysis shows that regional differences, industrial sectors, study lengths, and environmental and financial performance metrics all significantly impact the association.

Waste Water Treatment of Hydrocarbon, Costs and Accounting Implication

Beni et al. (2023) looked at the problems related to treating wastewater from the petroleum industry. They stress that petroleum hydrocarbons are the main source of pollution in effluent from refineries. This effluent has high levels of phenol, other dissolved organic materials, light and heavy hydrocarbons, oil, and fat in suspended particles. These compounds can pollute the environment if they are released without being properly treated. According to Beni et al. (2023), traditional techniques for handling petroleum wastes are frequently expensive. On the other hand, the solar distillation method can be applied because there is sufficient room to build solar distillation ponds and plenty of sunshine, especially close to the equator. Beni et al. (2023) also reveal that novel approaches to the biological treatment of petroleum wastewater are provided by membrane bioreactors, which use the biological breakdown and transformation of oils and waste oil constituents (Beni et al., 2023).

In research on treating petroleum-related wastewater hydrocarbon, Mohammadi et al. (2020), among others, found that crude oil and gasoline naturally contain petroleum hydrocarbon chemicals such as benzene, toluene, ethylbenzene, and xylene. They further highlight that these substances are often found in surface and subsurface water because of industrial processes, specifically the processing of petrochemicals. These oil molecules are difficult for conventional wastewater treatment techniques to remove, and the presence of these contaminants in large concentrations, along with active sludge, can negatively affect refineries' overall productivity (Mohammadi et al., 2020).

The complexities and resource-demanding nature of the petroleum wastewater hydrocarbon treatment process attract costs and, hence, an attendant effect on the financial performance of the petroleum industry. To strive toward the reduction of related cost involvements, the application of relevant cost accounting becomes apposite. Accounting for hydrocarbons is somewhat unique from conventional financial accounting. CEOAL (2024) expatiates that in the oil and gas sector, hydrocarbon accounting is an essential procedure that guarantees precise ownership tracking from the time of extraction to the point of delivery to a storage facility, export pipeline, or vessel. In terms of focus, CEOAL (2024) highlights that hydrocarbon accounting is concerned with recording the actual amounts of oil and gas, as opposed to standard accounting, which is mostly focused on financial transactions.

RESEARCH METHOD

This paper applied a soft quantitative and inductive approach. According to Gong et al. (2019), a soft quantitative approach helps to bridge the accuracy gap between high and low-precision systems. Mauldin (2020) asserts that an inductive research approach starts with a set of observations, which seeks to identify some patterns in these observations and theorise the observed patterns.

Firstly, this paper explored the literature on corporate wastewater management and its relationship with firm performance (share price). On the one hand, five-year data excluding 2020 data due to COVID-19 (2017-2022) on hydrocarbon content reduction in offshore and onshore wastewater discharge was collected from the TotalEnergies (2022&2023) Sustainability and Climate Progress Report. On the other hand, the data on TotalEnergies stock price was collected from the FusionMedia (2024) online stock price index. Given the objective behind this paper, data were analysed through the application of a graphical approach. Gantz (2023) proves that graphical analysis is a powerful technique because the visual transparency in graphical analysis reduces mounds of quantitative variables for easier comprehension.

RESULTS

In compliance with Mauldin (2020), this paper first observed an important pattern in TotalEnergies' effort to reduce the annual hydrocarbon content of their offshore and onshore wastewater and the attendant correspondence in their stock price values. The author observed a gradual annual reduction in their wastewater hydrocarbon content, albeit with minor spots of difference in the downward trend. Furthermore, the author also observed an unexpected and interesting pattern where the share price of TotalEnergies continued to rise in value despite the apparent period increase in the content of wastewater hydrocarbon (Figure 2).

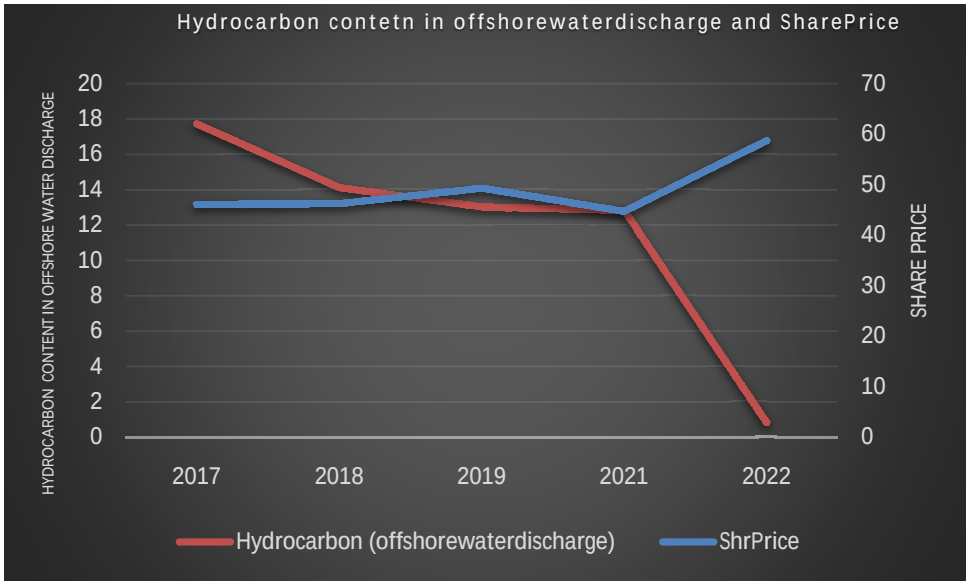

Figure 1. **Hydrocarbon Content in offshore water discharge & Share Price Performance**
Source: author's own graphical analysis with data from TotalEnergies.

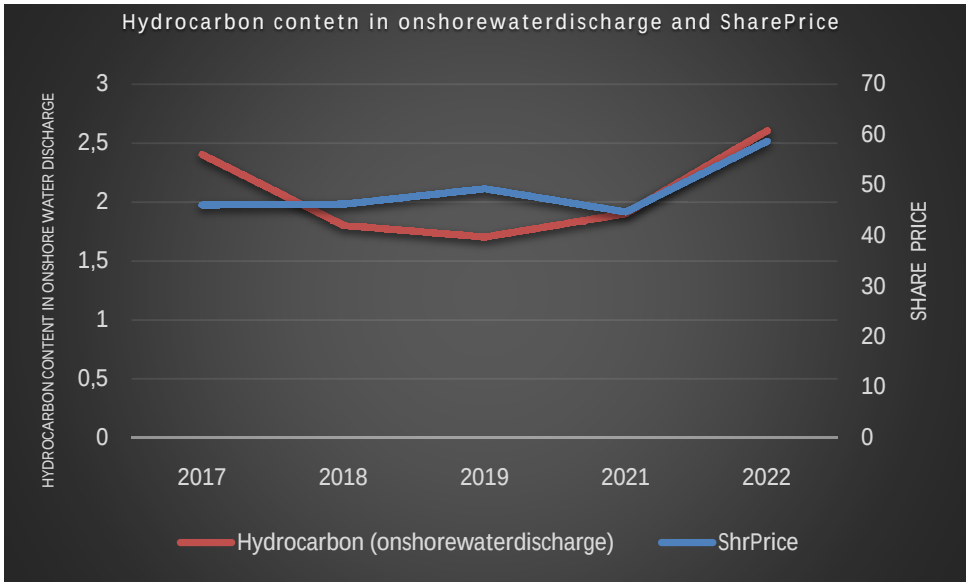

Figure 2. **Hydrocarbon Content in onshore water discharge & Share Price performance**
Source: author's own graphical analysis with data from TotalEnergies.

Accordingly, visual findings in the graphical analysis depicted in Figure 1 and Figure 2 display two important pieces of information vital for industry wastewater management and environmental management accounting theory. Firstly, Figure 1 shows that TotalEnergies' effort in the reduction of hydrocarbon content of offshore wastewater discharge is highly rewarded by the stock market as the stock price shows a corresponding increase in value as the wastewater content of hydrocarbon kept its reduction trajectory. This is reassuring to corporate operational efforts in reducing wastewater-related pollution since the market and functions recognise this as a catalyst for boosting the company's market value. Furthermore, the second phase of the objective of this paper sought to ascertain whether the impact on share price can be positively sustained even during times of negative reduction in hydrocarbon. The trend in Figure 2 clearly shows that wastewater management may attract a long-lasting positive effect on share price even outside of the positive reduction in hydrocarbon content. This points to a theoretical induction that wastewater hydrocarbon reduction may enshrine long-term legitimacy in a company.

These results show that the stock market appreciates corporate green practices in wastewater management and rewards such green practices by adding more value to the company's stock price. This finding corroborates earlier findings by Kwisinski et al. (2024), who found a positive relationship between corporate eco-partnership and stock price. It also confirms another corporate environmental management strand of research findings, such as the event's study findings, which show investors positive rewards to companies on the issue of green bonds (Rahmberg & Jesper, 2022). On the contrary, research by Puopolo et al. (2015), which applies a dual model of the Capital Asset Pricing technique and the Fama-French three-factor technique, found no evidence of investor reward to a corporate green standard.

This current research is unique and contributes novel findings to the existing literature by demonstrating through graphical analysis that the stock market not only rewards an oil company's wastewater management of hydrocarbon reduction (see Figure 1) but also rewards the company both during the times of positive reduction of hydrocarbon and during times of rising hydrocarbon content in wastewater (Figure 2). This additional finding brings important new light to our understanding of how stock market investors may treasure and keep their positive value on companies that adopt environmental management. Specifically, this finding shows that the stock market may keep rewarding a company's wastewater management even retrospectively (see Figure 2) – an indication of learned green trust and confidence in the company. In Figure 2, between 2020 and 2021, even with a slight increase in the hydrocarbon content of wastewater, the share price continued to increase following earlier patterns of stock price rewards to earlier reductions in hydrocarbon. This shows that investors' attraction to and their reward for corporate wastewater management may endure even beyond the visible time of positive hydrocarbon reduction – a sign of investor's patronage, patience, trust, legitimacy approval and retrospective reward for corporate green performance. This is a new finding that has manifested in this paper through graphical analysis. This finding provides a good agenda for future research to use time series to further extend this research by using a regression model to replicate this research. Furthermore, the findings of this brief study draw very close to the earlier argument by Rodella and De Giacomo (2023), wherein they posited that during times of uncertainty, stock markets may continue to sustain companies who practice proactive environmental management for climate change advocacy.

Based on this current finding, the author provides the following inductive hypothesis for a broadened future research analysis: *the stock market offers extended positive stock price reward to corporate wastewater with low hydrocarbon content both within the period of low hydrocarbon content and within the period of slightly rising hydrocarbon content.*

CONCLUSION

Wastewater management is closely associated with global advocacy for equitable clean water availability and sustainable development (Gosh et al., 2020). Recently, the corporation has joined the global campaign for clean water through proactive waste management strategies such as improved quality of wastewater discharge. This genre of corporate environmental responsibility endears and elevates corporate legitimacy and has implications for corporate performance (Gull et al., 2022; Nyahuna et al., 2023) because contemporary corporate stakeholders, including investors, are becoming more environmentally conscious than ever before.

This paper contributes to the existing research on wastewater management by focusing on a narrow niche of less-researched research, which is the reduction of hydrocarbon content of offshore and onshore wastewater and the link with stock price performance. Findings from graphical analysis of data have essential practical and theoretical value. Firstly, the results show a corresponding relationship between a reduction in wastewater hydrocarbon and an increase in the stock price value. Secondly, the results show that the increase in stock price value continues even beyond the times of hydrocarbon reduction, which shows that investors compensate the company for its previously good performance in hydrocarbon reduction. This legitimacy-ingrained compensation shows that good positive wastewater management via hydrocarbon reduction protects the company's value even in uncertain and/or hindrances in positive wastewater management. Based on this finding, the paper develops an inductive hypothesis for future research engagement as follows – *the stock market offers extended positive stock price reward to corporate wastewater with low hydrocarbon content both within the period of low hydrocarbon content and within the period of slightly rising hydrocarbon content*. This paper thus opens a novel agenda for further research that may test the above proposition using econometric models.

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