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Research paper

Exploring The Impact of Environmental Accounting on Corporate Financial Performance: An Indian Power Sector Perspective

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Abstract

Environmental accounting is an important component of environmental, social, and governance reporting since it encompasses the systematic tracking of expenses associated with protecting natural resources. It offers both quantitative and qualitative insights that aid organizations in making informed decisions regarding environmental management. This study explores the connection between environmental cost and key financial parameters, namely return on assets, return on equity, and return on capital employed, which are considered as dependent factors, whereas environmental cost is treated as the independent factor for this study. The sample size is selected from the top ten Indian power sector companies listed on the BSE from 2019-20 to 2023-24 in terms of market capitalization. Data are analyzed by using panel regression in SPSS version 26. The results indicate that environmental costs have an insignificant impact on firm performance. Based on these findings, it is recommended that companies develop effective strategies for managing environmental expenditures, which could help enhance their public image and support long-term sustainability.

Keywords: *Environmental Issues; Environmental Management; Environmental Costs; Sustainability.*

1. Introduction

Environmental accounting is an evolving area of research that integrates traditional accounting practices with ecological sustainability and conservation efforts. While some environmental impacts of business operations are inevitable, others can be mitigated through responsible management. With growing scrutiny from regulators, investors, and the public, companies are increasingly expected to address the environmental consequences of their activities, particularly in relation to resource depletion. Environmental accounting supports better decision-making by emphasizing the importance of incorporating environmental considerations into business strategies, thereby aligning the interests of both shareholders and stakeholder groups.

Environmental reporting and accounting both shape and are influenced by organizational behavior. As noted by Enahoro J. (2009), shareholders and potential investors require a clear and accurate representation of a company's financial standing, and overlooking environmental costs can lead to significant gaps in economic reporting. Profitability should not be assessed solely through financial indicators. There are significant concerns over the impact of environmental accounting and transparency on business performance, especially in the power industries. Both internal and external stakeholders are increasingly vocal in expressing their concerns and expectations in this regard. Moreover, the way management addresses environmental accounting practices is now under heightened scrutiny.

Accordingly, the central research question of this study is: "What is the impact of environmental accounting on the financial performance of Indian power sector companies listed on the Bombay Stock Exchange (BSE)?" More specifically, the research explores how environmental cost reporting and disclosure practices influence the financial performance and market valuation of the companies.

India's Approach to Environmental Disclosure

In India, environmental reporting has traditionally followed a conventional approach. It is generally classified into two categories: compulsory (mandatory) disclosure and voluntary disclosure. Most large corporate organizations engage in sustainability reporting as a means of voluntarily disclosing their environmental practices. In a broader context, sustainability reporting encompasses information related to environmental, social, economic, and governance issues. These disclosures now form the foundation of ESG (Environmental, Social, and Governance) reporting. ESG reporting offers non-financial insights that support effective corporate management and foster trust and transparency among stakeholders. It allows stakeholders to access essential information beyond financial data, which can significantly impact

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business outcomes. In 2021–2022, India introduced ESG reporting as a new framework, incorporating environmental, social, and economic dimensions into corporate disclosures.

Essential role of environmental reporting

Environmental reporting involves gathering and sharing information related to the natural environment with various parts of an organization. Today, degradation of the environment has become a major issue. The corporate sector is often seen as a major contributor to the decline of environmental quality, leading to the deterioration of living conditions. In response, the government has implemented various regulations aimed at ensuring that corporate entities take responsibility for protecting and preserving the environment. Any organization operating in India is required to comply with these environmental laws and guidelines; failure to do so may result in legal action by the authorities. It is both a moral and legal obligation for companies to contribute to environmental conservation by allocating a portion of their profits, especially since their operations heavily benefit from natural resources.

Environmental factors significantly influence an organization's financial outcomes. Companies need to compile and disclose information related to environmental costs, as this transparency enhances public trust and stakeholder confidence. Moreover, environmental reporting plays a vital role in facilitating informed and strategic decision-making within the organization.

Environmental Accounting Practices at Global, Corporate, and National Levels

Each country's unique background, governance structure, and industrial development shape its approach to environmental accounting. Moid S. (2017) highlighted the complexities accountants face in quantifying and integrating environmental factors into financial records. According to Moid S. (2017), environmental reports are typically descriptive, voluntary, and non-financial in nature, primarily intended to raise public awareness. Athma, P., & Rajyalaxmi, N. (2017). In their investigation of environmental accounting practices in Maharashtra, they discovered that organizations generally implement either a financial or a practical approach to address environmental concerns. The physical approach presents environmental data in tangible, measurable units, while the financial approach attempts to bridge the gap by assigning monetary value to environmental impacts-an aspect that the physical model alone fails to adequately capture.

Environmental accounting continues to be a challenging concept for many Chinese enterprises to implement Li, L., 2015). In American and European firms, the extent of voluntary environmental disclosure is often influenced by company size Meek G et al., 1995).

Research by Omnamasivaya, B., & Prasad, M. S. V. (2016) suggests that a company's age can influence the extent of its environmental disclosures in financial statements. The results indicated a negative relationship between a company's age and the level of its environmental disclosures, implying that older firms tend to report less environmental information. In Nigeria, oil and gas companies demonstrate varying levels of transparency, though overall disclosure remains low Enahoro J., 2009). Similarly, in Jordan, the absence of a universally accepted standard for environmental accounting has led to inconsistent reporting practices among industrial and mining companies, with company size playing a significant role Altarawneh, G. A., 2015). In the Philippines, mining firms also displayed diverse disclosure practices. Nevertheless, 90% of the firms had adopted environmental rehabilitation plans, and 60% disclosed adherence to IFRIC, which pertains to rights concerning environmental restoration, decommissioning, and rehabilitation funding.

Institutional theory supports the notion that companies are sometimes compelled to comply with disclosure obligations, as emphasized by Hamilton, K. (2016). Overall, research shows that companies use a variety of environmental reporting techniques and cost recognition methods, due to a lack of defined norms and the flexibility that firms have in deciding whether to disclose environmental information. Consequently, the adoption of environmental reporting remains limited across different countries and industries.

Sustainable Accounting for Business Growth

Bassey et al. (2013); Carreira et al. (2014) found that companies in Nigeria's oil and gas sector and those on the Lisbon Euronext Exchange saw improved financial outcomes with greater environmental disclosure. An environmental transparency index was also developed to evaluate the comprehensiveness of information presented in the companies' annual reports. Additionally, Connelly & Limpaphayom (2004) identified a significant relationship between environmental accounting practices and firm valuation in Thai enterprises. Research by Al-Tuwaijri et al. (2004) further confirmed strong positive associations among environmental transparency, environmental performance, and corporate profitability. Jaggi and Freedman (1992) concluded that environmental pollution adversely affects the financial performance of pulp and paper companies, a view echoed by investor sentiment.

Cost-Benefit Analysis of Environmental Impact and Economic Worth

Iatridis, G.E. (2013), observed that investors place significant value on environmental accounting disclosures, which, in turn, contribute to improved corporate performance and higher firm valuation. His conclusion that environmental disclosures are positively correlated with market value is consistent with earlier findings by Connelly & Limpaphayom (2004), as mentioned previously in this study.

On the other hand, Qiu, Y. et al. (2016), found no meaningful connection between environmental reporting and company value. They suggested this might be due to how investors view environmental activities and the shortcomings of environmental accounting in the industries involved.

Over the years, research in this area has yielded mixed results, primarily due to the use of different independent variables and the diversity of research settings. Additionally, such studies are influenced by national economic conditions, environmental policies, and regulatory frameworks. The current research endeavors to expand the scholarly literature by analyzing the linkage between environmental accounting practices and the financial outcomes of listed firms within the Indian context.

Multi-Dimensional Impact of Environmental Reporting on Company Performance

Environmental accounting was found to be highly negatively connected to ROCE and EPS, whereas, positively correlated with net profit margin and dividends per share, Makori, D. M., & Jagongo, A. (2013). In contrast, Nandini E.S. (2020) identified a significant positive connection between environmental accounting and profitability for BSE-listed firms. On the other hand, Japee P. (2018) reported no meaningful influence of environmental accounting on the creation of shareholder value. A cross-country analysis by Abdul et al. (2020), A study of corporations in Malaysia, Singapore, and Thailand, found no clear link between environmental disclosures and financial performance.

Conversely, research by Khandelwal and Chaturvedi (2021) revealed a significant positive correlation between comprehensive environmental disclosures and key performance indicators such as ROA and ROE in leading Indian companies. Which is found that firms enhancing their environmental performance are likely to see a favorable impact on shareholder net worth. Furthermore, Al-Waeli, A. J., et al. (2021), identified a strong positive correlation between environmental disclosures and financial performance, suggesting that comprehensive environmental reporting may improve a company's financial position by attracting investors and mitigating regulatory risks. According to Agarwal, B. et al. (2023), ESG performance of the healthcare industry is negatively correlated with the market-to-book ratio. Abdi et al. (2022) observed that the relationship between ESG and MTB becomes positive when a moderating factor is taken as the firm's age and size. As Ben Ali and Chouaibi (2024) pointed out, the mediating role of ESG practices is positive and significant in improving financial performance of banks. ESG disclosure has a positive and significant impact on the firm value as measured by the Tobin Q, ROA, and ROE Hamdouni, 2025). whereas firm size mediates this relationship, and larger Sharia-compliant companies have a greater advantage in ESG initiatives in terms of value creation.

After reviewing all the environmental performance factors, we found that many researchers studied the impact of environmental performance by using environmental score and environmental index disclosure, but environmental cost is an addition to our study. The review of previous studies underscores a research gap, leading to the formulation of the following objectives for the present study:

- To evaluate the relationship between environmental cost and key indicators of corporate performance.
- To analyse the influence of environmental costs on corporate performance metrics.

2. Research Hypothesis

H0: There is no statistically significant association of environmental cost with the financial performance metrics of the sample firms.
H1: There is statistically significant association of environmental cost with the financial performance metrics of the sample firms.

3. Methodology

The analysis is solely based on secondary data obtained from the annual reports of selected
power sector corporations in India. Additional sources such as financial websites (e.g., Money Control), scholarly articles, journals, and other relevant online resources were also consulted. The study focuses on the top 10 power generation companies as of August 1, 2023, resulting in a total sample size of 50 firm-year observations from 2019-20 to 2023-24. These sample companies capture more than 60% of the total market share of total Indian power generation companies, as well as the 3rd largest manufacturing and consuming sector in the world.
In this study, the dependent variables are business performance metrics, specifically ROCE, ROE, and ROA. The key independent variable is environmental cost (ENVC), while the firm-specific control variables are size Hamdouni (2025); Chouaibi, J. et al. (2024), operating cash flow Abdi et al. (2022), and leverage Chouaibi, J. et al. (2024).
Model Formulation:

- ROCE=β0+β1 ENVC+ β2 SIZ+ β3 OCF+ β4 LEV+ €i
- ROE= β0+β1 ENVC+ β2 SIZ+ β3 OCF+ β4 LEV+ €i
- ROA= β0+β1 ENVC+ β2 SIZ+ β3 OCF+ β4 LEV+ €i

Where β_0 represents the intercept term,
β_1 denotes the coefficient of the independent variable,
β_2, β_3, β_4 indicate the coefficients of the control variables.
€i = Error
SIZ: Firm Size
OCF: Operating Cash Flow
LEV: Leverage.
ENVC: Environmental Cost
ROCE: Return on Capital Employed
ROA: Return on Assets
ROE: Return on Equity

4. Data Analysis and Interpretation

This study uses statistical tools to support the aims of this investigation. Causal statistics like regression analysis and correlation, as well as descriptive statistics like mean, median, mode, and standard deviation, among others. The formula of variables taken into consideration for the analysis is shown below.

Table 1: Formulation of Variables

Sl. No		Factors	Description
1.	Independent factors	ENVC	Total spent on Environmental Protection
2.	Dependent factors	(ROCE)	$\frac{\text{Profit before interest and tax}}{\text{Capital employed}}$
		(ROA)	$\frac{\text{Net profit}}{\text{Total Assets}}$
		(ROE)	$\frac{\text{Net profit}}{\text{shareholder's Equity}}$
3.	Control factors	SIZ	Total Assets
		OCF	Total Cash flow from operating activity
		LEV	Total Debt/Equity

Source: Self-compiled.

Table 2: Descriptive Results of Power Sector Companies

	N	Min.	Max.	Mean	Std. Dev.
ROA	50	-0.12	0.10	.025	.039
ROE	50	-0.82	2.37	.088	.369
ROCE	50	-0.08	0.14	.042	.046
ENVC	50	-3.91	4.29	1.46	1.69
SIZ	50	6.79	14.63	10.13	1.65
OCF	50	6.70	10.69	8.40	1.07
LEV	50	0.32	77.21	4.00	10.92

Source: Self-compiled.

Table no-2, describes that the descriptive statistics of 50 power sector companies reveal notable trends and variations across key financial indicators. ROA has a modest average of 2.5% with a relatively low standard deviation of 0.039, indicating generally weak but stable profitability from assets. ROE shows a wide spread, ranging from -82% to 237%, with a mean of 8.8% and a high standard deviation of

0.369, suggesting significant differences in how effectively companies are generating profits for shareholders—likely influenced by varying leverage levels and profitability margins. ROCE averages 4.2%, reflecting modest efficiency in using capital, with relatively consistent performance across firms. The ENVC variable varies widely from -3.91 to 4.29 with a high standard deviation of 1.69, indicating less inconsistency in environmental performance or reporting practices. SIZ measured logarithmically, averages 10.13 with moderate variation of 1.65, suggesting that the sample includes both medium- and large-sized samples. OCF is relatively stable across firms, with a mean of 8.40 and a standard deviation of 1.07, indicating steady operational performance. In contrast, LEV shows extreme variability, ranging from 0.32 to a striking 77.21, with a large standard deviation of 10.92, pointing to significant differences in capital structure and potential financial risk. The above table highlights there is diversity in financial health and environmental engagement within the power sector.

Table 3: Correlation Results of Variables

		ROA	ROE	ROCE	ENVC	SIZ	OCF	LEV
ROA	Pearson Correlation	1	.348*	.858**	-.001	-.224	.159	-.095
	p- Value		.013	.000	.992	.118	.271	.510
ROE	Pearson Correlation	.348*	1	.087	.059	-.266	.095	.779**
	p- Value	.013		.549	.686	.062	.510	.000
ROCE	Pearson Correlation	.858**	.087	1	.007	-.051	.067	-.390**
	p- Value	.000	.549		.963	.723	.644	.005
ENVC	Pearson Correlation	-.001	.059	.007	1	.311*	.133	.026
	p- Value	.992	.686	.963		.028	.359	.859
SIZ	Pearson Correlation	-.224	-.266	-.051	.311*	1	.352*	-.323*
	p- Value	.118	.062	.723	.028		.012	.022
OCF	Pearson Correlation	.159	.095	.067	.133	.352*	1	-.004
	p- Value	.271	.510	.644	.359	.012		.979
LEV	Pearson Correlation	-.095	.779**	-.390**	.026	-.323*	-.004	1
	p- Value	.510	.000	.005	.859	.022	.979	

Source: Self-compiled.
**. 1% level of significance.
*. 5% level of significance

Table no-3 describes that the correlation matrix of Indian power sector companies reveals key relationships among financial and environmental variables. ROA shows a strong positive correlation with ROCE ($r = 0.858$, $p < 0.01$), suggesting that firms efficient in using capital also tend to generate higher returns on assets. It also has a moderate positive correlation with ROE ($r = 0.348$, $p = 0.013$), indicating that asset performance contributes to equity returns. ROE is highly positively correlated with LEV ($r = 0.779$, $p < 0.01$), implying that higher leverage significantly boosts shareholder returns, though it may also reflect greater financial risk. In contrast, ROCE has a significant negative correlation with LEV ($r = -0.390$, $p = 0.005$), indicating that increased leverage may reduce overall capital efficiency.
ENVC has no meaningful correlation with financial performance indicators like ROA, ROE, or ROCE, suggesting that environmental variables are relatively independent of financial outcomes in this sector. However, ENVC shows a weak positive correlation with SIZ ($r = 0.311$, $p = 0.028$), suggesting that larger firms tend to be more engaged or visible in environmental activities. SIZ also shows a negative correlation with LEV ($r = -0.323$, $p = 0.022$), indicating that larger companies may rely less on debt financing. Lastly, OCF is weakly but significantly correlated with SIZ ($r = 0.352$, $p = 0.012$), suggesting that larger firms tend to generate more stable cash flows. Overall, the matrix reveals that leverage plays a critical role in shaping financial returns, while environmental performance appears largely disconnected from financial indicators in the power sector.

Table 4: Regression Results of ROA

Model		R	R^2	Adj. R^2	Std. Error
		.409[a]	.168	.094	.03785
ANOVA[a]					
	Sum of Squares	d.f	Mean Squared	F	P- value
Regression	.013	4	.003	2.266	.077[b]
Residual	.064	45	.001		
Total	.077	49			
Coefficients[a]					
	Unstandardized Coefficient	Std. Error	Unstandardized Coefficient Beta	t	P- value
(Constant)	.039	.048		.801	.427
ENVC	.002	.003	.101	.698	.489
SIZ	-.011	.004	-.437	-2.682	.010
OCF	.011	.005	.298	2.038	.047
LEV	-.001	.001	-.238	-1.627	.111

Source: Self-compiled.

Table no-4 shows that the regression results of the dependent variable provide insights into how environmental and financial factors influence asset profitability among Indian power sector companies. The model explains 16.8% of the variance in ROA ($R^2 = 0.168$), with an adjusted R^2 of 0.094, suggesting a modest explanatory power. The overall model is not statistically significant at the 5% level ($F = 2.266$, $p = 0.077$), indicating limited reliability in predicting ROA based on the selected variables.
Among all the predictors, SIZ has a significant negative impact on ROA ($\beta = -0.437$, $p = 0.010$), suggesting that larger firms in the power sector tend to have lower returns on assets, possibly due to higher capital intensity or operational inefficiencies. OCF has a significant positive influence on ROA ($\beta = 0.298$, $p = 0.047$), indicating that firms with stronger cash flows from operations tend to be more profitable in terms of asset utilization. However, LEV shows a negative but statistically insignificant effect on ROA ($\beta = -0.238$, $p = 0.111$), suggesting that while debt may reduce asset returns, this relationship is not strong enough to be conclusive. Lastly, ENVC has a very weak and insignificant positive impact on ROA ($\beta = 0.101$, $p = 0.489$), indicating that environmental engagement does not significantly influence profitability in this sector. Overall, the findings suggest that larger firm size may detract from it, with environmental and financial structure factors playing a lesser role.

Table 5: Regression Results of ROE

Model		R	R^2	Adj. R^2	Std. Error
		.788[a]	.621	.588	.23725
ANOVA[a]					
	Sum of Squares	d.f	Mean Squared	F	P- value
Regression	4.156	4	1.039	18.456	.000[b]
Residual	2.533	45	.056		
Total	6.689	49			
Coefficients[a]					
	Unstandardized Coefficient	Std. Error	Unstandardized Coefficient Beta	t	P- value
(Constant)	-.194	.303		-.638	.526
ENVC	.011	.021	.048	.495	.623
SIZ	-.018	.025	-.080	-.732	.468
OCF	.041	.034	.120	1.218	.230
LEV	.025	.003	.752	7.623	.000

Source: Self-compiled.

Table No. 5 indicates that the regression results for ROE as the dependent variable reveal a statistically strong model explaining a substantial portion of the variance. The R^2 value is 0.621, indicating that 62.1% of the variation in ROE among Indian power sector companies is explained by the explanatory factors—ENVC, SIZ, OCF, and Leverage (LEV). The model is highly significant overall ($F = 18.456$, $p = 0.000$), demonstrating strong explanatory power.

Among all the predictors, LEV is the most influential variable, with a strong positive and highly significant effect on ROE ($\beta = 0.752$, $p = 0.000$). This indicates that companies with higher debt levels tend to generate substantially higher returns on equity, likely due to the amplifying effect of leverage. The other variables—ENVC, SIZ, and OCF—do not show statistically significant effects. ENVC ($\beta = 0.048$, $p = 0.623$) and SIZ ($\beta = -0.080$, $p = 0.468$) have very weak and insignificant relationships with ROE, while OCF ($\beta = 0.120$, $p = 0.230$) shows a positive but non-significant impact.

The above regression model indicates that leverage is the key driver of equity returns in the Indian power sector, while environmental performance, firm size, and operating cash flow do not significantly affect ROE within this sample. This highlights the central role of capital structure in shaping shareholder returns in this industry.

Table 6: Regression Results of ROCE

Model		R	R^2	Adj. R^2	Std. Error
		.464[a]	.215	.146	.04256
ANOVA[a]					
	Sum of Squares	d.f	Mean Squared	F	P- value
Regression	.022	4	.006	3.090	.025[b]
Residual	.082	45	.002		
Total	.104	49			
Coefficients[a]					
	Unstandardized Coefficient	Std. Error	Unstandardized Coefficient Beta	t	P- value
(Constant)	.073	.054		1.342	.186
ENVC	.002	.004	.089	.635	.529
SIZ	-.008	.004	-.291	-1.838	.073
OCF	.007	.006	.156	1.096	.279
LEV	-.002	.001	-.486	-3.422	.001

Source: Self-Compiled.

Table No. 6 indicates that the regression results of ROCE indicate a moderately significant model. The R^2 value of 0.215 shows that around 21.5% of the variation in ROCE is explained by the independent variables—ENVC, SIZ, OCF, and LEV. The model is statistically significant overall, with an F-value of 3.090 and a p-value of 0.025, suggesting that the set of predictors has a meaningful effect on ROCE.

Among all the variables, LEV emerges as the most influential factor, with a significant negative impact on ROCE ($\beta = -0.486$, $p = 0.001$), indicating that higher debt levels are associated with lower capital efficiency. SIZ also hurts ROCE ($\beta = -0.291$, $p = 0.073$), which indicates there are insignificant results at the 5% level, implying that larger firms may be slightly less efficient in capital deployment. OCF and ENVC show weak and statistically insignificant relationships with ROCE ($p = 0.279$ and $p = 0.529$, respectively), suggesting limited impact on capital efficiency from cash flow performance and environmental engagement.

The above analysis's regression results show that, in the Indian power sector, leverage significantly decreases ROCE, whereas firm size has a less pronounced and barely noticeable impact. According to this model, operational cash flow and environmental factors have no visible effects.

5. Conclusion

The above analysis indicates that environmental costs have a negligible impact on the financial performance indicators of the selected power sector firms. This could be attributed to the substantial spending on environmental initiatives, which may negatively affect overall profitability

According to an earlier study by Makori, D. M., & Jagongo, A. (2013), there exists a strong negative relationship between environmental accounting and ROCE. In contrast, Nandini E.S. (2020) reported a positive and significant correlation between environmental costs and ROCE, ROA, and ROE. Similarly, research by Khandelwal and Chaturvedi. (2021) found a significant link between total environmental disclosures and both ROA and ROE. Furthermore, Kalola A.R. (2021) concluded that environmental accounting is significantly associated with firm profitability.

This study contributes to the existing literature on corporate social responsibility by focusing on environmental accounting and disclosure procedures. Its findings may assist regulatory bodies in developing comprehensive frameworks or guidelines for integrating quantitative environmental disclosures into corporate annual reports. Firms are encouraged to emphasize strategic planning in environmental cost

management, as this could enhance their overall corporate performance and long-term sustainability. The impact of environmental expenses on financial performance is often understated in India's power sector, where tariff pass-through advantages, government subsidies, slow benefit realization, and industry-specific priorities all reduce their direct impact on profitability.

6. Implications of The Study

This study contributes to the existing literature on corporate social responsibility by focusing on environmental accounting and disclosure procedures. The finding may help regulatory bodies to establish uniform metrics, connecting these costs with financial outcomes, and enforcing reliable reporting in corporate annual reports. Companies are encouraged to emphasize strategic planning in environmental cost management, as this could enhance their overall corporate performance and long-term sustainability as a source of value rather than an expenditure. Achieving this balance necessitates linking ESG investments to long-term profit potential, effective risk reduction, and increased investor trust via clear disclosures, incentive use, and creative funding options.

7. Scope for Further Study

This study provides opportunities for future investigation. firstly, it only covers one country, as well as a small sample size, i.e., 50 firm observations. Secondly, this analysis does not consider various other independent variables like ESG score, EID score, carbon emission score, environmental impact assessment, etc., that could also have an impact on business performance. Thirdly, this study is confined only to this power generation industry; other environmentally sensitive industries could have been studied to the extent of future research.

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