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AIR CONTAMINATION AND ECOLOGICAL INFORMATION DISCLOSURE FROM SOUTH AFRICA'S HIGH ENERGY CONSUMPTION INDUSTRIES

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Abstract:
Globally, South Africa is currently amongst the countries with the poorest air pollution. Recently, organization ecological information disclosure has turned out to be a progressively more prevalent method for ecological by-laws. However, at the moment, there is an absence of empirical confirmation on the organization ecological information disclosure effects of air contamination. This research investigates the relationship between air contamination and organization ecological information disclosure applying cross sectional data gathered from listed South African companies in high energy consumption sectors from 2015 to 2021. The findings disclose that the link between air contamination and organization ecological information disclosure is substantially adverse. The Northern province has huge effects on organization ecological information disclosure in comparison with the Eastern province. Furthermore, effect air contamination has on organization ecological information disclosure also varies in companies situated in province with various corporate ecological information disclosure transparency. This study makes available a portrait of the interaction between air contamination and ecological information disclosure expansion in emerging economies such as South Africa. This provides evidence-based justification for policy makers and environmentalists to make policies and regulations in sync with the results such as promoting the use of systematic environmental disclosure on the listed companies in South Africa.

Keywords: Air Contamination, Ecological Information Disclosure, Johannesburg Stock Exchange, South Africa.
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INTRODUCTION

South Africa has attained outstanding economic progress after attaining independence in 1994. On the other hand, the economic growth has brought heavy ecological contamination, particularly air contamination, making it a matter that cannot be overlooked in South Africa (Wasara & Ganda, 2019). A number of scholarly research has disclosed that severe air contamination has enormous harmful effect on human life and production leading to massive welfare loss (Acar & Temiz, 2020; Passetti et al., 2018; Mathuva & Kiweu, 2016). In this context, South African government and the public have been acutely disturbed by the likely effects of air contamination. This renders the effects of air contamination a hot topic.

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Emerging economies such as South Africa largely relies on fossil fuels through high energy consumption sectors. Altieri and Keen (2016) report that South Africa depends on coal for "97% of its primary energy". Hence, the South Africa Air Quality Index presently displays a Particulate Matter (PM) 2.5 level for the country (Altieri & Keen, 2016). This is 1.4 times exceeding the range accepted by the Wealth Health Organization. This calls for South Africa to put measures to ensure a decline in air contamination so as to reduce health losses. One such measure is the ecological information disclosure in annual corporate reports.

Environmental administration through information disclosure was found to be another approach to "command and control mode of environmental regulation" (Zhang & Xie, 2020). The speedy development of information technology has fast-tracked this environmental information in emerging markets, including South Africa, through lessening information communication costs (Liu, 2020; Cho & Patten, 2013). South African government has of late been on the fore front to inspire organizations to adopt environmental information disclosure. For instance, in 2014, recently reviewed environmental laws brought-up regulations to resolve matters linked to environmental contamination.

The ecological gains from corporate environmental information disclosure are clearly acknowledged by numerous research. For instance, Belhaj and Damak-Ayadi (2011) discover a positive connection between ecological performance and corporate ecological information disclosure. Furthermore, extant literature argues that the disclosure as well has significant strategic importance for corporate sustainability namely improved communal status and enticing new investment (Zeng et al., 2010; D'Amico et al., 2016; Fondevila et al., 2019).

The repercussions of air contamination have lured considerable focus lately. Despite several scholars having evaluated the impacts of air contamination, research on company behaviour remains inadequate and restricted. Specifically, research on the impact air contamination possess on corporate environmental information disclosure is insufficient (Lin et al., 2021; Artene et al., 2020). Therefore, this paper aims to extend literature by investigating the impact of air contamination on corporate environmental information disclosure of listed high energy consumption industries in South Africa. In this case, this paper empirically evaluates whether companies lean towards disclosing more ecological information in high polluted regions.

The key justification for corporate environmental information disclosure includes legitimacy theory and stakeholder theory. The nexus between air contamination and organization ecological information disclosure can be described by stakeholder theory. The stakeholder theory underlines that stakeholders like the government and the public are important to corporate survival. Tzouvanas et al (2020), and Sun et al. (2019) accentuate that organizations adopt environmental information disclosure to disclose their approach and spending on ecological conservation to interested parties to acquire their confidence and support.

As air contamination gets worse, government which is mainly mandated with ecological administration is stimulated to enhance air quality due to environmental performance evaluation by the various stakeholders. Therefore, critical air contamination culminates in higher governmental concerns which may substantially influence environmental information disclosure in South Africa. Also, the citizenry's request for better air quality is robust and worry regarding environmental information disclosure is also amplifying. As noted by the stakeholder theory, organizations may achieve more reliance and backing by employing ecological information disclosure. As a result, in areas with critical air contamination, the organization may opt to reveal additional ecological information to handle pressure from the stakeholders.

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H1: The nexus between air contamination and organization ecological information disclosure can be positive

Nevertheless, it must be acknowledged that the government can make a compromise between economic development and ecological conservation. In case of facing the predicament, the government always selects economic performance as opposed to environmental protection. In other areas with higher air contamination, the government may be much worried around economic expansion and tax proceeds gotten from heavy pollution companies, exposing the environment to be unattended. Consequently, it is likely that the high air contamination is frequently the outcome of implicit endorsement by the government. Additionally, high polluted areas are oftentimes characterized by companies with high environmental contamination. The revelation of contamination information might convey opposing impacts, hence high energy consumption companies ought to discriminatingly reveal or lessen the quality of ecological information. Generally, in high contaminating zones, heavy polluting companies possess substandard ecological administration leading to inferior class of ecological information disclosure. Considering the evaluation above, this research proposes the following hypothesis:

H2: The nexus between air contamination and organization ecological information disclosure can be adverse

Based on the description above, the authors chose the study's title, "Air Contamination and Ecological Information Disclosure from South Africa's High Energy Consumption Industries".

METHOD

This study focuses on all high energy consumption sectors on the Johannesburg Stock Exchange since high energy consumption sectors are the chief contributors to air contamination (D'Amico et al., 2016). Also, numerous scholars have indicated that the quality of environmental information disclosure in high energy consumption sectors is greatly in excess of other industries (Pein, 2020; Belhaj & Damak-Ayadi, 2011; Brooks & Oikonomou, 2018; Mahenna & Dorweiler, 2004). In this study, high energy consumption sectors encompass 11 types namely cement, mining, metal processers, etc.

The sample involves data from 2015 to 2021. The research uses data from 2015 owing to the air contamination data quantified by air quality index (AQI) are offered from 2015. Earlier to 2015, Wasara and Ganda (2019) posit that "the air pollution index (API) was designed to quantify air quality by the South African government". The AQI and API mirrors divergent characteristics and yet extremely interconnected (Fonseka et al., 2019). For easiness, the researchers of this study only used AQI to act as the basis to quantify air contamination or air quality.

The study's data are largely acquired from; (1) data on environmental information disclosure emerged from the annual integrated reports based on content analysis, (2) data on air contamination is gathered from the Ministry of Environmental Affairs in South Africa's website (3) data for control variables originates from the JSE. The data are additionally vetted as follows: companies without adequate data on air contamination or some control variables. Lastly, in total 345 firms were used, with 2415 firm year.

Dependent variable. Ecological information disclosure, which projects the business ecological information disclosure is designated as the study's dependent variable. In line with Mol et al. (2011) the researchers develop the environmental information disclosure index based on the disclosure underpinning grounded on the content analysis from annual integrated reports, environmental and sustainability reports. Accounts of "disclosure level, quantity information disclosure, non-amount disclosure and no information disclosure are given values of 3, 2, 1 and 0, respectively" (Mol et al.,

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2011). The researchers lastly condense the available amounts of every single proxy to get the following ecological information disclosure index.

$EID_{it} = \Sigma^{n}_{i=1} \; eid_{ijt}$

Where EID_{it} is the sum of ecological information disclosure of a company i in year t. eid_{ijt} shows the amounts of proxy j. In this case, j involves data spanning 1 to 10 signifying that 10 objects of ecological information disclosure exist in this study. Greater EIDit means greater quality of environmental information disclosure. To borrow from Iatridis (2013), the researchers as well split environmental information disclosure into "hard and soft environmental information disclosure". Table 1 indicates the subjects of ecological information disclosure, where objects "1, 2, 3, 6, 7, 8" have its place in "hard" ecological information disclosure and "soft" ecological information disclosure covers objects "4, 5, 9". "Hard" ecological information disclosure constantly denotes numerical data and "soft" ecological information is non-numeric data.

Table 1. Assessment Indexes of Ecological Information Disclosure

Object	Content	Nature
1	Ecological conservation investment	Hard
2	Tax decrease linked to ecological protection	Hard
3	Toxic emission and its decline	Hard
4	Information linked to ISO scheme	Soft
5	Extent to increase eco-environment	Soft
6	The impact of governmental conservation rules	Hard
7	Loans linked to ecological management	Hard
8	Ecology linked litigation, reward, fines and awards	Hard
9	Ecological management vision and matters	Soft
10	Supplementary matters of environment linked incoming and outgoing	Hard

Source:

Independent variable. As revealed earlier, the independent variable of the study is Air Quality Index (AQI) to act as a proxy of air contamination. The AQI is developed at the centre of "six atmospheric pollutants, including ozone (O3), sulfur dioxide (SO2), carbon monoxide (CO), nitrogen dioxide (NO2), suspended particulates smaller than 10 and 2.5 mm in the aerodynamic diameter (PM10 and PM2.5)" (Hassan & Romilly, 2018). In addition, larger volumes of AQI imply that lesser air quality, meaning higher air contamination.

Control variables. Given that ecological information disclosure is influenced by several aspects, control variables are chosen with particular reference to contemporary literature. This study adopts firm size, return on equity (ROE), years listed on JSE, net profit margin (NPM), number of board directors and leverage as control variables. Size of board of directors is a critical factor to epitomise company administration. Company size is projected by the sum of total sales. ROE is defined as "is the measure of a company's net income divided by its shareholders' equity" (Wasara & Ganda, 2019). Put differently, ROE measures a firm's profitability and in what way it makes those incomes. NPM is known as the quantification of net income in relation to revenue. Hassan and Romilly (2018) view leverage as "the ratio of a company's loan capital (debt) to the value of its ordinary shares (equity); gearing".

Model Specification. In testing the association between air contamination and ecological information disclosure, this research figures the following regression model.

$EID_{it} = B_0 + B_1 + AQI_{it} + \Sigma C_{it} + \varepsilon_{it}$

Where i represent numerous companies, t is the time, EID is the dependent variable proxied by quality of ecological information disclosure. AQI is the independent variable signifying air quality. C_{it} characterises control variables, ε_{it} represents the random error.

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RESULTS AND DISCUSSION

Descriptive analysis. Given that environmental information disclosure in influenced by several factors, control variables are chosen with particular reference to contemporary literature. This study adopts firm size, return on equity (ROE), years listed on JSE, net profit margin (NPM), number of board directors and leverage as control variables. Size of board of directors is a critical factor to epitomise corporate governance.

Table 2. Descriptive analysis

Variable	Min	Max	Mean	S.D.	N
Environmental information disclosure	0	19	12.16	5.454	2415
Hard environmental information	0	21	9.180	4.297	2415
disclosure	0	8	1.752	0.915	2415
Soft environmental information	3.215	6.772	4.821	1.653	2415
disclosure	2.562	9.301	4.028	2.904	2415
Log of air quality index	-0.067	0.044	0.043	0.073	2415
Total sales (log)	0	26	12.56	5.821	2415
Return on equity	-5.862	32.01	0.271	1.097	2415
Years listed on JSE	0	14	6.751	2.976	2415
Net profit margin					
Number of board members					
Leverage	-0.786	0.863	0.051	0.071	2415

Table 2 depicts the descriptive analysis of the variables. The maximum rate of environmental information disclosure is 19; the least value is 0 and mean value is 12.16. This submits that the general quality of environmental information disclosure remains comparatively low in South Africa's heavy polluting companies. Furthermore, it is observed that a large number of companies disclose their ecological information in the annual report. The subject of ecological information is dispersed and mostly qualitative. This shows absence of ecological information systems within South African companies to fully integrate ecological information. Hence, it is vital to normalize corporate environmental information disclosure behavior, in so doing enhancing the genuineness and quality of environmental information (Patten, 2002). Additionally, the mean amount of AQI is 4.821 signifies that the air class massively enriched after ecological administration.

Correlation analysis. With the intention of testing the connection between the variables, the researchers perform correlation coefficient examination with Pearson assessment. As per Table 3, the class of ecological information disclosure and air contamination proxy by air quality index is adversely connected at a 0.1 level. This class ecological information disclosure is as well considerably linked to firm size, net profit margin, and leverage.

Table 3. Correlation coefficients of main variables

	EID	AQI	Size	ROE	Years	NPM	Board
AQI	−0.0165*	-	-	-	-	-	-
Size	0.0720*	−0.1538*	-	-	-	-	-
ROE	−0.1432	0.1647	0.0085	-	-	-	-
Years	0.0663	0.2276*	0.5218*	0.1188*	-	-	-
NPM	0.0888*	0.0666*	0.3675*	0.0987	−0.0987	-	-
Board	−0.8765	−0.0326*	−0.0876	0.9853*	−0.0985	0.0875*	-
Leverage	0.0774*	0.0897*	0.0128	0.0997	−0.0544	0.2786*	0.6543*

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Note: * specifies the significance at 0.1 level.

We expect companies situated in cities with critical pollution to reveal more ecological information for ecological administration. Conversely, companies situated in high polluting cities seem to reveal less, regrettably. The imaginable explanations consist of earlier findings by researchers that revealing of environmental information at times can culminate in negative effects on the corporate performance, such as revealing information of penalty. Due to South Africa's present environmental information system's imperfectness, several polluting companies opt to reveal environmental information one-sidedly or choose to avoid revealing. As stated, the high pollution can be the outcome of implicit endorsement by the government. Generally, in high polluting regions, heavy polluting companies exercise inferior environmental administration, contributing to the outcome of lesser quality environmental information disclosure.

In the midst of the study's control variables, firm size is considerably positive meaning that bigger companies appear to reveal more environmental information. Net profit margin and leverage both have positive association with environmental information disclosure. This can be explained by that higher NPM and leverage tend to motivate firms to disclose environmental information more due to availability of resources. On the other hand, ROE and number of board member show a negative influence, though not significant, on environmental information disclosure. The possible explanation is that shareholders can misuse specific rights to avoid environmental liability and also that bigger board of directors contribute to difficult communication, disturbing decision and monitoring competence.

Heterogeneous impacts of various provinces. This study's sample was divided to the region where the company is located. The regions were categorized into two for the purposes of the study; Eastern and Northern. As exhibited in Table 4, the air contamination in Northern Provinces shows more effect on company ecological information disclosure in comparison to the Eastern region. The possible explanation is that both regions vary in environmental by-laws and financial performance. Therefore, companies in the Northern region lean towards decreasing the class of ecological information disclosure compared with the Eastern region.

Heterogeneous effects of ownership type. In South Africa, ownership type is a critical aspect determining business ecological information disclosure. Ecological administration is perceived to impose huge effect on government entities as "state-owned entities are regularly used as a pilot for implementing new laws" (Liu & Anbumozhi, 2009). The empirical findings in Table 4 reflect that a significant negative link between air contamination and ecological information exists in both government and private entities. In addition, the impacts of air contamination are somewhat identical.

Heterogeneous influence of ecological information transparency. The association between air contamination and corporate ecological information disclosure varies vigorously as environmental circumstances adjust. A good system is a key determinant of organization ecological information disclosure, encompassing "policies of government regulation". Therefore, province-size contamination information disclosure can drive the effect of air contamination on ecological information revelation. In this study, the researchers applied the pollution data management index (PDMI) to quantity province-level disclosure, availed by the Ministry of Environmental Affairs.

The study divides the entire sample into high PDMI and low PDMI. The PDMI is assembled to analyse the execution of the measures by the government (Wasara & Ganda, 2019). The findings show that the coefficient of AQI is critically inverse related in both provinces. Conversely, the air contamination in the provinces showing high PDMI has larger effect on environmental information disclosure in comparison with low PDMI regions. This is perhaps explained by the view that the

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once the domestic environmental laws are weaker, companies are at a reduced rate put under government monitoring and stakeholder pressure and as a result less impacted by air contamination.

Table 4. Heterogeneity evaluation

Variable	Northern	Western	Stated-owned	Private	High PDMI	Low PDMI
AQI	−6.701***	−5.274***	−4.0534	−4.772	−7.179	−6.098
	(0.937)	(0.925)	(0.971)	(0.964)	(0.813)	(0.712)
Size	2.245*	0.000311	−0.0112	−1.983	−0.1001	−0.0235
	(0.254)	(0.0745)	(0.0786)	(0.0982)	(0.0887)	(0.099)
ROE	0.187***	−0.0832***	−0.0887***	−0.0721***	−0.0981***	−0.0771***
	(0.862)	(0.0106)	(0.0231)	(0.0431)	(0.0241)	(0.0998)
Years	−0.691***	0.1187	−0.275	−0.942	−0.376**	−0.0986
	(0.871)	(0.432)	(0.297)	(0.871)	(0.337)	(0.251)
NPM	−1.731	2.776*	5.791**	−1.902	−5.887	5.841
	(3.991)	(1.443)	(3.665)	(3.512)	(4.667)	(4.889)
Board	0.952	1.889	4.442**	−1.320	−3.662	3.992
	(4.772)	(1.998)	(1.662)	(5.221)	(4.661)	(4.882)
Leverage	0.093	0.078	0.0852	0.0193	0.0109	0.0992
	(0.022)	(0.010)	(0.0772)	(0.0224)	(0.0982)	(0.0421)
Constant	21.70***	32.73***	27.92***	31.52***	23.17***	31.76***
Observations	1785	886	1210	975	1200	1340
R-Squared	0.301	0.213	0.189	0.291	0.219	0.217
Fstatistic	10.69***	10.33***	10.22***	10.09***	9.85***	8.52***

Note: * , ** and * specifythesignificanceat0.01,0.05and0.1 level.**

Swapping of predictor variable. Fine Particulate Matter (PM2.5) is commonly applied to quantify air contamination in the prior studies. So, we substitute the predictor variable AQI with PM2.5. The control variable remains unchanged. The researchers observe that air contamination measured by PM2.5, has substantial negative effects on ecological information disclosure, indicating that our regression findings are robust.

Table 5. Robustness analysis

Variables	Swapping Predictor Variable			Swapping Predicted Variable		Ecological Law	Lag for One Period	GMM	EID
	EIDH	EIDS	EID	EID	EID				
AQI	−3.662***			−1.987***		−1.987***	−1.987***	−1.987***	-
	-			(0.524)		(0.112)	(0.432)	(0.752)	(0.882)
PM2.5	−1.652***			-		-	-	-	-
	(0.122)			-		-	-	-	-
Size	1.352***			2.112***		0.611***	1.914***	1.881***	0.977
	(0.443)			(0.523)		(0.0861)	(0.201)	(0.981)	(0.981)
ROE	0.0887			0.0872		0.0872	0.0872	0.0872	0.0872
	(0.122)			(0.871)		(0.0321)	(0.124)	(0.241)	(0.211)
Years	−0.0652			−0.9811**		0.00198	−0.0249*	−0.0192	−0.321

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	(0.0321)	(0.08713)	(0.00512)	(0.0139)	(0.09981)	(0.762)
NPM	−0.0554***	−0.07732***	−0.0823***	−0.0427***	−0.07712***	−0.0762
	(0.0776)	(0.09861)	(0.009981)	(0.0117)	(0.06632)	(0.03421)
Board	−0.221	−0.0665	−0.0421	−0.0798	−0.0191	0.276
	(0.0984)	(0.08712)	(0.0442)	(0.0819)	(0.00192)	(0.872)
Leverage	0.0998	−0.1123	0.192	−0.290	3.211	−5.872*
	-	(0.0612)	(0.00912)	(0.0140)	(0.0233)	(0.0432)
Law	-	-	-	1.803***	-	-
	-	-	-	(0.151)	-	-
L.EID	-	-	-	-	-	0.772***
	-	(0.08871)	-	-	-	-
Constant	28.81***	21.76***	17.23***	26.24***	24.81***	5.662*
	(1.981)	(3.652)	(2.443)	(3.163)	(2.212)	(3.662)
Observations	2415	2415	2415	2605	1890	1994
R-squared	0.281	0.212	0.182	0.294	0.981	-
AR(1)	-	-	-	-	-	0.001
AR(2)	-	-	-	-	-	0.087
Sargantest (P)	-	-	-	-	-	0.811

Note: * , ** and * specify the significance at 0.01, 0.05 and 0.1 level.**

Swapping of predicted variable. As revealed earlier, environmental information disclosure can be split between "EIDS and EIDH". To evaluate the impact of air contamination on environmental information disclosure, we substitute the predicted variable of ecological information disclosure at "EIDH and EIDS". Table 5 depicts the outcome. We discover a significant negative association relating to EIDH and air contamination, also as between EIDS and air contamination. This highlights that the study's regression outcomes are strong.

Allowing for the influence of new ecological regulation. In 2009, the ecological regulation came into being. First-ever, listed companies, including those in high energy consumption sectors, were mandated to publicly reveal ecological information thoroughly in their annual reports. In view of that, the researchers are curious if the companies are properly responding to the environmental regulations to enhance the class of ecological information disclosure. So, considering the adoption of new environmental regulation into play, the variable of regulation is co-opted into the regression model, where regulation is equivalent to one after 2009. If not, then regulation is equivalent to nil. Once co-opting the variable of regulation, the researchers discover that regulation is critically positive suggesting that the adoption of new ecological regulation really inspires companies to reveal extra ecological information. Furthermore, the importance of key variables mostly remains unchanged, signifying that findings in our research are strong.

Endogenous evaluation. Organization environmental disclosure might have impacts on corporate performance and therefore the concern of reverse causality maybe present which then contributes to endogenous glitches and estimation bias. To overcome this concern, the researchers use one period lag of predictor variables and the application of the logical GMM methods in turn. Based on Table 5, the "air quality index" is considerably adverse, meaning the findings are strong.

CONCLUSION

This paper examines the impact of air contamination on company ecological information disclosure. The observed findings disclose that the association between air contamination and organization ecological information disclosure is critically negative. The results also indicate that

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general class of ecological information disclosure in heavy polluting companies remain comparatively at a low level. The air contamination in Northern Province has larger effect on corporate environmental information disclosure in comparison with Eastern province. Furthermore, the effect of air contamination on organization ecological information disclosure varies according to companies' locations. The enactment of innovative ecological regulations inspires companies to reveal more environmental information. The findings of the study culminate in the ensuing consequences and recommendations.

First, the concerns of air contamination remain a boiling subject. In what way firms react to variations in air contamination is a critical matter requiring to be addressed. Earlier studies, to the best of researchers' knowledge, have ignored to precisely set apart air contamination and organization ecological information disclosure. The paper concludes that in some provinces with dire air contamination, the companies in high energy consumption sectors are averse to reveal ecological facts. In what way to motivate companies in high energy consumption sectors to disclose the larger degree of ecological performance requires more research. Second, this research as well leads to improved understanding of organization ecological behaviour in emerging economies particularly in South Africa. Due to the radical arrangement in South Africa, the government may desire economic expansion as opposed to environmental enhancement, resulting in the upsurge of environmental challenges. Given this background, some companies will disregard environmental matters and afford little consideration to environmental responsibility. Therefore, to properly manage environmental challenges in South Africa, it essential to address the conflict between economic growth and ecological contamination.

However, the study is without limitations. In fact, a number of companies seem to reveal straightforward data that is helpful and but problematic to authenticate. It is tough to evade this challenge when quantifying environmental information through content analysis of environmental and sustainability reports. Consequently, the company's true behaviour and reaction to air contamination may be miscalculated and misconstrued. Further studies can consolidate the figures of ecological investments to completely apprehend the concerns of air contamination on companies.

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