

## Climate change mitigation information disclosure of oil & gas sector in India: A perception analysis

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**Abstract.** Greenhouse gas (GHG) information of business activities disclosed in corporate annual reports lack consistency in content due to variability of perceptions on environmental issues among company executives. Prior studies examined factors affecting environmental disclosures by comparing different firm characteristics, but no reference of executives' perceptions on climate change disclosures was identified in the existing literature. This study aimed at investigating perceptions of executives from 26 listed oil and gas (O&G) companies on climate change mitigation (CCM) information disclosures in annual reports. A questionnaire was constructed referring to the sustainability reporting framework of International Petroleum Industry Environmental Conservation Association (IPIECA) to receive responses from executives of the sample O&G companies. The study revealed that the executives of O&G companies across different value chains perceived materiality for disclosure for all the four climate change indicators- GHG emission, energy use, renewable energy, and flared gases. Significant differences in mean scores of CCM information disclosures existed within four groups of executives holding different positions as well as executives who had different levels of knowledge about annual reports. This study puts forward that climate change mitigation disclosures in annual reports gets affected by level of positions held by executives in their respective companies and their level of knowledge of annual report.

**Keywords:** annual report; climate change mitigation; disclosures; environmental issues; GHG emission; oil and gas; perceived; value streams

### 1. Introduction

The issue of global climate change has been seen as one of the most compelling global challenges in diverse forums by a range of actors and agencies. Given the complexity of this challenge, there have been different ways to approach and manage the issue (Cherian 2015). Climate change mitigation is a human intervention to reduce the sources or enhance the sinks of greenhouse gases.

The principal objective of the Paris Agreement, Article-2 "holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the

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temperature increase to 1.5°C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change” can be achieved through mitigation together with adaptation (UNFCCC, 2020). Mitigation of climate change is to slow things down and thereby decelerate the rate of global temperature rise or to stop it entirely, written in a book by Farmer and Cook (2013). The authors claimed that earth is becoming hotter due to global warming caused appreciably by greenhouse gas increases which are due to burning of fossil fuels supplied from O&G companies. The current global energy consumption matrix is essentially based on fossil fuels. Therefore, oil and gas (O&G) are the most relevant fuels (Cunha 2017).

The petroleum industry covers a wide variety of activities, ranging from exploration and production of O&G to storage and transportation of petroleum products to retail consumers. These companies’ activities value chain is typically divided into three areas along with their associated business functions namely upstream, downstream, and chemicals (IPIECA 2011). While this sector plays key role in boosting the global economy; it is also responsible for a significant share of greenhouse gas emissions and monitoring these emissions is vital to curbing climate change (Cunha 2017).

As per Paris Agreement, India communicated its Intended Nationally Determined Contribution (INDC) to UNFCCC on 2nd October, 2016 with a commitment to reduce energy intensity of its Gross Domestic Product (GDP) to the tune of 33-35% by 2030 from 2005 level. The document clarified that India’s NDC did not bind any sector specific mitigation obligation or action. However, India intends to reduce overall energy intensity and improve energy efficiency of its economy going forward.

The 3rd Biennial Update Report (BUR) submitted by India to UNFCCC stated that “in 2016 India’s total GHG emissions, excluding Land-Use, Land-Use Change and Forestry (LULUCF) were 2,838.89 million tons of CO<sub>2</sub>e”, It reported 40% and 3% of total GHG emissions were from energy sector producing electricity using fossil fuels and refining sector to produce petroleum products from crude oil, respectively. It is therefore, imperative that companies in O&G sector do not only take steps to reduce GHG emissions and mitigate climate change, but also disclose this information to the relevant stakeholders to meet their information needs.

Corporate annual report is the most important publication of all that communicates the operating performance and other relevant information of a company to its different stakeholders (Batra 2007, Ane 2012). The informational requirements of the users of the annual reports and the willingness on the part of the management to disclose the information play an important role in corporate annual report disclosure practices (Choi and Mueller 1978). Previous researches revealed that stringent regulatory requirements, high impact environmental incidents, and growing public awareness have resulted in increase of companies’ release of environmental information in annual reports (Pahuja 2009).

### *1.1 Greenhouse gas emission issues of O&G industry*

Environmental sensitivity of an industry is a key driver to its decision to provide environmental disclosures (Ten 2009). The level of greenhouse gas emission that results from O&G industry operations are highly dependent on the nature of their activities - be it crude oil processed to produce products by an oil refinery or the geology of the reservoirs from where crude oil and gas are obtained (IPIECA 2011).

Companies in the O&G industry generally have systematic processes in place to manage and reduce environmental impacts (Boyle and Depraz 2015). The industry carries out numerous

processes that have direct consequences on the environment, especially atmospheric emissions, liquid effluents, solid and hazardous waste.

Companies are to disclose performance data related to environmental issues such as Climate Change and Energy, Biodiversity and Ecosystem Services, Water and Local Environmental Impacts which are material for companies. These environmental issues are associated with eleven performance indicators which illustrate the environmental systems, development and achievement of the O&G company activities (IPIECA 2020). This study focuses, from the IPIECA guidelines framework, on the Climate Change and Energy issue which is about climate change mitigation indicators to be disclosed in annual reports by O&G companies.

### 1.2 Climate change and energy

Oil and gas energy supply of 57.3% (oil – 33.1%, gas – 24.2%) of total global energy mix in 2019 remained as the highest source of fossil fuel by petroleum companies (World total energy supply 2021). Emissions from gas flaring by production of crude oil and gas by upstream companies and downstream emissions from refining and petrochemicals units having different crudes processed and varieties of products produced, cause climate change effects. Consequently, to minimize GHG emissions companies have responsibility to improve energy efficiency, develop new technologies for alternate energy use, and reduce gas flaring. This climate change and energy issue includes four reportable indicators namely GHG emissions, Energy use, Alternative energy sources, and Flared gas as per IPIECA guidelines framework for environmental disclosure by O&G companies in their annual reports.

## 2. Research objectives

Attitude of company executives is, among other things, a factor that impacts corporate environmental disclosure practices for annual reports of the organisations. Wilmshurst & Frost (2000) in their study stated executives' perceptions, for information needs of annual report users, could be expected to play a role in the extent of environmental disclosure observed in the corporate annual report. A variety of firm characteristics were used as determinants for voluntary corporate environmental disclosure (Matta *et al.* 2019). But no known prior studies were found on how India's O&G company executives perceived disclosure of environmental issues in corporate annual reports, which motivated the researchers to study perceptions of listed O&G companies' executives on climate change mitigation (CCM) disclosures and its relation with characteristics of executives' and industry. Therefore, to understand the CCM information disclosures practiced by O&G companies, the following objectives are proposed:

1. to assess the order of preference for four indicators for Climate Change and Energy (CCE) issue perceived to be disclosed in annual reports of O&G companies.
2. to examine the direction and strength of relationship between CCE indicators.
3. to compare the difference of means of perceived CCM information disclosure index among groups of executives' and value streams of O&G companies.

The remainder of the paper is structured as follows: Section 3 presents review of existing literature in the area and rationale of the present study. Section 4 deals with research methodology used in data collection and analysis. Section 5 presents research findings and analysis of the results. Section 6 gives discussion. Finally, Section 7 concludes the paper, and presents research limitations and future perspectives.

### 3. Review of existing literature

The present study referred to existing researches by authors at different times on global warming, voluntary carbon emission, GHG emission or climate change information published in journals, conference proceedings, annual reports, environmental reports, sustainability reports, etc. published in different countries (Choi *et al.* 2013, Ghomi and Leung 2013, Sudibyo 2017, Ooi and Amran 2018, Leeson *et al.* 2017, Emam 2015, Berthelot and Robert 2011, Bach 2017, Krishnan *et al.* 2020).

Deegan and Gordon (1996) undertook an analysis of environmental disclosures with annual reports published in 1991 by a sample of 197 firms' belonging to 50 different industries listed in Australian Stock Exchange as at 31 December 1991. Their results indicated sample Australian firms usually disclosed less environmental information and their disclosures were usually self-praising with little or no negative news. The study suggested there was a positive trend of environmental disclosures in annual reports occurred between 1988 and 1991. The analysis revealed a positive correlation between firms belonging to environmentally sensitive industry and the level of corporate environmental disclosure. Similar correlation existed between their sizes and disclosure level also.

Maclagan (1999) while evaluating corporate social and environmental disclosure practices, stated that some elements such as values and motives, which influence the perceptions, attitude and decisions of those who are responsible for the organisation performance, needed to be considered.

Healey and Palepu (2001) pointed out that among other things, higher chances of getting as well as increasing compensations were the goals managers aimed at achieving by disclosing voluntary information. Trueman (1986) and Owen *et al.* (2001) found in many cases non-financial information was considered by managers as a means to build reputation of firms instead of discharging enhanced firm responsibility towards environment and society.

Al-Khater and Naser (2003) found firm's involvement in issues of environment, society and ethics was likely to impact its public image. Their study further indicated that enhancement of company's image became the main goal for some managers, instead of benefiting environment, people and society at large. Brown and Deegan (1998) in their study confirmed that some managers may use environmental disclosure in particular ways to shape or alter the perceptions of information users. In continuation of these thoughts, Elsakit and Worthington (2012) reasonably presumed that managers may exert to produce only positive information by omitting negative ones.

Ten (2009) in the study of 79 Malaysian companies used stakeholder's theory to explain environmental reporting attitude. The investigation showed that the top management's conviction to adopt and disclose environment friendly practices was much related to demand of different stakeholders. It was concluded in the report that owing to low level of environmental awareness in Malaysia, the environmental reporting was still not a normal practice.

Feedman and Jaggi (2011) studied the impact of the Kyoto Protocol on disclosures of carbon emissions and found that environmental disclosures by U.S. and Indian firms were comparatively less than that of firms from Canada, Japan and some EU countries. The study also established that there was no significant relation between GHG disclosures and carbon emissions.

Rankin *et al.* (2011) examined a sample of 187 firms from ASX 300 (Australian Securities Exchange) list and established that firm disclosing GHG emission information are larger in size with quality governance system in place, implemented an Environmental Management System

(EMS), and operated in either energy, mining, or industrial sectors.

In exploratory research by Liao *et al.* (2014) to examine impact of corporate board's characteristics on GHG information disclosure showed that the percentage of female directors in the board was significantly correlated with both the desire and the level of GHG information disclosure. The study also established the presence of an environmental committee indicated proactiveness of a firm in environmental issues.

Larrinaga *et al.* (2002b) described non-financial environmental information can be quantitative, or narrative and descriptive. Generally, quantitative data describe indicators, in physical terms, of emissions of pollutants into the atmosphere, as well as the amounts of waste discharged into the water or soil, energy and raw material consumption, noise reduction, among others. On the other side, the narrative data address the policies and actions undertaken in environmental matters, the description of the environmental impact and the activities carried out in research and development as cited in (Cunha 2017).

The study using annual reports published by a sample of 114 manufacturing companies listed on the Indonesia Stock Exchange (IDX) in 2016, showed that successful companies are characterized with solid CSR mission and commitment to emission disclosures (Shodiq 2017). It also implied successful companies would be applying CSR missions to control GHG emissions by emission disclosures in annual reports. But this study did not examine how CSR mission and carbon emissions disclosure impacted on the company success directly.

Broadstock *et al.* (2018) studied empirical relationships between GHG emissions reporting and a range of business performance parameters for UK FTSE-350 listed firms index since 2000 up to the end of 2015. The study found sample companies were slow in adopting voluntary disclosure of GHG emissions despite policy driven environmental necessity over this period. The researchers observed that the decision to report GHG emissions was not directly influenced by wider social/governance disclosure attitudes of a firm, thus suggesting that firms disassociated environmental responsibility from social responsibility.

Elvidge *et al.* (2018) compared satellite-derived natural gas flaring data from 13,605 flaring sites worldwide, with 12,227 upstream sites, 861 downstream sites and 517 industrial sites with the submitted Nationally Determined Contributions (NDCs) greenhouse gas reduction targets to indicate the potential role of gas flaring reduction in meeting country specific targets. Their findings indicated less than 2% of global flaring represented the NDC greenhouse gas reduction targets. However, majority gas flaring was concentrated in few countries, making the possibility that flaring reduction could contribute a considerable portion of the NDC targets for specific countries.

Faisal *et al.* (2018) studied for determinants of GHG information disclosures by 37 firms of nine different industry sectors and found company's profitability was significantly associated with its economic performance. The study also found that lowly leveraged companies tend to disclose more GHG information in their annual reports. Whereas, company size and industry type were positively and significantly associated with the extent of GHG information disclosure. However, the researchers did not find any significant relation between government ownership and GHG emission disclosures.

Annual reports published during 2013 to 2016 by 62 oil, gas and coal companies in non-Annex 1 member countries of UNFCCC were studied by Hapsoro and Ambarwati (2018) to examine the economic consequences of the carbon emissions' disclosure by the sample companies and to determine the characteristics of companies that voluntarily disclosed carbon emissions. The research showed that firm leverage, profitability and age had a positive effect on the carbon

emissions' disclosure, in line with previous studies.

Indonesian mining companies listed in Indonesia Stock Exchange were studied by Halimah and Yanto (2018) to investigate and find empirical evidence on determinants of carbon emissions disclosure by final sample of 14 mining companies. They studied annual reports as well as sustainability reports of 4 years using content analysis technique to measure carbon emission disclosure. The research findings indicated that company leverage, profitability, firm size, and institutional ownership had significant and negative effect on carbon emission disclosure.

Ramadhan *et al.* (2018) found firm size, corporate profitability ratios such return on assets (ROA), return on equity (ROE), and environmental performance were not significantly associated with the disclosure of greenhouse gas emissions.

Swift (2019) cited growing pressure from key stakeholders, such as shareholders, customers, employees who are demanding information about the company's environmental impact was one of the many factors that organisations reported their GHG emissions for. The author claimed that most large companies provide some public disclosure about GHG emissions by referring a KPMG (KPMG 2015 as cited in Swift 2019) survey report, on corporate social responsibility, indicated 82% of the world's 250 largest companies report on carbon emissions in any of the media such as sustainability report, corporate website or Carbon Disclosure Project (CDP) website.

Turkish firms were studied by Akbas and Canikli (2019) from a sample of 84 firms belonging to 10 sectors to examine relation of firm characteristics and GHG disclosures in CDP 2016 Climate Change Report, Turkey edition by conducting binary logistic regression models. The results concluded that a greater number of Turkish firms over the years disclosed GHG emissions having financial sector at the highest rate of response as well as disclosure. Their results, in line with prior research findings, indicated that only firm size and institutional ownership are significantly and positively related to both the response and disclosure behaviour of Turkish firms.

Examining the quality and quantity of greenhouse gas emissions disclosures by a sample of 50 South African companies having large or small carbon footprint, Pittrakkos and Maroun (2020) found high and low carbon companies provided similar levels of carbon emissions and climate change reporting in both reports but differed in the integrated report, which was a primary report to stakeholders. Their research also revealed that the largest firms having highest environmental impact appeared to rely on majorly qualitative disclosures to meet stakeholder information needs by providing adequate details in the integrated as well as sustainability reports.

To understand the key drivers of CO<sub>2</sub> emissions changes to support future mitigation, a study was conducted by Xia *et al.* (2020) in 138 countries globally for the period 2000-2017 and they found income and population are the main drivers of increased emissions over time, to global CO<sub>2</sub> emissions changes. Energy intensity was the key mitigation driver and though carbon intensity increased overall CO<sub>2</sub> emissions during the period 2000-2017 with a contribution of 4%, it has started to reduce emissions in recent years, the study found. The researchers emphasised differences in country's economic developmental stages need to be considered to formulating climate effective change mitigation policies for the nation.

Thus, considerable work has been done to discuss and examine the perceptions, motivations and attitudes of the first group (preparers) regarding social and environmental issues related to firms' activities, assuming that findings gained might help explaining and bridging the gap (Elsakit and Worthington 2012). Information gap between managers and investors can be reduced by providing adequate and related information to the investors by managers, argued by Cormier and Magnan (2003). They stated such act of managers will enable them to obtain users' trust and gain many benefits to a firm, such as allowing it to lower its cost of capital, higher stock valuation multiples,

increase liquidity and enhancing interest of institutional investors.

Prior studies have approached the environmental disclosure in general and preparers' relation from different theoretical perspectives with mixed results. However, relationships between executives' characteristics, such as their positions held in the organisation, their knowledge of annual reports and company's value streams, with perceived climate change mitigation (CCM) information disclosure practices in annual reports remained unexamined by previous researchers. In view of above background this study has been carried out to examine executives' perceptions towards climate change mitigation information disclosure practices listed O&G companies in their annual reports in India.

#### **4. Research methodology**

There were 30 companies under exploration and refineries sectors listed on National Stock Exchange (NSE) and Bombay Stock Exchange (BSE) of India. Twenty-two companies were commonly listed in both the exchanges, 4 companies were listed only in BSE and 4 companies were not traded. Therefore, 26 out of 30 listed companies were taken as sample in this study. As per a table for determining sample size, a given population size of 30 corresponds to a research sample size of 28 (Krejcie and Morgan 1970). However, in this study the sample size of 26 O&G companies was considered due to limitation of listed companies. These 26 companies belonged to either of these categories - crude oil and natural gas exploration and production, crude oil refining, petroleum and related products storage and distribution, and retailing to customers. At respective firm level this spectrum is referred to as the value stream or value chain, a concept that conveys the spread of business activities of O&G companies from raw materials to finished products (IPIECA 2015).

A self-administered questionnaire was constructed based on O&G industry guidance on voluntary sustainability reporting (IPIECA 2015) framework. This internationally practiced reporting framework included three major sustainability issues namely 1) environmental, health and safety, 2) social and 3) economic relevant to the industry. Environmental issue consists of climate change and energy, biodiversity and ecosystem services, water and local environmental impact which are considered to be material to the O&G companies. The study questionnaire considered only climate change and energy issue of the guidelines to construct the questionnaire. Response data from 7 questions pertaining to 'Climate Change and Energy' were used to analyse climate change mitigation perception of O&G company executives.

About 2200 questionnaire were circulated to executives with personal appeal in different companies, which yielded 830(37.7%) acceptable responses which were used as primary data source for this study.

##### **4.1 Dependent variable**

Dependent variable of this study, is the corporate Climate Change Mitigation Information Disclosure Index (CCMIDI) computed based on weighted means of responses to questionnaire developed on 'Climate Change and Energy' issues of O&G industry mentioned in Table 1.

Respondents were encouraged to follow the answering rules to express their perceptions on Likert scale ranging from "very high" (5), high (4), average (3), low (2) to "very low" (1) to be opted by clicking on the chosen option.

Table 1 Climate change issues and indicators for O&amp;G Industry

Environmental issues	No. of indicators	Indicators	No. of questions
Climate change and energy	4	1. Greenhouse Gas (GHG) emissions	1
		2. Energy use	3
		3. Alternative energy sources	2
		4. Flared gases	1
Total			7

Source: (IPIECA, 2015)

Each environmental indicator was normalised in percentage (%) by dividing the sum of Likert Scale Scores for number of questions associated with the indicator by the product of maximum score value 5 and no. of questions associated with the particular Climate Change and Energy indicator. The formula used to calculate normalised value of each indicator as follows:

$$\text{Climate Change Indicator}_i (\%) = \sum_1^n \text{Score} / (n \times 5) \times 100 \quad (1)$$

where,  $i$  = score of each answer associated with an indicator,  $n$  = no. of questions per indicator, e.g. for Energy Use indicator (see Table 1) there were 3 questions, supposing responses received as 'above average (4)' for each of 3 questions, therefor the normalised score of this indicator for the particular respondent was  $((4+4+4) \times 100) / (5 \times 3) = (12 \times 100) / 15 = 80.00\%$ , where 5 is the highest option score value and 3 is the no. of questions for this environmental indicator (energy use). Further, the perceived CCMIDI for the annual report for individual respondent associated with Climate Change and Energy indicators was derived as a continuous variable by dividing the sum of normalised scores of four environmental indicators 1) greenhouse gas emission, 2) energy use, 3) alternate energy sources, and 4) flared gases by 4. Thus, formula for perceived CCM Information Disclosure Index so derived as:

$$\text{CCMIDI} = \sum_i^n \text{Climate Change Indicators}_i / n \quad (2)$$

where  $i$  = the normalised score of CC indicators,  $n$  = no. of CC indicators as 4. Example: for 4 CC indicators the weighted scores (%) were 77.14 for greenhouse gas emission, 73.33 for energy use, 75.00 for alternate energy sources, and 85.00 for flared gases and hence CCM Information Disclosure Index value is  $(77.14 + 73.33 + 75.00 + 85.00) / 4 = 77.62$ .

## 4.2 Independent variables

### 4.2.1 Value streams of the company

Oil & gas companies are divided into different streams depending on their activities in the hydrocarbon value chain. Most companies, do not operate across the total value chain, but have common sustainability issues including environment. The environmental issues related to wastewater, solid waste, oil spills and impact on ecology from different streams of O&G sector activities are to be reported in annual reports as per guidelines. Respondents belonged to either of these streams and their perceptions on environmental disclosure is a matter to be examined

whether there existed any statically significant difference across value chain in this study. These streams are labelled 1 for “upstream” to 4 for “integrated” O&G companies as nominal independent variable.

#### 4.2.2 Executives' job positions

The respondent executives are companies' internal stakeholders who occupy certain positions in the sample companies. Companies' activities are managed by these group of employees who monitor environmental impacts of their operations. Decisions on capital as well as operational expenditure including environmental expenses of the O&G companies are taken by management of the companies. Their perception on stakeholders' information need is a key driver for companies to disclose environmental performance indicators. Therefore, the study seeks to test if their positions in the organisation have influence on the CCM information disclosure in annual reports.

#### 4.2.3 Executives' knowledge of annual report

Hines (1988) and Gray *et al.* (1955) said among all reports, disclosure in the annual report is probably the most important document in terms of the way a company builds its own social impression to all stakeholder (as cited in Pillai *et al.* 2014). Company executives' awareness of the need of environmental information by the stakeholders contributes to improved disclosure of environmental information of the organisation. Knowledge of annual report is acquired, either by experiences of reading or direct participation in preparation of inputs for it, the information must be organized and interpreted appropriately related to the subject. Therefore, executives' knowledge of annual report is the key contributors towards CCM information disclosure of a company. This study attempted to verify if there was any significant statistical difference in perception on climate change mitigation disclosure among executives with different levels of knowledge of annual reports.

## 5. Results

To address the first research objective on order of preferences for four Climate Change and Energy (CCE) indicators perceived to be disclosed in annual reports of O&G companies, a descriptive statistical analysis was carried using four indicator variables mentioned in Table 1 including the Climate CCMIDI. The findings in Table 3 revealed Renewable Energy was the highest preferred indicator ( $M = 79.78$ ,  $SD = 18.93$ ) whereas Flared Gas was the least preferred indicator ( $M = 66.34$ ,  $SD = 23.28$ ) but had the highest variability ( $SD$ ) of all. The central tendency ( $M$ ) and variability ( $SD$ ) of other two indicators namely Energy Use and GHG Emission were ( $M = 78.41$ ,  $SD = 17.33$ ) and ( $M = 72.76$ ,  $SD = 15.44$ ) respectively. Test of Normality (Shapiro-Wilk) for data distribution of four indicators and overall CCM Disclosure Index indicated they were not normally distributed as their  $p$  values were statically significant ( $p < .05$ ).

To examine direction and strength of association among 4 Climate Change and Energy indicator variables of CCMIDI, a bivariate correlation of two tailed Pearson's coefficient test in SPSS was conducted. The results of the Pearson's test shown in Table 4 indicated a significant positive statistical linear relationship among 4 climate change and energy indicator variables. The strongest positive statistically significant correlations was found between Energy Use and Renewable Energy production/use  $r(828) = .705$ ,  $p < .001$ . On the other hand GHGs Emission and

Table 3 Descriptive statistics of climate change and energy of O&amp;G Industry (N = 830)

Climate change and energy	Mean	Std. deviation	Test of normality (Shapiro-Wilk)
Renewable energy	79.783	18.933	Not normal (p < .05)
Energy use	78.41	17.328	Not normal (p < .05)
GHG emissions	72.763	15.437	Not normal (p < .05)
Flared gases	66.337	23.285	Not normal (p < .05)
CCM information disclosure	74.323	15.136	Not normal (p < .05)

Table 4 Pearson's correlations between climate change mitigation indicators (N = 830)

Indicators	Correlations	GHG emissions	Energy use	Renewable energy	Flared gases
GHG emissions	Pearson correlation Sig. (2-tailed)	1			
Energy use	Pearson correlation Sig. (2-tailed)	.502** 0	1		
Renewable energy	Pearson correlation Sig. (2-tailed)	.437** 0	.705** 0	1	
Flared gases	Pearson correlation Sig. (2-tailed)	.549** 0	.567** 0	.440** 0	1

\*\* Correlation is significant at the 0.01 level (2-tailed)

Table 5a Kruskal-Wallis H test ranks CCMIDI across categories of value streams

Value Streams	N	Mean rank
Upstream	28	409.05
Midstream	42	401.49
Downstream	562	409.11
Integrated	198	437.52
Total	830	

Table 5b Kruskal-Wallis H test statistics<sup>a,b</sup>

	CCM Information disclosure
Kruskal-Wallis H	2.234
Df	3
Asymp. Sig.	0.525

a. Kruskal Wallis test

b. Grouping variable: Value streams

Renewable Energy production/use showed the significantly weakest positive correlation,  $r(828) = .437, p < .001$ .

GHGs Emission also showed statically significant positive correlations with Energy Use,  $r(828) = .502, p < .001$  and Flared Gases,  $r(828) = .549, p < .001$ ; Energy Use,  $r(828) = .567, p < .001$  and Renewable Energy,  $r(828) = .440, p < .001$  have statistically significant correlations with

Table 6a Kruskal-Wallis H test ranks CCMIDI across categories of executive position

Executive Position	N	Mean rank
Junior level executive	182	391.34
Middle level executive	446	405.96
Senior level executive	182	461.54
Top level executive	20	429.00
Total	830	

Table 6b Kruskal-Wallis H test statistics<sup>a,b</sup>

CCM Information disclosure	
Kruskal-Wallis H	9.335
Df	3
Asymp. Sig.	0.025

a. Kruskal Wallis test

b. Grouping variable: Executive position

Table 7a Kruskal-Wallis H test ranks CCMIDI across categories of knowledge of annual reports

Knowledge on AR	N	Mean Rank
Little	14	308.21
Somewhat	140	359.20
Much	333	388.12
Great Deal	343	469.43
Total	830	

Table 7b Kruskal-Wallis H test statistics<sup>a,b</sup>

CCM Information disclosure	
Kruskal-Wallis H	32.244
Df	3
Asymp. Sig.	0.000

a. Kruskal Wallis test

b. Grouping variable: Knowledge on AR

Flared Gases too.

To compare means of perceived CCM information disclosure across company value streams, executives' job positions, and their knowledge of annual reports published by the companies, non-parametric Kruskal-Wallis H Tests were conducted for each independent variable with CCMIDI as dependent test variable.

The Kruskal-Wallis H test output in Tables 5a and 5b showed that there was no statistically significant difference in CCMIDI scores between the different value streams of the companies in which respondent executives belonged to,  $\chi^2(3) = 2.234, p < 0.05$ , with a mean rank CCMIDI score of 409.05 for Upstream Sector, 401.49 for Midstream Sector, 409.11 for Downstream Sector, and 437.52 for Integrated companies.

Non-parametric test was also performed to observe how executives occupying different positions in their respective companies perceived the CCM information disclosure in annual reports. Kruskal-Wallis H test in Tables 6a and 6b showed statistically significant difference in CCMIDI scores between levels of executives' positions in their respective companies,  $\chi^2(3) = 9.335$ ,  $p < 0.05$ , with a mean rank of CCMIDI score of 391.34 for Junior Level Executives, 405.96 for Middle Level Executives, 461.54 for Senior Level Executives, and 429.00 for Top Level Executives about annual reports.

## **6. Discussion**

The present study aimed at gathering a better understanding of managerial (executives) perceptions on practices of climate change mitigation information disclosures in annual reports published by O&G companies listed on Indian stock exchanges. The input data from respondents of sample companies was collected using a self-structured questionnaire constructed in line with IPIECA guidelines for voluntary sustainability reporting by O&G companies.

It was evident from the findings of the study that responding executives working in different O&G companies recognised the need for CCM disclosures in the annual reports as a strategic business activity that would benefit their organisations and stakeholders including themselves as employees. The sample O&G companies included companies of different sizes. This shows that executives perceive disclosure of CCM related information as important irrespective of size and activities of the companies. This is in contrast to findings of some previous studies which showed that large size companies disclosed more GHG emission information in annual reports and reasoned that this is because GHG emission issues are more relevant for large size companies (Akbas and Canikli 2019, Pitrakkos and Maroun 2020, Swift 2019).

The survey revealed that 'Renewable Energy' was the most preferred climate change mitigation issue to be disclosed in annual report as per the responding executives across exploration, production, refining, marketing and transport of oil and gas. This issue focuses on aspects of O&G operations that have potential to create regional or local impacts on air by producing and consuming green energy such as solar, wind, and bio-fuels etc. The impacts from alternative energy production and usage are far less on climate change than that from fossil-based high carbon energy sources. Therefore, O&G companies should disclose their renewable energy related information including efforts to reduce dependency on fossil fuels and transition to alternate less polluting green energy sources in the annual reports for climate change mitigation strategies across organisational value chain.

Reporting of 'Energy Use' information in annual report was considered as the second most important climate change issue by the respondents. O&G companies' activities require consuming of high carbon fuels which have potential to cause direct and indirect impacts on biodiversity and ecosystem through global warming. It is imperative for these companies to disclose information on their energy usage including information on energy conservation and energy efficiency improvement programs. Oil and gas companies may disclose qualitative and/or quantitative information on energy use data and strategy of energy transition to comply with Paris agreement goals.

In this study, disclosure of information on 'GHG Emissions' issue was found at third position. Various O&G activities, including use of fossil fuels to produce energy, lead to release of GHG emissions. CO<sub>2</sub> equivalent of these emissions should be reported periodically along with

information on efforts to reduce these emissions. Flared gas burning from operational facilities is an integral process for most O&G companies across geographies to sustain their operations, yet this issue was perceived to be at fourth position in importance by the executives. It is, perhaps, due to uncertainty over release of process gases to flaring system caused by process upsets and emergency situations. However, flaring of hydrocarbon gases across value chain is essential to keep operation stable and safe. Flaring activity also releases unburnt Methane (CH<sub>4</sub>) gas which has more than 80 times the global warming power of CO<sub>2</sub>. Oil and gas companies are required to report the amount of hydrocarbon gas flared to the atmosphere from their operations in the annual reports. Disclosure of flaring is considered as the measure of gaseous energy consumption which contributes to GHGs and other gaseous emissions to pollute the local environment (IPIECA 2020).

Statistical tests were carried out to examine if significant statistical differences existed for perceived CCM information disclosure mean values within different value streams of O&G industry. The finding of the study indicated that there was no difference in the perceptions of the executives belonging to companies from different value chains of the industry. This shows that the responding executives found CCM issues resulting from O&G activities to be material for disclosure irrespective of their companies' business characteristics. However, this finding was in contrast with the outcome of a study by Waxman *et al.* (2020) who observed potentially higher prominence of upstream and downstream O&G facilities in terms of GHG emissions in the studied region of USA. The study projected GHG emissions of 541 million tons of CO<sub>2</sub> equivalent (CO<sub>2</sub>e), by 2030 from existing and soon-to-be constructed O&G infrastructure, which comprised of CO<sub>2</sub> emissions of 31.3%, 22.4% and 46.3% from upstream, midstream and downstream facilities respectively. Their data supported a higher emission of GHG from downstream facilities that includes oil refineries. The findings of the current research work have implications for the industry regulators in India who should try to make regulations related to CCM disclosures in the annual and other reports in such a way so as to ensure consistency of these disclosures across the value streams.

An attempt was also made to verify if statistically significant differences existed in means of perceived CCM information disclosures among the executives working at different positions in the companies and having different levels of knowledge about annual reports. The findings of the study confirmed a strong, positive and statistically significant association between CCM and the predictor nominal variables such as executives' positions and their knowledge on annual reports. It was clear from our findings that senior executives perceived higher degree of GHG emission information to be disclosed in annual reports supporting finding of a report which claimed Directors and Managers at higher levels may already be aware of the environmental issues and their potential financial impacts that are relevant to the companies (ICAEW 2015).

Extent of CCM information in annual reports is an indication of management's attitude towards sharing environmental information for the stakeholders voluntarily. Inputs for CCM information to be published in annual report of any O&G company are prepared by company executives. The findings suggest that if higher level executives are associated in providing information for CCM, higher extent of CCM information would be reported in annual reports. Therefore, management of the company may decide to place senior executives with responsibility to prepare material for disclosures in environmental/sustainability reports. Moreover, knowledge about annual reports gives these executives a better understanding about the information needs of different stakeholders which can be satisfied by adequate disclosure of information on climate change issues. Annual report's knowledge adequacy would help in reducing environmental information gap between managers who are preparers of social and environmental information and users of these information

as indicated by some prior studies (Deegan and Rankin 1999, Lungu *et al.* 2009). Rosa *et al.* (2012) also stated in their study that companies have relevance to the socio-economic development of the country, and considering the environmental impact generated by their activities, the environmental managers of these companies need to have extensive knowledge of environmental disclosure management. They confirmed that decision makers considered emissions management to be a strategic action due to societal as well as international agreements on sustainable development. Their case study to improve environmental disclosure process allowed managers to develop an understanding of disclosure management. The findings of our study makes a valuable contribution to the existing literature on CCM information disclosure issue. An involvement of senior level executives with knowledge of information needs of the users of annual reports would help in deciding what CCM information to be disclosed to improve overall corporate environmental disclosures.

## 7. Conclusions

In the backdrop of global temperature rise due to GHG emissions from activities carried out by energy sector, this study intended to understand how O&G company executives prioritised climate change mitigation (CCM) information disclosure indicators for reporting in annual reports. It was found that O&G company executives perceived disclosures of all CCM performance indicators material to be disclosed in the annual reports. Disclosure of information on CCM measures can be used by these companies as a strategy to justify their actions which cause global warming resulting in climate change and to seek legitimacy from the society to continue its business. The senior executives holding top positions in their companies perceived higher importance of GHG emission information to be disclosed in annual reports supporting findings of some earlier reports which claimed that corporate executives at higher level are well aware of the environmental issues and their potential financial impacts that are relevant to the companies and the stakeholders. The present study pointed out that O&G companies should practice to place senior executives who are well conversant with annual report at key positions to deal with sustainability disclosure affairs. In contrast to findings of some existing studies, the present study found no significant difference in perceptions of the executives belonging to different value chains of the industry regarding CCM disclosures, despite separate streams have different activities and environmental aspects leading to varying climate change impacts on the atmosphere. Concern for sustainable operations of a company is addressed through the leadership of the executives who are responsible to meet the environmental requirements. The findings of the study confirmed that senior executives are well concerned of the need of CCM information disclosures in the annual report, implying an effective and committed practice to ensure improved reporting of environmental information for the benefit of stakeholders.

### 7.1 Future perspectives

The scope of the present study is limited to analysis of perceptions of executives from O&G companies on CCM disclosure related issues. Further studies can be conducted to understand opinions of executives belonging to other polluting industries operating in India on disclosure of GHG emissions and climate change information. Another important research area could be to compare perceived CCM information disclosures index between sectors and across countries. The

opinions of other stakeholder groups like consumers, suppliers, creditors and investors can also be obtained to understand their information needs regarding CCM issues. Research can be further extended to compare expected CCM information disclosures and actual CCM information disclosed by companies to find CCM information disclosure gap.

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