International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 • Website: www.ijfmr.com • Email: editor@ijfmr.com

Corporate Accountability of Indian Energy Sector in Achieving Net Zero Targets: A Study on Greenhouse Gas Emissions

Shristi Agarwal[1], Dr. Rajni Gupta[2]

[1]Student, Bachelors Of Management Studies, St. Xavier's College (Autonomous), Kolkata.
[2]Assistant Professor, Bachelors Of Management Studies, St. Xavier's College (Autonomous), Kolkata.

Abstract

Climate change mitigation has become a critical global priority, with the energy sector being a major contributor to greenhouse gas (GHG) emissions. India, as the world's third-largest emitter, faces the dual challenge of meeting rising energy demand while progressing toward its net-zero emissions target by 2070. This study examines the extent of corporate accountability within the Indian energy sector by analysing whether sustainability commitments made by firms are reflected in actual emissions performance.

The research adopts a descriptive and comparative approach to analyse Scope 1, Scope 2, and Scope 3 greenhouse gas emissions of four leading Indian energy companies—Indian Oil Corporation, NTPC Ltd., Adani Power, and JSW Energy—over the period FY 2021–22 to FY 2023–24. Secondary data were sourced from annual reports, Business Responsibility and Sustainability Reports (BRSRs), ESG disclosures, and sustainability reports. Trend analysis and emissions intensity per rupee of turnover were used to assess inter-firm and intra-firm performance, alongside an evaluation of reporting transparency against global standards such as the GHG Protocol, GRI, and CDP.

The findings indicate a decline in Scope 1 and Scope 2 emissions intensity in the initial years, followed by a slowdown in progress, suggesting that early efficiency gains may not be sufficient for long-term decarbonisation. Scope 3 emissions intensity shows a consistent downward trend, reflecting improvements in supply chain and operational practices. However, significant disparities across firms persist, highlighting uneven progress and potential accountability gaps.

The study concludes that while India's energy sector has made measurable progress toward net-zero objectives, stronger governance, improved disclosure quality, and deeper structural interventions are essential to align corporate actions with national climate goals.

Relevant keywords: "Indian energy sector," "greenhouse gas emissions," "net zero targets," "renewable energy," and "sustainability" were used to conduct the search.

Introduction

One of the growing global concern is the issue of climate change that needs to be urgently addressed. This has only boosted over the years. One major aspect that forms the problem of climate change is the greenhouse gas (GHG) emissions. It mainly constitutes carbon dioxide, methane, and nitrous oxide release which act as the primary drivers. Emissions like these trap heat in the Earth's atmosphere, expediting global warming and its related impacts. In this context, one of the major contributors to greenhouse gas emissions, the energy sector, has come under inspection. India, being the world's third-largest emitter of greenhouse gases, has been facing scaling pressure to address the issue of carbon emissions and take concrete steps towards achieving its net-zero targets.

According to the Environmental Performance Index (EPI) India's position has been declining over the years, with the ranking of the country being 176 out of 180 countries in the year 2024. The EPI Index is a tool that helps in measurement of a country's performance on various environmental parameters, namely air quality, water and sanitation and climate change mitigation. India's poor performance on mitigation of climate change has been due to the high carbon emissions from the energy sector.

In addition to this, there has been a steady growth in the power demand in India because of the rise in urbanization, industrialization, and rising incomes. Also, as per the Central Electricity Authority (CEA), India's electricity demand is projected to double by 2040. The energy sector is responsible for meeting this demand. It has also seen a surge in carbon emissions over the years. This sector is not only a major employer, but it also contributes significantly to the country's GDP. However, there is another side to the coin. This sector is also a significant contributor to greenhouse gas emissions. Hence, it has become extremely important for the Indian energy sector to reduce its carbon footprint and move towards cleaner energy sources to ensure a sustainable future.

A target has been set by the Government of India for achieving net-zero carbon emissions by 2070, with a significant reduction in emissions by 2030. It is expected by the energy sector play a vital role in achieving this target, keeping in mind its contribution to carbon emissions. Therefore, the present study aims to investigate the contribution of the Indian energy sector in achieving the net-zero carbon emissions target by studying the greenhouse gas emissions of Indian energy sector firms. This paper will investigate the efforts made by these firms towards reducing their carbon emissions, the obstacles that they face, and the potential opportunities for reducing emissions. Major Indian energy corporations, including Indian Oil Corporation, NTPC, Adani Power, and JSW Energy have been taken up which significantly affect the country's carbon footprint through fossil fuel operations and energy production.

Need/Rationale of the Study

This report helps us decipher how seriously Indian energy companies are taking their promises to curb pollution and be more eco-friendly and maintain sustainability in the long run. By analysing their sustainability reports, and public statements and checking if they follow global climate regulations, we can observe whether they are actually reducing emissions or just showcasing to be green while continuing business as usual. The study will also reflect where these companies need to be more honest and responsible about their environmental impact identifying the scope for accountability and transparency.

Research Motivation

On 5th December 2024 a report was released by World Resources Institute which compared the greenhouse gas emissions across different sectors. According to this report, the energy sector comprised of 75.7% emissions globally.

Parallelly, on 12th January 2025, India’s Prime Minister, Shri Narendra Modi made a public statement as follows: “India is the land of Mahatma Gandhi, whose vision for sustainable development inspires us greatly. We have shown what it is to realise key principles like Green Future and Net Zero.” Forming the backbone to this claim was the announcement of 7.93% drop in greenhouse gas emissions. This progress drove my curiosity towards understanding what progress has been made in different sectors, with the focus on the major contributor, energy sector. Moreover, it would help me understand the situation of this topic of concern within our country, thereby enhancing our knowledge and understanding of the same.

Literature Review

The study of the contribution of the Indian energy sector in achieving net-zero targets has become increasingly important in recent years due to the global concerns about climate change and the urgent need to reduce carbon emissions. Some of the relevant literature on this topic are as follows.

The **International Energy Agency (IEA)** published a report titled **"India Energy Outlook 2021"** which provides a wider picture of the Indian energy sector and how much it contributes towards achieving the desired net-zero targets. It is drawn from the report that India is the world's third-largest emitter of greenhouse gases and the energy sector of the country is the reason for two-thirds of its emissions. The report has also brought forward the need for a significant shift towards cleaner energy sources, such as solar and wind power, to achieve net-zero emissions by 2050.

W. Lamb (2021) and colleagues published a paper in the Environmental Research Letters, This paper analysed the trends of greenhouse gas emission across various sectors in the time period of 1990 to 2018. The attention was on factors like growth in the economy, affects due to advancing technological progress and government interventions or policies.

Naidu et al. (2020) published a study in the Journal of Cleaner Production that laid its foundation by narrowing the focus towards the carbon footprint of the Indian energy sector. Moreover, a search for opportunities that would reduce carbon emissions was also taken up. The study brought forward that the power generation sector was the primary contributor to carbon emissions in the Indian energy sector. A shift towards renewable energy sources and use of cleaner resources would be required for minimising emissions from this sector.

The Journal of Sustainable Energy and Environment published another study by **Banerjee et al. (2020)** who made an analysis of the potential of capturing carbon, its utilisation and the technologies for storage in reducing carbon emissions in the Indian energy sector. Technology was found to be a key tool which could reduce carbon emissions from the power generation and industrial sectors in India.

Jinghong Gao. (2018) published a paper in Environmental Pollution which reviews ways that could be used to curb greenhouse gas emissions and how it would affect related health co-benefits across different economic sectors. It also throws some light on the knowledge gaps and policy implications.

P. Salas (2013) in his research paper published energy models which were devised keeping the economic backdrop as the point of concern to study how technological evolution has affected the power sector, its uncertain drivers and the implications for greenhouse gas emissions.

Gopal K. Sarangia, Arabinda Mishrab, Youngho Changc, Farhad Taghizadeh- Hesaryd (2019) used a sustainable development framework and carried out a holistic assessment of the sectoral performance. The paper adds to the knowledge pool by carefully identifying a set of variables that characterise the sustainable development of Indian electricity sector. Additionally, it also focused on analysing how these variables perform over a decade. The conclusion put forth that the Indian electricity sector appears to be moving on sustainable development trajectory though some aberrations exist in the performance.

Sources of Literature: This literature review involved searching conducted across different databases, including academic journals, books and reports.

Research Gap

1. There exists very few research that compare and contrast the declared sustainability intentions with actual emissions data. Majority of the existing research focuses on legislative frameworks compliance and company pledges.
2. Most of the studies evaluate Scope 1 and Scope 2 emissions, but the analysis for Scope 3 emissions is often overlooked, which makes up a sizable amount of indirect emissions from supply chains and operations that are outsourced.
3. It is not much known about the actual functioning of the corporate accountability systems, especially when it comes to detecting "greenwashing"—which means situations where companies exaggerate their eco-friendly efforts merely to look good to the public and portray a positive image of themselves.

Objective

The study has been carried forward keeping in mind these mentioned objectives:

1. Examination of the greenhouse gas (GHG) emissions of India's top energy corporations (Indian Oil Corporation, NTPC Ltd., Adani Power, and JSW Energy) over the three-year period from FY 2021-22 to FY 2023-24.
2. Analysing how India's national climate goals align with the companies' promises to cut carbon emissions over time. The focus is on checking if there are any gaps between what the country aims for and what businesses are actually doing.

Research Methodology

The research methodology for the topic Corporate Accountability of Indian energy sector in achieving Net Zero Targets – A study on Greenhouse Gas Emissions ' where a trend analysis of air emissions of Indian energy sector have been done, aided by the secondary data that is available to the masses would involve the following steps:

Research Design

This study is carried by incorporating a descriptive research design that examines greenhouse gas (GHG) emissions trends and corporate accountability practices within India's energy sector. The four major Indian energy corporations— Indian Oil Corporation, NTPC Ltd., Adani Power, and JSW Energy have been selected for the purpose of this research.

Selection of the Sample

The companies were chosen on the basis of:

- Their market dominance within India's energy sector which is measured by revenue and market share as of 31st January 2025.
- Having major impact on emissions as they are involved in oil refining, coal-based power generation and renewable energy development projects.
- Availability of data about the emissions through public disclosures such as annual reports,

sustainability reports, and Business Responsibility and Sustainability Reports (BRSR)
- This handpicked sample enables a depth analysis of corporate practices among the most influential players in India's energy field.

Period of Study
The data will cover a period of three years from FY 2021-22 to FY 2023-24.

Sampling Technique
A sampling technique that was not based on probability was used wherein the companies were chosen specifically as per their relevance in India's energy shift to cleaner resources, transparency and disclosure policies, and their impact on environment to ensure data reliability.

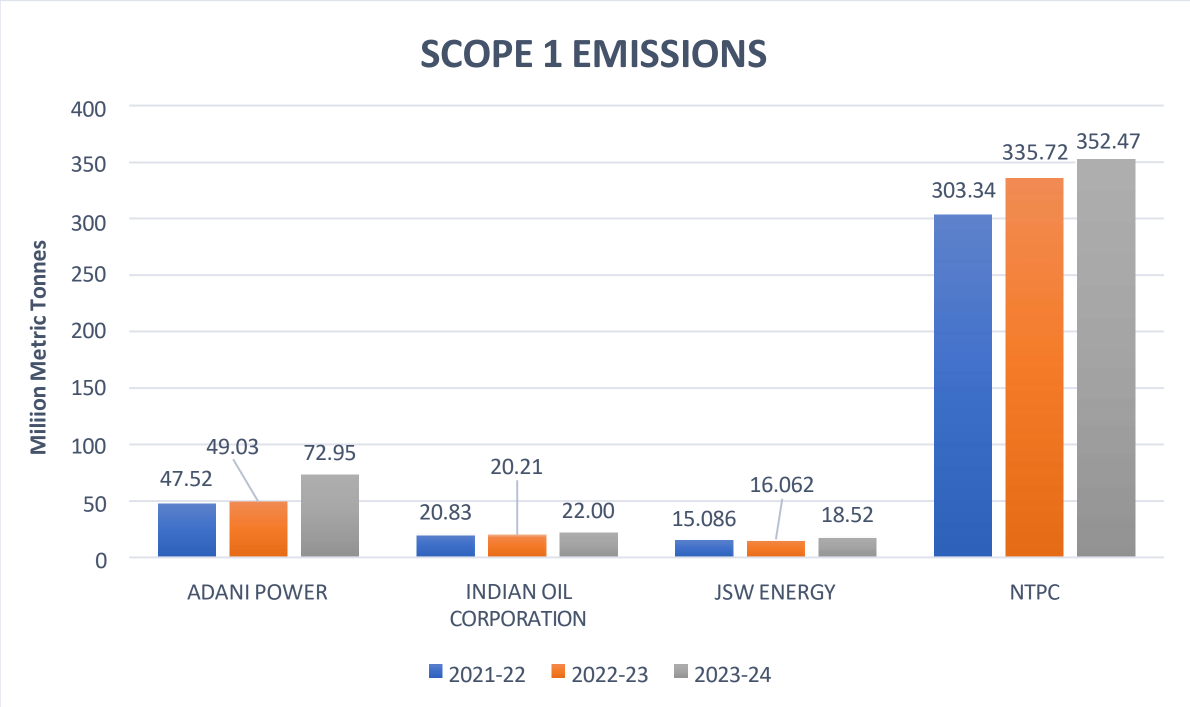
Method of Analysis
- To examine the trends in GHG emissions- mean, median, and standard deviation were calculated and analysed for all Scope 1, Scope 2 and Scope 3 emissions. It intends to track changes over time.
- The performance comparison is twofold. One of them being between companies (inter-firm) and the second within the same company (intra-firm) over the period of study to identify differences in sustainability efforts.
- Corporate reports, such as sustainability reports, ESG disclosures, and BRSRs are evaluated for transparency and compliance with international standards including CDP, GRI, and GHGP.
- The emissions trend analysis is compared with the Net Zero Targets set by the Indian government to assess the progress made by the four companies towards achieving the targets. It helps in determining if these companies are on the right track to fulfill their climate-related national and international obligations.

Data Collection Sources
- Annual reports of energy sector firms in India, including Indian Oil Corporation, NTPC Ltd., Adani Power, and JSW Energy.
- BRSR Reports (Business Responsibility and Sustainability Reports) of energy sector firms in India.
- ESG and sustainability reports of the firms.
- Academic papers and research articles on the energy sector and carbon emissions in India.
- Reports from international organizations like the International Energy Agency (IEA), Central Electricity Authority (CEA), Yale Centre for Environmental Law and Policy.

Data Analysis and Findings
The study is focused on analysing the share of the Indian energy sector in achieving net-zero targets. It is done by studying the greenhouse gas emissions of four prominent companies that are Indian Oil Corporation, NTPC Ltd., Adani Power, and JSW Energy for the period ranging from FY2021-22 till FY2023-2024. A trend analysis was conducted to observe any changes in air emissions over the period of study
For trend analysis, units of air emissions (tCO_2e) have been converted into a uniform unit Metric Tonnes to ensure consistency.
Moreover, mean of air emissions across 4 companies is also calculated for three years so that the trend

can be established.

Scope 1 Emissions (Direct Emissions)



Intra-Firm Analysis

NTPC recorded the highest emissions that marked an upward trend by increasing from 303.34 million metric tonnes (MMT) in FY2021-22 to 352.47 MMT in FY2023-24, making a 16.2% increase over the period analysed.

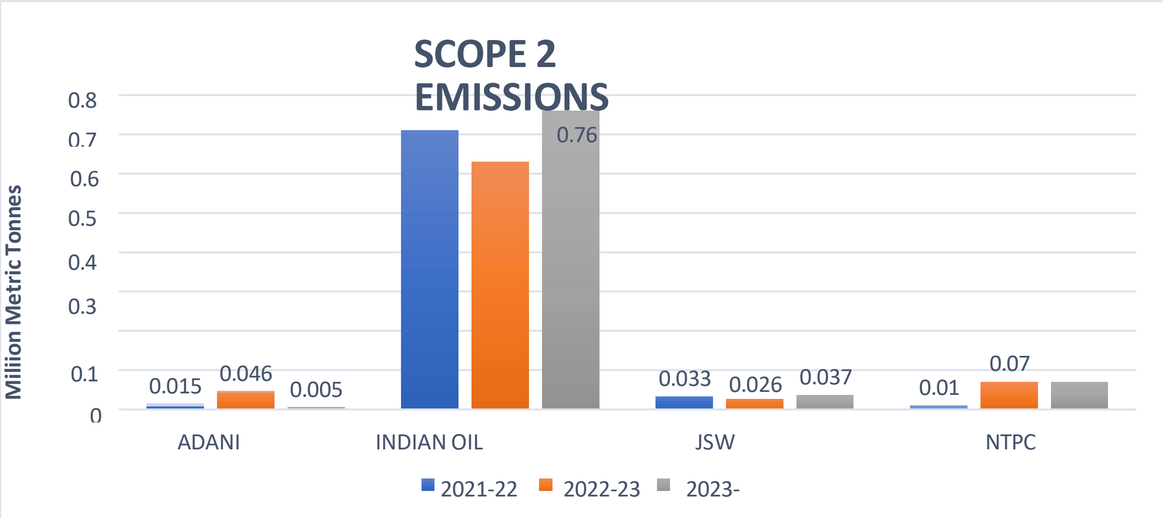
Adani Power had the highest percentage growth, with emissions rising from 47.52 MMT in FY2021-22 to 72.95 MMT in FY2023-24, reflecting a 53.6% increase. Indian Oil Corporation, on the other hand, showed minimal fluctuation, rising from 20.83 MMT to 22.00 MMT, a 5.6% increase over the period.

JSW Energy saw a middling increase, from 15.086 MMT to 18.52 MMT, a 22.7% growth.

Inter-Firm Analysis

NTPC stays as the major emitter, significantly surpassing all other firms. Adani Power's rapid increase in emissions hints at its growing operational intensity, while Indian Oil Corporation and JSW Energy's emissions remain relatively stable, with only elevation.

Scope 2 Emissions (Indirect Emissions from Purchased Electricity)



Intra-Firm Analysis

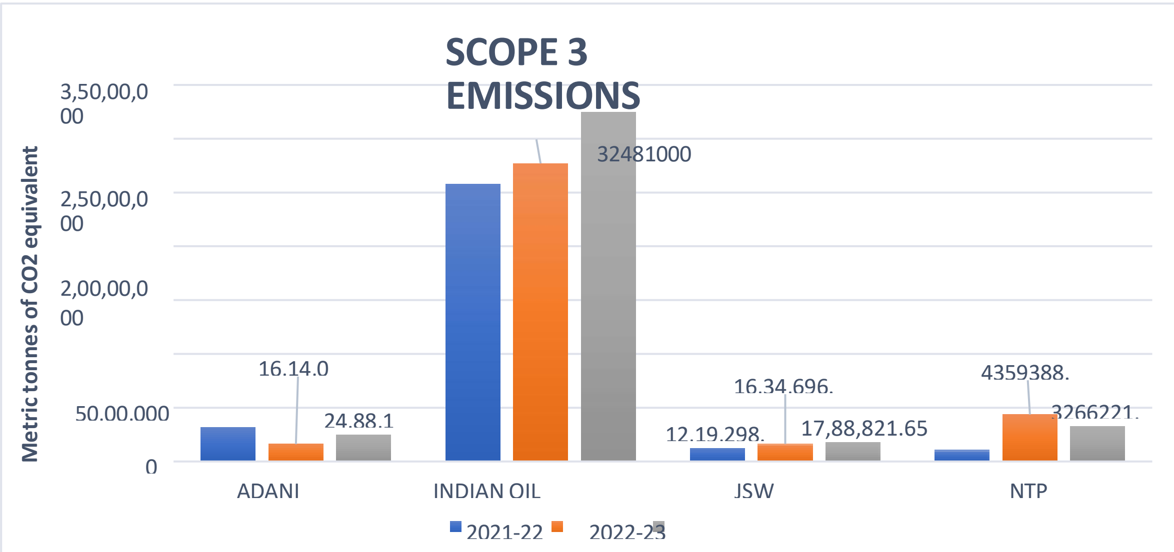
Indian Oil Corporation has the highest Scope 2 emissions, increasing from 0.71 MMT in FY2021-22 to 0.76 MMT in FY2023-24 which marks a rise of 7%.

Adani Power's emissions plummeted from 0.015 MMT in FY2021-22 to just 0.005 MMT in FY2023-24, marking a 66.7% reduction, pointing towards improved energy efficiency. JSW Energy's emissions expanded from 0.026 MMT to 0.037 MMT, a 42.3% rise. NTPC's Scope 2 emissions remained constant at 0.07 MMT, reflecting stability in energy procurement.

Inter-Firm Analysis

Indian Oil Corporation leads in Scope 2 emissions, highlighting its dependence on purchased energy. Adani Power's significant reduction indicates better energy efficiency strategies, while NTPC remains stable. JSW Energy's increasing trend suggests rising energy consumption.

Scope 3 Emissions (Supply Chain and Other Indirect Emission)



Intra-Firm Analysis

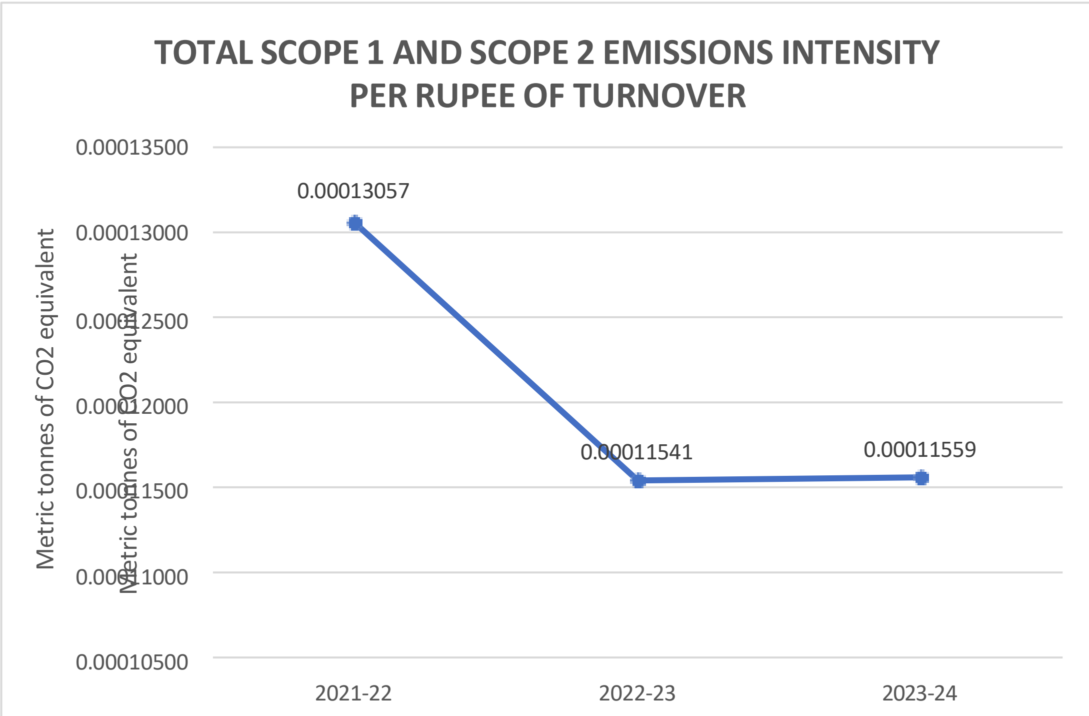
Indian Oil Corporation has the largest Scope 3 emissions, rising from 25,80,00,000 metric tonnes in

FY2021-22 to 32,48,10,000 metric tonnes in FY2023-24, marking a 25.9% increase. NTPC reduced its Scope 3 emissions significantly, from 4,35,93,888.78 metric tonnes in FY2021-22 to 3,26,66,221.74 metric tonnes in FY2023-24, a 25.1% decrease, indicating improvements in carbon management. Adani Power's emissions fluctuated but ultimately increased, from 31,60,406 metric tonnes in FY2021-22 to 24,88,172 metric tonnes in FY2023-24, a 21.2% rise. JSW Energy's emissions rose from 12,19,298.14 metric tonnes to 17,88,821.65 metric tonnes, marking a 46.7% increase.

Inter-Firm Analysis

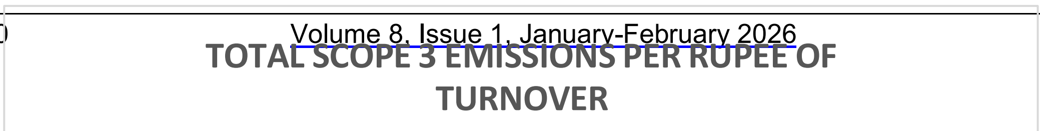
Indian Oil Corporation's Scope 3 emissions are the highest, significantly surpassing all other firms. NTPC is the only firm that has reduced Scope 3 emissions, showing a positive trend toward sustainability. JSW Energy has the lowest Scope 3 emissions but also the highest percentage increase (46.7%), indicating a rising operational impact.

Trend analysis of the Energy sector



The total Scope 1 and Scope 2 emissions intensity per rupee of turnover has declined from 0.00013057 metric tonnes of CO_2 equivalent in FY2021-22 to 0.00011541 in FY2022-23, reflecting a 11.6% reduction. However, the decline slowed significantly in FY2023-24, with emissions intensity at 0.00011559, marking only a 0.16% increase compared to the previous year.

This trend indicates that while companies initially made significant improvements in emissions efficiency, progress has stagnated. The sector likely implemented early-stage energy efficiency measures or cleaner energy transitions, but further reductions may require more advanced interventions



Total Scope 3 emissions intensity per rupee of turnover declined steadily from 0.0001405 in FY2021-22 to 0.0001274 in FY2022-23 (a 9.3% reduction) and further to 0.0001153 in FY2023-24 (a 9.5% reduction). This suggests that the sector is making consistent progress in managing emissions across its supply chain and product life cycles.

The steady decline in Scope 3 emissions intensity suggests better sustainability practices, such as supplier engagement, improved logistics efficiency, and lower- carbon raw materials Furthermore, the findings indicate that the Indian energy sector is actively participating in achieving global sustainability goals by reducing its carbon emissions. Another observation from the trend analysis is that the companies are taking proactive measures to look into the issue of climate change and how it impacts the environment.

In a nutshell, the study brings forward the importance of tracking and analyzing carbon emissions to achieve net-zero targets. It also showcases the efforts made by the Indian energy sector to reduce its carbon emissions, which is a step forward towards building a future that is sustainable.

Measures taken by Adani Power towards achieving their commitment of Net Zero Emissions

Energy efficiency is an important factor for reducing the cost and establishing sustainability objectives. With that, it is seen that energy intensity has decreased by 26% from FY 2021–2022.

Energy-efficient LED lights have taken the place of conventional lighting in an effort to increase sustainability. The percentage of renewable energy rose from 1% in FY 2021–2022 to 13% in FY 2022–2023, indicating significant advancements in the use of clean energy. In order to achieve the goal of 15.39 million trees by 2030, 13 lakh trees will be planted by 2022 as part of the implementation of nature-based climate solutions.

To help India become more self-sufficient in renewable energy, Adani Solar is constructing a 1.5 GW wind turbine factory and a 10 GW solar module facility annually.

Measures taken by JSW Energy towards achieving their commitment of being Net Zero by 2050

JSW Energy is dedicated to reaching Net Zero goals and does so by implementing Science-Based Targets Initiatives. With a concentration on wind, solar, and hydroelectric power, the corporation wants to reach 10 GW of renewable energy capacity by 2025 and 20 GW by 2030. In order to lower emissions from coal- based power stations, it is investigating Carbon Capture, Utilization, and Storage (CCUS) technology. By investing in cleaner fuels, energy storage technologies, carbon reduction initiatives, renewable energy, and energy efficiency, JSW Energy is aiming to achieve net-zero carbon emissions by 2050.

Measures taken by Indian Oil Corporation towards achieving their commitment of being Net Zero by 2046

Indian Oil helped achieve national climate targets by preventing or reducing 3.36 MMT of carbon emissions in FY 2021–2022. In order to help India reach its goal of 15% natural gas in the energy mix by 2030, the company is developing its infrastructure for compressed biogas (CBG) and natural gas. Indian Oil now has 237.77 MW of renewable energy (RE) in its portfolio, with plans to build up to GW-level capacity in order to meet net-zero goals. In an effort to promote cleaner mobility, some 1,900 EV charging stations have been established with 10,000 more planned over the next three years. The company uses 15,000 km of pipes, which generate 75% less carbon than rail transport, to support a

cleaner supply chain.
With a combined capacity of 111.5 MW, solar power units have been deployed at over 20,000 retail locations (~57%), lowering reliance on traditional energy sources.

Measures taken by NTPC towards achieving their commitment of being Net Zero by 2070

With a 15,000 MW project pipeline, NTPC increased its renewable energy capacity to 3,090 MW (mostly solar) by March 2023, with an aim of 60 GW by 2032. This will account for 45% of its total projected generation capacity. With the use of sophisticated cooling systems and water conservation measures, the corporation lowered specific water consumption to 2.83 m^3/MWh in FY 2022-23, a 7.5% decrease from the year before. In order to reduce sulfur dioxide emissions by over 90% at plants that are equipped, NTPC made an investment in air pollution control by granting Flue Gas Desulphurization (FGD) contracts for 64.7 GW of its coal-based capacity, with 8 GW installed.
By planting more than 40 million trees, including 2.3 million in FY 2022-23, the corporation made sure that green coverage surpasses 40% at multiple power plants, above the 33% statutory requirement.

Net Zero Emission Target By Government of India

PM Modi, on 1 November 2021, presented India's five-point agenda famously termed 'Panchamrit' at the 26th session of the Conference of the Parties (COP26), to the United Nations Framework Convention on Climate Change (UNFCCC) held in Glasgow. These commitments are concrete steps which India needs to take to achieve net zero.

Commitment Of GOI	Adani Power	Indian Oil Corporation	JSW Energy	NTPC
India is committed to achieve the Net Zero emissions target by 2070	No commitment has been made	Commitment of achieving Net Zero Carbon emissions by 2046	Commitment of achieving Net Zero Carbon emissions by 2050	Commitment of achieving Net Zero Carbon emissions by 2070

Conclusion

As per the data analysis that has been conducted, it is clear that there has been significant progress towards achieving net-zero targets through the reduction of carbon emissions by the energy sector. Methods such as employment of cleaner technologies, improvement in efficiency of energy and the escalating utilisation of renewable energy have been incorporated by these firms for fulfilling their commitments.
The Scope 1 and Scope 2 emissions per rupee of turnover plummeted by 11.6% in FY 2022-23 marking a falling trend in intensity of emissions. However, this development reduced pace dramatically in FY 2023-24, indicating that initial efficiency measures were effective, but not enough. In such a case, increased use of renewable energy sources or carbon capture is imperative for further reductions. Adding to it, the intensity of Scope 3 emissions has been continuously declining by about 9% per year, hinting that the sector as a whole is using lower-carbon raw materials, focusing on enhanced supplier involvement and more efficient logistics.

NTPC achieved its success in lowering Scope 3 emissions but still continues to be the biggest emitter overall. Adani Power has observed a worrying increase in Scope 1 emissions but lowering Scope 2 emissions, suggesting a change in energy sources. JSW Energy which has the lowest overall emissions, demonstrated a steady increase across all categories. This sparked questions about its long-term sustainability strategy. In contrast, Indian Oil Corporation leads Scope 3 emissions, showing major supply chain consequences.

Initiatives like carbon capture exploration, water conservation, afforestation projects, and flue gas desulphurization have been taken up rapidly by businesses. However, there are still issues regarding reduction of Scope 3 emissions, maintenance of transparency, and removal of greenwashing. To match corporate actions with sustainable goals, stronger reporting standards, independent verification, and regulatory monitoring are necessary.

In order to further increase accountability, there must be more investment by companies in advanced renewable energy technologies, science-based targets, and improved emissions tracking. To fill the gap between sustainability commitments and quantifiable environmental outcomes, it is required to strengthen corporate governance, policy frameworks, and stakeholder involvement.

To sum it all up, the research has put forth the major contribution of the Indian energy sector in reducing carbon emissions and its shift towards net-zero targets. However, more needs to be done to accelerate and elevate the transition towards cleaner energy sources and achieve the net-zero target by the deadline. Both the government and the private sector shall work collaboratively towards this goal. It can be achieved through the adoption of innovative and sustainable practices. The Indian energy sector has a key role to play in achieving a sustainable future and it must continue to take strong and bold steps towards reducing its carbon footprint while parallelly meeting the growing power demand of India.

Limitations

There are a few limitations to this study that should be taken into account. Firstly, the study relied primarily on secondary data sources from FY2021-22 till FY2023-24, such as reports and articles, which may not be entirely comprehensive or up to date. Hence, the latest developments and changes in the Indian energy sector might not have been captured. Furthermore, there may be some inaccuracies or omissions in the data gathered despite efforts aimed at maintaining utmost accuracy while collection. Additionally, the study did not consider potential biases or limitations that may have existed in the data sources used.

Secondly, certain companies could not be included in the market capitalization-based order for analysis as their data was not suitable for this research. A reason for the same would be that some firms reclassified portions of their Scope 3 emissions into Scope 2 thus preventing fair comparability, while others did not provide sufficient disclosures on emissions which led to limited transparency and accountability in their sustainability reporting. Moreover, there are only 4 major companies under study which might not show the true picture of the entire energy sector. An inclusion of more companies would lead to improved results.

Thirdly, the study used a quantitative research methodology which is based on numerical data and statistical analysis. While one side of the coin portrays the strengths of this approach, such as the ability to produce precise and reliable data, the other side showcases its limitations in terms of the depth of understanding it can provide. A more qualitative research approach, such as interviews or case studies, could provide an in- depth understanding of the challenges and opportunities faced by Indian energy sector firms in the practical world.

Additionally, SEBI's Business Responsibility and Sustainability Reporting (BRSR) guidelines for the formatting was not followed by all companies. The data collected had to be reformatted and aligned with BRSR criteria in order to ensure a standardised and fair comparison, which might have led to slight differences in interpretation.

Lastly, the study only concentrated on greenhouse gas emissions, which is just one pillar of sustainability. Other aspects, such as water extraction and discharge practices, waste management and energy consumption were not explored in this study. However, their inclusion may provide a holistic understanding of the Indian energy sector's contributions to sustainability.

Scope of future research

The scope of this research paper can be extended in several ways to further explore and analyze the contributions of the Indian energy sector towards achieving net-zero targets. Some potential areas of scope for future research include:

- Conducting a more detailed analysis of the potential economic costs and benefits of transitioning towards cleaner energy sources in the Indian energy sector.
- Exploring the effectiveness of different policies and regulations in driving sustainability and reducing carbon emissions in the Indian energy sector.
- Comparing the sustainability performance of Indian energy sector firms with their counterparts in other countries or regions.
- Analyzing the role of renewable energy technologies, such as solar and wind power, in reducing greenhouse gas emissions in the Indian energy sector.
- Examining the role of innovation and technology in driving sustainability in the Indian energy sector.

Overall, the scope of this research paper can be broadened to explore different aspects of sustainability in the Indian energy sector and identify opportunities for further improvement.

Acknowledgement

I would like to express my sincere appreciation to St. Xavier’s College (Autonomous), Kolkata, and the Department of Business Management Studies for providing the academic environment and resources necessary to undertake this research. I am grateful to the various public institutions, regulatory bodies, and corporate organizations whose reports, disclosures, and databases formed the foundation of this study.

I also acknowledge the support received from academic databases, international agencies, and policy institutions such as the International Energy Agency, Central Electricity Authority, and Yale Center for Environmental Law and Policy, whose published data and reports were instrumental in the analysis. Finally, I extend my gratitude to my family and peers for their encouragement and support throughout the research process.

References

1. Abraham, S., & Ghosh, S. (2019). A comparative study on sustainability and corporate social responsibility among Indian power and energy companies. *Energy, Sustainability and Society, 9*(1), 13. https://doi.org/10.1186/s13705-019-0232-1

2. Adani Power. (2022-23). *Business Responsibility & Sustainability Report FY 22-23.* https://www.bseindia.com/xml-data/corpfiling/AttachHis/ace98bc5-ac07- 463f-bce5-64ec6083900b.pdf
3. Down To Earth. (2018, November 26). *India has three of the world's 50 nitrogen emission hotspots.* https://www.downtoearth.org.in/news/air/india-has-three- of-the-world-s-50-nitrogen-emission-hotspots-61988
4. Down To Earth. (2019, August 20). *India emits the most sulphur dioxide in the world.* https://www.downtoearth.org.in/news/air/india-emits-the-most-sulphur- dioxide-in-the-world-66230
5. IBEF. (n.d.). *Power sector in India.* https://www.ibef.org/industry/power-sector-india
6. International Energy Agency (IEA). (2025). *Growth in global energy demand surged in 2024 to almost twice its recent average. https://www.iea.org/news/growth- in-global-energy-demand-surged-in-2024-to-almost-twice-its-recent-average*
7. International Energy Agency (IEA). (2021). *Energy in India today.* In *India Energy Outlook 2021* (pp. 1-36). IEA. https://www.iea.org/reports/india-energy- outlook-2021/energy-in-india-today
8. International Energy Agency (IEA). (2021). *India Energy Outlook 2021.* IEA. https://www.iea.org/reports/india-energy-outlook-2021
9. Nair, G. R., & Jayaprakash, R. (2022). *Energy transition challenges and opportunities: A study on India. Energies, 15*(2), 477. https://doi.org/10.3390/en15020477
10. Press Information Bureau (PIB). (2021, November 12). India committed to reduce GHG emissions intensity of its GDP by 33-35% by 2030: Dr Jitendra Singh. https://pib.gov.in/PressReleasePage.aspx?PRID=1832058
11. Sarkar, S., Saha, A., & Ghosh, S. (2019). A study of ESG performance of Indian power companies.EnergyPolicy, 134, 110953.https://doi.org/10.1016/j.enpol.2019.110953
12. Sharma, N. (2021, September 17). Power sector stumbling block in India's net-zero journey. Observer Research Foundation. https://www.orfonline.org/expert- speak/power-sector-stumbling-block-in-indias-net-zero-journey/#:~:text=India's%20coal%2Dbased%20thermal%20power,fuel%2Drelated%20CO2%20emissions
13. Univest. (2025, January 31). Top companies in the power sector in India.
14. https://univest.in/blogs/power-sector-stocks
15. Yale Center for Environmental Law & Policy & Yale Data-Driven Environmental Solutions Group. (2022). State of the environment: NOx. Environmental Performance Index. https://epi.yale.edu/epi-results/2022/component/noe
16. Yale Center for Environmental Law & Policy & Yale Data-Driven Environmental Solutions Group. (2022). State of the environment: SOx. Environmental Performance Index. https://epi.yale.edu/epi-results/2022/component/soe
17. 23 Degrees. (2022). EPI 2022: Environmental Performance Index. https://global-reports.23degrees.eu/epi2022/root