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India's Path to Net Zero: A Journey through the Nifty Fifty Companies

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Abstract: The United Nations climate change conference, COP 28 (Conference of Paris) was held at Duba, UAE from 30th November 2023 to 13rd December 2023. The event registered around 85000 participants which included heads of state, government representatives, civil society representatives, research scholars, students, business community, youth, philanthropists, social entrepreneurs, climate change activists and so on.

COP 28 was remarkable as it concluded global stocktake of the world's efforts towards actions/decisions on climate change under Paris agreement. Global stocktake is a process through which countries and other stakeholders will assess the collective progress towards goals of climate change action as per Paris agreement. The first global stocktake opined that the progress is very slow and needs rapid action from all stakeholders to accelerate the journey towards achieving goals of Paris agreement. This will require all stakeholders to consider more stringent and effective measures to achieve required standards.

At COP 2026 held at Glasgow, Indian Prime minister announced that India will achieve net zero emission by 2070. India has also updated its NDC (Nationally determined contributions) in August 2022. According to this emission intensity of GDP has been increased to 45% by 2030 and non-fossil-based energy resources out of total installed capacity is enhanced to 50% by 2030. These targets are very ambitious and will require all stakeholders to aggressively pursue measures to achieve the targets set by the government.

Corporate sector is one of the major players who can contribute towards climate change action. Especially, manufacturing and production units can contribute towards controlling all 3 types of emissions – scope 1, 2 and 3.

In this study, researchers will examine corporate disclosure with reference to GHG/CO2 emissions, energy efficiency and waste management for Nifty Fifty companies. The data will be collected from Bloomberg terminal and analysed sector wise. Appropriate statistical tools will be used to bring out meaningful inferences from the data collected.

Keywords: *GHG emissions, Global Warming, Climate Change, Fossil Fuel, Industrial Production, Sustainability, Net Zero Emission.*

INTRODUCTION:

Global warming and climate change are the biggest risks the world is grappling with currently and this is impacting day to day life on planet Earth. Natural calamities like floods, excessive heat, extended

winters, cloud bursts, draughts, increase in sea levels and so on are occurring in frequent intervals causing loss of precious lives, properties and resources. Excessive GHG emission (Greenhouse gases) caused by humans is one of the major reasons for this scenario. The overarching goal of Paris Agreement (December 2015) was to "restrict increase in the global average temperature to well below 2°C above pre-industrial levels" and pursue efforts "to limit the temperature increase to 1.5°C above pre-industrial levels." (UNFCC). Leaders across the globe are stressing on the need to limit the global warming to 1.5° C by the end of the century. Intergovernmental panel on climate change (IPCC), an Intergovernmental body of the United Nations in its 2018 report suggests the following targets if the goal of limiting global warming to 1.5°C is to be achieved: Firstly, human induced CO2 emission should fall by 45% from 2010 levels by the year 2030 and net zero carbon emissions need to be achieved by 2050. This is an ambitious and humungous target to achieve, and all stakeholders should pursue their initiatives/activities aggressively to work towards achieving this common goal. Net zero emission indicates maintaining a balance between GHG emissions added and GHG emissions taken out from the atmosphere. (Climate Council)

Global warming is a process that begins when sunlight falls on earth. 30% of the sunlight that reaches the Earth are sent back to the space by atmospheric ground surfaces like oceans and clouds. The remaining sunlight is absorbed by ocean, air and land. This enables heating up of the surface of the planet and atmosphere due to which life becomes feasible (Shahzad, Umair 2015). Planet Earth needs to maintain a constant temperature which means it must get rid of excessive heat/energy to enable cooling effect. The excess heat is emitted as thermal energy, infrared and it is transmitted to the space. When Sunlight falls on earth, different places heat up at different levels depending on whether the surface absorbs the sunlight or reflects. While snow reflects the sunlight, deserts absorb the sunlight, hence the former stays cooler and the later warms up. (CMMAP). Some portion of the outgoing radiation is reabsorbed by the carbon dioxide, methane, ozone and other gases in the atmosphere and radiated back to the earth which causes extreme heat and abnormal global warming. The gases which cause such reabsorption are termed as greenhouse gases. GHG gases retain high temperature in the lower atmosphere due to which less heat is transmitted back to the space. This creates greenhouse gases effect and global warming (Borduas, Nadine et.al., 2017). Major GHG include water vapor, carbon dioxide, methane, nitrous oxide, halocarbons and SF6 and molecular hydrogen. (Global atmosphere watch). Re-absorption process and presence of GHG in the atmosphere is essential as otherwise the temperature on earth will be extremely cold. Greenhouse effect is a very important process that helps in regulating the temperature on earth. Presence of greenhouse gases in the atmosphere makes life comfortable on earth. The ability of certain GHG to be transparent and allow heat to reach earth and yet opaque for the radiated energy from earth is an important event in the atmospheric sciences. (Darkwah, Kweku Williams et.al,.2018). The issue of global warming started when GHG emission was artificially inflated by humans at an alarming level since the past two centuries. Temperature on earth has increased by 0.9°C from 1970 to 2024. The major cause for this is the presence of excessive GHG in the atmosphere. There are notable climate disasters since 1970 like hurricanes, floods, cloud burst, volcano eruptions and El Nino impact in different parts of the world. (Brönnimann, S. et.al., 2018). The impact of climate change and global warming is not just restricted to natural calamities; it impacts the entire ecosystem – be it agricultural production, survival of different species, impact on water and air quality, onset of various diseases. (Abbass K, et.al., 2022). In a nutshell, this is the most difficult situation the world is dealing with which needs to be addressed and actions need to be initiated swiftly to reduce the GHG emissions. 2011-2020 has been the warmest decade in the history of mankind and in 2019, temperature recorded 1.1°C higher than the pre industry levels. Global warming induced by humans is growing at a rate of 0.2°C per decade. If the same level continues and reaches the level of 2°C increase compared to pre industry levels, there will be serious repercussions on day-to-day life of individuals impacting human health and wellbeing. This scenario can also lead to catastrophic and dangerous situations in the environment. This has led the international community to swing into quick action and recognize the need to limit the increase in temperature by 1.5°C compared to pre industry levels by the end of this century. The major reasons for massive increase in the GHG emissions include burning coal, oil and gas, deforestation, livestock farming, chemical fertilizers and fluorinated gases (EU, climate change) Every tonne of carbon dioxide emitted adds significantly to excessive global warming and reduction in emissions will slow down the impact.

World Meteorological Organisation (WMO) report 2024 indicates that GHG levels have surged to new record levels with a 10% increase in the last two decades. High fossil fuel CO2 emissions due to human and industrial activities is quoted as one of the major reasons for the current level GHG emissions. (State of the Global Climate 2023, WMO). COP 28, UN climate conference Dubai closed with an agreement which signals 'beginning of the end of fossil fuel era' (UNCC).

It is quite evident that unless fossil fuel emissions due to human and industrial activities and limited and controlled, it is impossible to achieve climate action targets and net zero emission standards. When it comes to industrial emissions though few sectors like power and transportation dominate, most businesses houses involve large operations and will add to the total GHG emissions significantly. Global power industry contributes highest carbon dioxide emission which accounts to 38% whereas transportation industry comes next with 21% share in the global CO2 emissions. (Statista 2023). Realizing the importance of controlling industrial emissions, many countries across the globe are encouraging corporate sectors to take proactive measures like automating and shortening manufacturing cycles, shifting to renewable energy and sustainable manufacturing processes, control measures on industrial waste disposal, taking proactive measures through community engagement like contributing towards afforestation, lake rejuvenation, rain harvesting, water recycling and so on. From the perspective of business houses being a responsible organization towards environment is as important as earing profits. The performance of companies is assessed holistically on three parameters– profits, people and planet. The companies are required to disclose all information regarding their operations for public consumption and it is a mandate for all listed companies.

Industrial emissions can be classified into 3 categories – scope 1, scope 2 and scope 3. In the path to net zero, an important toll to assess companies' performance in emission levels is to track progress through scope categories (national grid). Scope 1 are the direct emissions by the company through resources owned by them whereas Scope 2 and 3 are indirect emissions due to consequences of the activities of the company but through resources not owned by the firm.

India is the fifth largest economy in the world with a nominal GDP of 3.94 trillion USD. The economy is growing rapidly, and the industrial activities are bound to increase going forward. While growth is extremely important, at the same time it is also important that the growth must be holistic and sustainable. The important stakeholders in this journey like government and corporates realise this fact and are in the process of devising strategies to achieve net zero target by 2070. At COP 2026 held at Glasgow, Indian Prime minister announced that India will achieve net zero emission by 2070. India has also updated its NDC (Nationally determined contributions) in August 2022. According to this emission intensity of GDP has been increased to 45% by 2030 and non-fossil-based energy resources out of total installed capacity is enhanced to 50% by 2030. These targets are very ambitious and will require all stakeholders to aggressively pursue measures to achieve the targets set by the government.

Literature Review: In recent years, developed countries have led the way in advancing corporate sustainability disclosures, especially for companies with high carbon emissions. These disclosures are increasingly focused on climate change, with a growing emphasis on transparency, regulatory compliance, and active engagement with stakeholders (Grahn 2024). Companies are now not only tracking their greenhouse gas (GHG) emissions more closely but also expanding their reporting to include all emission categories—both direct (Scope 1 and 2) and indirect (Scope 3) emissions (Fiechter et al. 2022). This broader approach reflects a strategic pivot where transparency is used as a powerful tool to drive corporate performance and align with international climate goals, such as achieving net-zero emissions (Christensen et al. 2021).

Over 40 nations have now mandated emissions reporting in line with their commitments to the Paris Agreement. These requirements push companies to continuously monitor emissions, reduce them in line with national targets, and provide data critical to market-based climate initiatives. As a result, financial institutions and policymakers gain the insights needed to assess climate risks across economies, creating a structured pathway for industries to transition toward greener practices (Hickman 2020). In tandem with regulatory shifts, corporations are increasingly setting their own net-zero targets, often through measures like carbon offsetting, emissions reduction, and adopting renewable energy

sources. This commitment to net zero aligns corporate strategies with global climate objectives, pushing sustainability to the core of regulatory and business priorities (Vaibhav et al. 2011). Globally, the Paris Agreement has been a driving force behind these initiatives. The agreement, through its Nationally Determined Contributions (NDCs), sets ambitious targets to limit global warming to 1.5°C or 2°C. Achieving these goals will require substantial changes in energy sources, a push for renewable energy, and broader decarbonization efforts (UFCCC 2019). Countries worldwide are scaling technologies such as wind, solar, and electric transportation. These efforts bring a dual benefit: they help meet climate targets and create green jobs (Stanef-Puica 2022). However, balancing economic growth, energy needs, and climate mitigation remains a challenge, especially for emerging economies, requiring international cooperation, policy alignment, and innovative financing solutions. New technologies, like zero liquid discharge (ZLD) systems, play a crucial role in achieving sustainability goals by reducing wastewater and recovering reusable water, minimizing the environmental impact of sludge management (Poomalay 2022). Additionally, smart monitoring systems powered by IoT are revolutionizing sludge management, boosting energy efficiency and lowering costs. By adopting such innovations, companies and nations alike are finding more sustainable ways to manage waste and recover energy (Santos 2019).

In India, Corporate Social Responsibility (CSR) has evolved beyond philanthropy, becoming integral to business strategies, especially as companies align with global frameworks like the UN Sustainable Development Goals (SDGs) and the Paris Agreement. The country's journey toward net-zero emissions, particularly for energy-intensive sectors, is gaining momentum, driven by both regulatory changes and stakeholder expectations. Indian companies are increasingly focused on reducing greenhouse gas emissions and enhancing energy efficiency, but the real challenge lies in balancing this transition with economic growth (Charumathi 2017). CSR, therefore, is now a key driver of sustainable value, with companies adopting sustainability reporting and carbon accounting practices to demonstrate alignment with climate objectives. India's journey to net zero, particularly in the power sector, is central to its climate strategy. With ambitious targets set for 2050 or 2070, the country is heavily investing in renewable energy sources like solar and wind, improving energy efficiency, and exploring carbon capture technologies (Vaibhav et al 2021). As India phases out coal and other fossil fuels, it is positioning itself as a model for other developing economies grappling with similar challenges. But achieving this transition is not easy. Policy tools like carbon pricing, renewable energy mandates, and financial incentives are essential to create market conditions that accelerate decarbonization. In this landscape, corporate transparency about GHG emissions becomes a vital asset, helping policymakers design effective, supportive strategies (PWC 2024).

India's electricity sector, the nation's largest carbon emitter, contributed approximately 1240 $MtCO_2e$ in 2019, which accounted for 39.5% of total emissions. With a high emission intensity of 0.668 $kgCO_2/kWh$, the sector requires targeted decarbonization to align with national and global climate goals (Papadis 2020). Economic growth and increasing electricity demands are set to raise India's per capita electricity consumption significantly from its current 1255 kWh to nearly European levels, estimated at 6687 kWh, as India progresses economically. To address this rise sustainably, India has set ambitious renewable energy targets, including achieving 500 GW of non-fossil fuel capacity by 2030, and has already reached 43% of non-fossil fuel in total installed capacity as of 2024 (Durga 2022). Achieving these goals will necessitate coupling renewable energy generation with technological solutions for grid stability and storage to manage renewable intermittency. Research identifies two potential decarbonization pathways: a rapid transition (R1) with a quicker emissions peak or a slower approach (R2) with emissions peaking at higher levels, both heavily dependent on policy support and investment in green technologies (Chaturvedi 2021). Policies promoting carbon pricing, renewable mandates, and financial incentives are crucial for driving market conditions favorable to decarbonization. Technological advancements in grid-scale storage will also play a pivotal role in transitioning to a renewable-dominated grid (Saeed 2023). Overall, India's pathway to a low-carbon economy will require balancing rising energy demand with sustained investment in clean energy and grid infrastructure, positioning the power sector as central to the nation's climate strategy. Transitioning fully to net zero will require thoughtful planning, especially as the country phases out thermal power, which could bring economic challenges alongside potential gains. As electrification of surface transport aligns with a green electricity grid, India could reduce nearly half of its current emissions (Mukherjee 2022). However,

hard-to-abate sectors like cement will need breakthroughs, as substitutes for fossil fuels are limited. For these sectors, options like afforestation, carbon capture, and storage will be essential to manage remaining emissions. This transition will require ongoing analysis, stakeholder consultations, and a mix of policy instruments, ultimately steering India towards a cost-effective, net-zero future and solidifying its position as a leader in sustainable growth (Zieri 2019)

Technological innovation is another critical pillar in India's transition. Companies that invest in renewable energy, grid modernization, and storage technologies like hydrogen and advanced batteries are setting benchmarks for global practices (Subhashish 2022). Large-scale investments in these areas are not only driving the country's energy shift but also attracting investor trust and public support, underscoring a broader trend toward green finance. India's climate commitments, including its ambitious renewable energy targets, position the country to become a leader in solar and other green technologies (Gangadhar 2017). This transition offers India a competitive edge globally while contributing significantly to its climate goals. Learning from developed nations, such as the EU's renewable expansion and emissions trading frameworks, could help India accelerate its transition to net zero.

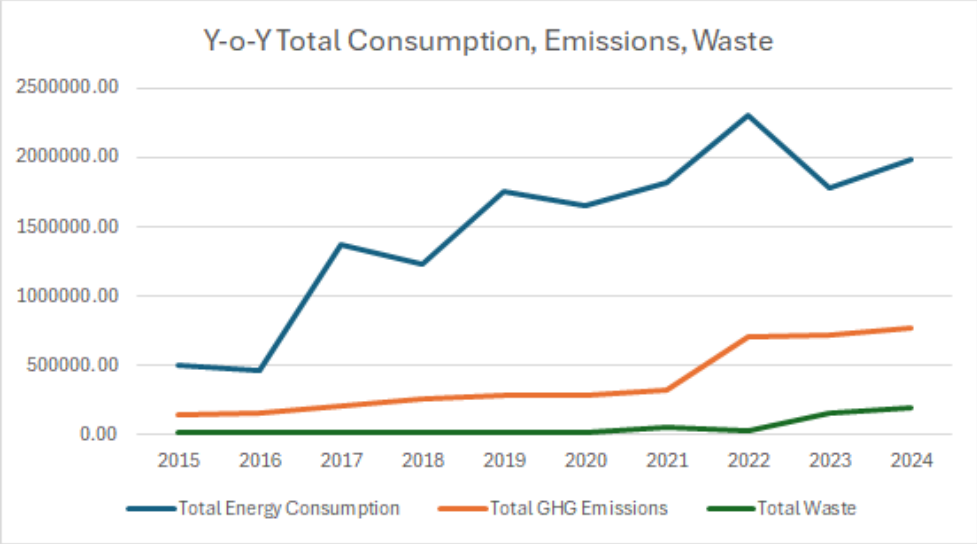
On a global stage, India's green transition is interconnected with international climate goals. Partnerships with global organizations, such as the International Solar Alliance, are vital for scaling solar production and supporting renewable ambitions (Carmo 2022). India's commitment to a sustainable future offers valuable insights for other developing nations and stands as an example of how global cooperation, innovative policies, and advanced technologies can shape a resilient, sustainable world.

Research Methodology: This study aims to evaluate the trajectory of Nifty Fifty companies towards achieving net zero emissions targets. The contribution is assessed through three key indicators: Reduction in Total Energy consumption, Reduction in Total emissions, and Reduction in Total waste. To carry out this analysis, data was collected from Bloomberg, a reliable and comprehensive source of corporate environmental performance metrics. Since, Net zero target for India was announced in the year 2021, the secondary data is studied for the financial years 2022, 2023 and 2024. The data covers a multi-year span and includes figures on energy consumption, carbon emissions, and waste generation. These metrics were extracted and collated for each company. Further, the data was categorized sector-wise to allow for comparative analysis across different industries. The analysis of the data involved both quantitative and graphical approaches. Pie charts were employed to depict the sector-wise distribution of total energy consumption, emissions, and waste reductions. Bar graphs were used to compare the performance of individual companies within each sector regarding their contribution to net zero efforts. The analysis was conducted using spreadsheet tools for data organization and graph generation.

Results and discussion: The Net zero target can be achieved through technological advancements aligned towards the global climate objectives. Corporates contribute majorly towards it through their approach towards environmental sustainability. Based on the environmental metrics data for Nifty Fifty companies, extracted from the Bloomberg database (as represented in Graph 1) the initial analysis from 2015 to 2024, shows that 2022 recorded the highest total energy consumption, with a combined figure of 2,301,516.59 kWh. The peak for total greenhouse gas (GHG) emissions occurred in 2024, with a record 777,065.92 metric tons of CO_2e. Additionally, 2024 saw the highest total waste generation,

amounting to 196,550.44 tons. These figures highlight the environmental footprint of these companies during the period under review.

Graph 1: Y-o-Y Total Consumption, Emissions, Waste



Source: Author derived

Table 1: Total Consumption, Total Emissions, Total Waste

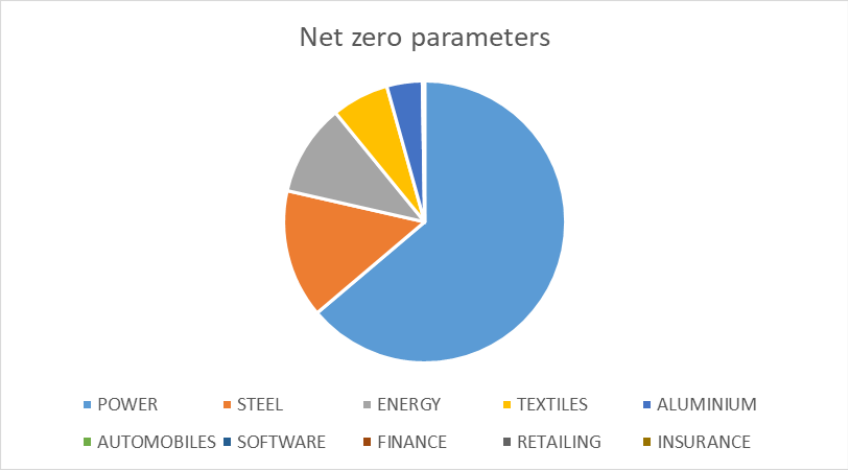
Year	Total Energy Consumption	Total GHG Emissions	Total Waste
2022	2301516.59	712487.30	30025.21
2023	1779626.67	722895.13	154525.94
2024	1989298.47	777065.92	196550.44

Source: Bloomberg database

The data in Table 1 reflects environmental trends for Nifty Fifty companies over the study period from 2022 to 2024. In 2022, total energy consumption was at its highest, while greenhouse gas (GHG) emissions and waste generation were relatively lower. By 2023, energy consumption decreased, but both GHG emissions and waste generation increased substantially. In 2024, energy consumption rebounded, though not to 2022 levels, while GHG emissions and waste generation reached their peak, marking 2024 as a critical year in terms of environmental impact.

This analysis over the three-year study period highlights fluctuations in energy efficiency and growing challenges in managing emissions and waste despite attempts at reducing overall energy consumption.

Graph 2: Chart representing sector-wise contributions

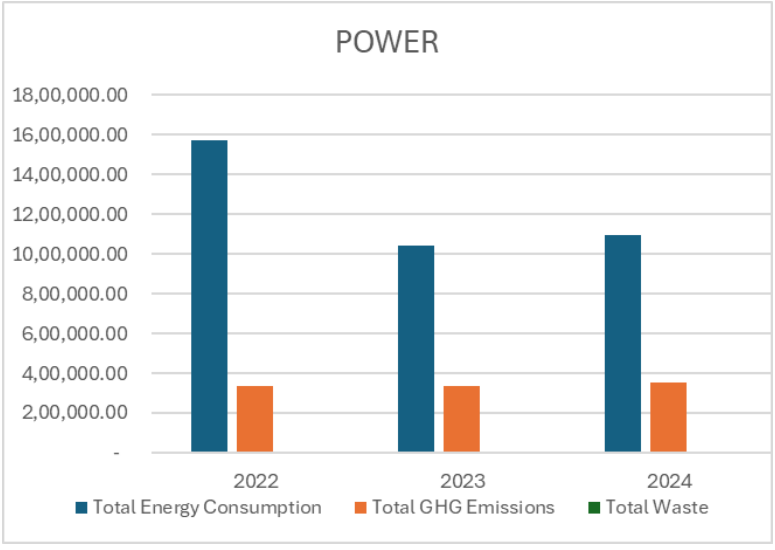


Source: Author derived

Further, the study wanted to investigate the sectors which contribute most and the least to each of the components. Therefore, the companies were divided into 20 sectors as mentioned on the National Stock Exchange (NSE) website. Among the 20 sectors, Power, Steel, Energy, Textile, and Aluminum stand out as major contributors to overall energy consumption, emissions, and waste generation (as represented in Graph 2). These industries are typically resource-intensive and have high operational demands, making their environmental footprint significant. On the other hand, sectors like Finance, Retail, Insurance and Software have a comparatively lower impact on these parameters given their less energy-intensive nature and smaller waste generation profiles.

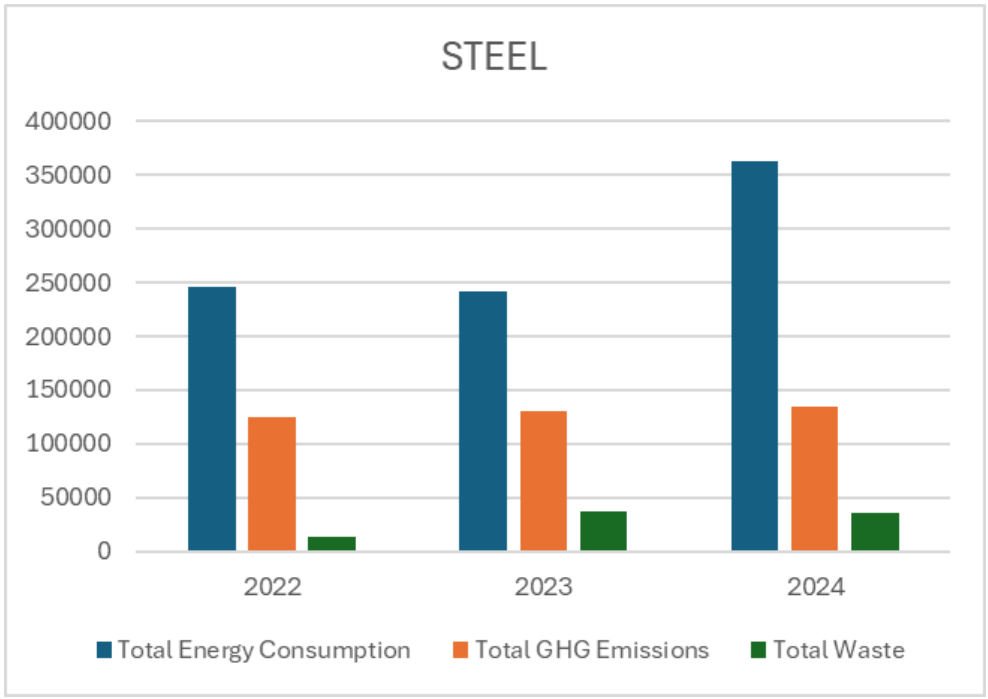
While analyzing the individual performance of sectors, it was observed that 2023 recorded the lowest contributions among both the highest and lowest performing sectors. In contrast, 2022 and 2024 showed the highest contributions across these sectors. This trend is illustrated in Graphs 3, 4, 5, and 6.

Graph 3: Contribution of Power sector



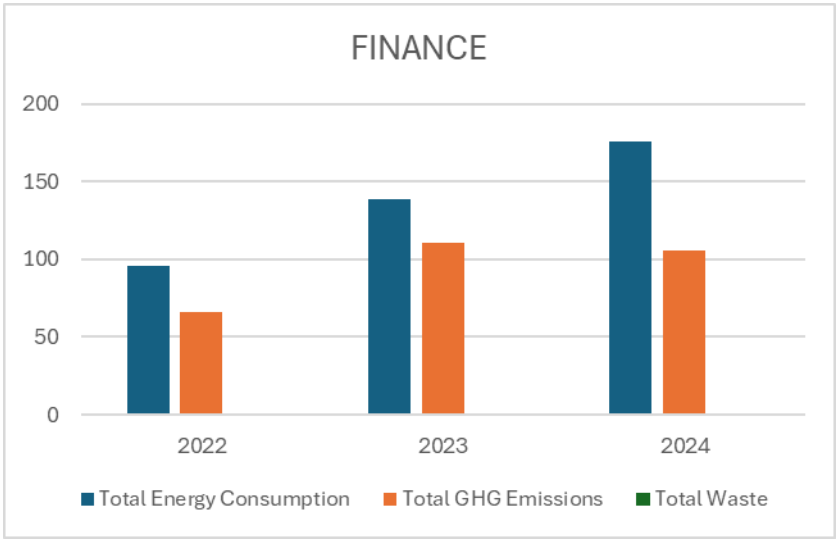
Source: Author derived

Graph 4: Contribution of Steel sector



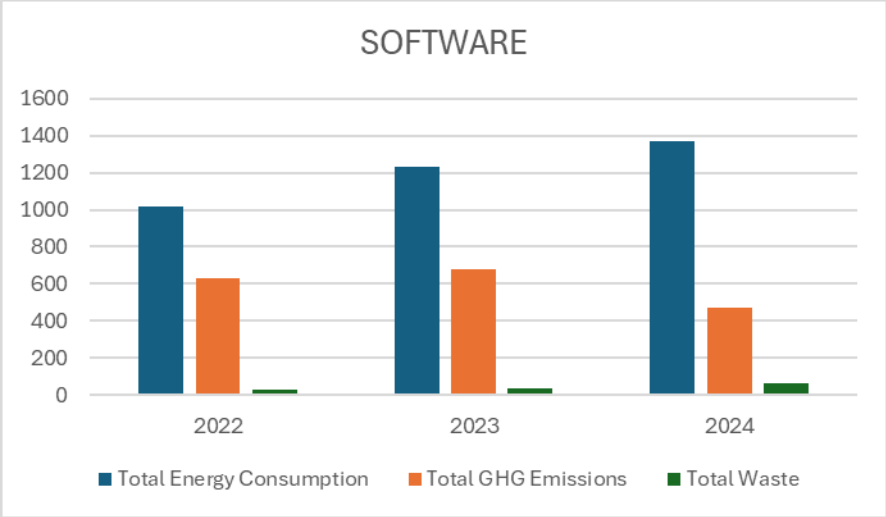
Source: Author derived

Graph 4: Contribution of Finance sector



Source: Author derived

Graph 5: Contribution of Software sector



Source: Author derived

The Overall Trends can be summarized as:

- Total Energy consumption: Most sectors, except textiles and energy, show either a decrease or stabilization in energy consumption by 2024, potentially reflecting energy efficiency measures or production adjustments.
- Total emissions: Emissions tend to rise in 2024 across the board, even when energy consumption is lower, indicating a need for better emission control technologies or cleaner energy sources.
- Total Waste generation: Waste management remains a challenge, particularly in the Power and Steel sectors. Textiles and Energy show some improvement, suggesting better waste-handling practices.

Findings and Suggestions: The study provides key insights into the contributions of Nifty-Fifty companies toward Net Zero targets. By classifying these companies into various sectors and evaluating their sector-specific impacts, the analysis uncovered several critical findings regarding their progress and role in achieving sustainability goals. Firstly, the companies which fall under the manufacturing sector such as Power, Steel, Energy, Textile, and Aluminum sectors are inherently resource-intensive, as they rely on extensive raw materials, energy, and processes that lead to high emissions and waste. Reducing energy consumption poses a significant challenge for these companies, as it directly affects production levels. Although they are increasingly relying on alternative energy sources to address emissions, managing waste generation remains complex and harder to forecast accurately. In contrast, sectors like Finance, Retail, Insurance, and Software are service-oriented, relying less on physical resources, which minimizes their environmental impact. Secondly, among all the sectors, there are fluctuations in the output among all three parameters during the study period. Some of the reasons for such an increase would be due to operational viability i.. e, changes in the production level, policy changes or regulatory influence in terms of strict guidelines of reporting and economic factors or supply chain constraints, such as raw material availability or energy costs, could have influenced these

variations, with companies responding adaptively each year. To tackle this problem, companies need to prioritize sustainability goals by focusing on energy efficiency, waste reduction, and emission control. This includes adopting energy-efficient technologies, using renewable energy sources, and optimizing processes to reduce energy use. Waste can be minimized by applying circular economy principles, recycling, and waste-to-energy solutions. Emissions can be lowered by switching to low-carbon fuels, investing in carbon capture, and improving energy efficiency in buildings. Real-time monitoring, employee training, and transparent reporting will support these efforts, while collaboration with suppliers and investment in green technology R&D can drive long-term sustainability. Industry emissions due to transportation can be controlled by switching to electric vehicles (EV) and by limiting employee and executive travels wherever possible. During Covid-19, many businesses realised that normal business operations are a possibility through online. This also contributes to controlling expenses for the firms. With regards to investment in EVs governments of the day need to give incentives in the form of subsidies and discounts. EV manufacturers must be encouraged through funding and other infrastructure requirements. EV ecosystem needs to be built though proper policies and procedures, so the people invest in this sector with confidence..

Conclusion: Post industrialization man has achieved extraordinary feats which has contributed immensely to quality of human life. Today human beings can travel 1000s of miles in a short span of time, can be connected to each other 24/7 through communication devices and internet, complicated medical surgeries are possible due to top class research and inventions, manmade robots can work on behalf of human beings, man has landed on the moon and mars and the list of such human accomplishments are endless. These inventions and innovations have created countless opportunities and value to millions of people across the globe. It has made life on earth more interesting, simple and valuable. It indicates a human being's brain is the most powerful tool. But at the same time, human greed has created many complications which are detrimental to human existence in the years to come. One such biggest fallout is climate change and global warming. Since post industrialization, the situation is getting worse with every year's GHG emission rate is higher than the previous year. It is a known fact that though human brain is powerful and capable of creating unimaginable products and services, nature is supreme, and this cannot be disputed. When we exploit nature to our maximum benefit without thinking of the consequences, we must face catastrophic outcomes which we are experiencing on a regular basis all over the world – be it floods, cloud burst, increase in temperature, extreme heat or cold, melting of glacier and so on. Global warming is not only creating issues for human beings but also to animals and birds. Many species have become extinct or on the path of extinct. Many species have been declared as endangered. Human beings have occupied places which belongs to animals through deforestation and excessive GHG emission has ruined life for many animals and birds. The only way forward that seems to be viable in this precarious situation is to device a road map for co-existence with nature. Reducing or eliminating fossil fuels totally, switching to renewable energy, and taking other proactive measures by involving all stakeholders of the society are the long-term but only

workable solutions possible. The most important players in this journey are industry and respective country's governments. Journey towards net zero is a long battle ahead but it is worth fighting for the sake of generations to come.

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