Environmental Performance of IT Sector in India: A Comparative Study between Infosys and TCS

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Abstract:
This study investigates the sustainability performance of two leading Indian IT companies, Infosys and TCS, concentrating on four main environmental factors: energy usage (GJ), water usage (kl), waste production (metric tonnes), and greenhouse gas (GHG) emissions (MTCO2e). The research seeks to evaluate inter-firm and intrafirm trends from 2021 to 2024, offering a comparative examination of their environmental effects and resource management approaches.

The approach includes a detailed quantitative assessment of yearly data, monitoring shifts in each parameter on a yearly basis. The research reveals that although both companies show an overall increase in energy and water usage, Infosys has significantly improved in minimizing waste production and greenhouse gas emissions. On the Contrary, TCS has shown a consistent growth in waste production and a sharp increase in Scope 3 emissions, even though it has been successful in lowering its Scope 1 emissions.

A comparison between these firms shows that TCS continually utilized more energy and water than Infosys during the period of study, with the difference increasing annually. Infosys, conversely, excelled beyond TCS in waste management, demonstrating a 32% decrease in waste production by 2024, while TCS's waste output shot up by 209%. Furthermore, Trends in GHG emissions reaffirm Infosys's success in bringing down both direct (Scope 1) and indirect (Scope 3) emissions, whereas TCS faced difficulties, especially with Scope 3 emissions, which almost tripled by 2024.

The results serve as an alarming call for TCS to tackle its increasing Scope 3 emissions and adopt better, efficient waste management practices. Infosys's noteworthy achievement in these sectors indicates the possiblebenefits of investing in sustainable methods and resource-efficient technologies.

Ultimately, this research contributes to the broader discussion on corporate sustainability within the Indian IT industry, providing practical insights for firms aiming to harmonize growth with environmental accountability. The comparative analysis not only highlights the most efficient practices but also pinpoints key areas for improvement, intending to drive policy formulation and corporate strategies toward a more sustainable future.

Keywords: Environmental Sustainability, Indian IT Sector, Infosys, TCS, GHG Emissions, Waste Management, BRSR, Scope 3 Emissions; JEL Classification: Q56, M14, 032

Introduction:

Sustainability, in layman terms, refers to meeting today's demands without putting future generations at a disadvantage. Studies suggest that sustainability can be bifurcated into three key areas: environmental efforts to reduce impact on nature, economic goals for ethical and sustained business growth, and social priorities that

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support workers and local communities. Collectively these form the backbone of sustainable development.

Lately, sustainability has evolved rapidly—it's no longer just a nice-to-have for companies but an intricate part of their strategy formulation. Businesses integrate it into their operations, not just to meet regulatory compliances but also to stimulate profits over time, polish their public image, and keep stakeholders on board. Tools like the Business Responsibility and Sustainability Report (BRSR) demands transparency from companies on their environmental and social impacts.

This research especially focuses on environmental sustainability in India's IT sector. A general notion persists that IT is a clean industry since it's mostly about services, but it actually leaves a hefty environmental footprint—think power-consuming data centres, heaps of e-waste, and recurring demand for water. With over reliance into digital systems globally, how IT firms manage their environmental impact matters more than ever for tackling climate issues and optimum utilisation of resources. The study looks at how Indian IT companies manage waste, water usage, and emissions, intending to show how tech giants can set an example for greener practices without dropping the ball on efficiency.

Research Motivation and Relevance of Study

The rapid advancement of the IT sector, driven by AI, cloud computing, and data centres, has transformed industries worldwide. However, this progress has resulted in grave environmental complications, including high energy consumption, carbon emissions, excessive water consumption, and increasing e-waste. Addressing these issues while maintaining technological advancements is the key driving force behind this research.

This study emphasizes on finding sustainable solutions for the IT industry, such as reducing AI-driven energy consumption, making data centres carbon-neutral, promoting e-waste recycling, conserving water, and encouraging eco-friendly research and development. By exploring these areas, the research aims to provide practical recommendations for businesses, policymakers, and environmental organizations.

The study is highly relevant today as businesses face growing pressure to adopt greener practices. Transparent sustainability reporting, renewable energy adoption, and responsible innovation are essential for reducing the IT sector's environmental impact. A data-driven approach will facilitate companies to balance technological growth with environmental responsibility thereby ensuring a sustainable future for the industry and the planet.

Literature Review

The IT sector's environmental impact has started standing out as worries grow over carbon emissions, toxic waste, and resource use. It doesn't look like a traditional polluter next to factories, but it's always-on data centres, sloppy e-waste habits, and reliance on dirty energy add up. A range of studies helped shed light on waste management, emission cuts, and the rules shaping the IT field.

The **Central Pollution Control Board's 2021 report on e-waste** rules lays out some hard facts about India's policies. It points to the massive amounts of electronic junk IT firms produce and flags how enforcing the rules is a struggle, hinting at a need for tighter control to stop environmental damage.

Kumar and Patel (2020) took a close look at Extended Producer Responsibility rules, showing that IT companies often fall short on proper waste disposal. They push for smarter recycling as a way to ease the harm.

Ghosh and Sharma (2021) ran the numbers on IT carbon footprints in India. Their work shows that while IT isn't as bad as heavy industries, its energy habits still pump out a big chunk of the country's emissions. They suggest switching to renewables and tweaking data centres for efficiencyA Swiss study by **Wäger et al. (2012)** caught attention with its take-back programs for e-waste. It's not about India, but the ideas could work here to clean up waste practices.

The **Ministry of Environment's 2016 E-Waste Management Rules** set a legal line— IT firms have to manage their products from start to finish. It's a handy yardstick for checking if they're stepping up.

The **International Energy Agency's 2020 report** flags how much electricity IT pulls, thanks to data centres and cloud setups. It calls for energy-saving tech and greener power sources to shrink the sector's carbon load.

Numbers from the **Centre for Science and Environment (2020)** back up IT's role in water use, waste, and emissions, pressing for tougher oversight. On the flip side, the Confederation of Indian Industry (2019) shares examples of IT leaders using circular economy ideas—reusing materials to lighten their impact.

Naidu et al. (2020) dug into carbon cuts in India's energy sector, which matters since IT leans on that power. They see green energy as a big opportunity. Banerjee et al. (2020) explored carbon capture tech—not an IT fix directly, but it sparks ideas for broader sustainability.

Looking at all this, the Indian IT sector clearly grapples with big environmental headaches—e-waste, emissions, and energy demands. Research points to weak spots in enforcing rules, a need for better green plans, and chances to tap into renewables. Policies like the E-Waste Rules and reports from groups like the CPCB and IEA set the stage, but following through is shaky. Ideas from abroad, like take-back setups and circular approaches, could help. Fixing this will take strong rules, fresh tech, and companies owning up to their role.

Research Gap:

Digging through past studies turned up some clear holes in what's been covered so far:

- The IT sector gets plenty of praise for driving growth and tech breakthroughs, but its downsides—like energy use, e-waste, and water needs—don't get enough attention.
- Lots of work talks about rules like the BRSR, yet few dive into what companies actually, do about sustainability or what results they're seeing.
- Details on how IT firms handle waste, cut water use, or lower emissions are hard to come by.
- It's unclear whether the sustainability reports companies publish are fully openor detailed enough.
- Not much effort has gone into figuring out if these green plans really work or tie into bigger environmental targets.
- There's no solid, all-in-one look at India's major IT players—their promises, hurdles, and progress in going green.

Research Objectives:

The study has been conducted keeping in mind the following objective:

1. To evaluate the environmental performance trends of Infosys Limited and Tata Consultancy Services (TCS) by analysing waste generation, including hazardous e-waste, water consumption, and carbon emissions over the fouryear period from FY 2020-21 to FY 2023-24.

2. To assess the sustainability efforts of the top two Indian IT companies, Infosys and TCS, by examining their waste management practices, water usage efficiency, and carbon footprint reduction initiatives over the specified timeframe

Research Methodology:

Research Design: This study adopts a descriptive research design to evaluate the trends in waste generation, water consumption, and emissions in Infosys and TCS.

Sampling Size and Selection Criteria: Two major IT firms—Tata Consultancy Services (TCS) and Infosys Limited—have been selected for analysis based on:

1. Their market capitalization as on 31st March 2024 ensuring they represent industry leaders.

2. Their disclosure practices, ensuring the availability of reliable sustainability data to compare trends in waste generation, water consumption and energy emissions

Period of Study: The study covers a four-year period from FY2020-21 to FY2023-24, allowing for a comprehensive trend analysis of the sector's environmental performance.

Sampling Technique: A non-probability purposive sampling technique has been used, focusing on firms withcomprehensive environmental disclosures to ensure data reliability.

Data Collection Sources: The study pulls from secondary sources like:

1. TCS and Infosys annual reports.

2. BRSR reports packed with ESG details.

3. Sustainability and ESG documents from the firms.

4. Academic papers on IT sustainability.

5. Reports from heavyweights like the International Energy Agency, Central Pollution Control Board, and UN Environment Programme.

Method of Analysis: The collected data will be analyzed using descriptive statistical techniques such as:

1. Mean, median, and standard deviation to observe trends in environmental impact indicators.

2. Trend analysis for total emissions (Scope 1, Scope 2), waste generation, and water consumption.

3. Inter-firm and Intra-firm Analysis: Comparing hazardous waste trends across firms and within each firm over time. Categorization of Waste:

4. Classifying waste data into electronic waste (e-waste chemical waste, and other hazardous

5. Sectoral benchmarking to compare firm-level sustainability performance with national and international sustainability goals.

Comparison with Sustainability Targets: The findings from the trend analysis will be assessed in comparison to:

1. India's sustainability commitments, including the net-zero targets set by the government.

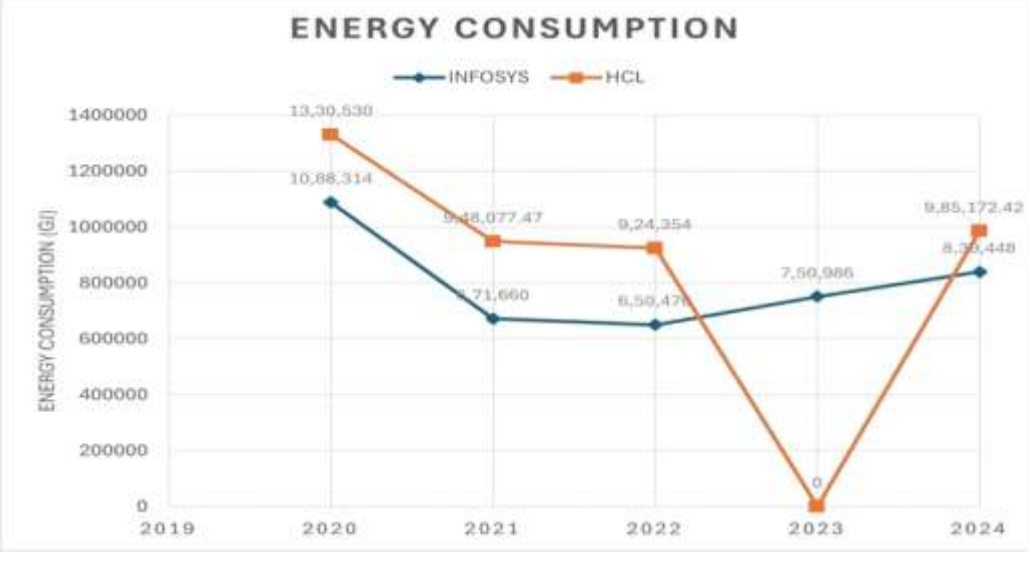
2. Global benchmarks, such as the United Nations Sustainable Development Goals (SDGs) and Science-Based Targets initiative (SBTi).

3. Corporate sustainability goals, as outlined in firm-specific ESG strategies.**Data Analysis:**

Energy Consumption Findings:

- **Intra-firm Analysis**: Infosys exhibited fluctuations in energy consumption, with a decrease from 671,660 GJ in 2021 to 650,476 GJ in 2022, followed by a significant increase to 839,448 GJ by 2024 — marking an overall 25% rise. TCS, however, demonstrated consistent growth, starting at 1,082,657.2 GJ in 2021 and reaching 1,709,183 GJ in 2024 — an increase of approximately 58% over the four years

- **Inter-firm Comparison**: TCS consistently reported higher energy consumption than Infosys across all years. The gap widened over time, with TCS consuming about 60% more than Infosys in 2021 and doubling Infosys' energy usage by 2024. This indicates TCS's larger operational footprint or greater energy dependency compared to Infosys



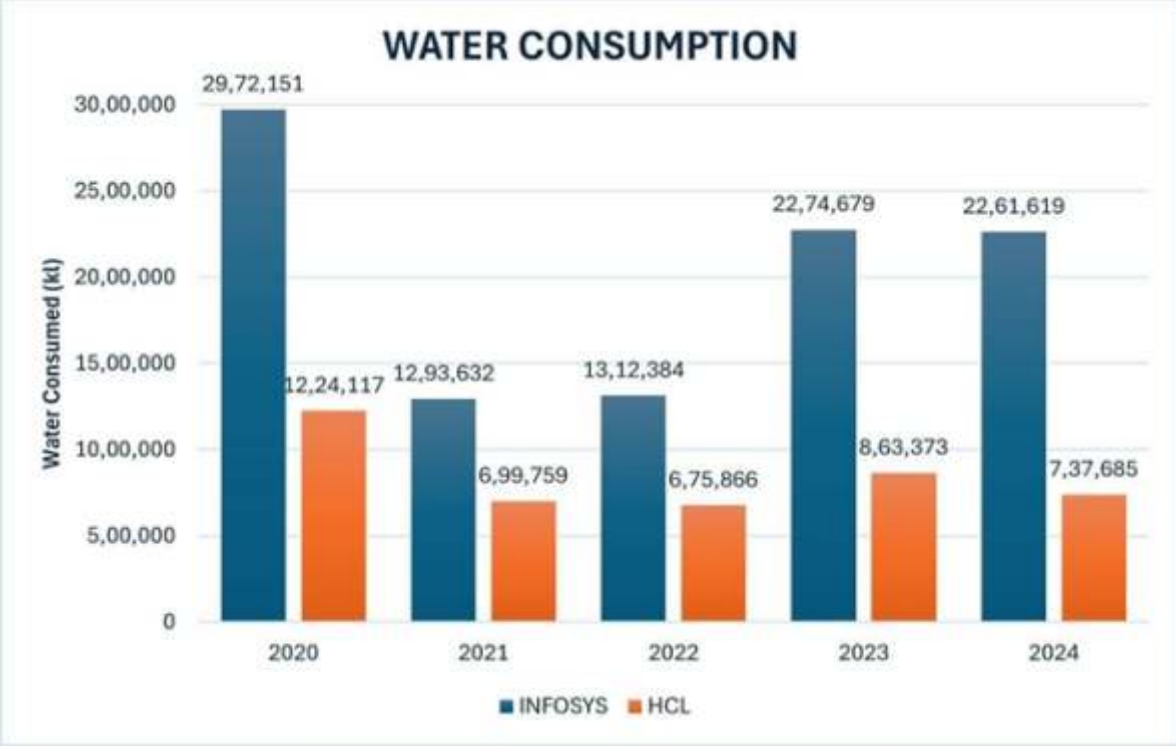
Water Consumption Findings

- **Intra-firm Analysis**:

Infosys showed a steady rise in water consumption from 1,293.63 kl in 2021 to 2,274.67 kl in 2023 but experienced a slight decline to 2,261.61 kl in 2024 — reflecting a 75% increase from 2021 to 2023 and a minor 0.5% drop in 2024. TCS reported continuous growth, increasing from 1,268.19 kl in 2021 to 2,467.34 kl in 2024 — an overall 94% rise over the period.

- **Inter-firm Comparison:**

Infosys and TCS reported comparable water consumption in 2021 and 2022. However, from 2023 onwards, TCS's water usage increased at a faster rate, surpassing Infosys. By 2024, TCS consumed 9% more water than Infosys, suggesting either an expansion in TCS's operations or higher water-intensive processes compared to Infosys.



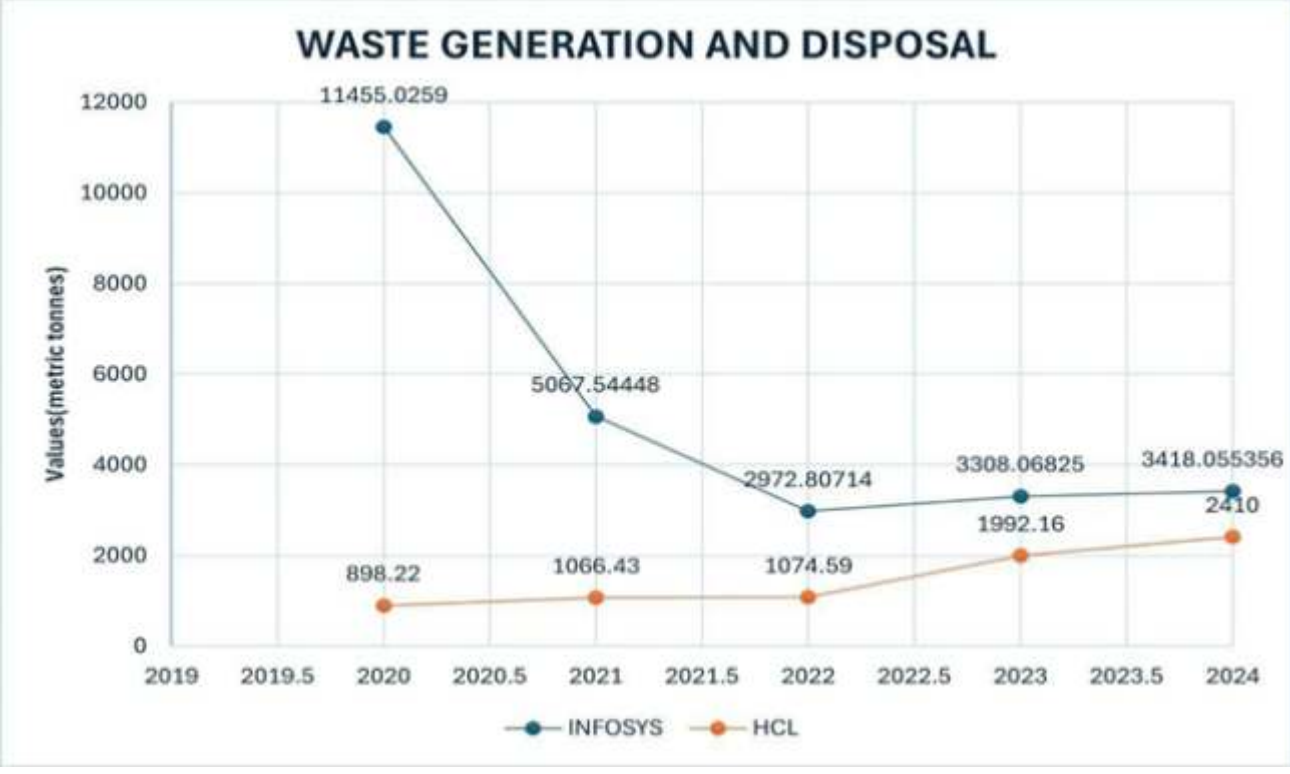
Waste Generation Findings

- **Intra-firm Analysis:**

Infosys's waste generation showed a sharp decline from 5,067.544 metric tonnes in 2021 to 2,972.801 metric tonnes in 2022, followed by a gradual rise to 3,418.054 metric tonnes in 2024. This marks a net 32% decrease from 2021 to 2024. In contrast, TCS recorded a steady year-on-year increase in waste generation, starting at 2,174.20 metric tonnes in 2021 and peaking at 6,716.20 metric tonnes by 2024 — a 209% increase over the four years.

- **Inter-firm Comparison:**

Infosys produced more waste than TCS in 2021, but after a sharp drop in 2022, TCS overtook Infosys in waste generation. From 2022 onward, TCS consistently generated more waste, with the gap widening each year. By 2024, TCS's waste output was almost twice that of Infosys — reflecting either a larger production scale, less effective waste management practices, or more resource-intensive processes.



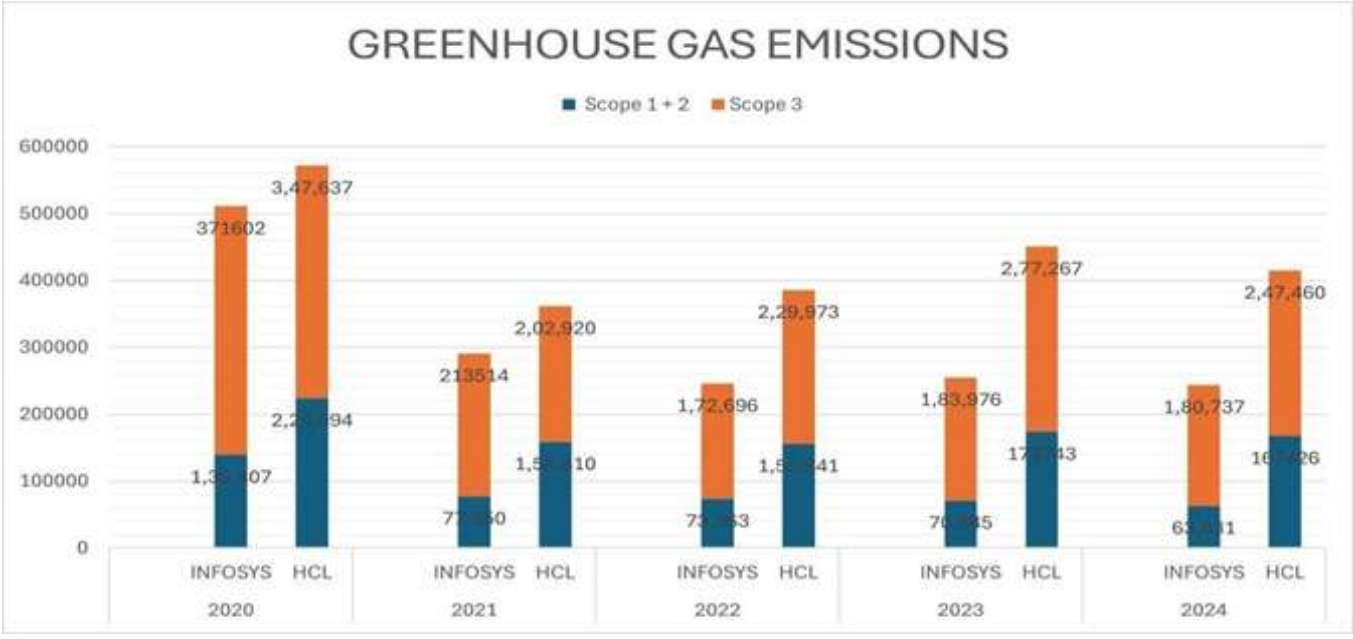
GHG Emissions (Scope 1 + Scope 3) Findings

- **Intra-firm Analysis:**

Infosys displayed a consistent decline in GHG emissions. Scope 1 emissions decreased from 77,350 MTCO2e in 2021 to 63,031 MTCO2e in 2024 — an 18% reduction. Scope 3 emissions also fell from 213,514 MTCO2e in 2021 to 180,737 MTCO2e in 2024 — a 15% drop. TCS showed mixed trends: Scope 1 emissions dropped sharply from 210,278 MTCO2e in 2021 to 95,671 MTCO2e in 2024 — a 55% reduction. However, Scope 3 emissions rose from 234,614 MTCO2e in 2021 to 498,509 MTCO2e in 2024 — reflecting a 112% increase over the period.

- **Inter-firm Comparison**:

Infosys reported higher Scope 1 emissions than TCS in 2024, while TCS's Scope 3 emissions surged significantly. By 2024, TCS's Scope 3 emissions were almost three times those of Infosys. This indicates that while Infosys effectively curbed its direct and indirect emissions, TCS experienced a dramatic rise in indirect emissions, potentially due to supply chain expansions or increased outsourcing activities.



Limitations:

A few limitations that have been taken into consideration while carrying on this study are as follows:

1. Secondary data sources were the main medium of data collection. It was taken from a period of FY2020-21 till FY23-24. Official company reports and articles which are publicly available may not be up to date. Hence, the study may not include the latest developments and changes that took place in the IT sector. Despite efforts to ensure the accuracy of the data, there is always the possibility of inaccuracies. In addition to this, potential biases or limitations that might've shaped the data present at these sources have been omitted

2. The focus of the study was on the carbon emissions of the Indian IT sector firms. Emissions from other industries were not included. This limitation may lead to aberrations in the findings as the IT sector's impact on carbon emissions could be influenced by other sectors' activities. Moreover, there are only 2 company that have been taken as the sample for the purpose of this study. The results can be improved if more companies could be studied

3. The broader impact of industries apart from IT such as coal, oil & gas, and energy transmission might influence the overall environmental footprint of the IT sector. This has not been considered and the focus is given to evaluation of Indian IT sector firms by analyzing carbon emissions, waste generation and water consumption.

4. The research focuses on only two major IT firms that are Infosys and TCS. This may not provide a true representation of sustainability practices across the entire Indian IT industry. The study would have been more accurate and reliable if the sample size was expanded. Moreover, the findings if generalized would give a better picture of the situation.

5. The study has been based on a quantitative research methodology. This method is based on numerical data and statistical analysis. While this approach has its strengths, such as the ability to produce

precise and reliable data, the other side of the coin is the depth of understanding provides. Alternatively, also using qualitative research approach such as interviews or case studies could help overcome this challenge.

Recommendations for a Sustainable IT Sector: A Data-Driven Approach

The IT sector's environmental footprint has grown with advancements in AI, cloud computing, and expanding data centers. Rising emissions, water consumption, and ewaste demand urgent action. Below are key recommendations, backed by research, to promote sustainability in the IT industry.

1. Mandatory AI & ESG Disclosures for Transparency: Why It Matters:

- AI and cloud computing have resulted in exponential rise in energy and water consumption.
- AI workloads standalone has the capability to consume electricity equivalent to a small country by 2030 (IEA, 2023).
- Lack of transparency allows companies to underreport their environmental impact.

Recommendations:

✓ IT firms should disclose AI-related energy and water usage in their ESG reports.

✓ Standardized sustainability metrics should be introduced for fair comparisons.

✓ Third-party audits should verify AI-driven energy consumption to ensure accountability.

2. Carbon-Neutral Data Centers by 2030: Why It Matters:

- IT contributes nearly 1% of global CO_2 emissions (IEA, 2022).
- India's data center industry is growing rapidly, increasing energy demand (NASSCOM, 2023).

Recommendations:

✓ IT firms should transition to 100% renewable-powered data centers by 2030.

✓ Innovations like liquid cooling and AI-optimized power management should be adopted.

✓ Policies should penalize high carbon footprints and reward carbon-neutral efforts.

3. Circular Economy for E-Waste: Zero-Landfill IT Hardware: Why It Matters:

- More than 1 million tonnes of e-waste are generated in India annually, of which less than 5% recycled formally (CPCB, 2023).

- Serious environmental threat is posed by hazardous IT hardware materials.

Recommendations:

✓ A zero-landfill policy should require firms to recycle outdated IT equipment.

✓ Extended Producer Responsibility (EPR) laws should mandate proper disposal.

✓ Circular economy models should encourage refurbishment and reuse of components.

4. Water-Neutral IT Operations: Why It Matters:

- A data centre, standalone, is capable of consuming as much water as a city of 30,000 people yearly (Uptime Institute, 2023).
- Over exploitation of water reservoirs can lead to regional scarcity.

Recommendations:

✓ Closed-loop water recycling systems should be made a compulsion in IT operations.

✓ Water usage per unit of computing power should be reported by firms for accountability and transparency

5. Tax Incentives for Green R&D and Sustainable AI Why It Matters:

- Inventions in the field of AI need immense processing power leading to a rise in emissions.
- Monetary aid is required to conduct studies on eco- friendly AI and energy efficient computing needs.

Recommendations:

✓ For green R&D tax benefits should be offered by the government in:
- Artificial Intelligence Prototypes with less power usage
- Maximizing energy efficiency using Quantum Computing
- Optimizing Resources and their usage by Incorporating AI

✓ carbon credits or tax rebates should be provided to company's meeting sustainability targets With the above strategies in place, the IT sector can strike a balance between continuous innovation and responsibility towards the environment, reinforcing longterm sustainability.

Conclusion

The IT industry is experiencing an era of unparalleled expansion due to the quick development of AI, cloud computing, and data centres. The environmental cost of this expansion is substantial, though, as evidenced by growing e-waste, excessive water use, rising carbon emissions, and rising energy consumption. The sector needs to understand that sustainability is now essential to long-term survival and cannot be ignored.

The IT industry can reduce its environmental impact without sacrificing innovation by implementing mandatory AI and ESG disclosures, moving to carbon-neutral data centres, implementing circular economy principles for e-waste, attaining water-neutral operations, and providing incentives for green research and development. A paradigm shift towards responsible technology will be fuelled by these actions, which are supported by strict regulations and corporate accountability.

The defining challenge of our time is finding a balance between environmental stewardship and digital advancement. Businesses that put sustainability first now will not only prepare for the future of their operations, but they will also set the standard for a more resilient and environmentally conscious IT sector. Now is the moment to take action.

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