THE HEURISTIC STUDY TO INTEGRATE ESG WITH DIGITAL ECONOMY LEADING TO CARBON FOOTPRINT REDUCTION: AN INTEGRATED LITERATURE REVIEW MODEL

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ABSTRACT

Purpose: *The article underscores the pivotal role of carbon emission governance in achieving environmental sustainability based on extensive literature reviews. It highlights the myriad factors, ranging from regional nuances to governance structures that impact carbon emissions. Mainly, it showcases India's unique approach to harmonizing digital transformation with environmental responsibility. By synthesizing the Digital Infrastructure Index (DII) and the Digital Economy Development Index (DEDI), India exemplifies how nations can promote digital growth while remaining committed to carbon reduction. This note is a testament to the importance of interweaving digital advancement with sustainable practices for future progress.*

Design/Methodology/approach: *A systematic literature review (SLR) adhered to strict protocols to minimize bias, ensuring a rigorous and transparent research process, provides a holistic understanding of existing evidence, identifies gaps in current research, and offers a foundation for future studies. Fifty selective articles were selected from 2010 to 2023 with a clear, well-defined research objective that dictates the scope of the review. Selective studies were done on 35 plus articles to systematically extract findings and gaps after assessing quality and potential bias. The findings helped synthesize the index and integrated model specific to India.*

Findings: *The comprehensive analysis underscores the multifaceted nature of carbon emissions in India, influenced by factors ranging from digital development to socioeconomic considerations. Prioritizing digital strategies, smart cities, green innovation, and financial stability can significantly mitigate India's carbon footprint. Integration of DEDI and DII, tailored to India's unique context, accurately represents its digital progression. The adapted indices offer a holistic view by focusing on rural digitalization, meticulous digital infrastructure examination, renewable energy, and socio-economic parameters. India's commitment to sustainable digital transformation, leveraging these indices and integrating ESG approaches, presents a path towards technological progress and environmental responsibility.*

Originality: *The integration of ESG with the digital economy is original as the digital economy may either lead to an ESG score but with an initial assumption of positive direction. The outcome brings the underlying concepts, such as the importance of the digital economy in reducing carbon emissions or the significance of the Digital Infrastructure Index (DII) and Digital Economy Development Index (DEDI), based on established ideas in the earlier scholastic research till 2023.*

Value: *To make DEDI and DII more representative of India, integrate metrics for rural digital adoption, detailed infrastructure insights, renewable energy, and EV parameters. Incorporate innovation dynamics, socio-economic realities, global trade impacts, and*

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correlations between population density, urbanization, and digitalization. This holistic approach enhances the indices' depth, relevance, and predictive power.

Keywords: ESG, Energy Consumption, Digital Economy Development Index, Digital Infrastructure Index, Green innovation, GHG emission, Sustainable Development.

INTRODUCTION

The Phenomena of Carbon Footprint under the Ambit of Digital Ecosystem: An Overview

The global network known as the "digital economy" comprises the information and communications technologies (ICT) that facilitate economic activity, business transactions, and professional contacts (Bukht & Heeks, 2017). As the final step of the economy's devolution, the digital economy—which considers what transpires in our daily activities—became the benchmark for the world's economic development. Businesses often use networks to carry out and re-engineer manufacturing processes, simplify procurement procedures, attract new clients, and run internal operations (Mesenbourg, 2001).

The culmination of countless advancements and creative steps is Digital India. These improve the general population's lives and alter people's lives from various angles. The 'Digital India' program is a noteworthy project of Mr. Narendra Modi, the prime minister, who will establish new movements in each area and make creative efforts for the future (Gokilavani & Durgarani, 2017).

Based on sectors and types of IT-enabled business activity that are anticipated to be significant drivers of economic growth during the coming decade, these include the I.T. sector itself, business-to-business electronic commerce, the distribution of goods and services digitally, and the retail sale of actual things aided by I.T. (Gumah & Jamaludin, 2006). Before the Internet was considered a for-profit service, these advances began (in the U.S.) in the 1950s and were extensively developed in the 1960s, 1970s, and 1980s (Kling & Lamp, 1999).

A well-known notion known as the "carbon footprint" refers to the life cycle of carbon equivalent emissions and the consequences associated with a good or service. Given the growing worry about global warming, any sector should consider its carbon footprint, relative size, and development trends. The World Economic Forum's experts named global warming the top threat to society and the economy in 2016 (World Economic Forum, 2016).

All signatories committed to combat climate change and lower greenhouse gas emissions during the COP21 conference in Paris in December 2015. After careful consideration for two decades (Doğan et al; 2020). It was decided to set a 2°C upper limit on global temperatures, which would be accomplished by coordinated action based on nationally determined contributions (NDCs). The Paris Agreement (COP21) includes a roadmap for political actions to limit the adverse effects of climate change.

The Parties (states that have ratified the UNFCCC) met in Paris on December 13 to reach an agreement that will serve as a roadmap for future global climate change legislation and initiatives. No government voiced protest, which is a testament to the 40,000 attendees at COP21, primarily activists, scientists, and investors. Even a flimsy global pact brought them together. They can now proceed confidently, knowing that everyone views climate change as a problem and a top priority (Robbins, 2016).

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LITERATURE REVIEW

The Bygone Days of Research on Carbon Emission Impacted by Digitization

The digitization of economic processes is one characteristic of digital economic systems, which are described as economic systems with technology as their primary driving force. The foundation for the coordinated promotion of the digital economy and green development has been formed by the new growth mode driven by technological innovation-led digital economy development. In order to continually advance industrial integration, the digital economy depends on technological innovation (Zuo, et al. 2020).

Industrial Development Leads to Carbon Emissions

While changes in industrial and economic development models will directly impact changes in carbon dioxide emissions, so will financial restructuring Hosseinzadehh. Global warming and climate change are the two most pressing and divisive environmental issues of our day. Most experts concur that the accumulation of carbon dioxide emitted from burning fossil fuels and other human-caused greenhouse gas emissions worldwide are to blame for atmospheric warming (Boutabba et al., 2014).

By merging energy supply, investment, and employment into a multivariate framework, the ARDL limits testing approach and Johansen-Juselius maximum likelihood process were utilized to analyze the causal relationship between carbon emissions and economic growth (Ghosh, 2010). India gives development a high priority. Between 2000 and 2007, the economy grew by 7.7% annually on average, and between 1950 and 2008, fossil fuel emissions rose by 125%, making the country the third-largest CO2 emitter in the world. The Government of India has set a provisional aim of 9% GDP growth from 2012–2017, which will necessitate an increase in the energy supply of 6.5% annually (Boutabba et al. 2,014).

Series of Studies under the Lens of digitalization Impact on Less Carbon Emission Year-wise Year: 2023: An Integrated Approach to promote Digitalization in order to eliminate the substantial impact of carbon footprint under the adoption ESG Framework

Urbanization, technological innovation, and environmental regulation positively influence the integrated development of the digital and energy industries. Various elements are essential in encouraging the merger of various businesses, resulting in increased energy efficiency, decreased carbon emissions, and sustainable growth. This paper has explored Regional disparities in curbing carbon immersionists' positive relationships (Wang et al., 2023**).**
According to Tang and Yang's research, the development of digital infrastructure has raised overall carbon emissions and per-person and carbon intensity emissions. Digital infrastructure has increased energy consumption and accelerated climate change despite its role in economic growth and progress. Specific laws, such as the carbon emission trading plan, can efficiently mitigate the detrimental environmental effects of digital infrastructure. The balance between the efficiency improvements and the increased energy consumption from digital infrastructure determines whether the digital economy decreases carbon footprint. To prevent the expansion of the digital economy from accelerating carbon emissions and climate change, it is essential to expand digital infrastructure while investing in renewable energy, increasing energy efficiency, and implementing sustainable practices (Tang & Yang, 2023).

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Improvement in technological innovation, internal control, and environmental information disclosure are crucial for the reduction. The impact is more pronounced in regions with robust intellectual property protection and capital-intensive enterprises. This research has not found any heterogeneity in enterprise types, environmental regulation intensity, and information infrastructure construction (Shang et al., 2023).

The impact that has to be considered in order to continuously foster a healthy innovation environment that is favorable to the growth of the digital economy sector, development of digital technology on environmental protection, and playing a leadership position in the market (Wang et al., 2023).

Reducing energy and carbon intensity of energy use is an essential step towards reaching peak carbon in the region. Additionally, this study has shown that it is possible to achieve it by combining several strategies, such as boosting the use of renewable energy sources, promoting the construction of energy-efficient buildings, and applying energy-saving technology in various businesses (Chen et al., 2023).

This study by Yang et al. has significantly contributed to different aspects, such as substantial geographical variability and city variances, and the digital economy significantly contributes to carbon emission efficiency.

From an adjustment value chain viewpoint, industrial structure rationalization reduces the impact of the digital economy's efforts to reduce carbon emissions to some extent, whereas industrial structure upgrading strengthens that impact (Lyu et al., 2023).

This research has depicted multi-dimension such as

(1) Digital finance significantly and positively reduces CEI, which has proven consistent across robustness tests and adjustments for potential endogeneity.
(2) Second, the usage depth and Digitization significantly reduce CEI.
(3) The impact of digital finance on CEI varies across regions and over time.
(4) Digital finance influences CEI by reducing energy intensity and altering energy consumption patterns (Lu et al., 2023).

The research of Zhang and Wang has shown in their study on Chinese geography that the development of China's digital economy is unbalanced among regions, showing a geospatial pattern of decreasing from east to west (Lyu et al., 2023).

The development of the digital economy has laid a foundation for China to achieve carbon peaking and carbon neutrality through increased human capital investment and green innovation level, which has promoted the reduction of cities' carbon emission intensity and the greening and upgrading of cities.

Jun and Jiang's extensive study found that regional carbon emission efficiency has a spatial correlation. The effectiveness of neighboring regions' carbon emission reduction, however, is relatively unaffected by the growth of the digital economy. Moreover, it is found that Industrial Structure adjustment, energy structure, and technological progress are further analyzed as three mechanisms reflecting carbon emission. It has been discovered that while the energy structure greatly hinders the increase of carbon emission efficiency, the quality of industrial structure modification substantially encourages it. There is no discernible relationship between changes in industrial organization and technical advancement and the effectiveness of carbon emissions.

The n-shaped trend of change that this study discovered from a geographical standpoint is that industrial digitization has generally demonstrated a negative tendency in the central, western, and northeastern areas. From an industry perspective, industrial digitalization has a

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considerable impact on the performance of the production and supply of electricity, heat, gas, and water, with a relatively solid impact on the performance of the mining sector's carbon emissions.

Year 2022: An Attempt to Understand the Correlation between Regional Carbon Emission and Digitalization

According to Lau's study on energy conservation in the Thai economy, for the power sector to reach net zero by 2050, renewable electricity output must increase at an average annual growth rate (AAGR) of 7.1% between now and 2050.

By promoting green innovation, modernizing industrial buildings, and using less energy, Zhang and colleagues' study elaborated on how creating smart cities may lessen the intensity of urban carbon emissions. The findings from this study can guide low-carbon development and urban transformation.

According to this study, digitization in carbon-related fields is still early. As a result, academic and practical efforts should be made to further digital development in these domains.

The findings demonstrate that regional digital development considerably lowers carbon emission intensity. This influence on overall carbon emission follows an inverted "U" curve pattern of first growing and then dropping—second, technical advancement, industrial design, and energy policy all impact carbon emissions.

Third, the heterogeneity study highlights the central and western areas' benefit from the late development of carbon neutrality and carbon peaking objectives by demonstrating that the impact of digitalization is more critical in these regions than in the eastern regions.

The Study meticulously explores the various dimensions and pathways through which the digital economy influences carbon emissions. Again, it has emphasized the critical role of digital technologies in shaping sustainable production and consumption patterns, which, in turn, contribute to carbon emission reduction. The authors provide insightful analyses and discussions on the potential of the digital economy to drive significant changes in carbon emissions patterns, offering valuable perspectives for policymakers and stakeholders in understanding and leveraging the digital economy for sustainable development and carbon neutrality in China.

The essential results of this study show that China's Internet economy positively affects CEE; precisely, a 1% rise in Internet economy indicators would produce a 0.141% increase in CEE indicators. Third, our research has also found an asymmetric strong relationship between the Internet economy and CEE. Second, the Internet economy indirectly impacts CEE by enhancing human capital, clean technology innovation, and the non-coal energy mix (Wang et al., 2022).

Innovation in green technologies and changes to the industrial structure are important mediating variables, and the digital economy may actively encourage high-quality green development. This empirical study has shown how the role of the digital economy in local low-carbon development is becoming increasingly important. The primary ways the digital economy impacts LCD are environmental regulation, technical development, and improved industrial structure. According to specific theories, there are significant differences between "*hyper-digitized countries*" and "*under-connected countries*" in terms of the extent of growth of the digital economy.

Additionally, it demonstrates that the growth of the digital economy considerably lowers the intensity of carbon emissions while encouraging increases in per capita carbon emissions. It

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has been shown how the digital economy and carbon emissions are mediated by economic growth, financial development, and industrial structure modernization (Dong et al., 2022).
This study also suggested using straightforward economic analysis to reduce carbon emissions. From a practical standpoint, lowering carbon emissions might be accomplished through improving resource movement and transportation, resulting in a direct decrease in fuel use and emissions. Additionally, using biodiesel and renewable energy sources instead of diesel will reduce emissions and energy use for conventional generators and transportation. This study discusses many operational efficiency solutions that can lower carbon emissions (Rizqi et al., 2022).

Energy efficiency was used to derive additional measures. In a secondary steelmaking industry, a case study was undertaken to show how digitization and energy-efficient equipment might reduce carbon emissions. In a secondary steelmaking industry, a case study was undertaken to show how digitization and energy-efficient equipment might reduce carbon emissions.

Although scenarios have the lowest energy usage metric, they are less desirable due to their high purchase costs. The company's demands are satisfied by integrating digital tools and energy-efficient equipment; nevertheless, reducing carbon emissions per cost is the criteria (Stavropoulos et al., 2022).

The authors investigate whether advancements in the digital economy contribute to improvements in carbon emission efficiency, a critical aspect of environmental sustainability and climate change mitigation.

The Study provides a comprehensive analysis, examining various factors and dimensions of the digital economy and their potential impact on carbon emissions (Lange et al., 2022)
Target conducted by Wang and Dong exhilarated that the fixed effects Model results verify that financial risk hurts carbon emissions. This relationship may be influenced by technological Innovation and energy transition. Second, a significant single-threshold effect exists between financial risk and carbon emissions. When research and development (R&D) expenditures and renewable energy consumption exceed the threshold, there is a significant decrease in the contribution of financial stability to carbon emissions. Third, the slow growth of technological innovation in OECD countries compared to renewable energy consumption highlights that the potential of technological innovation for carbon reduction needs to be further explored (Wang & Dong, 2022**).**

The authors investigate whether advancements in the digital economy contribute to improvements in carbon emission efficiency, a critical aspect of environmental sustainability and climate change mitigation. The study provides a comprehensive analysis, examining various factors and dimensions of the digital economy and their potential impact on carbon emissions. The study's findings highlight the digital economy's contribution to increasing carbon emission effectiveness and fostering sustainable development, providing insightful information and supporting data for decision-makers, stakeholders, and enterprises.

The research findings offer valuable insights and evidence for policymakers, stakeholders, and businesses, highlighting the role of the digital economy in enhancing carbon emission efficiency and promoting sustainable development (Han & Jiang, 2022**).**

Using empirical data from a developing market, the authors perform a detailed analysis to determine the connection between digital banking and carbon emissions. The study explores many facets of digital finance, such as online banking, fintech, and digital payments, and evaluates how they affect carbon emissions. The study's conclusions provide crucial implications

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for policymakers, financial institutions, and companies in emerging countries by shedding light on the potential for digital finance to reduce carbon emissions. The study emphasizes the necessity of digital money for sustainable development and lowering carbon emissions in developing nations. (Zhao et al., 2021, p. xx)

The study has shown that eradicating extreme poverty is separate from ambitious climate change mitigation in India. However, our analysis suggests C.F. reduction policies within India need to target high-expenditure households, which are responsible for nearly seven times the carbon emissions than low-expenditure households (living on $1.9 consumption a day). These vast disparities in the carbon footprint of citizens in India highlight the need to differentiate individual responsibilities for climate change in national and global climate policy (Lee et al., 2021).

Three dimensions—trend, structure, and driving factor—reflect the features of the "new normal." The findings indicate that while China's energy and carbon footprint growth rate has slowed, the total footprint is still growing. Consumption footprints have progressively surpassed export footprints and tertiary industrial sectors have become crucial nodes in footprint networks. Additionally, the rise of the energy and carbon footprint has been significantly influenced by economic structure and degree of development. (Yu et al., 2021)

According to a survey, alternative additives, materials, processes, and systems can cut CO2 emissions by up to 90% at various building and construction phases. The most noteworthy finding of an intriguing study was that the carbon emissions generated by telemedicine equipment were extremely low in contrast to emissions saved by reduced travel. This may significantly affect the worldwide carbon footprint of healthcare services (Purohit et al., 2021)
According to reports, alternative additives, materials, methods, or systems can cut CO2 emissions by up to 90% at various phases of the building and construction process (Sizirici et al., 2021). This Study on green technology innovation and its impact on carbon emission found another significant outcome and compared results, built a transparency catalog for C.F. calculations, and evaluated the transparency (reporting quality) of the available evidence for virtual care (V.C.) intervention (Razzaq et al., 2021)

The outcome of this research signifies that In the long-term and the short-term, the growth in forest areas is responsible for decreased carbon emissions. Increased use of renewable energy results in a reduction in carbon emissions. Additionally, the rise in agricultural financial development was paralleled by increased carbon emissions. By calculating the non-Granger causality test, one can determine the unidirectional causation between variables(Koondhar et al., 2021).

While using renewable energy and financial development in Chile lower consumer-based CO2 emissions, economic expansion and electricity use increase carbon emissions based on consumption. Results from the gradual shift causality test are consistent with those from the ARDL, FMOLS, and DOLS estimators (Kirikkaleli et al., 2021).

2020: The Series of Studies on Understanding the Transformation in Adopting Sustainable Practices in Business

A study on e-carsharing and its impact on carbon emission examined that such e-car sharing schemes offer direct and indirect benefits to urban mobility (especially to electric vehicle adoption) and that they depend on how the Government supports them (Luna et al., 2020).

Over the past two decades, the EU28 has decreased its GHG footprint by 8%, mainly due to more effective domestic and overseas technologies. One-third of the emissions footprint of the

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EU28 are embodied in imports, and their amount has stabilized since 2008. Compared to products made in the EU, foreign industry has caused more significant emissions. However, this effect's impact is minimal compared to the much more significant (global) technology advancements and consumer increases. Therefore, rather than the overall effects of trade, today's emphasis should be on accounting and accountability for effecting change. Last, integrating non-CO2 GHGs in the study demonstrates their significance in the traded element, especially for the mining and agriculture industries (Wood et al., 2019).

Extensive, Pohl and Santarius research has excerpted an array of dimensions such as

(1) The creation, use, and disposal of information and communication technology (ICT) have direct consequences on the environment,
(2) Energy productivity gains from digitization,
(3) Economic expansion due to higher labor and energy productivity
(4) The emICT services have sectoral shifts or tertiaryization.

The analysis incorporates empirical and theoretical findings from discussions on green I.T. and ICT for sustainability and discussions on energy usage from economic growth. Our key findings: Energy consumption tends to rise due to effects 1 and 3. It tends to be reduced by effects 2 and 4. Additionally, the study's research indicates that the two impacts of growth predominate, leading to an overall rise in energy consumption due to digitalization (Lange et al., 2020).

There are several potential directions, according to research on the BRICS nations. For the BRICS as a whole, carbon emissions will fall by 0.8122% for every 1% rise in R&D spending, demonstrating that R&D spending has a good effect in separating economic expansion from environmental pressure. This effect on individuals is most potent in China, while it is less in Russia and India.

It should be noted, though, that the decoupling of economic growth and carbon emissions cannot be accomplished solely by increasing research and development spending. Instead, various factors must also be considered, including economic activity, industrialization, urbanization, and renewable energy sources. The findings also demonstrate that decoupling is negatively impacted by economic activity, industrialization, and urbanization, but decoupling is promoted by renewable energy usage (Wang & Zhang, 2020).

According to Sharma's study, there has been a growth in ESG reporting to satisfy the stakeholders' growing concerns. As a result, this study highlighted the extent to which Indian corporations report on their ESG activities and assisted the government in determining the extent to which Indian companies report on their CSR operations. The Study demonstrated how much ESG information is disclosed in annual and sustainability reports of businesses, and it built a CSR index based on the GRI methodology and Clause 49 of the listing agreement (Sharma et al., 2020)

2018: Examining the impact of the environment on different business sectors

The findings disprove the Environmental Kuznets Curve (EKC) theory and demonstrate that innovations did not, over the long run, have a statistically significant impact on energy, transportation, and other sectors. It was also shown that when innovation grows in the industrial sector, carbon emissions decrease; while innovation grows in the construction industry, carbon

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emissions rise. Because of this, it might be advised that specialized policies should be established for each sector separately in addition to national measures to reduce CO2 emissions.
This Study has investigated the impact of carbon emissions on the construction sector and revealed a few significant areas, such as

1) In 2009, the worldwide construction industry produced 5.7 billion tonnes of CO2 emissions, or 23% of all CO2 emissions caused by global economic activity. Indirect emissions account for 94% of the total CO2 produced by the worldwide building industry.
2) Gasoline, diesel, other petroleum products, and light fuel oil are the four primary energy sources for direct CO2 emission in the global construction sector. The indirect CO2 emission mainly stems from hard coal, natural gas, and non-energy use.
3) The emerging economies cause nearly 60% of the global construction sector's total CO2 emission. China is the most significant contributor to the construction sector (Huang et al., 2018).

2016: Attempts to Correlate the Relationship between Environment and Energy-Efficient Technology

Results show that a long-run cointegration relationship exists and that the environmental Kuznets curve validates significant aggregated and disaggregated levels. Furthermore, energy (total energy, gas, oil, electricity, and coal) consumption has a positive relationship with carbon emissions, and a feedback effect exists between economic growth and carbon emissions. Thus, energy-efficient technologies should be used in domestic production to mitigate carbon emissions at the aggregated and disaggregated levels (Alkhathlan & Javid, 2013).

2015: A pathway to find the impact of emission over socio-economic factors

The long-term association between socioeconomic conditions and CO2 emissions is significant. Short- and long-term CO2 emissions are positively impacted statistically by population density, energy use, and economic growth. Population density emerges as the primary determinant of CO2 emissions fluctuations among these three causes (Ohlan, 2015).

2014: An attempt to understand the Carbon Footprint Estimation and its Impact

Data on the consumption of goods and services resulting in GHG emissions was gathered at the household level through a door-to-door survey from a few localities in Mumbai and rural areas within 100 km of the boundary. Equivalent carbon emission factors were used to estimate the carbon footprint from significant sources like electricity, transport, cooking fuel, and food for these areas. The average annual per capita carbon footprint was estimated to be 2.5 tons CO2e in the urban area and 0.85 tons CO2e in the rural area. For each area (rural and urban), substantial variation in carbon footprint has also been observed across different socio-economic classes (Bhoyar et al., 2014).

Comparisons are made between the measurement findings obtained from experiment alll values and the outcomes of two theoretical estimating approaches, the mass balance approach, and the default methodology. As opposed to the Intergovernmental Panel on Climate Change method (0.036 kg CH4/kg of waste) or theoretical methods (0.355 kg CH4/kg, 0.991 kg CO2/kg of trash), experiments showed emissions of 0.013 g CH4/kg of organic fraction of municipal solid waste and 0.165 g CO2/kg. This is significant. The mass balance technique indicated that the total daily methane and carbon dioxide emissions are 670,950 and 1,870 tonnes per day

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(TPD), respectively, based on the elemental composition and general theoretical chemical equation of aerobic and anaerobic waste quantities. (Ramachandra et al., 2014)

2011: Explored the Possibilities of Emission based on Demographics

Based on fundamental demographic traits, the size and make-up of carbon footprints significantly vary within and within geographic regions. Despite these variations, substantial cash-positive reductions in carbon footprints are visible across all household types and regions (Jones & Kammen, 2011).

2010: Redefining the Dynamics of Carbon Emissions

Although the study cannot prove a long-term causal link or equilibrium relationship between economic growth and carbon emissions, there is a bi-directional, short-run causal relationship between the two. Therefore, any attempt to cut carbon emissions might cause the national income to decline in the short term. Additionally, this analysis reveals a one-way short-run causal relationship between economic development and energy supply and between energy supply and carbon emissions (Ghosh, 2010).

Compared to chapati, a food made from wheat flour, cooked rice had a life cycle GHG emission that was 2.8 times higher. Mutton produced 11.9 times as much greenhouse gas (GHG) emissions as milk, 12.1 times as much as fish, 12.9 times as much as rice, and 36.5 times as much as chapati. Since fresh foods grown nearby are what Indians want to eat, 87% of mission revenue came from food production, followed by 10% from food preparation, 2% from food processing, and 1% from transportation. An adult Indian male ate 1165 g of food for a balanced diet (vegetarian) and released 723.7 g of CO2 equivalent GHGs. A non-vegetarian lunch with mutton produced 1.8 times as much greenhouse gas (GHG) as a vegetarian meal, 1.5 times as much as an ovo-vegetarian meal, and 1.4 times as much as a lacto-vegetarian meal. (Pathak et al., 2010)

METHODOLOGY

In India, research often uses the seven steps recommended by the Cochrane Collaboration to conduct a systematic literature review. The systematic literature review (SLR) methodology for "The Digital Economy Leads to a Reduction in Carbon Footprint: A Heuristic Study on the Application of the ESG Framework in Business" involved the formulation of a research question focused on the impact of the digital economy on carbon footprint reduction and the application of the Environmental, Social, and Governance (ESG) framework in business. A comprehensive search strategy was developed, utilizing relevant keywords and databases to identify studies. Inclusion criteria encompassed publications from the last decade, primary research, case studies on digital technologies and their effect on carbon emissions, and the integration of the ESG framework. Findings were synthesized through thematic analysis, highlighting trends in digital solutions for carbon reduction and ESG implementation in business contexts. Potential biases were addressed, and a comprehensive discussion contextualized the synthesized results, acknowledging limitations and proposing avenues for further research. The review adhered to PRISMA guidelines, ensuring transparency and rigor throughout the process, leading to an informed understanding of the relationship between the digital economy and carbon footprint reduction.

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The presence of smart cities, innovation, quick adoption of E.V., and extensive data analysis are crucial steps in the digital transformation that must be included in the Study.

Analysis and Findings: A path forward for Future Research

The digital economy is crucial in reducing carbon emissions and developing more sustainably. However, challenges such as regional disparities, the balance between efficiency gains and additional energy consumption, and ensuring the widespread adoption of green technologies and practices remain. Effective policy interventions, government oversight, and global coordination are essential to overcoming these challenges and ensuring that the burgeoning digital economy does not exacerbate carbon emissions and climate change. The synergy of various stakeholders, including governments, industries, and communities, will enhance the efficiency and effectiveness of initiatives aimed at bolstering renewable electricity generation and ensuring environmental sustainability in the era of the digital economy. The digital economy, characterized by the extensive use of digital technologies and information, is increasingly becoming an integral part of the global economy. This integration positively influences carbon emission reduction, steering various sectors towards more sustainable development paths.

Table 1
FACTORS FOR REDUCTION IN CARBON FOOTPRINT

Factors	Impact on Carbon Footprint	Analysis
Positive		
Urbanization	Propels the demand for efficient and sustainable energy sources, and digital technologies aid in optimizing energy use, leading to enhanced energy efficiency and reduced carbon emissions.	Regional disparities exist, as urban areas with greater access to digital technologies can more effectively reduce emissions, creating a divide in emission reduction efforts.
Innovation	Innovations like smart grids, IoT, and AI contribute to more efficient energy management and use, ultimately reducing carbon emissions.	Technologically advanced regions leverage these innovations more, creating disparities in emission reduction efforts across different areas.
Regulation	Regulatory measures promote cleaner and more efficient energy sources and technologies.	Regions with more stringent environmental regulations may experience greater integration of digital and energy industries, exacerbating regional disparities in carbon emissions.
The potential of the digital economy	The digital economy could reduce the global carbon footprint by optimizing energy use and improving logistical operations.	The additional energy consumption from digital infrastructure can offset these gains.
Policy	Comprehensive policies can play a pivotal role in mitigating the adverse environmental repercussions of digital infrastructure.	Ensuring global coordination and implementation consistency is a significant challenge.
Minimizing environmental footprint	These elements contribute significantly to minimizing the environmental footprint of various industries.	Ensuring robust intellectual property protection and continued investment in innovative technologies across regions is crucial.
Alignment with environmental goals	Governments can foster an innovation-friendly environment and ensure the alignment of the digital economy with environmental protection goals.	Continuous assessment and monitoring of the impact of digital technology on the environment is essential for ensuring sustainability.
Digital finance	Digital finance substantially impacts the	The impact is not uniform across regions,

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	reduction of Carbon Emission Intensity (CEI) by streamlining and optimizing financial operations.	emphasizing the importance of contextual factors.
Green technologies	The development and use of green technologies minimize carbon emissions in various sectors, including healthcare.	Ensuring widespread adoption and implementation of green technologies across sectors is a significant challenge.
Harmful		
Regional disparities.	Regional disparities exist, as urban areas with greater access to digital technologies can more effectively reduce emissions, creating a divide in emission reduction efforts.	This can be exacerbated by a lack of investment in digital infrastructure in rural and underserved areas. Additionally, regional disparities in environmental regulations can contribute to regional disparities in carbon emissions from the digital economy.
Construction and proliferation of digital infrastructure	Augments total and per capita carbon emissions and carbon intensity. Substantial energy consumption associated with digital technologies and infrastructures.	This is a developing issue as the demand for digital technology rises and the digital economy continues to expand. It is crucial to design digital infrastructure to be more energy-efficient and to power it with renewable energy sources.
Additional energy consumption from digital infrastructure,	Especially if sourced from fossil fuels, can offset the gains from enhanced efficiency. Contributes to increasing carbon emissions and climate change.	This is a complex issue, as the digital economy can both lead to energy savings and increased energy consumption. It is important to carefully consider the overall impact of digital technologies on energy consumption and to take steps to mitigate the negative impacts.
Current energy structure	Found to significantly inhibit the improvement of carbon emission efficiency. Calls for an urgent reassessment and transformation for a more sustainable model.	The current energy structure, heavily reliant on fossil fuels, is a significant obstacle to reducing carbon emissions from the digital economy. It is important to transition to a more sustainable energy mix, such as one that is based on renewable energy sources.

The digitization journey involves overcoming initial challenges related to technology adoption, integration, and investment. However, the long-term benefits, including significant carbon emission reductions and improvements in operational efficiency, highlight the critical importance of embracing and investing in digitization and sustainable technologies for a greener and more efficient future across sectors. Industry-specific strategies and solutions tailored to address unique challenges and leverage opportunities are essential for realizing the full potential of digitization in enhancing sustainability and reducing carbon emissions in both industry and healthcare sectors.

Table 2
FACTORS FOR TWO IMPORTANT INDUSTRIES

Factors	Financial Industry	Healthcare Industry
Digital Transactions	Reduces the need for physical infrastructure, leading to lower energy consumption and emissions.	Reduces carbon emissions from reduced travel and operational efficiency.
Optimization of Financial Operations	Efficient and streamlined operations minimize waste and reduce energy use, contributing to lower carbon emissions.	Significant reduction in carbon emissions from reduced travel and operational efficiency. Enhanced accessibility and efficiency in healthcare delivery.

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Dematerialization	Digital finance promotes paperless transactions, reducing waste and the carbon footprint of paper production.	Digital finance can help reduce the paper consumption of the healthcare industry, which can significantly reduce its carbon footprint.
Remote Services	Allows users to access financial services remotely, reducing the need for transportation and associated emissions.	Digital finance enables patients to access healthcare services from anywhere, reducing the need for transportation and associated emissions.
Enhanced Accessibility	Digital finance enables broader access to clean and renewable energy financing, promoting the adoption of sustainable energy sources.	Digital finance can increase access to financing for healthcare projects, supporting the transition to a more sustainable healthcare system.
Promoting Sustainable Investments	Facilitates investment in environmentally friendly projects and companies, indirectly contributing to emission reduction.	Digital finance can help channel investments into sustainable healthcare projects and companies, which can reduce greenhouse gas emissions.
Technological Advancements	Utilizes advanced technologies to enhance energy efficiency and sustainability in financial operations.	Digital finance can utilize advanced technologies, such as artificial intelligence and big data, to enhance energy efficiency and sustainability in healthcare operations.
Improved Energy Consumption Patterns	Aids in optimizing energy use in financial operations and services, reducing energy consumption and emissions.	Digital finance can help healthcare institutions optimize their energy consumption patterns, reducing overall energy consumption and emissions.

Persistent efforts and investment in digitization and sustainable technologies are crucial. Despite the short-term challenges, the long-term gains in terms of environmental and operational performance make the investment worthwhile. The industry should focus on leveraging technology to improve operations and contribute positively to environmental sustainability. While presenting specific challenges, the digitization of industries offers substantial benefits regarding carbon emission reduction, operational efficiency, and overall sustainability. It is essential for industries to strategically plan the implementation of digital technologies and focus on long-term goals to realize these benefits.

Digitization can lead to significant reductions in carbon emissions. By adopting digital technologies, industries can become more operationally efficient and manage energy usage better.

Table 3
ANALYSIS OF OVERALL INDUSTRIES

Challenges	**Opportunities**	**Strategies**	**Implications**
High Initial Costs	Carbon Emission Reductions	Implementing IoT, AI, and Smart Grid Technologies	Long-term Benefits
Integration Issues	Improved Energy Efficiency and Sustainability	Investing in Renewable Energy Sources and Infrastructure	Focus on Industry-Specific Strategies and Solutions

Challenges

High Initial Costs: The initial investment required for implementing new digital technologies can be substantial. This can be a barrier to entry for smaller businesses and businesses in developing countries.

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Integration Issues: Integrating digital technologies with existing systems and operations can be challenging. This can require significant changes to business processes and employee culture.

Opportunities

Carbon Emission Reductions: Digitization can help industries reduce carbon emissions by optimizing production processes, supply chains, and energy consumption.

Improved Energy Efficiency and Sustainability: Digitization can help industries to improve their energy efficiency and sustainability by making integrating renewable energy sources into the grid and managing energy demand easier.

Strategies

Implementing IoT, A.I., and Smart Grid Technologies: These technologies can drive digitization and improve operational and environmental performance.

Investing in Renewable Energy Sources and Infrastructure: This is a key strategy for ensuring long-term sustainability.

Implications

Long-term Benefits: The long-term benefits of Digitization, such as reduced carbon emissions and improved operational efficiency, outweigh the short-term challenges and costs.

Focus on Industry-Specific Strategies and Solutions: This is essential for effective Digitization and sustainability.

The Digital Infrastructure Index (DII) is a critical metric to gauge the infrastructure's readiness and ability to support digital transformation, innovation, and sustainability, which are vital for reducing carbon footprint. Below is the structured format of the Digital Infrastructure Index, much like the Digital Economy Development Index. A higher DEDI, indicating a more developed digital economy, should be accompanied by strategic actions to leverage digital technologies for sustainability. Ensuring that advancements in the digital economy translate into tangible carbon reduction and environmental benefits requires coordinated efforts across sectors and a strong commitment to sustainability goals.

Table 4
DIGITAL INFRASTRUCTURE INDEX

Added Value of the Secondary Industry to GDP Quantitative Assessment: Calculate the percentage contribution of the secondary industry to GDP. Higher values indicate a more significant contribution to economic activity, which can be correlated with digital infrastructure readiness. Relevance to Carbon Footprint: An economy that leverages digital infrastructure might optimize secondary industry processes, leading to more efficient operations and potentially lower carbon emissions.
Proportion of Digital Talent Quantitative Assessment: Calculate the percentage of employment in computer services and software within the urban workforce. Relevance to Carbon Footprint: A higher concentration of digital talent can drive innovation in green technologies and practices, reducing carbon emissions.
Usage Cost (PCTR) Quantitative Assessment: Evaluate per capita telecommunications business revenues. Higher values may indicate

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a greater willingness to pay for digital services. Relevance to Carbon Footprint: Enhanced digital services can lead to more efficient and sustainable practices, helping to reduce carbon emissions.
Coverage Quantitative Assessment: Calculate the number of internet users and cell phone penetration rate per 100 people. Relevance to Carbon Footprint: Increased connectivity can facilitate the spread of emerging technologies that contribute to carbon footprint reducing carbon footprint Be Controlled Under Activism
Energy Mix Quantitative Assessment: Calculate the ratio of coal consumption to total energy consumption. Relevance to Carbon Footprint: Reducing reliance on coal and increasing the use of renewable energy sources can significantly lower carbon emissions.
Level of Economic Development Quantitative Assessment: Evaluate GDP per capita at constant 2010 prices. Relevance to Carbon Footprint: Higher economic development can provide the resources and motivation to invest in clean, sustainable technologies.
Technology Level Quantitative Assessment: Evaluate the share of science and education expenditures in the local general budget expenditure. Relevance to Carbon Footprint: Investment in science and education can spur innovation in technologies that reduce carbon emissions.
Financial Development Level Quantitative Assessment: Calculate the proportion of total loans of financial institutions to GDP. Relevance to Carbon Footprint: Strong financial development can facilitate investment in green technologies and initiatives.
Degree of Fiscal Decentralization Quantitative Assessment: Calculate the ratio of general budget fiscal expenditure to general budget fiscal revenue. Relevance to Carbon Footprint: Fiscal decentralization can empower local governments to implement policies that are more suited to their specific environmental challenges. Relevance to Reduction in Carbon Footprint
Technological Innovations Qualitative Assessment: Assess the adoption rate of clean and efficient energy technologies like smart grids and IoT-based energy management systems. Relevance to Carbon Footprint: Accelerates developing and deploying technologies that directly reduce carbon emissions.
Improve Internal Control Ability Qualitative Assessment: Evaluate the use of automated, real-time monitoring systems for energy use and emissions. Relevance to Carbon Footprint: Improves operational efficiency and compliance with environmental standards, leading to reduced emissions.
Alleviation of Information Asymmetry Qualitative Assessment: Assess the availability and use of digital platforms for sharing best practices in emission reduction. Relevance to Carbon Footprint: Facilitates informed decision-making and enhances communication about environmental efforts, leading to effective emission reduction strategies.

Table 5 **DIGITAL ECONOMY DEVELOPMENT INDEX**
Digital Economy Development Index
Internet Development Level Measurement: Internet Penetration Rate (Number of Internet access users per 100 households). Analysis: A higher internet penetration rate indicates a more developed digital economy. The internet is a key enabler for accessing digital services, sharing information about sustainable practices, and promoting remote work, which can reduce carbon emissions.

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Relevance to DEDI and Carbon Reduction: Higher internet penetration can lead to more efficient operations and the dissemination of sustainability knowledge to carbon reduction.
Internet-Related Practitioner Measurement: Proportion of computer services and software industry employees among urban unit employees. Analysis: A higher proportion developing and implementing, potentially leading to more technological innovations for sustainability. Relevance to DEDI and Carbon Reduction: More professionals in the field can mean more focus on developing and implementing carbon reduction technologies and practices.
Internet-Related Output Measurement: Total telecom services per capita. Analysis: Higher output indicates a more advanced digital infrastructure, which can support technologies and practices that reduce carbon emissions. Relevance to DEDI and Carbon Reduction: Enhanced telecom services can facilitate better communication and the implementation of sustainability initiatives.
Cell Phone Penetration Rate Measurement: Number of cell phone subscribers per 100 households. Analysis: Higher cell phone penetration can lead to increased access to information and services related to sustainability and carbon reduction. Relevance to DEDI and Carbon Reduction: Increases access to digital platforms for sustainability information and initiatives.
Digital Technology Application Analysis: The application of digital technology in various fields can contribute to efficiency and innovation, potentially leading to carbon reduction. Relevance to DEDI and Carbon Reduction: Direct impact on the development and implementation of technologies that contribute to carbon reduction.
Technology Innovation Capability Measurement: Number of digital economy-related invention patent applications in the current year. Analysis: More patents can indicate a higher level of innovation in the digital economy, including innovations that can reduce carbon emissions. Relevance to DEDI and Carbon Reduction: Indicates the capacity for technological innovation that can contribute to carbon reduction.
Digital Finance Development Level Measurement: Level of digital financial inclusion. Analysis: Digital finance can enable investments in sustainable projects and technologies. Relevance to DEDI and Carbon Reduction: Enhances the ability to finance and invest in carbon reduction initiatives.

Integrated Model Relevant to India

The analysis reveals the multifaceted influence of various factors on carbon emissions, including R&D investment, digital development, financial risk, and socioeconomic considerations. A comprehensive, integrated approach involving these factors is essential for effectively reducing carbon emissions and advancing towards sustainability goals. The emphasis on renewable energy consumption, digital finance, smart cities, and targeted policies for different socioeconomic groups further enhances the potential for impactful change in emerging economies, contributing to global efforts for carbon emission reduction and environmental sustainability. The decoupling of economic growth from carbon emissions is a critical challenge facing emerging economies. The complexity of this issue requires a multifaceted approach, integrating aspects such as research and development (R&D) investment, renewable energy consumption, and digital development. The correlation between these variables and carbon emissions provides a pathway for formulating efficient and effective strategies for carbon emission reduction and sustainability.

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Digital development has the potential to play a major role in reducing India's carbon footprint and achieving its climate goals. By investing in digital technologies, smart cities, green innovation, sustainable finance, and electric vehicles, India can create a more sustainable future for its citizens. India's carbon emission reduction framework can incorporate enhanced energy efficiency across all sectors, promotion of sustainable agricultural practices, and significant efforts towards the protection and restoration of forests. Elevating climate change awareness and advocating for individual action further complement the comprehensive approach for significant carbon emission reduction Tables 1-7.

Table 5
FACTORS RELEVANT TO INDIA

Factors	**Key Points relevant to India**
Role of Digital Development	Digital development could substantially lower India's carbon footprint by enhancing energy efficiency across different sectors such as transportation and industry. - Smart grid technologies can augment the efficiency and reliability of the electricity grid, promoting the integration of renewable energy sources. - Low-carbon transportation solutions: enhanced digital framework supports the development of electric vehicles and expansive public transportation systems.
Smart Cities	Smart cities can lead the low-carbon transition by reducing energy consumption and increasing investment in renewable energy. - Application of sustainable principles strengthens the commitment to reduced carbon emissions.
Green Innovation	Focus on renewable energy, energy efficiency, and low-carbon transportation. - Boosting the green innovation landscape, propelling India towards carbon reduction goals.
Financial Stability	Promotion of green bonds and climate funds underpins the commitment to low-carbon development. - Ensures substantial investment for the proliferation of green technologies.
Socioeconomic Considerations	Addressing carbon emission discrepancies across various social strata enhances the effectiveness of carbon reduction efforts.
Electric Vehicles:	Offering financial incentives and developing a comprehensive charging infrastructure fosters the transition to electric vehicles.
Total Carbon Emissions Computation	Assists in understanding the impact of the digitized economy on carbon emissions.
Dual Nature of Carbon Emissions in Digital Economy	Continuous energy input for digital infrastructure could heighten emissions. - Streamlined digital infrastructure facilitates optimized production processes and an intensified focus on decarbonization.
Important Relevant Factors	Active commitment to environmentally friendly activities and improved factor productivity contribute to carbon reduction.
Potential of Manufacturing Sector	Utilization of advanced digital technologies such as AI and Big Data can optimize manufacturing processes, leading to efficient resource use and lower emissions.

India is increasingly focusing on ESG approaches, which are environmental, social, and governance factors. These factors are considered when making investment decisions and when developing corporate policies and procedures. India can align DII and DEDI with ESG approaches by focusing on investment in digital infrastructure that is energy-efficient and sustainable. This could include data centers that use renewable energy and networks made from recycled materials by promoting digital technologies to reduce carbon emissions. This could use Socio-economic-digital technologies to improve energy efficiency in buildings and transportation and to reduce waste by ensuring that the benefits of the digital economy are shared

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equitably. This could include investing in digital skills training and supporting digital entrepreneurs.

In addressing the interplay between digital infrastructure, the digital economy, and carbon emissions in India, a tailored approach to the Digital Infrastructure Index (DII) and the Digital Economy Development Index (DEDI) is essential. The metrics and methodologies must resonate with India's unique digital landscape and sustainability goals.

Table 6
MAKING DII AND DEDI RELEVANT TO INDIA

Point	Adaptation	Implementation
Revising DII for India	Consider India's prominent secondary sectors and their respective contributions to GDP and emissions; factor in India's diverse workforce and educational levels in assessing digital talent	Employ India-centric surveys and studies for accurate data collection; engage stakeholders across sectors for comprehensive insights
Customizing DEDI for India	Factor in regional disparities in internet access in India; consider urban-rural divisions in cell phone usage	Utilize Indian governmental and independent research agency data for robust metric assessments; collaborate with local communities for grounded insights
Mapping to Carbon Emission Metrics	Use India-specific emission factors for various energy categories; include sources of emissions predominant in India	Coordinate with the Indian environmental bodies for precise emission data; apply regional adjustments for accurate mapping
Impact Assessment	Integrate India's national and state sustainability goals; address the socio-economic dimensions unique to India	Utilize local experts for nuanced impact assessments; ensure the application of regional sustainability frameworks
Technology and Manufacturing	Address India's diverse manufacturing sectors and technology adoption rates	Collaborate with Indian tech and manufacturing stakeholders for aligned strategies
Digital Transformation for Sustainability	Prioritize India's sustainability targets within digital transformation initiatives	Engage with Indian governmental and non-governmental bodies for streamlined implementation
Challenges and Opportunities Analysis	Understand the distinctive challenges and opportunities within India's digital and sustainability landscapes	Conduct India-specific risk and opportunity assessments

When integrating DEDI and DII within the Indian context, it is paramount to make them as relevant and reflective of the Indian digital landscape as possible.for making DEDI and DII most relevant to India, it is crucial to integrate a range of variables from various sectors. Collaborative efforts from different government departments, robust data analysis, and a comprehensive approach are essential to ensure the success of this integration, ultimately leading to a more accurate representation of India's digital economy and infrastructure development. This inclusive approach will offer insights into the current state and pave the way for a digital and sustainable future for India.

Table 7
INTEGRATING DII AND DEDI TO INDIA

Suggestions	**Action**	**Integration**

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Adoption of Digitalization in Rural Areas	Conduct detailed surveys and utilize data from organizations like the Telecom Regulatory Authority of India to measure the reach and impact. Of digital infrastructure in rural regions.	Update the DEDI and DII to include metrics that consider rural digital adoption and infrastructure, ensuring these indices are representative of the entire nation.
Microscopic Perspective on Digital Infrastructure	Undertake case studies on specific digital infrastructure components like data centers and networks to analyze their carbon footprint.	Include these detailed insights into DEDI and DII, aiding in more targeted and effective policy-making.
Analysis of Specific Digital Infrastructure Components	Commission comprehensive studies to assess the individual and cumulative impacts of specific digital infrastructure components on carbon emissions.	Integrate these findings into DEDI and DII to enhance their depth and relevance.
Integration with Renewable Energy and EV Adoption	Collaborate with the Ministry of New and Renewable Energy and the Ministry of Heavy Industries and Public Enterprises to obtain data on renewable energy integration and EV adoption.	Enhance the DEDI and DII by including parameters related to renewable energy and EVs, aligning them with global sustainability objectives.
Alignment of Innovation with Digital Development	Work with organizations like NITI Aayog to analyze how innovation aligns with digital development in India.	Enrich the DEDI and DII by integrating an innovation parameter, offering crucial insights into the innovation-digital development dynamic.
Household Income and Urban/Rural Division	Utilize census data and surveys to obtain data on household income levels and urban/rural divisions.	Make the DEDI and DII more holistic by incorporating these socio-economic factors, ensuring they are reflective of ground realities in India.
Import and Export Impact on Footprint	Analyze data from the Ministry of Commerce and Industry to assess the impact of international trade on India's carbon footprint.	Integrate these aspects into DEDI and DII to lend a global perspective, showcasing their impact on India’s carbon footprint.
Relation between Population Density, Industrialization, Urbanization, and Digitalization	Use data from various government agencies to analyze the relationships between these variables.	Acknowledge and analyze these relationships within the DEDI and DII to enhance their explanatory and predictive power.

CONCLUSION: A MULTIPLE DIMENSION FOR FUTURE RESEARCH

Carbon Emission has been studied on the aspect of environmental concern and its role and responsibilities to maintain a sustainable practice in the business. Various studies have found a significant relationship between carbon emission and its retrospective negative impact on the environment. Moreover, numerical studies have inferred the existence of non-conscious governance in business is responsible for more emission and cause of environmental hazards. Regional, geographical, biographical studies have also been considered as the factor of influence in emitting carbon to the atmosphere. Country-specific research has been conducted to understand the responsibility of the concerned country as well as the region of the same country in terms of exercising good governance in reducing the level of carbon emission. Hence, this integrated litereview research concludes that there are ample opportunities to understand the role of the ESG (Environment, Social and Governance) framework and its role to curb the carbon emission across all the business sectors.

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The synthesis of the Digital Infrastructure Index (DII) and Digital Economy Development Index (DEDI) within India's unique context is a testament to the nation's commitment to sustainable development in the digital age. India's approach, which encompasses urban-rural dynamics, specific sectoral contributions, and national sustainability goals, provides a robust framework for integrating digital transformation with carbon emission reduction. The emphasis on rural digitalization, innovation alignment, and renewable energy showcases India's holistic vision. Collaboration with various governmental bodies, a focus on both macroscopic and microscopic perspectives, and the utilization of comprehensive data sources all contribute to this endeavor. Ultimately, India's tailored adaptation and integration of DII and DEDI emphasize its dedication to a sustainable, digital future, striking a balance between growth and environmental responsibility through carbon reduction.

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Received: 10-Oct-2023, Manuscript No. AMSJ-23-14085; **Editor assigned:** 11-Oct-2023, PreQC No. AMSJ-24-14085(PQ); **Reviewed:** 30-Mar-2024, QC No. AMSJ-24-14085; **Revised:** 29-Apr-2024, Manuscript No. AMSJ-24-14085(R); **Published:** 18-Jul-2024

Citation Information: Agrawal, P., Sen, P., & Mukherjee, S. (2024). The heuristic study to integrate esg with digital economy leading to carbon footprint reduction: an integrated literature review model. *Academy of Marketing Studies Journal, 28*(5), 1-21.