CARBON EMISSIONS DISCLOSURE IN DIGITAL INFRASTRUCTURE AND E-GOVERNANCE

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ABSTRACT

Modern lifestyles of people and businesses, government are largely dependent upon on digital technology, which is used across various sectors like healthcare, fintech platforms. These technologies are linking the world and individuals seamlessly together that's where the digital infrastructure comes into picture and redefined this process and operated efficiently. But functioning of this digital infrastructure like data centres, artificial intelligence, cloud services, web browser and connected devices relies on the vast amount of the electricity, water from the non-renewable resources. Even though these infrastructures bring us the great innovation and increase economic growth of the nation, but it also creates environmental cyber risks. These led to carbon emissions, which traps heat from the sun and make the planet warmer leading to rise in temperature. This in turn contribute to the climate changes such as floods, heatwaves, storms etc. This not only affects operational risks, but it also creates cyber environmental risks that leads to disruptions such as system failures, downtime and power outages. Traditionally cyber laws primarily focus on the data protection, privacy issues, systemic risks, Does not look into the environmental consequences of these digital systems. That's why it is vital to have carbon emissions disclosure for digital infrastructures to strengthen sustainability, cyber resilience and to determine responsibility, transparency of this digital infrastructure. This paper argues that cyber law in India must integrate the environmental accountability with E- Governance under Information Technology Act ,2000 supported by corporate compliance and green computing techniques.

Keywords: Carbon emissions, Digital infrastructure, E-governance.

1.1 INTRODUCTION

The major innovation comes with the significant consequences. India, as developing nation and being world fourth largest economy, becomes growing hub for industries. Industries depend on fossil fuels, electricity, water to do operate. Although it gives economic benefits, it results in generating greenhouse gas like Co2 causing air pollution and affect climate change. As India being third largest emitter of the greenhouse gas and being pledged to Paris agreement, it has committed to reduce emissions intensity of gross domestic product by 45% by 2030 and to achieve net zero emissions by 2070, ensures 50 % of energy requirements from renewable sources.

India is experiencing the digital transformation now, which is made possible due to digital India initiative. The rapid expansion of these digital infrastructures like data centres, artificial intelligence, cloud services, web browser and connected devices relies on large amounts of electricity, water from non-renewable sources. Environmental harm caused by digital infrastructure is itself serious risk making digital systems less reliable and less sustainable. Digital infrastructure has not only reshaped functioning of digital markets, economy, finance but also digital governance making it important to evaluate the environmental aspects of it to achieve sustainability. Tang and Tang 2023 shows that digital infrastructure in Chinese cities has increased carbon emission, per person carbon emissions and overall energy use. carbon emissions contribute to climate extremes such as heatwaves, rainfall and floods. EGUsphere 2024 shows that extreme climate conditions cause problem in electricity supply. power outages rise 20-70 % on very windy days, 80-220 % during heavy rain, 15 -60% in heatwaves and during severe floods 2-5.5 times longer. These disruptions can affect digital systems causing failures, downtime and risk of data breaches. Digital growth and environmental protection go hand in hand it can promote sustainability, can help each other and if it is not managed properly, it can create conflicts. This research differs from traditional environmental aspects such as pollution, climate changes, industrial impacts and focuses on integrating the environmental accountability with E- Governance under Information Technology Act ,2000 supported by corporate compliance and green computing techniques. Digital infrastructure plays dual role it can increase emissions and provide solutions to reduce it. [1]

[1] Tang, Kaijie & Gongyan, Does Digital Infrastructure Cut Carbon Emissions in Chinese Cities (2023). Evidence of the impacts of the climate extremes on power system outages in India, J. Verschuur & S. Balakrishnan, EGUsphere (2024)

According to OCED recommendation of ICT and environment , digital technologies can affect the environment in 3 ways like direct effects life cycle of technology from production to disposing ,enabling effects it is indirect impacts like such as smart grids, AI, Internet of things promoting efficiency in other sectors however this efficiency gains leads to energy consumption and water consumption which generates co2 ,systemic effects refers to behavioural changes and social systems because of spread of digitalization change in consumer patterns, this change can lead to increased demand for digital infrastructure thereby resulting in the energy consumption due to digital dependence and it creates rebound effect . therefore, carbon emissions disclosure becomes essential to ensure accountability, responsibility, transparency for digital infrastructure.[2]

NITI Aayog promotes sustainable digital policies by encouraging data centres, paperless records and energy efficient digital systems. [3]

1.2 LITERATURE REVIEW

Jasper Verschuur & Srijith Balakrishnan, Evidence of Impacts of the Climate Extremes on Power System Outages in India, 8 Nat. Energy 1053 (2023).

This paper presents the empirical evidence showing that how climate extremes such as heatwaves, flood, high winds and intense rainfall can affect India's electricity systems, increasing power outages. This supports argument in this paper that environmental factors generate cyber environmental risks by causing disruptions to digital infrastructure dependent upon continuous power. Circular causation, where digital growth leads to a climate change and climate change weakens digital security.

Ruchi Gaur**,** *Green Computing: Approaches, Techniques and Its Implementation,* 5 **Int'l J. Computer Sci. & Mobile Computing** 227 (2016).

This paper highlights how green computing practices like green usage, green disposal, green design and green manufacturing promotes the energy conversation. Using these methods

[2] OECD, Review of Relevance of the OECD Recommendation on ICTs and Environment, OECD Digital Economy Papers No.3702 (2024)
[3] NITI Aayog, Strategy for New India: Digital infrastructure & Governance (2018).

reduce the environmental footprint of the digital technology. This mechanism has been adopted in this paper.

Oana Pricopoaia, Nicoleta Cristache, Adrian Lupaşc & Dorin Iancu*, The Implication of Digital Transformation and Environmental Innovations for Sustainability,* 14 **Sustainability** 11237 (2022).

This paper states that digitalization helps the economy grow and encourages eco- friendly innovations but also creates developmental problems like high energy use, electronic use and carbon emissions.

Henrik Andersson & Bruno Jullien, *Environmental Sustainability and the Digital Revolution: A Systematic Review of the ICT and Its Environmental Impact (*Toulouse Sch. of Econ., June 12, 2023).

This paper states that environmental impact of the information and communication technology is overlooked, because emissions occur at different stages such as production, use and disposal. This aligns with this paper that digital infrastructure generates hidden environmental harm, which weakens digital security because of circular causation of digital infrastructure growth and climate conditions.

Albandari Al Sowaidi & Rima J. Isaifan, *Click, Store, Emit: The Environmental Cost of Digital Infrastructure*, 4 **Digital Technologies Res. & Appl.** 194 (2025).

Digital transformation through data centres, communication networks and AI systems creates substantial environmental cost in forms of carbon emissions. This supports with this paper environmental impacts of digital infrastructure are over looked. This creates need for carbon disclosure.

1.3 STATEMENT OF RESEARCH PROBLEM

The increasing dependence on digital infrastructure comprising data centres, artificial intelligence, and cloud-based governance systems has led to growing carbon emissions that contribute to climate change. Yet, these emissions remain largely unclassified and undisclosed within India's environmental reporting frameworks. While the Information Technology Act, 2000 forms the legal foundation for e-governance by ensuring integrity and authenticity of

electronic records, it does not extend these principles to cover the accuracy or environmental verification of data related to carbon emissions. This creates a critical gap where digital governance operates without environmental accountability, and climate change risks linked to digital operations remain legally unaddressed. The research problem, therefore, concerns the extent to which the existing legal framework under the IT Act, 2000 and e-governance mechanisms can respond to the environmental implications of digital infrastructure and contribute to climate accountability

1.4 RESEARCH OBJECTIVE

1. Analyze the relationship between digital infrastructure, carbon emissions and cyber environmental risks.

2. Explore the international standards such as the Greenhouse gas protocol, Carbon disclosure project, ISO 14064, BRSR and how it can be applied in the terms of the India's digital infrastructure

3. Integration of environmental compliance in digital governance under information and technology act 2000.

4. To identify the challenges and recommended green computing techniques to reduce emissions of digital infrastructure.

5. Analyze role of accuracy as component or dimension with integrity

1.5 RESEARCH QUESTIONS

1. How does digital infrastructure contribute to carbon emissions and climate risks?

2. How can international standards like GHG protocol, ISO 14064 can be adapted for digital infrastructure?

3. How can environmental compliance be integrated into e-governance under the Information Technology Act, 2000 to ensure transparency and sustainability in digital operations?

4. Why is "accuracy" essential in environmental data, and how can it be recognized as a dimension of integrity under the Information Technology Act, 2000 to ensure reliable

verification of carbon emissions data?

5. What are the legal mechanisms required to ensure mandatory carbon emissions disclosure through existing portals.

1.6 SCOPE & LIMITATION OF STUDY

This study examines the carbon emissions and environmental impact of digital infrastructure, focusing on the applicability of environmental compliance within e-governance under information and technology act 2000. It also considers international standards such as the Greenhouse Gas Protocol, Carbon Disclosure Project, ISO 14064, along with India ‘s BRSR framework have been looked for their relevance to India’s digital infrastructure.

This study is confined to doctrinal and analytical approach, so empirical emissions data are not measured directly. Technologies advancements in AI, cloud computing and occur rapidly which may influence future trends beyond this study ‘s time frame.

1.7 RESEARCH METHODOLOGY

This research adopts a doctrinal method to explore the integration of environmental compliance within e- governance framework under information technology Act 2000

2. CLIMATE CHANGE AND DISPRUTIONS OF DIGITAL INFRASTRUCTURE

- **Physical and systemic risks**

Digital infrastructure like web browsers, cloud services, data centres, AI services become a heart and brain for the digital technology. When people think about climate change and digital infrastructure, they often picture this as a visible physical damage such as flooded data centres, server facilities are damaged due to extreme heat etc. Even though physical harm is real, severe and obvious, it is surface level problem which could be solved. For instance, in 2024, hurricane Helene happened in North Carolina affecting the telecommunication infrastructure. This storm caused heavy rainfalls, landslides, tornadoes and led to power outages, disrupt communication lines.[4]

[4] Disaster Tech lab, Comprehensive Report on the Impact of Hurricane Helene on Telecommunications Infrastructure and Services in North Carolina (2024)

- **Circular Causation**

Deeper down lies a hidden risk, systemic risks to digital infrastructure. Each part of digital infrastructure is interconnected, it does not function independently. It depends on electricity grids, Fiber networks, cooling systems, semiconductor supply chains etc. when one part of digital infrastructure had failed means other interconnected parts are also said to be affected. This means even minor climate change or environmental factors can have chain reactions which can cause cascading failures of interconnected digital systems, the failure of one part may spread to other parts. This may end up causing disruptions such as downtime, power outage, system failures and risk of data breaches, e-commerce interruptions, can increase exposure to cyber-attacks. these disruptions can affect the confidentiality, integrity, availability of data. Thereby this confidentiality, availability, integrity becomes important of digital infrastructure and ensures digital reliability. At same time growing demand for data, AI services, cloud services increase so does the need for power and cooling the digital infrastructure. This in turn needs higher energy consumption and leads to climate change. Digital system not only merely suffers from the climate change it also contributes to it. It has circular causation which is not recognized properly. This circular causation creates a cycle where digital growth increases climate change and climate change weakens digital systems.

Developed countries have advanced technology to deal with climate change, whereas developing countries lack such type of technology to deal with climate change, so they heavily rely on coal based electricity grid. This, in turn results in generating carbon emissions and exposure to climate change, thereby creating vulnerabilities for the digital systems.

Climate change and digital infrastructure have a dual and interconnected relationship. On one hand Climate change affects the digital systems by creating systemic and physical risk. On other hand, the dependency of digital technology and its growth increases carbon emissions, making climate change worse. This led to circular causation climate change harms digital systems and expansion of digital technology led to climate change. Therefore, carbon disclosure is necessary to ensure transparency, accountability. [5]

2.1 DIGITAL INFRASTRUCTURE CARBON'S FOOTPRINT

[5] Climate Sustainability Directory, How Does Climate Change Affect Data Security? (2025)

- **Overview of emissions sources**

Digital technologies contribute to 4 % of greenhouse gases in the world. As world depend on digital technology, this digital technology needs internet to operate. A searching in browsers through the internet is like sending and receiving information in the form of data. Like from opening web page, streaming videos, sending email etc where data goes from the device through the internet to data centres. Where users are concerned about their activity in digital sphere behind this there is network which requires energy consumption and contributes to carbon emissions at every step. Even though it is convenient from perspective of the user means more power usage in background. Data centres are filled with the computers and is running 24/7 which need constant energy consumption to power servers and cooling systems to avoid overheating. Even though data centres use renewable energy instead of non-renewable energy but maintaining these data centres still leaves environmental footprint. Cloud services depend upon this data centre thereby it stores and process data on remote servers. To access, to upload, to download files, to retrieve, to send or to store device must connect to the servers through the internet. By using internet only cloud services can transfer data between the devices and servers. All these steps require energy consumption and generating carbon emissions. Every action done on the internet contributes carbon emissions, linking everyday digital activity to climate change.

As digital technology needs internet to operate, using internet to access to web browser. This single webpage generates around 1.76 kg of co2 equivalent for each page view. According to data from the website emissions .com carbon calculator, each visit to google webpage generates of 0.19g of co2. According to similar web.com website, 82.6 billion people visits google in single month with average visit duration is 10 minutes 14 seconds and 8.86 pages per visit. From these estimates we can infer that most activities are done in online through the internet and there is user interaction with google, this shows that wider the infrastructure more energy consumption and carbon emissions unless they follow sustainable or green computing methods.

According to the European commission study which states that between 2018 and 2025, there will be a 28% increase in data canter energy consumption. Cloud services become heart of the digital infrastructure by storing the personal, corporate and confidential data and processed through the remote servers in data centres. Cloud services contribute 3 % to world's energy consumption and which expected increase to 8 % in coming years. Even though it seems to be

virtual yet relies on physical networks that requires vast amounts of electricity. [6]

- **AI's Growing impact**

Artificial intelligence becomes part of day life, gains widespread after covid era. Applications such as ChatGPT, Gemini's image generator Nano Banana, Harvey, and numerous other tools are being applied in various fields which are transforming societies, economies and legal systems globally. In 2023, Lawrence Berkeley National Laboratory suggests that AI operations could use over half of the electricity in U.S. data centers, resulting in an annual consumption of 22% of American households. In 2025, 78 % of the organizations use AI function in their business. In 2024, 55% of the organizations use AI function in their business. There is a significant increase in use of AI across various sectors this year.

ChatGPT consumes 0.03 to 0.04 Watt hours of the energy, emits 0.15 grams Co2. whereas Gemini AI consumes 0.24 Watt hours of the energy, emits 0.03 grams Co2. These figures indicate that amount of energy consumption and carbon emissions can differ across vary AI models. Even individual interactions with these AI models can contribute to energy consumption lead to environmental impact. When millions of people around the globe perform the same thing, all these amounts add up and create an overall influence on the environment.[7]

- **Invisible Harms**

Unlike traditional industry, harm is visible through burning fossil fuels or pollution through smoke or waste. where in digital infrastructure harms remains invisible and this harm arise not only from single source but also consist of numerous factors attribution, scattered too. This must Studied properly to know factors attribution to evaluate these harms and find ways to measure and reduce them. As digital services expand, the demand for data generation, cloud computing and artificial intelligence also rises which in turn it increased the energy consumption and carbon emissions. It states need for regulatory attention towards the energy efficiency and carbon transparency. Carbon disclosure mechanisms and investing in green

[6] Rémi L., The Environmental Impact of the Web in Numbers (2024), Atipik. Climate Action Accelerator, Web browsers and search engines (2025). Howarth, Josh, 34 Amazing Cloud Computing Stats (2024). GreenMatch, Environmental Impact of Technology: Stats, Trends and Insights (2024). Spowart, Blair, Cloud Emissions: The Ultimate Guide to the Carbon Footprint of the Cloud in 2025, seedling.

[7] Zewe, Adam, Explained: Generative AI's Environmental Impact, MIT News (2025). Jennifer L., ChatGPT Hits 700 M Weekly Users, But at What Environmental Cost? CarbonCredits (2025)

computing methods can ensure sustainable digital governance in the digital era.

2.2 CARBON DISCLOSURE METHODS

Covers carbon disclosure methods such as greenhouse gas protocols, carbon disclosure projects, ISO 14064, European union corporate sustainability reporting directive, Greenhouse gas reporting programs.

- **Greenhouse gas protocol**

Greenhouse gas protocol is an international accounting standard, developed by the world resources institute and world business council for sustainable development. It was created to in response to support principles of UNFCC, implementation of emission measurement and reporting obligations under the Kyoto protocol and Paris Agreement.

Greenhouse gas protocol is an important framework for measuring the greenhouse gas globally. It provides standards for carbon accounting and reporting. It comprises six greenhouse gases, such as carbon di oxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride. It classifies emissions into three different scopes.

Scope 1 describes direct emissions, which are emissions that originates from an organization owned and controlled source.

Scope 2 describes indirect emissions, which are emissions that results from the use of purchased energy consumption.

Scope 3 describes other indirect emissions, which include all other indirect emissions that happen along the value chain and are not directly under an organisation’s control.

GREEN HOUSE GASES PROTOCOL SCOPE	**DIGITAL INFRASTRCTURE**
SCOPE 1 DIRECT EMISSIONS	Data centres use diesel generators for backup power. Refrigerant leaks in cooling systems.

SCOPE 2 INDIRECT EMISSIONS	Electricity used to power servers, cloud facilities, AI compute clusters, webpage
SCOPE 3 ALL OTHER INDIRECT EMISSIONS	Server & chip manufacturing, hardware components, e-waste. Creation and use of webpage. Power consumption by end user accessing digital systems.

The greenhouse gas protocol requires organizations to report their greenhouse gas emissions in a manner that is relevant, complete, consistent, transparent, accurate.

Relevant means including all information that influences decisions and th organization's effect on climate.

Completeness refers to include all required emissions. Consistent ensures that same methods are followed every year, allowing for comparison and the identification of trends.

Transparency involves showing methods, presumptions and limitations used in the reporting process.

Accurate refers to use best available data and efforts to minimize errors. This reporting is important for stakeholders to understand their emissions and mitigation measures.

1. Reporting

Report should clearly specify what type of organization are covered and the parts involved in assessment such as business unit, production sites, subsidiaries or other operations. It must also explain how organizational and operational boundaries are determined, including the approach used such as equity share approach, financial control approach, operational control approach. The report should differentiate between mandatory and optional reporting. Scope 1 and 2 emissions are mandatory reporting, while scope 3 are optional reporting. Organisation must disclose their greenhouse gas emissions in both metric tonnes and co2 equivalents. Base year must be identified to compare current emissions, to assess whether similar trends, pattern that occur and explain any change that affects patterns such as new facility, increased production, acquisition. They must show how emissions are calculated including the methods used, data collection techniques, emissions sources. if any emissions source is excluded, it must be

disclosed and justified. Additional details may include Scope 3 emissions category depending upon emissions by location or product, emissions per unit or per employee and any emission reduction measures undertaken. it should also indicate whether the data was verified by the third party and align with current climate goals.

2. Verification

Verification is an independent assessment that ensures the transparency and accuracy of reported greenhouse gas emissions in line with recognized reporting standards such as GHG protocol and ISO 14064. It strengthens the stakeholder's confidence by confirming that the report reflects organization's climate impact.

Verification can be external or internal.

- Internal verification supports internal monitoring and control
- External verification provides third party assurance, provides higher credibility to the public, stakeholders and regulators.

The process is based on the principle of materiality, which considers whether an error, misstatement or omission could influence stakeholders' decisions. If the inclusion or exclusion of information changes the perspective or interpretation contained in the report, then it deemed to be material. Material discrepancy occurs due to incorrect data, errors, misstatement, incorrect calculations, alter the actual intended meaning or value. Generally, an error is exceeding the 5%of total emissions is considered material, even smaller discrepancies may qualify if it affects the outcomes. verifiers define the scope and boundaries of the assessment, review calculation and measurement methods. They also evaluate documents such as energy bills, emission factors and base year data. if errors are found, organization must correct them. The verifier issues a statement that emissions are free from major errors and can suggest improvements for future reporting.[8]

- **Carbon disclosure project**

The carbon disclosure project is a nonprofit organization, that operate a global disclosure

[8] World Resources Institute & World Business Council for Sustainable Development, The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard (Revised Ed.) (2004)

system to measure and know environmental impacts. Each year, it issues questionnaires in three areas such as climate change, water security and forests. Must collect data from the organization on their environmental impact. Organization must disclosure their Scope 1, Scope 2, Scope 3 of green hose gas emissions along with other climate risk which is submitted through their online CDP portal. Based on these disclosures CDP assigns score for organization ranging from A to D

Score A -Has science based targets and proven emission reduction

Score B- Taken steps to reduce emissions

Score C- Awareness of risk and impacts

Score D - Organization started to disclose their information

Organization achieving A gain a reputation and attract investors by demonstrating serious commitment to climate action.[9]

- **ISO 14064**

The ISO 14064 framework provides standards for quantification, reporting and verification of greenhouse gas emissions.

Part 1 - Establishing baselines, defining boundaries and converting the emissions into co2 equivalents.

Part2 - Baseline determination for emission reduction projects and assessing that claimed reductions are valid.

Part 3 - Independent validation, verification through audit process.

- **European union corporate sustainability reporting directive**

The European union corporate sustainability reporting directive builds on non-financial reporting directive. It mandates disclosure of environmental, social, governance including greenhouse gas emissions, sustainability targets, risk management practices. Reports must be

[9] IBM, What is the Carbon Disclosure Project (CDP)?, IBM THINK (2024)

assured by third party and submitting in the European single electronic format. It is based on the double materiality, which requires organization to report how their activities affect the environment and how sustainability issues impact their operations. it applies to large EU companies and non-EU company generating over 150 million in annual EU revenue.

- **Greenhouse gas reporting program.**

In US, the environmental protection agency mandates reporting of greenhouse gas emissions under greenhouse gas reporting program. Organization emitting more than 25,000 metric tonnes, co2 equivalents must submit their data electronically through EPA using the electronic greenhouse gas reporting tool.[10]

2.3 INDIA 'S COMMITMENTS AND REPORTING MECHANISMS

India, as signatory to Paris agreement has committed to achieve net zero emissions by 2070. It adheres to GHG protocol and ISO 14064 standards. Submissions of national communications and biennial update reports are filed electronically with the UNFCCC through their online portal and in prescribed formats.

The Business responsibility sustainability reporting introduced by Securities and Exchange board of India mandates India's top 1000 listed companies to disclose their Environmental, social, governance factors such as environmental protection, human rights and ethical governance. It corresponds with the Global reporting initiative and climate related financial disclosures. It must become a part of a company's annual report, both financial and non-financial disclosures. Companies submit it in PDF and XBRL formats through the

- NEAPS – filing with the National stock exchange
- BSE - filing with the Bombay stock exchange.

Additionally, filings may also be uploaded on MCA21 portal, an e governance system that enables submissions of statutory and compliance documents.

India 's national greenhouse gas emissions, such as national communications and biennial update reports does not separate digital infrastructure emissions into different category,

[10] Lucas Bettle, "GHG Reporting: A Comprehensive Guide," ERA Environmental Software Solutions (2025)

however these emissions are accounted within energy and industry sectors. In 21century industries heavily rely on digital infrastructure and technology, it is vital to address digital infrastructure separately. Digital technology can both increase and reduce remissions, like emissions are generated and digital tools are introduced to reduce these emissions in turn creates emissions resulting circular causation. For this reason, having state levels emissions or inventories that include digital infrastructure is important to track and manage emissions. Because each state differs in terms of industrialization levels, extent of digital infrastructure and availability of the renewable energy. This essential to achieve the net zero emissions by 2070.[11]

2.4 CARBON EMISSIONS DISCLOURE FOR DIGITAL INFRASTRUCTURE

It allows for integration emission reduction targets into state climate action plans and helps to identify emissions hotspots, also encourages the development of data centres and IT facilities powered by renewable energy sources. Decentralized disclosure mechanism increases accountability, transparency and responsibility in cyber and environmental governance. The GHG Protocol and ISO standards such as 14064 recognize principles such as relevance, completeness, accuracy, consistency, transparency for emissions reporting which can be applied to digital infrastructure. Emissions inventories should cover all digital operations including telecommunications, cloud facilities, data centres and digital manufacture. The inventory must include all scope 1,2, and 3 emissions from private and public digital entities operating within each state. Reporting method consistent across years to enable trend analysis and methods must be disclosed along with emissions factors, data sources necessary for public scrutiny. Emissions data should be verified by third party audit to ensure accuracy. Operational boundaries should classify scope 1 ,2,3. State must prepare annual state digital infrastructure carbon reports aligned with existing corporate methods. It should include energy consumption data, equivalent co2 and emissions per terabyte of data processed. There should be reductions measures, and it must be documented. Verification of data should follow ISO 14064 Part3 and India's BRSR standards. Digital emissions reporting should be integrated with existing compliance including MCA21 and BRSR which enhances governance coordination. Emission data discrepancies greater than 5%must be corrected before it is published.

[11] Ecovadis , India's Business Responsibility and Sustainability Reporting (2025)

2.5 E-GOVERNANCE AND DIGITAL TRANSPARENCY

The report from the Parliamentary standing committee (2024-2025) under Ministry of Home affairs and Ministry of Electronics and information technology, indicates the need to strengthen cybersecurity mechanisms to address cybercrimes such as phishing, ransomware and identity theft. To address this issue, recommended the digital forensics and AI based monitoring systems for real detection and analysis. However, the expansion of cyber infrastructure leads to greater computational demand. Blockchain Verification, Continuous data processing for AI based monitoring systems, digital forensics operation in the infrastructure requires high computational power and large scale storage systems due to their energy intensive nature. Although these initiatives prevent cybercrime and strengthens the digital security, they contribute to unintended environmental footprint due to energy consumption and carbon emissions from servers, cooling systems and 24/7 digital operations. Thereby digital infrastructure increases carbon foot print.

The term digital governance refers to how governments use digital tools and technologies such as online portals, AI based systems and artificial intelligence, Cloud services, data centres to provide services, maintain transparency and manage information. Currently these systems mainly focus on data security, privacy and cyber security. However, they often overlooked the environmental cost such as carbon emissions brought on by constant energy consumption. Digital governance must integrate environmental compliance. It means that all digital operation run by government, intermediaries or private entities must adhere with sustainability norms such as using energy efficient algorithms, renewable energy sources and maintaining carbon disclosure and energy usage in line with India's climate goals.

According to the information technology act 2000, the principle of integrity stipulates that a record must be remain complete and unaltered after creation, which ensures the security of electronic records. However, integrity cannot be limited to assurance of non-tampering alone in context of carbon emissions disclosure. Accuracy is necessary for environmental compliance in digital governance since incorrect information can mislead regulators, investors and the public.

In order to ensure that electronic records remain unaltered and verified, Section 3 of the Information and technology act requires affixing of the digital signature using an asymmetric cryptography. It establishes the technical foundation of integrity but leaves out the accuracy of

such content. Environmental compliance in digital governance, especially in carbon accounting, lifecycle assessment and sustainable disclosures where accuracy becomes of important component or dimension of the integrity. The accuracy of carbon emissions inventories and emissions depends not just on data security but also on transparency of the information. Accuracy is emphasized as reporting principle in international frameworks such as greenhouse gas protocol, ISO standards. Inaccuracy weakens sustainability assessments and weakens public confidence in digital governance. To integrate accuracy, verifiability and reliability in environmental compliance, the integrity must evolve.

Section 4 states that electronic records such as carbon emissions audit, environmental audit, sustainability filing and other reports submitted in online portals cannot be denied legal effect simply because they are in electronic form. They hold the same legal status as paper based records and remain accessible for future reference, thereby creating trust and transparency in digital sustainability reporting.

Section 5 emissions disclosures, environment audit submitted through online portals MCA21, BRSR must be authenticated securely. Using electronic signature ensures that submissions are verified, valid and later cannot be changed, forged.

Section 6 facilitates electronic submissions of business responsibility and sustainability reports, MCA21 filing and other carbon related audits, greenhouse gas inventory in digital platform. This ensures carbon emissions data, inventory remain secure, authentic and legally valid.

Section 6 A Government can appoint authorized service providers to manage digital disclosure systems that can collect, verify and publish carbon emissions data. Their tracking portal should be integrated with MCA21 filing, BRSR. It provides for application programming interface can link carbon emissions tracking databases such as MCA21 and BRSR for data sharing and transferring for verification. They can collect fees for their services.

Section 7 allows for retention of records in electronic form. Electronic emissions data, once filed through the portal like MCA21 filing, BRSR retains validity over time. Which facilitates long term storage of emissions data, which required for inventory reporting. Government can maintain emissions data for trend analysis, auditing, verification and minimize cyber environmental risks such as data leak.

Section 7 A Enabling the auditing of digital carbon emissions, it's verification and ensuring that carbon inventories are credible and valid.

Section 9 Does not compel organizations to use or accept the electronic record if they lack necessary infrastructure. some state may adopt digital filing immediately, while others may depend upon the transformation of infrastructure or cybersecurity risk may adopt it.

Section 10 enables digitally signed emissions filings under MCA21 filing, BRSR become legally binding, verifiable and cannot be tampered.[12]

2.6 GREEN COMPUTING TECHNIQUES

Green computing is a phenomenon, which attempts to reduce the adverse impacts of information technology operation on environment and develop a sustainable digital infrastructure. Sometimes it is referred as ecofriendly computing. To promote an ecofriendly environment, green computing practices must be executed in every area from product production to disposal.

Four pillars of green computing

Green Usage - implies usage of energy of digital infrastructure in way to save energy consumption such as putting into sleep modes, shutting down inactive systems, switching to light clients that consume less energy than regular computers .Advanced configuration and power interface helps operating systems to control amount of power given to the each part of digital infrastructure by reducing energy consumption and cooling requirements about 40 % of data centres energy . if this fails during outages, it can disrupt the monitoring tools, which in turn results in cyber risk linking energy efficiency and cyber security.

Green disposal -Main aim is to reduce e-waste by recycling and reusing old electronic equipment. Improper disposal increases scope 3 emissions and which, in turn resulted in cyber risks since a device or system is improperly disposed means can result in data breaches and leakage of information, thereby weakening the digital security.

Green design – It implies making use of devices and systems in a way that use less energy and

[12] India, Information Technology Act, 2000(Act No.21 of 2000) (India)(2000)

last longer. Such as using SSD instead of hard drives, low power servers, LED screens. Design a device or system in a way to minimize the damage and instead of purchasing new parts, can replace parts that are in default which in turn reduces the harm. if system or device is not built in a way to reducing a heat in hot weather, overheating can result in breakdown and cause a security risks.

Green Manufacturing – It implies making use of devices and systems in a way that is safe for environment from the start. Instead of using lead, chromium, cobalt use nontoxic and recyclable materials. Follow clean production methods to reduce pollution and wastage generation. Use ethically obtained resources rather than toxic production chains and unsafe mining. Because technology supply chains are interconnected across various countries, this might result in ethical issues, cyber risks and international disputes.

Adhere to the green computing approach such as product longevity, terminal servers, virtualization, power management and efficiency, power supply, storage and display efficiency, data centre design. Digital technologies are beneficial for the environment, when it is used effectively. Clouding computing which contributes 5.3 % to carbon emissions globally, it can reduce usage of energy consumption through the adoption of virtualization and server sharing. When 5G technology combined with fog computing which increases the system performance and uses 68% less energy consumption in many applications, by bringing the data processing close to users. Most of global electronic waste is dumped in developing countries, end up in unsafe recycling sites, causing pollution and health problems. In order to solve this problem concept of Internet of Things is adopted, which focuses on making interconnected devices, systems more environment friendly. It encourages use of non-renewable energy sources, nontoxic materials and energy efficient cloud computing.[13]

2.7 CHALLENGES IN CARBON EMISSIONS DISCLOSURE FOR DIGITAL INFRASTRUCTURE

There are structural, technical, institutional challenges in implementing mandatory carbon

[13] Karmankar, Pooja S.& Tadse, Prof.Praful, Application of IoT in Green Computing, 8J. Emerging Technologies & Innovative Research (2021). Bijapur, Chirag S., Gnanesh., & G. Pramod Sai, Green Computing Approaches for Data Centres and Storage Systems: A survey of green Computing Strategies for Resource Efficiency, SSRN Elec. (2023). Haque , Safwana & Haque , Farhana, Mitigating Carbon Footprint via Efficient Green Cloud Computing : A review ,10 J. Comp.& Info.Tech .(4)(2019)

emissions disclosure for digital infrastructure in India

- **Emissions Identification**

  Because digital activities involve several factors such as users, cloud providers and data centres, then it becomes difficult to assign responsibility of the emissions.

- **Measurement Precision**

  To what degree the emissions should be measured. Every server, every AI query, every terabyte of data processed may all calculated in a numerous way. if it is too general, may conceal energy waste. However, if it becomes too much detailed may end up creating too much data. Having single standards to measure and compare emissions is challenging.

- **Differences among the state**

  Due to variations in digital and energy capacities around the state, uneven reporting becomes burdensome.

- **Limited capacity**

  Small and medium sized firms are unable to do conduct carbon audits because of Financial and technical constraints.

3. CONCLUSION

In order to address environmental impacts caused by the digital infrastructure like data centres, cloud services, AI which significantly increase energy consumption and carbon emissions, this paper discusses how carbon disclosure of digital infrastructure can be integrated into environmental compliance within digital governance under information technology act 2000. Cyber security and sustainability are closely connected, stable environmental conditions are necessary for the secure digital systems and carbon disclosure, energy efficient infrastructure and green computing methods are necessary for responsible digital governance to mitigate the harm.

Integrating environmental compliance into cyber law strengthening the digital trust, enhance transparency in emissions reporting and ensuring that India's transformation remains both secure and sustainable. Such integration will improve the accuracy and reliability of carbon emissions disclosure of digital infrastructure, support standardized emissions inventories and align with India's commitment under Paris agreement. Digital growth and environmental compliance are interdependent cornerstones of digital sustainable governance not opposing goals.

4. SUGGESTIONS

- By linking the existing systems, create a digital environmental compliance portal that makes reporting streamlined, digital and transparent.
- Develop a digital environmental compliance rule that should include third party verification and legal obligations for carbon emissions disclosure digital infrastructure.
- Require state wise digital emissions inventory for emissions of scope 1,2,3.
- Include environmental compliance within digital governance, which would require periodic carbon disclosure and energy usage reporting.

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