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Usage of Environmental Sensor Networks in Green Buildings: Comparative Analysis from an Indian and International Lens

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In the existing legal status quo of India, it is observed that 'Environmental Sensor Networks' are the pivotal point for green buildings in India. Such networks are the stepping stones towards advanced sustainability and technological innovation. This is because these networks can monitor and provide real-time and historical data on various environmental parameters like temperature and energy profiles of individuals to enhance energy efficiency and minimize carbon footprints. However, there are multiple complexities in implementing such networks in green buildings in India, primarily legal frameworks and environmental policies. This problem is exacerbated as no express law exists for ESNs in India. Because ESNs' potential for contributing to the environmental sustainability of green buildings is significant, it becomes imperative to navigate through the legal and regulatory terrain to govern and regulate their deployment, utilization, monitoring, maintenance, and audit. Thus, in this research article, firstly, the authors shall discuss the definition, functionality, and growth of Environmental Sensor Networks. Secondly, the authors shall discuss the pros and cons of implementing Environmental Sensor Networks in green buildings. Thirdly, the authors shall conduct a legal analysis for implementing Environmental Sensor Networks in green buildings from the perspective of laws of India and the European Union. Lastly, the authors shall provide robust recommendations for a seamless transition of India toward using Environmental Sensor Networks in its green buildings.

Keywords: *sensor networks, environment, India, green building.*

INTRODUCTION

Legal Definition and Functionality -

India ranks as the world's third-largest energy consumer, trailing behind China and the United States.[1] India's energy consumption is projected to surge by 3% until 2040, outpacing the global average of 1%, establishing it as the fastest-growing energy market.[2] Due to this energy demand, the Indian government is proactively seeking sustainable domestic solutions to mitigate the environmental impacts of such growth.[3] One such potential solution involves the development of smart green buildings that integrate both green (sustainable) practices and smart technologies. These buildings employ innovative technology that allows for real-time environmental monitoring, management of energy consumption, and an overall reduction in environmental footprints.[4] In this context, it is argued that Environmental Sensor Network (**ESN**) technology should be integrated into green buildings to mitigate the environmental impact of this growth.

ESNs, as the term suggests, are networks of sensors that monitor various environmental parameters like air quality, sound, temperature, light, and other similar parameters.[5] According to 'Black's Law Dictionary,' these sensors are defined as a '*device that detects changes in environmental conditions or the state of another device and sends the information to another place.*'[6] This implies that ESNs are not just a collection of individual sensors but are integrated into a network of various other sensors that collectively monitor, analyze, and communicate environmental data. This data processing is carried out by an array of sensor nodes equipped to measure specific environmental parameters like air, sound, temperature, and other similar parameters.[7]

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[1] 'India's Hydrocarbon Outlook - 2022-2023' (*Directorate General of Hydrocarbons Ministry of Petroleum and Natural Gas*) <https://www.dghindia.gov.in/assets/downloads/ar/2022-23/13/> accessed 04 July 2024
[2] *Ibid*
[3] *Ibid*
[4] Jacob Kriss, 'What is Green Building?' (*UGBC*, 06 August 2014) <https://www.usgbc.org/articles/what-green-building> accessed 29 March 2024
[5] Jane K. Hart and Kirk Martinez, 'Environmental Sensor Networks: A revolution in the earth system science?' (2006) 78(3-4) Earth Science Review <https://doi.org/10.1016/j.earscirev.2006.05.001> accessed 02 April 2024
[6] *Black's Law Dictionary* (vol 78, 2nd edn, West Publishing Co 1910)
[7] Andrew Nellis, 'To Predict Environmental Changes, Researchers Create a New Generation of Wireless Sensor Networks,' (*UChicago*, 12 January 2023) <https://pme.uchicago.edu/news/predict-environmental-changes-researchers-create-new-generation-wireless-sensor-networks> accessed 22 March 2024

These arrays of nodes are then interconnected through a wireless or wired network infrastructure, enabling them to transmit collected data to a central processing unit or server. This processing enables the ESN to generate immediate responses to changing conditions, such as adjusting the heating, ventilation, and air conditioning (**HVAC**) settings in a building to optimize energy consumption based on occupancy levels and external weather conditions.[8]

Thus, it can be understood that deploying ESNs in green buildings and urban projects can lead to energy efficiency and cost improvements for three reasons. *Firstly*, ESNs carry out precise monitoring and management of energy consumption in buildings, which leads to a drastic reduction in energy wastage, thereby mitigating the environmental impact of India's energy usage. *Secondly,* energy reduction through ESNs helps reduce reliance on conventional energy sources such as fossil fuels, leading to a decrease in greenhouse gas emissions and the fulfillment of sustainable development goals. *Thirdly*, the improved energy efficiency that arises from deploying ESNs results in cost savings for businesses, which can be reinvested into further technological innovations or infrastructural improvements, contributing to growth and sustainability.

Growth and Development of ESNs Worldwide -

The growth and development of ESNs have occurred via an amalgamation of technological innovations, increasing environmental consciousness, and the escalating need to address and mitigate global environmental challenges. This evolution can be traced back to advancements in sensor technologies, such as miniaturization or enhanced sensitivity and connectivity, expanding the deployment and application scope of ESNs across diverse environments. Further, the rise of the 'Internet of Things' provided networks and connectivity that facilitated aggregation, transmission, and processing of data development from various sources, providing a better understanding of environmental conditions.[9]

Several countries worldwide have leveraged ESNs to achieve their sustainable development goals. For instance, ESNs have been vital in optimizing agricultural outcomes in Kenya by

[8] *Ibid*
[9] *Ibid*

enabling precision farming practices that conserve water and increase crop yields.[10] This leveraging has helped Kenya attain SDG-2, i.e. 'zero hunger'. In China, ESNs are being utilized to monitor air quality amid its rapid urbanization phase, directly contributing to SDG-11, i.e., the achievement of sustainable cities and communities.[11] Similarly, in the Netherlands, ESNs are being utilized in water management systems by detecting pollutants in water bodies and optimizing water use in agriculture, advancing SDG-6, i.e. clean water and sanitation.[12]

ESN IN THE REAL ESTATE SECTOR AND GREEN BUILDINGS: A MAP OF PROS AND CONS

Pros of Implementation of ESNs -

Implementing ESNs in the real estate sector and green buildings presents several benefits regarding energy efficiency and environmental protection. There are several potential benefits of integrating ESNs in green buildings, which are as follows. *Firstly*, ESNs ensure enhanced monitoring and safety of indoor and outdoor environmental conditions within properties and green buildings. This is because ESNs leverage many sensors to monitor multiple environmental parameters continuously. This results in the early detection of issues such as gas leaks, mold, or poor air quality, enhancing safety and minimizing damage. Thus, ESNs pre-emptively help tackle several safety matters, saving costs related to potential damages and legal liabilities.

Secondly, ESNs play a vital role in optimizing energy usage. This is because ESNs continuously adjust heating, cooling, and lighting based on real-time data in properties and green buildings. This adaptability ensures that energy is not wasted, enhancing energy usage efficiency. Such optimization significantly lowers operational costs, reduces the property's and green building's carbon footprints, and contributes to the broader goals of environmental sustainability and compliance with national and international environmental standards.

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[10] Jared Makario et. al., 'Long Range Low Power Sensor Networks for Agriculture Monitoring- A Case Study in Kenya' (IST-Africa Week Conference (IST-Africa), May 2019)
[11] Drew Meyers et.al., 'Initial Deployment of a Mobile Sensing System for Water Quality in Urban Canals' (2022) 14(18) Water <https://doi.org/10.3390/w14182834 > accessed 29 March 2024
[12] *Ibid*

Thirdly, ESNs have the potential to significantly improve the accuracy of valuations of various properties and green buildings. This is because traditional valuation methods often overlook the nuanced impacts of environmental factors on property desirability and value. However, modern methods like ESNs provide a detailed account of air quality, noise levels, structural integrity, and other critical parameters. This environmental data gathered by ESNs enables more informed decision-making for buyers, sellers, and investors and may potentially increase property values in areas with optimal environmental conditions.

Fourthly, ESNs can enhance the health and productivity of property and green building occupants. This is because ESNs continuously monitor air quality and adjust ventilation systems, ensuring clean air, reducing the risk of potential respiratory issues, and enhancing cognitive function.

Fifthly, ESNs contribute to a property's and green building's resilience against natural disasters. The sensors deployed in ESNs monitor the structural health of the property. They can detect early signs of strain or damage, allowing for timely maintenance and prevention of property damage during disasters such as floods, earthquakes, and other similar instances. ESNs can also enhance emergency response efforts by warning about gas leaks, fires, and other similar events.

Sixthly, the utilization of ESNs in properties and green buildings streamlines the process of compliance with environmental regulations and sustainability standards. This is because the environmental data collected by ESN sensors provide concrete evidence of a building's environmental performance, simplifying the reporting process for certifications and compliance with laws. This can be particularly beneficial in jurisdictions with strict environmental regulations or securing green building certifications.

Lastly, on a larger scale, the widespread adoption of ESNs in properties and green buildings contributes to urban sustainability goals. This is because the overall reduction of energy consumption, emission, and water conservation brought about by deploying ESNs plays a significant role in creating more sustainable cities. This environmental data from multiple buildings collected through ESNs can also be instrumental in urban planning and environmental policy-making.

Cons of Implementation of ESNs -

It is pertinent to note that ESNs present several challenges in operational feasibility, implementation, data privacy, and other aspects. These challenges can broadly be subsumed under three broad challenges. They are as follows. *Firstly*, it is the data privacy concerns in ESNs. In this context, it is essential to highlight that ESNs operate by detecting changes in environmental parameters within a particular area, collecting this data, and transmitting it to a central processing unit for further processing to generate predictions or outcomes. This implies that various forms of personal data, including sensitive information such as a property's occupancy and usage patterns, are collected, stored, and processed. In this regard, issues about the applicable consent mechanism, lawful processing practices, and access to personal data collected arise, which necessitates the need to impose adequate safeguards to protect the privacy of the environmental data collected through ESNs.

Secondly, the conundrum of high implementation costs exists owing to the nascent and complex nature of ESNs. ESNs generally warrant more significant costs for initial set-up, periodic maintenance, and data analysis. This may further lead to the issue of inaccessibility for small to medium-sized real estate operators who may opt for low-cost sensors compared to high-end sensors, thereby leading to issues about calibration of reliable environmental data, which are essential for making informed decisions, thus resulting in a digital divide in the ESN industry.

Thirdly, the technical expertise associated with ESNs may pose challenges. This is because deploying and managing these systems require technical expertise, which may be lacking in traditional real estate businesses, including green buildings. Further, the absence of the requisite technical expertise in traditional real estate businesses will likely affect sensor data's reliability due to hardware malfunctions and environmental interference.

LEGAL ANALYSIS OF ESNS IN GREEN BUILDINGS

When we discuss the legal framework for ESNs for green buildings in India, we comprehend that no specific legislation or policy is dedicated to ESNs. Further, no particular court cases (legal jurisprudence) deal with ESNs in India. This means that: (a) ESNs, from a statutory standpoint,

are highly undeveloped; (b) ESNs, from a policy standpoint, are close to absent from policy considerations; and (c) ESNs, from a jurisprudential standpoint, are at a highly nascent stage. Due to this, it becomes imperative to analyze the possibility of bringing ESNs under the ambit of existing legal frameworks and policies in India.

Analysis of Existing Environmental Laws for ESNs in Green Buildings: An Indian Perspective -

The Energy Conservation Act 2001:[13] The Energy Conservation Act 2001 (**2001 Act**)[14] is the primary legislation that governs and regulates the efficient use of energy and its conservation in India. It prescribes norms and standards for equipment, appliances, and other infrastructure like green buildings for efficient energy utilization and conservation. Under the 2001 Act,[15] ESNs can be brought under its ambit as follows.

Firstly, Section 13 of the 2001 Act gives various powers and functions to the Bureau of Energy Efficiency (**BEE**).[16] These powers and functions include: (a) BEE can ensure research and development is happening towards energy consumption;[17] (b) BEE can 'formulate and facilitate' pilot projects for efficient energy consumption and conservation;[18] (c) BEE can promote the use of efficient energy processes and equipment;[19] (d) BEE can recommend to the central government various standards and norms for efficient energy consumption;[20] and (e) BEE can prescribe guidelines for energy conservation and sustainable building codes like green buildings.[21]

[13] The Energy Conservation Act 2001
[14] *Ibid*
[15] *Ibid*
[16] Energy Conservation Act 2001, s 13
[17] Energy Conservation Act 2001, s 13(2)(h)
[18] Energy Conservation Act 2001, s 13(2)(j)
[19] Energy Conservation Act 2001, s 13(2)(k)
[20] Energy Conservation Act 2001, s 13(2)(a)
[21] Energy Conservation Act 2001, s 13(2)(d)

Such powers and functions can be applied to ESNs in green buildings in the following manner respectively:

- BEE can be nudged towards research and development activities in developing ESNs and their subsequent usage in green buildings, as ESNs help monitor and regulate energy consumption.
- BEE can assist in launching pilot projects for using ESNs in green buildings as ESN technology is aimed at efficient energy consumption and conservation in green buildings.
- BEE can promote the use of ESNs in green buildings as ESNs help in the use of efficient energy processes and equipment in green buildings because ESNs monitor and show accurate data on which deployed processes and equipment are energy draining and assist the green building management to take informed decisions on the need of replacement of such processes and equipment in green buildings.
- The central government can be provided with a recommendation from BEE. In this specific recommendation, the following can be emphasized: usage of ESNs in green buildings must be standardized as the same ensures uniformity in the applicability of laws. Further, the usage of ESNs would significantly assist in efficient energy consumption in green buildings, owing to the capability of ESNs to gather environmental data in these buildings.
- BEE can prescribe guidelines and sustainable building codes by including the utilization of ESNs in green buildings, as the same would give legal recognition to ESNs in India.

Secondly, Section 14(a) of the 2001 Act allows the central government to specify norms and standards for processes and energy consumption for any building that may consume energy.[22] Similarly, in the present case, the central government can specify the usage of ESNs in green buildings as a norm and standard for energy consumption. This should be done because using ESNs can better assist green buildings in monitoring their energy consumption levels and energy consumption processes. ESNs assist in gathering related data such as temperature levels, humidity levels, power levels, and other associated data sets. The collection of such data assists

[22] Energy Conservation Act 2001, s 14(a)

green building management (central processing units) in making informed decisions on reducing their carbon footprint by reducing their energy consumption and replacing or modifying their energy consumption processes. Similarly, Section 15 of the 2001 Act allows for the central government to give 'preferential treatment' to processes or equipment that are energy efficient.[23] This means that the central government can provide preferential treatment to ESNs as they are energy-efficient equipment that helps develop energy-efficient processes.

Thirdly, Section 14AA of the 2001 Act allows for issuing carbon credit certificates to entities that comply with the 'carbon credit trading scheme' requirements.[24] In the present case, the utilization of ESNs in green buildings can significantly help in the issuance of carbon credit certificates in the following manner:

- ESNs can offer real-time, historical, and verifiable data on the green building's energy consumption, greenhouse gas emissions, and other environmental metrics that are relevant to comply with the requirements of the carbon credit trading scheme.
- To be eligible under the carbon credit trading scheme, a green building must demonstrate its quantifiable emission reductions that are additional to what would have occurred in the absence of a specific carbon reduction project, thereby meaning that ESNs can help to accurately measure such emission reductions and show the particular energy conservation measures and technologies deployed in the green building.
- Carbon credit trading scheme rewards actions that lead to enhanced energy efficiency, thereby meaning that ESNs can track the energy efficiency of 'Heating, Ventilation, and Air Conditioning' (**HVAC**) systems, lighting, and other energy-consuming processes in the green building to be eligible for such rewards.

Thus, if the 2001 Act is applied to ESNs, it would be apt as it would allow better regulation of green buildings in India due to the enhanced capacity offered by ESNs towards mitigating the effects of constantly changing weather conditions exacerbated by climate change.

[23] Energy Conservation Act 2001, s 15(g)
[24] Energy Conservation Act 2001, s 14AA

The Environmental Protection Act 1986:[25] The Environmental Protection Act 1986 (**1986 Act**) is a pivotal legislation on the protection and conservation of the environment.[26] It is applied in the present context of ESNs and green buildings because the 1986 Act prescribes legal standards and protections for protecting the environment. Because ESNs help in the same through monitoring and data collection, ESNs and green buildings can be brought under the ambit of the 1986 Act[27] in the following manner.

Firstly, Section 3 of the 1986 Act gives various powers to the central government to take measures that can help to 'protect and improve' environmental pollution in the following manner: (a) the central government can execute national programs to curb environmental pollution;[28] (b) the central government can lay down standards for environment quality;[29] (c) the central government can impose restrictions[30] and procedures[31] on industrial units with safeguards to reduce environmental pollution; (d) the central government can examine manufacturing processes and materials that are likely to cause environmental pollution;[32] and (e) the central government can prepare manuals, codes, and guidelines for prevention and control of environmental pollution.[33]

Such powers and functions can be applied to ESNs in green buildings in the following manner respectively:

- The central government can execute a national program for implementing and using ESNs in green buildings. This would help curb environmental pollution due to the real-time, accurate, and verifiable data ESNs provide on various environmental metrics.
- The central government can lay down standards for using ESNs in green buildings, as using ESNs helps monitor environmental quality.

[25] The Environmental Protection Act 1986
[26] *Ibid*
[27] *Ibid*
[28] Environmental Protection Act 1986, s 3(2)(ii)
[29] Environmental Protection Act 1986, s 3(2)(iii)
[30] Environmental Protection Act 1986, s 3(2)(v)
[31] Environmental Protection Act 1986, s 3(2)(vi)
[32] Environmental Protection Act 1986, s 3(2)(viii)
[33] Environmental Protection Act 1986, s 3(2)(xiii)

- The central government can impose restrictions and procedures on green buildings, wherein such green buildings would be required to implement ESNs as environmental safeguards.
- The central government can use ESNs in green buildings to examine manufacturing processes and materials better. ESNs offer various environmental data such as pollution levels, particulate levels, and other similar data.
- The central government can prepare separate manuals and guidelines on the development, implementation, usage, maintenance, and audit of ESNs in green buildings, allowing green building management to have a concrete roadmap for using ESNs.

Secondly, Section 10 of the 1986 Act allows the central government to examine and test any equipment utilized anywhere.[34] Section 10 can be applied in the present case because it will enable the central government to examine and test ESNs used in green buildings. This can be done in the following manner:

- The central government can inspect whether ESNs in green buildings accurately collect, monitor, and report environmental data. This can be done by verifying the proper operability of sensors tracking the air quality, energy consumption, water usage, and waste management in green buildings. This means that the central government would check whether the ESNs comply with technical standards such as checking for tampering, data falsification, and the use of non-approved or malfunctioning sensors.
- The central government can verify any suspected discrepancies between the actual environmental conditions in and around the green buildings and the reported data from green buildings. This would ensure that the green buildings genuinely contribute to environmental sustainability and not merely engage in greenwashing practices.
- Suppose there is a scenario where a green building has caused environmental harm, such as improper waste disposal or exceeding permitted emission levels. In that case, the central government can inspect ESNs as a part of their investigation. They can check

[34] Environmental Protection Act 1986, s 10(1)(c)

whether the ESNs detected such an issue, whether there was reporting of the same, and if the ESNs were tampered with by the green building management to conceal the environmental offense.

- Under Section 10 of the 1986 Act,[35] the central government also has the power to seize any equipment. This would mean that the central government can seize ESNs from green buildings if such ESNs are reported to have been malfunctioning and causing environmental pollution.

Thus, if ESNs in green buildings are brought under the ambit of the 1986 Act,[36] it would allow the central government authorities to appropriately keep a check on the utilization of such systems in green buildings, wherein such checks would ensure legal and accurate monitoring of environmental data.

Data Privacy Perspective for ESNs in Green Buildings -

Section 2(1)(o) of the Information Technology Act, 2000[37] (**2000 Act**) and Section 2(h) of the Digital Personal Data Protection Act 2023[38] (**2023 Act**) define 'data' as a 'representation' of information that is processed or is intended to be processed in a formalized manner by human beings or in an automated manner. Similarly, in the context of data privacy and ESNs in green buildings, we comprehend a concrete intersection between these concepts because ESNs' primary responsibility is to collect, monitor, and transmit 'environmental data'. Green building management processes this environmental data, which may be done manually or with the help of artificial intelligence technology (automated manner). Thus, ESNs in green buildings can come under the ambit of the 2000 Act and the 2023 Act in the following manner.

Firstly, Section 66 of the 2000 Act[39] punishes any person who dishonestly or fraudulently commits any act mentioned in Section 43 of the 2000 Act.[40] Such acts are non-consensual acts and may include altering, destroying, or disrupting any information in any computer. As per

[35] Environmental Protection Act 1986, s 10
[36] *Ibid*
[37] Information Technology Act 2000, s 2(1)(o)
[38] Digital Personal Data Protection Act 2023, s 2(h)
[39] Information Technology Act 2000, s 66
[40] Information Technology Act 2000, s 43

the definition of 'computer' in Section 2(1)(i) of the 2000 Act,[41] ESNs can be a 'computer' because they are a high-speed data processing device that performs memory functions by data processing. Thus, in the present case, if any person in green buildings non-consensually and dishonestly or fraudulently tampers with ESNs that lead to the alteration, destruction, or disruption of the environmental data to manipulate the final data communicated by ESNs, such a person can be held liable under Section 66 of the 2000 Act. This would mean that the concept of consent applies in ESNs when its physical structure or its data is being handled with the consent of the green building management, and not otherwise, as the latter scenario attracts criminal liability of imprisonment of 3 years and civil liability of a fine of Rs. 5,00,000 under Section 66 of the 2000 Act.[42]

Secondly, Section 72A of the 2000 Act states that if any person, while providing services under a lawful contract, gains access to the personal information of any person and non-consensually discloses such information with the intent to cause wrongful loss or gain, such a person would be held liable through imprisonment for three years and with a fine of Rs. 5,00,000.[43] Although the 2000 Act does not define personal data or information, the 2023 Act defines 'personal data' under Section 2(t) as any data that is capable of identifying an individual in relation to such data.[44] In the context of ESNs in green buildings, this personal data may include:

- Occupancy data is based on the number of occupants present in the green building. It is personal data because it can reveal information about individuals' personal schedules, specifically when individuals are generally in and out of the offices of green buildings.
- Movement patterns to improve lighting, heating, and security systems. It is personal data because such information can be used to infer personal habits, routines, and time of sensitive business meetings for various individuals in the green building.
- Energy consumption profiles can be tracked to improve energy efficiency and reduce costs. It is personal data because such profiles can indicate personal behaviours, such as

[41] Information Technology Act 2000, s 2(1)(i)
[42] Information Technology Act 2000, s 66
[43] Information Technology Act 2000, s 72A
[44] Digital Personal Data Protection Act 2023, s 2(t)

the usage of specific appliances or devices, times of activity, and lifestyle patterns of various individuals in green buildings.

- Suppose the ESNs use biometric data like facial recognition for personalized and security settings in green buildings. In that case, such data is personal data because of its highly personal and sensitive nature.
- ESNs may record individual preferences for temperature and lighting to enhance comfort and efficiency. These preferences can be personal data as they help infer additional personal information, attributes, and behaviours about individuals in green buildings.

In the context of Section 72A of the 2000 Act,[45] if any employee of the green building management leaks the above personal data non-consensually, it would breach individuals' privacy and constitute an offense under Section 72A.[46] This problem is exacerbated because, according to Section 8(7)(a) of the 2023 Act, such personal data can be retained as long as the purpose for the collection and processing of such data is being served, wherein this decision shall be made by the 'data fiduciary' (green building management).[47] This means that green building management can retain the data for several years (and indefinitely). It may be argued that retaining such data (in its real-time and historical format) is quintessential to taking accurate measures for energy efficiency, environmental protection, and conservation. In other words, even after a personal data breach under Section 72A of the 2000 Act,[48] such personal data will continue to be retained due to the lack of any mandatory provision under the 2000 Act[49] and the 2023 Act[50] to erase such personal data in cases of personal data breach. This contravenes the principle of 'purpose limitation,' which states that once the purpose for which the personal data was collected is achieved, such personal data should no longer be retained. However, in the present case, it can be argued under this principle that the initial purpose of personal data processing is no longer relevant after a data breach as the personal data is compromised regarding its integrity and confidentiality. This is because, after such a data breach, there is no

[45] Information Technology Act 2000, s 72A
[46] *Ibid*
[47] Digital Personal Data Protection Act 2023, s 8(7)(a)
[48] Information Technology Act 2000, s 72A
[49] *Ibid*
[50] The Digital Personal Data Protection Act 2023

specific, legitimate, and express subsequent purpose to justify the retention of the breached personal data. This means that the continued retention of personal data, even after its breach, can be seen as incompatible with the original purpose, thereby violating the principle of 'purpose limitation'.

Thirdly, Section 69 of the 2000 Act states that the central or state government, as the case may be, can intercept or monitor any data transmitted and stored in any computer under specific circumstances, such as a threat to national security or public order.[51] In the context of ESNs in green buildings, it would mean the following:

- As ESNs collect personal data related to occupancy patterns and individuals' energy profiles, such personal data may be used to plan and execute activities that may threaten public order. This is because mishandling of such personal data can be used to target green building infrastructure to infer the number of occupants present in a building, their timings of entry and exit, the sensitive timings of business meetings involving multiple people, rooms with most people present and least people present due to the heat signature data collected by the ESNs, and such other similar behaviour. In such a scenario, the government can intercept or monitor environmental data transmitted in green buildings through ESNs to protect public order under Section 69 of the 2000 Act.
- The government can access such personal data under exceptional circumstances of threat to public order and other similar circumstances. Apart from this, individuals present in the green buildings can also have access to such personal data collected through ESNs as they have expressly consented to the collection and processing of such personal data under Section 6 of the 2023 Act, which states that consent must be unequivocal, express, specific, informed, and unconditional.[52] They have access to such personal data due to Section 11 of the 2023 Act, which allows individuals (data principals) access to what kind of data is being collected, the related processing activities, and how such data is shared.[53]

[51] Information Technology Act 2000, s 69
[52] Digital Personal Data Protection Act 2023, s 6
[53] Digital Personal Data Protection Act 2023, s 11

Thus, it is essential to bring ESNs to green buildings under data privacy laws. This would help individuals protect their personal data and keep the green building management accountable for their data processing, storage, and sharing practices.

Analysis of Indian Jurisprudence -

As previously mentioned, no direct cases in India discuss ESNs or their utilization in green buildings. Similarly, no indirect cases distantly touch upon the concept of ESNs. Regardless, two relevant and recent cases need to be discussed in the context of this paper.

Firstly, on 21 March 2024, the Indian Supreme Court (**SC**), in the case of ***MK Ranjitsinh v Union of India***,[54] held that individuals have the fundamental right to be free from the adverse effects of climate change. In this regard, the Supreme Court held that: *By recognizing the right to a healthy environment and the right to be free from the adverse effects of climate change, states are compelled to prioritize environmental protection and sustainable development, thereby addressing the root causes of climate change and safeguarding the wellbeing of present and future generations. It is imperative for states like India to uphold their obligations under international law, including their responsibilities to mitigate greenhouse gas emissions, adapt to climate impacts, and protect the fundamental rights of all individuals to live in a healthy and sustainable environment*. This means that the SC essentially recognized India's primary duty to mitigate the effects of climate change and greenhouse gas emissions to create a healthy and sustainable environment. This purpose can be achieved using ESNs in green buildings because ESNs are a direct measure to monitor, control, and reduce energy consumption and greenhouse gas emissions in green buildings and the surrounding area. This is made possible because ESNs provide real-time data on energy use and enable the implementation of enhanced energy-efficient practices and technologies, wherein the usage and efficiency of renewable energy sources are also monitored. This would mean that ESNs help to identify areas of environmental improvement. Thus, implementing ESNs in green buildings would directly align with India's duty to mitigate climate change impacts, contribute to the reduction of the overall carbon footprint, create sustainable living and construction practices, and ensure continuous advancement towards sustainability goals.

[54] *MK Ranjitsinh v Union of India* AIR 2021 SC 209

Secondly, in 2023, in the case of ***Kaushal Kishore v State of Uttar Pradesh***,[55] the SC held that action could be brought against non-state actors like private entities under Article 32 of the Indian Constitution[56] for violation of Article 21 of the Indian Constitution.[57] This means that, in the present case, the right to be free from adverse effects of climate change was recognized as a fundamental right under Article 21 of the Indian Constitution; individuals can file writ petitions against private entities like green building management for violation of fundamental rights. This requires private entities to take aggressive measures to mitigate climate change effects and enhance energy consumption, environmental protection, and conservation. Thus, implementing ESNs in green buildings becomes even more urgent as failure to do the same will likely result in tedious litigation against such private entities (green building management).

Thus, from the aforementioned, it is evident that the implementation of ESNs in green buildings has become a need of the hour, necessitating swift action from governmental authorities for its development, implementation, monitoring, and maintenance.

Analysis of Existing Environmental Laws for ESNs in Green Buildings: An International Perspective from the Lens of the European Union -

When we discuss the need for a comparative analysis, the European Union (**EU**) becomes an apt jurisdiction for such comparative analysis. This is because (a) India's existing energy laws are based on EU's existing energy laws (India's 'National Action Plan on Climate Change' being similar and based on the EU's 'Renewable Energy Directive,' India's 'carbon credit trading scheme' being similar and based on EU's 'Emissions Trading System,' and India's 'Energy Conservation Building Code' is similar and based on EU's 'Energy Performance of Buildings Directive'); and (b) EU has been a pioneer in reducing energy consumption and enhancing its contributions towards sustainable energy as compared to other global countries.[58]

[55] *Kaushal Kishore v State of Uttar Pradesh* (2023) 4 SCC 1
[56] Constitution of India 1950, art 32
[57] Constitution of India 1950, art 21
[58] 'Energy Efficiency Statistics,' (*Eurostat*, 19 December 2023) <https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Energy_efficiency_statistics> accessed 29 March 2024

Firstly, in 2023, the EU passed the first-ever Artificial Intelligence (**AI**) Act.[59] It is essentially aimed at regulating and governing AI developers and deployers. According to Article 3(1) of the EU AI Act, an 'AI system' is any system that is autonomous and machine-based, capable of adapting to each use and learning on its own how to generate outputs such as content.[60] The exact definition is given under 'Organization for Economic Co-operation and Development' AI Principles, 2019.[61] In the context of ESNs, they can be categorized as AI systems because they are autonomous and machine-based. They can adapt to each use and learn on their own how to generate outputs such as content in terms of data transmission, storage, and processing. Thus, the EU AI Act shall apply to ESNs in the present case. When the EU AI Act is compared to India, the following lacunae are evident: (a) India does not have a standalone AI Act for better governance and regulation of AI systems like ESNs and (b) the 2023 Act falls short of including AI systems under the definition of 'data' as given in Section 2(h) of the 2023 Act.[62] This means severe lacunae exist to govern and regulate AI-based ESNs in India, unlike the EU, which has a standalone AI Act.

Secondly, the EU's Energy Performance of Buildings Directive (EPBD) contains various policy measures for the energy efficiency of buildings. Article 8 of the EPBD essentially allows the installation of 'technical building systems' to enhance their overall energy performance.[63] Similarly, in the context of green buildings, they can install technical building systems like ESNs because such systems (ESNs) help enhance the overall energy performance of green buildings. This means that the EU's fundamental building code includes specific measures for installing systems that can enhance the overall energy performance of the buildings. However, in India, its fundamental building code, i.e., the 'Energy Conservation Building Code,' does not have such concrete and robust policy measures to incorporate the usage of ESNs in green buildings. Due to this, we have to seek the assistance of other legislation in India when the most fundamental legislation for buildings in India falls short of such a vital measure.

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[59] The Artificial Intelligence Act 2024
[60] Artificial Intelligence Act 2024, art 3(1)
[61] 'OECD AI Principles Overview' (*OECD Policy Observatory*) <https://oecd.ai/en/ai-principles> accessed 30 March 2024
[62] Digital Personal Data Protection Act 2023, s 2(h)
[63] Council Directive, 2018/844 O.J. [2018] (L 156), art 8

Thus, considering the above analysis, it is evident that: (a) the EU has a better legal framework to govern the usage of ESNs as its fundamental building code directly deals with the implementation of ESNs in green buildings to enhance energy conservation; (b) India's legal framework still falls short of direct utilization of ESNs in green buildings as its fundamental building code does not have robust measures for the implementation of ESNs like that of EU, due to which, the implementation of ESNs has to be sought under other legislation like the 2001 Act and the 1986 Act; (c) the consequences of lack of India having a standalone AI Act are significant as ESNs can be classified as AI systems that necessitate the regulation of such AI systems under law, however, considering that the 2023 Act and the 2000 Act fail to consider autonomous and automated systems under their ambit, it becomes highly arduous to appropriately govern the usage of such AI ESNs in green buildings.

RECOMMENDATIONS

Considering that the implementation of legal frameworks for ESNs in green buildings in India is imperative, the following recommendations are made.

Firstly, it is recommended that the following framework be adopted to regulate ESNs in green buildings in India. A structured approach is proposed, divided into two levels, to regulate the sensors' equipment and the data it collects and processes. Tier I level deals with machinery and the operational aspects of the ESNs under specific conditions that safeguard the environment and define operational boundaries in alignment with broader environmental law principles. Tier II level proposes more rigorous and enforceable constraints on the data the ESNs detect, collect, process, retain, and store.

Tier I Level: India must develop and adopt separate legislation that expressly supports, encourages, and promotes the development of ESNs in green buildings, with a primary focus on enhancing energy consumption, safety, and environmental protection. This would act as a hard, law-binding legal instrument that offers rights, duties, recommendations, guidelines, and remedies, thereby establishing normative standards on what is and is not to be expected from the Indian states regarding the integration of ESNs in green buildings. This legislation would articulate the expectations for ESNs in the real estate sector regarding the quality of the

equipment employed and the periodic reviewing processes to which this equipment must be subjected to ensure optimal efficiency and compliance with the industry standard equipment. This legislation would also outline the criteria that would be responsible for triggering an 'Indian state' responsibility in the case of the breach of its provisions, grounding them in the principles of environmental protection and sustainable development.

Tier II Level: This level introduces binding, enforceable restrictions focusing on the data processing practices of these ESNs. These restrictions would focus on, but will not be limited to, the type of data collected, the processing practices of this data, the entities that would receive access to it, the period for which this data will be retained, and the consent mechanism that would be applicable. To facilitate this, Indian states must conduct periodic 'Data Impact Assessments' and 'Algorithmic Impact Assessments' throughout the ESNs' lifecycle. This assessment would achieve two goals: *firstly*, it would encourage developers to proactively consider the implications of their technologies on environmental sustainability and consumer safety, which would be instrumental in ensuring transparency and upholding the values and principles established at the outset of development. *Secondly*, it provides the documentation of all the decisions made in developing ESNs at different points of their life cycle, improving access to information, transparency, and accountability to the public.

Secondly, it is recommended that a multi-state regulatory national body be established in India to enforce compliance with the proposed legislation. This body would be entrusted with performing regular inspections, providing appropriate documentation, and verifying compliance of ESNs with industry and legal standards in green buildings in India.

Thirdly, it is recommended that India must amend the 2023 Act and include the scope of AI-based systems (like ESNs) under its ambit. This would ensure that the data collected, processed, stored, and retained by AI ESNs is expressly regulated, and it would ensure that the individuals have express rights to access their personal data collected through such ESNs. Although India is contemplating implementing separate legislation for AI, 55 will be a time-consuming and lengthy exercise before such legislation can be passed. For example, it took more than six years for the 2023 Act to be passed in India. Due to this, providing temporary catharsis to the

individuals whose personal data is collected by ESNs and green building management who deploy such ESNs is imperative.

Fourthly, a 'regulatory sandbox' for early testing of ESNs is recommended. To facilitate the early and controlled testing of ESNs, the central government can establish 'regulatory sandboxes'. These sandboxes would be designed as controlled experimental environments where ESN providers and deployers, including 'small and medium enterprises,' can undergo voluntary testing, training, validation, and experimentation of their systems under regulatory supervision before their market launch. This approach not only facilitates the development of ESNs but also ensures that these innovations align with regulatory requirements from an early stage. Further, each Indian state could be tasked with establishing or participating in a sandbox, operating under a unified set of rules to ensure consistency and coherence in ESN innovation support across India. Furthermore, ESN providers participating in these sandboxes should provide a written report detailing their activities within the sandbox, documenting compliance with the national law requirements and potentially expediting the market approval process for ESNs.

Fifthly, pre-market conformity assessments are recommended. Before introducing ESNs, providers must conduct a conformity assessment to ensure that the system meets the outlined technical and legal requirements. This assessment verifies the system's adherence to essential safety standards, accuracy, and data governance. ESN providers can undertake this assessment independently, provided they adhere to procedures and methodologies that align with internationally approved technical standards. However, it is pertinent to note that in specific contexts, a third-party conformity assessment should also be carried out by an accredited body. This external evaluation becomes essential if the system in question is an integral product component that, due to sectoral regulations, already necessitates a third-party safety assessment. Furthermore, the requirement for an external assessment is triggered when ESN providers choose not to utilize or cannot apply the international standards. This structured approach to pre-market assessment will ensure a high level of scrutiny for 'high-risk AI systems' like ESNs, particularly in contexts where the deployment of ESNs could have significant safety or privacy implications.

Lastly, the following post-market obligations are recommended. After the ESN is introduced to the market, the obligations of ESN providers should still extend beyond initial compliance, focusing on ensuring the ESNs are safe and conforming with the operation throughout their lifecycle. ESN providers should be required to keep logs generated by these ESNs, provided they are within their control, for at least six (6) months. This facilitates accountability and traceability of the ESNs' operations. When an ESN is found to be non-conforming, ESN providers must promptly undertake corrective actions to address the issue and notify other stakeholders within the value chain about the non-conformity.

Additionally, ESN providers must cooperate with national competent authorities or the BEE by furnishing necessary information and documentation to demonstrate conformity when requested. This is part of a broader responsibility to monitor the performance and safety of ESNs continuously, ensuring they remain in compliance with the national laws over time. ESN providers must also be mandated to report serious incidents or malfunctions that could infringe on fundamental rights to the relevant authorities. Further, a new conformity assessment must be required if substantial modifications to the ESN exist, either in its intended purpose or adjustments impacting regulatory compliance. This requirement holds irrespective of whether the modifications were made by the original provider or a third party. This comprehensive framework of post-market obligations underscores the commitment to maintaining high standards of safety, compliance, and accountability for ESN systems throughout their operational life.

Therefore, if the above-mentioned recommendations are implemented, it would ease the hurdles in implementing and utilizing ESNs in green buildings in India and help India achieve its green economy and sustainable development goals faster.

CONCLUSION

From the preceding arguments, it is evident that the utilization of ESNs in green buildings in India is of quintessence importance. This is because of the varied pros that it offers to enhance energy consumption and environmental protection and conservation, ranging from monitoring temperature changes to transmitting energy profiles of individuals. However, there is a problem

with developing and implementing ESNs in green buildings in India due to the lack of any express legal framework for them. The lack of such a legal framework is exacerbated by the fact that no legal jurisprudence is available for ESNs in India. Such absence of legal governance is likely to hinder India's transition towards a green economy because legal frameworks, especially guidelines, and measures, are quintessential as they help provide a robust roadmap to green building developers and owners to deploy, maintain, monitor, and audit the usage and implementation of such ESNs. Such legal frameworks also provide the green building developers, owners, and individuals entering and exiting such buildings with legal safeguards regarding rights and remedies in case of any disputes. Thus, implementing and using ESNs in India's green buildings can offer India a renewed chance to align with its goals to mitigate climate change.