

**Major Project Dissertation Report on**  
**HOW DATA CENTERS CAN BE MADE MORE**  
**SUSTAINABLE?**

Submitted By

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## **CERTIFICATE**

This is to certify that Ms. Priyadarshana Mishra, have completed the project titled “How Data Centers can be made more sustainable?” under the guidance of Dr. Chandan Sharma as a part of Master of Business Administration (MBA) curriculum of Delhi School of Management, New Delhi. This is an original piece of work and has not been submitted elsewhere.

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## **DECLARATION**

By signing this statement, I certify that the project work submitted to Delhi School of Management titled " How Data Centers can be made more sustainable?" is an original work I created under Dr. Chandan Sharma's supervision. The project work that is presented satisfies requirements for the EMBA degree. No other University or Institute has submitted the findings of this study for the award of a degree or diploma.

## **ACKNOWLEDGEMENT**

I want to convey my sincere appreciation to my mentor, Dr. Chandan Sharma, for their skillful guidance and support in helping me finish my project.

I also want to express my gratitude to Dr. Archana Singh, Head of Department, for providing me with all the facilities I needed. I also want to express my gratitude to Trane Technologies PLC, for helping me with the data I needed to perform analysis.

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## EXECUTIVE SUMMARY

In a world which is increasingly getting connected through the digital medium, the quantum of data created on a daily basis is growing enormously every day. This phenomenon has empowered technology & data to be the core of almost everything. Businesses and organizations, more than ever before, are relying highly on the data generated information and the related Information & Communication Technology (ICT) infrastructure. The dependence on data is increasing every day. Hence, the prerequisite for a strong, scalable, consistent and sustainable data center rises as well.

Further, it is rather practical to define data as, “the ultimate renewable resource” as it enables a profitable, rapidly growing industry and enables countless ways in which it can improve the world.

Additionally, due to complicated and rapidly moving environment, there is an evident operational necessity for organizations to restructure business resilience, identify new opportunities and reconsider their future.

The key question is, how can organizations accomplish the above objective, and more precisely, how can the organizations learn or use the up-to-date digital trends readily available in the market for the same purpose.

The industry has grown drastically over the past years in India and is expected to continue growing over the near future. Earlier a big walk-in refrigerator, cooled to the core and packed to the brim with giant servers, is now expected to get less visible as the years pass. The evolution from old enterprise facilities to progressive, intelligent, hyperscale and cutting-edge data centers is useful and evident for both public and private sector entities observing a consistent growth. It is also a must for those who desire to take advantage of the cloud facilities without the complexities to govern them. The demand for capacity establishes a rising trend. The need for a more sustainable and ecofriendly design has become acute.

With the Indian Government wanting to help the data center industry, global data & cloud service providers are entering India. There are numerous initiatives taken by the GOI to promote data localization, to encourage digital adoption and to digitally enable Small & Medium Enterprises (SME). This has led to a boom in digital adoption and consumption.

A few initiatives worth highlighting include the GOI Cloud/Meghraj, Draft Data Protection Bill, the Storage of Payment System Data and Single Window Clearance system.

This paper will deliberate on how India will be a fast-growing nation in data center (DC) market over near & distant future with the support of the GOI. We will also delve into the present technology footprint and how it will create an impact. The ultimate aim will be to identify a sustainable way to become a market leader in Data Center (DC) market globally.

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# 1. Introduction

## 1.1 What is Data Center?

Everything and anything that occurs online is facilitated by a Data Center. Data Centers, often vast, are facilities that house the foundations of our internet - the servers & digital applications. The importance of the Data Center to present day's growing digital economies can hardly be exaggerated, with Data Centers playing an essential role in enabling the policies of governments, activities of businesses and daily tasks of individuals. The fundamental design of a Data Center is based on a complex network of computers and storage devices which enable the seamless delivery of applications & data. Data Centers are made up of a range of components, including power systems, ventilation, uninterrupted power supplies (UPS), cooling systems, backup generators, fire suppression, and contacts to external networks.

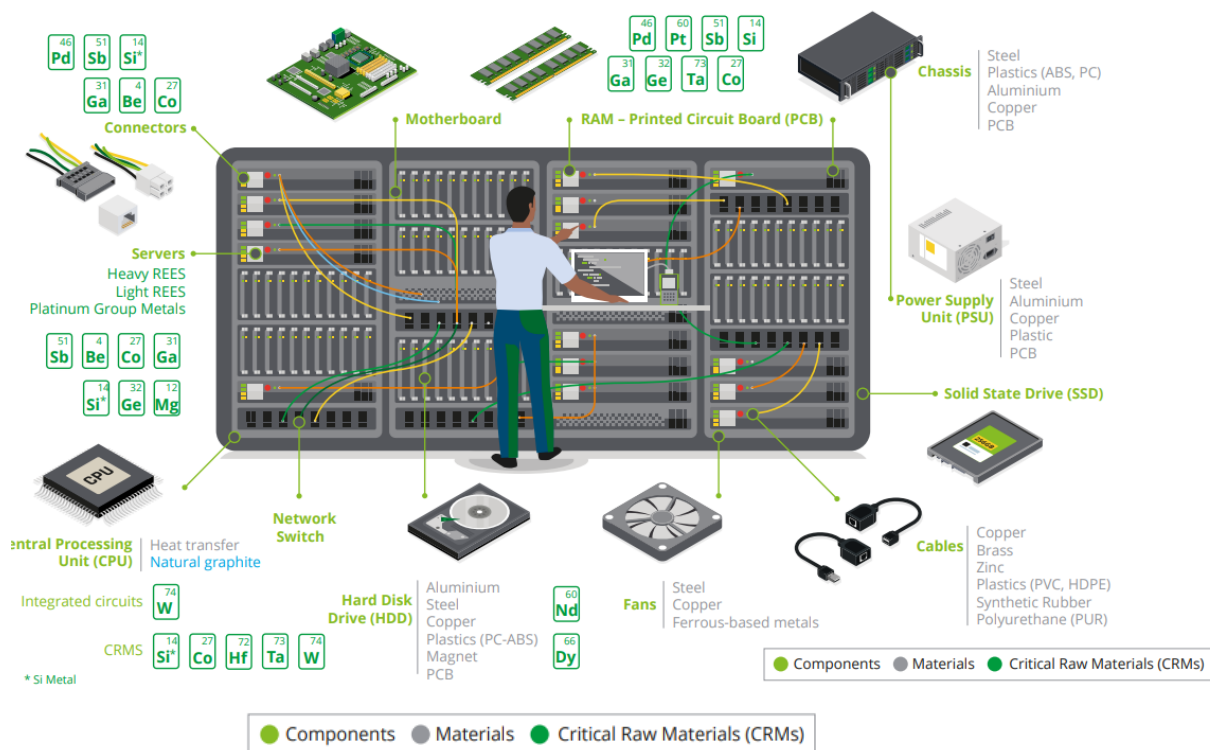
The main purpose of DCs is to provide:

- Networking infrastructure: Connected servers, external connectivity to end-user locations and storage
- Infrastructure for storage: It's responsibility is to store the data itself.
- Computing infrastructure: Servers to provide the memory, processing, network connectivity and local storage that drive applications

Data Centers vary significantly in terms of size, technology used and ownership. They are classified into four unique groups:

- a. Enterprise - Enterprise Data Centers are owned, built and operated by businesses and are optimized for users.
- b. Managed services - Managed service Data Centers are managed by external parties on behalf of an organization.
- c. Colocation - Colocation Data Centers are where an organization rents space within a Data Center and it is located off site locations. The Data Center hosts infrastructure, and the organization manages the components.
- d. Cloud - Cloud Data Centers are at off-site locations; data & applications are hosted by a cloud service provider





## 1.2 India – An emerging nation in data center market

Soon after Independence, with the entry of technology firms into the Indian market, India's digital journey started. This trend led to coming up of many Indian IT firms and India experienced a huge technology revolution in our local corporate landscape.

The Indian government launched programs such as National eGovernance Plan (NeGP) and the Digital India initiative to change & enhance the digital competences of our country.

The key focus was on leveraging digital technologies in diverse sectors including education, e-commerce, healthcare, industrial, agriculture sector and many more. In its path to digitalization, India has reached a place wherein it is now respected to be one of the rapidly growing and biggest markets enabled by digital customers with approximately half a billion internet subscribers.

A data center is a facility or dedicated space that house computer systems and associated components to store, processing, and disseminate data and applications. Since IT operations are crucial for business activities and continuity, they also include infrastructure for power backups, data communications connections, environmental controls, and various security devices.

India, at present, has 132+ data centers spread across the nation. Approximately 45% of these data centers are located in Mumbai. Chennai, though second, is an emerging market and is the the next hub for data centers market (DC) in India. With the advancement of usage in data exhaustive technologies like IoT, Big Data etc., need for data being gathered and kept is growing exponentially,

which in turn is influencing Indian data center market development, which is at present determined to be US\$ 1.5 b and is likely to grow at Compound Annual Growth Rate (CAGR) of 11.4%. This movement is predicted to only rise upwards and DCs are at the center of the rising technological focus and would remain to evolve and have multiple alterations in this revolution.

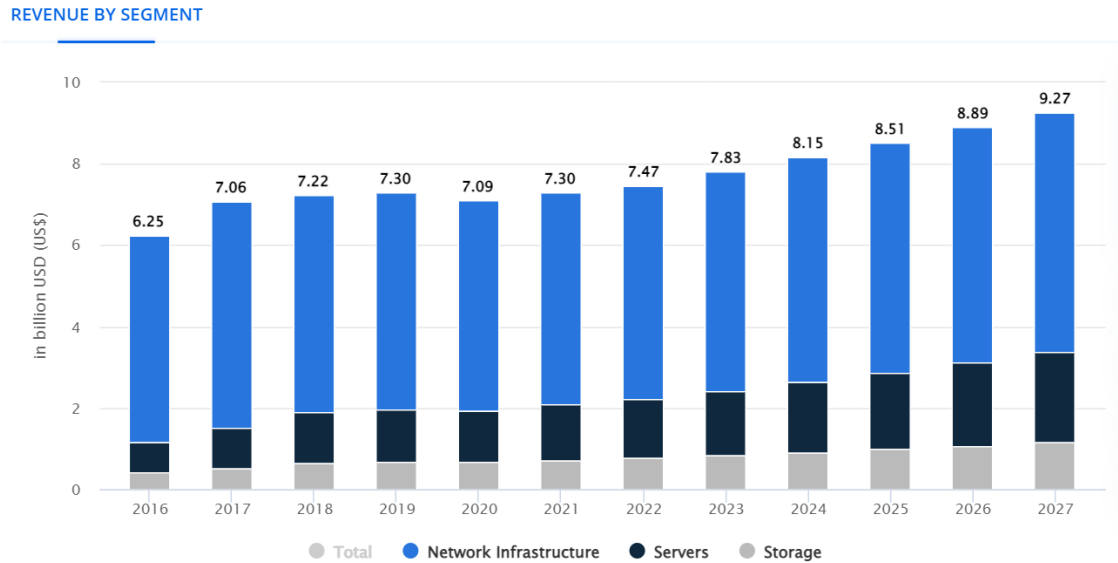


Figure 1: Revenue in the Data Center is projected to reach \$8.15 in 2024 in India

Below are a few factors that are responsible for rise of data center infrastructure in India:

- a. **Rise in digital customers:** Undoubtedly, India is a hub to one of the biggest and rapidly growing bases of digital consumers and is digitizing faster than many mature and emerging economies. Propelled by the falling cost and rising availability of smartphones and high-speed connectivity. India currently has the second highest number of internet subscribers as manifested by the latest subscriber data published by Telecom Regulatory Authority of India (TRAI) with 78 Crore broadband subscribers. The telecom sector has seen remarkable growth over the last few years due to many factors, such as affordable tariffs and wider service availability, evolving consumption patterns of subscribers, and a conducive regulatory environment.
- b. **Increasing work culture that is virtual:** The outbreak of COVID-19 has given new push to digitalization, especially with regards to operations mostly turning towards the virtual mode. The Government is continuously striving to offer highspeed internet connectivity all over the country through its programs such as National Knowledge Network (NKN), BharatNet etc., and is extending the internet connectivity to the basic ground level. This experience has motivated the Government to push towards eliminating digital deficiency on a mission mode, and further encourage every citizen to help contribute to growth in economy, provide employment, etc.

- c. Digital initiatives by Government:** The Government of India, in its drive, has initiated citizen-centric applications like E-Aadhaar, e-Parivahan, Digi Locker, Crime and Criminal Tracking Network and Systems (CCTNS), e-Courts, Poshan, e-District, eNAM, ePFO, DIKSHA, GSTN, etc. As Winston Churchill once said, “Never leave a good crisis go to waste”. Similarly, the government has handled the COVID-19 crisis by creating a national hospital management information system and issue digital vaccine certificates to the citizens through “Aarogya Setu” app. The government has further launched applications like e-Sanvad grievance redressal, Su-Swagatam, Ente Thai, Pauti, mSevanam, to serve the different sections of the society
- d. Relying new technologies -** India is identifying ways to establish “smart cities” mainly relying on technologies like IoT, Machine Learning, Automation, Artificial Intelligence, etc. Increase in demand by online citizen services and initiatives launched in digital areas by the government, data center marketplace is poised for an exponential rise in the coming years
- e. Digital Economy:** The constant drive from the government to make online transactions formal through online payment mechanism is also increasing the need for data centers to be setup to handle huge volumes of data being thus generated. The launch of Unified Payment Interface (UPI) in April 2016, in which only 21 banks had subscribed initially, has increased to 330 banks as of June 2022 with a transaction volume of INR10.14 Lakh Crore. The compounded annual growth rate in volume of UPI transactions has been almost 400% and is expected to grow multi folds in the next five years as it is increasingly occupying the pole position of one of the most favored mode of financial transactions in India. Apart from the UPI method of payment, RuPay card, Immediate Payment Service (IMPS), Bharat Interface for Money (BHIM) and Bharat Bill pay are all equally popular to make financial transactions. The government had also launched the \*99# mobile banking service based on Unstructured Supplementary Service Data (USSD), which has generated traction of INR 12.48 Crore worth of transactions as of June 2022. With India planning to grow its cloud, the requirement for data centers handling these humongous transactions is also growing
- f. Data localization:** The Indian Government had suggested the Data Protection Law in 2021, which regulates data localization. This law stressed on India’s tactical objectives regarding privacy, building a domestic data economy and national security. This will further mandate that an exact mirror replica of the sensitive personal information also called sensitive personal data (SPD) and critical data (CPD), which are already with foreign entities, be compulsorily be brought to the country in a timely manner

## 1.3 Problem Statement

Although data center setup in India is rapidly growing, there is an ever-increasing demand to prioritize sustainable data centers. It is required to have a balanced climate goals with making out optimized digital infrastructure. The growth of data centres and demand for better and efficient energy infrastructure is an insistent concern for many businesses today.

The market for data centre has registered a remarkable growth recently, and this robust impetus is set to last even in the coming years. At present, globally there are more than 7.2 million data centres and as the world remains to generate 2.5 million terabytes of data on a daily basis, supported by the growth of IoT, Industry 4.0, and 5G, the requirement for data centres is speculated to reach boundless heights in the next five years.

At this stage, the country is taking the fore front in becoming a leader in fighting against the climate change. Under its Nationally Determined Contribution to Paris Agreement, it has promised to cut down its emission intensity by 30-35% by 2030. Since sustainability is taking centre-stage, green data centres in India is to become of topmost importance. With that demand and the data localization approach of the Government, the demand for data centre in India is set to rise exponentially in the next decade.

The following factors elaborate reasons why sustainable data center is so crucial:

- a. The growth for data centric tools has been so huge that data centres have become one of the world's biggest consumers of power. They are responsible for 1-1.5 per cent of energy consumed globally – almost comparable with aviation industry. This is predicted to rise to almost eight per cent by 2030, if nothing is done.
- b. Electricity utilized for cooling systems and IT accounts for roughly 86 per cent of total energy consumed in a data centre. Data centres quantify their energy usage effectiveness by a measurement scale called Power Usage Effectiveness (PUE). Essentially, the energy that is being consuming to really run the servers is calculated as “one”; anything beyond that – such as building systems security, the cooling infrastructure and general heating, etc. – is calculated separately or added on top.
- c. There is an enormous amount of ask from investors, regulators, and customers to adopt and develop sustainability to attempt and to limit its adverse impact on change in climate.
- d. As ESG initiatives evolve, so does the evolution of applications crucial to understanding the impact of green initiatives. To continue to innovate and effect impactful change, data needs to be collected and analyzed, goals established and refined, and strategies executed based on the

insights the data provides.

### **1.3 Objectives of the Study**

The objective of this study is to identify and implement strategies that can reduce the environmental impact of data centers while maintaining their efficiency and reliability. Specifically, the focus is on reducing energy consumption, water usage and carbon emissions associated with data center operations. This involves analyzing the current energy and resource usage patterns of data centers, identifying areas for improvement, and implementing sustainable practices and technologies such as energy-efficient hardware, virtualization, renewable energy sources, and water recycling. The ultimate goal is to ensure that data centers can continue to meet the growing demand for digital services while minimizing their impact on the environment, social and governance criteria.

### **1.4 Scope of Study**

The scope of study for data center sustainability would typically involve analyzing the environmental impact of data centers and identifying opportunities to reduce their energy consumption, carbon footprint, and other negative effects on the environment. This might include examining factors such as:

- a. **Energy efficiency:** Data centers are often major energy consumers, so identifying ways to reduce their energy consumption is critical. This might involve analyzing the efficiency of the IT equipment, cooling systems, and other components, as well as exploring options for renewable energy sources.
- b. **Water usage:** Water is also a critical resource for data centers, particularly for cooling purposes. Analyzing water usage patterns and identifying ways to reduce consumption or improve recycling can help improve sustainability.
- c. **Waste management:** Data centers generate a significant amount of waste, including e-waste, cooling system byproducts, and packaging materials. Developing strategies for recycling or repurposing these materials can help reduce the environmental impact.
- d. **Carbon footprint:** Data centers can be significant contributors to greenhouse gas emissions. Analyzing the sources of these emissions and identifying ways to reduce or offset them can help improve sustainability.

- e. Social responsibility: Data centers also have a responsibility to consider the social impact of their operations, including issues such as labor practices, community engagement, and ethical sourcing of materials.
- f. Governance responsibility: Design and implementation of internal policies and undertake leading best practices to enable sustainable data center operations

Overall, the scope of study for data center sustainability involves a holistic approach that considers the environmental, social, and governance impact of data centers and seeks to identify ways to reduce their negative effects while maximizing their positive contributions.

## 2. Literature Review

Software is the backbone of virtually all the intelligent solutions designed including the efforts designed to support the environment. For example, blockchain drives a few of the modern-day green solutions like microgrids that allow residents to trade environment friendly energy.

And the energy consumption increases with the complexity/accuracy of the systems. In an experiment, researchers applied an AI – Artificial Intelligence model on a minor set of data of iris flowers. This model was further used in classifying various species of flowers. It achieved

- a. an accuracy of 96.17% with just 964 joules of energy
- b. further accuracy increase of 1.74%-point needed 2,815 joules of consumption in energy
- c. Remaining 0.08% increase took almost 400% additional energy than first level itself

Apart from AI, the technology has made deep homes in our day to day consumptions. According to the Electronicsforyou research, a brief list of facts about a minute on internet are

- a. 28,000 subscribers watching films/programs on Netflix
- b. €1.6 million used on online shopping
- c. a total of 500 hours of overall video content uploaded on YouTube
- d. swipes made on Tinder are 2 million
- e. 700,000 images shared on Instagram
- f. 9,000 new connections made on LinkedIn
- g. 5,000 downloads from TikTok

Hence, data centers offer a good business opportunity and could be a sector of the present that could drive our next decade of growth.

According to the Wire, regulation of data centres offers many economic advantages and at the same time offers ability to attain data sovereignty. Furthermore, the strong geographic connectivity to influential markets and planned location at the juncture of various submarine cables shows why India (Both private

and public sector) needs to invest in data centres.

Acknowledging the facts above, the Government of India issued a preliminary National Data Centre Policy in the year 2020. The major states, following the footsteps of the Center, have also alerted their respective data centre policies. A few more signed Memorandum of Understanding with private teams to organize the data centres.

But, the above policies, blatantly, ignore the Environmental Impact of the Data Centers envisioned.

Hence, in the absence of policy, we have

- a. to rely on the economic benefits of the ESG practices
- b. to reward ESG practices in choosing our suppliers
- c. to help policy makers understand and design ESG based policies specific to the Data Storage sector

To understand ESG, let's start with the first point in the data storage supply chain i.e. how can companies go green with their software?

According to a study done by Sanjay Podder, Adam Burden, Shalabh Kumar Singh, and Regina Maruca at Harvard, It's a process that is divided into three parts. Starts with designing a plan that has some boundaries, then aims towards SDLC (Software Development Life Cycle), and prepares greener cloud too. Not a single company, that they studied, was engaged fully in the above mentioned process or utilizing the full aids of greener software. However, many growing organizations — including Volkswagen, Google, and Rainforest (software testing company) — were initiating parts of implementation.

Hence, there is an immediate need to understand the Indian Context of the data storage story and study the ESG measures implemented by developed Economies like Singapore, UK and Ireland.

Pilot data center (DC) call for Application Exercise was launched by Singapore's Infocomm Media Development Authority (IMDA) and Economic Development (EDB) to aid the construction of new Data Center capacity and encourage standardized and sustainable growth in Data Centers in Singapore. EDB and IMDA will partner with the industry to facilitate DCs that bring together best practices for sustainability, focusing on areas of energy efficiency and decarbonization. IMDA and EDB will come in a partnership with industry for a greener Data Center to adhere to environmental regulations under the 2015 Paris Agreement also helping in the needs of Singapore's Digital Economy.

The EU Climate Neutral DC Pact positions to be a significant part of legislation, whose objective is to assist in driving Europe's bid to obtain climate neutrality by 2030. The Pact basically pledges by businesses who own or run DCs, and includes activities on clean energy, energy efficiency, circular

economy, water, governance and circular energy systems.

In a report released by Government of Ireland on the topic “Government Statement on The Role of Data Centres in Ireland’s Enterprise Strategy”, the Government decided to strengthen Strategic Policy Framework for the continuous growth of DCs in Ireland, as a part of attaining regional development and wider economic growth.

### 3. Research Methodology



Research methodology is a type of methodology for assembling all types of statistics and data relating to the matter in question. We have used **secondary research** as a research methodology. The detailed explanation on the steps performed for the study are as follows:

- **Identify source** – Trane Technologies plc is a company that manufactures ventilation, heating and refrigeration and air conditioning systems. The manufacturing company had published data on the impact of data centers. The data collected was further analyzed for the study. Other source of data includes company websites, annual reports, corporate social responsibility reports and statistics from Statista.
- **Validate the Data** – During the course of study, the researcher combined the data collected over four years i.e. from 2019 to 2022 and compared the data on different KPIs for ESG
- **Analyze data** – The above data was further analyzed to assess the impact of data centers on ESG criteria
- **Recommendations** – Basis analysis and its impact, recommendation on Environmental, Social and Governance criteria were provided to make data centers more sustainable

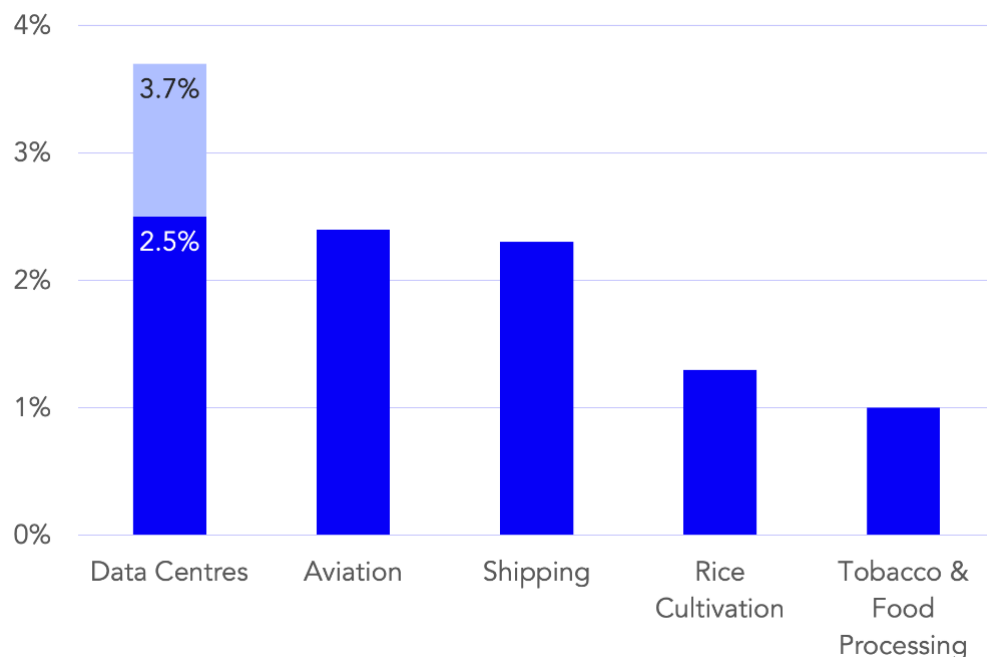


## 4. Case study

To achieve our objective of research, a case study was used to provide better results. Trane Technologies plc is a company that manufactures ventilation, heating and refrigeration and air conditioning systems (HVAC). Trane Technologies uses market leading practices in sustainability. Trane Technology aims to have a stronger plan for long-term growth – for the company and for the planet. The researcher has taken data points and provided recommendations upon analyzing the data points for Trane Technologies.

### 4.1 Environmental Analysis

Emissions from constitutes of 2.5% to 3.7% of all the global greenhouse gas emissions, thus surpassing emissions from aviation industry which is about 2.4% and other factual actions that fuel or add to global emissions in our global economy.



*Figure 2: Share of Global CO2 emission generated by sector/category*

Below are the main factors that lead to carbon footprint:

- a. Electricity consumed to help servers run
- b. Water consumed to cool down the servers
- c. And the time period of the machine/equipment which influences the number of time the equipment is to be replaced

All three above variables have exclusive features that should be included when performing any type of calculations.

Below are the environmental factors considered for analysis for the period 2019-2022

**a. Environment**

Greenhouse Gas Emissions	2019	2020	2021	2022
GHG emissions (metric tons CO2)	4,71,752	4,19,087	3,98,201	3,55,290
Other Air Emissions (metric tons)	2019	2020	2021	2022
NOx	104	95.26	98.46	107.79
Sox	7	5.48	5.56	6.90
Absolute Energy Use (billion KJ)	2019	2020	2021	2022
Total Energy Consumption	3,075.00	2,861.00	2,979.00	3,068.00
GHG Emissions/ Total Energy Consumption	153.42	146.48	133.67	115.81

Source: ESG Data Center, Trane Technologies 2023

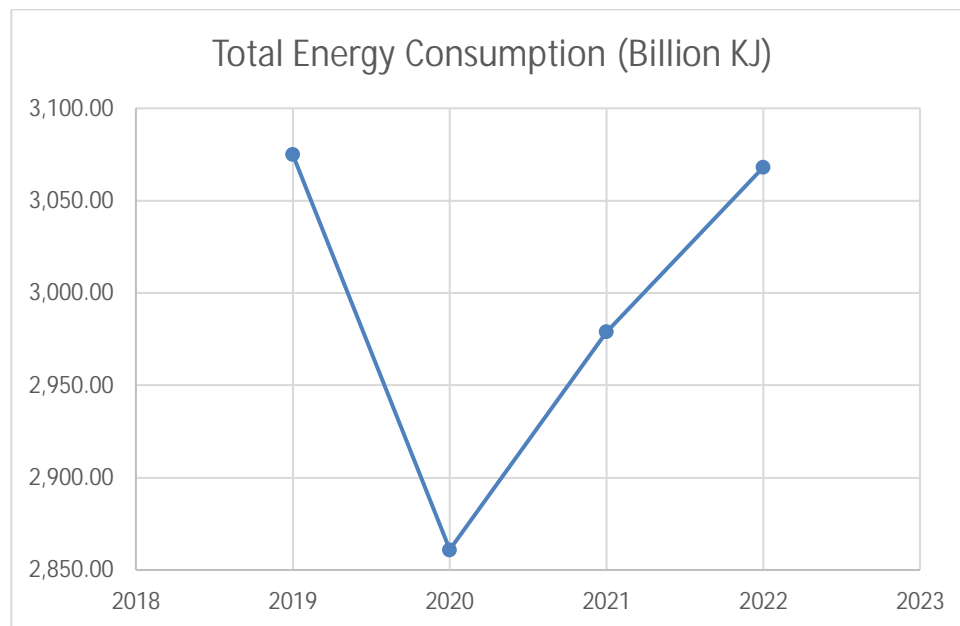


Figure 3: Total energy consumption from 2019 to 2022

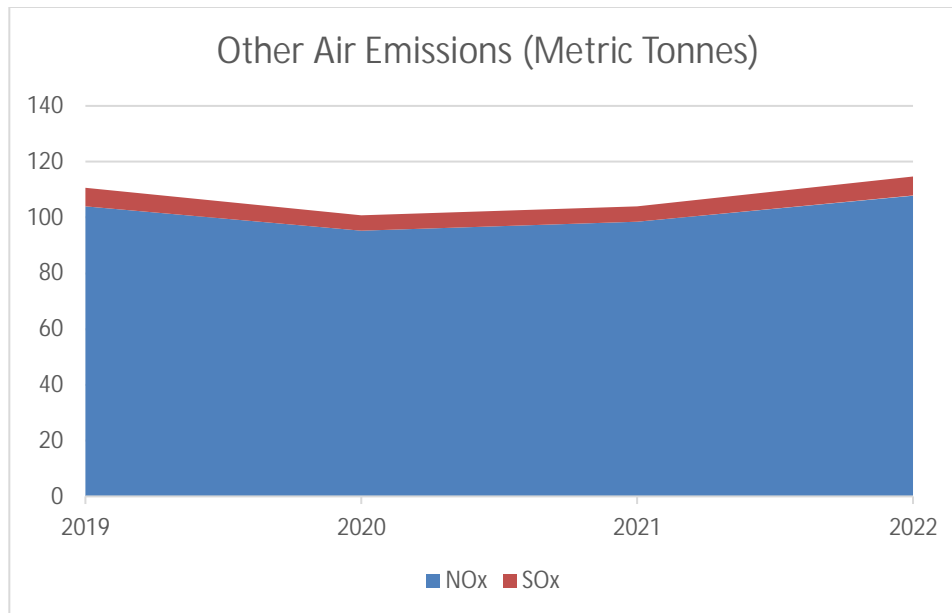


Figure 4: Other Air Emissions (NOx and Sox) from 2019-2022

The above data reports a green picture, but if we try and analyze the details, we observe

- a. It was noted that the GHG emissions have gone down from 2019 to 2022 by 24.69%. One of the probable reasons for the same could be the reduction in digital consumption post COVID lockdowns. But, the levels of NOx emissions and the SOx emissions have not gone down proportionately. Total other air emissions has increased by 3.32% from 2019 to 2022. NOx stands for Oxides of Nitrogen collectively: Nitrogen Monoxide (NO) and Nitrogen Dioxide (NO<sub>2</sub>). When fuel is burned nitrogen reacts with oxygen to form Nitrogen Monoxide and can then be further oxidised to form Nitrogen Dioxide:  $2\text{NO} + \text{O}_2 \rightarrow 2\text{NO}_2$ . This means that the organization is using data centers with installed diesel generating capacity.
- b. Although the energy consumption has gone down from 2021 to 2022, but the energy consumption is still at a higher level compared to average, 2995.75 billion KJ, of the energy consumed from 2019 to 2022. Hence, the way to sustaining a green data storage operation, must involve a renewable source of energy. It has been recognized and promoted by a lot of developed economies and should be made a part of the policy design. Efficiency in energy can be obtained in 5 steps – from enhancing IT power, Data Center space, Data Center cooling, removing DC power inadequacies and applying Data Centre Infrastructure Management Software (DCIM).
- c. The ratio ‘GHG Emissions/ Total Energy Consumption’ has gone down from 153 in 2019 to 115 in 2022. This means that the ESG initiatives introduced by the developed world are showing good results.

## b. Waste

	2019	2020	2021	2022
Waste Generated (metric tons)				
Total solid waste generated	10,521	8,758	6,832	6,332

Source: ESG Data Center, Trane Technologies 2023

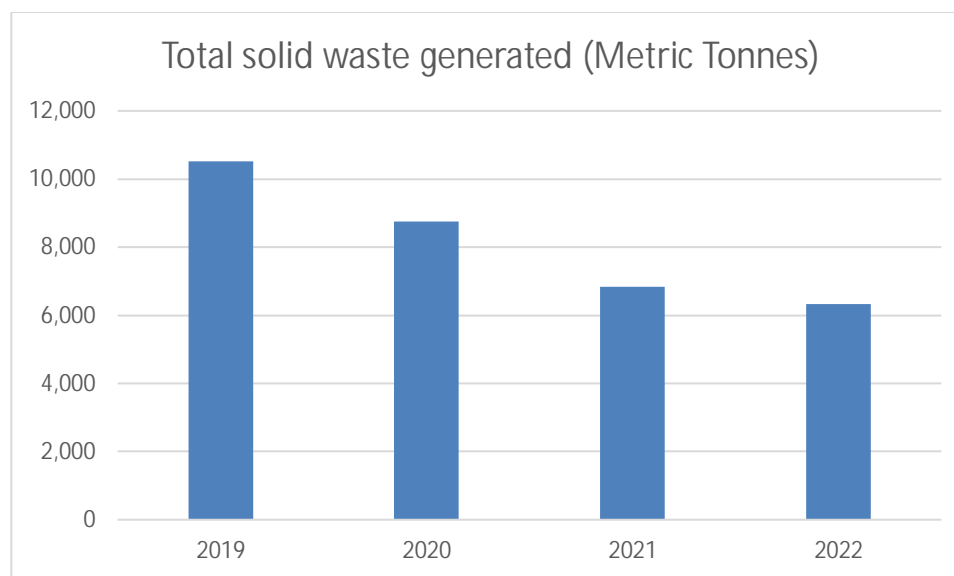


Figure 5: Total solid waste generated from 2019-2022

The above data shows that the waste generated in the Data Center for Trane Technologies has reduced over time. The left-over also comprises of limited precious metals, which are very important to our movement in achieving a future that is greener and power-driven by electricity. Data Center server infrastructure may contain almost 50 different elements. A lot of these constituents and rare metals have been categorized as crucial raw resources by the European Commission. Storage ecosystem, predominantly consists of E-waste. The E-waste produced by data centers contains racks, computing equipment, monitors, circuits, electrical components (wires, LED's, diodes etc.) and semiconductors. Electronic waste contains toxic components highly dangerous to human health including lead, mercury, cadmium, barium, lithium and polybrominated flame retardants. The toxic components can have very serious effects on heart, brain, liver, skeletal and kidney system damage.

## c. Water

	2019	2020	2021	2022
Usage of (million cubic meters)	2.94	2.78	2.89	2.45

Source: ESG Data Center, Trane Technologies 2023

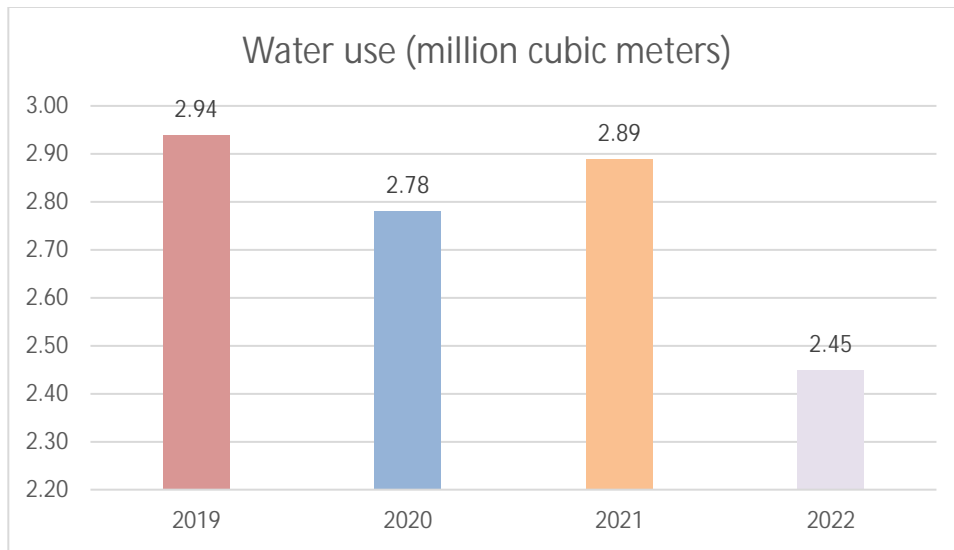


Figure 6: Total water consumption from 2019-2022

Data centers use huge volumes of water for

- a. Cooling system – Cooling towers, pumps, chillers, piping, computer room air conditioner units and heat exchangers / condensers
- b. Humidification systems
- c. Facility maintenance

According to researchers, though cheap cooling buildings are unsafe, unnecessary, and inefficient in recent hyperscale data centres. The “Dry” alternative knowledges, like the dry coolers are widely used in EU data centres.

Water from cooling towers of data centers is either:

- a. consumed i.e. it evaporates into the atmosphere or
- b. discharged to a local wastewater treatment plant as industrial waste

Since its independence, India’s annual per capita accessibility to water has decreased from 6,042 cubic meters in 1947 to 1,486 cubic meters in 2021. A drop by 75%.

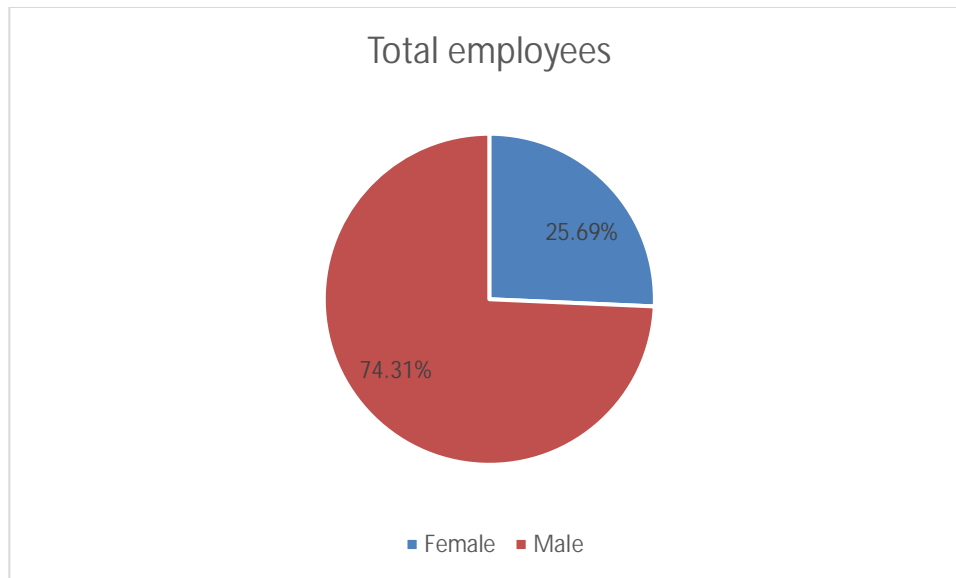
## 4.2 Social Analysis

Social criteria considered for the “S” in ESG are: Global Workforce, Racial & Ethnic Diversity, Gender Diversity

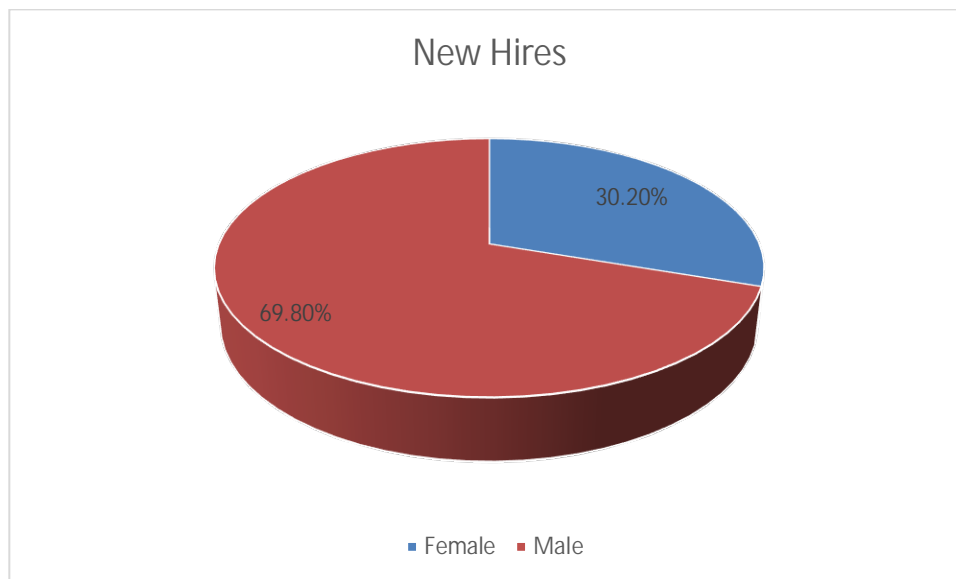
### a. Global Workforce

	Female	Male
Total employees	9678	27991
New Hires	30.2%	69.8%

Source: ESG Data Center, Trane Technologies 2023 & Trane Technologies 2022 Annual Report



*Figure 7: Percentage of female and male employees*



*Figure 8: Percentage of female and male new hires*

According to a report released by McKinsey, companies with gender diversity of more than 21% are more likely to experience above-average profitability (Hunt et al., 2018). There is tremendous pressure on public companies by investors to maintain gender diversity among their director ranking, showcasing more mindfulness of the requirements pertaining to environmental, social, and governance (ESG) issues. Companies need to face external pressures from activist shareholders, institutional investors, and potential

employees and consumers to have more representation of females in C-suite positions, corporate boards, and in executive leadership position. It is also required that women have equal pay scale and there is provision for mobility for women and people of color. This will influence how organizations worldwide will address inclusion, diversity, and gender difference. Since gender diversity is very important and plays an important role in performance and corporate strategy, organizations that fight to include inclusivity may impose risks for investors. As per Statista, female work force contribution rate across India in 2022 was 23.9%. Henceforth, it is very vital for a business to have appropriate female representation.

**b. Racial & Ethnic Diversity Data**

	2021	2022
Racial and ethnic diversity presentation - US salaried employees	18.40%	19.60%

Source: Trane Technologies 2022 Annual Report

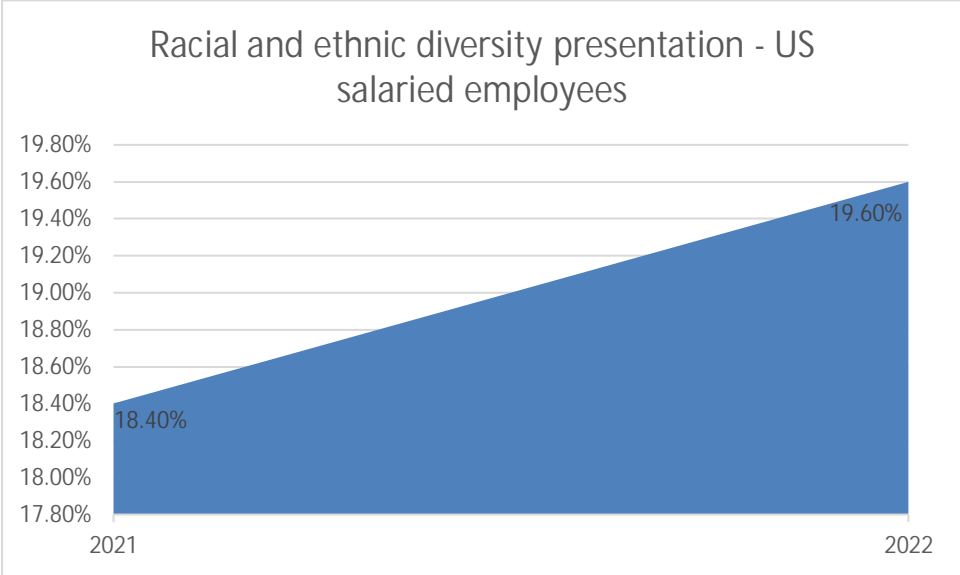


Figure 9: Percentage of racial and diversity presentation

In order to achieve racial and ethnic diversity and achieve workforce diversity, Tran Technologies has improved and increased ethnically and racially diverse U.S. salaried personnel from 18.4% to 19.6%. These activities comprises of increasing women representation and ethnically and racially diverse people in the fields of technology, science, math and engineering, addressing food waste and nutrition reductions. Supplier diversity program of Trane Technologies embraces suppliers who have diverse ownership, including ethnically and racially diverse people from different backgrounds, veterans, women and LGBTQ individuals or individuals with disabilities. The organization has also included people from diversified background to select diverse candidates for Board of Directors. The Board of Directors is nominating five

female directors (Ms. Arnold, Ms. Berzin, Ms. Miller Boise, Ms. Hudson and Ms. Schaeffer), one Black director (Ms. Miller Boise) and one international director who is an Irish citizen (Mr. Lee) out of a total of 11 directors.

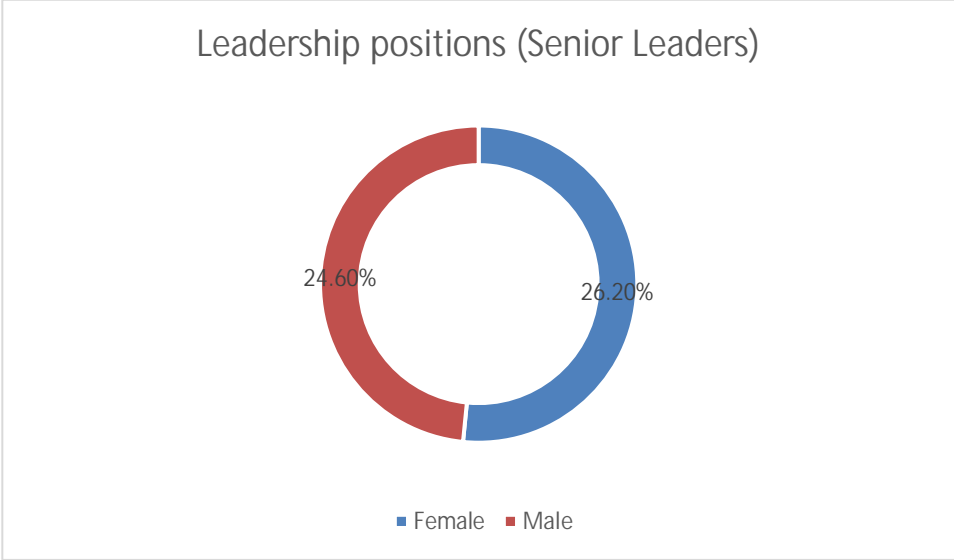
**c. Gender Diversity**

	Female	Male
Leadership positions (Management)	24.20%	23.10%
Leadership positions (Senior Leaders)	26.2%	24.6%

Source: Trane Technologies 2022 Annual Report



Figure 10: Percentage of female involvement at Managerial Leadership positions





In 2022, women in management increased from 23.1% to 24.2% and in senior leadership from 24.6% to 26.2%.

Apart from above factors, a socially responsible data center can also include below factors:

- Should not require displacement of people or destruction of homes because of DC construction
- Mainly employs locals to the maximum extent possible, as opposed to recruiting in high-paid technicians from somewhere else who may contribute to redevelopment or dislocation of populations.
- Provides equitable and safe working conditions for their employees

### 4.3 Governance

According to the discussion draft of the “Data Centre Policy 2020”, issued by Ministry of Electronics & Information Technology (e-Governance Division), the government’s view on ESG for Data Center is as follows

*“Encourage use of renewable energy for Data Centres – solar or windbased power – by collaborating with Ministry of Power on their various green and sustainable energy initiatives.”* And

*“Encourage efficient utilization of energy by promoting innovative techniques and solutions for energy management for reducing the carbon footprint of the Data Centres”*

Hence, the Governance has to be internal to a company and would be enabled by the market perception value associated with an ESG compliant organization. ESG controls the perception of a company and holds the power to affect perceived value and lasting success.

Governance covers the management of the company, decision making process, executive remuneration, shareholder rights, transparency and ethics.

In the context of a data center, Governance can be enhanced through the data collection (Via use of sensors) and data analytics. The primary areas of monitoring include power and environmental data points. The collection of data should be supplemented with a Data center Infrastructure Management Software.

Solving the problem of software with more software might seem counterproductive. But, these tools can be used to track and oversee the performance of an organization in real time. It allows for more transparent and responsible decision-making through innovative reporting. The sensors can be designed to track the

consumption of resources such as power and water, and data analytics can enable identification of waste areas or inefficiencies.

A Data center infrastructure management software [DCIM] can help optimize the utilization of existing resources, dodge unproductive buildouts, and drive sustainable behavior.

A perfectly designed DCIM may require funds and resources, but it can enable

- a. Monitoring power in real time and planning for any risk in the sustainable supply rising out of weather or storage issues
- b. Identifying ghost servers that use power but serve no purpose
- c. Identifying power hogs that run inefficiently and should be replaced, repaired or virtualized
- d. Setting threshold alarms for temperature and humidity, plus rack, inlet and circuit-breaker loads

## 5. Conclusion

- Environment sustainable growth requires all the datacenter environmental effects to be more measurable and controlled to make economic and additional incentives to decrease datacenter effects on the environment. In order to attain this goal, it is very important that data centers frequently publish numbers and statistics on various types of resource consumption, representing their sources, flow in sizes in complete form, and also technical features of the corresponding machine. It is essential to develop payment rates for thermal pollution and carbon footprint and match the existing lists of pollutants, demonstrating corresponding rates of payment to the atmosphere, release to natural marine life, and disposal of solid wastes
- Integrating sustainability areas as Key Performance Indicators and implanting those into the governance structures is central for businesses as they move towards greener practices in business
- Organizations should target for PUE (Power Usage Effectiveness) 1. PUE is a significant constituent in energy efficiency. It denotes to the connection between total energy that is entering a Data center and the energy that is utilized by Information technology equipment inside the DC (heating, cooling, ventilation, distribution, power conversion, utility plugs and lighting).

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