3.6 GREEN DATA CENTRE

The demand for data centre capacity world wide has been on the rise. This has also lead to a steady increase in carbon emissions.

This is so because servers will not only handle greater volume but will also require greater processing.

Data centres house a suit of large computers and associated networks of the organization, forming the heart of most businesses.

Data servers can be seen as powerful computers that have the capacity to store as well as process vast amount of multiformatted data.

As Cloud computing makes rapid strides, data, in its myriad multimedia format will have to be stored and instantly made available upon request.

The business users need to store data endlessly and also comply with the legislations. The demand of storing and processing of data is unabating.

The businesses that particularly deal with contents have to improve their data centres through innovative strategies in data management.

The data management solutions need to be agile so as to cater to rapidly changing data needs.

Dynamic and agile data management implies ability to modify, update, backup, and mirror data even as the organizational needs of the data keep changing.

Innovation, together with disciplined operational management of the data centre is required. Costs and carbon emissions are also closely tied together in case of data centres.

3.6.1 Influencing factors of green data centres

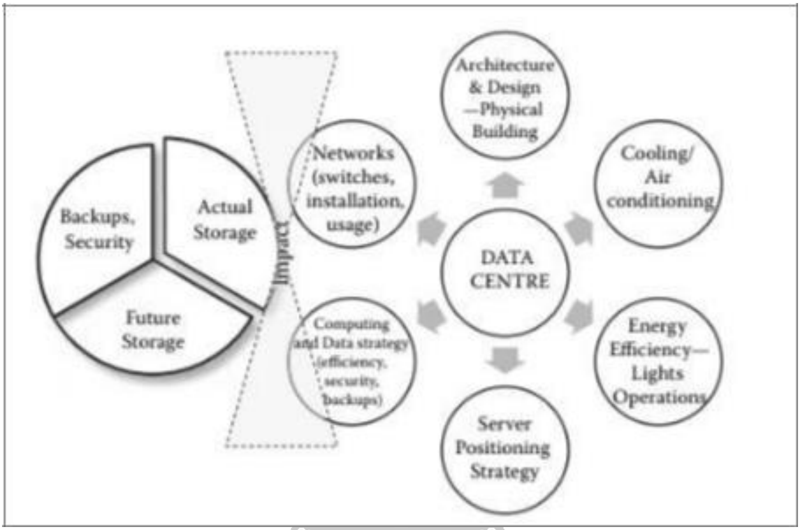

Fig 3.6: Influencing factors of Green data centre

Data centre design, layout, and location:

Physical building in which the data centre resides. This can be one building, or multiple buildings that house the machines but are themselves spread across geographical regions.

Architecture and design of the building, its geographical region and the material used in construction of the building are all valid considerations here.

The size and design of rooms in which servers are housed and also the location of the server rooms within the data centre can play a role in carbon reduction.

Cooling, air conditioning, power source and power consumption:

This includes the cooling strategies of the servers; and the air conditioning relating to the actual building.

This also includes use of green energy sources.

The impact of the physical location of the rooms to be cooled, that are housing the servers.

Power management:

This includes lights and operational aspect, number of people working, opening and closing of doors.

This would include procurement and installation of green products and use of green services.

Servers:

Their numbers, positioning and corresponding energy-efficient computing plays pivotal role.

Physical location of the racks, t heir positioning (hot isle/cold isle), architecture and the physical rooms in which they are placed are also important.

Design of each server—water cooled, air cooled, and other efficiencies are also to be considered.

Data strategy:

The main concerns here are including security and backup.

Virtualization within each server, and combined virtualization.

Organization of a cluster of servers—private cloud,
Space storage and usage strategy.

Virtualization aims to pool resources together to deliver data centre services by pooling resources that may be otherwise underutilized.

Adopting virtualization strategies will foster the development of many virtualization architectures that will enhance the data centre energy efficiency.

Networks and communications equipment:

This made up of land-based as well as wireless communications such as switchgears, routers, and modems.

The numbers and capacities of these equipment in the data centre contribute to its carbon footprint.

3.6.2 Data Centre ICT Equipment—Server Strategies

They are housed within the green data centre and require specific strategies for positioning, cooling, and usage. Servers are powerful computers that form a significant part of the IT assets of an organization. Increasingly these powerful servers provide the organization with the ability to access, provide, analyze, and store data, information, knowledge, and intelligence in myriad different ways.

There is ever increasing demand for more powerful servers with increased storage and processing facilities. With more powerful processors and proliferating number of servers the power consumption continues to climb rapidly. Servers belong to the data centre manager who is responsible for providing a service to the rest of the organization rather than using it directly themselves.

The following are a list of green server strategy considerations:

Online, real-time list of server inventory that enables location and uses of the servers.

Power consumption bill in real time—mapped to carbon generation, that provides operational feedback to the entire organization.

Bit to carbon ration as part of comprehensive data **strategy that provides metrics on not only the used —bits‖** but also the carbon generated by the provisioned bits.

Mirroring backup strategies that are balanced by the **—acceptable risks‖ of the data** centre director.

Data capacity forecasting: Server capacities need to be estimated on a continuous basis as the business changes. The correlation between business change and growth, and corresponding data centre capacity, is ascertained based on statistical analysis, trend spotting, and estimating the impact of technological innovativeness.

Carbon-cost visibility: Lack of visibility of server costs and particularly its mapping to individual or departmental use of space.

Efficient decommissioning: Once the purpose of a server is consummated, there is a need for a formal yet quick way of decommissioning the server.

Incorporation right redundancy

Enhanced server distribution: Need to distribute, through proper assignment, the use of the data space across and between various departments/users.

Incorporate server switching: Data servers should be capable of being switched from one type of usage to another.

Incorporate Cloud computing and server virtualization.

3.6.3 Data Strategy and the Carbon Emitting Bit

Data strategy encompasses the use, storage, mirroring, security, backups, clean ups, and architectures for data. It covers both external and internal approaches to data management. Data efficiency in relational database management systems includes use of techniques such as data normalization and incremental storage. Such practices enable creation of nonredundant and flexible data structures which tend to save data storage space when multiplied on a large scale. Using the correct data type would also affect the amount of data space that is being used in **every —bit‖ of data. Every —bit‖ adds to the carbon generation** from the data centre. Following are the impact of one extra bit in a data centre on the green performance of the organization:

Additional free s pace provisioning.

Speed and density.

Backup

Mirroring.

Quality and reliability.

Security.

Provisioning. Each bit requires provisioning for spare capacity, with corresponding need for spare room space, people and infrastructure.

[***1 bit + m b it (additional) leads to → 1.m bit × n w atts (direct energy need) → leads to nxp watts (support energy-infrastructure) influences → People (attitude)]***

In addition to the data server strategies discussed thus far, there is also a need to compliment those strategies with astute IT governances that ensure incremental improvements to the data centre performance. IT governance with additional focus on data centres help to manage the overall number of servers, their lifecycle and the underlying server virtualization strategies.

3.6.4 Data Servers Optimization

Optimization of servers deals primarily with the numbers, usage, and collaborations amongst the servers. This data server optimization can be improved through better organization of the databases including t heir design, provisioning for redundancy, and improved capacity forecasting.

Optimization also includes consolidation of various physical servers that would reduce their total numbers. Some of the techniques that could be considered by an organization for server optimization are:

Undertake intense and iterative capacity planning for the data centre.

Undertake in-depth optimization through identification of unused capacity of servers and storage disks within them.

Implement full storage virtualization that will enable hosting of multiple data warehouses on the same server.

Efficient server operations.

Efficient management of air-conditioning and cooling equipment that require, at times, even more power to cool the servers than required to operate them.

Decommissioning servers once their service level agreement has expired.

Applying virtualization during architecture and design of the servers, corresponding operating systems, and even applications.

Making use of infrastructural and hardware economies of scale.

Increasing B2B relation for a more common and efficient solution service

3.6.5 Data Servers Virtualization

Data server virtualization, as a key strategy, includes creation of many virtual servers from one physical server. Virtualization has been popular as an efficient hardware resource utilization; however, it also has significant impact on reducing carbon emissions. A rough virtualization, data centres can consolidate their physical server infrastructure as multiple virtual serversarehosted on lesser number of servers. This data centre specific program aims to improve energy monitoring, advanced 3-D power management and thermal modeling capabilities, better design techniques, cutting-edge virtualization technologies, enhanced power management systems, and new energy- efficient liquid cooling infrastructures. These initiatives can not only improve building use, data server use, but also reduce carbon emissions by almost 7,500 tons a year. Virtualization has to be supported by the operating system that would separate the underlying hardware from corresponding application software. Various types of virtualization are:

presentation virtualization- wherein users get a feel for owning the presentation of an application, whereas it is actually shared

application virtualization- enables multiple users to use the same application

desktop virtualization- applies the virtualization techniques of the servers at a local, desktop level

storage virtualization-applied to databases

network virtualization- relates to the communications and networking equipments of the data centre.

3.6.6 Physical Data Server Organization and Cooling

The physical arrangements of data servers, their organization, and the manner in which the floor space and racks are physically organized also impacts the overall carbon emission from that data centre

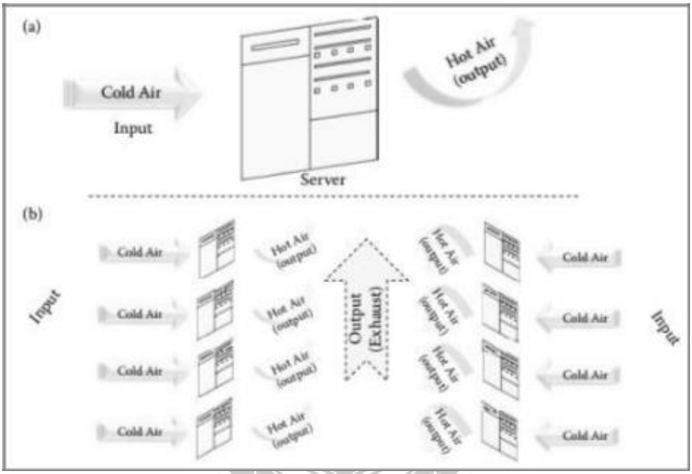

Fig 3. 7: Two ways of physical arrangement of servers

Data centres use a number of techniques to cool their servers.

Water cooling has been popular to handle the heat dissipation issues

Air cooling of servers using the concepts of hot-aisle and cold-aisle

They not only reduce the carbon footprint of the organization but, at the same time, improve its economic performance by reducing power consumption. Therefore, physical organization of the data servers, their operational effectiveness and cooling strategies all play a crucial role inthe overall reduction in carbon footprint.

Physical arrangements of servers require the following considerations:

Server optimization

Disk identification.

Implement a multitiered storage solution.

Specify low-power consumption, low voltage servers together with high-efficiency Power Supply Units

Equipment Reuse.

Re-engineer Layout.

3.6.7 Cloud Computing and Data Centres

Cloud computing provides lot of opportunities for organizations to consolidate their hardware and data space requirements. Cloud computing cuts the costs of services and also reduce carbon emissions. Saas can be used to to access key enterprise applications such as customer relationship management (CRM) and supply chain management (SCM) through the Internet. The opportunities to reduce carbon emissions increase with consolidation of both hardware and software applications. Furthermore, the payment models for SaaS-based applications is usually based on its usage. The typical data centre planning that makes provision for eventualities can be sidestepped for an overall planning by the cloud service provider.

3.6.8 Networking and Communications Infrastructure

The data centres hold the communication equipment and related assets. These communications infrastructure support the internal and external networks of an organization and play a significant role in its carbon footprint. Some of the communication devices that contribute to carbon emissions includes switches, routers, the LAN, WAN, and associated mobile transmission devices. Monitoring of networks, their interoperability, their uptimes and full-times, are also factors contributing to the carbon footprint. Reduction of communication traffic reduces server load, thus minimizing the memory and processing time of the server. Following are the categories of which demands attention in the context of carbon emissions:

Local Area Networks (LAN): Local networks of the organization that are made up of the physical connections amongst the machines and data centre. Usually they lack planning and architecture for LANs is a major factor in consuming substantial power and thereby adding to the cooling requirements.

Wide Area Networks (WAN): This enables communication amongst its desktop and laptop machines with and beyond its data centre. WAN comprises use of communication lines that make up the virtual private network (VPN) of the organization.

Mobile Networks: The mobile communications infrastructure stack is made up of TCP/IP at the base, followed by Well-integrated and optimized networks. They incorporate combination of centralized and decentralized approaches and plug-in sensors which can increasingly play a major role in reducing carbon effects.

Other techniques: Personal Area Networking (PAN), Metropolitan Area Networks (MAN), the IEEE 802.1x group of standards and Infrared, Bluetooth, RFID, WiMax, and Wireless VoIP also produce carbon.

Wireless L AN/WAN: While wireless communication may give the impression of reduced hardware and infrastructure it may still be inefficient and result in substantial carbon if not properly architected during installation and not monitored during operation.

WiMax: Mobile standard for point-to-point communication that is based on radio frequency standardized technology (IEEE 802.16) that tends to consume power, especially when it is on but not in use. WiMax, made up of transceivers to base antennas, need standards to ensure these networks are switched on-and-off depending on their usage pattern.