

4.8 EMERGENT CARBON ISSUES: TECHNOLOGIES AND FUTURE

Development of new environmental standards, potentials for new global understanding in terms of protocols, development, and integration of new CEMS adds value to the carbon reduction mission. The business models have also undergone changes that contributes to carbon reduction. The emergent technologies, innovative processes, innovative business models, demanding customer preferences, synergetic standards, and new, positive social attitudes will foster the development of Green IT.

4.8.1 Future Carbon Landscape

The factor influencing Green IT are scientific breakthroughs, innovative approaches, updated standards and legislations, social attitude towards carbon emissions.

The directions of growth in Green IT focus towards:
Technology, Economy, Process and Social factors.

Use of knowledge management tools can foster the creation of more insights and knowledge in Green IT domain.

Carbon trading will bring in application of mathematical formulae like Black scholes and Binomials, graphs and tables to price and facilitate trading in the software applications. These applications need to allow for further changes to environmental standards, legislations, and processes.

Users also have a varying level of knowledge and appreciation of Green ICT and their interests and priorities also vary. Hence Green ICT applications will have to remain continuously adaptable and agile.

The future of Green ICT is in innovation that makes use of social media networks ,puts together groups of people and organizations in consortiums, enhances general opinion on the issues, and activates the Green HR function within the organization.

Social networks relating to Green IT and environmental responsibilities can be formed at local, regional, and global level.

At each level, these groups have different interpretation and priorities in terms of the environment. Innovation in social approaches will capitalize on these different interpretations and priorities and bring them together on a common platform.

This can be achieved by organizations and governments getting actively involved in the social media network phenomena rather than merely observing it or making attempts to control it.

The innovation requires due consideration to the mind maps of the individuals operating with carbon reduction responsibilities within the organization, the tools and technologies used by them, and the way these individuals are trained, retained, and promoted.

4.8.2 Green ICT and Technology Trends

Environmental intelligence (EI) includes the correlation and insights into carbon data and information and innovative application of technologies. The technologies that have an impact on Green IT are Cloud computing, software as a service, nanotechnologies, quantum/ternary computing, ecodesign and biomimicry. Similarly, alignment of these technologies with business will be promoted through creation and upgrading of ISO standards, corporate governance standards and fresh look at Green IT strategies and policies.

Cloud Computing

The underlying premise of Cloud computing has been the consolidation of hardware and software services that are made available through the uninterrupted internet connectivity.

Lot of advantages can be listed in terms of carbon emission reduction through consolidation of resources.

The sharing of infrastructure and applications, pooling of reusable data, and flexibility in terms of IT planning resulting from the Cloud has many possibilities that are yet to be explored.

The opportunities to reduce the overall carbon footprint through dynamic collaboration are on the rise by creation of public and private Clouds.

Dynamic collaboration on the Cloud enhances the opportunities to use the business principle of Cloud **computing: —pay as you go in terms of using computing services.**

The future of Cloud computing will also be affected immensely by the availability of commonly accepted standards as well as excellence is metrics and measurements.

Currently, carbon emission calculations in the Cloud are treated external to the organization, resulting in a reduction of the carbon footprint of the user organization.

A much more precise calculation that balances the consolidation of computing devices with the power expended by the communication networks in communicating with those centralized computing devices is required.

Cloud-based services will be offered by a conglomeration of large computing vendors with specialist skills, including those in server management, location and infrastructure, metrics and measurements, standards, and, of course, ability to comply with the legal and reporting requirements.

Following are the areas of Cloud computing that have the potential for reducing the overall carbon emissions across the industry:

Infrastructure

Applications development

Application execution

Reusable Data service

SaaS

Software as a service (SaaS) provides an ideal way to deploy software applications. SaaS provides access to the application that is executing on a remote server, by anyone, as and when needed.

SaaS is the execution of application from a centralized server through the connectivity accorded by the Internet.

SaaS model offers a combination of shared services model, improved power consumption, cooling efficiency, and equipment density. Thus SaaS is closely associated with Cloud computing, and adheres to the principle of pay as you go, mentioned earlier.

While the Cloud offers opportunities to consolidate infrastructure and hardware, and enables expansion without the usual overheads, SaaS creates opportunities to execute applications that are not installed, and configured on the local servers of the organizations.

Application vendors themselves may no longer be offering their applications as packages but, rather, as services.

The challenge with SaaS-based deployment is related to data, its integration and its security. SaaS applications are easier to maintain and upgrade as they are installed and configured in centralized place.

With increasing acceptance of SaaS-based deployment of software there will be a significant reduction in the —**clutter** of hardware and software components.

Nanotechnologies

Nanotechnology deals with computing at a microscopic level.

These technologies have the potential to impact Green IT in terms of both its hardware and its software.

Nanotechnologies provide means to create, measure, and manipulate electronic data and communications at atomic size.

The reduction in size requires considerable research effort—design, development, and production.

The power to these minuscule devices requires innovation in battery power technologies. However, the amount of power required by these devices is also small due to their smaller size.

Reduction in device size, potential elimination of movement (e.g., spinning of disks) within the devices, and ease of handling can all reduce overall carbon emissions resulting from these devices.

Quantum/Trinary Computing

Trinary (or ternary) computing has significant possibilities not only for computing itself but also for improving on the carbon footprint of IT. Trinary computing works at the very fundamental of computing by adding to the binary bit **options of 0 and 1, another option of -1.**

New Renewable Energies

Wind, solar, tidal, nuclear, and biomass are some of the renewable energy resources. Exploring new energy sources that would not deplete with use is a field on ongoing research.

Advent of the renewable sources of energy will change the carbon emissions calculations as the emissions resulting from these energies are expected to be much less than those generated by coal and gas.

ISO—New and Upgraded Standards

The ISO 14001 standard, specifies the requirements of an environmental management system in the context of a specific product or an organization. However, this standard does not contain requirements for that would handle environmental practices associated with collaborative organizations—especially if these organizations are collaborating dynamically.

Either the ISO 14000 series of standards need to be upgraded to include dynamically collaborating businesses or a new set of standards are required to cover the environmental practices of such collaborations.

The environmental governance standards that deal with embedding environmental management within corporate governance structures are also required.

Standards that can dictate, from an environmental perspective, the use of aforementioned emerging technologies, are also required.

Security and Legal

The current legal frameworks governing carbon emissions come out of the ratification of agreements at various international summits on the environment.

However, a carbon emission in the context of IT is a global phenomena—especially as Cloud, SaaS, and outsourcing continue to dominate the ITservices sector.

While the real user of a service could be sitting in one geographical region, the emissions resulting from his or her work will be attributed to a totally different geographical region.

The laws that govern these emissions, and the standards and protocols that surround the measurements of these emissions, need to be developed and agreed upon.

The dichotomy between the developing and developed nations in terms of carbon emissions is also a key in the development of laws and regulations that can apply globally.

Integral to such a legal framework are the issues associated with security of carbon data. This is particularly so when the data is generated and owned by one organization, whereas it is stored, maintained, and backed up by a totally different vendor of such services.

Security of carbon data requires procedures, norms, practices, standards and legal framework.

Ecodesign

This is based on the environmental design in very early stage of architecture and design of product lifecycle.

While environmental consideration is a product, lifecycle themselves are not a new thing, in depth consideration of the Green P-O-D is involved in this process.

Thus eco-design can cover design, raw materials, production, packaging, and distribution.

Biomimicry

Biomimicry, as an emergent trend, requires substantial study, experimentation and usage in all areas of an **organization's products and services. Biomimicry can be** considered as a combination of science and art that aims to learn from and emulate nature, which is usually sustainable. Nature uses only the energy it needs to carry out a function, ensures that the functionality matches the form, recycles and relies on diversity. Lot of opportunities can be explored by Green IT in the area of data centre infrastructure, design, operations and communication systems. Going by nature, which relies and makes good use of local expertise, the Cloud architecture may become a distributed architecture that takes advantage through decentralizing some aspects of the otherwise centralized architecture.

4.8.3 Green ICT—Business and Economic Trends

Collaborations, based on internet connectivity offer many business opportunities.

New collaborative business models that are also dynamic can lead to many different ways in which Green IT is understood and implemented by these collaborations.

Collaborations enable relationships between a network of organizations enabling them to buy and sell their products and services electronically, thereby making them cheaper to sell or buy as well as enabling the businesses to reach a wide range of market.

Business collaborations offer opportunity for reusability of data, processes, and systems that in itself is advantageous in reducing carbon footprint.

This can also foster information and knowledge gained in implementing Green IT strategies.

Green IT should become a self-sustaining commodity that can be traded for its own sake, or increase the share value of a firm.

Product based businesses need significant use of the Cloud for calculating raw materials and inventories, relating them to supply chains and also distributing the finished products.

Service-based industries have negligible raw materials, inventories are only associated with the equipment and there is no distribution network.

Cloud-based business models, wherein these businesses are using Cloud computing, require the service level agreements to be drafted differently.

The services and support required from the cloud as service based business has time critical components.

Numerous aspects of such a business model come into play including requirements for uptime, redundancies in data and systems, staff support, education and training, and even marketing and advertising.

From a business viewpoint, the future of Green ICT can also be linked closely with good corporate citizenship and ensuing promotion and marketing.

Business models reflect changes to the internal organization of business. deliver results. The internal

business model includes addressing internal communication, integrating processes, and enabling sharing of information amongst team members.

4.8.4 Dichotomy of Developing Economies

The dichotomy exists between rapid economic development and corresponding carbon control in the developing economies.

This issue was the main point of contention between these two groups of economies and was based on the need to consider total carbon emissions over a substantial period of time.

If emissions are considered only over last couple of years or even a decade, then the developing nations produce substantial emissions—as the economic development is more or less related to increases in carbon emissions.

The developed economies, in the past, generated significant carbon during their own growth periods.

New and emergent approaches to sustainability in practice need to incorporate the global factors.

Governments, companies, and individuals need to build on them further by bringing in elements of geographical regions as well as time periods in measuring and restricting emissions.

Thus new economic models in the way resources are shared over regions and time is required.

The disparity of consumption and corresponding carbon emission between the developed and developing countries needs to be bridged.

4.8.5 Collaborative Environmental Intelligence

The various areas of collaborations include those between various stakeholders and parties: between organizations, between individuals and organizations and between government and organizations. Thus, collaborative EI goes beyond the insights required and used by a single organization and into the realms of multiple, dynamic collaborative entities. Collaborative intelligence is a technical platform where multiple organizations are collaboratively sharing their business intelligence for the win-win outcome without compromising their own market position and differentiation. Developing and formalizing the collaborative EI capabilities will provide collaborating organizations with market differentiators in the environmental space. The following are topics of interest in collaborative EI:

- Collaborative carbon data for trend plotting
- Collaborative data warehouses
- Collaborative EI using Cloud computing
- Collaborative EI with mobile technologies.
- Collaborative EI and Green Blogs
- Collaborative EI and Web 2.0/Web 3.0.
- Collaborative EI and GRID computing