Unit-4

GREEN COMPLIANCE

4.1 GREEN COMPLIANCE

Environmental Compliance or green compliance are the actions performed during or after operations to obey the requirements of all Environmental Laws or contractual commitments related to reclamation of the Properties or other compliance with Environmental Laws.

In a broad sense, green compliance involves conforming to various state, federal and local environmental laws and regulations.

This a broad range of regulations, laws and standards created to manage the environment.

The legislation affects everyone from householders to multi-national companies.

The scope of green compliance includes wide range of areas such as carbon emissions, carbon management,

water quality, site permits, waste handling and storage, etc.

The set of laws, regulations and standards vary from country to country.

The purpose of this type of legislation is to make sure businesses that manufacture, import and sell products are responsible for their end of life environmental impact.

Some of the goals of green compliance includes:

Tracking of programs and schedules to ensure that steps requires to comply with the agreement is done.

Processing, validating and evaluating data for compliance with reporting or creating alerts

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Generating compliance reports for internal purpose and for government agencies.

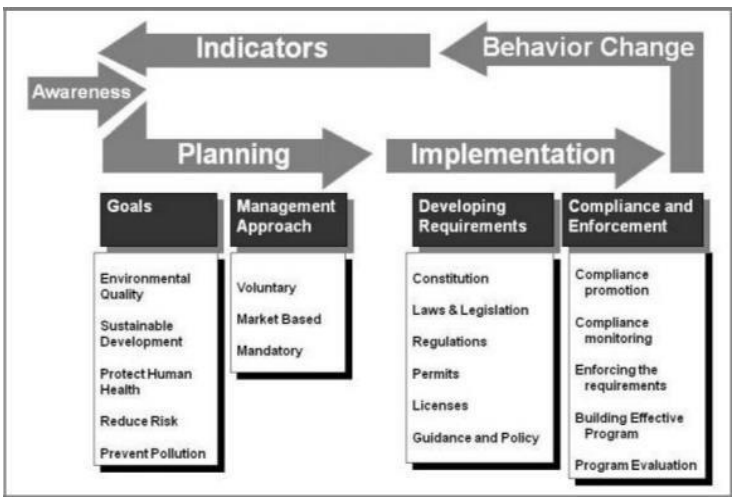

Fig 4.1: Green Compliance management lifecycle

The green compliance management lifecycle involves the following steps:

Defining the goals

The first phase starts with awareness or acceptance that there is an environmental problem and there exists adequate support to address the problem.

Then the program supporters must begin strategic planning and goal setting.

These primary goals will focus on reducing environmental risk, preventing pollution, reducing harmful emissions or clearing past contamination.

Selecting a Management Approach

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The focus shifts to selecting the appropriate management approach or hybridization of existing approaches, to achieve program goals.

Developing Requirements

The chosen approach may require the support from specific laws or regulations.

Laws and regulations, will include some specific requirements that define specific practices and procedures to directly or indirectly reduce or prevent harmful environmental effects.

Evaluation, Compliance and Enforcements

Evaluating the impact of the implemented program through the use of compliance and enforcement

indicators is very crucial to measure the success of the management strategy.

Evaluation leads to greater awareness of how the program is addressing the targeted environmental problem.

The evaluation process results in development of compliance and enforcement indicators.

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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.

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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.

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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 that 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.

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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.

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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:

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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.

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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 t heir smaller size.

Reduction is 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‖**

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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.

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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.

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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 b**e 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.

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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 the reis no distribution network.

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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.

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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 w in-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:

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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

4.7 GREEN COMPLIANCE: PROTOCOLS, STANDARDS AND AUDITS

Successful Green enterprise transformation (GET) should result in a carbon-compliant organization. The organization should understand, measure, and Report its carbon performance according to the regulatory requirements of the carbon legislations in that region. Measuring, Reporting and validating the reports are crucial part for carbon compliance.

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Formal and informal audits of the carbon measures and reports are part of the governance for a responsible green organization. Meters and other recording devices, carbon-content databases, applications, and systems, used in producing the compliance reports and the accuracy of external green web services embedded in the applications should be formally audited. Carbon Emissions Management Software (CEMS) is developed for managing carbon performance of the organization. Various countries and regions interpret the need to reduce carbon differently. This variation is based on a number of factors such as the physical location, demographics, political will of the

government, public opinion, economic and social development of the region, and the state of the industry.

4.7.1 Protocols and Standards

United Nations Framework Convention on Climate Change (UNFCCC, Rio)

The UN Framework Convention on Climate Change (UNFCCC) is an intergovernmental treaty developed to address the problem of climate change.

The Convention, which sets out an agreed framework for dealing with the issue, was negotiated from February 1991 to May 1992 and opened for signature at the June 1992 UN Conference on Environment and Development (UNCED) — also known as the Rio Earth Summit.

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The UNFCCC entered into force on 21 March 1994, **ninety days after the 50th country's** ratification **had** been received. By December 2007, it had been ratified by 192 countries.

The UNFCCC sets out a framework for action aimed at stabilizing atmospheric concentrations of greenhouse **gases to avoid —dangerous anthropogenic interference** with the climate system.

Controlled gases include methane, nitrous oxide and, in particular, carbon dioxide.

Kyoto Protocol

In light of increasing scientific evidence about the risks of climate change, it soon became evident to policy

makers that a further negotiated agreement might be necessary.

In December 1997, delegates at COP 3 in Kyoto, Japan, agreed to a Protocol to the UNFCCC that commits developed countries and countries in transition to a market economy to achieve quantified emission reduction targets.

These countries, known under the UNFCCC as Annex I parties, agreed to reduce their overall emissions of six greenhouse gases by an average of 5% below 1990 levels between 2008-2012 (the first commitment period), with specific targets varying from country to country.

The Protocol also established three flexible mechanisms to assist Annex I parties in meeting their national targets cost-effectively:

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an emissions trading system; joint implementation (JI) of emission reduction projects between Annex I parties

Clean Development Mechanism (CDM), which allows for emission reduction projects to be implemented in non-Annex I parties (developing countries).

Following COP 3, parties began negotiating many of the rules and operational details governing how countries will implement and measure their emission reductions.

To date, the Kyoto Protocol has been ratified by 177 countries, including Annex I parties representing 63.7% of Annex I greenhouse gas emissions in 1990.

The Kyoto Protocol entered into force on 16 February 2005.

Green House Gas protocol

The Greenhouse Gas Protocol (GHGP) provides accounting and reporting standards, sector guidance, calculation tools, and trainings for business and government.

It establishes a comprehensive, global, standardized framework for measuring and managing emissions from private and public sector operations, value chains, products, cities, and policies.

The GHG Protocol also provides webinar, e-learning and in-person training and capacity-building support on its standards and tools.

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In addition, GHG Protocol offers companies and **organizations the opportunity to apply for our —Built on GHG Protocol‖ mark that recognizes sector guidance,** product rules, or tools that are in conformance with GHG Protocol Standards.

GHG classifies emissions into three separate Scopes (1, 2, and 3) from which a basis for calculating the **organization's overall carbon footprint can be** established (see OSCAR for details of calculations):

Scope 1 emissions—The direct emission of GHGs by the organization.

Scope 2 emissions—emissions form the indirect consumption of energy such as electricity.

Scope 3 emissions—emissions embedded in the supply chain of the organization—primarily belonging to the business partners.

Copenhagen protocol

The Copenhagen Climate Change Conference raised climate change policy to the highest political level. Close to 115 world leaders attended the high-level segment, making it one of the largest gatherings of world leaders ever outside

UN headquarters in New York. More than 40,000 people, representing governments, nongovernmental organizations, intergovernmental organizations, faith-based organizations, media and UN agencies applied for accreditation.

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It significantly advanced the negotiations on the infrastructure needed for effective global climate change cooperation, including improvements to the Clean Development Mechanism of the Kyoto Protocol.

Significant progress was made in narrowing down options and clarifying choices needed to be made on key issues later on in the negotiations.

It produced the Copenhagen Accord, which expressed clear a political intent to constrain carbon and respond to climate change, in both the short and long term

The Copenhagen Accord contained several key elements on which there was strong convergence of the views of governments.

This included the long-term goal of limiting the maximum global average temperature increase to no more than 2 degrees Celsius above pre-industrial levels, subject to a review in 2015.

Developed countries' promises to fund actions to reduce greenhouse gas emissions and to adapt to the inevitable effects of climate change in developing countries..

Agreement on the measurement, reporting and verification of developing country actions, including a reference to "international consultation and analysis", which had yet to be defined.

4.7.2 The ISO 14000:2004 a Family of STANDARDS

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The primary objective of the ISO 14000 series of standards is to promote effective environmental management systems in organizations. The standards seek to provide cost-effective tools that make use of best practices for organizing and applying information about environmental management. The ISO 14000 family was developed in response to a recognized industry need for standardization. With different organizational approaches to environmental management, comparisons of systems and collaboration had proved difficult

ISO 14001

ISO 14001 standards are part of a family of standards (ISO 14000) designed to promote and guide an environmental management approach. It is appropriate for any kind of organization (company, NGOs, union, etc) concerned about improving its system of production, management, and operations as a way to better control its environmental impacts.

ISO 140001 has 2 main objectives:

To give a standardized and proven framework that can help organizations to develop an effective environmental management strategy;

To work as an official recognition and prize for the **organizations' efforts to improve their environmental** strategies.

The application of ISO 14001 is not a legal obligation and like all standards set by ISO, adopting it is voluntary. Nevertheless, despite not being mandatory, it imposes a compliance commitment with the current environmental regulation and its future developments for those who follow it. The basic principle of ISO norms is the search for continuous improvement, in successive cycles, according to the four-step process of the Deming (PDCA) cycle:

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Plan

Do

Study/Check

Act

Following the steps of the cycle PDCA mentioned above, the implementation of the ISO 14001 standards is carried out in three stages:

At first, there is the need to audit the current organizational practices regarding environmental management and their compliance or non-compliance with the regulations and objectives of the ISO 14001 standards.

This will allow organizations to identify and have a clear picture of their procedures, making it easier to re-think and transform them in order to achieve the necessary improvements required by the ISO 14001 standards.

This self-audit can be done internally before-hand, but **all the information about the organization's** environmental procedures and policies will have to be endorsed to the certification entity and confirmed by its consultants.

Once the inventory has been completed, a program of measures to be taken and actions to be developed (prerequisites needed for the certification) need to be established and implemented according to an appropriate schedule.

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Finally, a rigorous evaluation of the new practices and their environmental impact will be carried out regularly (an annual audit within every three years), where updates **or changes on the organizations' environmental** management systems may be requested.

ISO 14001 standards are above all a management tool.

As such, they do not impose certified organizations to achieve certain environmental objectives. Instead, ISO 14001 demands certificated organizations to have a system of procedures that must be respected in order to manage their environmental impacts.

An ISO 14001 certified organization is not necessarily an ecological one, what it means is that it has a system that allows it to improve on its environmental issues.

USA Energy Star

ENERGY STAR is a federal voluntary program run by the U.S. Environmental Protection Agency (EPA) to help people learn more about the many ways they can save money and help reduce environmental degradation through improved energy efficiency. Under the program the EPA identifies and promotes energy-efficient products and buildings, all with the overall goal of reducing energy consumption, improving energy security and reducing pollution.

One of the major sources of pollution is the formation of greenhouse gases. According to ENERGY STAR, two thirds of greenhouse gas (GHG) emissions in the U.S. come from energy use in homes, buildings and industry. Lowering the amount of greenhouse gases that go into the environment, then, has been a primary focus of the ENERGY STAR program and its ENERGY STAR rating system

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A critical part of ENERGY STAR is its ENERGY STAR rating system, which focuses on three main areas: products, homes (new and existing) and commercial businesses. Getting an ENERGY STAR rating — which not every appliance has — means that a product meets certain federally mandated guidelines regarding energy efficiency. The guidelines vary depending on the product. The water requirements for a dishwasher to get an ENERGY STAR rating are different than for a washing machine. The EPA establishes its product specifications based on certain guiding principles:

Product categories must contribute significant energy savings nationwide.

Certified products must deliver the features and performance demanded by consumers, in addition to increased energy efficiency.

If the certified product costs more than a conventional, less-efficient counterpart, purchasers will recover their investment in increased energy efficiency through utility bill savings, within a reasonable period of time.

Energy efficiency can be achieved through broadly available, non-proprietary technologies offered by more than one manufacturer.

Product energy consumption and performance can be measured and verified with testing.

Labeling would effectively differentiate products and be visible for purchasers.

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EPEAT—Electronic Product Environmental Assessment Tool

The Electronic Product Environmental Assessment Tool (EPEAT) is a global ecolabel for the IT sector. EPEAT helps purchasers, manufacturers, resellers, and others buy and sell environmentally preferable electronic products.

The EPEAT program provides independent verification of **manufacturers'** claims and the EPEAT online Registry lists sustainable products from a broader range of manufacturers than any comparable eco label.

National governments, including the United States, and thousands of private and public institutional purchasers

around the world use EPEAT as part of their sustainable procurement decisions.

The Green Electronics Council (GEC) manages this flagship program, including ensuring the integrity of the EPEAT system.

EPEAT is one example of how GEC supports institutional purchasers around the world, fostering a market for sustainable IT products to achieve our mission of a world of only sustainable IT.

Purchasers can search for electronics based on product category, manufacturer, geography or EPEAT rating.

EPEAT-registered products can even be identified based on specific attributes valued by an organization (reduction of toxic materials, recyclability, use of recycled plastic, etc.).

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Manufacturers register products in EPEAT based on the **devices'** ability to meet certain required and optional criteria that address the full product lifecycle, from design and production to energy use and recycling.

Bronze-rated products meet all of the required criteria in their category.

Silver-rated products meet all of the required criteria and at least 50% of the optional criteria, while Gold-rated products meet all of the required criteria and at least 75% of the optional criteria.

Manufacturers' claims of compliance are subject to ongoing verification by qualified conformity assurance bodies.

Products claims found non-conformant are announced publicly and removed from EPEAT to ensure Purchasers worldwide can use the system with confidence.

- Implementing EPEAT contract **language also gives purchasers a vehicle for requiring suppliers to document all EPEAT-registered products purchased through that contract during a given year.**

This data, if shared with the Green Electronics Council, qualifies the purchaser for annual recognition and can be used to calculate the **purchaser's** specific financial and environmental benefits.

EPEAT-registered products meet strict environmental criteria that address the full product lifecycle, from energy conservation and toxic materials to product longevity and end-of-life management. EPEAT-registered products offer a reduced environmental impact across their lifecycles.

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Over their lifetime, the 1.34 billion EPEAT-registered electronics purchased globally since 2006 will deliver significant environmental benefits.

Compared to products not meeting EPEAT criteria, these electronics will result in the reduction of 184 million metric tons of greenhouse gasses, elimination of 830,311 metric tons of hazardous waste, and will reduce solid waste by the equivalen**t of 528,098 U.S. households'** annual waste.

EU RoHS—Restriction of Hazardous Substances Regulations

This restricts the use of six hazardous materials found in electrical and electronic products. All applicable products in the EU market since July 1, 2006 must pass RoHS compliance.

Directive 2011/65/EU was published in 2011 by the EU, which is known as RoHS-Recast or RoHS 2.

RoHS 2 includes a **CE-marking directive**, with RoHS compliance now being required for CE (Carbon Emission) marking of products. RoHS 2 also added Categories 8 and 9, and has additional compliance recordkeeping requirements.

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Directive 2015/863 is known as RoHS 3.

Any business that sells applicable electrical or electronic products, equipment, sub-assemblies, cables, components, or spare parts directly to RoHS-directed countries, or sells to resellers, distributors or integrators that in turn sell products to these countries, is impacted if they utilize any of the restricted 10 substances.

With the rapid spread of digitization, the world's production of electrical and electronic devices is exploding.

Besides mobile devices, think about the coming wave of IoT, smart home assistants, robots, drones, 3D printers, and home medical devices to all corners of the planet are regulated by RoHS.

EU WEEE—Waste Electrical and Electronic Equipment Regulations

The objective of the Directive is to promote re-use, recycling and other forms of recovery of waste electrical and electronic equipment (WEEE) in order to reduce the quantity of such waste to be disposed and to improve the environmental performance of the economic operators involved in the treatment of WEEE.

The WEEE Directive sets criteria for the collection, treatment and recovery of waste electrical and electronic equipment.

Waste of electrical and electronic equipment (WEEE) such as computers, TV-sets, fridges and cell phones is one the fastest growing waste streams in the EU, with some 9 million tonnes generated in 2005, and expected to grow to more than 12 million tonnes by 2020.

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WEEE is a complex mixture of materials and components that because of their hazardous content, and if not properly managed, can cause major environmental and health problems.

Moreover, the production of modern electronics requires the use of scarce and expensive resources (e.g. around 10% of total gold worldwide is used for their production).

To improve the environmental management of WEEE and to contribute to a circular economy and enhance resource efficiency the improvement of collection,

treatment and recycling of electronics at the end of their life is essential.

To address these problems two pieces of legislation have been put in place:

The Directive on waste electrical and electronic equipment (WEEE Directive)

The Directive on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS Directive)

Green Grid—2007

The Green Grid is an affiliate membership level of the Information Technology Industry Council (ITI), a premier trade association that works to advance public policies for the tech sector.

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ITI's Green Grid works to improve IT and data centre energy efficiency and eco-design around the world. It is an open industry consortium of information and communications technology (ICT) industry end-users, policymakers, technology providers, facility architects, and utility companies.

. The Green Grid works globally to create tools, provide technical expertise, and advocate for the optimization of energy and resource efficiency of Data Centre ecosystems which enables a low carbon economy.

The Green Grid was founded in 2007 with the collective viewpoint that energy efficiency in the data centre is one of the most significant issues facing technology providers and their customers.

This situation is not only due to exponential increases in power and cooling costs over the past few years, but also because customer demand for concentrated computing is outpacing the availability of clean reliable power in many places around the world.

The Green Grid is the first industry initiative chartered to take a holistic view of the ICT ecosystem, with a focus on addressing the pressing issues facing data centre users.

In 2019 TGG was acquired as an affiliate member of the Information Technology Industry Council (ITI), which is a premier trade association that works to advance public policies for the tech sector.

CSCI—Climate Savers Computing Initiative

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The CSCI promotes the use of technologies such as power management features that both cut energy use when computers are not inuse and improve power delivery efficiency.

Google and Intel founded CSGI in the U.S. as a nonprofit group of consumers, businesses and conservation groups aligned to reduce IT-related greenhouse gas emissions.

Consumer members of the initiative are asked to use energy efficient computers and enable power-management capabilities, such as sleep or hibernate mode.

Participating manufacturers agree to develop products that meet or surpass Energy Star standards, while

systems buyers commit to use power management features and choose Energy Star products in their procurement.

NGOs agree to educating end users on power management tools and the perks of energy efficiency.

4.7.3 Green IT Audits

Green IT audits are formal, independent verification and validation of the carbon performance and carbon reporting of the organization.

With increasing legislative demands on carbon reporting, these Green IT audits play a vital role in establishing the Green claims of the organization.

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Auditing of CEMS is a part of these audits. Every carbon reporting and carbon related transaction will be audited through an independent module of the CEMS itself—that is owned and controlled by the auditors.

Internal and external audits have slightly different roles to play in terms of carbon emissions reporting.

Internally, they provide the confidence to the decision maker on her investment in the Green project, and externally, they provide the legal backing required of any formal reporting of data. Such audits, as part of the overall audits of an organization, provide systematic assessment of the organizations structures and operations.

Externally they provide legitimacy to the reporting and the claims to greening made by the organization.

Green audit assess a company's environmental credentials and its claim for green products and services.

Audits can also determine whether the compan**y's supply** chain and/or product line can be accepted as truly environmentally sustainable.

Green audits are very closely associated with metrics and measurements. Green audits primarily validate that whatever is being reported in terms of carbon emissions is accurate and sufficient. Green audits can

also suggest areas for improvements in the **organization's compliance with standards as well as** legislations.

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Green audits can cover the regularity accuracy, calculations, analysis, reporting, and storage of carbon emission data. Such validated data analysis can ascertain the Green IT readiness and maturity of an organization, that of its corresponding industry and even at a global.

This need of businesses to have reliable carbon data need to be supported by new metrics and measurements that are being invented rapidly and standardized across the industry.

Audits prove the validity of concrete carbon measures that enable comparison ,justification, and optimization of **an organization's green credentials.**

Everything that can be measured within Green IT is not **necessarily a good —indicator| of the greenness of the**

organization. Furthermore, everything that needs to be measured is not necessarily easy to measure.

The challenges to these measures stem from the fact that currently many emissions get omitted, others get double calculated.

Green metrics

There are five areas of green metrics:

Measure: What is being measured? Is that measurement sufficient for reporting purposes?

Are there additional areas of carbon data that should be included in the measurements?

Monitor: What is the mechanism to collect the data? Where are the meters located?

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Manage: Validate the feedback and management mechanisms of carbon data, information, and analysis. The carbon management, governance standards, processes, and controls are audited in this area.

Mitigate: Is the measurement and reporting of carbon data also being used to reduce the emissions?

What are the systems in place for carbon mitigation and how well they are operating? The audit in the area of mitigation will be mainly of interest to the internal stakeholders of the organization, but will have external effect.

Monetize: Audits of the monetizing aspects of carbon data will be of immense regulatory interests as the businesses move toward carbon economy. Ability to

trade carbon requires accuracy and authenticity of systems that enable that trade.

Advantages in undertaking Green IT audits within organizations:

Validation of entire organizations asset register from a carbon emissions perspective.

Formalization of metrics and associated measurements

Validation, internally of cost-benefit calculations that demonstrate the ROI on green initiatives to corporate governance board and the shareholders on indexing of carbon measures with financial performance of the organization.

Cross-check on smart meters used for automatic reading and display of carbon data.

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Stocks take of the skill set, experience, and necessary expertise within the organization to put together a Green IT measurement and optimization program.

Ratifying the agreement among the organizations stakeholders as to what should and should not be included within carbon emission calculations.

Validation of the calculation on electronic waste and its disposal.

Adequacy of policies and practices in addressing the complete and comprehensive carbon footprint of an organization.

Being part of the value proposition for business through its green initiatives both internally and externally.

Assist in objectifying (making explicit) the other tacit attitude and viewpoints of participating employees and management in measuring the green credentials of the organization.

Reducing the confusion and, perhaps, duplication of calculations that may occur in a collaborating group of partners.

Provision of relative benchmarks from audit to audit.

Validating the measuring of degree of sophistication or maturity.

4.7.4 Types of Green Audit

Green metrics and measurements used for green audits purpose need to be validated themselves. Measurement systems must be developed that can establish baselines and measure carbon storage and emissions changes on various scales, from individual machines to large processes of the business. The advanced ICT technologies and techniques such as SOA, web services, mobile technologies, semantic networks, Cloud computing, Information Management Systems can play an important role in the development of monitoring and measuring emission tools. Mitigation deals with reducing the carbon footprints of a business by identifying ways of operating more efficiently and thus reducing the costs and CO2 emissions. Monetizing is poised to take advantage of the opportunity to trade carbon credits in future. The following are the collection and use of carbon data needs to be audited during green audits:

Data collection mechanisms and corresponding gadgets/meters.

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Data analysis undertaken by software systems

Carbon trends: Plotting of the carbon trends, their accuracy and reliability

Carbon compliance: Both internal and external auditing parties are involved in ensuring that the organization is complying with the limits set for emissions by the regulatory bodies.

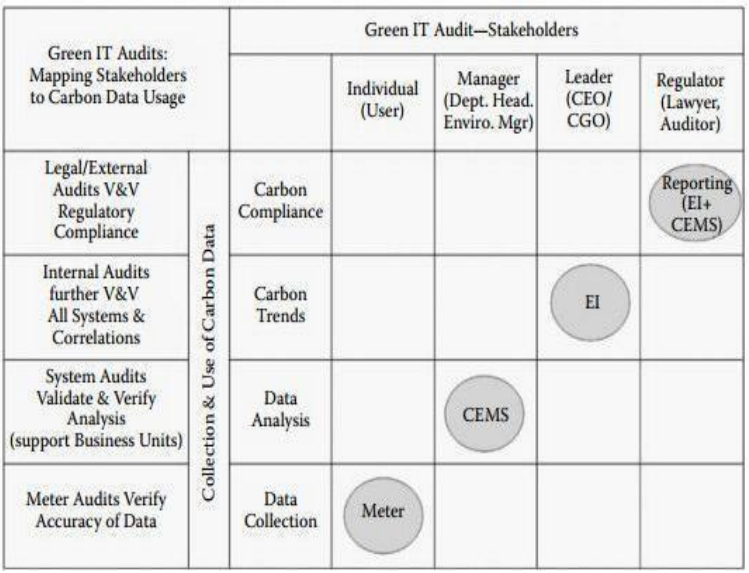

Fig 4.14: Various elements in Green audit

The stakeholders of green audit are as follows:

Individual users: provides input into the data collection mechanisms.

Departmental heads: involved in analysis provided by the software system (CEMS) dealing with carbon data. This analysis would show to a business unit or a

department clearly the amount of carbon generated by its activities as well as potential carbon savings.

CEO/chief green officer (CGO): interested in all aspects of the Green IT audits, but particularly in the environmental intelligence aspect of the organization.

Regulators: external parties that want to determine the accuracy and validity of carbon data reporting as undertaken by the organization.

4.7.5 Green IT Audits—Approach, Maturity, and Comparison

An integrated model for Green IT audits includes steps required in the audit, the various dimensions of an organization that need to be audited, ascertaining the Green IT maturity of the organization and the various areas. within the organization that will be audited.

Undertaking Green IT Audits

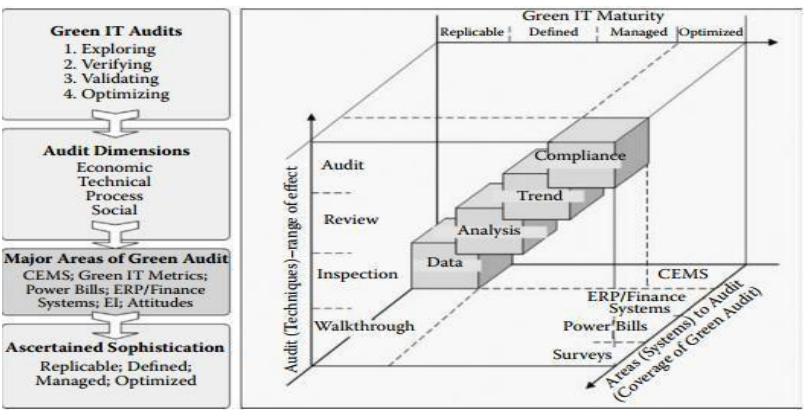

Fig 4.14 Integrated model for green IT systems

The core areas apply to the various systems, packages and surveys. The known quality techniques of walkthroughs, inspectors, reviews, and audits can be applied in undertaking audits. The following are the ways of conducting green audits:

Walkthroughs: Individually performed, to identify basic emissions data relating to an individual or a department. Walkthroughs can also be conducted of the CEMS algorithms that are used in calculating the emissions data.

Inspections: more rigorous than walkthroughs and are carried out by a person or party who is not the original producer of the artifact. Thus while the Green IT auditors will carry out the inspections, the staff responsible for smart meters and other gadgets used in collecting data, as well as those responsible for the processes for storing, reporting, and managing carbon data will provide the necessary information, and answer queries

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Reviews: go beyond walkthroughs and inspections, and formally verify and validate a process. In the Green IT domain, reviews are conducted by both internal and

external auditors. Reviews would require preparation beforehand of the areas to be reviewed—such as systems, databases, equipment lifecycle, and wastage disposal processes. Reviews also encompass verification and validation of the accuracy and efficacy of the governance processes and methodologies, and also cover economic and social dimensions.

Audits: very formal, both internal and external to the organization. Green IT auditors will be invited or may enter the organization to conduct formal audits of the carbon data collection, analysis, and reporting. Audits cover all work areas and all four dimensions. Audits can make use of the aforementioned quality techniques of walkthroughs, inspections, and reviews. At the end of the auditing process, a formal report is prepared to present and discuss the outcomes. Whenever carbon benchmarks or limits are transgressed by the organization, they are pointed out by the auditors. Appropriate actions are also discussed and a plan to undertake them is highlighted during the audits.

4.7.6 Audit and Use of Carbon Emissions Management Software (CEMS)

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A CEMS helps an organization manage its energy consumption by accurately recording, analyzing, and reporting on the carbon data. It is responsible for reduction and management of carbon emissions and help an organization meet its environmental goals.

Auditing a CEMS requires attention to the following:

Accuracy of the data captured by the system.

Security and ease of storage of carbon data.

Security and ease of retrieval

Validity of analysis and trend creation

Frequency and reliability reporting of emissions and related information

Ease and accuracy of updating environmental parameters that drive CEMS

Interfaces to the government regulatory portals using web services

Environmental compliance by vendors and other business partners

Use of CEMS in the audit function itself

Comparative Audits

Audits provide an organization with a feedback on its current performance as well as Green maturity. The results of audits will enable an organization to understand where it stands on the Green CMM. Audits can be conducted to ascertain the current state of an organization and plan for the future state. Reports on the results of a properly conducted Green IT audit will also enable an organization to understand its strong and weak areas, and thereby help it in its ongoing optimization effort by enabling selection of right projects within its transformation programs.

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4.3 GREEN ENTERPRISE TRANSFORMATION ROAD MAP

Green Enterprise Transformation (GET) is a program undertaken by an organization to change its structure and dynamics that would change its carbon footprint for the better. This transformation brings about the changes to the structure and dynamics of an organization. This may hinder normal operations and also its relationship with its customers and suppliers. Detailed analysis should be done to provide definitions for activities and tasks, deliverables and roles that can be used to achieve the goals of that transformation along with metrics and measurements. Such transformation is further augmented by a competent suite of metrics and

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The GET has four phases:

Diagnosis

Planning

Enactment

review based on metrics

GET framework forms a matrix of the four phases and the four dimensions along which these phases get applied. The organization is viewed in a detailed GET through its various internal verticals such as its business portfolio, its networks and other IT infrastructure and, its people, and their attitudes. The enterprises should adopt a framework called **Green point method** that is an IT-specific Green framework encompassing equipment lifecycle, the end-user devices, the data centres, and servers within, and IT as enabler across the organization. There are two types of frameworks:

Green ICT framework and its various elements that help understand and model the Enterprise.

GET process framework that is used for undertaking the transformation process.

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There are three elements that brings transformation namely cost, carbon, and customer priorities.

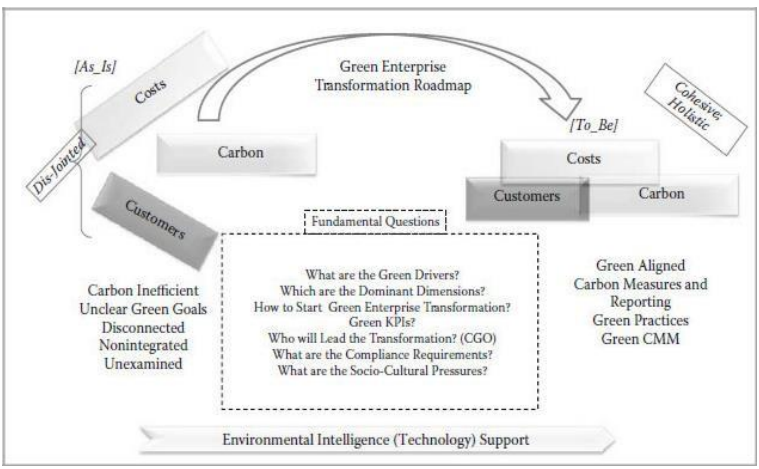

Fig 4.7: Process of Green Enterprise Transformation

The GET process must be able to identify the business goals, the current structure and maturity of the business and steps to be undertaken to become anew, cohesive, agile, efficient, and collaborative green business. A GET is planned and executed along the following four dimensions of an organization facilitate its transformation from where it is to its future green state:

Economic

Technical

Process

Social

A business can be modelled and understood in various ways and through multiple dimensions as a part of its transformation. The modelling should consider he associated risks and its advantages. The prominent factors that have to be considered are people, process and technologies.

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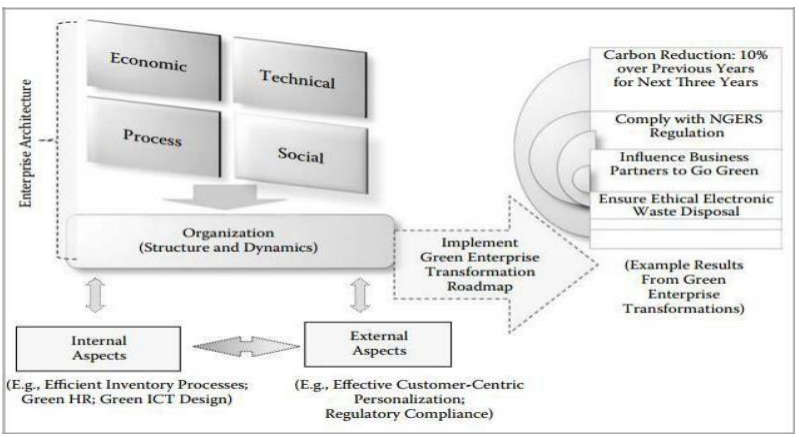

Fig 4.8: Four dimensions to achieve GET

These dimensions are foundations for achieving GET. It is also essential to include the current and future business trend as a part of the model. All the effects caused by GET will be placed under internal (eg: inventory) or external aspects (eg: CRM). Key Performance Indicators (KPI) will be the metric to measure this transformation process. This transformation process framework investigates scopes and incorporates these dimensions within its transformation phases.

Impact of Economic Dimension on GET

The major economic changes in Green transformation in terms of financial steps is changes in budget, product portfolio and Return On Interest (ROI) estimation.

This transforms the perception of business, investment strategies, customer relationships and partnering ventures.

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This brings about great change in the business model.

Impact of Technical Dimension on GET

Great changes are needed to transform technologies right from hardware, software, databases, ICT based security protocols, networks and its infrastructure based on the carbon emission ratings.

A best way is to adopt virtualization technologies which can greatly reduce the carbon footprints.

The real metric for assessing the technical impact is the reliability and ease of use of the new technology.

These green technologies should be validated, passes the quality assurance with proper testing.

Also these products must be agile, so that they can adopt to changing business circumstances.

Impact of Process Dimension on GET

This deal with how the business conducts its transactions including both internal and external processes of the organization.

GET changes the manner in which the business interaction happens with its customers, customers and various collaborations.

The success of GET in this dimension can be measured by reduction in carbon emission without compromising the quality and value.

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Impact of Social Dimension on GET

The social dimension of GET deals with the sociocultural changes that occur in the GET business transformation.

The transformation must focus on the interest in the people aspect of transformation including clients, employees and business users.

Changes to work culture by adopting telecommuting, telemarketing can greatly impact the people and bring about socio economic change.

Senior managers and leaders of the organization have a substantial effect in changing the attitude of individuals within the business.

These organizational changes can take time to be implemented. Proper training, motivation and aspirations will positively contribute to the success of GET.

A balance between the performance and functionality needs to be maintained during transformation.

Effects of advertisements, value systems of the customers, ethical business practices, and adherence to **the industry's code of conduct are also part of the** social dimension.

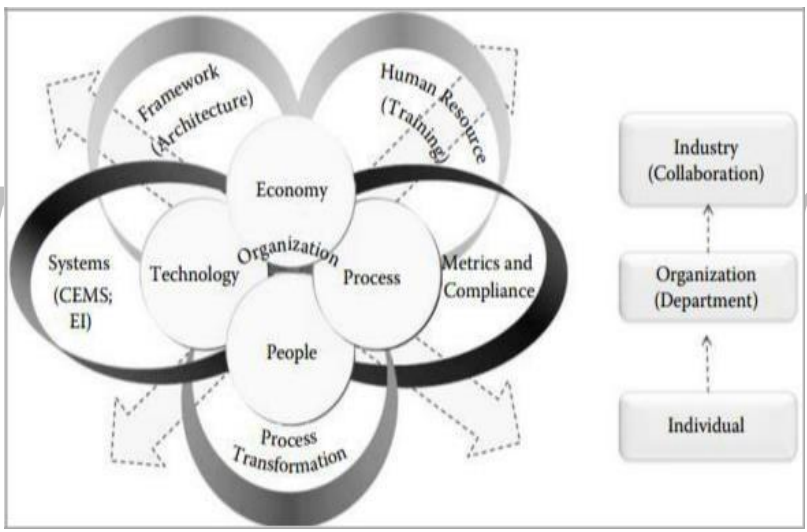

Fig 4.9: Overall framework of GET dimensions

4.3.1 Transforming the Individual, Organizational, Collaborative Processes

Transforming the individual, organizational and collaborative process are three main aspects of the GET. In addition to this, the supporting metrics, and the actual operation

of the organization also undergoes change. The GET transformation requires a diagnostic approach to identifying and documenting the current state of the organization, followed by the vision of the organization. This will affect all the projects, technologies, processes, and demands redefinition of roles. Also, identifying the current and future state, outlining the path to complete the gap and executing the GET requires a combination of internal and external skill sets. Inviting a full-on consulting group for this exercise can include costs, and risks associated with the potential lack of knowledge of the core operations of the organization. Using only internal resources has the risks of not knowing the external legislations, consortium-based actions, and available technologies and resources for GETs. The green metrics for the transformation is given in fig 4.10.

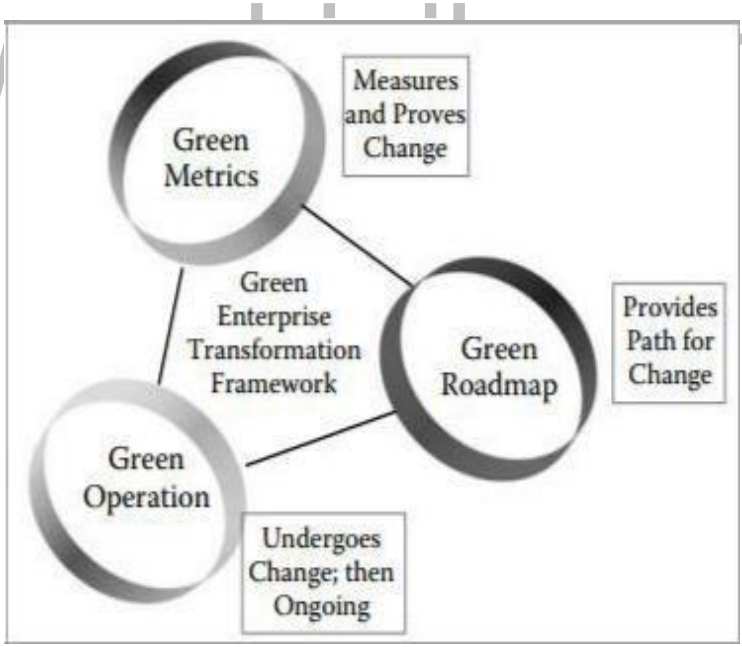

Fig 4.10: Green metrics and supporting roadmap

4.3.2 A Green ICT Framework

Green ICT is the application of technologies and practices that materially reduce resource consumption and harmful emissions in Information and Communications Technology (ICT)life cycles. It involves practice of using computers and telecommunications in a way which maximizes positive environmental benefit and minimizes negative impact.

The GET mainly focus on the state of the organization than the transformation process. The framework given in Fig 4.11 includes major areas of an enterprise from the Green IT perspective. It is actually a is made up of a matrix of four vertical **—pillars| and five horizontal —rows.. The pillars depict** the areas within an organization that will undergo change: equipment lifecycle, end-user computing, enterprise, and data centre and ICT as a low carbon enabler across the organization. The horizontal rows includes attitude, policy, practice, technology, and metrics.

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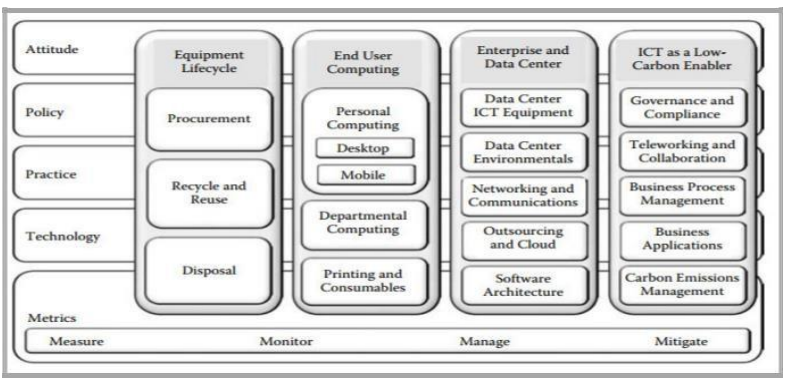

Fig 4.11: Green ICT framework

4.3.3 Equipment Lifecycle

Equipment lifecycle deals with the procurement, recycling and reuse, and eventual disposal of all equipment within the organization.

All equipment in the organization undergo this cycle where in they are procured (POD): Procurement, Operations and Disposal. At disposal of the equipments includes issues relating recycling or reuse. The entire equipment lifecycle is of immense interest in Green ICT as the process of carbon reduction can be initiated right from the procurement phase and continue through its operation and eventual disposal. Supply Chain Management (SCM) and procurement management systems are involved in supporting the optimization of the equipment lifecycle.

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4.3.3 Procurement

Procurement makes great impact on sustainability. Focusing the design and procurement of ICT equipment makes a substantial impact on its Total Carbon Cost of Ownership (TCCO). Two major aspects are concentrated:

the nature of the equipment itself

the nature of the suppliers of that equipment.

Energy Star and the Electronic Product Environmental Assessment Tool (EPEAT) should be used before purchase of **any equipment. Supplier's e**nvironmental values in the design and manufacture of equipment and how to measures them, its compliance with relevant environmental laws and codes of practice, and whether the supplier reclaims and recycles old

equipment from customers must also be studied. Energy efficiency, emissions over lifecycle emissions, and the level of waste associated with an equipment are important purchasing factors.

Requests For Proposals (RFPs) and tender documents evaluate suppliers on their environmental credentials and their own green policies and practices.

4.3.4 Recycle and Reuse

Equipments must be periodically replaced. Some equipment have regular refresh cycles, some wait till they have to, and some utilize some sort of continuous update process. This is a natural aspect of the ICT function. Areas of the organization that need newer hardware may be able to share their old equipment to other parts of the organization with less critical processes. Any equipment that complies with the base hardware standards, and that can support the software, is potentially redeployable. Redeployment may also be based on changes to organizational structures, especially when roles are not being refilled.

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4.3.5 Disposal of ICT Systems

After extending the useful life of equipment and eventually selling or reusing it, there will can be a situation where it will need to be physically disposed. Environmentally sound disposal practices are vital aspect of Green ICT. The importance of electronic waste disposal has led to the growth of an entire industry around the disposal of ICT and other electronic equipment, often based on the extraction of precious metals from printed circuit boards and other components. The

industry has to be regulated, and there have been legislations, making the environmentally friendly disposal of e-waste mandatory. The manufacturers of computer monitors, printers, photocopiers, laptops, and mobile phones must know what has gone into these products and also understand the repercussion so its disposal in the air, water, and soil.

4.3.6 End-User Computing

End-user carbon efficiencies is very important. End-user computing has the greatest effect on the wider green attitudes **and behavior of the organization's workforce. End**-user computing deals with IT Efficiencies that the end-user has most control over. There are three main areas where Green ICT can be implemented: personal, departmental computing, and printing. The range of technologies where Green IT is deployed:

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Desktop computing: Important practices include turning PCs off and various PC power management techniques, and important technologies include thin client computing.

Mobile computing: May have similar power management issues to desktop computers. An array of mobile devices, such as notebook computers, smart phones, and PDAs, may not in themselves use a large amount of power, but there are still a number of Green ICT considerations that need to be taken into account with their usage.

Departmental computing: This computing that is localized to a department and not under direct control of the IT department of the organization.

Printing and consumables: Consume significant energy particularly due to their large numbers and inbuilt inefficiencies.

4.3.7 Enterprise and Data Centre

Enterprise and data centre represent those aspects of an organization that are controlled directly by the IT department. The organizations which are large enough to have a data centre must implement the effective management of the equipment within it and its environmental can be one of the most important aspects of Green IT:

Data centre ICT equipment

Data centre environmental

Networking communications

Outsourcing and Cloud

Software architecture

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4.3.8 Data Centre ICT Equipment

The two most important types of ICT equipment in the data centre include servers and storage devices. Servers are usually the biggest consumers of power, and that power consumption continues to rise as more powerful processors are used inside them, and as the number of servers proliferates. Average power consumption of a rack of servers has increased five-fold over the last 10 years when cooling requirements are taken into account. Storage usage is also increasing exponentially—and as prices drop storage devices are often used very inefficiently. Server and storage virtualization has become

one of the key technologies in data centres in recent years. It is often touted as a technology for reducing power consumption, because it reduces the overall number of devices, but in practice most data centre**'s power consumption continues to** rise because the devices are becoming more powerful and use more electricity. The infrastructure of data centre is made up of the following three main aspects:

Power supply: Data centres usually have dedicated power supplies, and very often more than one. Their efficiency varies enormously. Data centres can also generate their own power, and backup power supplies are common for business continuity.

Cooling and lighting: Modern ICT equipment typically demands significant amounts of cooling, either air cooling or water cooling. there are many design and implementation issues that affect power consumption. Lighting is also a factor.

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Building that houses the data centre: It may be a dedicated stand-alone facility, or it may be purpose-built within a larger facility, or it may be retrofitted into existing premises. Whatever the case, there are a number of aspects of the built environment that will have an effect on power consumption, such as insulation.

4.3.9 Networking and Communications

The area where Green ICT can be implemented in networking:

Local area networking: Many organization's LANs and data centre networks consist largely of collection of cables that consume large amounts of power and which

add to cooling requirements. More efficient cabling design means lower power consumption.

Wide area networking: Many organizations use leased data lines or VPNs over the Internet. While they do not have direct control over these networks, their inefficient usage adds to overall power consumption and increases the overall carbon footprint.

Wireless communication: Wireless will never wholly replace cabling, but it is becoming more widely used and it does have a major role to play. But wireless communications can be very inefficient, especially when transmitters and receivers are left on when they are not being used.

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4.3.10 Outsourcing and Cloud Computing

Outsourcing has been one of the big issues in ICT since the industry began. The main issues here are cost and capability. The outsourcing vendor has economics of scale and availability of skills. Many facilities management companies are now highlighting their green credentials and building energy-efficient data centres that they say will enable users to lower their overall carbon footprint. The key issue is the measurement. It is impossible to tell if outsourcing is a good deal or not financially **if you don't know the real cost of what is being outsourced.**

4.3.11 Software Architecture

Computer systems consist of software running on hardware. Software is the system, and hardware is simply an enabling technology. Most discussion about Green ICT refers to

hardware, but software is also a factor. Software architecture often determines the hardware architecture, which in turn may have a significant effect on the amount or type of hardware used—with all the consequences of the energy consumption of those systems. A software that preinstalled on new devices, come bundled with other downloads, or are injected into your system through malicious sites are bloat wares. Systems can be developed from scratch, adapted or borrowed from other software, or purchased off -the-shelf. Each approach has consequences for energy consumption.

4.3.12 IT for Enterprise

A vital aspect of Green IT is its use in reducing the carbon footprint as the whole organization. It is generally agreed that IT emissions are mainly through the usage of electricity which in turn comes from carbon emitting power stations. The real potential benefits of Green IT are in using IT as an enabling technology to help the organization, and the wider community, reduce its carbon emissions.

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4.3.13 Governance and Compliance

Publicity about climate change and related issues has greatly raised the profile of sustainability, and virtually all organizations are attempting to boost their green credentials. In some cases they do it because they are forced to. Many organisation sincerely wants to do the right thing. Corporate governance is the processes by which organizations ensure that they are properly managed, not only in terms of meeting their regulatory obligations, but to ensure that they do the right things by all their stakeholders. This also includes management, shareholders, and staff , and is extended to include business partners and others in

the organizations extended supply chain. This extension is based on a growing awareness that, when it comes to the environment, everybody is a stakeholder, and that good corporate governance also includes good environmental management. Green ICT is in many ways a management and governance issue.

4.3.14 Teleworking and Collaboration

Teleworking is a range of technologies and practices that have to do with working at a distance or working remotely. The carbon reduction benefits of teleworking are mostly associated with reduction in personal travel obviating the need to drive a car or catch a plane reduces the carbon footprint of that activity by the amount of fuel generated by that travel. Teleworking also opens up opportunity to collaborate more than in the physical world. Collaboration tools and techniques enhance the capability of a group of people to work together. There are a great many ways to do this, but all of them entail being able to share **documents, processes, and information. Ā is showing makes the** business processes more efficient and reduces the need for physical contact.

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4.3.15 Business Process Management (BPM)

Business process management is the process of improving the ways an organization or an individual does things thus making them more efficient, with fewer steps or greater effect. Green BPM identifies five phases relating to a process: design, modeling, execution, monitoring, and optimization. A Green BPM refers to the managing and improving of all business processes from their carbon perspective. Environmental intelligence has a major role to play in Green BPM.

4.3.16 Business Applications

ICT-based business applications include financial management systems (FMS), enterprise resource planning (ERP), supply chain management (SCM), and customer relationship management(CRM). Many organizations also run customized applications that are specific to their industry that would provide them with competitive advantage.ICT is very important in each of these applications, which essentially support BPM. Green BPM seeks greater efficiencies in every phase of every process. Even small improvements can have a significant effect on carbon reduction, because of the scale of the operation and because of flow-on effects further up the supply chain. Green ICT has a very important role in improving the efficiency of many industrial and commercial processes specific to individual industries, paving the path for their leanness.

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4.3.17 Carbon Emissions Management

Carbon emissions management is an emerging discipline that focuses on the management and ultimately the mitigation of **an organization's carbon e**missions. This includes the use of ICT systems specifically designed to reduce the carbon footprint, rather than doing so as a by product of greater efficiency. A key ICT application is CEMS, which provide a compliant and consistent format for presenting greenhouse gas emission data to executive management and regulators. As the carbon emissions regulatory framework continues to evolve, CEMS is becoming an increasingly popular tool to manage the carbon emissions lifecycle.

4.3.18 Attitude

Though attitude is intangible trait, it is a major part of the subjectivity in the social dimension of GreenIT. Much of the success of GETs depend on the attitude of the people within the organization. It is also very subjective. Attitude can be understood as a desire and a commitment to change by the individual that is based on honest belief in the ensuing results. Having a positive attitude toward Green IT is at the heart of the transformation as it is depend on individuals. And, as is often the case in business, those attitudes are most effective if they come from the top. Management buy-in is an essential part of any Green IT program.

4.3.19 Policy

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Policies help set the direction for the organization and provided basis for action. Communication of policies is also vital and needs to take the HRs in confidence. Examples of policies affecting the entire organization include the organization shall only provide goods and services from certified, green vendors; users will be encouraged to not take separate, individual backups of their databases.

4.3.20 Practice

Practices are the things that are carried out in the organization. Practices implement policies. They are the techniques, the behavior that is expressed by the individuals and organizations. An interesting aside to practice is that they, like processes, involve alteration of habits and change of mindsets (attitude) rather than procurement of new equipment. This is involves training. Examples of practices include switching off

computers when not in use; implementing virtualization of all services; replacing existing high carbon emitting equipments with new, green ones; and ethically disposing of electronic waste.

4.3.21 Technology

Technology is the hardware, databases, and network and systems aspect of Green IT. Green IT techniques of using thin clients, ritualizing data servers, and using duplex printers are all examples of technology-based changes in the organization that lead it toward Green IT. Procurement of new, low carbon emitting equipment is an investment that needs to be considered in the long term in the context of the TCCO metrics. The costs associated directly with a new equipment also needs to consider the waste inherent in disposing of the old equipment—especially if that equipment is still operational. An ideal way to approach equipment replacement is to balance out the change and incorporate the practice of Green IT as part of the normal equipment replacement cycle.

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4.3.22 Metrics

Green IT metrics deal with measurement of carbon emissions of the organization in its state. Metrics also determine the future state has been achieved or not. Choosing the right tools to measure, monitor, and potentially mitigate power consumption and carbon emissions, both inside and outside the IT department, is critical in the GET. Good set of green measures ensure that Green IT projects receive maximum business commitment and are proven to be successful over time. Only with adequate measurement can progress be proved. Hence, metrics need to be supported by smart metering.

4.6 GREEN IT TRANSFORMATION DELIVERABLES

The following are the IT deliverables:

Green IT Business Case: documents the ROI, the budgets, and overall justification for the project

Enterprise Emission Measures: documents the existing carbon e missions across the organization

Green Enterprise Emission Measures: resulting at the end of the GET

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Enterprise Architecture Document: that documents the enterprise architecture, using an existing or modified framework

SLA

Various docs relating to suppliers; outsourcing partners; legal

4.6.1 Phases in GET

There are four phases in GET:

Diagnosis phase

Planning phase

Enacting phase

Review phase

The deliverable in each phase is discussed here.

GET: Diagnosis Phase

Accurate diagnosis provides a good understanding of the current state of the organization by investigating into the various work areas of the business from the point of view of transformation.

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An understanding of the structure and dynamics of the organization, as well as its ability to achieve goals, manage risks and ascertain the leading dimension of transformation is developed here.

The state of an organization, with respect to its carbon emissions is based on the current emissions at this early stage.

The demographics of the organization, its motivator, goals, size, and type would all affect its current state, as ascertained during this diagnostic activity.

Diagnosis also includes a review or stock take of existing assets across all work areas.

Diagnosis indicates the state of maturity of the organization.

Once the transformation is complete along all dimensions and through all the work areas, the organization can be said to be in a matured green state.

In this state the Business Transformation Office (BTO) is now fully set up and organized. The Business Transformation Board (BTB) is functioning and reporting to the corporate base. The Business Transformation Champion (BTC) is also busy managing stakeholder expectations. The diagnosis phase also ascertains and progresses the lead dimension of the organization for GET.

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The diagnosis activities are carried out at these levels in any organization:

Equipment lifecycle carbon efficiency

End user computing's carbon efficiency

Data centre carbon efficiency

IT as low carbon enabler

All of these levels possess unique challenges and deliverables in the GET.

Equipment lifecycle carbon efficiency

Activities	Challenges
✸ Lifecycle evaluation ascertains current Green maturity. ✸ updates the business case on the Green IT project. Reviews the existing procurement and disposal attitude Identify operational carbon emissions (CE). updates P&L carbon emissions. evaluates the business case risks reviews policies with business partners Reviews recycling policies and practices are revised. A certain the greenness of equipment using energy stars Optimization of operations is ascertained. Revise Waste disposal policies and practices	✸ Uncertain data on Current Carbon Emissions across Lifecycle/ Procurement ✸ Impact on SLAs a major challenge ✸ Minimal Industry experience in Changes to Software for Carbon Emissions

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End user computing's carbon efficiency

Activities	Challenges
✸ Green IT champion creates and updates the business case on the Green IT project. ✸ end-user provides input into a survey to help ascertain the attitude toward Green IT. ✸ Measurements of carbon emissions are undertaken per device ✸ IT governance is involved in permitting the creation of a device inventory; measurement of overall carbon emissions. The corporate governance evaluates the overall end-user policies on Green IT. Corporate governance also evaluates business case for Green IT as presented by the Green IT champion	✸ Patterns of usage based on End-User roles ✸ Existing Device Inventory may include irrelevant materials ✸ Existing Current Green technologies include software for **—computers off etc.**

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Data centre carbon efficiency

Activities	Challenges
updates the business case on the Green IT project. takes an inventory of IT equipment from the point of view of calculating the current CE. Monitoring of CE are undertaken per server(or similar unit of hardware measure). IT governance board (or similar governing body) reviews the existing SLAs Corporate governance (board or similar governing body) evaluates the overall end-user policies on Green IT. Corporate governance also evaluates the cost of running the data centre, and the costs associated with the Green initiatives related to the organization list of current virtualization or server consolidation techniques in use is made. physical environment and the facilities is recorded.	Patterns of Carbon Emissions can be daily, monthly, yearly. Data/Information Ownership is a major challenge of Virtualization

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IT as low carbon enabler

Activities	Challenges
✸ Evaluates existing organizational Green practices ✸ Ascertains the overall enterprise green maturity. ✸ Updates the business on the Green IT project. Updates the divisional use of IT and models the current business processes. Examines software and hardware inventories. Evaluates the existing enterprise Green IT policies and ascertains or confirms the greening dimension. Telecommuting/teleconferencing. Collaboration tools and SaaS. Supply chain.	✸ Overall organization presents a bigger challenge than I T ✸ Green IT has to convince business management, corporate governance

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GET: Planning and Scoping Phase

The strategic thinking and innovative capability of the organization are translated into actionable activities and their sequences in setting up the Green transformation project.

Creative ways of bring about the change, including maximum use of internal and external resources, are explored in this phase.

It is important to note that this road map remains a live document which means later, during enactment phase, this same road map is also

modified depending on the nuances of the project

refined through the feedback gleaned during transformation.

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The road map includes the Green transformation plan, the Green pilot project (which can be embedded within the transformation plan for small projects), the overall work area plan, the plan for the lead work area and the quality plan (which will include verification and validation of the changes).

The deliverables resulting from the road map are the plans themselves as also the project task list, the performance and ROI measures, the ranking of risks and the plans to audit the results of the transformation.

The roles involve in transformation planning include the GTC, the project manager, the quality manager, work area lead, business manager, and the IT auditors.

The planning and scoping phase of GET explores the output of the previous diagnosis phase to identify and formalize the planning of the transformation project.

Once the significant aspects of the business are identified, planning outlines the tasks to be performed for transforming each work area.

While the risks are managed in practice during enactment, the planning phase identifies and ranks these risks, and also incorporates the effect of changes on the organization.

Balancing between costs and benefits, technology and business; and balancing risks with outcome.

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Each organization has to separately identify and document its green success criteria in this planning phase and formulate the right metrics and measurements that would be used to ascertain its success.

Work areas are organized, leaders for those work areas are nominated, and interrelationships between work areas are highlighted in planning phase.

Planning for the Green IT project starts with the Green IT champion—who finalizes the leading area of the organization that will undergo transformation.

The leading area will start becoming obvious through the diagnosis, but it is important to decide formally whether the end-user efficiencies should lead the way, or whether it should be the equipment lifecycle and procurement, or the data centre.

Enterprise Lifecycle Plan

Roles and activities	Deliverables: Input and Output	Challenges
Green IT Champion: Works with the business management, to plan the changes to product/ equipment lifecycle and procurement that will make the organization greener **Business Management:** Plans, along with the Green IT champion, to procure, use, and dispose equipment in a carbon-sensitive way. **IT Governance:** Oversees the planning process for hardware and software upgrades throughout the business lifecycle. **Corporate Governance**:	**Input** Green IT Business Case: Includes justification for the new equipment, their TCCO, and replacement costs. **Output** **Green IT Transformation Plan:** Includes plans for green recycling, updates on the Energy Star and other ratings, green procurement strategies, optimized operations, and waste disposal. **Procurement and Disposal Plan:** Specifically focused on procurement of	✸ procurement, disposal lifecycle is an integral part of overall business ✸ C hanges to SLAs with external arties/ business partners require upfront planning.

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Participates in the planning process on how the policies for corporate purchases and disposals will change.	equipment and their decommissioning. **SLA With Business Partners/External Parties:** will change the current lifecycle and moves toward a green lifecycle.	

Planning for End-User Efficiencies

Roles and activities	Deliverables: Input and Output	Challenges
Green IT Champion: Involved in leading and coordinating the planning activities; reporting to the board **End-User Representative:** Planning for the training as well as planning and	**Input** **Green IT Business Case:** Contains justification for the project. **Industry Standards:** Such as EPEAT are incorporated in the plan to ensure green procurement	✸ Estimations on Green IT costs and savings vital for corporate support ✸ Plan for training in attitude change: based on roles.

budgeting for the time and eff ort required to change to green practices. **IT Management:** Plans for the upgrades to the software and the hardware that will be required for the green eff ort.	and usage **Output** **GreenIT Transformation Plan:** Updated with step-by-step instructions on how to carry out the transformation enactment later. **GreenIT Enterprise Standards:** These are the new, expected, green standards within the organization for expected carbon emissions per end-user device, per day/month/year, and so on	

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Enterprise IT Data Centre Efficiencies

Roles and activities	Deliverables: Input and Output	Challenges
Green IT Champion: Works to upgrade the Green IT transformation plan with the data centre details **Data Centre Director:** Plans, a long with the Green IT champion, to u pgrade the building, power supply, and air-conditioning/cooling upgrades. Server virtualization, which is a vital part of green initiative, is also a part of this planning process **IT Management:** Continues to participate in the planning process, including plans for changing to the current	**Input** **Green IT Business Case:** Provides justification for the investment in data centre upgrades; costs associated with server virtualization and optimization are listed. **Industry Standards:** Relating particularly to DCiE/ PUE metrics. **Output** GreenIT Transformation Plan: GreenIT Enterprise Standards:	✸ Plan for virtualization must include data/ information ownership, backup plans ✸ Green data is a new suite of data within the organization

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data centre practices **Corporate Governance:** Participates in the planning process		

Planning for IT as a Low-Carbon Enabler for the Enterprise

Roles and activities	Deliverables: Input and Output	Challenges
Green IT Champion: Works with the business management, IT governance and, most importantly, corporate governance to plan out strategies for transformation to a green enterprise. **Business Management:** Plans, along with the Green IT champion, to promote green activities across	**Input** Green IT Business Case **Output** **Green IT Transformation Plan:** Gets updated here with plan for the entire organization. **Task Plan:** Step-by-step tasks to be carried out in implementing the Green IT project plan.	✸ **Challenges** Return on investment is the major question that corporate governance asks, and planning in this dimensions must help enable answering that question. ✸ Organization-wide risks need to be estimated and prioritized

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the business unit which, in turn, would result in a green organization. **IT Governance:** Oversees the planning process for technology upgrade across the organization. **Corporate Governance:** Participates in the planning process on how the corporate policies need to change together with possible changes to the business model and the organization structure.		

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GET: Enactment Phase

Enactment is the execution of the business transformation plan created in the previous phase.

This primarily includes risk management, monitoring of progress, measurements and reporting.

Following are issues to be considered during a GET enactment phase:

Identification of risks during execution of the transformation plan, their priorities, and how to ameliorate them.

Interrelationship amongst work areas, their dependencies and management of the lead work area as first priority.

Measurement of the GET outputs. Use of metrics created during diagnosis and formalized during planning are used here to ensure common measures for comparison with the help of CEMS.

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Reporting to stakeholders and managing their expectations.

While a GET project can be driven through any of the work areas, ideally the lead area is dictated by the lead dimension of transformation.

Green information systems play a major role in measuring and reporting change related to the environment.

Each individual employee's carbon generation can be measured, collated, and reported with the help of information systems.

Feeding this information back to the employee through smart metering can bring about immediate change in behavior.

The information coming out of the Green ICT systems that bring about positive change includes reports of daily, monthly, and yearly GHG generation and using that data to impact practices in enactment.

Green ICT information systems need to produce numbers that not only focus on the environmental performance of the organization but also its overall efficiency and effectiveness.

Metrics allow the transformation to provide visibility to success by understanding green strategy.

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The transformation plan may be utilized to help determine how best to measure progress and introduce accountability into the Green ICT initiatives, both at the enterprise and solution levels.

IT governance representatives (board) may be also put in charge of supporting measurement and reporting, as well as of identifying when a realignment of internal measures or systems is needed to ensure that the expected results are seen, evaluated, and realized.

Technology-Driven Enactment

The ICT-driven enactment of the GET involves ICT systems, applications, and databases at the centre. There are many in-house systems that are affected by the transformation. The factors that affect these management levels include the

standards, need for integration, the approach to testing and quality assurance, the contractual requirements and the deployment of the new ICT systems, applications, and databases. The adaptation of the organization to the new technology permeates all aspects of the organization.

Customer Relationships Management (CRM)

The CRM systems are updated during GET with the goal of combining green value to the customers. This value includes reliable and good quality service, personalized attention to customer need and support. A good CRM ensures that the customer is provided a single unified view of the business and not the possible internal fragments of the business.

Supply Change Management (SCM)

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These applications undergo change to enable users, primarily employees of the organization, to perform many common warehouse, inventory, and shop floor related tasks. A technology-led transformation will monitor and control materials, their delivery and order status. Reduced movement of goods, holding of inventory and accurate production estimates are achieved by the Green SCM. Integration and migration are important technical consideration in these ICT systems, as substantial carbon data gets added to these systems.

Human Resource and Payroll Systems

HR systems provide opportunities for Green HR to be implemented. The HR systems are upgraded to offer greater support to individuals and departments in terms of training, rewards, and career. GET also changes the job roles, responsibilities, management, organizational structures, and hierarchies.

Business Partner's Systems

GET projects aim to improve the interactions of the business with its partner businesses. WS based technologies change the way the business sources services. Information and knowledge management within is changed to make it robust, accurate, reliable, and accessible.

Integration

A major challenge of ICT-driven GET is the handling of integration issues. While integration is always a challenge in even routine upgrades of systems, during GET this issue becomes particularly challenging as all the work areas of the business are likely to change. Integration of ICT systems has to also consider corresponding effect on people, their organizational structures, their device usage.

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Business Process–Driven Enactment

Business process, partners, customers, operations, ICT systems and regulatory areas are the foundation of business transformation. Broadcasting and informative business processes are easy to transform as they have less security requirement but they are of less value to users. **Transactive processes**, the next a level of complexity, are mostly commercial in nature. **Operative processes** help in providing and ensuring efficiencies in different departments such as inventory, HR, and finance. **Collaborative processes** are most complex and require interfaces between business processes of external and internal business parties. The GET project should incrementally incorporate these levels of complexities of business processes. The integration of various systems, affects

the internal, as well as external business processes. These business processes and supporting systems in the current state of the organization are studied carefully to effectuate the necessary changes in those processes and systems that would result in a unified view to the users. Process modeling tools and techniques can be very helpful in this regard. Training is a crucial aspect of deploying new and reengineered business processes Training of employees needs to handle the transformational complexities. Similarly, training in-house needs to be complimented by potential training for business partners and customers involved in large and complex transactions.

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4.4 GREEN TRANSFORMATION PROCESS

Project from various dimensions in the business, infrastructure and systems area make up the transforming program. The four major phases of transformation are diagnose, plan, enact, and review. These phases are iterative. The number of iterations required for a successful transformation to be decided by the Chief Green Officer (CGO) together with the person responsible for GET. The objectives of the green transformation framework:

To identify the current status of the organization and enlist the goals of GET. These goals will be identified, updated, and finalized through the diagnosis work.

To add justification for the project using ROI calculations within a business case.

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To provide target metrics

To organize the actual GET program.

To provide the basis for the pathway/road map or project plan for transformation

To review whether the KPIs have been achieved or not

To promote the success along the individual, departmental, and organizational level.

Fig 4.12: Green Transformation framework

The proposed framework is based on the transformation activities such as detailed planning, project accounting, risk management, and ongoing measurements. These phases are a logical approach to transforming any business.

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4.5 Organizational Focus Areas for GET

The focus areas provide the structure of the business that will undergo change and to which the GET process and their emphasis can be applied.

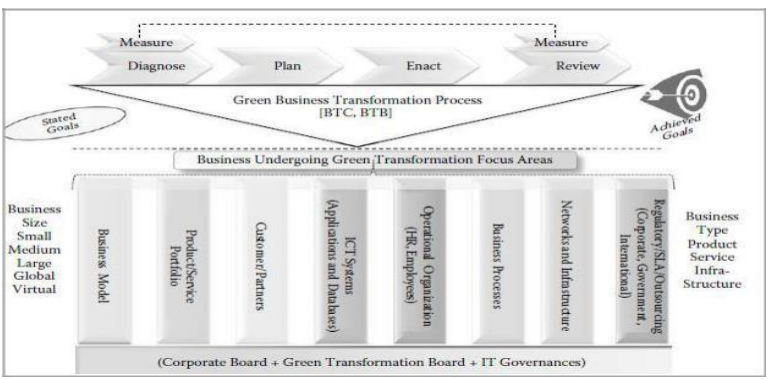

Fig 4.13: Focus areas for GET

Business Model: which deals with the way a business is organized. GET influences and, usually, changes the business model to reflect the green priorities of the organization. Smaller organizations have a simple, subjective business model that can change easily.

Product and Service Portfolio: provides an overall summary of the offerings of the business. GET results in the organization having new green products and, also, dropping of carbon-intensive products and corresponding services. Infrastructure-intensive organization may have buildings and facilities instead of products or services.

Customers and Partner: describes the external parties interacting with the business.

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ICT Systems, Applications, and Databases: includes the technological changes in the software systems and technologies of the business.

Operational, Organizational: handles the internal parties such as employees and management, and their reporting hierarchies, within the business.

Business Processes: model and describe the way in which all activities of the business are sequenced and carried out.

Networks and Infrastructure: focus on the underlying communications technologies used by the business.

Regulatory: deals with legal, accounting, and financial aspects of the business.

Configuring a GET Road Map

Major considerations in GET:

Type and size of organization

Nomination of roles and responsibilities

Formation of the Green enterprise transformation board (GETB)

Diagnose

Plan: Formation of work areas; Outlining the GET deliverables, their format and their timings

Enact: Format, timing and frequency of reporting

Review

Measure

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GET Program: Roles and Deliverables

Chief Executive Officer (CEO) nominates the board, comprising experts, leaders, and personnel from marketing, technology/infrastructure, finance/legal, CRM, communications, and HR/union. The CEO, together with the members of the GTB, selects the Green Transformation Champion (GTC). A GTB is drawn from within the organization with occasional representation from outside such as a consulting organization specializing in GET. This works together with the various other governance boards that run the organization. These various governance setups participate in, and are affected by, the GET. The functions namely diagnose, plan, enact, review, and measurement phases of transformation are directed by the GETB.

Setting Up a Business Transformation Office (BTO)

The physical activity of setting up the BTO can be undertaken either before the commencement of the project or at the state of the diagnosis phase. BTO houses the transformation board which provides the administrative support to the project. The chief responsibility of BTO is taking care of the operational matters related to the project, coordination amongst various work areas, documenting the contractual requirements of the project and promoting the project within and outside the organization.

Forming Transformation Work Areas

Formation of the work areas for GET is based on the current state of the organization. The size and type of the organization affects the formation of these work areas. The current technical and process maturity of the organization also influences the work areas. In some cases, one work area may be more important than other. Formation of transformation work areas includes nomination of a work area leader who has expertise in that particular area of the business or technologies.

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Green IT Project Roles

The goal of Green IT project include the business partners, business architect, technical architect, Green IT champion, end-user representative, IT managers, IT governance, business manager, data centre director, Green IT auditors, and corporate governance. A GTC takes leadership responsibility for the project.

Role of Green Enterprise Transformation Champion (GTC)

The responsibility of GTC will includes:

Formalizing the leadership and constitution of the GETB

Identifying the current Green maturity state of the organization based on Green metrics

Benchmarking best practice goals for the organization **that describe its —to be state**

Manage budgets

Organizing the creation of project management plan for GE T.

Creation of an approach to risk management for GET that is based on priorities of the organization, its lead dimension, and so on

Stakeholder management including expectation management of the board, related external parties, and the society

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Report progress on the GET to the corporate board

Monitor KPI

Coordination and management of GET resources, as well as the organizational resources undergoing **transformation. Ā is will be done in conjunction with** Green HR

Coordinate implementation of changes through change management processes across the various focus areas of the business

Balance the —driving dimension of GET with other dimensions

Track progress and of the GET project

Astute use of the tools, technologies, and processes of GET.

Business Architect and Variations

GTC will appoint business architect to investigate and handle business model work area. The Business architect is aware of the underpinning technologies that can serve the business but is not a technical expert. A business architect takes a long-term view of the organization (3–5 years and above) when she participates in the GET project. A business architect would create business architectural map that will provide the overall view of the business model and associated work areas. This business architectural map can be a part of the overall enterprise architecture that is also used by the architect in creating operational strategies for the business after transformation. The map ensures that the technologies are aligned with business plans and the changes are tracked and monitored.

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Technical Architect and Variations

GTC also appoints a technical architect. For smaller sized organizations undergoing small transformation, this role may be played by the GTC. The technical architect is responsible for the following:

Creation of a technical architecture map to understand where the organization currently is.

Collection and use of a toolbox of various tools that are used in technical implementations during GET.

Creation of a comprehensive repository of software applications currently used by the organization—with a view to changing and integrating them.

Dividing and categorizing these repositories of applications into different business/application domains that will enable ease of modification with carbon data.

Ensuring that the applications that support specific decision making are part of the overall EI suite, and are available to decision makers.

Creation of a new technical architecture that would reflect the goals of the business transformation itself.

Ongoing alignment of technologies with business plans during and after GET.

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Coordinating the development of a Green IT portal.

Tracking and monitoring technical changes resulting from applications notification and upgrades and integration.

Managing quality initiatives during GET

Develop an understanding of the future trends in technology that the organization will have to deal with after the GET.

Produce a suitable technical strategy including a technical roadmap for transformation.

Business Partners

As the business interests of collaborating partners coincide, there is added impetus to provide wide array of

support to the partners. This support can take shape in the form of knowledge and experience sharing, providing relevant tool support and help with understanding dynamic customer preferences as the business transforms.

Participate

Collaborate

Interface

Integrate

Green IT Auditors

Auditors carry out checks and balances throughout and after the transformation. Auditors measure and audit to ensure that the transformation has created value for the business as stated by its goals. These audits can use the reporting features of CEMS, if implemented and that the transformation has not adversely affected any of the reporting and regulatory requirements of the business. Furthermore, auditors are involved in the review process, ensuring that the calculations leading up to the ROI are accurate and reflect the reality resulting from transformation.

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End-Users

End-users are the employees, managers, and customers of the organization who are affected by the

GET. The roles are:

Represents user groups

May be more than one

Highlights device usage

Highlights attitude for roles

Helps in Green HR

Understands CEMS and smart meters

IT Managers

IT management deals with the operational and management aspect of IT within the organization. They are responsible for the IT systems, their operations on the corresponding hardware and approaches to using IT for overall carbon reduction.

Business Managers

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Business managers assume the responsibility at department level to measure, report, and reduce emissions. They are more interested in the economic and process dimension of the GET than in technology and social dimensions. The economic dimension directly affects their performance and the process dimension is the one on which they have immediate control. This business managers can directly assist in the modeling of business processes, their investigations, and optimizations.

IT Governance

This is an activity for which more than one roles within the organization can assume responsibility. IT governance deals with overseeing the IT management and providing strategic and policy input in the process of greening an organization.

Corporate Governance

Some of these processes have a need to be upgraded or fine tuned to reflect the green requirements of the business:

Lean—will move toward Lean-Green, as was alluded to in the process.

Six Sigma—will not only focus on quality but also the efficiencies in carbon reduction

TQM—Total Quality Management—will incorporate metrics for carbon reduction in addition to defect reduction

KPIs—the Key Performance Indicators are not only to enable corporate governance but also green governance

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SIFA (Skills Framework for Information Age), AIBA (Australian Institute of Business Analysis) and PMBOK (Project Management Book of Knowledge) are examples of processes and frameworks that will all be modified to reflect the green awareness and green goals of the organization.

4.2 SOCIO- CULTUTAL ASPECTS OF GREEN IT

The socio-cultural aspect of any technology should adhere to the following aspects:

maintaining decent work

establishment of health care, safety and good working conditions

commitment to improving environmental quality

promoting environmental education

promoting sustainable development in the construction industry

the participation of government social projects

encouraging "socially inclusive" motions

producing maintenance manuals for buildings and systems users

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The revolution in Green IT should comply with certain regulations, laws and standards apart from adhering to the socio cultural and political status of the region. Any organization that

shifts its focus towards Green IT must adopt green working style and the employees must develop a green attitude.

The social implications of Green IT is purely subjective. The degree of commitment by the employees and stakeholders directly influence the green transformation of the organization.

Effectiveness of green transformation changes depend on the leadership changes. Significant amount of subjectivity in the decisions and practice of Green IT by the leadership.

Green transformation of an entire society involves green ethics, morals, value systems, and attitude across multiple layers of people.

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This makes environmental changes for the society even more complicated than organizational and governmental changes.

Initial efforts for green transformation by business units faces the social challenge of resistance to change. There is a great variation in the way in which the resistance to green transformation appears in various industry sectors.

Government is also involved in the resisting activities

Training and awareness associated with the Green IT issues can play a key role in handling the subjective nature of green transformation.

The social values change and green consciousness gets inbuilt in the new generation of individuals.

But this sociocultural transformation takes time to achieve and needs to be accommodated with the economic reforms and innovative market-driven setup.

Discussions on the social aspects of green IT should include individuals, governments and industrialists as the environmental responsibility affects the structure and operation of the organizations and the society in which it exists.

The outcome of this discussion results in Corporate Social Responsibility.

Corporate social responsibility (CSR) is a self-regulating business model that helps a company be socially accountable to itself, its stakeholders, and the public.

4.2.1 Organizational knowledge

Any organization can discharge its CSR by incorporating Green IT in both subjective and explicit domains of the organization by delving the knowledge.

The organizations needs to be environmentally and socially responsible.

It requires regular and unified systems for knowledge management to implement Green IT.

This is because an organization has to learn how to develop the necessary capacities and capabilities in discharging its CSR.

Knowledge management brings about behavioral change within the organizations relating to sustainability.

As the enterprise evolves to a green enterprise, there are changes associated with attitude, leadership and management styles, interpretation of technology, and the business environment.

These subjective change require the organization to implement green knowledge management.

The process of systematically and actively managing and leveraging the stores of carbon-related knowledge in the organization is termed as Green knowledge management.

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The green knowledge management systems involve synchronization of the tacit and explicit bodies of knowledge carried by its stakeholders.

This knowledge synchronization aspect of Green IT becomes more challenging in global, multinational organizations, whose business units and subsidiaries are often spread across geographical regions, exhibiting their quite distinct cultural attitudes and characteristics.

Stakeholders in such global organizations need to particularly consider cross-cultural interactions in their green initiatives.

4.2.2 Issues with Green stakeholders

Inoder to handle cross-cultural issues in long-scale green transformation is increasing the opportunities for

physical (face-to-face) communications among the diverse stakeholders.

Information flow between various groups of employees in different regions supported by the organizational change management is required for successful transition to a green organization.

The issues relating to collaborative groups of people and organizations include their individual preferences, corporate policies, government regulations, social norms and practices, and ethical codes of conduct, different age groups, their preferences as customers, employees, and regulations, and their sociocultural background.

4.2.3 Role based Green IT

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Green IT initiatives and their subjective interpretations are based on various roles.

When it comes to organizational stakeholders, these roles within an organization require detailed study.

Green IT initiatives thus continue to have a wide-ranging subjective impact on the individuals and roles they play at work.

It affects the way people are organized and operate within organizations.

The roles and their subjective impact is given below:

Decision maker: Major interest in the ROI. But also involves in Legal, compliance requirements, however, change the balance of their ROI metrics,

Green IT strategy formulation and policies, Participation in consortiums.

Project manager/quality assurance manager: Interested in the implementation of the green program, the steps to be taken for that implementation, and the successful review at the end of the project. Aims to complete the project with minimum time and budget.

Environmental regulator: Creation of regulatory benchmarks. Compliance metrics, their measurements, reporting of that carbon data. Interested in issues arising out of noncompliance. Participation in standard creation.

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Advisor (management consultant): Analyses of the organization business processes in order to introduce green environment. How to reduce risks in implementing Green IT. Lean process. Participation in standards compliance.

IT consultant (including Green IT): Model processes, optimize, smart networks, green enterprise architecture (ISO standards).

Engineer (manufacturing/ production): Optimize production, improve design.

Technical manager: Focus on technologies for carbon reduction.

Researcher: Undertaking Green IT investigation, pure and applied research.

Formation of attitude toward carbon emissions and its impact on the workplace provides a significant challenge to the transformation of the society to a carbon-conscious
society.

The physical commuting (the normal, standard way of working) is replaced by land-based or wired means of communications and, eventually, totally location-independent mobile communications.

These varied communication mechanisms have direct bearing on the carbon contents of the processes followed by these employees.

Change in the business models by using collaborative technologies that foster resource sharing has also impacted the reduction of carbon content. These collaborative tools also enables sharing of tasks resulting in quicker completion time and less carbon.

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The underlying technologies and systems relating to environmental intelligence have also been used to reorganize processes that have a social impact.

4.2.4 Green practices

The three areas of changes to working lifestyles that are involved in a green enterprise transformation are video conferencing, telecommuting and usage of mobile devices.

These changes has greatly reduced the carbon footprints of the organization.

Videoconferencing is technology that is used to better communicate with a group that may be geographically dispersed.

Care should be taken, however, to balance the carbon savings due to the use of videoconferencing (such as fuel costs associated with vehicles or airplanes) versus the carbon generated as a result of videoconferencing itself.

Another important user practice in the context of Green IT is reengineering of business processes of an organization based on virtual team.

The changes resulting from formation and operation of virtual teams require corresponding changes to the processes that describe the way in which business is carried out is business reengineering.

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These virtual teams will be collaborating globally across the time z ones, with colleagues from diverse areas of business at various levels all drawn together to deliver outcomes.

4.2.5 Attitude and degree of Subjectivity in Green IT

Subjectivity of Green IT can be viewed from a sociocultural perspective or in e role-based perspective.

The green enterprise transformational work in the social dimension is based on bringing together the viewpoints of roles within and also outside the organization.

The Environmental *Decision-Making* is justified as: **—Given the critical state of the world's environment, it is** crucial to employ all of the beneficial knowledge,

technology and tools that scientists, engineers and other **professionals can offer.‖**

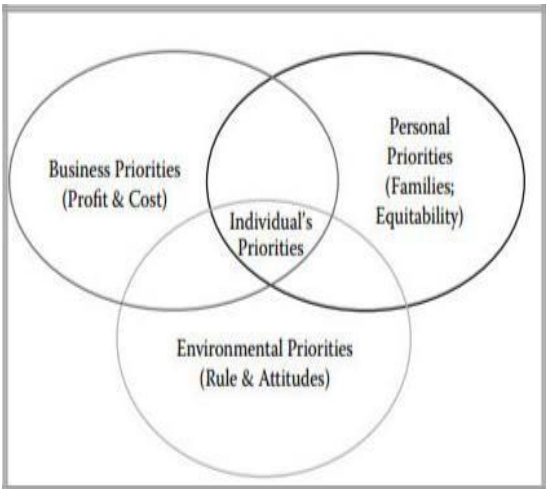

Fig 4.2: Subjectivity in Green IT

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From Fig 4.2, it is evident that the business priorities, the environmental priorities, and the personal priorities of individuals are disjoint.

The area of intersection of these three priorities needs to be studied under the social aspect of Green IT.

The organizational (HR) policies and practices then have to work on expanding that intersection of the three priorities.

The domain of sustainability is highly complex and highly dependent on the context. The application and practice of sustainability requires knowledge that is specific to the context.

The context is the situation and role played by the person. The knowledge acquired by that person confines to be local.

Hence HR department must take utmost efforts to impart global view to the individuals in the organization.

Imparting this knowledge makes the individuals change their attitude and behavior on carbon emission related to them. The data and information related to carbon emission is likely to be interpreted in accordance with the personal needs, existing attitudes, and interests of individuals.

It is common that whenever approached with a new system, processes, and corresponding changes in the approach to work, users tend to be extremely sensitive

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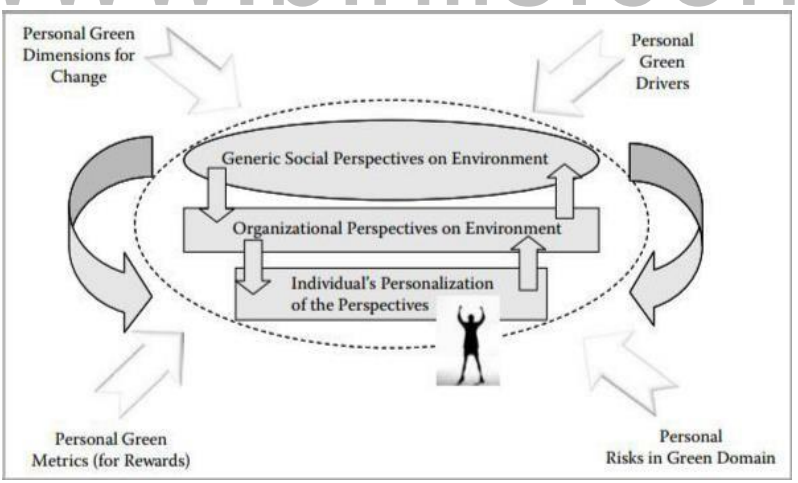

Fig 4.3: Personalization of the green context by end-users leads to change in attitude

The success or failure of the entire green enterprise transformation program, from a social perspective, rests on the perceived ease, perceive usefulness, and perceived relevance of the initiative.

Technology adoption, is the adoption of the Green IT systems to help, support, measure, and report on the activities and tasks of individual users.

The effect of the green system on the career, future growth, and rewarding structure are issues of concern for the individual users.

Starting right from the —personal‖ aspects of the drivers that drive this Green IT transformation and the dimensions or channels along which the transformation actually takes place, this personalization remains at the centre of the attitude of the users and their personal **—buy-in.‖**

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The tiers of influence namely social, organizational and personalized play great role in the green enterprise transformation

The management, ICT, and other professionals within the organizations needs to collaborate in using the emerging technologies as a means to effect changes in their environmental behavior. Employee and customer participation is also very crucial for the success of Green IT.

The strategies for acquisition and management of information as well as for proper implementation include all the employees in order to influence their practices,

secure their participation, and thus ensure success of the overall campaign-Green IT.

4.2.6 Green IT Ethics and Code of Conduct

IT is a newer profession when compared with other professions like teaching, medicine etc.

Green IT needs a code of conduct. Extending the current IT professional codes of conduct, and adding green-specific requirements to them, produces a list of code that individuals and organizations can strive to follow.

Having an ethical base enables Green IT to have a common view, a common set of behavior and understanding that is shaped by the experiences of practitioners, sharing of case studies, and relating of work experiences.

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Green IT ethics are meant to provide guidelines through which an interpretation of what is commonly believed to be right or wrong can be made.

The Green IT code of ethics also needs to delve into the seven areas of Information Criteria, that is, effectiveness, efficiency, confidentiality, integrity, availability, compliance, and reliability.

The discussions in the context of Green IT should be communicated honestly with authenticity.

Ethics and code of conduct for Green IT can control displeasing activities and bring in clarity and positive focus.

This increases reliability and trust in green data, information, and knowledge dissemination.

From the ethical point of view, Green IT needs to ensure that the transformation of the organization to a green organization contributes to society and human well-being.

Thus the code of conduct provides the organization with guidelines and direction to remain compliant to the guidelines.

Green transformation process must ensure ongoing compliance while evaluation of IT systems, analysis of possible risks, with their impacts.

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Advantages of Green IT code of Conduct:

The following are the advantages of establishing code of conduct in Green IT:

Agree to a fundamental obligation of business to reduce carbon emissions in all the activities.

Conform to total honesty in recording, analyzing, and reporting of carbon data.

Ensure that the effort to reduce carbon is undertaken in a socially responsible way and with no harm to people involved in the reduction attempt.

Ensure ongoing effort at all levels of IT ranging from architecture, design, development, testing, deployment, and maintenance to reduce their carbon footprint.

Ensure ongoing effort to reduce carbon in procurement, operation, and disposal.

Promote confidentiality and integrity within the organization and the IT profession.

Maintain security and confidentiality of carbon data and information.

Make the carbon data available publically.

Avoid green washing or incorrect promotion of the **organization's carbon reduction effort.**

Contribute toward development of Green IT standards worldwide and their application in practice.

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Ensure participation in industry and research surveys including workshops to increase the overall body of knowledge.

Attempt to use all emerging technologies to reduce existing carbon emissions and prevent increase in carbon emissions due to future business activities.

Endeavour to maintain validity of carbon data by subjecting itself to regular reviews and audits.

Maintain the security and privacy of carbon data.

Honor contracts, responsibilities, protocols, and agreements associated with Green IT and carbon trading.

Promote public understanding of the issues related to carbon emissions particularly in the context of the industry sector in which the individual/organization operates.

Prioritize all business activities based on their ability to reduce carbon emissions.

Adhere to these ethics and endeavour to create values that are based on the new green order of things.

Ensure high level of competency in all carbon-related activities of the organization such as measurement and reporting of carbon data.

Honestly represent —skills, knowledge, service and product‖ relating to carbon.

Endeavour to interact with other disciplines within the organization to reduce the overall carbon footprint.

4.2.7 Privacy and Security issues in Green IT

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The transformation of an organization to green enterprise needs to address the privacy and confidentiality related issues of the information that is generated in the process.

The sensitive nature of the carbon data requires careful control, secured storage, and proper reporting.

It is the sole responsibility of the management to secure this data as the firm undergoes green transformation and later, as the data gets stored in the organizational systems.

A trade off has to be maintained between data security and access of green information.

The carbon data that is stored may include the emissions data pertaining to an individual, a department, or an organization in varied timespans.

The organization has to compare their carbon footprint level with the benchmark set by the government in regular time intervals.

Preserving the confidentiality of these data is a challenging task in large organizations.

Elements of enterprise data architecture, principles of backup and security of data, and risks associated with maintenance of data needs to be applied to carbon data as well.

Provisioning smart metering for automatic recording and analysis demands stricter security measures to protect data.

4.2.8 Communications in Green Transformation Projects

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Effective organizational communication, from a green viewpoint, focuses on creating and understanding of the technologies and processes that are explicit and the green attitude that are implicit.

The subjectivity of attitude toward Green IT requires communication at multiple levels and various forms.

The purpose, content, channel, frequency, entities involved, feedback, and interactivity are all part of the Green IT communication.

Communication is required between internal departments of organizations to relate corporate philosophies, encourage teamwork, and develop strong relationships within and outside of an organization.

The internal communication of the organizations includes instruction in the development and maintenance of transformed green process.

Effective organizational communication, from a green viewpoint, focuses on creating an understanding of the technologies and process that are explicit and the green attitude that are implicit.

The two major communication in the organization occurs:

Within the organization—between managers and employees.

Outside of the organization—with the customers, partners, and regulators

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The communications can occur in standard documents, emails, verbal phone, and so on.

4.2.9 Channels of communication in Green IT projects

Communication can be through various channels in a Green IT transformation program. The important parts of a green transformation project need to be explained in the most clear and understandable way. Green IT terminology can be a challenge in this communication and needs to be articulated correctly. The frequency of communication needs to be high earlier in the project. Standard meeting protocols like taking the minutes and circulating them to apply in particular to Green IT projects. Following are the categories of communication channels:

Personal: face-to-face communication

Collaborative: group-based electronic communication mechanism

Mobile: phones and SMSs that enable context-based communications.

Asynchronous: electronic communication that can be **uploaded on the organization's site and then accessed by** employees and users at their own convenience.

Physical: paper form of communication

Group: electronic as well as physical communication facilities (webinars, seminars, workshops).

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4.2.10 Green HR and Changing Organizational Structures

Organization's social changes due to Green IT

transformation initiative include changes to the skill set of individuals supporting the organizational systems and processes. This requires support from the green HR function of the organization in terms of understanding, positions, training, and rewarding the staff for their Green IT effort. It is favorable to equip the organization with greater automated, location-independent, and personalized capabilities of IT. The same occurs in business process reengineering initiatives. Changing skill sets of highly skilled workers demands advanced problem solving, superior communication skills, and the ability to leverage on Green I T is within the domain of HR.

Fig 4.4: Genesis of Green IT in an organization

The following are pipeline of activities in bring the Green IT transformation in the organization:

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A HR has to engender change from the social perspectives.

This change is initially focused at an individual level with the organization. The departmental change deals with procedures and practices. The organizational change involves restructuring the hierarchy, creation of new green-specific role, and spelling out the reward structure for meeting green goals.

The HR department need to be organized.

The adoption of the changes in working lifestyle will also occur in different ways and with differing pace in the new green enterprise. The various types of individuals and their varying speeds of adoption should be carefully planned for, and factored in, in the green HR initiatives of the organization.

The three parameters that motivate the employees towards any transformation are:

Work with the support of technologies

Personalization of working style

Rewards and incentives

The subjective or tacit aspects of Green IT systems are an important consideration in the social dimension of Green IT transformation

Bridging of the gap between this tacit knowledge and the corresponding explicit knowledge stored in the green knowledge-base of the organization is vital in the social dimension.

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Green IT systems should offer spaces of interaction, permitting people to ask questions, to discuss themes, to define priorities, in ways of fostering the creation of knowledge, and doing a better use of the available knowledge.

Institutionalized support for the available use of social media communication in Green IT transformations is vital. These social media networks also enable participation from employees, customers and public.

4.2.11 Decision Makers in Green IT: Roles and Skill Sets

Green HR considerations has led to creation of new job profile namely green collar worker. Green HR has to define and position green-collar workers correctly.

Green-collar workers are the ones that are associated directly or indirectly with an organization's endeavor to become a green organization.

A Green IT project will create new roles, as well as transform the known roles in IT and in the business. The business analysts, project managers, architects, and quality assurance managers may also be classified as green-collar workers. The following are the three main green collar categories:

Roles that are newly created within the organization and that are specific to the green initiatives.

Roles that exist within the organization but are modified to befit the green organizational initiatives.

External roles that deal with the specification of carbon levels, and audits of its compliance.

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4.2.12 Skill set Framework for Information Age (SFIA) and Green HR

The possibility of applying an industry-wide standard to the green collar roles should be considered by Green HR. The skills framework for information age (SFIA) provides an excellent framework for positioning Green IT roles within the organization. The mapping is given in Fig 4.5. SFIA is increasingly becoming popular because it enables identification of suitable levels of competencies within the IT industry. SFIA can be used to create formal description, registration, certification, and training of Green IT roles. Green HR will be most interested in the description and the training aspect of these

new roles. Existing roles can also be redefined and/or mapped to the SFIA skill set. Together with the CMM scale for green maturity, and Green IT code of conduct, SFIA can be used in helping in the maturing of Green IT as a profession.

Scaling of Skillset

The SFIA skill levels can be mapped into three categories for carrying out Green activities:

Level 1 to 4: Managers and Team Leads

The functions carried out at this level are Operational reporting and Training on reporting of green metrics within business operations

Level 4 to 6: Senior Management

Functions to be accomplished are Operational risk management and Training on environmental risk and carbon risk within risk management

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Level 6 to 7: Strategists and leaders

They are responsible for Risk Anticipation Plan for carbon risks, legislative changes and global carbon trading.

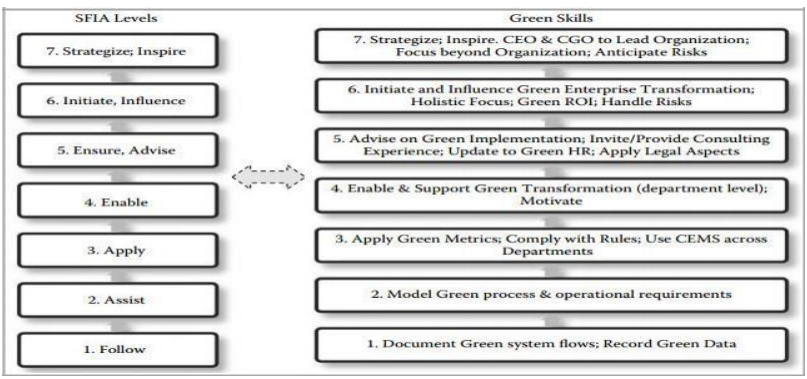

Fig 4.5: Mapping of SIFA roles with Green IT

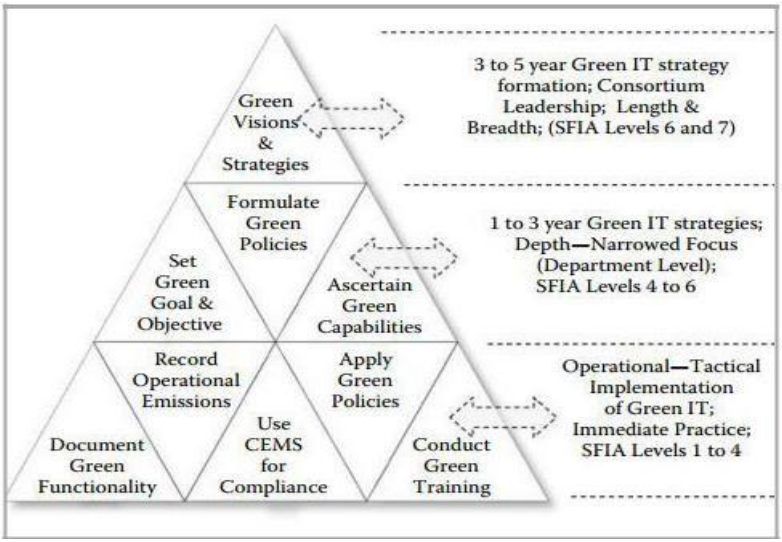

Fig 4.6: Levels of SIFA and green collar roles

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4.2.13 Green Virtual Communities

A virtual community formed through social networks allow people to interact irrespective of geographical and political boundaries.

Green virtual communities can be social groups that addresses green issues.

As people spend more time in these communities, they travel less, thus reducing carbon foot prints.

They also play a major role in formulating consensus and opinion on green initiatives and enable diffusion of knowledge on environmental sustainability.

The knowledge created through these communities can be embedded in knowledge management systems of the organization.

Green enterprise transformation also implies a level of generalization that can be applied in the context of green environment

Socialization and virtual communities help creation of subjective green knowledge which can then be codified into explicit green knowledge.

Social networks can also participate in collaborative effort from a group of organizations rather than a single organization in creating and maintaining data centres.

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