

Implementing Green IT Practices in Non-IT Industries in Sri Lanka: Contemplating the Feasibility and Methods to Ensure Sustainability

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Abstract—Green IT is a term that refers to the collective strategic and tactical practices that unswervingly condense the carbon footprint to a diminished proportion in an establishment's computing procedures. This concept has been tightly knit with IT related organizations; hence it has been precluded to be applied within non-IT organizations in Sri Lanka. With the turn of the century, computing technologies have taken over commonplace activities in every nook and corner in Sri Lanka, which is still on the verge of moving forth in its march towards being a developed country. Hence, it needs to be recursively proven that non-IT industries are well-bound to adhere to 'Green IT' practices as well, in order to reduce their carbon footprint and move towards considering the practicality of implementing Green-IT practices within their work-arounds. There are several spheres that need to be taken into account in creating awareness of 'Green IT', such as the economic breach, technologies available, legislative bounds, community mind-set and many more. This paper tends to reconnoiter causes that currently restrain non-IT organizations from considering Green IT concepts. By doing so, it is expected to prove the beneficial providence gained by implementing this concept within the organization. The ultimate goal is to propose feasible 'Green IT' practices that could be implemented within the context of Sri Lankan non-IT sectors in order to ensure that organization's sustainable growth towards a long term existence.

Keywords—Computing practices, green IT, non-IT industries, Sri Lanka, sustainability.

I. INTRODUCTION

GREEN IT is a topic at verge. The increasing awareness and concern towards the natural environment and energy usage and release has brought about the necessity and mandated the society to direct major focus towards this topic at present. Though this term can be loosely used to simply stick to preserving the environment, the underlying broken down analysis and deep understanding of *Green IT* reveals its contribution and importance in cross platform spheres.

Sri Lanka, in spite of being a small island, has been built into a vast IT industrialized social base. With the turn of the century that brought about an explosive technological advancement, numerous IT companies have sprung in every corner around the island. Though in oversight this can be seen as a positive step towards development, this IT explosion has its self-attached negative progression with regard to the energy utilization. The impact of IT has posed a threat, and several sources of these IT energy releases have been observed from a

varying spread and do not merely stipulate to dedicated IT industries.

A common misconception in the Si Lankan community often coherently attaches Green IT principles as prerequisites of IT companies. But, the availability of IT operations and services in all types of organizations at present dictates equivalent and more contribution and relation of Green IT initiatives with non-IT firms in Sri Lanka. Hence, this paper tends to contemplate the current structure of Green IT adjacent to non-IT industries in Sri Lanka, their contribution towards these energy concerns, the constraints that are prevalent in non-IT industries implementing Green IT policies and finally propose some viable Green IT initiatives based on the Sri Lankan context.

II. BREAKING DOWN THE GREEN IT CONCEPT

A. Green IT Elucidation

An energy efficient IT infrastructure that dictates initiatives and principles to enhance, minimize and reformulate energy utilization and expense [1].

B. Economic Breach and Green IT in Sri Lanka

Green IT is a concept that is tightly knit with energy utilization, especially carbon energy releases. This toxic accumulation in the atmosphere poses a serious threat to the environment as it tends to increase the surrounding temperature ultimately resulting in global warming. And global warming recursively is an environmental factor that serves as the root cause for several other catastrophes.

At present in Sri Lanka, the effect of global warming has taken a toll in the naturally preserved indigenous ecosystems such as rainforests and mangroves. The fading land proportions of these ecosystems have brought about several adverse effects influencing the herbal medical industry, fisheries industry based on mangrove bred aquatic life, timber and saw milling industries, rubber sectors, coconut and tea plantation, and so on.

Since the Sri Lankan economy is highly dependent on its natural product and export, the negativity imposed by the environment, on these export products and its untethered natural surroundings has become a serious issue and major concern that needs to be considered at the moment. The prime effect of this also elucidates national development on the larger scale.

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C. Scope and Visualization of Green IT

The term 'Green IT', on the whole, can be applied to various spheres without bounds. Any field that incorporates better energy management principles via the usage of enhanced IT principles falls under the scope of Green IT. Hence, it is crucial to define scoped classes within which industries can be brought into, in order create a containment for the solution definition. As such, the two major binding classes with which *Green IT* can be scoped are the *Green Initiative forms* and the *Carbon Footprint as a measurement*.

D. Green Initiative Forms

In identifying the solutions to move towards better Green IT practices, the solutions need to be considered based on the type of Green Initiative form that the industry is going in for. Hence, these Green Initiative forms can be classified as follows.

- a. Primary Green Initiatives
- b. Secondary Green Initiatives
- c. Tertiary Green Initiatives

1. Primary Green Initiatives

Primary Green initiatives comply with the basic non-investment based modifications that could be brought about in habitual and physical layout of the staff and structure of the industry. This type of initiatives does not require major capital investments or work-at-stake changes. Instead, it is a matter of the staff and stakeholders adopting to better practices.

Some such initiatives can include instructions for the staff to power off their computers, lighting devices or coolers when they leave, work in naturally-lighted spaces to minimize using lighting energy sources during the day, etc.

2. Secondary Green Initiatives

Secondary Green Initiatives take the concept a step further and require investments both financially and physically. These investments do not always fall under the industry's budgetary expenditures. Secondary initiatives call each individual to invest towards better Green IT principles by allocating minimally towards energy efficiency.

To specify an initiative that could aid in implementing these principles is requesting staff to avoid charging their digital devices at work places and instead charge them at their home environments or resolve to utilize power banks. Though this will reduce the industry or company's overall energy utilization, each staff member needs to invest towards paying for their energy usage with a trivial increase in energy bills.

3. Tertiary Green Initiatives

Finally, the Tertiary Green Initiatives are implemented upon identifying the dire austere need for work practice changes within an industry. The major implications caused by an industry's work practices on the environment or the economy lead to resolving to this type of initiatives. These are seldom required by small-level industries. But, with the augmentation in ecosystem wipeouts, large scale, IT-service dedicated, massive machinery, and energy expending industrial sectors need to consider the implementation of tertiary green

initiatives. These principles and solutions require major financial input and critical work-practice changes which may even resolve to cutting down on staffing and work-around area. This places the staff's job security at stake, and serious adjustments to new practices can levy stress levels on staff.

E. Green Initiative Selection

Before resolving to any type of initiative class, the industry needs to analyze its state based on the green scale. There are several metrics and measures that aid in understanding the energy utilization of an organization. But, the prime metric that reveals the seriousness of the organization or industry's contribution towards negatively progressing IT and environmental practices is the *Carbon Footprint*.

F. Carbon Footprint

The Carbon footprint has been defined by the Carbon Trust Fund as the sum of greenhouse gas emissions that are a resultant of an individual, industry, a process, or a product [2].

By simply stating, the Carbon Footprint can be mentioned as overall energy releases from an industry's processes, services or products. These energy releases can either be manageable by the industry such as controlling its procedures, or these can be invisible or uncontrollable energy releases that are a byproduct of their procedures and products.

The carbon footprint can be measured in tonnes of CO₂ equivalent (tCO₂e). By analyzing the carbon footprint against standard baselines, the industry can come to conclusions in identifying their impact contribution and selecting the form of Green Initiative that they need to resolve to. This investment in IT and digital enhancement to diminish an organization or industry's Carbon Footprint in its entirety, regardless of the field of operation, is stated as the '*Silicon Trading*' [3].

III. SRI LANKAN INDUSTRIAL STRUCTURE

The Sri Lankan economy is dominated non-IT dedicated industries due to its reliance on its natural produce and exports. The community tends to hold a common misconception where energy releases such as greenhouse gas emissions and other toxic waste releases are immediately correlated to dedicated IT service industries. But, what needs to be elucidated is the proportion at which each and every industrial sector contributes towards these energy releases.

A. Overall Green House Gas Emissions from Sri Lanka

Excluding non-IT dedicated industries, greenhouse gas emissions can be viewed upon based on the energy industry, agricultural industry, and waste management.

Though '*Energy*' as a solely standing concept encapsulates all IT operations and digital device power management, it does not necessarily always take place within dedicated IT industries such as Software companies and IT service industries. There are several industries that utilize IT services to render some other type of (non-IT) service to its consumers. And the proportion of greenhouse gas emissions from these industries is at an alarming rate in comparison to Sole-IT industries.

The overall greenhouse gas emissions from various industrial sectors in Sri Lanka are shown in Table I [4]. Summarizing these collected statistics, the proportions can be illustrated using Fig. 1 [5]. The energy sector was found out to dominate the greenhouse gas release status in Sri Lanka as analyzed by the World Resources Institute Climate Analysis Indicators Tool (WRCAIT) [6].

TABLE I
SUMMARY OF GREENHOUSE GAS RELEASES IN SRI LANKA [4]

Sector	CO ₂ Gg	CO ₂ Removals Gg	CH ₄ GgCO _{2eq}	N ₂ O GgCO _{2eq}	Total GgCO _{2eq} (Net)
Energy	10,430.01		881.37	251.10	11,562.48
Industrial Processes	492.40				492.40
Agriculture			3,887.94	821.50	4,709.44
LUCF-Emissions	10.34		35.07		45.41
Waste			2,033.22		2,033.22
Total-Emission	10,932.75		6,837.60	1,072.60	18,842.95
LUCF-Removals		-6,253.99			-6,253.99
Total-Net	10,932.75	-6,253.99	6,837.60	1,072.60	12,588.96

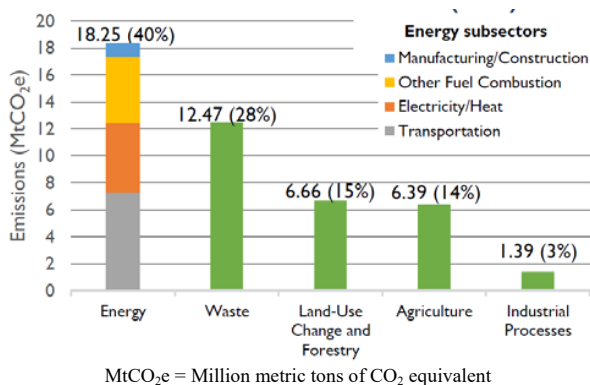


Fig. 1 Sri Lanka's greenhouse gas emissions by sector and percent of total emissions [5]

According to the above stated statistics, the energy industry seemingly generates high levels of CO₂ which is a major greenhouse gas that brings about both useful natural cycles as well as adverse atmospheric accumulations. Hence, Table II [4] moves forth into analyzing and breaking down the Energy sector's greenhouse gas release.

TABLE II
GREENHOUSE GAS RELEASES FROM THE ENERGY SECTOR [4]

Fuel Type	Emissions (Gg)						
	CO ₂	CH ₄	N ₂ O	CO	NO _x	NM VOC	SO ₂
HFO	1535.58	0.06	0.01	0.03	4.01	0.10	29.93
Diesel	1530.25	0.06	0.01	0.31	4.17	0.10	2.89
Total	3065.84	0.12	0.02	0.61	8.18	0.20	32.82

HFO=Residual Fuel Oil, CO₂=Carbon dioxide, CH₄=Methane, N₂O=Nitrous oxide, CO=Carbon monoxide, NO_x=Nitrogen oxides, NMVOC=Non-Methane Volatile Organic Compounds, SO₂=Sulphur dioxide.

The energy sector goes on to analyze greenhouse gas emissions based on the energy releases from fossil fuel

combustions in electrical power generation processes, refinery operations, industrial processes, transportation services household processes, and commercial sectors.

Similar to the analysis of the energy sector's contribution, there are the other sectors such as transportation, agriculture, etc. that contribute considerably. Hence, better IT principles and technology need to be implemented to bring about environmental sustainability via Green IT initiatives in non-IT industries in Sri Lanka.

IV. RESILIENCE IN IMPLEMENTING GREEN IT INITIATIVES IN SRI LANKA

The initial and crucial stage in the process of implementing Green IT initiatives in industries is to identify the constraints that exist in moving forth with the implementation or the restraints that prevented the possibility of considering Green IT as a viable solution to environmental and industrial sustainability.

Some of the key resilient factors identified are elucidated here.

A. Service Production Technology vs Green IT Technology

Most of the industrial sectors direct major focus on enhancing their processes and procedures that lead towards a direct betterment of the service rendered or the product built. Green IT concepts within a non-IT dedicated industry are often considered to be an isolation from the industry's regular work routine and is seen as an external unit within the organizational structure. Hence, when idealizing the implementation of Green IT initiatives within an industry, the decisive management level leans towards investing on advancing their technology that directly reaps benefits in their products and services, and Green IT initiatives are excluded from being considered as a plausible solution or not paid enough attention to.

B. Fallacious Green Initiative Type Identification

In Sri Lanka, the community has become more concerned and aware about the environment at present. The deleterious implications that are brought about due to the blast of an industrial explosion that started taking place with the turn of the century have surfaced more obviously creating an increased awareness among the society to preserve its environment. Hence, it is not completely true to specify that industries have put up a wall from considering Green IT initiatives as an add-on in their procedures. But, what is not properly identified here is the level at which their industry standards are and which correlates to the type or class of Green Initiative that the industrial sector needs to resolve to.

Most of the industries that seldom consider the viability of green initiatives tend to go to the extremes of choosing *Tertiary Green Initiatives* all at once. This might be either unnecessary or unfeasible, ultimately resulting in the idea being rejected due to financial restraints or in a process failure.

C. Deficiency of Established IT Infrastructure

As understood obviously, Green IT requires the usage of

well-established IT networks. Due to the fact that most of the industries are presently in the still-developing stage along with the country's status, having state of the art technological resources seems worth-while only within dedicated IT companies. Since some of the solutions proposed for Green IT procedures require the companies' IT resources to have a strong expertise to manage and to maintain the implemented principles, IT needs to be considered as a separate team or sector within the industry itself. But, not all of the industries in Sri Lanka have such well-established IT infrastructures in addition to their direct regular sectors.

D. Staff Resistance

Whenever a new rule or regulation is being implemented within an industry, staff resistance towards that new initiative is well expected in almost all the possible scenarios. Likewise, in the context of introducing Green IT principles, an augmented resistance level can be expected due to the fact that this process not only brings about changes in the organizational infrastructure, but also dictates personal behavioural change in every individual working under this organizational structure. For example, if the industry is eligible under the Secondary Green Initiatives, when requesting staff members to avoid charging their personal devices like mobile phones in their home environments or utilizing power banks rather than charging them at their work place, the staff members may tend to get resistive towards the management analyzing the situation to be a deprivation of their personal rights. Hence, Green IT is a concept that requires the undivided cooperation from the administration as well as the staff. The staff members need to look over the changes with an open mind instead of being defensive from the initial phase itself. A trial period might be useful for both the Green IT pioneers and the staff of the industrial sector to fully realize the value.

E. Financial Constraints

One of the major concerns in implementing such initiatives is the associated cost factor. In addition to the administration's hesitance in allocating a budgetary proportion towards Green IT, the lack of a measurable success story in the Sri Lankan context at present, leads to a questionable future success rate. This brings about the negligence of considering the principles proposed.

F. Distanced from Expertise

Sri Lanka is a still developing country that has a long way to go in the path of development, whereas it has the highest literacy rate in all of South Asia which is 92.61% [7]. The reason, that well trained expertise or skilled personal knowledge in Green IT implementations is not available in Sri Lanka, is a fact to be blamed on the industries since they are not willing to accept this.

V. VIABLE SOLUTIONS TO OVERCOME THE CONCERNS IN GREEN IT IMPLEMENTATION

A. Smart Grid Implementation

Rather than going in step by step with Green IT implementations in each organization, the smart grid can be mentioned as a single large scale solution to Green IT.

Yet this is still a conceptual experimentation even in developed countries, the full realization of well-established network points in the power supply and consumption chain from the utilities to the consumers can lead industrial sectors to reap the benefits of Green IT sustainability while consuming energy in an efficient manner.

The smart grid is a composition of communication channels and transmission lines that subsume smart appliances to monitor, manage, control, customize, and regularize the way in which a building or living environment utilizes and meets its energy demands [8].

Correctly analyzing the smart meter metrics to assess the energy utilization of the industrial sector can aid in moving forth with a greener work-around.

B. Green Architectures and Sustainable Buildings

Green architectures have currently been placed in the spotlight, world-wide. These types of buildings and architectures aim towards preserving the environment along with its livelihood by the utilization on "Green" materials. These "Green" architectures consider a wide variety of concerns in designing buildings.

Some examples of green architectures include characteristics such as the minimalist yet efficient usage of space, usage of recycled materials in building, ensuring non-toxic, non-radiating material usage in the process, reuse existing building structures by adapting them for sustainability and so on. These architectural designs can be a way into a financially feasible and architecturally advanced solution that also results in a Greener building and environment.

C. Thermal Energy Management and Reuse

In industries that generate high thermal energy as a byproduct during their processes, this energy can be redirected and utilized by some other heat requiring systems or procedures. This heat recycling technique is often utilized in high thermal-energy-generating data centers [9].

One of the many notable examples of recycling data center heat is the system developed by Paul Brenner from the University of Notre Dame Center for Research and Computing [10]. In his approach, he had developed a set of high performance computing nodes and placed them at a local municipal green house, the South Bend greenhouse, and a Botanical Gardens. This helped the plants to retain the required heat for a stable growth. By redirecting the waste thermal energy, this approach does not simply reduce energy released to the atmosphere but it also reuses it to expand and preserve the "Green" environment directly and indirectly. But, applying the same theory to any industry will prove to reduce heat to the atmosphere and to enhance process efficiency and energy recycling simultaneously.

D. Switch to Cloud Based Storage Rather than Data Centers

The major differentiation between Data Centers and Cloud based storage is that data centers are on premise hardware that stores data, whereas the cloud is an off-premise technological platform that uses the Internet to store data [11]. Data centers have proven to be a major issue based on the fact that they release high heat energy to the atmosphere. Hence, resolving to cloud storage can cut back on these energy releases. It also bears the attached benefit of being a cost-saving and reliable method, where storage can be flexibly extended.

E. Solar Energy Usage

Since Sri Lanka is a tropical country that is located right next to the equator, solar energy is as free and abundant as it can get. Utilizing this solar energy to generate power in the buildings is a free and sustainable solution in the Green IT paradigm.

F. Wind Energy Usage

The same applies to utilizing wind energy as solar energy. Windmills provide an equally viable solution in getting free and renewable energy without the release or utilization of toxic energy and byproducts.

VI. CONCLUSION

With the augmenting concern about the environment and sustainability, Green IT concepts have merged as a primal solution. Sri Lanka, being an island with a rich, indigenous ecosystem, is now at the brim of sustainability due to the aggregating threat to the environment from various IT and non-IT industrial operations. Hence, the application of Green IT practices within various industrial sectors, including those that do not simply stipulate to dedicated IT services, needs to be considered. In doing so, the analysis of the class under which the Industry falls has to be discovered in proposing solutions to overcome their energy utilizations. Three major Green Initiative classes have been defined based on the severity and contribution that the industry possesses in the Carbon Footprint and toxic energy release scales. Based on these, measures can be taken ranging from trivial to extreme work-around vicissitudes to ensure Green IT sustainability. Hence, based on the type of industries available in Sri Lanka and their respective negative contribution towards the Green IT, existent constraints and viable solutions have been proposed in order to seal environmental, economic and industrial sustainability which ultimately results in National development.

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