

How to Improve Software Sustainability?

An overview of software sustainability and how to systematically enable sustainable transformation activities for business benefits

WHITEPAPER



Abstract

Within the next few years, many CIOs will be evaluated based on how well their IT organization contributes to environmental goals. Software-related CO2 emissions also account for global emissions, equivalent to all combined aviation, shipping, and rail emissions. The majority of the carbon footprint of enterprise software systems comes from how they are designed and developed. A new feature that analyzes the environmental impact of software code was launched recently, showing that each code line we write affects the planet.

The emphasis of this paper is to build awareness of what, why, and how software sustainability is and provide possible step-by-step guidelines for improvements. **The purpose of this whitepaper is to introduce software sustainability factors for CIOs, sustainability teams, business analysts, and solution architects, and to help them integrate this element into their organization's wider IT and sustainability plan.** With a green software approach, organizations can identify how software affects the environment, create a systematic strategy to fix green issues, apply good practices to software development processes, and make sure that every solution is eco-friendly.

Key Takeaways

The key areas covered in this whitepaper are as follows:

01

What is software sustainability?

02

Use cases to adopt a systematic approach.

03

Step-by-step improvement based on KPIs.

04

How do you get started with software sustainability?

05

Tech Mahindra's approach

Introduction

If you are not using technologies to measure, report, and improve your organization's emissions and energy consumption, and if you are not familiar with the environmental impact of your solution, your source code's green issues, or the tools and resources to find and fix them in every software update, you will be considered as **carbon unaware!**

Your organization should leverage digital technologies to achieve net zero targets for the company and reduce carbon emissions, not neutralization. Even if digital technologies have an impact, you need to ensure digital technologies are efficient and do not contribute to an increase in carbon emissions.

In an increasingly data-intensive and interconnected world, as organizations expedite their digital transformation, the demand for electricity from IT is projected to surge exponentially.

Sustainable software transformation projects consider aspects of green software, which has two parts: Green **with** software and green **within** the software.

What is Software Sustainability?

Did you know, for example, that inefficiencies in both infrastructure and software are leading to a sharp increase in greenhouse gas (GHG) emissions within data centers? Could this be a significant factor driving hardware obsolescence and, consequently, contributing to electronic waste? Have you ever purchased a new smartphone because your old one couldn't support the latest version of your favorite app? This occurs because the app's code isn't designed to be compatible with as many previous mobile operating system versions as feasible. Developers should prioritize ensuring maximum backward compatibility of code. Additionally, **efficiency** remains a critical concern.

Some current trends are inescapable: Over the last decade, the average size of web pages has significantly increased. Meanwhile, does the increased memory requirement of **popular productivity software** 2019 compared to its 1998 counterpart suggest significant improvements in today's websites over those from 2013? Additionally, can we consider this software significantly superior to its 1998 version? These questions underscore the importance of **software sustainability**. It's not solely about the choice of programming language or the number of lines of code; writing clean, lightweight, and efficient code or algorithms is equally crucial. Such practices ensure optimal utilization of the hardware on which enterprise systems operate.

The **Green Software Foundation**, a non-profit organization, aims to establish a reliable ecosystem involving individuals, standards, tools, and best practices for developing environmentally friendly software. Additionally, the **Consortium for Information & Software Quality** (CISQ), has introduced automated source code metrics for assessing software's environmental impact. A tool that analyzes the environmental impact of software code has integrated CISQ standards into its static source code analysis to identify areas where software can be made more environmentally efficient.

The term green or sustainable software can be interpreted in two ways:

- (1) Green within the software**, the software code being sustainable, efficient, and agnostic of purpose
- (2) Green with software**: the software's purpose is to support sustainability goals, i.e., improving the sustainability of humankind, limiting energy consumption, and have a minimal environmental impact.

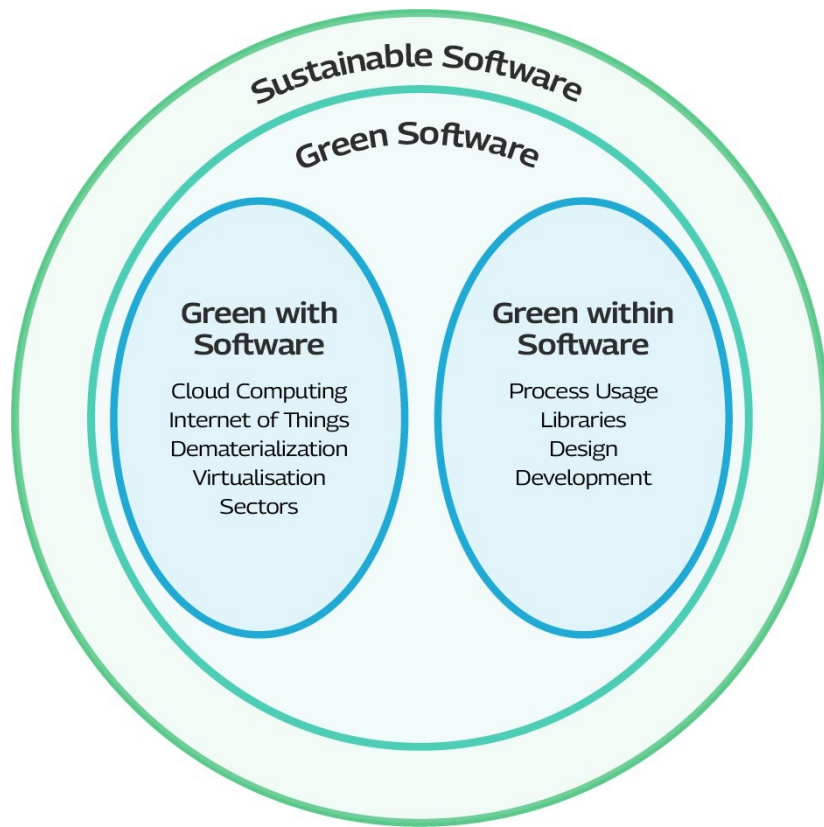


Figure 1 : What is Green Software?

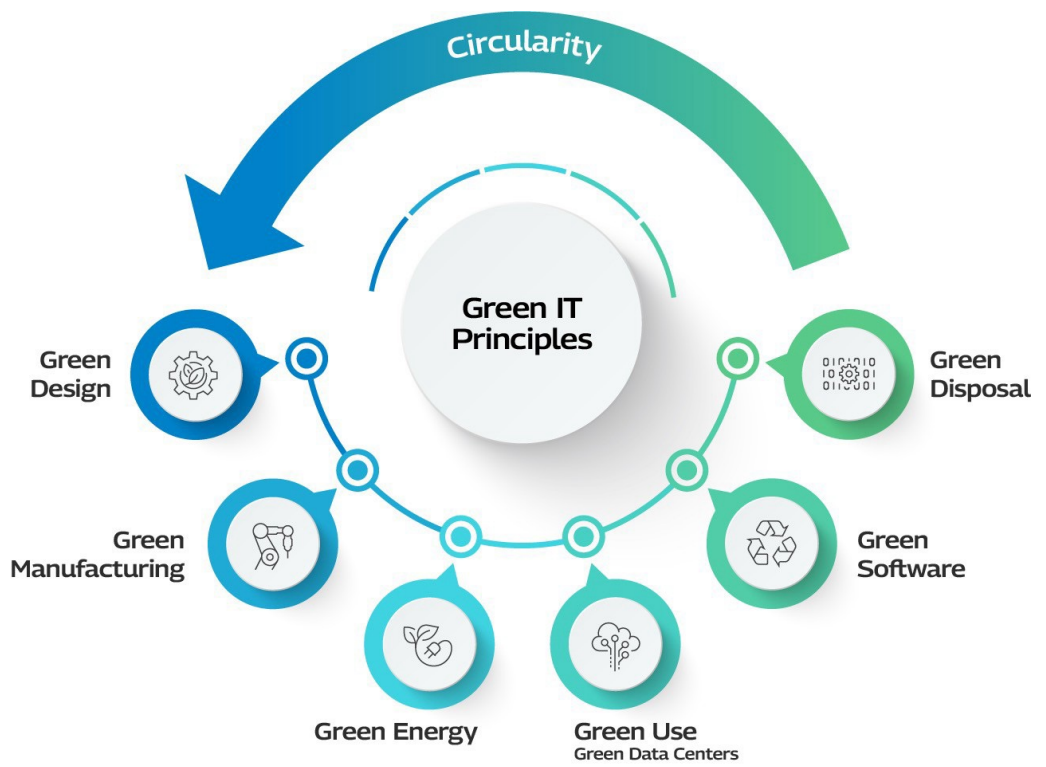


Figure 2 : Green IT principles

Driving the Road to Sustainable Software: Lessons from Fuel-Efficient Cars

Improving a car's fuel efficiency (mileage) has several parallels with improving software sustainability.

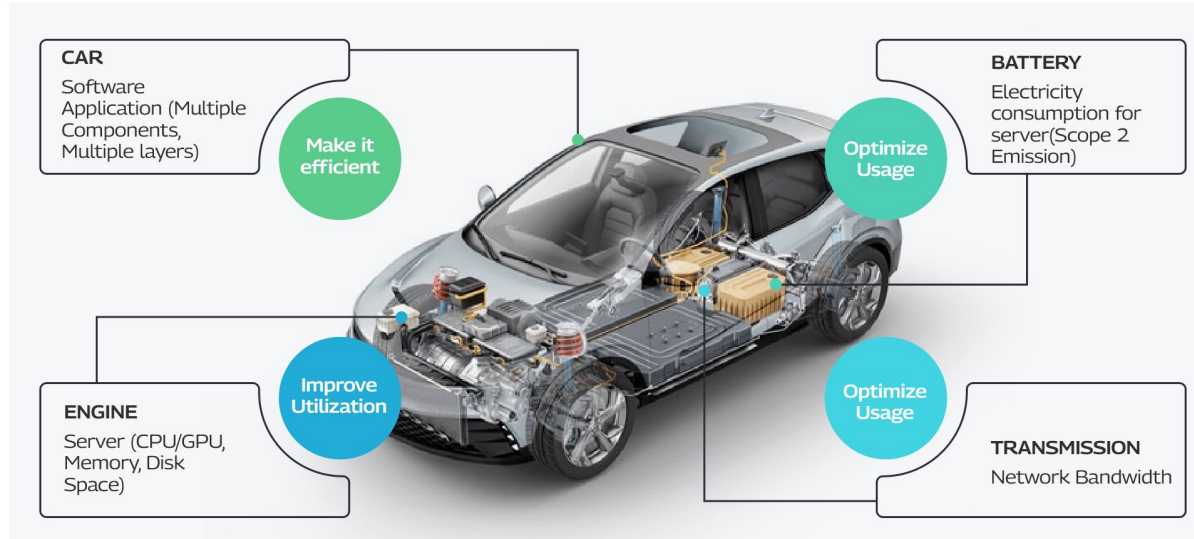


Figure 3 : Analogy between improving software sustainability v/s increasing car mileage

- **Optimized Code:** Just as electric cars benefit from efficient battery management; well-optimized code enhances software performance and helps reduce Co2 emissions.
- **Reducing Waste:** Efficient software avoids unnecessary computations or resource usage, like minimizing energy loss during charging.
- **Regular Updates:** Scheduled electric car software updates align with software patches and enhancements.
- **Driving Habits:** Responsible driving habits (smooth acceleration, energy-efficient breaking) mirror good coding and design practices (clean code, green architecture, responsible AI, avoiding sustainable debt).
- **Challenges:**
 - **Legacy Systems:** Older electric cars and outdated software face challenges due to changing environment standards and compatibility issues.
 - **Balancing Features:** Just as adding features affects an electric car's range, software enhancements must balance functionality and resource usage.
- **Benefits:**
 - **Cost Savings:** Efficient electric cars save money on charging; sustainable software reduces operational costs.
 - **Environmental Impact:** Both contribute to a greener future by minimizing waste and resource consumption.

In summary, improving software sustainability and increasing electric car mileage involves conscious efforts, regular maintenance, and a focus on efficiency. Just as a well-maintained electric car takes us farther, sustainable software ensures smooth operations and longevity in the digital realm.

To address this issue, TechM has assessed the sustainable software requirements of their clients and offered a systematic approach based on use cases to improve the software's environmental performance.

Our Solution - Tech Mahindra's Approach to Achieving Software Sustainability

Our 'green with software' solution includes recommending technology to achieve sustainability goals while implementing digital transformation and application modernization use cases, e.g., handling resource scarcity via waste management, the role of technology to achieve sustainable goals, leveraging AI/ML and cloud for sustainability, going green with edge computing and use of core networks.

Our '**green within software**' recommendations include architecture components within software systems, factors to be considered for architecture redesign, architecture patterns - serverless, container-based, database and UI, energy efficiency of UI/UX design principles, measuring sustainable debt via DevOps and usage of the tools for calculation of software footprint.

The critical use cases of our offerings, along with the customer issues that they solve, are listed below:

Use Case(s)	Role	Customer Issues	How are we helping our clients?
Establish a baseline for sustainability assessment	Leaders	Poor carbon awareness maturity	Our survey helps determine the organization's carbon awareness score.
Determine quick win solutions to improve sustainability	Leaders	No traceability between artifacts and deliverables	Ensures everyone relates recommendations to their book of work and identifies a deeper area for sustainable solutions.
Determine standardized organization-level sustainable metrics / KPIs	Leaders	No systematic sustainability debt removal mechanism	Provide a more profound recommendation of solution elements and associated implementation using one or two technology implementations
Implement sustainability transformation initiatives	Leaders	Lack of Green Talent	Our POD-based certified green skilled team members help realize sustainability transformation activities

How to Do Step-by-Step Software Sustainability Improvement?

1) Assessment (First, Establish a Baseline)

- Perform scoring-based inspection, which helps establish a baseline and create awareness on critical metrics like green impact, software resiliency, agility, elegance, and cloud readiness

Quick Assessment (101) - Ensures everyone relates recommendations to their book of work and identifies a deeper area for solution.

- Detailed Assessment (201) - Provide a more profound recommendation of solution elements and associated implementation using one or two tech implementations.

2) Track Energy Consumption and Carbon Footprint of Hardware and Software (Green Tools Procurement)

Evaluate the carbon footprint of devices and servers, Determine the relationship between energy sources and carbon footprints, evaluate alternative energy sources for hardware, identify carbon leaks (green deficiencies) in source code using a tool- based approach, and determine green impact trends and frameworks/solutions, SDLC practices that aid in footprint calculation—co-relate energy consumption and footprint and plan for loosely coupled energy compliant system.

3) Handle Resource Scarcity via Waste Management and Ensure Green Disposal (Facilitate optimal use of resources)

Implement 3Rs - Reduce, Recycle, and Reuse of hardware resources, especially check the utilization of procured servers; define waste management strategy; address supply chain and business processes inefficiencies and demand forecasting; Apply just-in-time storage principles while fine-tuning databases/cache; enforce delay loading of all resources on the webpage.

4) Role of Technology to Achieve Sustainability Goals (Green with software)

Use sustainable Web 3.0 technologies (AI, Blockchain, IoT) to manage energy consumption at the server level and cloud, implement application modernization and digital transformation activities. Make your data center green, redesign software components based on their carbon footprint, and improve the carbon impact of new-age data sources - email, IM, videos.

5) Implement Green Software Architecture and infrastructure (Green within software)

Within the software system, track the sustainable debt for every application component within a 7-layer modern application architecture; decide factors to be considered for architecture redesign; implement architecture patterns - server less, container-based, database; use of different coding languages; design human-centric and sustainable UI/UX, measure sustainable debt via DevOps during every new release of software.

6) Leverage AI/ML and Cloud for Sustainability (Green IT Project Implementations)

First, determine the energy consumption of AI/ML algorithms, Understand the importance of responsible AI design and delta training of models, design of cloud workloads for sustainability goals, Implement ESG data lake solutions, and Implement SRE and observability techniques for sustainable technology operations.

7) Go Green with Edge Computing

Access the need for edge computing, consider the applicability of IoT sensors for data collection, obtain a GPS roadmap of entire application architecture and focus on modes of communication for data exchange across application boundaries, apply data analytics at the edge, and implement digital transformation and app modernization use cases via robotics and RPA.

8) Leverage Core Networks

Leverage 5G and cloud native RAN (radio access networks) to implement decentralization use cases, explore the role of AI to avoid data movement across network boundaries, Leverage edge data and analytics in a 5G system, and ensure verification and validation of data happen in core network instead of using traditional hub and spoke model.

Business Benefits of Adopting Green Software Approach

With the current focus on climate change, there is a fundamental shift in how businesses view their sustainability investments. There is a constant need to relook at actions that the company undertakes and find alternative approaches to existing ways of working to minimize the impact on the environmental ecosystem and the finite resources that exist on the planet. These recommendations will look at creating an awareness of the topic of a green IT environment and how different digital transformation and application modernization initiatives via software are leveraged to achieve sustainability goals.

Typical benefits post sustainability improvements are:

30% energy saving post sustainability roadmap implementation

- Improved Green IT Index to help energy saving up to 30% using TechM solution approach
- Improved technology architecture and coding practices

15-20% reduction in sustainability debt after new release

- Reducing technical debt by code refactoring and adopting green software development lifecycle processes.
- Tracking and optimizing code carbon emissions during every release

30-40% Savings on OPEX and CAPEX over 3-5 years

- Cost optimization and reduced multi-vendor management overheads
- Greatly improve reliability and availability of the applications

30% reduction in application portfolio

- Reduction of application portfolio based on APR exercise.
- Reduced sustainable debt

30% of applications migrated to the cloud

- Cost reduction and operational efficiency improvement.

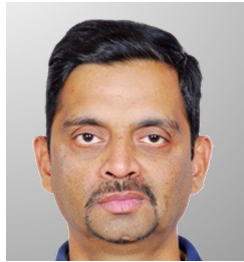
20% improved engineering velocity

- Segregation of transaction vs analytical data for online and offline queries
- Movement to DevSecOps / SAFe and adoption of shared IT platforms
- Optimization based on profiling, DB tuning, and data decomposition, and automation

Conclusion

With the ever-growing need for green IT and infrastructure, there is also a need for more skilled green resources to deliver solutions. However, software sustainability improvements can also provide solutions to businesses to adopt a greener development way to ensure power savings and protect the environment. The IT industry is far more prepared than any other industry to face the ever-growing rapid changes in trends. However, more awareness must be created to ensure every line of code we have written or the one we will write in the future accelerates towards making your solution environment positive. The IT industry is a crucial part of the sustainability program because of the amount of energy it consumes, the amount of e-waste that is generated, and the amount of hazardous waste that needs to be appropriately disposed of or recycled. Although there are barriers that need to be overcome, in the long run, for a greener and sustainable future, proactive action is required, and developing a sustainable green IT solution is the first step towards it. TechM's sustainability assessment framework maps the client requirements to KPIs and provides actionable insights that deliver tangible business value. TechM's advanced assessment approach, recommended AI-ML-based source code analysis tools, and detailed recommendations helps faster implementation by improving engineering velocity, resulting in quick go to market (GTM).

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Kedar Deo has 28+ years of proven track record in technology, consulting, pre-sales, and delivery solution architect, creating innovative solutions, building niche capabilities, complex delivery, and client relationship roles with P&L accountability. Currently working as group practice head and involved in creating multiple offerings, working with different client engagements to help implement sustainable transformation and develop customized approaches based on the client-specific sustainability improvement needs.

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