

## Ecomart

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### ABSTRACT

The rapid growth of e-commerce has transformed consumer buying behavior significantly by providing more convenience, accessibility, and efficiency but this growth has also brought environmental degradation by increase of carbon emissions from manufacturing, packaging, warehousing, transportation and delivery. As global awareness of sustainability increases, most existing e-commerce platforms are largely focused on profitability, operational efficiency and improving user experience with little to no information provided on the environmental impact of consumer purchases. This means consumers are often unable to make informed decisions about the carbon footprint connected to the products they choose to buy.

To tackle this challenge, this study proposes EcoMart, a sustainable e-commerce platform that aims at embedding environmental consciousness into the online shopping process by tracking carbon footprints at the product and order levels. The platform merges traditional e-commerce features such as product browsing, cart management, secure user authentication, and order processing with a hybrid intelligent carbon tracking system. EcoMart uses the ClimaTiq Carbon API to provide real-time carbon emission estimates related to

products and logistics activities at various stages of the product lifecycle. These calculations are based on internationally recognized Greenhouse Gas (GHG) Protocol standards, which allow the platform to offer transparent sustainability information to users throughout the entire purchasing process.

The platform has a fallback mechanism using machine learning to make sure that emission estimation is not interrupted, because real-time emission data may not be available in all cases due to limited supplier disclosures, incomplete lifecycle assessment data or API limitations. In particular, an Extreme Gradient Boosting (XGBoost) model is employed to predict carbon emissions based on several product-specific attributes, including product category, material composition, weight, packaging specifications, manufacturing details, and transportation-related factors. The proposed hybrid approach improves the accuracy, scalability, and overall reliability of the carbon footprint estimation in e-commerce environments.

EcoMart promotes carbon transparency and has a Green Points Incentive Module which is a gamified reward system that is meant to incentivize environmentally responsible purchasing behavior. Consumers can earn Green Points by selecting products with lower carbon emissions, which they can then use for discounts and other benefits. The proposed platform seeks to connect sustainability knowledge with consumer purchasing behavior through combining sustainability analytics with behavioral motivation strategies to encourage more sustainable consumption practices.

**KEYWORDS:** Sustainable E-commerce, Carbon Footprint Estimation, ClimaTiq API, Green House Gas Protocol, XGBoost, Machine Learning, Green Points, Environmental Sustainability, Intelligent E-commerce Systems, Green Computing.

### 1. INTRODUCTION

In recent years, the explosive growth of e-commerce has become an integral part of everyday life. The ease of online shopping, the wide availability of products and the delivery at your

doorstep has changed the consumer buying behavior to a large extent. But this swift expansion has also led to greater environmental concerns. The activities involved in the e-commerce process such

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as manufacturing, packaging, storage and transportation contribute significantly to the greenhouse gas emissions and environmental degradation.

Although many organizations are engaged in sustainable practices, most contemporary online retail platforms still continue to emphasize affordability, product availability, and efficient logistic services. The problem is that there are very few platforms that provide information about the effects that the products have on the environment. This makes it difficult for consumers to consider sustainability when making a purchasing decision. This means customers are often unaware of the carbon footprint of the products they purchase and the deliveries they receive. To help with this issue, this paper presents EcoMart, a sustainable e-commerce platform that aims to incorporate carbon footprint awareness into the online shopping experience. The platform allows users to see the estimated carbon emissions for individual products and their total orders. This data is derived from the integration of the ClimaTiq Carbon API, which adheres to the internationally recognized Greenhouse Gas (GHG) Protocol standards for estimating emissions at various stages of a product's lifecycle. However, one of the main challenges in putting these systems in place is the lack of carbon emission data for certain products. To address this issue, EcoMart uses a Machine Learning-based fallback method with the XGBoost algorithm. When real-time emission data isn't available through the API, the model estimates the carbon footprint based on factors like product category, material type, weight, packaging details, manufacturing location, and transportation mode. This helps ensure that users get sustainability information during their shopping experience.

In addition to tracking carbon footprints, EcoMart includes a Green Points reward system to encourage eco-friendly shopping habits. Users earn Green Points by choosing products with lower carbon emissions. They can later exchange these points for discounts and other perks. This game-like method aims to increase user participation while promoting sustainable consumption.

The goal of this research is to create a platform that combines e-commerce features with a focus on environmental awareness. EcoMart achieves this by tracking carbon emissions using API and also using machine learning for predictions, and including incentives for sustainability.

The key achievements of this study embrace the following: - Building of a sustainable e-

commerce platform that tracks carbon footprints for both products and orders. Integration of the ClimaTiq API for real-time carbon emission estimation. Implementation of XGBoost- based fallback model to predict emissions when API data is unavailable. Introduction of the Green Points incentive mechanism to promote eco-friendly shopping habits. Promotion of sustainability awareness by incorporating environmental analytics into e-commerce systems.

## 2. RELATED WORK

Research has been done on how sustainability and carbon accounting are connected to digital technologies, however when it comes to actually using these ideas in online shopping systems, it is not very common. Cloud Carbon Footprint did a study in 2020 where they made a tool to track the harmful effects that cloud infrastructure and data centers have on the environment. In this study it was shown how important is it to be accountable about the things we do to the environment when we use computers. They only looked at the computers and servers not at how people buy products online and what happens when we buy

one product or place one order [1]. Nguyen did a study in 2021 where they used machine learning models to guess the product and corporate level carbon footprint. However they did not make a way to use this information in real time dynamic consumer transaction when people are actually buying things online [2].

Liu said in 2023 that people prefer when products have labels that say they are carbon neutral. They are more likely to buy things that are good for the environment if the information is easy to understand [3].

Luccioni et al. in 2023 highlighted the importance of optimizing algorithms and infrastructure for sustainability. This study does not however provide any solution for reducing environmental impact in web based consumer application. EcoMart has implemented optimized algorithms for real-time emission tracking [4].

May also found out in 2023 that using gaming strategies and rewards to encourage people to choose eco-friendly options really works [5]. These discoveries mean that small actions can help make a difference in keeping the planet healthy.

Most studies just provided conceptual ideas and did not give clear plans on how to put carbon information and rewards into online shopping. EcoMart solves this problem by showing real time carbon footprint tracking data through an API and

machine learning based hybrid system and giving out Green Points for buying things that are good for the planet and ecology. EcoMarts approach combines openness about carbon use, with a reward system. It encourages people to make sustainable choices when shopping online.

CarbonCloud proposed an approach in 2024 that uses verified data to estimate carbon footprints across supply chains through CarbonCloud API. They utilize lifecycle assessment data for this purpose [6].

Climatiq also developed a carbon data platform in 2024. This platform is based on Greenhouse Gas Protocol methods. Helps organizations calculate emissions for their digital applications [7].

Around the time, Lang showed that machine learning models can estimate emissions for products with limited sustainability data.

These developments have made carbon estimation more accessible and accurate. However they mostly work as services. They do not solve the problems of adding carbon analytics to e-commerce workflows in real-time[8]. To address this issue EcoMart uses an approach that uses Climatiq API to retrieve emission data and a fallback prediction mechanism powered by XGBoost. This ensures that carbon information is always available during the shopping process.

People like Singh and Sharma looked at how online shopping works and found out that packaging storing things in warehouses and delivering products are big reasons for carbon emissions [9.]

X.He looked into how tracking emissions using green logistics can help online stores be more environmentally friendly[10] There was also a study called "Investigating Consumer behaviour and Environmental Sustainability for the Impact of CO<sub>2</sub>Emission Disclosure on Online Purchases" that showed people are more likely to make choices when they know how much carbon emissions are produced by their online purchases[11]. All these studies show that sustainability is important, for shopping but they do not give solutions that would help consumers see how they are affecting the environment when they shop online and do something about it.

More recent work has moved closer to what we proposed. Eco- Amazon in 2026 introduced an e-commerce dataset that provides information on product carbon footprint and uses AI to estimate carbon emissions. It helps suggest products with carbon footprints using AI-driven estimation techniques to support carbon aware recommendations [12]. Similarly, Carbon-Aware

Sustainable Digital Shopping also came out in 2026. They created a system that can reduce emissions when people shop online. It uses shopper behavior and shows real-time info on sustainability. These new approaches are helpful but do have some limits. They mainly focus on suggesting products or making datasets better. They do not offer a solution for e-commerce[13].

Overall, when you look at what people have researched, implemented or written about this topic you can see that there is a big loop hole in it about making smart online shopping platforms. These platforms should be able to track the carbon footprint of what we buy in time, use machine learning to predict emissions and also get people excited about shopping through gamification. Most of the time people are only looking at one of these things at a time which means we do not have a complete solution that really helps people shop in a way that is good for the planet.

To fix this problem we made this platform, EcoMart. EcoMart is unique because it shows people how much carbon is used to make and deliver the things they buy using the Climatiq API. If we do not have all the information we need to figure out the carbon footprint, EcoMart uses a kind of machine learning called XGBoost to make a good guess. We also want to encourage people to make choices when they shop so we made a reward system called Green Points.

EcoMart brings together multiple things like looking at how people affect the environment using artificial intelligence and trying to change the way people behave all in one platform that is focused on the people who use it. The goal of EcoMart is to make shopping better for the planet and to make it smarter.

### 3. PROPOSED METHODOLOGY

The proposed Eco Mart system was developed as a full stack sustainable e-commerce platform that integrates environmental awareness into conventional online shopping workflows. The methodology adopted for this research combines modern web development practices, real time environment analytics, machine learning techniques and behavioral incentive mechanism to create a comprehensive and user centric solution. Unlike traditional online shopping systems that prioritize primarily, accessibility, cost, competitive pricing, and logistic performance, EcoMart incorporates environmental transparency as a core component of purchasing process by enabling consumers to understand and minimize the environmental impact of their buying decisions.

The development of EcoMart followed an agile software development approach allowing iterative implementation, testing, and refinement of the system components. The system architecture was structured into multiple functional layers comprising, front end interface, backend services, database management system, carbon API integration, and a machine learning prediction module. The front end was developed using React.js and Tailwind CSS to provide interactive, responsive and intuitive usability. Server side functionalities were developed with Node.js runtime environment and Express.js framework. It is responsible for business logic execution, authentication, order processing, carbon data retrieval and communication with external services and APIs. MongoDB was utilized as a primary database for storing user information, product details, order records, carbon footprint values, and green point transactions. The integration of these technologies enabled the development of scalable, efficient and sustainable e-commerce. The multi-layer architecture ensures seamless communication between the user interface, sustainability services, and administrative functionalities.

The distinguishing characteristic of EcoMart is its hybrid carbon estimation framework which combines API driven emission retrieval with machine learning based prediction. Whenever a user views a product or proceeds to check out the system communicates with the ClimaTiq carbon API to obtain carbon emission estimate derived using international Greenhouse Gas Protocol (GHG) methodologies. The retrieved values represent emission associated with the various stages of the product cycle including manufacturing, packaging, transportation, and logistic activities. The resulting carbon footprint information is displayed alongside product details and aggregated during check out to provide user with both product level and order level environmental insights. This approach enhances transparency and empowers consumers to make informed purchase decisions.

To address situations where external carbon data might be incomplete or unavailable Eco Mart incorporates machine learning based fallback mechanism. The fall back model was implemented using the XGBoost regression algorithm due to its ability to handle heterogeneous datasets, capture non linear relationships, and provide robust predictive performance. The model was trained using sustainability datasets containing attribute such as product category, material composition product weight, packaging characteristics,

manufacturing location and transportation mode. The dataset was synthetically created using LCA literature from DEFRA, EcoInvent and openLCA.

The EcoMart system was further organized into 7 major functional modules each designed to address a specific aspect of the sustainable e-commerce implementation. The user authentication and security module manages the registration, login, Password encryption, session handling, and profile management to ensure secure access to platform. The product management module facilitates the addition, modification, categorization, and display of products while maintaining associated sustainability data and carbon emission values. The order management module oversees the complete order life cycle including order placement, status tracking, purchase history maintenance, and the recording of the order level carbon footprint for future analysis.

The carbon footprint tracking module represents one of the primary innovations in EcoMart. This module is responsible for retrieving real-time carbon emission data, calculating cumulative emissions at checkout, visualising environmental impact metrics, and maintaining transparency throughout the consumer journey. Complementing this functionality, we have the machine learning module that provides a dynamic emission estimation whenever API coverage is insufficient. EcoMart uses regression model XGBoost. The green point incentive module introduces the gamified approach to sustainability by rewarding users for selecting products associated with lower environmental impact. Users accumulate green points based on eco friendly purchasing behaviour and these are subsequently redeemed for discounts and platform specific benefits.

The final module that is the admin panel module provides administrators with comprehensive control over platform operations. The administrative dashboard supports user management, product administration, order monitoring, sustainability analytics, reward system supervision, and generation of environmental reports. Through this module administrators can analyze emission trends, evaluate consumer engagement with eco friendly features, monitor green point distribution, and identify opportunities for enhancing the platforms sustainability initiative. The availability of administrative insights contribute to the long term scalability and maintainability of the proposed system while facilitating data driven decision making processes.

The operational work flow of EcoMart begins when the users authenticate themselves and browse products through the web interface. During product interaction, carbon emission values are retrieved through the carbon API or predicted using ML fallback mechanism. Once the product is added to cart, the system aggregates pricing and carbon information to calculate the total environmental impact associated with the purchase. Following successful order placement, green points are allocated to the eligible users based on pre-define sustainability criteria and all transaction records are stored within the database for subsequent retrieval and analysis. This work flow establishes an integrated relation between e-commerce functionality, environmental analytics, predictive intelligence and user engagement strategy.

Through the implementation of these interconnected modules, EcoMart demonstrates how sustainability principles can be embedded directly into digital marketplaces. The proposed methodology does not only support conventional e-commerce operations, but also extends them by introducing real time carbon transparency, intelligent emission estimation, and incentive driven mechanisms aimed at fostering environmentally responsible consumer behavior.

#### 4. RESULTS AND DISCUSSION

The developed EcoMart platform was successfully implemented and tested as a sustainable e-commerce platform that integrates carbon footprint awareness into the online shopping process. The system was able to perform all the core e-commerce functionalities, such as user authentication, browsing products, cart management and order processing, while also providing environmental impact information to the users. During testing, the Climatq Carbon API was able to retrieve real-time carbon emission estimates for products and logistics activities whenever carbon data was available. The emissions values retrieved were displayed with product information, letting users assess the environmental impact of their purchase before proceeding to checkout. The system also calculated the total carbon footprint of an order, increasing transparency and facilitating informed decision making.

One of the main objectives of the research was to guarantee the continuous availability of the carbon footprint information even when the external carbon data were not available. Experimental results showed that the XGBoost-based machine learning model could generate carbon emission estimates based on product attributes, such as category, material

type, weight, packaging features, manufacturing location and transportation factors. The backup mechanism ensured that sustainability information was accessible at any stage of the shopping experience, thereby improving overall system dependability.

A Green Points incentive mechanism was also successfully integrated in the system. Reward points were awarded for choosing products with lower carbon emissions, incentivizing environmentally responsible purchasing behavior. This feature proved the possibility of combining sustainability analytics with gamification techniques to affect consumer choices.

The overall performance of EcoMart shows that the proposed hybrid approach combining real-time carbon data acquisition and machine learning based estimation is effective for sustainable e-commerce applications. The experimental implementation verifies the research objectives and demonstrates that the platform is capable of delivering carbon footprint transparency, intelligent emission estimation, and sustainability-driven user engagement in a single integrated system.

Thus, the results confirm the effectiveness of the proposed methodology and the fact that EcoMart is successful in achieving its goal of promoting environment-friendly online shopping.



Fig.4.1. Interactive Homepage of EcoMart

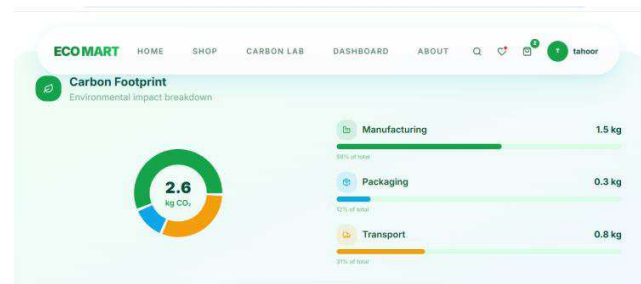
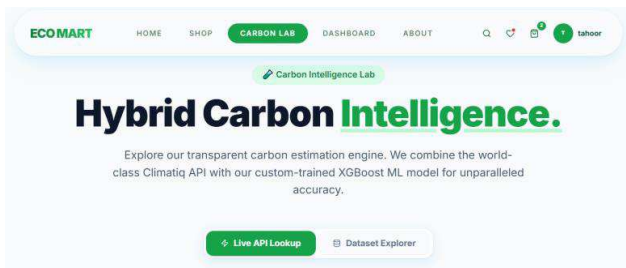
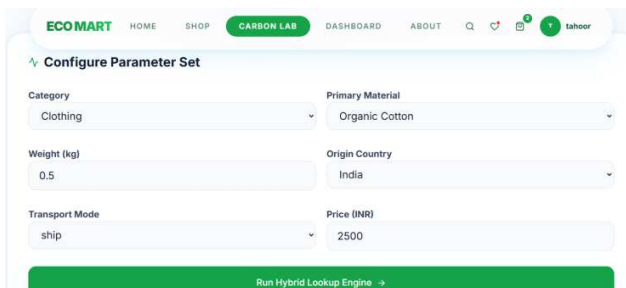


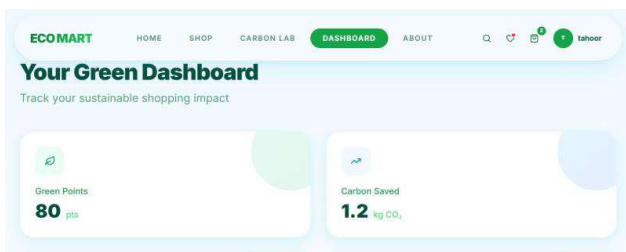
Fig.4.2. Breakdown of products carbon emission.



**Fig. 4.3. A hybrid carbon lookup.**



**Fig. 4.4. Configuring parameters for hybrid lookup.**



**Fig. 4.5. A green dashboard to track sustainable shopping**

## 5. CONCLUSION AND FUTURE SCOPE

This research proposed EcoMart, a sustainable e-commerce platform for integrating the environmental awareness into the online shopping process. The platform integrates traditional e-commerce capabilities with real-time carbon footprints monitoring, emission estimates through machine learning, and a reward-based sustainability model.

EcoMart uses the Climatiq Carbon API, and as a fallback, uses a prediction model XGBoost for carbon emission data when direct sustainability data is not available. The platform offers transparent environmental insights to consumers and rewards eco-friendly buying choices through its Green Points reward system.

The proposed system illustrates how modern web technologies, environmental analytics and machine learning can be combined to build a more responsible and sustainable digital marketplace.

EcoMart is not just about making customers aware of the effects of their purchases on the environment but also about the bigger picture of fostering sustainable consumption and reducing carbon emissions in e-commerce.

Future improvements to EcoMart may include using emerging technologies like blockchain for sustainability verification. This can boost transparency and trust in environmental claims. Smart logistics systems can help optimize delivery routes and cut carbon emissions. Adding AI-driven recommendation systems and environmental analytics can personalize sustainable purchasing decisions and offer deeper insights into consumer behavior and environmental impact. Moreover, developing mobile applications, cloud services, and carbon emission tracking tools can improve the platform's accessibility, scalability, and sustainability. By following green software practices and allowing businesses to include sustainability metrics in their e-commerce systems, platforms like EcoMart can significantly support future smart city projects and promote a green economy through environmentally friendly digital solutions.

## REFERENCES

- [1] Cloud Carbon Footprint, "An Open-Source Tool to Measure and Monitor Cloud Emissions," Cloud Carbon Footprint.org, 2020.[Online]. Available: <https://www.cloudcarbonfootprint.org/>
- [2] Q. Nguyen, "Predicting Corporate Carbon Footprints for Climate Finance Using Machine Learning," *Environmental Modelling & Software*, vol. 158, pp. 106–128, 2021.
- [3] C. Liu, "Consumer Behavior Patterns of Carbon Neutral Label and Its Impacts on Green Purchasing," *Journal of Environmental Economics and Policy*, vol. 12, no. 4, 2023, pp. 221–233.
- [4] A. S. Luccioni, et al., "Estimating the Carbon Footprint of BLOOM: A Large Language Model," *Journal of Machine Learning Research*, vol. 24, pp. 1–45, 2023.
- [5] C. May, "Sustainable Purchasing Behavior and In Store Interventions: Insights for Carbon Labeling," *European Journal of Sustainable Development Research*, vol. 8, no. 2, pp. 55–68, 2023.
- [6] CarbonCloud, "API and Product Carbon Footprint Solutions," CarbonCloud.com, 2024.[Online]. Available: <https://carboncloud.com/api/>
- [7] Climatiq, "Climatiq API Documentation– Accurate Carbon Emission Data," Climatiq.io, 2024. [Online].

Available:<https://www.aps.org/publications/aps/news/201905/physics-history.cfm>

Available:<https://www.climatiq.io/docs>

- [8] S. Lang, "A Simplified Machine Learning Product Carbon Footprint," ScienceDirect, Elsevier, 2024. [Online]. Available:<https://www.sciencedirect.com/science/article/pii/S2666389924000223>
- [9] M. Singh and R. Sharma, "Evaluation of Carbon Footprint of E-Commerce Platforms: A Life Cycle Analysis Perspective," Proc. ICCS Int. Conf. on Computational Sustainability, 2024, pp. 122–130.
- [10] X. He, "How E-Commerce Drives Low-Carbon Development: Mechanisms and Evidence," Sustainability, vol. 17, no. 6, 2025, Art. no.3124–3138.
- [11] "Investigating Consumer Behaviour and Environmental Sustainability for the Impact of CO<sub>2</sub> Emission Disclosure on Online Purchases," Human-Centric Intelligent Systems, vol. 5, 2025.
- [12] "Eco-Amazon: Enriching E-Commerce Datasets with Product Carbon Footprint for Sustainable Recommendations," arXiv preprint arXiv:2602.15508, 2026.
- [13] "Carbon-Aware Sustainable Digital Shopping: A Federated, Behavior-Aware System for Real-Time Basket-Level Emissions Optimization in E-Commerce," ResearchGate, 2026.

