

EcoBoard

A Sustainable Recycling Initiative
for Train Stations



Submitted By:

Benjamin ASARE

Chidinma Chika UKANDU

Emilia Eventus ASUAIKO

UNIVERSITÉ
MARIE & LOUIS
PASTEUR

Contents

Introduction	3
Context	3
Target Audience.....	4
Project Description	5
Impacts and Added Value	6
Artwork and System Diagrams	7
Budget, Financing, and Business Model.....	10
Agenda and Marketing Strategy	11
Conclusion	11

EcoBoard

Introduction

EcoBoard is a European circular-economy innovation, designed to revolutionize the relationship between passengers and the railway ecosystem. The underlying thread of EcoBoard is genuinely simple, yet effective: integrating smart recycling terminals at long-distance train stations, where passengers can deposit recyclable plastics before boarding. These are verified, analyzed, and transformed into reward points that travelers can use in return for traveling incentives. After being collected, the plastics enter a controlled recycling pipeline and go all the way through to the transformation into recycled plastic railway sleepers. By this process, EcoBoard actually links daily passenger behavior to material development in railway infrastructure, creating a closed loop from citizen engagement to sustainable mobility.

The project offers a cultural and operational shift in the mobility landscape by elevating passengers from passive users to active contributors in the green transformation of European transport. It aligns with the European Green Deal, the Circular Economy Action Plan, railway decarbonization efforts, and the broader societal expectation that public infrastructure systems demonstrate measurable sustainability leadership. This report analyzes EcoBoard according to the following elements: context, target groups, system architecture, artwork, budget, impacts, and implementation strategy.

Context

EcoBoard emerges at a time when Europe is undergoing profound economic, environmental, political, and social transformations. Economically, the European Union is prioritizing the development of circular industrial models, resource-efficient production systems, and low-carbon transportation networks. Railway infrastructure remains a strategic asset, yet it is heavily dependent on materials such as hardwood and concrete for sleeper production. With the rising costs of energy, diminishing access to suitable timber, and stricter regulations around environmental degradation, railway operators are increasingly turning to alternative materials. Recycled plastic sleepers have become an attractive solution due to their durability, long lifespan, and compatibility with sustainability objectives.

From a political standpoint, Europe is characterized by strong institutional frameworks supporting recycling, eco-design, and sustainable procurement. Initiatives such as the Circular Plastics Alliance promote the use of recycled plastics across multiple sectors. Plastics Europe provides sector-specific guidance for responsible plastics use, while RREUSE represents an international network of social enterprises dedicated to reuse and waste reduction. Through these networks, EcoBoard enters a landscape where policy, industry, and public institutions are aligned in the

pursuit of a cleaner and more circular economy. It also complements the work of the UIC Sustainability Unit and the European Environment Agency, which guide railway operators towards meeting environmental performance standards.

The environmental context is equally relevant. Europe faces persistent challenges in managing plastic waste. Despite high levels of consumer awareness, contamination, poor sorting, and limited traceability, these factors collectively weaken recycling rates. By intercepting plastics at the moment of disposal, EcoBoard dramatically increases recycling quality and reduces contamination. The shift from timber or concrete to recycled plastic sleepers mitigates resource depletion and reduces carbon emissions associated with traditional sleeper manufacturing.

Socially, European passengers are increasingly interested in engaging with sustainability initiatives integrated into their daily lives. Younger generations in particular value transparency, digital incentives, and quantifiable environmental impact. EcoBoard responds to this trend by allowing passengers to see and measure the positive outcomes of their recycling behavior, thereby reinforcing the social and cultural value of sustainable mobility.

Target Audience

EcoBoard targets passengers of long-distance trains that pass through major European stations. The categories of these passengers could include students, business executives, tourists, or commuters. Several of them wait for a considerable amount of time ahead of their departures, which would be perfect timing to engage them. EcoBoard turns this passive waiting phase of passengers into an opportunity for environmental participation, whereby passengers can engage in a visible and meaningful sustainability activity.

Another core stakeholder group would be the railway operators. The tangible end benefits that they will gain from this are improved customer satisfaction, an improved environmental reputation, and reduced challenges with waste management. EcoBoard enables operators to demonstrate quantifiable achievements in sustainability and strengthens their alignment with EU decarbonization policies.

Recycling companies and sleeper manufacturers benefit by receiving quality, uncontaminated plastic feedstock that reduces processing costs and increases the economic viability of manufacturing recycled products. The project bolsters local recycling economies and supports Europe's industrial shift toward circularity.

Larger ecosystem stakeholders, such as governmental agencies, environmental authorities, and relevant EU-funded programs, also have indirect benefits from the ability of EcoBoard to foster civic engagement coupled with measurable environmental impact. Ultimately, institutions benefit

from gaining a scalable model that furthers European sustainability objectives through public participation.

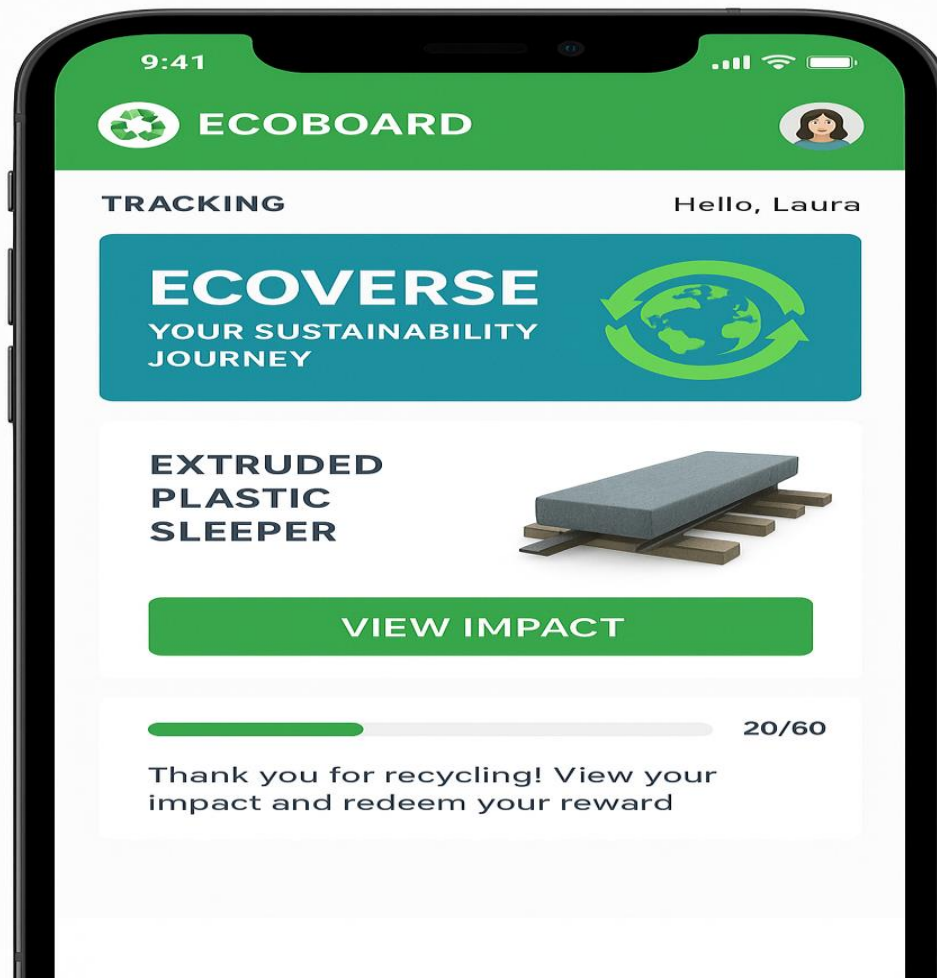
Project Description

EcoBoard is made up of three interconnected components: smart recycling terminals, a digital engagement platform, and a circular material-processing ecosystem. Combined, they will form a closed-loop system, connecting passenger experience to infrastructure development.

These smart recycling terminals are the primary components that users interact with. The passengers authenticate their identity through QR codes, NFC taps, or integration with existing rail operator ticketing systems. In the instance of a passenger depositing a recyclable plastic item, the terminal detects the material type and assesses contamination using optical and near-infrared sensors. Weight sensors detect the quantity of the material, and the internal compartments separate plastics such as Polyethylene Terephthalate (PET), High-Density Polyethylene (HDPE), and Polypropylene (PP). Based on the properties of the material deposited, reward points are assigned, informing the passenger in real time.

The digital engagement platform extends this experience to the passenger's mobile device. Through an intuitive, clean interface, passengers can see their point accumulation, track their environmental contributions, redeem travel-related rewards, and get updates on how their recycled materials are transformed and where those sleepers are installed. Gamification elements, such as weekly rankings that are also made available on station screens, create community participation and reinforce ongoing engagement.

Another integral part of the EcoBoard system is the circular material-processing chain. After being collected, the plastics are transported to certified recycling facilities, sorted, cleaned, shredded, and extruded into pellets. The resulting pellets act as raw materials for manufacturers producing recycled plastic railway sleepers. Sleepers are delivered to infrastructure operators, installed along the railway lines, and their deployment is reported back to the passengers via the EcoBoard platform.



Impacts and Added Value

EcoBoard presents considerable environmental, social, economic, and infrastructural impacts. In environmental terms, the system increases the volume and value of recycled plastics by capturing them prior to contamination. This assurance of better quality from recycling processes contributes to climate goals, reducing reliance on carbon-intensive materials. The transformation of plastic waste into railway sleepers contributes directly to enhancing sustainability in infrastructure development by reducing the reliance on natural resources and lowering lifecycle emissions.

Socially, EcoBoard redefines the passenger experience in that individuals can now contribute directly to public infrastructure. This builds a sense of shared responsibility and fosters a community around environmental stewardship. The transparency of EcoBoard's impact metrics ensures that passengers see tangible results from their efforts, strengthening trust, engagement, and environmental consciousness.

Economically, EcoBoard provides efficiency gains across multiple levels of the rail ecosystem. Cleaner feedstock reduces recycling costs, while long-lasting recycled sleepers' lower long-term maintenance expenditure. The presence of EcoBoard in Stations also enhances passenger loyalty, reinforces brand reputation, and supports operators to meet ESG commitments.

From an infrastructural perspective, EcoBoard contributes to the modernization and circular evolution of Europe's railway system. Recycled sleepers reinforce network durability and link rail development with broader strategies related to sustainability and material efficiency. The value proposition in EcoBoard is the ability to take something completely ordinary, like recycling a bottle, and to make an important contribution to the railway network, creating an emotional and practical bridge between citizens and public infrastructure.

Artwork and System Diagrams

Below are several schematic and conceptual designs to illustrate the architecture of EcoBoard. These diagrams visually describe how materials, information, and user interactions will be processed across the system.

First Diagram: System Flow Diagram - Below is the textual-visual of what this diagram would look like in its final, graphical form.

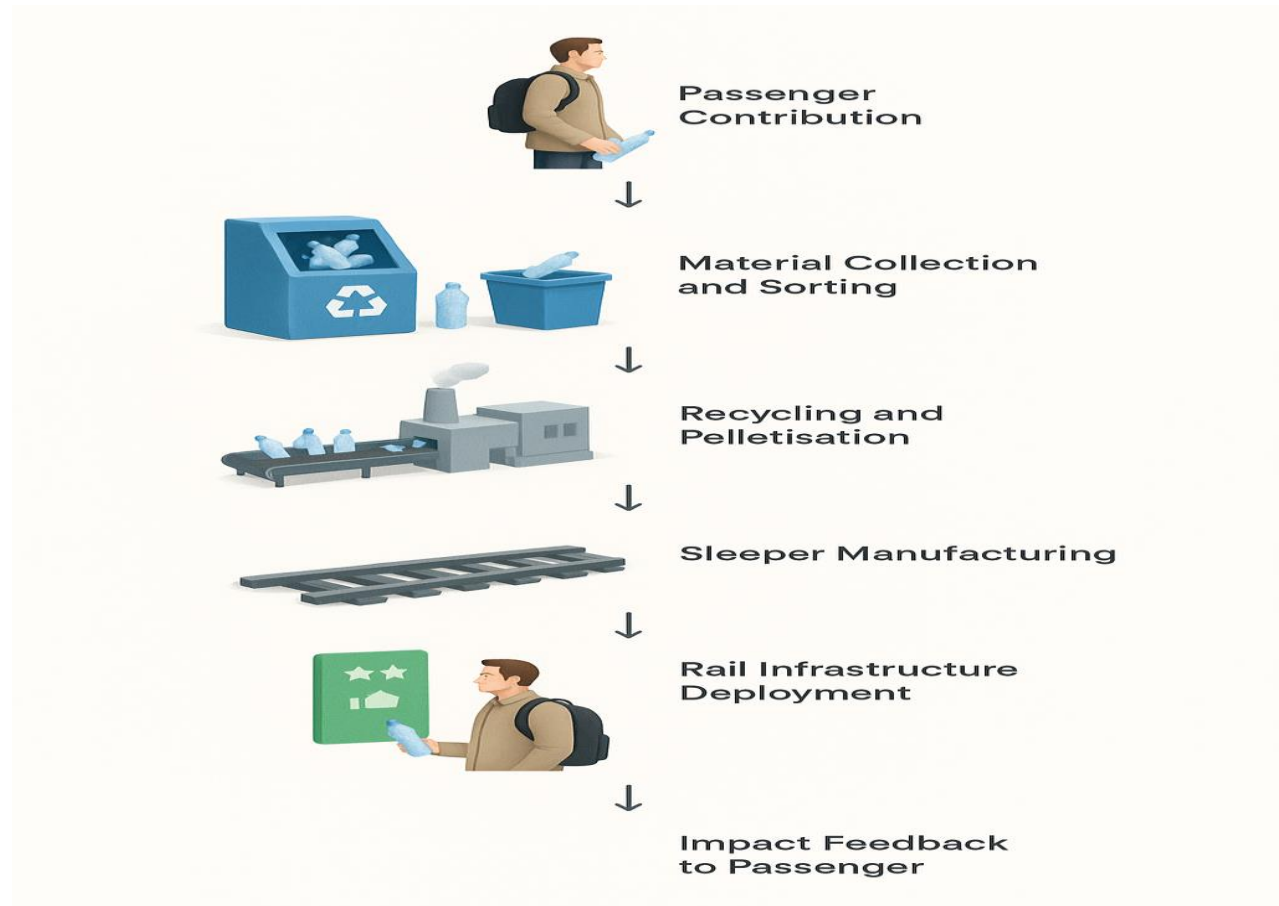
Passenger → EcoBoard Smart Terminal → EcoBoard Cloud Platform → Recycling Facility → Palletization → Sleeper Manufacturing → Railway Infrastructure



This diagram follows the linear flow from user actions to industrial transformation, showing how the contribution moves from a single plastic item to a sleeper installed on a railway track.

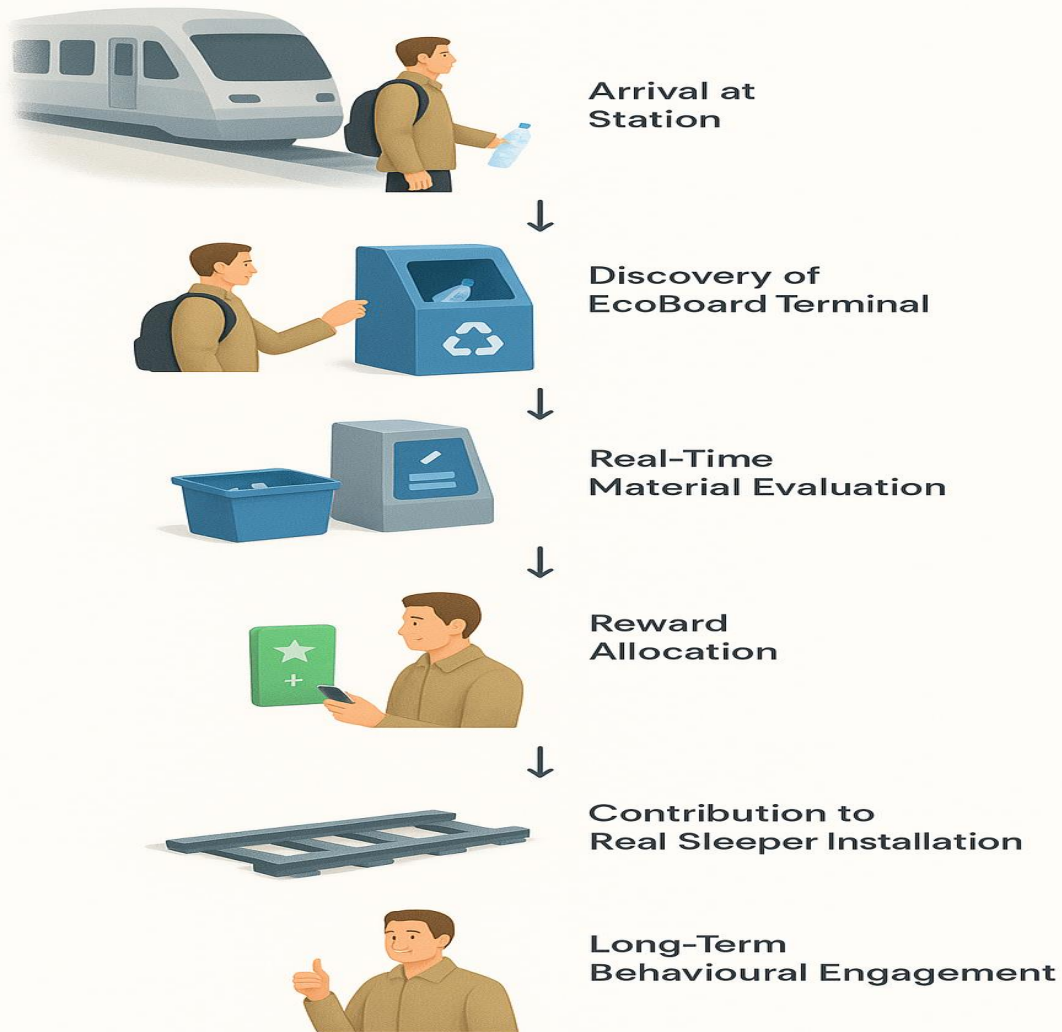
The second example is the Circular Economy Loop Diagram, which communicates EcoBoard's closed-loop sustainability logic:

Passenger Contribution → Material Collection and Sorting → Recycling and Palletization → Sleeper Manufacturing → Rail Infrastructure Deployment → Impact Feedback to Passenger → Renewed Motivation and Re-engagement



This visually strengthens the idea of circularity by displaying how every recycling cycle feeds back into user engagement to form a continuous ecological and behavioral reinforcement system. The third visualization is the User's Journey Diagram: a mapping of the passenger experience as a chronological story:

Arrival at Station → Discovery of EcoBoard Terminal → Authentication and Deposit → Real-Time Material Evaluation → Reward Allocation → Digital Impact Tracking → Contribution to Real Sleeper Installation → Long-Term Behavioral Engagement



Complementing diagrams, the artistic representation of the EcoBoard terminal includes a modern, curved design made of recycled composite materials, a digital interface that communicates instructions clearly, and reactive LED signaling guiding users through the process. The EcoBoard application is envisioned with a minimalist layout featuring circular progress visualizations, impact counters, and interactive maps that show infrastructure built using EcoBoard-collected material. On-site displays boast animated leaderboards and messages about sustainability to reinforce engagement.



Budget, Financing, and Business Model

The financial structure of EcoBoard is based on recurring infrastructure costs, digital platform maintenance, recycling and processing fees, and coordinated manufacturing activities. Initial investment covers the development and deployment of smart terminals, the integration of cloud-based data systems, security frameworks, and multilingual interfaces supporting pan-European expansion. Operational expenditures cover terminal maintenance, data hosting, impact reporting, recycling logistics, and partnerships with manufacturing companies producing recycled sleepers.

EcoBoard's revenue model is based on a combination of licensing agreements with railway operators, subscription access to analytics dashboards, partnerships with environmental organizations, and revenue generated through the sale of recycled plastic pellets. The business model combines technological service provision and circular economy resource management to ensure long-term financial sustainability.

Funding can come from European Union programmes, including Horizon Europe, the Connecting Europe Facility Transport, the LIFE Programme for environment and climate, and national-level circular economy grants. The company can also raise investment in its eco-friendly aspects through ESG-oriented funds, sustainability-focused venture capital, and climate impact investors looking for measurable environmental returns. Also, community crowdfunding campaigns could be a source in early deployment in certain regions as an installation of local participation and reinforcement for public ownership over sustainable infrastructure.

Agenda and Marketing Strategy

Implementation of the EcoBoard occurs in three steps. The first step establishes the technical foundations, proves the feasibility of the system, reinforces institutional alliances, and develops prototype terminals. This stage considers close collaboration with recycling companies, railway operators, and manufacturing partners for standards alignment and operational compatibility.

The second stage is the pilot deployment of EcoBoard terminals in select European cities. The pilot stations will enable the project team to study passenger behavior, improve the performance of the system, assess the rate of contamination, and refine gamification aspects for maximum participation. Station-based storytelling, digital content distribution, and visual display of the transformation of plastic waste into railway materials are the marketing means at this stage.

The third and final phase consists of spreading EcoBoard within Europe, integrating it with national and cross-border rail networks. A large-scale marketing campaign highlights the ecological and infrastructural contributions made possible by EcoBoard itself through social media visibility, animated infographics, public station displays, and institutional partnerships focused on the environment. By continuously communicating the measurable impact achieved by passengers, EcoBoard will build strong, long-term engagement with a shared culture of sustainability.

Conclusion

EcoBoard is much more than a recycling system; it is a game-changing model that redefines how people interact with public infrastructure. By connecting the simple act of recycling a plastic item to the construction of railway sleepers, EcoBoard creates an unparalleled circular link between daily passenger behavior and long-term material impacts. The system leverages technology, behavioral psychology, industrial recycling, and European sustainability policy to create a unified, emotionally resonant solution.

With the ability to boost recycling rates, strengthen environmental awareness, reduce material supply risks, and improve the sustainability profile of railway operators, EcoBoard represents a pioneering model in the field of circular mobility innovation. Its potential for European integration makes it a viable and scalable system with the ability to support the continental shift toward a greener, more resource-efficient future.