Digital technologies for a user-incentivized circularity of packaging

Layman's Report

Project Name: ENABLING DIGITAL TECHNOLOGIES for a USER-INCENTIVISED CIRCULARITY of PACKAGING
Project acronym: LIFE21-ENV-ES-CENTS4PACK
Project Number: 101074234
Duration: July 2022 – March 2025
Total Budget: €1,446,928.90
Coordinating Beneficiary: Valoriza Servicios Medioambientales SA
Other beneficiaries: Recircula Solutions S.L. (Candam Technologies S.L.)
With the support of: Guadalajara City Council

Co-funded by the European Union

Introduction

Every year, **millions of tonnes of packaging waste are generated in Europe**, posing a growing threat to the environment. In response to this problem, the European Union has adopted stricter recycling targets, aiming to recover up to 90% of plastic packaging by 2029 as part of the European Plastics Strategy.
To meet these ambitious goals, many EU countries, regions, and cities have begun exploring new ways to engage citizens in waste sorting and recycling. One such method is the Reward-As-You-Throw (RAYT) scheme, which offers citizens incentives—such as points or vouchers—for recycling properly. Successful RAYT initiatives are already operating across Europe in countries like Portugal, Spain, France, Austria, and the UK.

The CENTS4PACK project was created to support the rollout of these incentive-based recycling schemes. Its main objective was to develop and demonstrate a new technology called **RecySmart**: an intelligent device that can be installed on any urban waste bin and automatically recognize packaging waste such as glass, plastic, metal cans, or carton briks. Using innovative acoustic AI (Artificial Intelligence), RecySmart identifies both the user, and the type of material deposited, making it possible to reward good recycling behaviour in real time.

By combining cutting-edge technology with environmental awareness, **CENTS4PACK aims to make recycling easier, more attractive, and more effective in cities across Europe.**

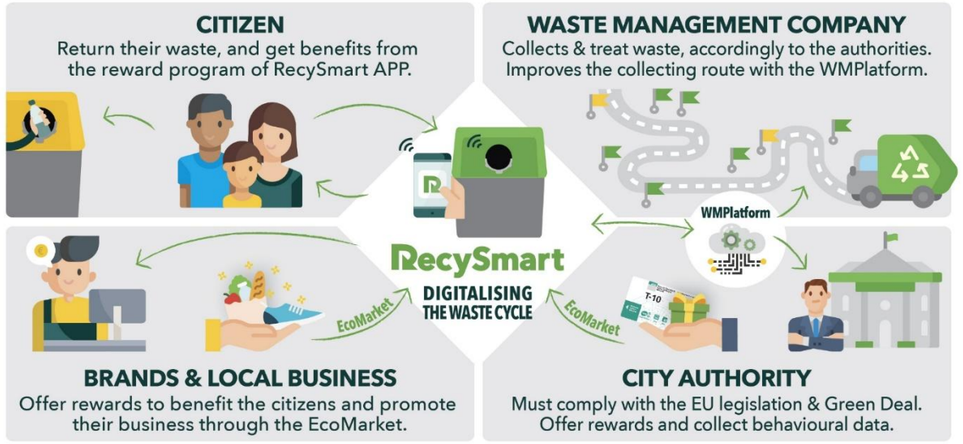
Goals of the project

The main objective of CENTS4PACK was to drive innovation in the waste management sector by demonstrating how advanced technologies—such as IoT and artificial intelligence—can enhance current recycling practices and contribute to a more sustainable and circular economy.

Specifically, the project aimed to:

- Develop and industrialize **RecySmart**, a smart device capable of identifying packaging waste and linking it to the user.
- Deploy and operate **400 RecySmart devices** across the city of Guadalajara, making it the first fully equipped municipality in Europe with a smart RAYT system.
- Encourage citizen engagement and behavior change through a **mobile app** that rewards proper recycling habits.
- Demonstrate the **technical, environmental, and social benefits** of this model under real-life conditions.
- Create a **replicable and scalable solution** that can be adopted by other cities and regions across Europe, contributing to the EU's transition towards smarter, data-driven waste management systems.

Finally, CENTS4PACK will allow the digitization of the waste cycle, bringing **transparency, trust, and efficiency** to all actors involved:



What was done

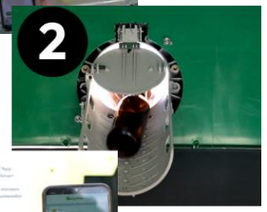
RecySmart: A Complete Smart Recycling EcoSystem

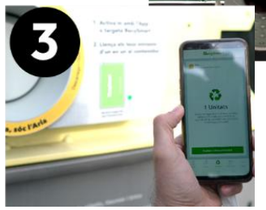
At the heart of CENTS4PACK is **RecySmart**, an innovative smart device that **transforms any waste urban bin into smart**. RecySmart recognizes all types of packaging material —plastic, metal cans, glass, or briks— in real-time with **acoustic techniques combined with AI algorithms**.

Thanks to the support of the LIFE programme, RecySmart was not only developed but also **successfully industrialized**, allowing its large-scale production and installation across the city of Guadalajara.

*"**Adaptable** to any waste bin"*

Side-loading | Crane-lift | Rear-loading | Underground





The system works in **four simple steps**:

1) First, the citizen identifies themselves using the mobile app or an NFC card

2) Once authenticated, they introduce packaging items one by one into the bin. RecySmart's advanced AI and acoustic technology then automatically classifies the packaging material.

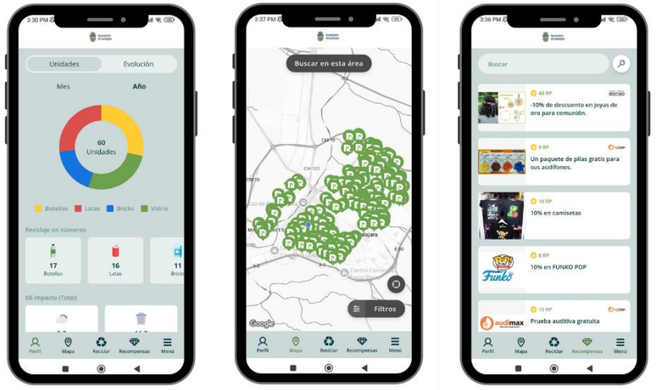
3) If the recycling action has been done correctly, the citizen receives recycling points through the Citizen App, which can be exchanged for discounts or rewards in local shops.

4) Finally, all data is securely transmitted to the cloud platform, where it is processed and made available for municipalities and service providers to track participation, recycling volumes, and environmental impact.

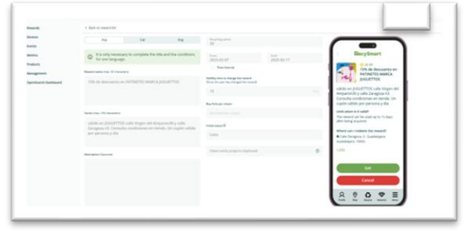
*"RecySmart is a perfect tool that enables local authorities to know **who is recycling and whether they are doing it correctly.**"*
— Jesús David García Galve, Environmental Councillor, Guadalajara City Council

Beyond the hardware, the project also created a **comprehensive digital ecosystem** to support citizen engagement and system management.

1. The **Citizen App** enables users to connect to the device and recycle, track their impact, and redeem rewards easily from their phones.
These tools work together to provide a **transparent and incentive-based recycling scheme**, making participation easy, rewarding, and measurable.



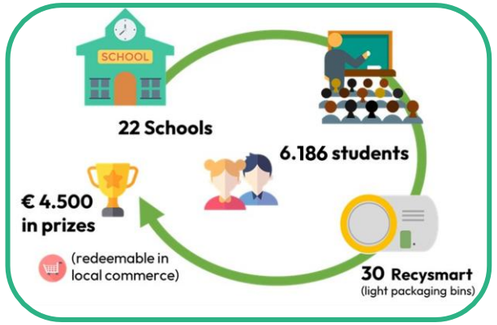
2. The **Ecomarket** is a dedicated space where local businesses can offer discounts and promotions in exchange for recycling points, promoting circular economy and local commerce.



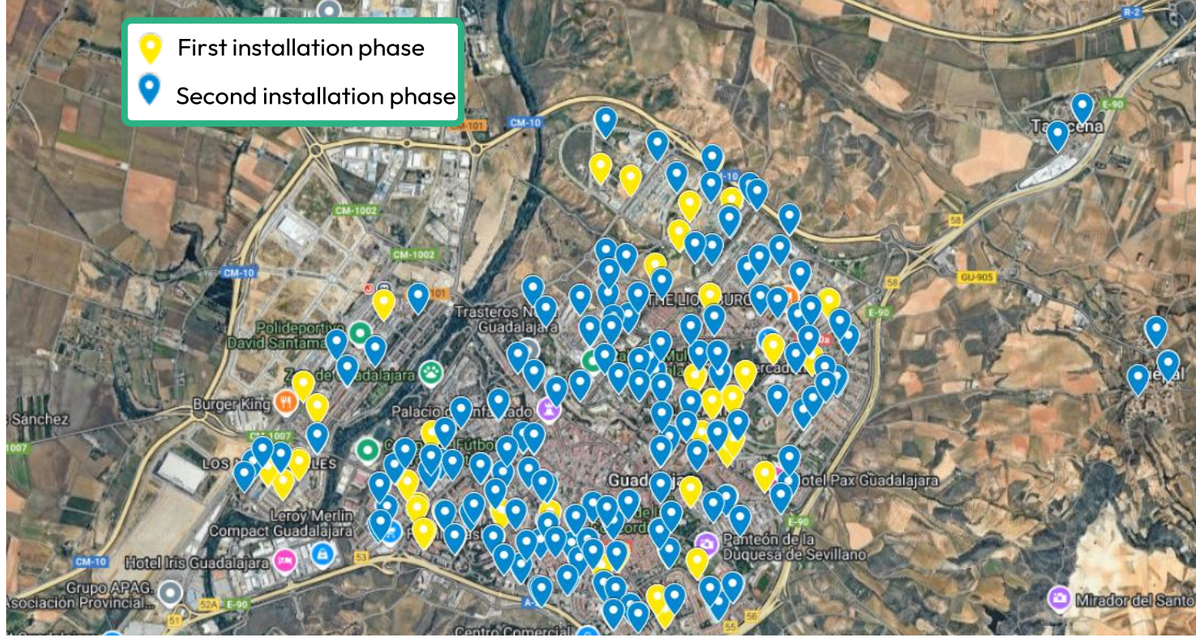
3. The **Backoffice** is a web-based platform that allows municipalities to monitor the system in real time and access detailed analytics.

From pilot to full-scale city deployment

The CENTS4PACK project began with a **pilot phase in 22 schools** in Guadalajara. This first test served to validate the RecySmart technology in a real environment with young citizens. The results were highly positive: students showed enthusiasm for using the device, and the app became a tool for raising environmental awareness in a fun and interactive way. This phase provided crucial feedback for optimizing both the hardware and the user experience.



Building on the success of the pilot, the project moved on to its **main implementation phase**: the installation of **400 RecySmart units throughout the entire City of Guadalajara**, serving a population of over **87,000 residents**. The deployment included light packaging and glass fractions.

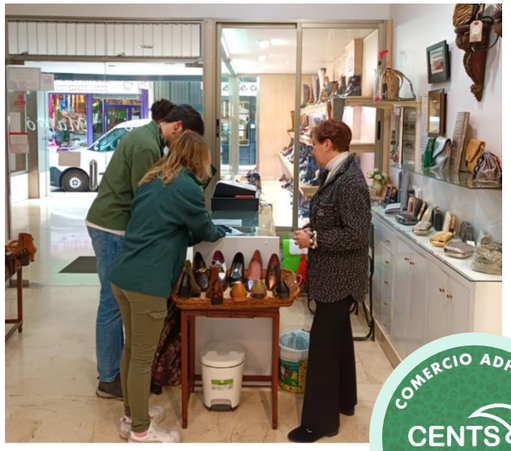


This full-scale rollout marked a **milestone in Europe**, as Guadalajara became the first city to cover all its packaging and glass waste bins with Recysmart devices. Thanks to this initiative, every recycling action in the city could be **tracked and rewarded.**
The collaboration between the city council, waste collection services (Valoriza), and Candam Technologies ensured a smooth integration into existing urban infrastructure.

400 Recysmart installed
(200 light packaging + 200 glass)

Building the Reward-As-You-Throw System

Alongside the full-scale installation of 400 RecySmart devices in Guadalajara, CENTS4PACK launched a local campaign **to activate the reward system and engage the community.**
A team of environmental educators visited shops throughout the city to invite them to join the initiative. Participating businesses offered real incentives — such as discounts and promotions — which were made available on the EcoMarket digital platform. At the same time, a public campaign was carried out in key areas of the city to inform citizens about how to recycle and exchange their points for rewards using the Citizen App.
By combining smart technology with citizen engagement and local business involvement, CENTS4PACK built a fully functional Reward-As-You-Throw scheme that encouraged more sustainable habits while benefiting the local economy.



Citizens' Campaign

Local Shops' Campaign

> *"One of the most remarkable aspects of this project is that it **not only aims for environmental improvement** but also **supports the local economy** through recycling."*
>
> — **Jesús David García Galve**, Councillor for the Environment, Guadalajara City Council

Results & Impact

CENTS4PACK delivered a multi-dimensional impact throughout its implementation. While primarily a technological project focused on developing and deploying an innovative smart device for waste collection, its large-scale deployment in the city of Guadalajara also produced significant environmental, social, and operational outcomes.

From an environmental perspective, the improvements in recycling rates were tangible:

- Light packaging collection increased by 18.1%, resulting in an **additional 175 tons/year** compared to the baseline.
- Glass recycling improved by 3.8%, **adding around 32.4 tons/year.**
- These figures translate into more than **200 tons of CO_2** emissions avoided and **2,314 m³ of water saved**, contributing meaningfully to climate and resource conservation goals.

Figure: Visual comparison between a RecySmart-equipped opening (left) and a conventional opening (right), highlighting the improvement in packaging quality and traceability through controlled deposit.

Results & Impact

Socially, the project directly involved over 3,000 citizens who interacted with the mobile app, earning rewards for their recycling efforts, and more than 60 local businesses who joined the EcoMarket to offer incentives. This collaborative approach not only encouraged sustainable habits but also strengthened ties between residents, institutions, and the local economy.

Technologically, CENTS4PACK proved the viability of integrating artificial intelligence and IoT into daily waste sorting practices. The project culminated in the development and large-scale industrialization of the RecySmart device, which was granted a **European patent in 2024.** This milestone recognized the originality of its acoustic recognition system and validated years of research and technical development.

Dissemination and Communication

The main tools used to publicise the project have been:

- Project websites and social media presence
- Explanatory leaflets for citizens and businesses
- Informational stickers on participating bins and stores
- Videos and audiovisual materials
- Articles in general and sector-specific media
- Coverage in local TV, radio, and press
- Participation in local and international events and fairs

Policy Impact

The CENTS4PACK project has contributed to the transition towards smarter, more transparent, and more efficient waste management practices, aligning closely with both European and national legislation. Its core technological solution, RecySmart, supports the implementation of policy instruments such as Pay-As-You-Throw (PAYT) and Deposit Return Schemes (DRS/SDDR), which are expected to become mandatory across Spain and other EU countries in the coming years.

At the European level, the project supports the objectives of the **Waste Framework Directive (2018/851)**, the **Single-Use Plastics Directive (2019/904)**, and the upcoming **Packaging and Packaging Waste Regulation (PPWR)**. These instruments call for higher packaging recovery rates, improved traceability, and greater involvement of citizens through Extended Producer Responsibility (EPR) schemes.

At the national level, **Spanish Law 7/2022** mandates the implementation of **PAYT systems by 2025**, while **Royal Decree 1055/2022** sets the basis for a **national SDDR** in case current recovery targets are not met. RecySmart offers municipalities the technical capacity to respond to these regulatory challenges by enabling accurate tracking of individual recycling behavior, integrating incentives, and facilitating compliance through robust data reporting.

Thanks to its modular design and user-friendly approach, the RecySmart system has proven to be an effective tool to support local authorities and waste managers in achieving recycling goals, fostering citizen participation, and preparing for upcoming legislative obligations. In this way, CENTS4PACK has positioned itself not only as a technological innovation but as a scalable policy enabler.

As highlighted by Jesús David García Galve, Councilor for the Environment at Guadalajara City Council:
*"The City of Guadalajara intends to use RecySmart to gather data on citizens' recycling behavior, to offer **waste fee discounts** and move toward what we call a '**fair waste tax**'."*

Long-Term Vision and Environmental Benefits

Beyond its successful implementation in Guadalajara, CENTS4PACK has laid the foundation for future growth. Several municipalities across Spain—including Santander, Galapagar, Torrelavega, and Tenerife—are preparing to adopt the RecySmart system as part of their long-term waste management strategies.

This scalability is expected to multiply the project's environmental benefits over time. Within three years, based on the planned replication and deployments, the projected impact includes:

Impact Type	Beyond 3 Years
Water Saving	28,644 m^3/year
Increase in Recycling Rates	+2,170 tons of light packaging, 401 tons of glass
Reduction of Greenhouse Gas Emissions	2,489 tons CO_2 eq/year

These figures highlight the long-term sustainability of the CENTS4PACK model. Through continued replication and refinement, the RecySmart system will help cities transition toward greener waste management systems that are fully aligned with circular economy principles.

CENTS 4 PACK

ENABLING DIGITAL TECHNOLOGIES FOR A USER-INCENTIVISED CIRCULARITY OF PACKAGING

Ayuntamiento de Guadalajara

candam TECH

VALORIZA

More information at:

- https://www.valorizasm.com/es/proyectos/cents4pack
- cents4pack.com

Co-funded by the European Union