The URBANRec Project:

New approaches for recovery of urban bulky waste to create high added-value recycled products

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Figure 1: URBANREC scheme

Introduction

Despite continuous advances in municipal waste management, there are still several waste streams that offer limited opportunities for material recovery and thus end up in landfills and incineration plants. One of these challenging streams is bulky waste, defined by the URBANREC project as "(Mixed) Waste from households and similar waste from companies that does not fit (because of its size, shape or weight) in the regular receptacles used for household waste collection."

Bulky waste includes furniture, mattresses, upholstery, garden and outdoor furniture, and other large fixtures and fittings. The European Union generates 19 million tonnes per year and more than 60% of this bulky waste is currently landfilled (some 11.5 tonnes according to WRAP-UK).

Bulky waste is a challenging stream for various reasons. Its bulkiness makes logistics complicated and bulky waste includes very heterogeneous products and materials that require either an effective source-separation system or the right sorting technology. Many items managed as bulky waste are also composite products (e.g. sofas made of wood, textile and foam) that require a dismantling process to recover their individual materials. Other challenges include the lack of stringent regulations and the scarcity of market outcomes due to the lack of cost-effective recovery methods, among other reasons.

This implies significant environmental impacts and the loss of resources that could be reused. A comprehensive solution is therefore required based on a circular economy approach.

In this context, the URBANREC project has developed and implemented a comprehensive eco-innovative bulky waste management system (to enhance prevention and reuse, improve logistics and develop new waste treatment methods to obtain high added-value recycled products) and has demonstrated its effectiveness in different regions. The reuse and recovery routes considered in the project include:

- rebonding and chemical solvolysis of PUR materials to prepare renewable adhesives and help with the preparation of PU foams (top foam mattresses and insulation panels) with renewable materials
- production of needle felt from textiles to obtain fabrics for use in the mattress industry and insulation panels for use in the construction industry
- production of fibre-reinforced composites from textiles
- manufacture of wood-plastic composites (WPC)
- the catalytic hydro-gasification plasma process for hard plastics and wood to obtain chemicals and fuel.

URBANREC aims to provide a basis for the development of a global EU framework on bulky waste and to collaborate on the definition and support of future EU legislation on urban bulky waste management.

As previously explained, four different territories are involved in the URBANREC project, each of which aims to improve its own bulky waste management. Each territory's status quo at the beginning of the project was established in URBANREC deliverable D1.1 (available online).

These four territories are quite different, yet are representative of the different scenarios in Europe:

- **Izmir Province** is located in Western Anatolia on the Aegean coast. Its climate is Mediterranean. It encompasses 30 districts (11 of which are in the metropolitan area and 19 of which are rural municipalities) and one metropolitan municipality. Its total population is about 4.32 million inhabitants.
- **The Valencia Region** is located in South-Eastern Spain. It is divided into three separate provinces, from north to south: Castellón, Valencia and Alicante, with a total area of 23,255 km². With 4,953,482 inhabitants, it is the fourth most populated region in Spain after Andalusia, Catalonia and Madrid.
- **Warsaw** is the capital and largest city in Poland, with a population of about 1,735,000 inhabitants, and a density of about 3,355 inhabitants per square kilometre.
- **The Flemish Region**, a low-lying territory with a coastline along the North Sea, occupies Northern Belgium and covers an area of 13,522 km² (44.29% of the country). It is one of the most densely populated regions in Europe with 477 inhabitants per square kilometre. The Flemish Region comprises five provinces, each consisting of administrative arrondissements that, in turn, contain municipalities (a total of 300 municipalities in Flanders as of 1 January 2019).

Figure 1: URBANREC Territories

URBANREC partners

URBANREC project partners represent the whole bulky waste value chain, thus ensuring the success of the project and its subsequent implementation at EU level. The URBANREC consortium has a well-balanced composition (of the 21 partners from seven countries, five are RO, seven SMEs, two large IND and seven other). It brought together a wealth of expertise and resources within the areas of global bulky waste management. This value chain approach pulled the critical mass of complimentary resources that enabled the URBANREC project to achieve its targeted organisational, technological, industrial and societal breakthroughs and ensure its commercial success.

The RO Partners (AIMPLAS, Fraunhofer-ICT, Centexbel, IOŚ-PIB and İYTE) had the necessary research expertise and has provided the SME partners with support to achieve their objectives. The SME partners (IZNAB, Ecofrag, BPP, RESCOLL, Procotex, Eurospuma and Delax) and Large IND partners (RAMPF, Vanheede) provided the fundamental knowledge, technologies and expertise required to achieve the project objectives, as their activities within the project were fully in line with their own core business and research strategies. Moreover, public urban amenity sites from the two selected regions (IMOG, Consorcio), together with the relevant local authorities from all four countries (OVAM, DV, the Capital City of Warsaw Municipal Waste Management Department and Bornova), interacted and implement the innovative waste management routes described in URBANREC and provide legislators with input on bulky waste management in the selected regions, thus providing a platform for further regulation and exploitation in industries throughout the EU with the aim of supporting the project's continued success. Another partner, ACR+, an international technical network with about 90 members covering more than 1,000 local and regional authorities active in the field of waste management, provided essential support for data collection, as well as project communication and dissemination. The consortium was fully committed to the project and capable of achieving the objectives and exploiting the results. The URBANREC project must not overlook another key player: citizens. Their participation in the management of bulky waste and delivering it appropriately promise further optimisation in terms of recovery.

URBANREC results

The URBANREC project finished in November 2019. It obtained good results in different areas and achieved the objectives specified at the beginning of the project. These objectives focus on technical and nontechnical developments to be applied in bulky waste management systems adapted to the economic, social and geographic conditions of different European regions.

Reuse and collection systems

According to the Waste Framework Directive (WFD), reuse consists of "any operation by which products or components that are not waste are used again for the same purpose for which they were conceived." Reuse can be directly applied to a product (e.g. donation or sale of second-hand products between two people) or made possible after a product that has become waste undergoes "preparation for reuse", which involves "checking, cleaning or repairing recovery operations" that will make its reuse possible.

Reuse and preparation for reuse are placed above recycling in the WFD's waste management hierarchy and are regarded as preferable options when it comes to bulky waste management. Besides the positive environmental impact of reuse, which curbs the production of new items to replace second-hand products, it helps create local, low-qualification jobs, often within the context of the social economy. It also generates second-hand products that are more affordable for low-income households. Reuse centres, therefore, serve both an environmental and a social purpose.

Bulky waste management strategies should thus identify the possibility for reuse and make sure they include a collection and management system that helps optimise the items sent for reuse and preparation for reuse while ensuring the quality and reusability of the items in these streams.

A proper collection system is a key element for product reuse. The collection system should preserve the integrity of the product, optimise the items collected, and ensure that they are reusable (or possibly repairable) and can then be sold.

Dismantling is a new service developed by IMOG within the framework of the URBANREC project. It has two objectives: to offer a complete dismantling service to residents and to collect more products for reuse.

The service involves removing the entire furnishings of a house (e.g. in the event of death or relocation). Residents call the service and an employee is sent to assess the reusable furniture and the time needed to empty the house. If more than four or five of the items are reusable, the service is provided free of charge. If the resident agrees, a date for dismantling is scheduled. The service includes the following steps: emptying closets and packing items, dismantling furniture, and taking reusable items to the reuse centre and waste to IMOG's facilities.

The Hangaar project, a **new system to enhance reuse in the Flanders** region, was also implemented with good results to give items a second opportunity through reuse and contribute to social inclusion.

Some reusable items may not be suitable for reuse shops because they are not quite perfect or there is little demand for them. To overcome this challenge, IMOG launched a new collaborative network called Hangaar made up of different organisations such as charities, social enterprises, second-hand shops and art schools. The network took the form of a physical warehouse where the people who belonged to the network

Figure 12: CONSORCIO CA site container prepared for reuse

Figure 13: Mobile application

Figure 14: Customer portal

could go once a month to buy items that were not good enough for reuse shops. The warehouse handled items not sold at reuse shops, as well as items with imperfections that were still functional. Prices were very competitive. The network also organised activities such as workshops and repair cafés by targeting residents and students. Through the Hangaar project, an additional 106 tonnes of bulky items were reused between December 2017 and October 2019.

The URBANREC Spanish partners also developed a strategy to boost reuse in their territory, thanks to the transfer of experience from the Belgian partners. One of the actions implemented was a reuse container successfully installed in the civic amenity (CA) site in Llíria in March 2018.

The container was brought to the premises of the Fundació Tots Units, a social economy company with which Consorcio has an agreement to manage the materials available for reuse. This experience had a positive impact on the visibility of the collected materials.

Furthermore, in Flanders, an **app was developed** with information about bulky waste collection/treatment, as well as an innovative service for bulky waste collection. A customer portal service was implemented at the CA site to help reduce bulky waste from becoming mixed with other waste by including information about costs and encouraging people to sort their own waste. These developments were evaluated in other regions and implemented according to each region's requirements. For example, **the first CA site was installed in Turkey**.

Following the implementation of a new waste collection system and promoting source-separation in Warsaw, new collection systems for bulky waste were developed, including the implementation of two civic amenity sites and five mobile civic amenity sites, as well as on-demand services. In 2018, the City of Warsaw started a cooperation agreement in the field of R&D activities with the Faculty of Design at Warsaw's Academy of Fine Arts. The objective was to develop study projects on industrial-scale recycling of cabinets for reuse and excellent results were obtained.

Reuse and Recovery Routes

Within the framework of the URBANREC project, a fragmentation technology was developed by Ecofrag to dismantle mixed bulky waste and extract valuable materials for recycling such as textiles, foams, metals, plastic and wood. The process uses laminated cutting technology for grinding and high-pressure waterjet cutting on the materials. For plastic fragmentation, a different technology was required. This was developed by URBANREC partner Vanheede and tested on actual samples of hard plastic collected in Flanders. These fractions of bulky waste are composed of different polymer types (including PP, PE, PVC, ABS, PS, PA, PC and PMMA) on the one hand and different production types (extrusion, blow moulding and injection moulding) on the other. They are also contaminated with materials such as metal, wood and stone. As part of the URBANREC project, waste materials from bulky waste are fragmented and turned into raw materials for newly developed reuse and recovery routes.

Innovative treatments were demonstrated to obtain raw materials from bulky waste, fragmentation and shredding technology. The waste materials obtained were processed along different reuse and recovery routes (e.g. solvolysis, rebonding, wood-plastic composites, textile technologies, compounding and injection). Any waste materials that could not be used directly in these routes due to their lack of homogeneity were subject to an innovative reuse and recovery process known as catalytic hydro-gasification with plasma (CHGP). Finally, several demonstrators were obtained within the project for turning waste material from bulky waste into new products that meet market demand. The following demonstrators were developed:

- Foam core layer—Delax and AIMPLAS
- Foam top layer—RAMPF, ICT and Eurospuma
- Foam mattress—Delax
- Adhesives—RAMPF, ICT and RESCOLL
- Needle felts—Procotex and Centexbel
- Fibre-reinforced composites—Vanheede and Centexbel
- Wood-based composites—Vanheede and İYTE
- Methylal—BPP
- Insulation panels made of textile fibres—Procotex
- Insulation panels made of PUR foam—RAMPF

Taking into account the implementation of these innovative treatments and reuse and recovery routes, a life cycle assessment (LCA) was performed for each region and a CO2 emission reduction of more than 20% was obtained in each one.

Transfer activities

It is worth highlighting all the transfer activities carried out since the project began.

Educational activities were implemented after being adapted to the specific needs of the regions and communities. Some were tailored for municipal authorities (OVAM) while others (focusing mainly on URBANREC project objectives and recycling and waste-sorting principles) were developed for a large group of city residents (URZAD Warsaw). Complex actions on recycling, climate change and waste management issues for students (Bornova) were also undertaken. In other cases, activities involved teaching schoolchildren and their families about proper bulky waste disposal methods, thus spreading the idea that bulky waste must be disposed of properly to be recycled, and that these practices will promote the use of materials and their transformation into new products so that bulky waste is not routinely dumped into landfills (DV).

Additionally, two guides were completed: the **Eco-Design Guide** and the **Guide on the URBANREC Bulky Waste Management System**, which includes 15 recommendations for future legislation on bulky waste management systems at EU level. These guides are meant for public authorities and waste companies in charge of managing urban bulky waste. They provide a comprehensive presentation on the main outputs of the URBANREC project and information for implementation

Scheme of legal recommendations addressed in URBANREC project

of the URBANREC bulky waste management solutions. The guides include an overview of bulky waste in Europe, present data and information collected during the project, and provide a list of conclusions that can help improve bulky waste reuse and recycling rates.

Both guides are available in an **interactive tool** developed to help end-users understand the results of the URBANREC project and their practical applications. This tool is designed for public authorities, waste managers and industry. The fully operational tool is accessible at: https://urbanrec-project.eu/tool.php

Image: Installation panels - PROCOTEX

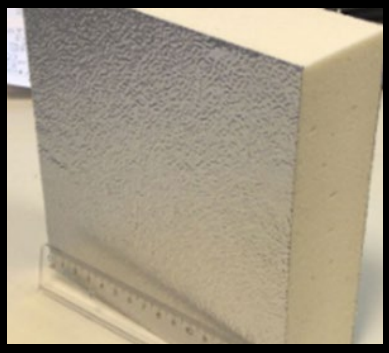

Image: Insulation panels - RAMPF

Image: Chair - VANHEEDE-IYTE

- Access to reusable items by professionals of re-use activities
- Exemption to environmental permitting for re-use activities
- Support the development of GPP criteria for bulky items
- Support of social enterprises via social clauses in tenders
- Using VAT

SUMMARY

The main objective of URBANREC has been to implement an eco-innovative and integral bulky waste management system (enhancing prevention and reuse, improving logistics and allowing new waste treatments to obtain high added value recycled products) and demonstrate its effectiveness in different EU regions: Northern, Mediterranean, Eastern and South-eastern areas in Europe, represented in URBANREC by three EU-28 countries and Turkey.

PROJECT LEAD PROFILE

AIMPLAS is the coordinator of URBANREC project. AIMPLAS is a non-profit research organisation that aims to operate as a technology partner for companies in the plastics industry, and offers comprehensive, customised solutions by coordinating research, development and innovation projects, as well as technological services (analyses and testing, technical assistance, training and competitive and strategic intelligence). AIMPLAS helps companies in the sector integrate circular economy criteria into their business models and turn the legislative changes that affect them into opportunities to improve efficiency and profitability and reduce environmental impact. AIMPLAS also undertakes research in areas such as recycling, biodegradable materials and products, and the use of biomass and CO_2.

PROJECT PARTNERS

RO Partners (AIMPLAS, ICT, CENTEXBEL, IOŚ-PIB and IYTE), together with ACR+, SME partners (IZNAB, ECOFRAG, BPP, RESCOLL, PROCOTEX, EUROSPUMA and DELAX) and Large IND partners (RAMPF, VANHEEDE), public urban amenity sites from the two selected regions (IMOG, CONSORCIO) together with the correspondent local authorities from the four countries (OVAM, DV, The capital city of Warsaw-Municipal Waste Management Department, BORNOVA).

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