

Plastics Recycling Update: Technology Edition

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

Although urban areas account for just 4% of the total area of Europe, almost 75% of EU citizens live in cities and urban areas, a figure that is expected to reach 82% by 2050. Cities require energy and resources to sustain life and, as a result, they generate waste that has an environmental impact on surrounding areas and the rest of the world. The right comprehensive waste management system is required to prevent further environmental and social problems in the near future and bring about sustainable growth in urban areas across the world.

In this context, bulky waste represents a challenging stream for a number of reasons: first, its bulkiness creates logistical problems. Second, bulky waste includes very heterogeneous products and materials that require either an effective source-separation system or the right sorting technology. Many items treated as bulky waste are also composite products (e.g. sofas made of wood, fabric and foam), which require a dismantling process to recover the individual materials. Other challenges include the lack of stringent regulations and the scarcity of market outcomes due to factors such as the lack of cost-effective recovery methods.



Figure 1. Kerbside collection of bulky waste.

Accordingly, bulky waste streams provide limited opportunities to generate value for EU society and therefore end up in landfill or incinerators. This creates significant environmental impacts, including increased CO₂ emissions, and leads to a loss of resources that could be recovered. Today's society demands a bulky waste management system that can help create value from waste by enhancing reuse, turning waste materials into secondary raw materials and creating innovative sustainable solutions and new jobs; in other words, a comprehensive solution that favours a circular economy approach.

With this in mind, the URBANREC project has developed 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 EU regions: Northern Europe, the Mediterranean, Eastern Europe and Southeastern Europe, represented in the URBANREC project by three EU countries and Turkey. These countries represent the different scenarios at European level for the evaluation of the activities proposed as part of the URBANREC project.

These four territories are quite different:

- **İzmir Province** is located in western Anatolia on the Aegean coast. It has a Mediterranean climate. 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 Valencian Community** is located in Southeastern Spain. It is divided into three separate provinces. These are, from north to south, Castellón, Valencia and Alicante. The region has a total area of 23,255 km² and 4,953,482 inhabitants, making it the fourth most populous in Spain, after Andalusia, Catalonia and Madrid.
- **Warsaw** is the capital of Poland and the country's largest city, with a population of about 1,735,000 and a population density of about 3,355 inhabitants per km².
- **The Flemish Region**, a low-lying territory with a North Sea coastline, occupies the northern part of Belgium and covers an area of 13,522 km² (44.29% of Belgium). It is one of the most densely populated regions of Europe, with 477 inhabitants per km². The Flemish Region comprises five provinces, each consisting of administrative arrondissements that, in turn, contain municipalities (as of 1 January 2019, there were 300 municipalities in Flanders).



Figure 2. URBANREC scenarios at European level.

The URBANREC project partners represent the entire bulky waste value chain, thereby ensuring the success of the project and its subsequent implementation at EU level. The URBANREC

consortium brought together a wealth of expertise and resources within the areas of global bulky waste management. The RO Partners (AIMPLAS, Fraunhofer-ICT, Centexbel, IOŚ-PIB and IYTE) had the necessary research expertise and supported the SME partners in achieving their objectives. The SME partners (IZNAB, Ecofrag, BPP, RESCOLL, Procotex, Eurospuma and Delax) and Large IND partners (RAMPF and Vanheede) provided the fundamental knowledge, technologies and expertise required to achieve the project objectives, since 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 and 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 implemented the innovative waste management routes described in URBANREC. They also provided 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 and covering more than 1,000 local and regional authorities active in the field of waste management, provided essential support in the areas of data collection and project communication and dissemination. The URBANREC project successfully included another key player: citizens. Their participation in bulky waste management and collection will help ensure further optimization in terms of recovery.



On the whole, the URBANREC project has provided the basis for the development of a global EU framework on bulky waste and for collaboration on the definition and support of future EU legislation on urban bulky waste management.

From a global management point of view, one of the goals of the URBANREC project was to improve logistics by implementing collection and reuse. Important results were achieved in this area:

- A **new dismantling service** was developed by IMOG with two objectives: to offer residents a complete dismantling service and to collect more products for reuse.
- A **new system to enhance reuse in Flanders**, the HANGAAR project, was also implemented with good results. This system was designed to give items a second opportunity through reuse and to contribute to social inclusion.
- URBANREC's **Spanish partners** also developed a strategy to **boost reuse** in their territory.

- 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 also implemented at the CA site.
- **The first CA site was installed in Turkey.**
- **Source separation was promoted in Warsaw** and new collection systems for bulky waste were developed.

With respect to recovery, URBANREC focused on the following raw material streams: PU foam, mixed hard plastics and mixed textiles. These streams are currently not recycled due to lack of eco-innovative, cost-effective solutions and the challenges associated with finding end-use applications. It also focused on wood, which accounts for most bulky waste. **Innovative treatments** based on fragmentation and shredding technology to obtain raw materials from bulky waste were demonstrated: ECOFRAG technology, which is mainly for foam and textiles, and VANHEEDE technology, which is for hard plastic and wood.



Figure 3. Images of raw materials from bulky waste and some of the demonstrators obtained.

The waste materials obtained were used in different recovery routes, including 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 recovery process known as catalytic hydro-gasification with plasma (HCGP). Finally, several demonstrators were obtained as part of the project for turning waste material from bulky waste into new products to meet market demand. The following demonstrators were developed:

- FOAM CORE LAYER (by DELAX and AIMPLAS)
- FOAM TOP LAYER (by RAMPF, ICT and EUROSPUMA)
- FOAM MATTRESS (BY DELAX)
- ADHESIVES (by RAMPF, ICT and RESCOLL)

- NEEDLE FELTS (by PROCOTEX and CENTEXBEL)
- FIBRE-REINFORCED COMPOSITES (by VANHEEDE and CENTEXBEL)
- WOOD-BASED COMPOSITES (by VANHEEDE and IYTE)
- METHYLAL (by BPP)
- INSULATION PANELS MADE OF TEXTILE FIBRES (by PROCOTEX)
- INSULATION PANELS MADE OF PUR FOAM (by RAMPF)

Recovery routes were optimized and final data for economic and environmental analyses obtained. During the last stage of the project, **environmental, economic and social analyses were performed**, and the findings demonstrated that the URBANREC solutions are economically viable; CO₂ emissions were cut by 20% when the URBANREC management system was implemented.

With respect to transfer activities, the URBANREC project also included an assessment of the current situation in the four areas selected and the definition of educational programmes tailored to each region to encourage citizens and urban traders to participate in bulky waste management in collaboration with the local authorities involved in the project (OVAM, DV, URZAD and BORNOVA). The assessment encompassed the whole chain, including prevention, collection, sorting, reuse, recycling, final treatment and information campaigns to raise awareness of bulky waste prevention and collection.



Figure 4. Images of different educational programmes implemented as part of the URBANREC project.

Two guides, **the Eco-Design Guide and the Guide to the URBANREC Bulky Waste Management System**, which includes a definition of bulky waste and **legal recommendations proposed for future legislation**, were completed and are available for public consultation.

Harmonised definition of bulky waste	Addressing hazardous
Promoting preserving collection for re-use and collection for recycling	Extended warranty for products
Separate quantitative target for preparing for re-use	Mandatory information on products and substances
Minimum recycled content	Standards and certification
Extending ecodesign Directive to bulky products	Extending Ecolabel to bulky items and re-use

Figure 5. Table of legal recommendations addressed by the URBANREC project.

The definition of bulky waste proposed by URBANREC is as follows:

‘Bulky waste’ is (mixed) waste from households and similar waste from companies that does not fit (because of its size, shape or weight) in the regular containers used for household waste collection.

Bulky waste includes items made of mixed materials such as furniture, mattresses, fixtures and fittings, upholstery and carpets, as well as single-material items such as rigid plastic, latex, wood, metal, fibre, leather and glass.

Construction and demolition waste, inert waste and waste for which there is EU waste management legislation (e.g. packaging, WEEE and batteries) are excluded from the definition of bulky waste.

The definition of bulky waste does not depend on the method used to collect this type of waste (kerbside collection, civic amenity site, etc.).

At the moment, bulky waste is not directly addressed in the Waste Framework Directive. It is mentioned in the section on municipal waste, so it is indirectly associated with the target set for municipal waste recycling, i.e. 50% of municipal waste must be recycled in each EU member state by 2020. The revision of the Directive has given rise to new targets, i.e. that 55% must be achieved by 2025, 60% by 2030 and 65% by 2035. The Circular Economy Package also set a target on the landfilling of municipal waste, i.e. that no more than 10% of municipal waste should go to landfill by 2030.

At EU level, the only regulation that indirectly addresses bulky waste is the WEEE Directive (2012/19/EU). Even though WEEE is not included in the scope of the URBANREC project, large WEEE is regarded as bulky waste in many territories, and some WEEE might still be collected with the mixed bulky waste stream. Therefore, the WEEE Directive has an impact on local bulky waste management schemes. It sets targets for the collection rate of WEEE for each of the 10 WEEE categories. Each member state transposed the Directive in different ways, thereby regulating the responsibilities of manufacturers, authorities, retailers and other stakeholders. The legal framework and general organization of bulky waste management in the four URBANREC territories are quite heterogeneous and offer a good overview of the different situations across Europe. This information was compiled at the beginning of the project and is included in the Guide to the URBANREC Bulky Waste Management System, which is available for consultation.

An **interactive communication tool** is available to allow citizens, local authorities and the general public to consult e-learning modules and information. The main results of the URBANREC project were presented during the **final project conference**, which addressed both policy-related and technical aspects of bulky waste management in urban areas.

All this information is available in an **interactive tool** that was developed to help end users understand the results of the URBANREC project and how they could be useful in practice. The fully operational tool is accessible at:



Figure 6. Website for the interactive tool.