



URBANREC GUIDELINES

‘New approaches for the valorisation of
URBAN bulky waste into high added value
RECYcled products’

Abbreviations

ABS	Acrylonitrile-butadiene-styrene
BPP	Blueplasma Power
CAS	Civic amenity site
CHGP	Catalytic hydro-gasification with plasma technology
CMR	Carcinogenic, mutagenic or reprotoxic
EEB	European Environmental Bureau
EEE	Electrical and Electronic Equipment
EPR	Extended Producers Responsibility
EuPC	European Plastic Converters
EUPR	Plastics Recyclers Europe
EUROATEX	European Apparel and Textile Confederation
EUROPUR	European association of flexible polyurethane foam blocks manufacturers
FRC	Fibre reinforced composite
GDP	Global domestic product
GFC	Glass fibre reinforced composites
GPP	Green Public Procurement
HWRC	Household waste recycling centre
LCA	Life cycle assessment
LWG	Legal working group
MCAS	Mobile civic amenity site
PA	Polyamide
PAYT	Pay As You Throw
PBT	Persistent, bioaccumulative and toxic
PC	Polycarbonate
PE	Polyethylene
PES	Polyester
PMMA	Polymethyl methacrylate
PO	Polyolefin
PP	Polypropylene
PS	Polystyrene
PU	Polyurethane
PUR	Polyurethane
PVC	Polyvinyl chloride
SCIP	substances of concern in products
SEK	Swedish krona
SME	Small and Medium Entreprises
SVHC	substance of very high concern
vPvB	very persistent and very bioaccumulative
WEEE	Waste Electrical and Electronic Equipment
WPC	Wood plastic composites
WRAP	Waste and Resources Action Programme



TABLE OF CONTENT

1. Introduction	6
1.1 URBANREC: new approaches for the valorisation of URBAN bulky waste into high added value RECYcled products	6
1.2 URBANREC territories.....	7
1.3 URBANREC’s guide: objectives	8
2. Bulky waste management: general considerations	9
2.1 Scope and definition	9
2.1.1 Definition of bulky waste	9
2.1.2 Scope of the URBANREC project	13
2.2 European overview	13
2.3 Bulky waste management organisation in URBANREC’s territories.....	14
3. Organisation of bulky waste management	16
3.1 Bulky waste collection.....	16
3.1.1 Kerbside collection.....	16
3.1.2 Collection on demand	17
3.1.3 Civic amenity sites	17
3.1.4 Mobile civic amenity sites.....	18
3.1.5 Collection at re-use centres	19
3.1.6 Other	19
3.1.7 Advantages and disadvantages of the different collection options.....	20
3.1.8 Recommendations for bulky waste collection.....	21
3.2 Re-use.....	22
3.2.1 Re-use: principles and objectives.....	22
3.2.2 Setting a re-use strategy	23
3.2.3 Collection for re-use.....	23
3.2.4 Re-use centres and shops	24
3.2.5 Optimising re-use: the keys to success in Flanders.....	25
3.2.6 Promoting repair of re-usable goods	26
3.3 Bulky waste sorting centres	26
3.3.1 Bulky waste sorting centres	27
3.3.2 Fragmentation technology.....	27
3.4 Data collection and management	27
3.4.1 Monitoring re-use	28
3.4.2 Analysing the recycling patterns: customer portal service	29



4.	URBANREC’s innovative practices for bulky waste management.....	30
4.1	Information and communication.....	30
4.1.1	Mobile app.....	30
4.1.2	Customer portal service.....	31
4.2	Promoting re-use.....	31
4.2.1	Dismantling service.....	31
4.2.2	Implementation of a re-use container in CAS.....	32
4.2.3	De Hangaar.....	33
4.2.4	Developing a re-use strategy in Warsaw.....	33
4.3	Developing source separation.....	36
4.3.1	Modification of the separation in civic amenity sites.....	36
4.3.2	Developing source separation and re-use in Bornova.....	37
4.4	Policy work in Flanders.....	38
4.4.1	Visitations of municipalities.....	38
4.4.2	Learning networks.....	38
4.4.3	Definition of bulky waste.....	39
4.5	Fragmentation of bulky waste.....	39
4.5.1	Fragmentation of mattresses.....	40
4.5.2	Fragmentation of mixed furniture.....	41
4.5.3	Fragmentation of Textile: upholstery, clothes, carpets, tyres.....	41
4.5.4	Fragmentation of plastic.....	43
4.5.5	How would a full-scale fragmentation plant run?.....	43
4.6	New valorisation routes for sorted materials.....	44
4.6.1	Adhesive and foams obtained from secondary polyols.....	44
4.6.2	Fibre reinforced Polypropylene materials from recycled textiles.....	45
4.6.3	Wood plastic composites.....	45
4.6.4	CHGP technology.....	45
4.6.5	Design and manufacturing of foam mattresses with recycled materials coming from bulky waste.....	46
5.	Bulky waste management and urban metabolism.....	48
5.1	Urban Metabolism.....	48
5.2	Environmental impact.....	48
5.2.1	Initial assessment.....	49
5.2.2	Impact of URBANREC’s technologies.....	50
5.3	Social impact.....	52
5.4	Economic impact.....	53
5.5	Transferring URBANREC solution: interactive tool.....	54



6. Policy recommendations.....56

6.1 Harmonised definition of bulky waste..... 56

6.2 Promoting preserving collection for re-use and collection for recycling 57

6.3 Separate quantitative target for preparing for re-use..... 57

6.4 Minimum recycled content 58

6.5 Extending Ecodesign Directive to bulky products..... 58

6.6 Addressing hazardous substances 59

6.7 Extended warranty for products 59

6.8 Mandatory information on products and substances 60

6.9 Standards and certification 60

6.10 Extending Ecolabel to bulky items and re-use..... 61

6.11 Access to reusable items by professionals of re-use activities 61

6.12 Exemption to environmental permitting for re-use activities 62

6.13 Support the development of GPP criteria for bulky items 62

6.14 Support of social enterprises via social clauses in tendering procedures 62

6.15 Using VAT 63

7. Conclusion.....64

1. Introduction

Despite the continuous progresses of municipal waste management, there are still several waste streams that have limited opportunities for material recovery and thus end in landfills or incineration plants. One of these challenging streams is “bulky waste”, which is defined by the URBANREC project as “(mixed) waste from households and similar waste from companies, that do not fit (because of size, shape or weight) in the regular receptacle used for the collection of household wastes.”

Bulky waste includes in particular furniture, mattresses, upholstery, garden and outdoor or other large fixtures and fittings, representing a European generation of 19 Mt/year. More than 60% of bulky waste is currently landfilled in EU (around 11.5 Mt according to WRAP-UK).

Bulky waste is a challenging stream for various reasons: first, its bulky nature makes logistics complicated. Secondly, bulky waste encompasses very heterogeneous products and materials, which requires either an effective source separation system or a proper sorting technology. Many products managed as bulky waste are also composite products (e.g. a sofa composed of wood, textiles, and foam), that require a dismantlement process to allow the recovery of the various materials included. Other challenges are the lack of stringent regulation, and the lack of market outcomes due to, amongst others, the inexistence of cost-effective valorisation methods.

This implies significant environmental impacts (as it is described in Impact Section) and a loss of resources that could be valorised. A comprehensive solution that allows a circular economy approach is required. URBANREC aims to be the base to develop a global EU framework on bulky waste, collaborating in the definition and support of future EU legislation in urban bulky waste management.

1.1 URBANREC: new approaches for the valorisation of URBAN bulky waste into high added value REcycled products

The URBANREC project aims to develop and implement an eco-innovative and integral bulky waste management system (enhancing prevention and re-use, improving logistics and allowing new waste treatments to obtain high added value recycled products) and demonstrate its effectiveness in different regions. The valorisation routes considered in the project include:

- rebonding and chemical solvolysis for the PUR materials, to prepare renewable adhesives and to help with the preparation of PU foams (top foam mattress and isolation panels) with renewable materials;
- production of needle felt to obtain isolation panels from textiles;
- production of fibre reinforced composites from textiles;
- wood plastic composites (WPC);
- catalytic hydro-gasification with plasma for hard plastics and wood to obtain chemicals or fuel.

The consortium gathers 21 partners from 7 countries, including 5 research organisations, 7 SMEs, 2 large industries, and 7 public authorities or network of public authorities. URBANREC project partners represent the whole bulky waste value chain, from collection to re-use or recycling and production, from local authorities to industry and research institutions, ensuring the success of the project and its subsequent implementation at EU level.

1.2 URBANREC territories

Four different territories are involved in the URBANREC project, each of them aiming at improving their bulky waste management. Their status-quo at the beginning of the project was established in URBANREC’s deliverable D1.1.



Figure 1: URBANREC’s territories

These four territories are quite different:

- **The Province of Izmir** is located in western Anatolia at the Aegean coast. Its climate is Mediterranean. It encompasses 30 districts (11 of them are in the metropolitan area, 19 of them are town municipalities) and 1 metropolitan municipality. Its total population is about 4.32 million inhabitants.
- **The Valencia Region** is located in the south-eastern part of Spain. It is divided into three separate provinces, from north to south: Castellón, Valencia and Alicante with a total area of 23,255 km². It is the fourth most populated in Spain after Andalusia, Catalonia and Madrid with 4,953,482 inhabitants.
- **Warsaw** is the capital and largest city of Poland, with a population of about 1,735,000 inhabitants, and a density of about 3,355 inh/km².
- **The Flemish region**, a low-lying territory with a coastline along the North Sea, 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 (in total 300 municipalities in Flanders as of 01/01/2019).

1.3 URBANREC's guide: objectives

These guidelines are meant for public authorities and waste companies in charge of managing urban bulky waste. They present the main outputs of the URBANREC project in a comprehensive way and provide information for the implementation of URBANREC's bulky waste management solutions. The guidelines provide an overview of bulky waste in Europe, present data and information collected during the project, and detail its different outcomes that can help improving bulky waste re-use and recycling rates.



2. Bulky waste management: general considerations

2.1 Scope and definition

2.1.1 Definition of bulky waste

“Bulky waste” generally refers to all municipal waste that cannot be handled by the regular collection system due to their size, shape or weight. However, there is no commonly accepted definition of bulky waste at European level, and no legal definition. It is most commonly used as an operational concept whose exact scope is defined at local level, depending on the scope of municipal waste and how municipal waste is collected.

The URBANREC project defined a common definition, including examples of waste included in the definition, as well as fractions excluded from the definition. The definition was defined and validated by the consortium, taking into account the differences among the different territories covered by the project, as well as existing definition found across Europe. Waste fractions including bulky items, which are already covered by EU legislation (such as WEEE) were excluded from the scope.

The definition proposed by URBANREC is:

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

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

Construction and demolition waste, inert waste and wastes for which waste management legislation at EU-level exists (e.g. packaging waste, WEEE, batteries, etc.) are excluded from the definition of bulky waste.

The definition of bulky waste does not depend on the way this type of waste is collected (e.g. kerbside collection, civic amenity site, etc.).

Several definitions could be found at national level across Europe. These definitions are not necessarily legal definitions, most of them can be regarded as “commonly accepted” definitions, provided for instance by national environmental protection agencies. Several examples of legal or operational definitions are presented in the following table:

Table 1: identified definitions of bulky waste across Europe

Country	Common legal definition?	General definition	Inclusion	Exclusion
Belgium (Brussels)	No	The definition depends on the waste management authority. Brussels Environment defines it as “waste that is too voluminous to fit in a normal garbage bag and that, moreover, is not collected source-separated”		Source-separated collected streams (WEEE, large metal or wooden products, tyres and inert construction waste)
Belgium (Flanders)	Yes	“Waste materials generated by the normal functioning of a private household, and similar waste that doesn’t fit in the residual waste recipient due to its size, nature, or its weight, collected door-to-door, as well as disposed of at the civic amenity site in order to be incinerated or landfilled”	Mixed bulky waste sent to incineration or landfilling	Source-separated collected streams (e.g. small hazardous waste, glass, paper & cardboard, green waste, textile waste, WEEE, tyres, rubble, asbestos-containing waste materials, plastic bottles and flasks, metal packaging and drinks carton, wood waste, metal waste, hard plastics)
Belgium (Wallonia)	Yes	“All waste that does not fit in a bag or a 60-l bin”		
France	Yes	“Waste that cannot be managed by the collection service for traditional waste (“ordures ménagères”) due to their size and volume”. ¹	Furniture, mattresses, bulky WEEE items (mixed or source-separated)	rubble, garden waste, tyres, gas bottles, and end-of-life vehicles
Germany	No	No uniform, legal definition. In general, it is understood as household waste that, due to their size, does not fit in containers provided by residential collection services		Construction waste, garden waste, tyres
Italy	No	Bulky waste is included in household waste, but no legal definition is provided. Definitions are provided by waste management authorities, depending on the organisation of the collection system		
Poland	No	No national definition. The Municipality of Warsaw defines it as “municipal solid waste that may require special collection and management due to		WEEE, construction and demolition waste

¹ <https://www.service-public.fr/particuliers/vosdroits/F31954>



		its shape, volume, and/or weight, excluding e.g. WEEE, and construction and demolition waste”		
Spain	No	“large waste that, due to its size, can interfere with the ordinary management of household waste” ²	furniture and fixtures, wood, large WEEE, and scrap metal	
Turkey	No	Not specific clear definition. The Solid Waste Control Regulation of Turkey defines as “larger solid waste, mostly voluminous waste, consisting of household goods such as refrigerators, washing machines, -furniture, and not in the shape of reusable.”	refrigerators, washing machines, furniture	
UK and Ireland	Yes	“Any article of waste which exceeds 25 kilograms in weight; and/or which does not fit, or cannot be fitted into: (a) a receptacle for household waste provided in accordance with section 46 of the Environmental Protection Act 1990; or (b) where no such receptacle is provided, a cylindrical container 750 millimetres in diameter and 1 metre in length.” ³	Commonly-used definitions include: furniture, electrical appliances such as white goods, bicycles, rugs, garden furniture and other portable household items	carpets or underlay, kitchen or bathroom units (i.e. those that are generally fixed to the wall), black bag waste, doors and windows, fencing panels or gates, greenhouses or sheds, boilers or storage heaters

The common ground for all these definitions is the fact that bulky waste does not fit in the containers used for household door-to-door (or bring bank) collection. However, there are some discrepancies on the waste streams included in its scope:

- What is explicitly included or excluded can be very different, and some fractions such as large EEE are included in some definitions, and excluded in others;
- In many countries, the definition is provided by the waste management authority/company, at regional or local level. Few territories (e.g. Flanders) set harmonised definitions for the different collected fractions.
- Some definitions only include the mixed bulky waste streams that are sent to incineration or disposal (Flanders, Brussels), while others do not refer to this aspect.

² <https://www.miteco.gob.es/es/calidad-y-evaluacion-ambiental/temas/prevencion-y-gestion-residuos/flujos/domesticos/fracciones/otros/Residuos-Voluminosos.aspx>

³ <http://www.wrap.org.uk/sites/files/wrap/Definitions1.pdf>



The local definitions might be more specific when it comes to the size or the weight of the waste, or include list of waste fractions that are included and excluded from the bulky waste collection system. For instance in the UK, The Waste & Resources Action Programme (WRAP) indicates that collection authorities generally define bulky waste as “items you take with you when you move house” (source: www.wrap.org.uk/sites/files/wrap/Definitions1.pdf).

There are also some confusions between the terms “bulky waste” and “mixed bulky waste” (i.e. bulky waste that is collected on the kerbside at a regular frequency or in a mixed waste container in a civic amenity site). Some definitions only include the latter in the scope of bulky waste, while other also include bulky waste and items that are collected source-separated.

The common definition agreed on by URBANREC partners is the result of a compromise among the consortium taking into several considerations:

- The necessity to have a definition that can be applied at local level regardless of the context;
- The wish to address fractions that are not already covered by existing EU regulations.

Moreover, the URBANREC project focuses on a specific scope:

- It is limited to municipal waste managed by/on behalf of local authorities;
- The scope of interest of the project is extended to the re-used products which are not regarded as waste but that could typically end up as bulky waste, focusing on the activities of re-use centres and shops, and excluding re-use between inhabitants (via direct exchanges, flea markets, or online market places).

2.1.2 Scope of the URBANREC project

The URBANREC project focuses on re-use and recovery of materials for the following categories:

- Mattresses for the extraction of PU foam and textiles;
- Furniture (including upholstery) for the re-use, the extraction of PU foam, and to recover mixed textiles, hard plastics, and wood;
- Other products such as carpets and artificial grass for the extraction of mixed textiles and/or plastics.

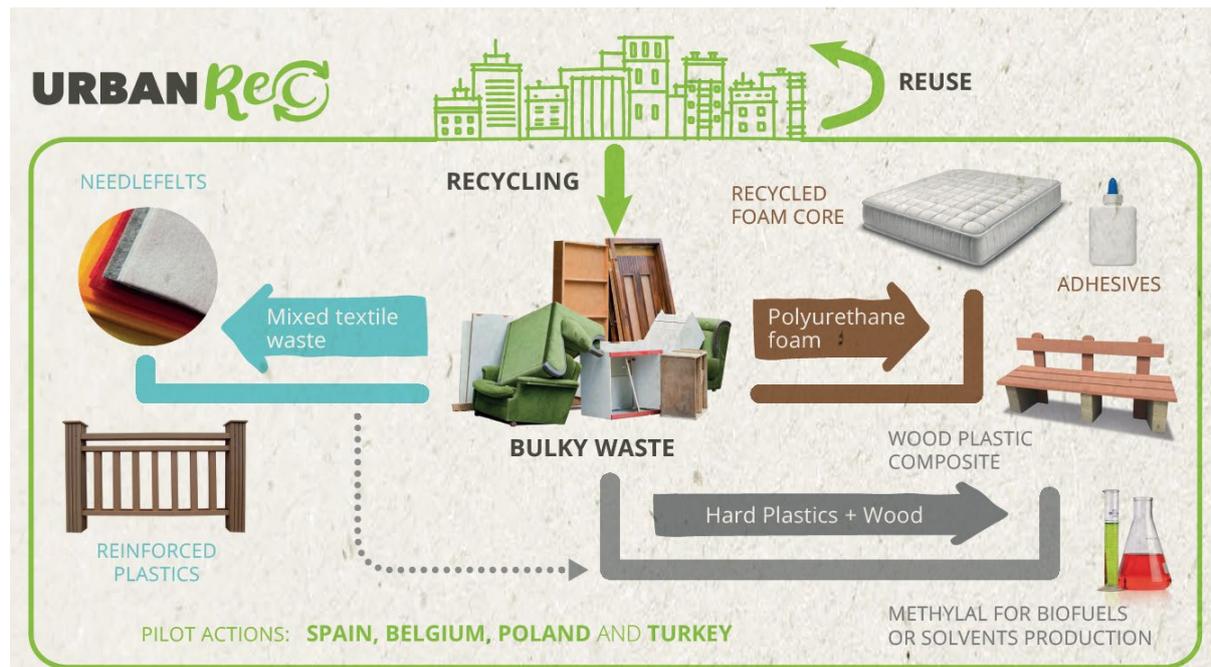


Figure 2: The scope of the URBANREC project

2.2 European overview

Bulky waste is identified by the European waste code “20 03 07”. However, the associated quantities are not available in the EUROSTAT database. Bulky waste is included in the 10.1 category, along with mixed residual waste and street bins. Therefore, no detailed statistical data are available for bulky waste at EU and Member State level.

The URBANREC project assessed a generation of about 19 Mt of bulky waste across Europe, among which 60% is currently sent to landfills⁴. Several Member States provide national figures for bulky waste collected quantities:

- In Germany, about 2.5 Mt of bulky waste was collected in 2015 (about 30 kg/cap)⁵;
- In France, about 1.9 Mt of bulky waste (including garden waste) was collected outside of civic amenity sites in 2015 (about 29 kg/cap), and about 4.6 Mt of bulky waste (including hazardous waste) was collected overall (about 69 kg/cap)⁶;

⁴ Aimplas, extrapolation made on the basis of WRAP’s data on the United Kingdom

⁵ Bundesministerium für Umwelt, 2019, *Abfallwirtschaft in Deutschland 2018 - Fakten, Daten, Grafiken*

⁶ ADEME, 2017, *Chiffres-clés déchets*

- In the UK, about 1.59 Mt of bulky waste was assessed to be collected either on the kerbside or in civic amenity sites in 2011 (about 25 kg/cap)⁷;
- In Italy, “mixed bulky waste collected for recovery” amounted to 0.48 Mt in 2015 (about 8 kg/cap)⁸.

These different figures show discrepancies on the reported quantities, which might reflect the fact that the scopes and definitions are inconsistent.

Bulky waste is currently not directly addressed in the Waste Framework Directive. It is mentioned as a part of municipal waste, so it is indirectly concerned by the target set for municipal waste recycling: 50% of municipal waste must be recycled in each EU Member State by 2020. The revision of the Directive has led to new targets: 55% to be achieved in 2025, 60% by 2030 and 65% by 2035. The Circular Economy Package also set a target on the landfilling of municipal waste, stating 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 URBANREC’s definition, large WEEE is regarded as bulky waste in many territories, and part of 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 capture rate of WEEE for each of the 10 WEEE categories. Each Member State transposed the Directive in different ways, regulating the responsibilities of manufacturers, authorities, retailers, and other stakeholders.

2.3 Bulky waste management organisation in URBANREC’s territories

The legal framework and general organisation of bulky waste management in the four URBANREC territories is quite heterogeneous, which provides a good overview of the different situations across Europe. The initial situation in the four territories at the start of URBANREC was as follows⁹:

- In the **Province of Izmir** (Turkey), there is little specific regulation on bulky waste. One regulation defines the bulky waste and prohibits mixing with municipal waste. In 2014, a national regulation made the implementation of civic amenity site mandatory, with the obligation to comply in 2017. Most of the districts resort to kerbside collection or collection on demand, with a given list of bulky waste that is accepted, and possibly against a given fee. Several re-use centres were also reported. In addition, these wastes are collected through scavengers and sold to junkyards. Little data is available, making it difficult to assess the current performance of the system, but most of the waste is supposed to be landfilled.
- In the **Province of Valencia** (Spain), there is also no specific regulation addressing bulky waste. Most of it is collected through civic amenity sites and mobile civic amenity sites, and the rest is collected through a mix of kerbside and on demand collection. About two third of the collected bulky waste (representing about 30 kg/cap/year in total) are sorted in civic amenity sites and then sent to recycling or sorting, the rest is landfilled.
- In the **City of Warsaw** (Poland), there is no specific regulation on bulky waste. The City set two civic amenity sites in 2018 and mobile civic amenity sites were implemented in the 18 districts. A monthly kerbside collection is also available for all

⁷ <http://www.wrap.org.uk/content/study-re-use-potential-household-bulky-waste>

⁸ ISPRA, 2017, *Rapporto Rifiuti Urbani, edizione 2016*

⁹ For more details, it is recommended [to consult the URBANREC report D1.1](#)



types of property. Mixed bulky waste is sent to a sorting facility and to an incineration plant. Little data is available on the performances of the system.

- The **Flemish Region** (Belgium) is the only territory in the consortium where the regulation sets specific rules for the handling of bulky waste (e.g. on the fractions to be source-separated, or the minimum and maximum tariffs that can be applied for collection). The regional implementation plan also sets minimal requirements regarding civic amenity site availability: a civic amenity site is mandatory for every municipality of more than 10,000 inhabitants. A municipality of more than 30,000 inhabitants needs to add a civic amenity site per parts of 30,000 inhabitants, or 90% of the inhabitants have to live up to max. 5 km away (in a nutshell) of the civic amenity site to which he can access. The main collection mode is civic amenity sites. Flanders also encompasses a well-organised network of re-use centres and re-use shops. It also implemented a landfill ban on recyclable and combustible waste, and an incineration ban on waste that by nature, quantity or homogeneity according to the best available techniques is appropriate for re-use or material recycling.

3. Organisation of bulky waste management

Due to its properties (size, volume, weight), bulky waste requires special handling systems. Various practices and options available to local authorities and waste operators to handle bulky waste are presented below, based on the information collected among the regions that are part of the project.

3.1 Bulky waste collection

There are two main options for the collection of bulky waste:

- Collecting at home, via door-to-door or kerbside collection, either on demand or at fixed collection dates, or both;
- Resorting to a “bring system” using containers, civic amenity sites or any other collection point.

The choice of collection options is based on various parameters, among which the necessity to optimise source-separation, the convenience for the users, the economic efficiency of collection, compliance with the regulation, etc. To be effective, collection systems must be linked with a proper information and communication system, which clearly explains the rules and practical information to the users. Other instruments (such as specific fees) can promote the use of the collection systems that are the most relevant for source-separation.¹⁰

3.1.1 Kerbside collection



Kerbside collection consists of door-to-door collection of household bulky waste. Waste materials are collected from resident's doorsteps at regular frequency, e.g. once a week or once a month. In general, kerbside collection will lead to the collection of mixed bulky waste and might limit the possibility of preservation of collected items and separation of materials. It is recommended to resort to other collection systems to ensure re-use and material recovery.

Inhabitants are informed of the list of waste that can and cannot be collected. The collected mixed bulky waste can possibly be crushed and compacted by the lorry to optimise its filling. Bulky waste collected via kerbside collection is generally sent either to sorting facilities or to incineration/disposal.

Figure 3: bulky waste collection in Bornova, Turkey

Kerbside collection is available in all the territories covered by the project but is not used the same way. In the Province of Izmir or in Warsaw, all the population is covered and not charged for it. In the Province of Valencia, only 22% of the population is covered, and in Flanders, kerbside collection is very limited and not available in most local authorities; the reason for this is that, in Flanders, the municipality has to set a minimum tariff that must be paid by the inhabitant, which is very difficult to apply for a normal kerbside collection.

¹⁰ WRAP, *Bulky Waste Guidance*

3.1.2 Collection on demand

Collection on demand consists in collection of household bulky waste in front of a house after an appointment (taken by phone, via a website, or other means). When making the demand, the inhabitant is usually asked to provide a description of the product/waste to be collected and is given a date and time when the item has to be made available (e.g. by putting it on the kerbside).

The concrete organisation of collection on demand can be very different from one place to another: it can be free of charge or not, the number of collections can be limited, other limitations can be set on the volumes or the number of items, etc. Moreover, it might be available only on specific days.

In Izmir, collection on demand is available to all inhabitants, but with a limited number of collections per year and a specific fee. In Flanders, collection on demand is usually available with a limited number of calls a year and the payment of a fee (between 0.06 and 0.66 €/kg). IMOG, an intermunicipal organisation in South West Flanders, provides monthly a collection on demand for mixed bulky waste including a fixed charge of 12€, in addition to a weight-based fee of 0.2€/kg. Collection on demand is not available in Warsaw. In Flanders, re-usable goods are collected for free on demand by the accredited re-use centres. Consorcio Valencia Interior (Province of Valencia) also provides such service for about 60% of their population.



Figure 4: collection on demand in Imog, Belgium

3.1.3 Civic amenity sites

Civic amenity sites (CAS) are guarded, fenced-off areas where inhabitants can dispose of and sort out their household waste into receptacles in order to be recycled or otherwise treated. An on-site supervisor is present to provide information and guidance to the users. Civic amenity sites also give the possibility to collect and source-separate fractions that cannot be handled by door-to-door or bring bank schemes, due to legal, technical, or financial reasons (hazardous waste, WEEE, construction and demolition waste, etc.).

There is an important diversity of civic amenity sites and many different ways to operate them. Their effectiveness for source separation will depend on several factors, for instance the number of containers they include, their proximity, their opening hours, the presence of trained employees helping the users, whether or not commercial waste is accepted, etc. An important



Figure 5: civic amenity site in Warsaw, Poland

element is the control of users, which is generally done by checking the ID, or providing inhabitants with individual user cards, as it is the case for Consorcio. Controlling the type of vehicle or the content of the waste brought can also help with the controls, especially if different systems or tariffs apply to non-household waste producers.

Another important element for sorting is a differentiation of tariffs: when mixed waste is more expensive than recyclable waste, the incentive for sorting will be

higher. Charges can be set according to the volume or the weight of the waste brought, the number of annual visits (controlled with individual cards). Another possibility is to charge the user when he uses the mixed bulky waste containers without necessarily weighing or assessing the volume of the waste. For instance, the city of Karlskrona, Sweden, charges the users that bring mixed bulky waste by 50 SEK (4.75€) for those using a personal car, and 100 SEK (9.50€) for those using a trailer or a small truck¹¹. This approach can be easier to implement since it does not require scales, but it might not be as effective as a weight or volume-based PAYT (Pay As You Throw) system.

It is also possible to limit the volumes of (mixed) fractions that can be brought by inhabitants. For example, the Flemish intermunicipal organisation IVAREM¹² allows 28 free entrances per household per year and charges the extra ones €5 per use, with additional limits of 2 uses per day and 2 m³ of waste per day. ID cards are used to control this system. In addition to those limits of volumes, citizens pay for some waste fractions, such as for bulky waste (0.30 €/kg).

Among the URBANREC territories, different approaches are in use regarding the charging system. Consorcio has developed a system of environmental points that are given to inhabitants when using the civic amenity sites, which then gives them possibilities to get discounts on their next waste fees. In Flanders, mixed bulky waste is charged according to the quantities brought, the fees ranging between 0.03 and 0.33 €/kg.

Depending of the size of the civic amenity site, many bulky waste fractions can be source-separated, such as bulky waste made of a single material such as wood, hard plastics, metal, etc. In URBANREC territories, the civic amenity sites were implemented to promote source separation: 27 fractions are sorted in average in the Province of Valencia, 39 different fractions in the 2 sites in Warsaw, and 39 in the IMOG territory.

In both the Province of Valencia and Flanders, civic amenity sites are the main collection mode for bulky waste. In the Province of Valencia, about 75% of bulky waste is collected in civic amenity sites. In Flanders, this figure is over 90%. This reflects the relatively high density of civic amenity sites: 22,500 inhabitant per CAS in Valencia, and 19,300 inhabitants per CAS in Flanders. The accessibility and convenience of use are also key factors of success: in Flanders, 95.8% of the population lives within 5 km of a CAS.

3.1.4 Mobile civic amenity sites

In places where space is limited or in remote areas, or to target specific populations that have difficulty using the civic amenity sites (social districts, elderly population, etc.), mobile civic amenity sites can be implemented to compensate the absence of traditional civic amenity site or the lack of awareness of traditional CAS. It might also be a way to make people that do not know about traditional CAS (or are unsure about the charging system) aware of the collection system as a whole and promote the traditional CAS.

These mobile civic amenity sites are temporary installations located in a public area where residents can sort their household waste in order to be recycled or otherwise treated. Unlike a regular civic amenity site, the mobile civic amenity site is only open during limited periods and is generally smaller. Mobile civic amenity sites can be composed of containers, crates, or

¹¹ <https://www.affarsverken.se/atervinningscentraler/maltans-atervinningscentral/>

¹² <https://www.ivarem.be/tarieven-recyclagepark>

collection areas materialised by fences. They are generally put in easily accessible public spaces (such as market places, town hall places, etc.) for half a day or a full day, at a regular frequency (e.g. every Saturday). This system allows using the same set of containers for different locations.



Figure 6: mobile civic amenity site in Valencia, Spain

The limited storage space might prevent to collect larger items. However, the mobile civic amenity sites proposed by Consorcio accept 16 different fractions, including furniture and mattresses. A 6-m³ container is used for collection.

It must be noted that the operational cost of mobile civic amenity sites might be more important than traditional sites, when comparing the cost per tonne collected. In Consorcio, the cost per tonne for mobile CAS amounts to 1,305 €/t, when CAS cost about 250 €/t.

In Flanders, under certain conditions, local authorities can get subsidies from the Flemish Government for small temporary or small permanent CAS.

The success of mobile CAS heavily depends on the communication activities to make inhabitants aware of their organisation.

3.1.5 Collection at re-use centres

Re-use centres can also accept products brought by inhabitants. This allows a visual pre-selection of goods and ensure a proper quality (of potentially sellable goods) or its reparability. The status of the items brought (whether it is regarded as a product or waste) depends on the national regulation and the status of the organisation running the re-use centre.

This collection system is available in the Province of Izmir, the Province of Valencia, and the Flemish Region. Little data is available; nevertheless, data is available for all goods collected by the accredited re-use centres in Flanders. About 42% of the products collected for re-use in Flanders are directly brought by the inhabitants.

3.1.6 Other

It is possible to take advantage of the available space in apartment blocks as a temporary storage or pre-collection point. In **Nantes Métropole (France)**¹³, this system has been applied for bulky waste collection in social housing. This experiment was launched following a study visit in Lille Métropole that also implemented such system. It came from a request from tenants who wanted to improve the local waste management and environment of five housing towers where more than 1,000 inhabitants lived, and where waste separation was not properly implemented. The project took advantage of the availability of the former waste storage building after new underground containers were implemented. Several waste fractions were included: wood, furniture, metal, textiles, WEEE, etc. Waste operators and re-use organisations were also associated to the project to recover the sorted waste. An intensive communication campaign targeting the tenants and inhabitants was implemented to ensure the active participation of waste producers.

The collection points are about 35 to 40 m², with an easy access to trolleys, a limited distance to main entrance doors (below 100 m) and the guarantee to ensure frequent removal of waste in case of unexpected increases due to inhabitants moving in. It is important to train people to

¹³ http://www.regions4recycling.eu/upload/public/Good-Practices/GP_Nantes_bulky-waste-collection.pdf



operate the collection points and ensure its convenience and cleanliness. An easy access for collection vehicles is also mandatory. This implementation allowed to reach similar collection quantities per inhabitant to the traditional civic amenity sites.

Besides, some retailers or producers set take-back systems for bulky items such as mattresses:

- In the UK, the Airsprung Group set a take-back system for mattresses where they would collect old ones when delivering a new mattress to the consumer. Old mattresses are then brought to a recycling centre to be dismantled, and where about 60 to 80% of the materials were recycled¹⁴. This system is also available in Flanders. For instance, the company Bedking takes back old furniture, slatted base and mattresses.
- Such service is also available for furniture. For instance, Ikea propose to take back existing beds, sofas, or appliances when delivering a new one, against a fee (20£ for a piece of furniture)¹⁵.

3.1.7 Advantages and disadvantages of the different collection options

Among the different collection options presented above, it is important to note that none can be regarded as an ideal solution; a mix of different solutions is likely to give the best results. The advantages and disadvantages of each collection method are presented in the table below:

Table 2: advantages and disadvantages for the different collection options for bulky waste

Collection option	Advantages	Disadvantages
Kerbside collection	Convenient for Citizen	Expensive Less effective for source-separation Difficult to control the waste producers, which can lead to irregularities Difficult to apply a PAYT system Less effective for preserving the quality/integrity of potentially reusable items
Collection on demand	Convenient for citizen Possibility to optimise collection routes Adequate solution for people that cannot come to the CAS (disabled, elderly people, no access to vehicles...) Possibility to charge the user for the collection When used for re-use: enable to check the quality of the items	Expensive Less effective for source-separation Less effective for preserving the quality/integrity of potentially reusable items when not specifically implemented for re-use
Civic amenity sites	Good solution for source-separation, provided that sufficient streams are collected source-separated.	Less convenient for inhabitants

14

http://www.wrap.org.uk/sites/files/wrap/Collection%20and%20take%20back%20of%20mattresses%20for%20recycling_0.pdf

15 <https://www.ikea.com/gb/en/customer-service/services/removal-recycling/>

	<p>Possibility to include a re-use container</p> <p>Possibility to charge the users when bringing certain (non- recoverable) fractions</p> <p>Possibility to raise awareness of the users on waste recycling and prevention</p> <p>Park keeper can assist the users</p>	<p>Requires sufficient space, making it more complicated in densely-populated areas</p> <p>Users need to have a vehicle, which might not be the case in very dense cities</p> <p>In remote areas, distances might be too important for inhabitants</p> <p>A sufficient number of park keepers have to be present, which can be expensive.</p>
Mobile civic amenity site	<p>Solution for source-separation in remote/dense areas where no CAS is available</p> <p>Solution for source-separation for inhabitants that cannot use the CAS or that do not know about CAS or afraid of being charged.</p> <p>Convenient, proximity service for inhabitants</p> <p>Possibility to raise awareness</p>	<p>Limited storage capacity might limit the collected amounts and the collection of largest items or of mixed bulky items. Traditional CAS should be regarded as a better option by inhabitants. Therefore, the conditions for bringing waste (e.g. prices) should be aligned with the ones in traditional CAS.</p> <p>High costs compared to traditional CAS</p>
Collection at re-use centre	<p>Allow a quality check of the items to ensure that they are reusable, repairable, and sellable</p> <p>Possibility to raise awareness of the users on waste prevention</p> <p>Extend the lifespan of the product, thus the amount of waste to be collected.</p>	<p>Less convenient for inhabitants</p> <p>Only relevant for re-usable products</p> <p>Requires much space.</p>

3.1.8 Recommendations for bulky waste collection

When considering the territories involved in the URBANREC project, it is interesting to note that both territories for which data is available (the Province of Valencia and Flanders) rely on civic amenity sites to collect most bulky waste. In both territories, the network of CAS seems relatively dense (about 20,000 inhabitants per site), which seems to make it convenient for inhabitants. It is also interesting to note that both territories tend to limit the access to kerbside collection (which is not provided anymore in Flanders).

Considering the advantages, disadvantages, and different possibilities that the different collection options offer, it is important to define the collection systems according to the local constraints and possibilities of the inhabitants, and to use a mix of collection possibilities. In particular, areas where inhabitants have limited possibility to access a civic amenity site should be provided with alternatives such as collection on-demand and mobile civic amenity sites; to limit the use of these services that do not necessarily allow the same possibilities in terms of source-separation, it is important to make them less attractive (either by making them more expensive or by restricting the type of waste accepted).

Besides the technical and logistical organisation of bulky waste collection, the key to success is a mix of instruments that includes:

- **Regulation:** bulky waste is not necessarily targeted by the local, regional, and national authorities, so it might be included in the general municipal waste targets, or included

in the provisions concerning residual waste. Specific regulation might contribute to source separation, such as the sorting obligations for various waste fractions set in Flanders; the rules of the availability of civic amenity sites can also be regarded as relevant to promote source separation. Other legal instruments such as incineration and landfill bans contribute to increase source-separation.

- **Financial instruments:** they are generally regarded as highly relevant to promote recycling, by making mixed bulky waste more expensive than sorted fractions, and landfilling and incineration more expensive than re-use or recycling. A mix of such instruments is used in Flanders, with very good results (a landfill tax – in addition to the tariff for landfilling – of 55 €/t for non-combustible waste and of about 71 €/t for other waste is applied to mixed bulky waste to which levies have to be added¹⁶, higher price for the collection of mixed bulky waste, higher price for door-to-door collection of mixed bulky waste, etc.). In the Province of Valencia, the use of civic amenity site is promoted by the user cards that allow waste producers to reduce their waste fees. The other two territories do not really resort to financial incentives.
- **Communication:** it is important to make the inhabitants aware of the collection methods and sorting guidelines, tariffs and price differences, as well as to promote source separation, especially if no other legal or financial incentives. All territories involved in URBANREC provide information on how the system work and organise communication campaigns promoting the use of the collection systems, especially the civic amenity site, highlighting the convenience and environmental benefits. Providing clear, practical information to the inhabitants regarding what they can do with their bulky waste is very important, and should direct them toward the most desirable outcome (preferred option being first re-use, preparation for re-use, then material recovery).

The different collection options all present some advantages and limitations. Not a single solution can be regarded as ideal to every type of bulky waste. It is important to take advantage of the available possibilities (for instance, available space in vertical housings for the temporary storage of bulky waste and sorted fractions to be collected, existing re-use shops that could be used as bring points, etc.) and to combine these different possibilities so that inhabitants can resort to various systems according to their own constraints. Regardless of the used systems, information on these possibilities has to be consistent and clear, and to promote the higher steps of the hierarchy (direct re-use, preparation for re-use, source separation for recycling).

3.2 Re-use

3.2.1 Re-use: principles and objectives

According to the Waste Framework Directive, re-use consists in “any operation by which products or components that are not waste are used again for the same purpose for which they were conceived.” Re-use can be directly applied to a product (e.g. donation or sales of a second-hand products between two people), or made possible after a product that became waste undergoes “preparation for re-use”, meaning “checking, cleaning or repairing recovery operations” that will make its re-use possible.

Re-use and preparation of re-use are above material recycling in the WFD’s Waste Hierarchy, and are regarded as preferable options when it comes to bulky waste management. Besides the positive environmental impact of re-use, which prevents the production of a new items by substituting a second-hand product, it also enables the creation of local, low-qualification jobs, possibly in link with the social economy. It also generates second-hand products that are more

¹⁶ OVAM, *tarieven en capaciteiten voor storten en verbranden actualisatie tot 2016*

affordable to low-income inhabitants. Therefore, re-use centres serve both an environmental and a social purpose.

Therefore, bulky waste management strategies should identify the possibility for re-use and make sure to develop a collection and management system that contributes to optimise the quantities sent for re-use and preparation for re-use, as well as ensuring the good quality and re-usability of these streams.

3.2.2 Setting a re-use strategy

Re-use activities are commonly organised by charity or social economy organisations. This is the case in the Province of Valencia and in the Flemish Region. Therefore, it is important to establish links and collaboration with local re-use organisations to adopt a consistent approach for the collection of re-usable products, and set a proper reporting system. Guidance on how to professionalise, develop, and promote approved re-use centres and networks is provided by Reuse¹⁷.

In Flanders, the regional authority accredited the re-use centres and determined for each of them a precise operating area to avoid gaps and overlaps. Each local re-use centre collaborates with the local authority for the collection of re-usable products. Re-use centres also receive some annual subsidies based on the number of population and the number of sold products, and they report their data in a follow-up report.

All Flemish re-use centres are united in the non-profit organization “HERWIN¹⁸”, which is associated in the different waste and materials initiatives and policies.

Moreover, Flanders is investigating the possibilities to increase re-use by embedding it more firmly in the product chain through examination of different policy instruments (legal instruments, economic instruments, ...). One of them is the financial support of the re-use model. Through policy choices in the past the re-use model in Flanders relies to a significant extent on financing of the government. This way of financing by the government has made the re-use model successful. However, other financing models can also have a positive effect to embed re-use in the product chain and not only re-use of the accredited re-use centres. A preliminary study launched within the URBANREC-project investigated the possibility of an innovative financial re-use support: the re-use allowance. The study is based on the furniture fraction. Three possible scenarios have been developed in which a re-use allowance can be established.

3.2.3 Collection for re-use

A proper collection system is a key element for the re-use of products. The collection system should preserve the integrity of the products, optimise the collected quantities, and ensure that the collected items are re-usable (or possibly repairable), and that they can be then sold.

The different collection options were mentioned in the previous parts. Some of them are adequate for the collection of re-usable items:

- **Collection on demand:** re-use organisations can propose an on-demand collection service to inhabitants. The principle is simple: inhabitants contact the re-use organisation by phone or via the internet, detailing the products to be collected. This first call can allow to determine whether or not the items are re-usable, and then an appointment is set. During collection, the operators have to check the items to

¹⁷ <http://www.rreuse.org/approved-reuse-centres/>

¹⁸ <http://www.hrwn.be>

determine whether it is re-usable, and possibly indicate another collection scheme to the inhabitant if this is not the case.

- **Dismantling service:** it consists in a service where the re-use organisation declutters a house (after a sale or the decease of the inhabitant), in order to empty the closet, dismantle the furniture, then send the re-usable items to a re-use centre and the rest to a waste collection facility. This service was implemented by URBANREC's partner IMOG and will be detailed in part 4.2.1.
- **Collection at re-use centres:** as presented in the previous section, inhabitants can be invited to bring their re-usable items in re-use centres.
- **Collection in civic amenity sites:** implementing an area to collect re-usable items is another solution. In Flanders, many local authorities implemented a re-use container. The implementation of such container/area requires the training of the CAS employees so that they can inform and provide advice to the users, as well as a convention with the re-use organisation that will then collect the goods. Clear information on what is accepted has to be provided to the users. The collection area must ensure the preservation of the products to be re-used. One possibly important parameter to consider is the status of the item: depending on the national regulation, an item collected in a civic amenity site might become a waste and therefore will be subjected to the waste regulation for further handling. A guide to include re-use in local authority civic amenity site procurement was proposed by WRAP and [can be consulted here](#)¹⁹. The experience of URBANREC's partner Consorcio within the framework of the URBANREC project will be detailed in part 4.2.3

In Flanders, two third of the collected quantities for re-use are brought by inhabitants (42%) or collected on demand (23%). The rest is collected via various systems, for instance re-use containers in civic amenity sites, textiles containers on the street or in CAS.

3.2.4 Re-use centres and shops

An accredited re-use centre is a centre operated by or on behalf of a local authority or by an association (charity, social economy organisation) where people can donate products/waste that are then prepared for re-use (checking, cleaning, and possibly repairing) and made available for redistribution or sales. Re-use centres generally accept items brought by inhabitants if they are considered re-usable or at least repairable.

In most of the URBANREC territories, re-use centres are not managed by local authorities, but by external re-use organisation (that are likely to be charity organisations or social enterprises). As explained above, it is advisable that local and regional authorities collaborate with these organisations for the collection or for the handling of non-reusable products.

Re-use centres can undergo different activities:

- **Collection of products** by welcoming inhabitants bringing re-usable items;
- **Sorting of products** to select the re-usable ones and discard the others;
- **Preparation for re-use:** the collected objects are checked, tested, cleaned, and possibly repaired by the employees, which might require specific technical skills and spare parts;
- **Sales of products:** the second-hand products can be proposed for sales to the visitors;
- **Awareness raising:** re-use centres can play an important role for the awareness raising of inhabitants by organising visits, displaying communication materials, etc.

¹⁹ <http://www.wrap.org.uk/content/how-include-re-use-local-authority-hwrc-procurement-0>

The sales of product are a very important part of re-use activity, and should provide a relevant source of incomes for the re-use organisation (about 40% of the turnover for the Flemish re-use sector). The shops must be as welcoming as possible, and easily accessible.

Part of the population might still be reluctant to buy second-hand products because of quality issue. One possibility to mitigate this is to define a quality label or a warranty period. In Flanders, a one-year warranty is applied to re-used electrical and electrical products sold by re-use organisations.

Within the project's activities, IMOG and Kringloopcentrum Zuid-West Vlaanderen (the re-use centre) also developed a new project to tackle the issue of unsold product: "de Hangaar", a sort of warehouse where unsold or lesser-quality products are proposed for sales at a discount price. This project and outcomes will be presented in more details in part 4.2.2.

3.2.5 Optimising re-use: the keys to success in Flanders

As mentioned previously, the re-use system set in Flanders Region is one of the most organised and well-documented system in Europe. In a report summarising the 20-year long experience in re-use²⁰, the success factors of the system are listed:

- **The link between re-use and the social economy:** the first re-use centres in the early nineties were mainly set by Public Social Welfare Centres and social organisation, in order to provide jobs to low-skill, long-term unemployed workers, while a limited number of them were set more for environmental reasons. Both reasons were combined as both the social economy policy and the environmental policy promoted the development of re-use centres.
- **Its close integration in Flanders waste management:** re-use centres were progressively integrated in the bulky waste management policies, in coordination with local authorities.
- **The federation of all re-use centres:** after realising they faced similar challenges, re-use centres formed a federation in 1994, that later became the Federation of Environmental Entrepreneurs in the Social Economy (KOMOSIE npo), which now became HERWIN²¹ after a merge between KOMOSIE and SST²² (Samen Sociaal Tewerkstellen, the network federation of social workplaces in Flanders). It provides support and promotes the exchange of experiences among the various re-use centres, and acts as a representative of the network when discussing with the authorities.
- **The progressive professionalization of re-use centres:** it consisted both in the optimisation of the various processes linked with re-use (collection, preparation for re-use, logistics, etc.) and the homogenisation of the organisation of re-use centres, with the definition of "operating areas" clarifying the geographical scope of the various centres, avoiding competition and facilitating the collaboration with local authorities. The re-use centres adopted a common brand (De Kringwinkel) making them more visible, as well as a quality management system, and a consistent reporting of data and performances.

²⁰ https://www.ovam.be/sites/default/files/atoms/files/2015_Folder-Kringloop-engels_LR.pdf

²¹ <https://www.herwin.be/nl/index.php#start>

²² <https://www.samensociaaltewerkstellen.be/>



Figure 7: "de kringwinkel", the common brand adopted by the Flemish re-use organisations

Flanders now encompasses 31 re-use centres, each of them operating on a well-defined "operating area" composed of various communes (including about 200,000 inhabitants each), and collaborating with the local waste authority. They employ about 5,353 employees, among which 80% are social economy employees. They collect about 10 kg/cap/yr of products, with about 50% being re-used, and 50% recycled.

3.2.6 Promoting repair of re-usable goods

Promoting reparation of reusable goods can also be supported by local authority. The City of Wien supported the creation of the "Reparaturnetzwerk Wien" (Wien Repair network). It brings together about 80 repair companies and provides a hotline for inhabitants to quickly identify the right service for reparation. Their website includes a search engine for repair services, second-hand shops, and re-use events. (More information here: <https://www.reparaturnetzwerk.at/>)

3.3 Bulky waste sorting centres

Mixed bulky waste might be sent to specific sorting centres. A bulky waste sorting centre is a facility intended to segregate recyclables such as paper and cardboard, plastics, wood and metals from the collected bulky waste through manual sorting, manual sorting belts and/or automatic processes such as air flow or optical separators.

Mixed bulky waste might still include recoverable materials. Data on the composition of mixed bulky waste are available for the Flemish region (2011) and presented in the following graph.

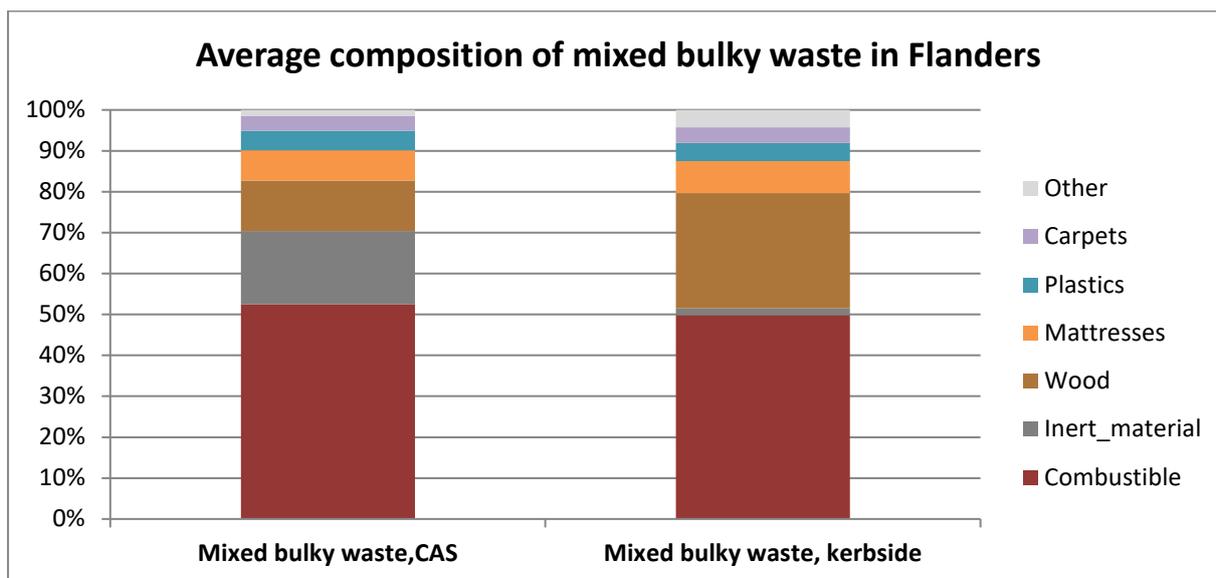


Figure 8: Average composition of mixed bulky waste in Flanders

Mixed bulky waste collected in civic amenity sites are mostly composed of mixed combustible (52.5%), inert materials (17.9%), wood (12.3%) and mattresses (7.4%). Mixed bulky waste

collected door-to-door are also mostly composed of combustible fraction (49.8%). The other main fractions are wood (28,2%) and mattresses (7.7%). Despite the efficiency of the source separation in Flanders, it seems that there are still recoverable materials in mixed bulky waste streams. It must be noted that the presented data are from 2011, and the latest development in bulky waste management entailed improvements that might have impacted the composition of bulky waste, such as a mandatory source-separated hard plastic collection, minimum and maximum tariffs of bulky waste, better price differentiations, ...

3.3.1 Bulky waste sorting centres

Bulky waste sorting centres are used in Warsaw and IMOG, where recyclable materials are extracted and the sorting residues are then sent to energy recovery. The one operated by IMOG is the only public sorting centre for bulky waste in Flanders.

At IMOG, the content of the mixed bulky waste container at the CAS, which is mainly composed of multi-material objects that do not fit in any other container for source-separation, is sent to the sorting facility. This sorting facility consists in several sorting stages:

- A pre-sorting of large, homogeneous objects (such as carpets);
- A shredder reducing the size of the waste;
- A magnet extracting the ferrous metal;
- A shaking sieve that takes out the inter materials, that is sent to landfilling;
- A manual sorting stage where the remaining valuable materials are extracted.

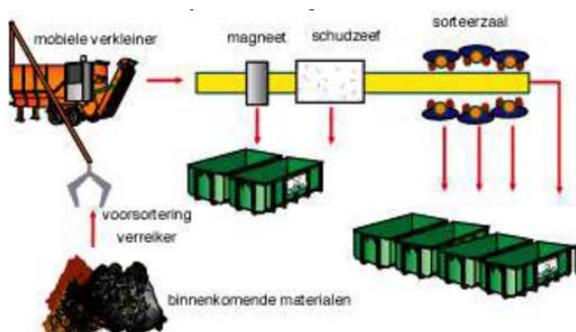


Figure 9: the sorting process in IMOG sorting facility

The remaining part is a mixture of different materials that is sent to energy recovery.

While sorting centre for bulky waste is a relevant method to extract the remaining materials from mixed bulky waste, the complexity and heterogeneity of bulky waste makes it challenging. Therefore, it is advised to rely on source-separation for material recycling, rather than on such sorting centres.

3.3.2 Fragmentation technology

Within the framework of the URBANREC project, a fragmentation technology was developed by ECOFRAG in order to dismantle mixed bulky waste to extract valuable materials for recycling, such as textiles, foams, metals, plastics or wood. The process uses laminated cutting technology for grinding, with water in high pressure conditions to cut the materials.

The fragmentation technology will be further detailed in part 4.4 of this report.

3.4 Data collection and management

As seen when analysing the different management strategies in the territories involved in the URBANREC project, missing information and data prevents from having a good overview of

the current situation and identify leads for improvement. Most territories had gaps in their data, especially when it comes to re-use activities. Data management and reporting is a key element to monitor the progress of the bulky waste management strategy and to improve it.

Mapping the waste streams is an essential part of monitoring and allows the calculation of relevant indicators to assess the performances of the system. Identifying the key performance indicators (linked with legal targets or operational needs) along with their calculation methods and the required data is important before setting the monitoring system. Such indicators can be the re-use and recycling rates, the number of on-demand collection requests, the number of visits to the CAS, the number of complaints linked with bulky waste management, etc.

Examples of performance indicators and calculation methods can be found in WRAP's Bulky Waste Guidance on data management and reporting²³. Other reports by WRAP provides more concrete examples of indicators and methods to monitor the progress of the bulky waste management system, on diverted quantities²⁴ and capture rates²⁵.

Monitoring the quantities collected from the various collection scheme, by type of waste, and mapping their intermediary and final destination should allow the calculation of the main waste-based indicators: sorting rate, recycling rates, landfilling and incineration rates. In this sense, it is important to equip civic amenity sites with scales to weight their inputs and outputs.

Composition analysis of bulky waste can give interesting hindsight on the remaining potential for re-use and recycling. Composition analyses are based on the analysis of various samples that should be representative of the local situation. It is then advised to refer to existing methods and appoint a consultant specialised on the composition analysis methods and standards to do so, in order to ensure of the reliability of the data. Examples of methods for composition analysis of bulky waste and of waste collected in civic amenity sites can be found in WRAP's report on "composition of kerbside and HWRC bulky waste"²⁶ The report also includes guidance on how to assess the potential for re-use, which can be useful to set realistic targets for re-use.

Collection of data is a key element when working with external organisations that have to be informed and possibly equipped and trained to ensure a proper collection of quality data. This is for instance the case for the collection of data on re-use by re-use organisations, which is developed in the following part. In general, it is important to define the type, form, and frequency of data required to ensure the proper monitoring of performances and targets. Clear definition, reporting templates, and possibly reporting systems have to be implemented and presented to the different stakeholders asked to provide data.

3.4.1 Monitoring re-use

Setting a reporting system for re-use is important and might require specific actions; re-use organisations might lack resources (time, equipment) to collect and report data. It is therefore important to set a proper and feasible reporting system, in collaboration with the relevant players. It can be also relevant to include the reporting requirements in the agreements signed between local authorities and re-use organisations. In Flanders, the reporting is ensured by the fact that subsidies received by re-use centres from local authorities are conditioned to reporting.

One of the challenges of monitoring re-use is that the terminology must be adapted to the fact that the monitoring focuses on products and not waste. While waste fractions are generally classified by type of materials (e.g. wood, cardboard, etc.), re-use is about products: books, furniture, etc. This makes comparisons between re-use and waste data complicated.

²³ http://www.wrap.org.uk/sites/files/wrap/Data_management.pdf

²⁴ <http://www.wrap.org.uk/sites/files/wrap/WRAP%20ME%20Guidance%20-%20CHP%206.pdf>

²⁵ <http://www.wrap.org.uk/sites/files/wrap/WRAP%20ME%20Guidance%20-%20CHP%207.pdf>

²⁶ WRAP, 2012, Composition of kerbside and HWRC bulky waste, available on request.

The Flemish re-use centres collect much information on their activities through a registration system for the management of collected goods, which ensures the consistency of the reported data. The information focuses on collected quantities, recyclables, sold articles, and waste.

The data on quantities consist in:

- **Products received in re-use centres**, that are weighted if a weighing system is available. If not, the incoming and outgoing items are counted, and standardised weights are applied for each category of products.
- Goods collected in containers (in or outside CAS) or door-to-door: these streams are weighted;
- **Outputs of the sorting centres:** the sold units are counted, while the remaining fractions either sent to recycling or disposal are weighted (by type of materials).

The categories monitored in Flanders are the following:

- | | |
|------------------------------|-----------------------------|
| - WEEE large white | - Gas appliances. and other |
| - WEEE refrigerators/freezer | - Household goods |
| - WEEE other | - Furniture |
| - WEEE television/screens | - Textiles |
| - Books musical multimedia | - Transportation |
| - Do-It-Yourself | - Leisure-time items |

Some data on average weight for bulky items are also [available here](#)²⁷.

Other elements can be relevant to monitor, such as the number of jobs created through re-use activities, or the CO₂ savings thanks to re-use activities.

3.4.2 Analysing the recycling patterns: customer portal service

Convenience is an important aspect of bulky waste collection, which requires a proper involvement from the inhabitants. Monitoring the use of the system and the satisfaction of the user can be relevant to ensure that it fits with their requirements.

Besides the monitoring of users' satisfaction (through survey, such as [this one](#)²⁸) and the monitoring of complaints, it can be interesting to identify the recycling patterns of the inhabitants. The URBANREC project also organised surveys directed to the inhabitants, whose results are presented in part 5.3.

To do so, the URBANREC project led to the creation of a customer portal service by IMOG, an innovative system to collect data on recycling patterns of citizens with specific focus on bulky waste. Data is collected at the city amenity sites where 90% of the recyclable material is collected in the IMOG-region. After data analysis and the identification of recycling patterns, specific communication and educational activities can be developed, targeting specific groups of citizens.

This customer portal service will be further detailed in part 4.1.2 of this report.

²⁷ <https://www.keepsotlandbeautiful.org/media/845885/average-weights-furniture-reuse-network-2009.pdf>

²⁸ http://www.wrap.org.uk/sites/files/wrap/Appendix_3_-_Sample_customer_survey.pdf

4. URBANREC’s innovative practices for bulky waste management

The URBANREC project offered the opportunity for different partners to develop and implement new practices to improve bulky waste management, focusing on various aspects: information to residents, re-use, collection, sorting of materials, and new valorisation routes for sorted materials. This part provides an overview of these different practices.

4.1 Information and communication

4.1.1 Mobile app

The Mobile App was developed by IMOG within the framework of the project as a way to improve the communication toward residents regarding bulky waste management, and harmonise the information regarding the different possibilities of collection: dismantling service, re-use centres, and bulky waste collection. The app also offers the possibilities for new ways of targeted communication, such as push-messages to raise awareness on bulky waste prevention and re-use, or to promote specific events.

The app includes the following functions:

- Info-pages on prevention and sorting guidelines
- Locations of re-use centres and civic amenity sites
- A price calculation tool
- Possibility to reserve different services from IMOG and the re-use centres (on-demand collection, dismantling service).

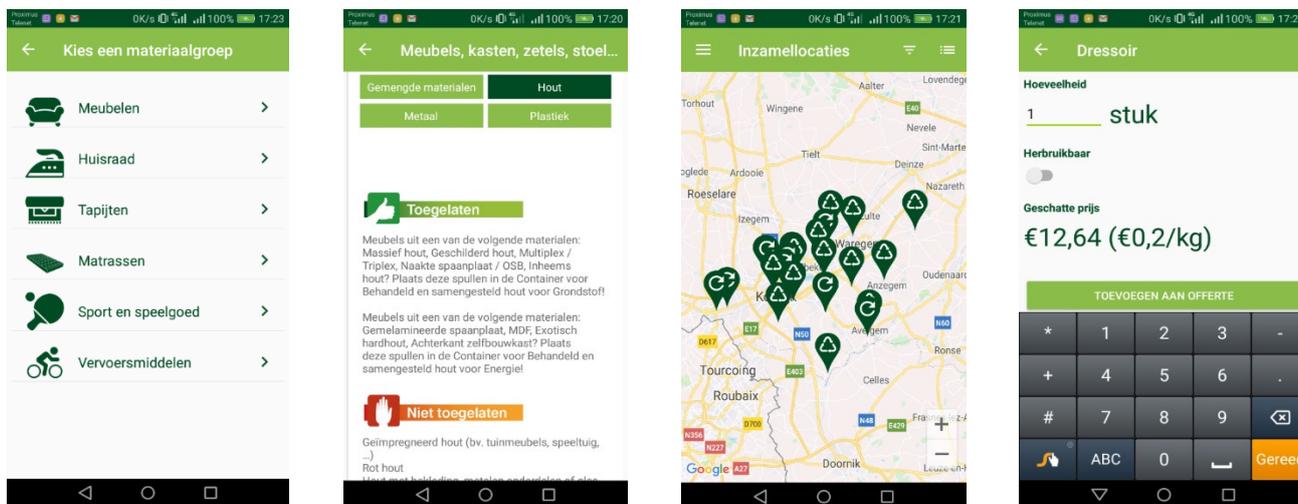


Figure 10: screenshots of the various sections of the Mobile App

The Mobile App is available in app-store (iOS) and play-store (Android) since January 2018 for the citizens of the IMOG-region. In mid-2019, about the app has about 400 users. A survey sent to the residents in the IMOG territory was conducted. It shows that about 25% of the respondents know the Mobile App, and that about 29% of them have already used it. The respondents were mostly interested in the practical information on CAS and re-use shops, the information on what to do with unneeded household appliances for recycling or re-use, and the information on IMOG and Kringloopcentrum’s collection services. Respondents also mentioned possible improvement, such as the possibility to directly contact a person for a personalised answer, the fusion with the Flemish recycling app (or the integration of information on other waste fractions), or more information about the outcome of sorted products/waste.

4.1.2 Customer portal service

IMOG also developed a customer portal service in order to collect data on recycling patterns of citizens with a specific focus on bulky waste. Data are collected when the residents are using the civic amenity sites, where 90% of the recyclable material is collected in the IMOG-region, and where residents have to use an individual card to access and pay for bulky waste collection. The data collection and analysis are then used to define specific communication and educational activities targeting specific groups of citizens.

The customer portal service was implemented in parallel of the new differentiated tariff for bulky waste brought in CAS: the civic amenity site is separated in two sections, where different fractions can be sorted. The first one is free and open to the public and welcomes sorted materials. The second section (where mixed bulky waste is collected) can only be entered via a barrier-closed entrance with an identification column. To access this section, visitors have to use their eID-card, the car is weighed, and he/she receives a temporary CAS-card for this specific visit. At the end of the visit to the paying section of the CAS, the citizen is paying for the charged fractions discarded. The payment is done via a payment-terminal. After payment the citizen can leave the CAS via a barrier-closed exit with identification column.

Some data are transferred to the customer portal (Gender, age, address, date of the visit, types of waste brought, quantities). The collected data are anonymised.

The communication activities can consist in additional information put on CAS containers, or even specific messages printed on the receipt of residents that used specific containers.

The survey addressing residents in the IMOG territory also focused on the customer portal and the information users could be interested in. Respondents are interested in getting more information on the quantities of sorted materials that they brought, as well as the amount of points that they collected for bringing valuable material for recycling.

4.2 Promoting re-use

4.2.1 Dismantling service

The dismantling service is a new service developed by IMOG within the framework of the project. Residents often asked about such a service, but IMOG or the re-use centres were not in capacity to offer it. The on-demand collection of bulky waste is only available for products that are put on the kerbside, and the on-demand collection for re-use does not offer the service of decluttering a whole house. Such service was also requested from the public housing sector, for the removal of furnishings after a relocation of people in a difficult social context. Therefore, this new service was set with two objectives: offer such service to residents, and collect more products for re-use.



Figure 11: dismantling service

The new service was implemented by IMOG and the Re-use Centre. Due to its focus on re-use, it was established within the existing structure and services of the local re-use Centre, that provides the pick-up team (consisting in 2 full-time equivalents through social employment) and a lorry. IMOG is responsible for the handling of non-reusable items. Training was organised for both staff in charge of the information and employees doing the dismantling.

The service consists in removing the whole furnishing of a house (e.g. in case of death or relocation). Residents can call the service, then an

employee is sent to assess the re-usable furniture and the time needed for emptying the house.

If more than 4/5 of the items are re-usable, then the service is provided for free. If the resident agrees, then a date is schedule. The service includes the following steps: emptying the closets and packing of the items, dismantling the furniture, and bringing the re-usable goods to the re-use centre and the waste to IMOG’s facilities.

The main results of the dismantling service are presented in the following table:

Table 3: first results of the dismantling service

	2017	2018	2019 (until beginning of Oct)
Number of dismantling	186 times	36 times	77 times
Collected re-useable quantities	195 tonnes	77 tonnes	70 tonnes
% of re-used quantities from total collected quantities	72%	83%	79%

The survey investigated the impressions of residents on the dismantling service. 23% of the respondents knew about it, and among them 29% have used it. 93% of the users were satisfied with the service. 71% of the respondents would be interested in using the service.

4.2.2 Implementation of a re-use container in CAS



Figure 12: Lliria CAS container in its first location

URBANREC Spanish partners also developed a strategy to boost re-use in their territory, thanks to transfer of experience from the Belgian partners. One of the actions implemented was a re-use container that was successfully installed in the CAS of Lliria in March 2018.

The container was brought to the premises of the Fundació Tots Units, a social economy company with which Consorcio has agreed on the management of the materials available for re-use. This experience had positive impact on the visibility of the collected materials, but the lack of controls (linked with the fact that the container was open and away from the

control booth) lead to the disappearance of some of the objects in better conditions.

Another experiment was launched in September 2018 in the CAS of Bétera, where a different way of storing bulky items that are potentially re-usable was experimented. A simple ship container, closed and with anti-lever and anti-shear lock was chosen on this occasion. This model has as a strong point the low cost of the container. On the contrary, the emptying is more complicated, since it requires either to be moved with a self-loading container carrier contracted expressly, or to make a manual emptying and loading of the contents in a cargo

vehicle that in turn must be manually unloaded at destination. It was decided to place it in the busiest area, next to the entrance.



Figure 13: Difference in the content of the containers in both models; Bétera (left), Lliria (right).

The first results of the experience of Bétera are encouraging, insofar as their filling has been much faster, and that the reports after the management of the company preparing for re-use indicate a greater content in re-used elements and less residues.

These experiments lead to the following conclusion: re-use containers will be put in a location where controls can be ensured, and the content will be kept hidden as much as possible.

4.2.3 De Hangaar

Some re-usable items might not be suitable for re-use shops, because of imperfection, or because they find no interest from the visitors. To overcome this challenge, IMOG launched a new collaborative network called “Hangaar²⁹” composed of different organisations: charities, social enterprises, second-hand shops, and schools of art. The network took the form of a physical warehouse where the people belonging to the network can come once a month in order to buy goods that were not good enough for re-use shops. The warehouse gathers all the items that were not sold at the re-use shops, or that have imperfections but are still functional. Prices are very competitive.

The network also developed activities such as workshops, repair cafés, etc. targeting residents, students, etc.

Through the Hangaar an extra 106 tonnes of bulky items were re-used between December 2017 and October 2019.

The survey also focused on de Hangaar: 31% of the respondents knew about it, among which 32% have already visited it. The survey also shows that 74% of the respondents are interested in buying second-hand products at the Hangaar, while 14% do not buy second hand products in general, and 12% are not interested for various reasons. People buying second-hand products are mainly motivated by promoting re-use and finding products at reasonable prices. Among the users, 87.5% were satisfied. Most users were satisfied with the prices (75%), while 54% were satisfied with the offer; the limited offer was mentioned several times for possible improvements.

4.2.4 Developing a re-use strategy in Warsaw

Following the implementation of a new waste collection system promoting source-separation in Warsaw, new collection systems for bulky waste were developed, including the implementation of 2 civic amenity sites and 5 mobile civic amenity sites, as well as on-demand services. In the meantime, and taking advantage of Poles’ raising interest for second-hand products, several actions to promote re-use were launched. The re-use strategy aims at

²⁹ <https://de-hangaar.be/>

introducing a network of re-use centres in collaboration with a network of relevant organisations, communication actions on the possibilities for bulky waste prevention, and education on re-use of bulky items.

To develop a network of re-use centres, it is regarded as very important to build upon the existing re-use initiatives to take advantage of their expertise and current infrastructure. The re-use centres are considered as integral part of social economy. Local authorities might need to ensure the control/certification of re-use centres to ensure the quality and reputation of the re-use network, and will ensure the proper information of residents.

Setting a collection system that ensures the preservation of re-usable items is seen as an important challenge. The favoured options are on-demand collection targeting first single-family houses (based on the existing collection system set for WEEE), and the collection in re-use centres located in the CAS, where the re-usability can be checked.

In 2018, the City of Warsaw started a cooperation in the field of R&D activities with the Faculty of Design at the Academy of Fine Arts in Warsaw. The objective was to develop study projects concerning the recycling of cabinet furniture for re-use on an industrial scale.

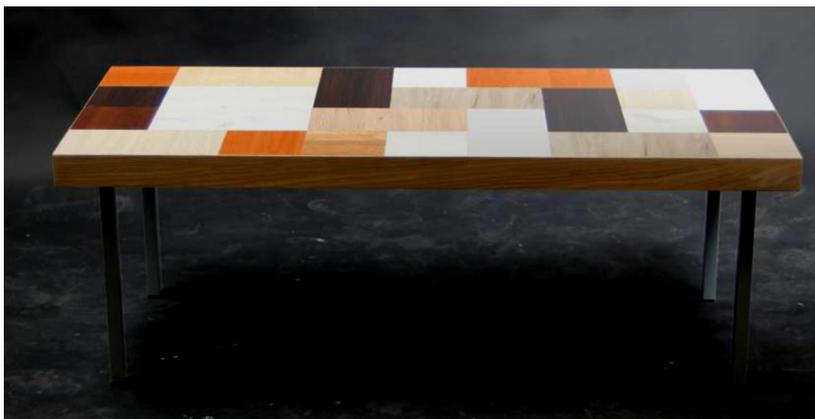
Students were first invited for a visit to the bulky waste collection facilities to get a better overview of the current management system. In January 2019, students presented their projects, including the following:

VINCER box game made of plywood and HDF board by Dominika Bielecka





A mosaic table made of plywood and HDF board, by Julia Młodzianowska



A municipal or district exchange system which can serve as a place for storing and exchanging parts of old furniture, made of plywood and HDF board by Dominik Krzysztofik

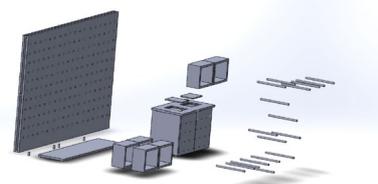
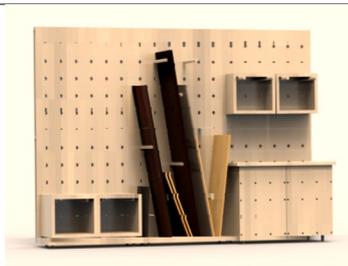


Figure 14: examples of students' projects to recover bulky waste materials

The designs are characterised by a practical, modern approach to the recycling of bulky waste. These interesting solutions seem to have a chance for commercialisation and marketing, if they manage to secure the necessary funding.

The greatest challenge which the authors of those works faced was to obtain materials of appropriate quality from bulky waste. In practice, the collection of waste without traces of damage in sufficient quantities turned out to be impossible. The students bought “scraps” of boards from furniture manufacturers and suppliers. It is a vital aspect which needs to be taken into consideration while designing the system:

- Make residents aware of the possibility to donate re-usable items;
- Ensure the preservation of their integrity (roofing, limited access of unauthorised persons);
- Develop awareness measures addressed to entrepreneurs and suppliers regarding the possibility of using spare production residue and unused elements as good quality raw materials.

Besides, source separation of mattresses was launched in both civic amenity sites, leading to the collection of 5.6 tonnes of mattresses in 2018 (compared to 300 tonnes for other bulky waste). Increasing the collected quantities is important to make the implementation of a

dismantling technology financially relevant; this will be done through the development of a network of 18 CAS and communication activities.

4.3 Developing source separation

4.3.1 Modification of the separation in civic amenity sites



Within the activities of the project, URBANREC partner Consorcio decided to adapt its separation protocol for bulky waste in its collection facilities to increase re-use and recycling. First, one of the civic amenity sites collected waste and monitored the quantities according to the new classification. This quantification led to a new distribution of containers and the final decision regarding the new fractions to be separated in the civic amenity sites. The main conclusions reached after this first phase were:

Figure 15: containers available in CONSORCIO's CAS

- The quantity of collected mattresses would allow, in the case of container availability, to pick up foam mattresses and springs separately, avoiding manipulating the waste in the sorting facility.
- Likewise, it would be possible to collect in a separate container hard plastic, in case there is room for an additional container.
- On the contrary, the number of bulky textiles is so small that it does not justify the separate collection of this flow.

The new set of containers used in Consorcio's civic amenity sites is presented in the following table:

Table 4: containers available in Consorcio's CAS

Name of the container	Types of waste collected
A1.- Container for garden debris	20 02 01 biodegradable waste (garden and park waste)
A2.- Container for construction and demolition waste	17 09 04 mixed construction and demolition wastes
A3.- Container for non-hazardous bulky WEEE	20 01 36 discarded electrical and electronic equipment other than those mentioned in codes 20 01 21, 20 01 23 and 20 01 35
A4.- Container for ferrous scrap	20 01 40 metals 20 01 36 discarded electrical and electronic equipment
B1.- Container for bulky wooden items. (Furniture, boards, etc. with little proportion of improper materials such as glass, metal or plastics)	20 01 38 Wood
B2.- Container for furniture made of various materials. (Wood, metal, textiles, foams...)	20 03 07 Bulky waste
B3.1.- Container for foam mattresses	20 03 07 Bulky waste

B3.2.- Container for spring mattresses	20 03 07 Bulky waste
B4.- Container for mixed bulky waste	20 03 07 bulky waste
B5.- Container for bulky hard plastics	20 01 39 plastics

Depending on the available space, containers A3 and A4, and containers B3.1 and B3.2 can be group together in one.

4.3.2 Developing source separation and re-use in Bornova

Within the framework of the project, the city of Bornova established a new CAS where 13 different fractions can be separated including bulky waste. Citizens are being informed about how they can use this new CAS.

In order to promote the CAS/MCAS system and the re-use activities in the URBANREC project, the city of Bornova informs inhabitants on what to do with their bulky waste by using posters, brochures and a special web page within Municipality’s official website³⁰.



Figure 16: collection of reusable items in Bornova

In addition to the CAS services, there is also a special storage of 1,500 m² for the bulky waste collected during the campaigns conducted by the Municipality of Bornova. The storage is established in order to keep re-usable bulky items that are donated by the inhabitants attended to the collection campaign of Bornova. The Social Services Department of Bornova is the responsible unit on checking, cleaning, if necessary, repairing, and finally delivering the bulky items to people from low socio-economic profile living in the municipal neighborhoods.

Furthermore, a re-use centre will also be available soon in Bornova, which will allow donors to bring their bulky items. Since there was no local waste plan or strategy, collection of bulky item-related data has been overlooked. Consequently, making a quantitative analysis of the current situation regarding bulky waste is challenging. This is also partly due to the fact that people firstly share their old items with the larger family members or with neighbours in need.



Figure 17: scavenger in Bornova

Considering this “social sharing” mechanism, it can be stated that almost no items in re-usable condition go to disposal. There are also the unregulated trash scavengers who collect any recyclable and reusable materials in order to sell to scrap/junk dealers.

In addition, there are second hand shops run by private owners, where people can buy and sell bulky items. Local personal observations indicate that recyclable waste and reusable items only go to landfilling when they are in bad condition or scavengers miss them on

kerbside before they are collected by the official collectors.

Hence, it would not be wrong to state that official/regulated bulky waste management is in its early stage of development: source separation is very limited and most bulky waste is sent to

³⁰urbanrec.bornova.bel.tr

landfill. Since there is no concrete data available about bulky waste streams in the city, Bornova has decided to collect bulky waste four times a year through the collection campaign, and started building up a database as a beginning.



Figure 18: communication materials on bulky waste collection in Bornova

Taking into account the lessons learnt from the implemented technologies used in the four URBANREC regions, it is anticipated that within a 5-year period Bornova will manage bulky waste streams in a better way by analysing the data obtained from the collection campaigns to be conducted four times a year. Considering the demands coming from the citizens, which may increase the bulky waste quantities over a year, Bornova will re-plan the frequency of the collection periods accordingly.

Besides the activities mentioned above, Bornova Municipality organizes “Donations Days” to increase the awareness on re-use of second hand furniture and other household items. In addition to this, Bornova is running socially oriented projects like the Warehouse Bank Project, and the Needs Map Project, to which people can donate their second hand items or ask for donated items.

4.4 Policy work in Flanders

4.4.1 Visitations of municipalities

In Flanders, every municipality has a tailor-made municipal waste target in which bulky waste is included. The OVAM assists the municipalities with high residual waste figures to reduce the residual waste produced by the inhabitants of the municipality by looking at their policy, to help them preparing a future action plan, etc. More than 50 out of 300 municipalities have been reached.

In general, municipalities with high bulky waste quantities have to work on a better civic amenity site infrastructure (more space to collect more source-separated waste streams, a better identification system, a weighing bridge, etc.), a better price setting (clear pay-as-you-throw system with an obvious difference in price between recyclable waste and non-recyclable waste), a better collaboration with the re-use centres, and extensive training of the park attendants. During the visitations, these aspects are discussed and examples of the URBANREC-results such as the URBANREC-app have been suggested. The URBANREC-training for technology session in Flanders has also taken into account those aspects by elaborating a module for park attendants in which the importance of source-separated collection on the civic amenity site is specified in relation to the innovative URBANREC technologies.

4.4.2 Learning networks

In the Implementation Plan for Household waste and Comparable Industrial waste, the municipalities in Flanders are divided into 16 clusters. The classification of municipalities within the clusters is based on 150 variables, such as demographic ageing, socio-economic position of the population (living standard), urbanisation, central function, tourism, tertiary activity, industrial character and demography (both the natural component as well as migration). The calculation of the residual waste target of the municipalities is based on this clustering. A cluster includes both municipalities that have already achieved their target and municipalities that still have to make extra efforts to achieve it. Learning networks have been set up during

which information about overall waste policy measures and collection methods are exchanged between the municipalities to reduce their residual waste of which bulky waste is part of.

4.4.3 Definition of bulky waste

Due to the discussions on the definitions of bulky waste in the URBANREC legal working group, OVAM is exploring the necessity of changing the definition of bulky waste in Flanders.

4.5 Fragmentation of bulky waste

When items are not re-usable, it is important to consider recycling as the next relevant options. However, many bulky waste items are composed of various different materials that need to be separated before being sent to different valorisation routes.

A new fragmentation process for bulky waste was developed within the framework of the project, aiming at reducing their size and separating the different material fractions of e.g. mattresses, sofas, chairs, etc. The process relies on laminated cutting technology, using high-pressured water to cut objects. The advantage of this technology is that it allows to obtain clean and differentiated components at higher speed, thus making it possible to use it for large quantities while reducing energy consumption.

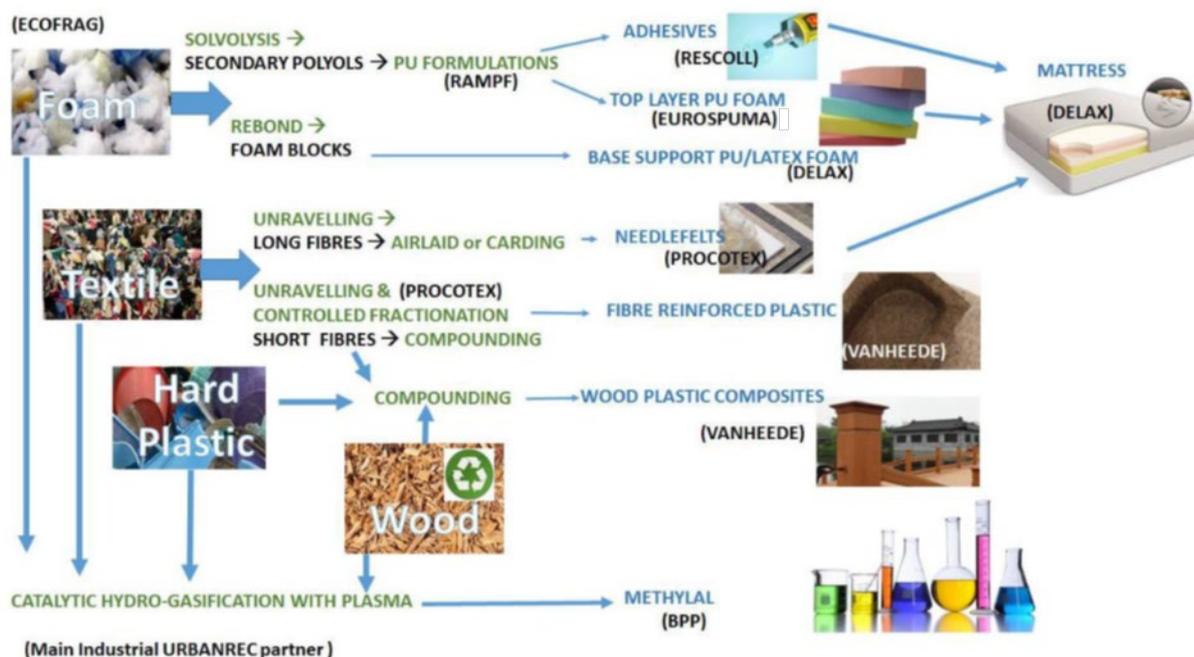


Figure 19: fractions separated by the fragmentation process, and applications for the separated fractions

The process was tested in a pilot plant on different types of bulky waste detailed below. The URBANREC consortium tested the fragmentation process on various, actual bulky waste items, and the obtained separated fractions were then tested to check their adequacy with the foreseen valorisation routes.



Figure 20: picture of the fragmentation pilot plant used during the project

4.5.1 Fragmentation of mattresses

Mattresses are collected together, but before fragmentation they are separated manually, between latex mattresses, mattresses with springs and mattresses without springs. Springs are separated before the cutting lamination process for recycling. Four different materials are obtained after mattresses fragmentation:

- Foam coming from mattresses without spring;
- Mixture of foam & textile coming from mattresses with spring;
- Textile and foam material coming from latex mattresses;
- Latex foam.



Figure 21: fractions separated from mattresses: metal, textiles, and foam

The mattresses processed over the course of the project were collected by Consorcio, and composed of Polyurethane (PU) or latex foam. For the mattresses with springs, metal parts were detached and sent for reselling.

The fragmentation process results in high purity products:

- The obtained PU foam can be applied for rebonding (i.e. the fabrication of new mattresses) and for glycolysis, to produce adhesives.
- The textile parts can be used to produce new textile applications (needlefelts, composites).



Figure 22: mattresses valorisation route

4.5.2 Fragmentation of mixed furniture

Two waste streams have been identified: hard plastic and wood. Hard plastics comprise mainly fruit baskets, chairs, and tables; wood furniture include sofas, chairs and tables.



Figure 23: plastic (left) and wood (right), before and after fragmentation

The obtained fractions are suitable for the production of wood plastic composite (WPC), which can be used to produce outdoor appliances and furniture.



Figure 24: valorisation route for wooden furniture

4.5.3 Fragmentation of Textile: upholstery, clothes, carpets, tyres

Two types of carpets are differentiated: those made from cellulose, mainly jute, and those made from synthetic fibres (polyamide).

Jute carpets can be separated into their front and back parts. The front parts, composed of cellulose and Polypropylene (PP), can be assessed for textile applications (needlefelts and textile composites) while the back parts cannot be recovered for such application, due to high amounts of glue.



Figure 25: valorisation route for jute carpets

The same results than for jute carpets are obtained for polyamide ones: the front and back parts are separated, and the front part can be recovered for textiles applications.



Figure 26: valorisation route for polyamide carpets

Besides, some samples of artificial grass are also being tested, since its structure is like that in the carpets, although they are made with different materials (plastic fibres and adhesives). On the other hand, artificial grass can be currently considered as urban bulky waste. The same results were obtained than for the carpets: the front part can be separated from the back part, and then sent to recovery for textile applications.



Figure 27: valorisation route for artificial grass

On their side, tyres are separated in three different kinds of waste: rubber, metal parts, and textile. The textile part is suitable for various textiles application thanks to the quality obtained with the process.



Figure 28: valorisation route for tyres

4.5.4 Fragmentation of plastic

For plastic fragmentation, a different technology is required. This was developed by URBANREC partner Vanheede and tested on actual samples of hard plastic collected in Flanders. Such fraction of bulky waste is composed of different polymer types (including PP, PE, PVC, ABS, PS, PA, PC, PMMA, etc.) on the one hand and of different production types (such as extrusion, blow moulding, injection moulding, etc.) on the other hand. It also includes contamination such as metal, wood, stone, etc.

The preparation of such plastic fraction for valorisation is achieved following several steps, a separation into polymer grades, followed by the cutting of materials into pieces of 10-15 cm. This resulted in 71% polyolefin (PO) materials of which the different fractions were further processed in the recycling line for PO plastics. This includes size reduction, washing and flotation, removal of the different metal fractions, regrinding and dedusting. While the obtained PO injection moulding fraction, composed of PP and PE, could be used as such in plastic processing, it was further purified to a 98% PP fraction in order to increase the material value. The start mix and sorted PP fraction of the PO injection moulding grade were processed via melt filtration to remove any residual non-melting impurities

Compared to virgin PP, both recycled plastics show a lower stiffness and impact strengths, but similar tensile strength and the PO mix fraction has a higher fracture strength.

4.5.5 How would a full-scale fragmentation plant run?

The fragmentation process can be applied to a wide range of waste fraction. A full-scale fragmentation plant would be adapted to process one specific type of waste. In this part, a description of a full-scale fragmentation plant to process mattresses is provided, to better explain how this process could be applied at industrial scale.

Such plant would produce sanitized foam, with removed odours, in different sizes depending customer needs (lower than 5 mm).

The process would be organised as follows:

- Firstly, the received mattresses are classified according to their characteristics such as the presence of springs, their material content (foam, viscoelastic, etc.) and their size. The production process is then organised based on this classification.
- Then, before the fragmentation process is initiated, the textile cover is removed. This fraction is sent to the green points until new applications are identified.
- After that, the fragmentation machine is fed by a conveyor belt where, through different setups, mattresses are split in its different components. Every different type of mattress, depending on its characteristics and the customer needs, will be processed by a different setup.

- The wet foam is then sent to a drying process, first mechanical and then radiofrequency-based, where moisture is reduced to below 5%.
- Finally, the dry sanitized foam goes through a vacuum packing system where several compacting presses reduce foam size to keep it packaged and stocked until it is sold.

The key figures of such a fragmentation plant are presented in the table below:

Table 5: key figures of fragmentation plant processing mattresses

Plant Capacity:	1 T/h
Product loss:	Up to 6% (Dependant of mattress age)
Water consumption:	100 l/t (90% water reuse)
Energy consumption:	500 Kw/t
Annual Assets Depreciation:	130.000 €

4.6 New valorisation routes for sorted materials

The URBANREC project has developed innovative valorisation routes for materials extracted from bulky waste. Even though they were developed at pilot scale, they show promising results for larger applications.

4.6.1 Adhesive and foams obtained from secondary polyols

Tests were performed to apply solvolysis route to obtain adhesives and foams using secondary polyols obtained from PUR foam coming from bulky waste. Two different solvolysis process were used: acidolysis and glycolysis.

Results of Urbanrec

Acidolysis

Glycolysis

Secondary polyols for...



Figure 29: Valorisation routes of secondary polyols coming from post-consumer polyurethane foam.

The obtained polyols from acidolysis was incorporated in viscoelastic mattresses top layer foam and used for PUR hot-melt adhesive. The secondary polyol from glycolysis process is used for insulation panel applications. The obtained polyol from post-consumer mattresses waste could be used successfully in flexible and rigid foam application and also for hot-melt adhesive.

4.6.2 Fibre reinforced Polypropylene materials from recycled textiles

The URBANREC consortium worked on the manufacturing of short fibre reinforced PP composite out of rigid plastic fraction from bulky waste. This works included several steps and test to determine the properties of the obtained materials.

The preparation of plastic fraction from collected bulky waste was presented in part 4.4.4.

Fibres were obtained through precision-cut of post producer waste (cotton, polyamide (PA) and polyester (PES)) and post-consumer waste (mattress textile). Granules of different types of fibre fluff (PES, cotton, jute, aramid) were prepared, using a fibre compacting machine.

This led to the development of short fibre reinforced composite (FRC). Different types and quantities of fibres were added to a virgin PP matrix, using a range of additives. The characteristics of the obtained products were then tested and compared to glass fibre reinforced composites (GFC) and wood plastic composites (WPC). Good results were obtained by adding cotton fibres and by increasing the fibre concentration. In terms of stiffness, the developed fibre reinforced composites are outperformed by the GFC to a great extent. However, they are comparable or even superior to the WPC material.

Replacing the virgin PP by the recycled plastics, and adding cotton fibres and a compatibilizer resulted in a considerable improvement of the mechanical properties. The tensile and flexural moduli and strengths even exceed those of the virgin PP grade.

The last test consisted in compounding and injection moulding of a storage box, using mattress textile fibres. The obtained fibre reinforced composite is outperformed by both the GFC and the WPC. Nevertheless, the FRC containing compatibilizer is definitely suitable for the production of storage boxes as it shows higher stiffness, flexural and impact properties than and similar tensile strength as the store-bought plastic box.

4.6.3 Wood plastic composites

Wood plastic composites are hybrid materials composed of wood flour and thermoplastic polymers, which combines the advantages of wood (lightness, processability, and durability), and the ones of plastic (molding capability and environmental resistance). Using wood as a fibrous filler material in WPC provides several advantages such as a low cost, and a wood-like appearance. The production of WPC also emits less greenhouse gases than the production of virgin plastic.

WPC were produced within the framework of the project, using fragmented recycled polymers (PP and PE from bulky waste) and recycled wood waste, using various filler composition for wood waste and different additives. The use of recycled plastics in the industrial manufacturing leads to a reduction in the melting temperature which results in a lower process temperature and a lower energy consumption, saving costs for manufacturers.

The product properties are at the levels presented by similar products made from virgin plastics available in the market. The demonstrations carried out in this study indicate the applicability of WPCs from recycled bulky waste in urban furniture and/or consumer goods sectors, in addition to other potential areas such as automotive, construction, and building.

4.6.4 CHGP technology

Catalytic hydro-gasification with plasma technology (CHGP) is a process that lead to the production of Poly-Methylal, that can be then used as a technical grade multifunctional chemical product or an additive for fuels. It can be applied to bulky waste (mixed hard plastic, wood, etc.) when no options are available for material recovery.

CHGP was applied to various mix of fragmented bulky waste (composed of plastic, textiles, and wood), which leads to interesting results:

- A reduction of volume by 90%, and of weight by 77% of the input;
- The production of 0.3-0.5 l of final product per kg of waste.

4.6.5 Design and manufacturing of foam mattresses with recycled materials coming from bulky waste

The URBANREC partners joined forces to design and manufacture a mattress as a demonstrator for the valorisation routes proposed in this project. The composition of the mattress is presented on the following figure:



Figure 30: Different components developed to set up the URBANREC MATTRESS DEMONSTRATOR

The different components are described in the following table:

Table 6: components used for the demonstration mattress

Component	Part of the mattress	Input used
Recycled polyol manufacturing	Top layer PU foam Adhesive	Post-consumer PU foam
Hotmelt adhesive manufacturing	PolyUrethane Reactive hot melts	Recycled polyols, along with petroleum-sourced polyester polyol and polyether polyol
Nonwoven manufacturing	Nonwoven	Post-producer and post-consumer mattress textile waste, different nonwoven processes tested

Top layer PU foam or soft viscoelastic layer manufacturing	Top layer	URBANREC F95 polyol
Mattress core manufacturing	Mattress core	Post-consumer and post-industrial PUR foam, two different rebounding processes

The final product was assembled by combining the different components mentioned above, following the key specifications to ensure their adequacy. Several processes had to be adjusted to meet these requirements.



Figure 31: materials obtained

The mattress underwent several tests and control to ensure its quality. Overall, it meets the objective set for most of them: density, resilience, fatigue resistance, biohazards, biomechanical comfort, and thermal comfort. The only unachieved objective is the rolling possibility.

5. Bulky waste management and urban metabolism

5.1 Urban Metabolism

Urban metabolism can be defined as “the sum total of the technical and socioeconomic processes that occur in cities, resulting in growth, production of energy, and elimination of waste³¹”. It can be used for various purposes, including the provision of sustainability indicators or input for environmental impact accounting.

An urban metabolism analysis of bulky waste management consists in understanding what can be its contribution to decrease the territories’ dependency to material and energy intakes and reduce its production of non-recoverable waste, while generating employment and growth, and maintaining its inhabitants’ well-being. The idea is also to see how URBANREC’s findings and outputs can contribute to improve on these aspects, and how citizens’ participation can be further secured.

Bulky waste management can have an impact on the urban metabolism of the city. A poorly performing system can generate illegal dumping, leading to the pollution of the environment, or illegal practices. Landfilling has a negative impact in terms of space consumption, production of greenhouse gases, as well as the “loss” of relevant secondary raw materials. On the contrary, the higher steps of the waste hierarchy can be associated with positive impacts: as mentioned previously, re-use generates benefits in terms of job creation (possibly in link with social employment), and environmental impacts (the re-used products are substituted to new ones, leading to the avoidance of the impacts associated with the extraction of raw materials, and the production and distribution of new products). Similar impacts can be linked with material recycling (economic value of the sorted materials, production of materials that can benefit to local companies, avoided environmental impact linked with the substitution to virgin raw materials, etc.).

The approach developed during the URBANREC project relied on the following analyses:

- An environmental analysis of bulky waste management in the different territories covered by the project, based on a Life cycle assessment (LCA);
- A social analysis performed by means of online questionnaires, targeting the four territories;
- A life-cycle cost analysis was conducted to assess the initial situation and the impact of the URBANREC’s outputs. Besides, business plans were developed.

These different analyses are developed in the following sections.

5.2 Environmental impact

Environmental impact assessments were performed for all four territories using an LCA model, which relates to the whole life cycle of the product or activity from the mining and mineral processing, product manufacturing process, distribution, use, re-use, maintenance, recycling up to the final disposal and transportation. LCA directs the study of the environmental impact of the product.

The analyses were based on the data communicated by the partners. The study focused on the management of mixed bulky waste, analysing the impacts linked with the handling of one tonne of bulky waste. It focuses on several environmental impact categories: climate change, ozone layer depletion, ecotoxicity, acidification/eutrophication, and fossil fuels.

The environmental analyses included the assessment of the initial situation, and how they would be improved thanks to the implementation of different URBANREC technologies.

³¹ Kennedy C, Cuddihy J, Engel-Yan J, 2007, The Changing Metabolism of Cities

5.2.1 Initial assessment

The management of mixed bulky waste differs from one territory to another. These initial situations are different from one to another, and reflects different types of bulky waste management, as well as different levels of details of the collected data. The scope of the LCA and its main results is presented in the table below:

Table 7: scope and main conclusion of the LCA for the four territories

Territory	Scope of the study for mixed bulky waste	Main conclusions
Warsaw	Mixed bulky waste sent to a dismantling station after collection, where ferrous metals and wood are sent to recycling, a part is sent to energy recovery as Refuse-derived fuel, and the rest is landfilled.	The main negative impacts come from the collection and transport of bulky waste (fuel combustion), and to a lesser extent from the emissions from decomposition in landfills. The recycling of ferrous metal and wood has a positive impact on the environment, as it is the case of the recovery of waste as refuse-derived fuel to produce heat.
Bornova	Mixed bulky waste is sent to landfill	Since no recovery of waste occurs, the environmental impact is negative, mainly due to the landfilling of waste, and to the consumption of fuel during collection and transport. Since all bulky waste is landfilled, there is also a significant loss of materials.
Valencia	A part of bulky waste is directly sent to recycling, another part is sent to landfilling, and another part is sent to a sorting facility (the outputs are going to recycling or landfilling).	The environmental impact is similar to the one observed in Warsaw, with landfilling being the main cause of the negative impact. Significant positive effects can be observed thanks to the recycling of ferrous metal and wood that are separated from the bulky waste.
Flanders	Bulky waste is collected either in CAS or on-demand. Mixed bulky waste is shredded, metals are sent to recycling while the rest is sent to incineration with energy recovery or landfilling	The negative environmental impact is associated with transport, shredding, and landfilling. Significant positive effects can be observed thanks to the recycling of ferrous metal that are separated from the bulky waste and from energy recovery in incineration.
IMOG (South West Flanders)	For IMOG, only the bulky waste sorted in the sorting centre is considered. This Bulky waste is collected either in CAS or on-demand. Mixed bulky waste is shredded, metals are sent to recycling while the rest is sent to incineration with energy recovery	The negative environmental impact is associated with transport and shredding. Significant positive effects can be observed thanks to the recycling of ferrous metal that are separated from the bulky waste and from energy recovery in incineration.

The environmental impact assessments in the four territories all point out the negative impact of landfilling and the potential savings of material recycling and energy recovery, which highlights the relevancy of identifying new possibilities to recover materials in mixed bulky waste. It is to be noted that for the sub-territory of South-West Flanders covered by IMOG, only the bulky waste sent to the sorting centre is considered, and bulky waste streams directly sent to landfill or incineration are excluded.



5.2.2 Impact of URBANREC’s technologies

The environmental benefit from implementing URBANREC’s demonstrator technologies in the different territories was assessed. The demonstrators’ products included in the assessments are:

- mattress with a recycled foam core based on rebounded foam, foam top layer and adhesives from recycled polyols and needle felt interlayer from recycled fibres;
- fibre reinforced composites;
- wood plastics composites from wood and plastic wastes;
- insulation panels;
- bio-based fuel additives;

In the “improved situation”, collection of mixed bulky waste would remain the same, but mixed bulky waste would be treated by the innovative URBANREC processes. The impact of each valorisation process was analysed, and then applied to the different territories. The destination and potential uses of the different fractions included in the analysis are presented in the table below:

Table 8: URBANREC processes and outputs applied to the different bulky waste fractions

Bulky waste fraction	Process	Output
Foam	Fragmentation process and rebonding process	Foam core layer /base support layer
	Fragmentation process and solvolysis process	Secondary polyols: <ul style="list-style-type: none"> ▪ adhesives production ▪ top layer PU foam production ▪ isolation panels production
Polyurethane and latex foam	Fragmentation process and catalytic hydro-gasification with plasma process	Methylal
Hard plastic	Fragmentation process and compounding process	Wood-plastic composites
Mixed bulky waste	Fragmentation process for catalytic hydro-gasification with plasma process	Methylal
Textiles: long fibres	Unravelling process and airlaid or carding process	Needlefelts Insulation panels
Textiles: short fibres	Unravelling and controlled fractionation process, and compounding process	Fibre reinforced plastic Textile fibres insulation panels
Textile fibres	Fragmentation process for catalytic hydro-gasification with plasma process	Methylal

The project analysed the environmental impact of URBANREC’s outputs in the different territories. Overall, implementing the technologies developed in the framework of the project would lead to significant saving compared to the current situation.³²

In all the regions, the positive effect is dominated by the production of mattresses with the use of foam, adhesives, and needlefelts produced from (mixed) bulky waste. In the Region of Valencia, the production of chemicals in Catalytic Hydro-Gasification with Plasma process (CHGP) technology has significant impact. The impacts of the improved situations are quite similar in all territories: the “saved impacts” mainly come from the production of chemicals in

³² URBANREC, D4.1 - Report on environmental, economic and social analysis

the BPP plant, and to a lesser extent to the used of plastic waste in the production of FCR chairs and WPC boxes, and recycled mattress production. Most of the remaining negative impacts comes from the landfilling of waste that cannot be recovered.

The positive impact on the environment of the final situation is seen in all 18 impact categories. As an example, the quantifiable result of the project is a significant reduction in carbon dioxide emissions, reducing the impact on climate change:

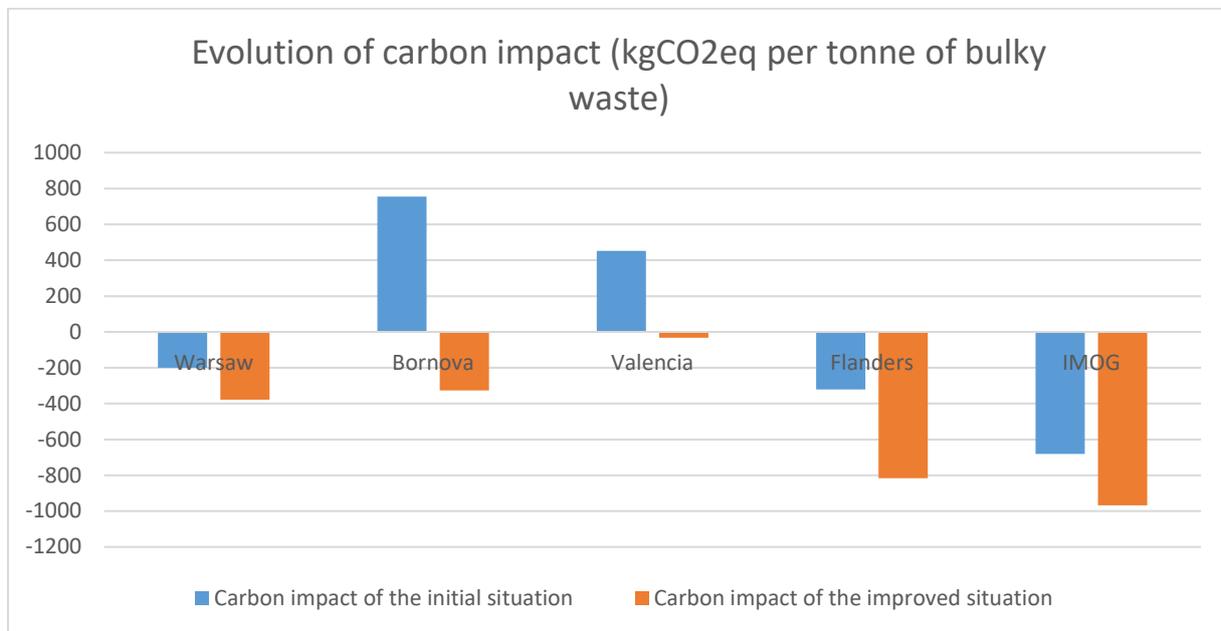


Figure 9: Evolution of carbon impact (kgCO₂eq per tonne of bulky waste)

The implementation of innovative technologies could lead to a reduction in the category “global warming” of more than 20% compared to the starting situation. The differences come from the different quantities and composition of mixed bulky waste, as well as the current performance of the waste management system.

In all territories, the implementation of URBANREC territories would results in an overall improved environmental impact. For instance, the following graph presents the differences in the impact of the initial situation (“SS”, in orange), with the impacts of the “improved situation” (“ES”, in blue):

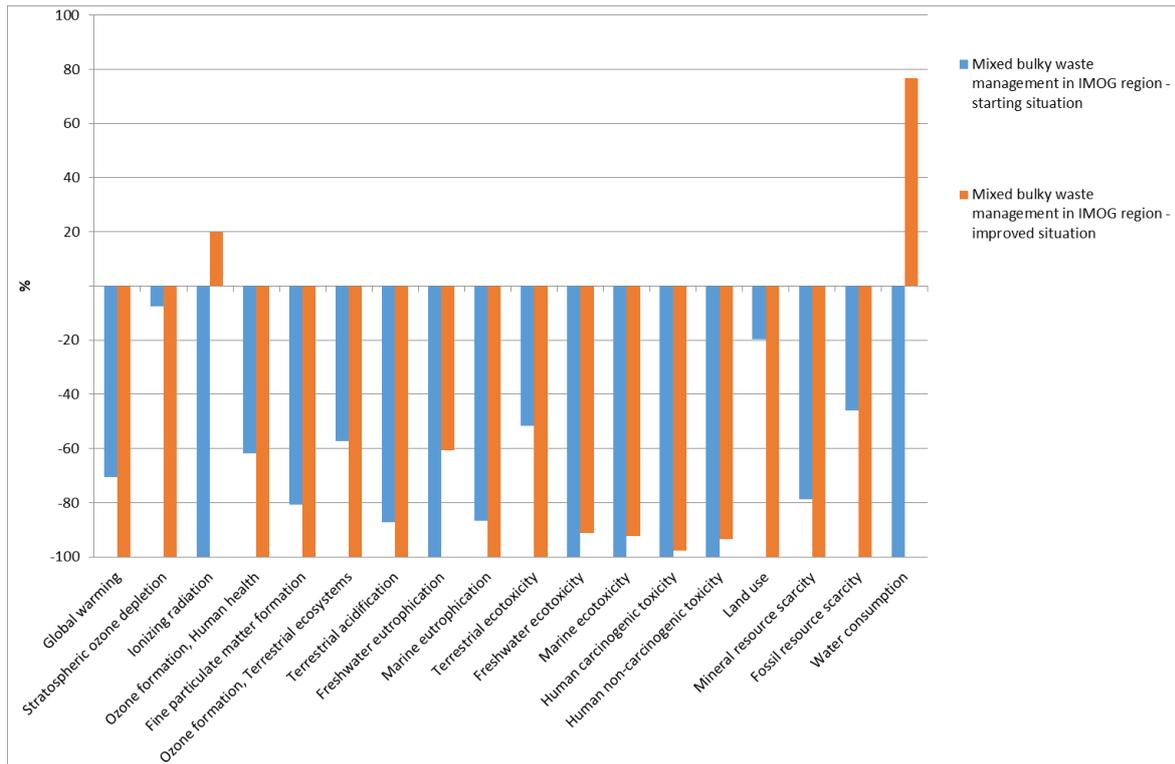


Figure 32: Comparison of characterized impacts of management of 1 Mg of mixed bulky waste in the IMOG region (starting vs end/improved situation)

However, the environmental impact can vary depending on the composition of mixed bulky waste, even though varying compositions does not change the fact that the overall impact is positive. It is therefore important to have good data on the quantity and composition of bulky waste to obtain relevant results on the environmental impact.

5.3 Social impact

For a waste management system to be successful, it is essential to secure the participation of waste producers, e.g. households. This is relevant to enable a proper source-separation that allows the preservation of products and/or materials, making re-use or recycling feasible. It is therefore interesting to assess the social acceptance of new systems and technologies to be introduced for bulky waste management, since it gives an indication on whether they might secure or promote residents’ participation.

Within the framework of the project, partners evaluated the social perception about the implemented measures and technologies (i.e. electronic cards, app, customer portal, re-use shops, etc.) and the opinion about the developed products from recycled materials (mattresses, insulation, urban furniture, etc.). A better understanding of citizens’ perception about the measures implemented in URBANREC contributes to the definition of future national or regional educational programmes in the selected areas. Moreover, it will help the URBANREC industrial partners to define marketing activities for the new developed products.

The social analysis was performed by means of public questionnaires. The online questionnaires were prepared in Flemish, Polish, Spanish and Turkish and disseminated in four regions: Belgium (the region of South-West Flanders), Poland (the City of Warsaw), Spain (Valencia province), and Turkey (the Bornova district of Izmir).

The outcomes of the questionnaires revealed some interesting insights:

- The use of Civic Amenity Sites is widespread in Belgium and Spain, but still has a potential for development in Poland and Turkey.

- More than 60% of respondents in Poland, Turkey and Spain think that adding bulky waste-related information to an already existing smartphone application for CAS services is a good idea.
- More than 80% of respondents in those countries are interested in passing on bulky items that they do not longer use or need to re-use shops.
- A special question directed to Belgian citizens was related to the Hangaar project which was developed within URBANREC to give a second chance of finding a new owner to bulky items which did not manage to get sold via re-use shops. Although less than 40% of respondents were already aware about the Hangaar project, 70% would be interested in buying second-hand items from the Hangaar shop.
- Similar was the outcome of another question regarding the dismantling service developed within URBANREC on the territory of South-West Flanders, consisting in the service of emptying an entire house. Less than 20% of interviewed respondents were aware of the existence of this service, but more than 60% would be interested in using it.
- Another interesting question sought to understand citizens' perceptions towards products made from recycled materials. The results reveal that respondents are largely in favour of such products but only if sufficient information (a label or a certificate) about the product and its characteristics are provided, indicating that they are safe to use.

The surveys show promising results concerning the introduction of new systems for bulky waste management, and that residents seem in majority interested in promoting re-use and recycling, regardless of the territory. It also shows promising results on products made out of recycling materials, even if some guarantees (regarding quality and safety) shall be provided in a clear manner.

5.4 Economic impact

A life cycle cost analysis was conducted in the different territories involved in the project to compare the current situation of bulky waste management, with a bulky waste management system improved by URBANREC's different outputs³³. To do so, various cost and revenue categories were listed, documented, and assessed. The analyses rely on actual data provided by the project partners, but also on assumptions and evaluations, with various degree of accuracy.

The analyses targeted the different territories involved in the URBANREC project and focused on mixed bulky waste as well as source separated fractions that can be then processed in the fragmentation plant, e.g. mattresses, or pieces of furniture. Assessments of life-cycle costs were also performed for each URBANREC process: fragmentation, acidolysis and glycolysis, production of adhesives, production of methylal, production of short- and long fibres, production of Natural Reinforced Plastics, production of wood plastic composites, production of fibre reinforced composites, and production of PU foam.

The analyses showed that the implementation of the URBANREC technology would be economically feasible in all four regions, as the available amounts of mixed bulky waste are above the threshold for systems to be profitable.

The comparisons of cash inflow/outflow of the current and "improved" situations for the four regions are presented on the following graph:

³³ See D4.1 and D7.2 report from the URBANREC project for more information

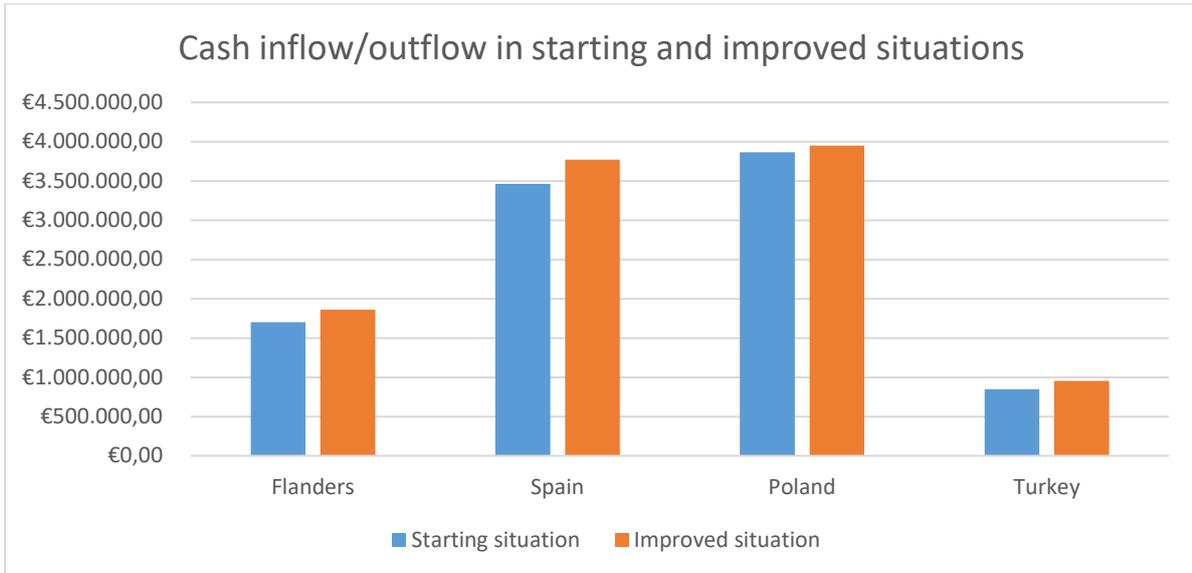


Figure 33: Cash inflow/outflow in starting and improved situations

For each of the URBANREC region, the potential quantities of bulky waste that can be used for the different URBANREC technologies, and the associated potential revenues from the products that can be manufactured out of the bulky waste, were assessed.

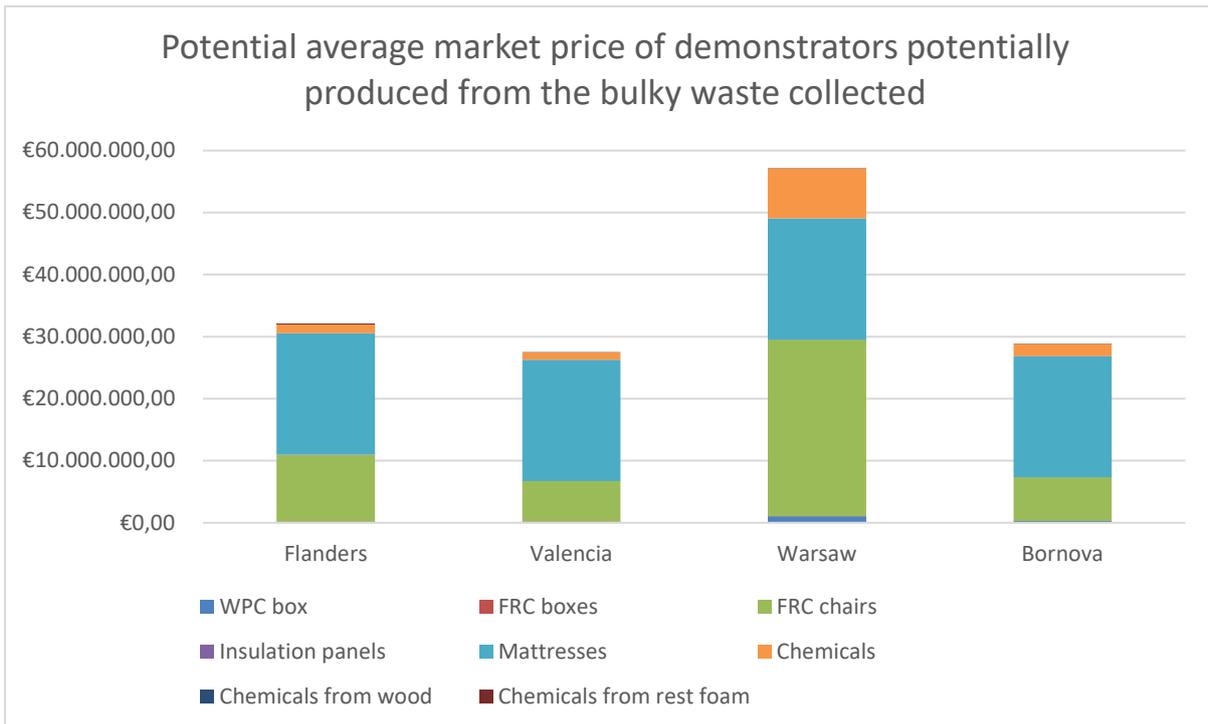


Figure 34: potential average market price of demonstrators potentially produced from the bulky waste collected in the different URBANREC regions

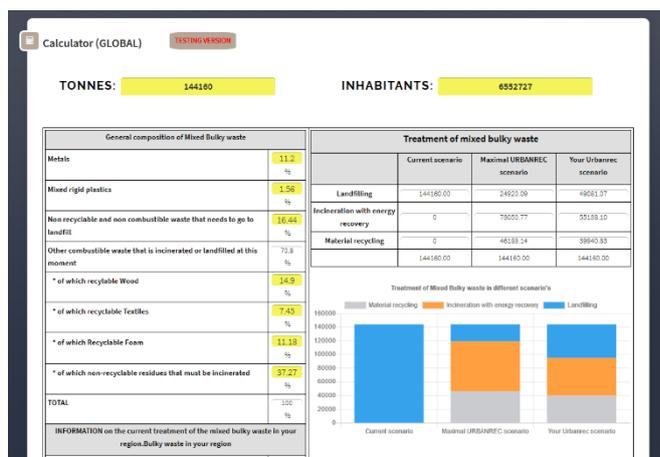
The graph shows a relevant potential for two main products: the fibre reinforced composite chair, and the mattresses.

5.5 Transferring URBANREC solution: interactive tool

The possibilities for implementation and potential impacts of the URBANREC solutions might be difficult to assess for any given territories. As presented above, the potential impacts will

depend on the available quantities, the composition of bulky waste, and the current bulky waste management system. While some more in-depth information was presented for the four URBANREC regions, which gives an overview from diverse types of situation, an interactive tool was developed by the project to help any territory to identify potential improvements though the implementation of URBANREC solutions³⁴.

In particular, a calculator is publicly available³⁵, allowing to obtain a first impression of the impact of URBANREC solutions on bulky waste management. The tool requires several local data, but leave the possibility of using pre-filled information. The user is able to fill in the following information: composition of mixed bulky waste, general information on the current management of mixed bulky waste stream, and to which extent it is decided to implement the URBANREC solutions.



The tool then presents how this implementation can impact the current bulky waste system in terms of treated quantities, which provides a first overview on the direct benefits for mixed bulky waste recovery.

Figure 35: screenshot of the URBANREC calculator

³⁴ https://urbanrec-project.eu/pre_tool.php

³⁵ https://urbanrec-project.eu/calculator_a.php

6. Policy recommendations

One of the main outcomes of the projects is to create the right European framework for the implementation and replication of the URBANREC results in EU Member States. The Local Authorities involved in the project are committed to consider the obtained results as a basis for future legislation and re-use/recycling incentives in every related country in the framework of their competences. The project's findings were aimed to inspire the proposal of recommendations for a draft European legislation addressing bulky waste.

In order to elaborate the recommendations, ACR+ established and has coordinated a Legal Working Group (LWG) involving the local and regional authorities partners in URBANREC, representing the four target territories of the project, as well as other industrial project partners. The LWG also invited representatives from the European institutions (mainly the European Commission and the European Parliament), federations of producers and recyclers (e.g. plastics and textile producers and recyclers, like EuPC, EUPR, EUROPUR, EURATEX, etc.), NGOs active in the field of environment and social economy (like RREUSE the European federation of social enterprises or EEB the European Environmental Bureau), and Member States and local and regional authorities representatives (like the Catalan Waste Agency).

Different meetings were held to identify and discuss the main barriers and opportunities regarding bulky waste management. The legal recommendations were defined according to these discussions, and agreed on by the whole consortium.

The legal recommendations are presented below:

6.1 Harmonised definition of bulky waste

In order to ensure that clearer and consistent European rules are implemented to bulky items reaching the status of waste, URBANREC proposes that the following definition of bulky waste (indifferently called urban bulky waste) is adopted at EU level and included in the relevant legislation, guidance and statistics:

'Bulky Waste' is (mixed) waste from households and similar waste from companies, that do not fit (because of size, shape or weight) in the local regular receptacle used for the collection of household wastes.

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

Construction and demolition waste, inert waste and wastes for which waste management legislation at EU-level exists (e.g. packaging waste, WEEE, batteries, etc.) are excluded from the definition of bulky waste.

The definition of bulky waste does not depend on the way this type of waste is collected³⁶ (e.g. door-to-door, civic amenity site, kerbside collection, etc.).

³⁶ Originally it was discussed to possibly include the following sentence: Bulky waste also includes "illegal dumping", e.g. bulky waste that is improperly disposed of by households and similar producers. However, after the approval of Directive (EU) 2018/851, the definition of municipal waste does not consider the collection or who is in charge of collecting as criteria; therefore the mentioning of littering becomes irrelevant since it is already de facto included in "mixed waste (...) from households" and "mixed waste (...) from other sources".

6.2 Promoting preserving collection for re-use and collection for recycling

Context:

- Member States have in the first place the obligation to support prevention of bulky waste by promoting re-use of goods and products.
- Preserving the integrity of products and then of materials should be a guiding principle for bulky waste collection.
- Reaching the current recycling targets for municipal waste could benefit from a specific collection of bulky waste in order to separate fractions presenting a high value and potential for recycling.
- This collection could be implemented via different options including, for instance, separation at a civic amenity site, at a facility operated by an operator of the re-use sector, etc.

Proposed recommendation:

Considering that the potential of re-use of products that could fall into the category of bulky waste after the end of their use phase might decrease due to the low preservation level of some bulky waste collection systems, URBANREC encourages the development of technical specifications aimed at diverting these products (including furniture, mattresses, etc.) from the municipal waste management system for the purpose of re-use, promoting “re-use friendly” collection models as well as specific deposit or storage locations at civic amenity sites for reusable products, and encouraging investments in such models as well as including re-use organisation in the design and/or organisation of bulky waste collection. This should also be supported with appropriate communication and awareness raising measures.

Moreover, Member States should support separate collection of different materials at the source in order to produce high quality recycled materials by the adoption of appropriate incentives and framework to facilitate this obligation. This could be done for instance via one or several of the following options: limit the collection possibilities for mixed bulky waste (e.g. via pay-as-you-throw on mixed bulky waste or limited quantity that can be collected, etc.), make it mandatory to propose source separation solution (CAS, on-demand collection for specific fractions, etc.) or others (e.g. targets on a number of collection points per inhabitants). In a pay-as-you-throw-scheme, the use of differentiated tariffs for mixed waste and source-separated wastes is essential.

Member States should support recycling as much as possible of the collected mixed bulky waste. Some good practices about collection and valorisation of bulky waste can be found in the results of the URBANREC project³⁷.

6.3 Separate quantitative target for preparing for re-use

Context:

The combined target for recycling and preparation for re-use of household and similar waste (e.g. the 65% target to be reached by 2030 included in the Directive (EU) 2018/851) might encourage Member States to focus on increasing the amount of recycling required to reach that combined target, rather than focussing on how to improve preparation for re-use rates. In addition, it seems necessary to introduce measures involving producers and importers of products that could fall into the category of bulky waste after the end of their use phase, in order to support cost coverage for re-use and preparing for re-use activities.

³⁷ Reports available here: https://urbanrec-project.eu/project_activities.php?op=2

Proposed recommendation:

URBANREC proposes that a separate European quantitative target for preparing for re-use (away from recycling) is adopted. Such target could be based on existing practices from Members States (E.g. in Spain the national plan for waste management 2016-2022 includes a 50% target for waste to be recycled or prepared for re-use by 2020 in which 2% of preparing for re-use should be reached. In Flanders, Belgium, the Waste and Materials Decree includes a target for re-use centres of 7 kg per inhabitant per year of reusable goods collected and resold). A clear methodology for monitoring the achievement of this quantitative target should be defined on the basis of further research.

URBANREC also proposes that Extended Producers Responsibility (EPR) principles are considered for certain types of bulky waste, for instance furniture, mattresses and carpets, in order to support in particular re-use, preparing for re-use and cost coverage of these activities (e.g. setting a take-back obligation as a priority approach, including the use of modulated fees to incentivise re-use and preparing for re-use, etc.). Furthermore, it is also proposed that EPR systems applicable to bulky waste include minimal quantitative target for preparing for re-use³⁸.

6.4 Minimum recycled content

Context:

The price at which recycled plastic can be produced is relatively stable while the price of virgin plastics fluctuates with oil prices. This volatility in the demand for recycled plastics and the related lack of market stability limits the incentives for long term investments in recycling technology and infrastructure and thus puts recyclates at a competitive disadvantage against virgin plastics. This issue is applicable to many fractions composing bulky waste.

Proposed recommendation:

URBANREC proposes that a minimum target for recycled content is adopted at EU level for some categories of products that allow relevant percentages of recycled content, for instance furniture. If possible, such target could focus on some specific material fractions from bulky waste recycling, like plastics and wood. Such target should be combined with standards/ measures to ensure consumer confidence/ health & safety.

Alternatively, Extended Producers Responsibility (EPR) principle to be established for certain types of bulky waste (for instance old furniture, mattresses and carpets) should include modulated fees taking into account recycled content if it does not reduce the potential for re-use (as a complementary approach to measures take-back obligation – see recommendation 3).

6.5 Extending Ecodesign Directive to bulky products

Context:

Drivers for improving product design and specification – in relation to recycled content, re-use of components, product durability, and design for disassembly/reassembly, repair, re-use, remanufacture and recycling – are weak or absent.

The Ecodesign Directive lays down the conditions and criteria for adopting implementing measures which set out binding requirements applicable to energy-related products. The

³⁸ E.g. in France EPR Organisations in charge of furniture have an objective to increase by 60% the rate of preparing for re-use by the end of their 4-year long authorisation compared to baseline situation, as well as specific quantitative targets for re-use furniture separately collected.

Commission now looks more systematically at resource efficiency aspects of the products covered by the Ecodesign Directive (but mostly for EEE).

Proposed recommendation:

URBANREC proposes that the scope of the Ecodesign Directive is extended to non-energy-related products (possibly via specific workplans per sector or product categories, amongst which, for instance, furniture, mattresses, carpets, etc.) and that it supports the removal of hazardous substances from products, and several circular economy approaches such as the inclusion of recycled materials, the long-lasting duration of products, the dismantling and reparability of products, as well as the recyclability of materials in bulky waste. This could be part of a larger non-energy products policy framework ensuring coherence of the process.

6.6 Addressing hazardous substances

Context:

There is a need to limit the risk that substances considered hazardous or risky according to current standards (E.g. carcinogenic, mutagenic or reprotoxic (CMR) substances, persistent, bioaccumulative and toxic (PBT) substances, very persistent and very bioaccumulative (vPvB), neurotoxicants, immunotoxicants, etc.) are incorporated in products that could fall into the category of bulky waste after the end of their use phase, as well as to limit the quantity of substances that can pose a threat to health or the environment.

The REACH regulation addresses most of these concerns in particular via the restriction procedure that can limit or ban the manufacture, placing on the market (including imports) or use of a substance that poses unacceptable risks to human health and the environment, as well as via the mandatory information to be shared in the supply chain. In addition, access to information about products including substance of very high concern (SVHC) will be facilitated in particular via the future ECHA database on SCIP – substances of concern in articles, as such or in complex objects (products)³⁹. However, the implementation of REACH is hampered by the low level of control in particular of imported products that could fall into the category of bulky waste after the end of their use phase and the cost related to that implementation.

Proposed recommendation:

URBANREC proposes that the control of products that could fall into the category of bulky waste after the end of their use phase is facilitated in particular by approving the testing of average composition of batches of certain types of these products (e.g. furniture) made of several complex articles (in the sense of REACH regulation) instead of requiring notification of each individual complex article composing those bulky products. A baseline of substances to be checked and a protocol for testing should be established in order to optimize the tests and limit the costs.

Further discussion should take place about easier and/or quicker procedures for some recycled materials, in order to facilitate the passage from waste status to new products.

6.7 Extended warranty for products

Context:

A longer lifetime for products, like the overarching concept of the circular economy, has the potential to generate new economic activities, increase the total GDP of the EU and offer societal and environmental benefits, while, at the same time, spurring innovation in existing business models. However, the concept of a longer lifetime for products is currently not explicitly present in policies and regulations in the EU and the Consumer Sales and

³⁹ More information about the SCIP database: <https://echa.europa.eu/scip-database>

Guarantees Directive does not include a guarantee that is long enough to cover bulky items: that Directive indeed only imposes a 2-year long guarantee, while bulky products like furniture or carpets usually already have a lifespan that is longer than 2 years, making this guarantee ineffective to these products. Thus, the current policy framework does not provide sufficient mechanisms to guide and regulate longer product lifetimes⁴⁰.

Proposed recommendation:

URBANREC proposes that minimum quality requirements and longer warranty periods, especially for furniture, are included into EU product policy, in particular the Consumer Sales and Guarantees Directive (1999/44/EC). In order to avoid a “rebound effect”, the warranty system should not consist only in “one to one” replacement, but should promote repair in the first place.

6.8 Mandatory information on products and substances

Context:

The first level in order to increase consumers’ trust in products incorporating recycled material is the availability of information about the presence of recyclates in those products. Such approach would also help to address the concerns about the presence of hazardous (legacy) substances in products and would be complementary to the information obligation along the supply chain set up by the REACH Regulation and the future ECHA database on SCIP.

Proposed recommendation:

URBANREC proposes that placers on the market (producers and importers of products that could fall into the category of bulky waste after the end of their use phase) have an obligation to provide information to the consumers about the recycled material incorporated in the product, such information being presented in a harmonised way defined by Law. This obligation should focus on specific material fractions, like plastics and wood, present in some categories of products that would become bulky waste after the end of their use phase, in particular furniture. To this end, recyclers should provide information to the producers on the origin and composition of their recyclates. Such mandatory product information could for instance take the form of standardised technical datasheets, with a range of content and residual values that would be acceptable for the consumer and in line with the REACH Regulation. A control system should be established in order to ensure that the information provided is reliable.

6.9 Standards and certification

Context:

Similar requirements for the quality of recycled material will help to ensure that bulky products incorporating recycled material achieve the same level of quality and have performances that are at least equivalent to those products using virgin material. It would also ensure that hazardous substances are properly addressed. The control of these quality requirements should be ensured by using a certification system that also follows the same rules.

Proposed recommendation:

URBANREC proposes that harmonised standards for recyclates (including testing of products in order to remove hazardous substances) and a single European certification system by third party organisations are established. The adoption of such certification system should be based

⁴⁰ In particular, a 2016 study “A Longer Lifetime for Products: Benefits for Consumers and Companies” commissioned by the European Parliament provides an evaluation of the potential impact of a longer lifetime for products in Europe, the (non-)legal context for an initiative on longer product lifetimes, and a wide range of policy options to optimize benefits to society.

on an analysis of existing certification schemes (e.g. EuCertPlast, etc.) and, when appropriate, implemented as early in the manufacturing process as possible. If these certified recyclates that still have the waste status are used in new products, these production processes can be exempted from the permit obligation for waste treatment installations and replaced by a declaration to the appropriate body.

6.10 Extending Ecolabel to bulky items and re-use

Context:

The EU Ecolabel is multi-criteria, based on scientific evidence and life-cycle based approach, third party certified and revised regularly to follow technological evolution. EU Ecolabel criteria cover the environmental impacts of the products, as well as their technical performance and social criteria (for products groups for which the social aspect is particularly relevant, e.g. textiles). Currently the Ecolabel applies only to furniture and mattresses. Besides, the re-use aspect is not covered by the EU Ecolabel.

Proposed recommendation:

URBANREC proposes that the EU Ecolabel is extended to new product groups, in particular products that could fall into the category of bulky waste after the end of their use phase not already covered by Ecolabel criteria, for instance carpets.

In order to support social acceptance of reusable products, URBANREC also recommends to take measures that will promote the adoption of quality guarantee label for second hand items and certification of re-use and preparation for re-use activities by professionals. Such certification could be inspired from “Approved Re-use Centres and Networks principles” proposed by the RREUSE network.

6.11 Access to reusable items by professionals of re-use activities

Context:

Professionals working on re-use and preparing for re-use activities (including social enterprises and charities) are important contributors to increasing the quantity of bulky items that are repaired and put back on the market via “second hand” shops, networks and similar initiatives. Their activities could increase if these organisations and professionals have access to items that are still in a state that will enable direct re-use or preparation for re-use.

Proposed recommendation:

Considering that the potential for re-use of products that could fall into the category of bulky waste after the end of their use phase might be limited once it reaches a collection site, URBANREC recommends that access to these products at the end of their use phase and bulky waste is granted to re-use organisations, either by collective schemes or directly by municipalities or other operators such as retailers. This should cover access to sites where potentially reusable products that could fall into the category of bulky waste after the end of their use phase are deposited as well as bulky waste. Access to spare parts of bulky items by re-use organisations should be ensured as well, in order to make sure that these products can be easily repaired.

Further details about this access could be provided within EPR schemes applicable to bulky waste, in particular to ensure cooperation between producers, municipalities and professionals working on re-use and preparing for re-use activities. This cooperation could also take the form of sub-contracting or subsidisation of bulky waste collection by public authorities to accredited re-use professionals, possibly with a role for local authorities to ensure the collection and treatment of non-reusable fractions.

Additional measures should include a quality requirement (ensuring that re-use organisations receive reusable products for instance) and obligations for EPR systems to collect products that could not be re-used from re-use organisations.

As a counterpart, the appropriate measures should be taken in order to ensure that re-use organisation effectively contribute to the second life of products, for instance by conditioning the support to re-use organisations to specific objectives.

6.12 Exemption to environmental permitting for re-use activities

Context:

Professionals handling waste at their site often require an environmental permit, if the organisation uses, treats, recovers, stores or disposes of waste. This also applies to bulky waste managed by Professionals working on re-use and preparing for re-use activities. In the case of an onsite re-use shop, for instance, “handling” generally refers to putting an item through the workshop, stripping down for recycling, safety testing, etc. Environmental permits can however create a significant burden for small operators involved in re-use and preparing for re-use activities. In some countries exemptions to environmental permitting are given on the basis of quantities of waste handled or because these waste handling activities are low risk.

Proposed recommendation:

URBANREC proposes that the waste management regulations support the functioning of the organisations active in the re-use, repair and refurbishment of products that could fall into the category of bulky waste after the end of their use phase, as well as their storage. For registered organizations operating in this field in accordance with certain standards, URBANREC recommends an exemption from waste management permits. Due to the applied technologies, the using of environmental permits is necessary and these organisations should be registered to the appropriate environment agency.

6.13 Support the development of GPP criteria for bulky items

Context:

Through their purchasing power, public authorities have the possibility to leverage the market and encourage the development at a larger scale of products that are more sustainable. The EU legal framework on public procurement supports a greater inclusion of environmental and social aspects in the tendering process, in particular via Life Cycle Costing. Moreover, the European Commission has developed guidance in the form of Green Public Procurement (GPP) criteria, in particular for furniture. Such approach remains however voluntary.

Proposed recommendation:

Following the example of EU GPP criteria for furniture, URBANREC proposes that GPP criteria are developed at EU level for additional products that could fall in the category of bulky waste after the end of their use and that such criteria promotes re-use as well as recycled content.

6.14 Support of social enterprises via social clauses in tendering procedures

Context:

Social clauses can be used in public procurement tendering procedures to support social enterprises for contracting certain activities such as bulky waste collection and re-use services. The European Directive on public procurement allows Member States to reserve

contracts for social reasons, but the impact of this measure will depend on whether Member States choose to implement this aspect of the rules.

Proposed recommendation:

URBANREC proposes that the principle of social clauses is integrated in the European Waste Legislation in order to ensure that re-use social enterprises are prioritised for public tenders for re-use schemes. Examples from France, Spain, Italy and Belgium demonstrate how social clauses are being used around Europe⁴¹.

6.15 Using VAT

Context:

Although the EU does not have a direct role in collecting taxes or setting tax rates, it has standard rules on VAT, which could be a way to incentivise products that are more easily repaired and disassembled or that include recycled material.

Proposed recommendation:

URBANREC therefore proposes that a harmonised approach for a zero or at least reduced rate of VAT is encouraged at EU level amongst others in the following cases:

- bulky products that include recycled material (in particular plastics and textile);
- repair and refurbishment activities and/or re-used products;
- products benefiting from the EU Ecolabel or equivalent recognition;
- business models encouraging optimisation of use and lifetime of products (e.g. leasing).

⁴¹ E.g. France has a national Social Economy Law which establishes that local authorities and public institutions will be required to develop and publish schemes to promote socially responsible public procurement.

7. Conclusion

The guidelines present a general overview on bulky waste management along with the main outputs of the URBANREC project to inform residents, promote re-use and source separation, and recover mixed bulky waste. It is important to keep in mind that bulky waste management systems are not necessarily transferable, and that the choice of collection and management systems must be done according to the local specificities and possibilities. However, it is also important to highlight the importance of preserving the integrity of products and/or materials during collection, to make re-use and recycling possible, and to make the collection of mixed bulky waste as unattractive as possible to promote source separation.

To secure the population's involvement, it is important to provide them with:

- **Consistent and clear information** on the collection system, explaining the different possibilities to bring their items or waste for re-use and recycling, detailing how source-separation should be done, and presenting the most preferred solutions first (e.g. re-use).
- **A convenient collection system** that takes into consideration the possibilities and constraints of inhabitants: a dense network of collection point, easy to access and open at convenient time, and/or on-demand collection that ensure quality sorted items;
- **Motivations and incentives** to go for the best option (re-use, recycling, then energy recovery), either by charging for mixed waste collection, or rewarding for source separation. Another motivation can be to highlight and inform inhabitants on the positive outcomes of their behaviours: job creation, positive environmental impact, production of quality second-hand products or secondary raw materials, etc.

While more ambitious bulky waste management systems might be more demanding for inhabitants, it is also important to highlight the fact that the URBANREC surveys tended to show that residents show interest in contributing to re-use activities by making their items available to re-use organisations.

The URBANREC project identified different solutions to improve local bulky waste management systems; data show that there is a significant potential to improve the current management of bulky waste across Europe, which mainly relies on landfilling. It seems that the implementation of URBANREC technologies could contribute to significant improvement in climate mitigation, with interesting economic outlooks.

These guidelines only present summaries of URBANREC outputs. More information is available in the project's publication that are [available here](#).