Treatment of mattresses for improved recycling of materials

In a nutshell

Summary overview							
It is best practice to sanitise and disassemble end-of-life mattresses, separating and sorting the different materials by type. Five main technical operations can be identified in a best performing end-of-life mattress treatment facility: • feeding and storage: reception (unloading) and dry storage to avoid contamination, sorting by type; • sanitising: applying chemical or heat treatments for sterilisation; • filleting: cutting the mattress' outer fabric cover and the binding flanges; • disassemble and sorting: separating and sorting the different materials by type; • handling materials: baling processes, product storage as bales, loose material (sorting residues) or in containers (metals), before delivery to downstream processes (e.g. recycling of metals). The disassembling and sorting operations can be carried out mechanically or (more commonly) manually.							
Waste management area							
Cross-cutting	**MSW - strategy**	**MSW - prevention**	**MSW - collection**	**MSW - EPR**	**MSW - treatment**	**CDW**	**HCW**
Applicability							
There are no main technical barriers to the applicability of this best practice. The simplicity of the treatment process does not require significant investments, even for the most automated processes. The most important obstacles for mattress recycling are identified as follows: • economic factors, notably the low cost of landfilling and the low quality of the materials arising from mattresses, linked to the need to store end-of-life mattresses in a clean and dry place and current mattress designs preventing easy disassembly; • the low treatment capacity of the facilities, limited by the end-of-life mattress flow collectable in the area surrounding the plant at affordable transport costs.							
Specific environmental performance indicators							

- Plant sorting rate (weight %), calculated as the annual quantity of materials sent for recycling divided by the annual quantity of waste mattresses processed.
- Energy efficiency (kJ/t), calculated as the annual total energy consumption of the plant divided by the quantity of waste mattresses processed.
- GHG emissions (t CO_2e/t), calculated as the annual total CO_2 equivalent emissions (scope 1 and 2) of the plant divided by the quantity of waste mattresses processed.

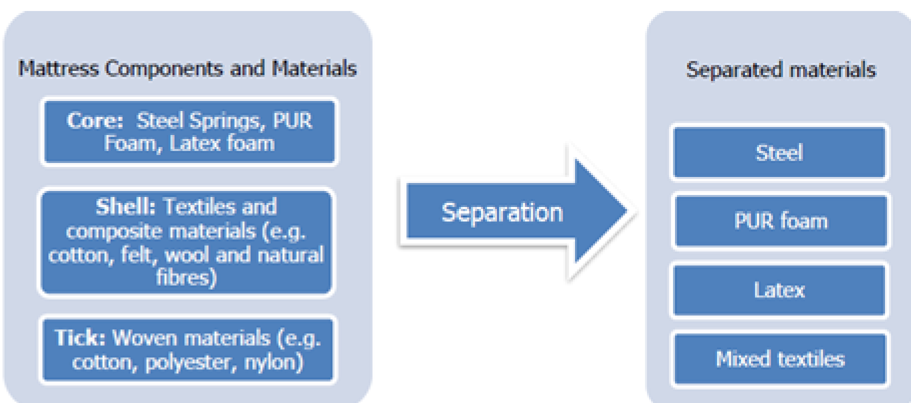
Benchmark of excellence
Facilities treating waste mattresses have a plant sorting rate of at least 91 %.

Description

In Europe, up to 30 million mattresses annually reach their end of life and it is estimated that 60 % go to landfill and 40 % are incinerated (EBIA, 2014). However, at least 85 % of their mass can be readily recycled through simple disassembly (CalRecycle, 2012). Their bulkiness makes them difficult to handle during waste pickup and transport, their low density makes them undesirable landfill material (an average mattress takes up 650 litres of landfill space as compression is difficult) and their springs have a tendency to damage landfill and transfer station compacting or shredding equipment. On the positive side, many municipalities throughout the EU already have in place effective collection schemes for bulky items, including mattresses, which can conveniently transport end-of-life mattresses to the treatment facilities (CalRecycle, 2012; ISPA, 2004; WRAP, 2013).

This best practice tackles the treatment of end-of-life mattresses, consisting of sanitising and fully deconstructing them, separating and sorting the different materials by class and supplying these materials to relevant end markets for recycling.

The composition of mattresses varies greatly, but they are usually categorised based on their main core material, which falls into three common types: steel springs, polyurethane foam and latex foam. Mattresses may also contain other shell materials surrounding the core and ticking which contain and protect the internal sections of the mattress (Zero Waste Scotland, 2013). In the mattress treatment process, these different material types are separated to achieve maximum value in end markets (Figure 1).



Source: Zero Waste Scotland, 2013

Figure 1. Composition of mattresses and types of separated materials

Despite the different mattress types and process methods applied, five main technical operations can be identified in a best performing treatment facility:

- Feeding and storage: this operation consists of reception (unloading) and storage of the end-of-life mattresses in a dry and covered area. Mattresses are stored off the ground, to prevent contamination and damage from water and dirt, and are stacked efficiently to maximise the number of units loaded in the storage containers. Best management practices are applied to check the mattresses for suitability, in order to keep unacceptable items out of the facility, and to prevent the spread of bedbugs. In most cases, mattresses are already stored according to type at this stage, as their type (and in particular the presence of inner springs) significantly influences the dismantling process.
- Sanitising: this operation is carried out by applying chemical or heat treatments for mattress sterilisation, in order to guarantee healthy working conditions and the hygienisation of the recovered materials.
- Filleting: this operation consists of cutting the mattress' outer fabric cover and the binding flanges.
- Deconstruction and sorting: this operation consists of separating and sorting the different materials composing the mattress by type; for innerspring mattresses, the first operation consists of separating the metal innerspring unit and the wooden box spring foundation from the other components; for the other mattress types or the other components of innerspring mattresses, the mattress is then dismantled in its different layers, separating and sorting the cotton and other textile fibres and the cushioning materials (including mainly polyurethane foam, memory foam, latex rubber foams and natural fibres).
- Handling materials: this operation consists of baling processes, product storage as bales, loose material (sorting residues) or in containers (metals), and includes loading operations for products and residue streams to be delivered to downstream processes.

The deconstruction and sorting operations can be carried out in different ways:

- manual processing, with the first filleting operations carried out using non-power box cutters or disc grinders and all the operations of removing, separating and baling the different materials done by manual labour, supported by simple equipment like forklift trucks with bale clamps, pallet trucks, pallet racking, workbenches, low-speed shredders/granulators and material balers;
- automated processing, by using specific equipment for the removal of the innerspring units[1] or even fully automated lines using metal detectors to separate non-metal and metal-based mattresses, machines for cutting mattress edges, peeling rolls for removing the outer textiles, magnets for removing the steel springs, cutting machines for reducing foams into manageable pieces[2]; in most cases, this method first requires manual operations for the filleting of the mattress;
- a combination of the two methods.

Currently, the most commonly applied option is manual deconstruction because of the high costs of automated sorting equipment and the low revenues for the recovered materials, but the most advanced treatment options based on the use of automated equipment, at least for some phases of the dismantling process, are also applied. Detailed operational data for the best performing case studies are included in the section on Operational data below.

Most of the recovered mattress' components can be recycled and made into new useful products (PSI, 2011; WRAP, 2013; ADEME, 2014; Zero Waste Scotland, 2013; Innortex, 2016):

- textile fibre components are reprocessed into a variety of products including geotextiles, industrial oil filters, construction and automotive insulation materials;
- foam is reprocessed as carpet underlay, gym mats, animal bed stuffing, cushioning material for upholstered furniture and even new mattresses;
- springs are recycled as metal scrap;
- clean wood is reprocessed for chipboard, mulch or animal bedding.

As already highlighted, the composition of mattresses varies significantly, but currently steel and polyurethane foam tend to be the main contributors to the weight of the materials recovered, as well as to the revenues from selling the materials to their existing end markets, as they have a positive market value. They are followed by textile fibres which are usually grouped together, as they are difficult to separate into the different materials due to the construction of the mattress, and are sold on to mixed textiles markets as low-quality fibres (short fibre length), often in the form of shredded mixture (Zero Waste Scotland, 2013). Latex foam can be used in small amounts when combined with other materials for carpet underlay while pure polyester layers have a high value and high recyclability (WRAP, 2013). Reference figures for the average mattress composition are provided in Table 1.

Table 1. Average mattress material composition

Material	Average mattress composition (kg)	Average mattress composition (%)
Steel	6.2	29%
PUR foam	5.3	25%
Cotton, non-woven	3.3	15%
Natural Fibres (e.g. coconut, sisal, jute)	1.6	7%
Felt	1.6	7%
Cotton, woven	1.4	6%
Wool	0.8	4%
Polyester, non-woven	0.8	4%
Latex foam	0.6	3%
Total	**21.4**	**100%**

Source: Zero Waste Scotland, 2015

In order to add value to the recovered materials, mattress treatment facilities can also directly reprocess them by producing secondary products. This is the case, for example, of ECOVAL and VALORMAT in France (see case studies description in Operational data).

Some of the mattress' components, i.e. the innerspring units and the cushioning materials, could also be reused for rebuilding new mattresses, but as no appropriate standards or labelling requirement currently exist at European level for this practice, and considering that it can pose a risk to consumers for hygienic (the potential presence of bedbugs, dust mites and their droppings and other allergens) or safety reasons (the compliance with flammability standards) (PSI, 2011), this option can be considered within the scope of the BEMP only as a future option.

[1] This is the case, for example, of Recyc-Matelas Europe in France, described as specific case study in operational data.

[2] This is the case of Retour Matras in the Netherlands, that has designed on its own the fully automated processing system. This case study is also described more in detail in operational data.

Environmental benefits

Recycling end-of-life mattresses can produce several environmental benefits:

- reduction of reliance on landfill disposal;
- recovery of valuable materials to make other products, thus reducing the need for virgin materials to be extracted; and
- reduction of greenhouse gas emissions and energy use by decreasing the energy-intensive production of new mattresses or other products.

As for the greenhouse gas emissions and energy implications of using different end-of life management methods for mattresses and box springs, a reference study that provides detailed and comprehensive data was developed by the California Department of Resources Recycling and Recovery in 2012 (CalRecycle, 2012). The study uses LCA methodology to estimate the greenhouse gas emission reductions that could be achieved through increased reuse and recycling of end-of-life products. The greenhouse gas emission reductions from reuse and recycling are calculated as the greenhouse gas savings from avoided landfill and avoided primary production minus the added greenhouse gas emissions from reverse logistics and reprocessing (extended boundary approach).

In more detail, the study estimates the greenhouse gas emissions considering product manufacturing (including all supply chain activities), forward logistics and product end-of-life management for an average mattress and box spring set characterised by the material composition reported in Table 2.

Table 2. Material composition of an average mattress and box spring set

	Mass (kg)	Mass (%)
Entire mattress and box spring	54.4	100
Steel	27.2	50
Wood	5.44	10
Foam	5.44	10
Cover (toppers)	5.44	10
Cotton	2.72	5
Unspecified	8.16	15

Source: CalRecycle, 2012

The analysis allows the comparison of the CO_2e emissions from landfilling or recycling of the mattress at its end-of-life. In both scenarios, the CO_2 emissions come from the product manufacturing, forward logistics, reverse logistics (i.e. the transportation of the mattress and box spring from their pickup location to the treatment/final disposal site) and from the end-of-life management steps described below:

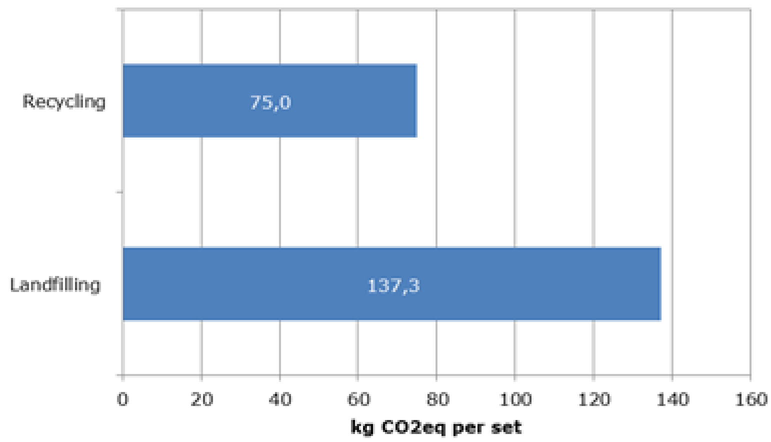
- Landfilling scenario: chemical and biological degradation process of the mattress and box spring materials in the landfill and construction, maintenance and operation of the landfill itself;
- Recycling scenario: reprocessing at the treatment facility via manual disassembly assisted by some basic equipment such as forklifts and balers, and recycling of secondary materials with the following assumptions:
    - the steel of the innerspring unit is used for steel making;
    - the polyurethane foam is used for making rebound carpet cushion;
    - the cotton fibres and covers are reprocessed via mechanical recycling into a variety of products;
    - the recycled materials displace their virgin counterparts;
    - no recycling benefit is calculated for the wood;
    - the unspecified material is landfilled.

The greenhouse gas emissions estimated in the two scenarios for one mattress and box spring set are reported in Table 3 and in Figure 2.

Table 3. Greenhouse gas emissions estimate per mattress and box spring set

Process phase	GHG emissions (kg CO_2e/set)
Landfilling scenario	
Production of mattress and box spring	129
Final disposal in landfill	8.3
Total CO_2e in landfilling scenario	**137.3**
Recycling scenario	
Production of mattress and box spring	129
Landfilling of treatment scraps (unspecified components)	1.2
Reverse logistics	4.1
Reprocessing	0.6
Net avoided burdens from secondary materials recycling	-59.9
Total CO_2e in recycling scenario	**75.0**

Source: CalRecycle, 2012



Source: own elaboration based on CalRecycle, 2012

Figure 2. Comparison of greenhouse gas emissions in the different scenarios

Comparing the two scenarios, it can be observed that recycling rather than landfilling allows a significant environmental benefit, reducing GHG emissions by 62.3 kg CO_2e (45 %).

Nonetheless, it should be noted that the results obtained in the study consider a mattress treatment process without any sterilisation treatment (which would in fact be recommended for the health of workers) and based on manual disassembly, while more automated processes would imply higher energy consumption and GHG emissions. Unfortunately LCAs for mattresses are limited in number and none analysing a more automated treatment process has been found. In any case, considering the relevant net margin observed in the case of manual deconstruction, it can be expected that the GHG savings of recycling versus landfilling would remain relevant in the case of automated processes, which could also improve the process productivity.

Side effects

It is expected that the only relevant environmental impact of the treatment process is associated with energy consumption in the case of mostly automated treatment processes. The safety and health of workers, in particular when performing manual deconstruction and sorting, have to be assured, with special regard to the risk of injuries during the cutting operations and to their exposure to dust and bedbugs, mites and other allergens.

Applicability

Mattress treatment facilities can be set up in any EU Member State as this best practice is perfectly in line with the EU waste legal framework and the simplicity of the treatment process, which does not require significant investments even in the case of the most automated processes, allows for EU-wide implementation.

Nevertheless, several barriers to the development of mattress treatment infrastructure exist at the European level (Zero Waste Scotland, 2013; WRAP, 2013). Of these, the following are identified as the most important:

- The economic factors, which is the main limiting factor for the need to rely on a gate fee much higher than the average landfilling one to sustain the business, due also to the low and uncertain value of materials to end markets. At present, landfill is cheaper than recycling in every EU country; therefore, other drivers such as the need for environmental performance, landfill bans or extended producer responsibility schemes for mattresses, as in the case of France, are required to promote the applicability of mattress recycling. Also, the development of stable and receptive end markets for the recovered materials is an important issue. Currently the end markets are limited and provide low revenues, due to the poor quality of materials, perceptions of their cleanliness and saturation of the markets. Considering for example PU foam, mechanical recycling at present provides materials whose properties are inferior to those of virgin material for a slightly lower price (10–20 %) and there is a need to develop different outlets to the uses of virgin polyurethane (ADEME, 2014). Promoting research and innovation initiatives for the recycling of the recovered materials, with particular reference to foam and textiles, into new valuable products would provide greater options and increase the market value of the materials.

- The low quality of the materials arising from mattresses is another relevant barrier, linked both to the collection methods and to the mattress manufacturers who pay little attention to the product disassemblability at its end-of-life.

As for the first issue, for the applicability of the best practice it is important to ensure a suitable supply of mattresses that are clean and dry. While the operators of mattress treatment facilities know how mattresses must be stored and handled to make recycling an option, many end-of-life mattress generators and collectors may not. For mattress recycling to be successful, it is important to publicise best practice methods of removal, collection, storage and handling to households as well as to major commercial and institutional mattress purchasers, such as hotels, universities and colleges, and healthcare facilities. Emphasis should be placed on the need to keep mattresses clean and dry, especially those that originate from locations that generate significant volumes of used mattresses (PSI, 2015). Specific requirements can be also set for the acceptance of mattresses in a treatment facility, as in the case of the Mattress Recycling Council Program, which in California has set specific guidelines that mattress collection providers must respect for the acceptance of their mattresses to the treatment facilities (Mattress Recycling Council, 2015).

As for the second issue, i.e. the improvements in mattress design, it must be noted that at present the design of mattresses prevents easy deconstruction and separation of materials. Encouraging design principles which align with end-of-life processing could be encouraged through mechanisms such as standards or Ecolabel schemes. However, this would likely take a long time to have an impact as mattresses have a lifetime of several years (Zero Waste Scotland, 2015).

- The low treatment capacity of these facilities, which is limited by the end-of-life mattress flow collectable in the area surrounding the plant at affordable transport costs. This factor determines poor economies of scale for the processing operations, limiting the scope for large-scale automated processing that would allow the achievement of much higher treatment capacities. It also requires the development of effective mattress collection plans that minimise the handling and transport of the products and allow for a consistent product flow (ISPA, 2004), not only relying on the collection schemes for bulky items usually offered to households by local authorities, but also setting up agreements with mattress retailers for the implementation of take-back schemes and offering specific collection services to hospitals, hotels, colleges and other institutions that produce significant numbers of discarded mattresses.

Economics

Reference literature on the economics of end-of-life mattress treatment or actual economic data from operating plants are limited (ISPA, 2004; Halifax C&D Recycling, 2009; Zero Waste Scotland, 2013 WRAP factsheets, 2013) and have been complemented with some specific calculations to provide an evaluation of the economies of scale for the processing operations.

The economic viability of a mattress treatment process has thus been evaluated estimating the potential expenditures and income sources considering different technical solutions and framework conditions. The estimation has been based on the following assumptions:

- Three different case studies have been considered: a facility applying manual deconstruction with a low treatment capacity (800 t/year or about 32 000 mattresses per year); a facility with a partially automated processing method with a medium treatment capacity (2 000 t/year or about 80 000 mattresses per year); a fully automated treatment facility with a high treatment capacity (4 500 t/year or about 180 000 mattresses per year).

- Gate fees for the incoming end-of-life mattresses ranging from a minimum value of EUR 240/t (EUR 6 per mattress), and a medium value of EUR 270/t (EUR 6.75 per mattress), to a maximum value of EUR 300/t (EUR 7.50 per mattress).
- Revenues from the main recovered materials also ranging from minimum to maximum unitary values, and calculated assuming a recovery rate of 93 % with the following percentage breakdown for the materials: 22 % steel, 36 % foam, 32 % textiles, 3 % wood.

These assumptions are summarised in Table 4.

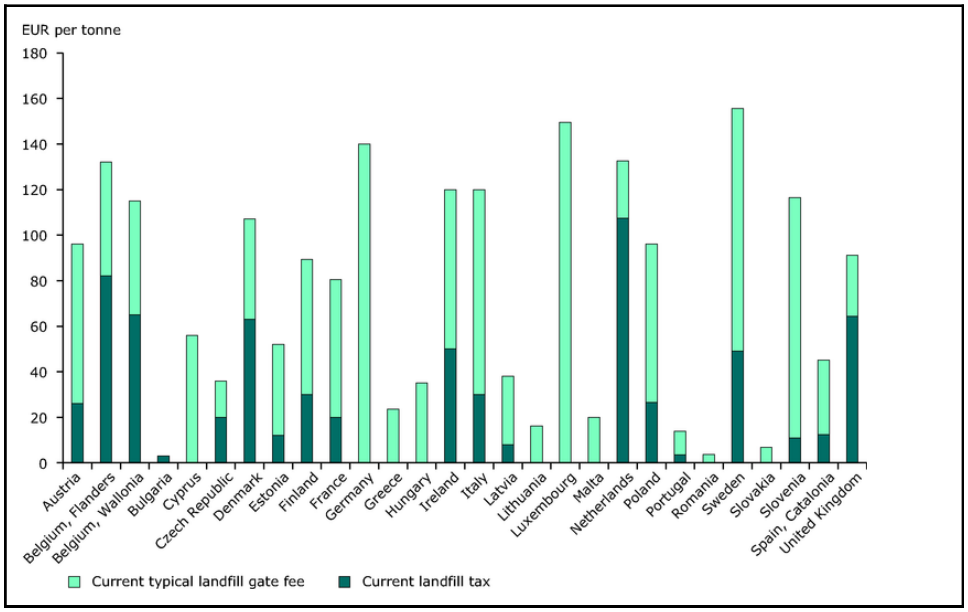
Table 4. Assumptions for the basis of the economic viability evaluation of mattress treatment processes

Mattresses treated per year			
	Low capacity Manual	**Medium capacity Partially automated**	**High capacity Fully automated**
Number of mattress/year	32 000	80 000	180 000
t/year	800	2,000	4 500
Range for gate fees - unitary values			
	Min.	**Med.**	**Max.**
Gate fee (EUR/t)	240.00	270.00	300.00
Gate fee (EUR/mattress)	6.00	6.75	7.50
Range for revenues from recovered materials - unitary values			
	Min.	**Med.**	**Max.**
Revenues for steel (EUR/t)	60.00	100.00	130.00
Revenues for foam (EUR/t)	100.00	120.00	140.00
Revenues for textiles (EUR/t)	60.00	80.00	100.00

Revenues for wood (EUR/t)	-	1.00	5.00
Recovery rates for the different materials			
Recovery rate for steel (%)	22		
Recovery rate for foam (%)	36		
Recovery rate for textiles (%)	32		
Recovery rate for wood (%)	3		
Total recovery rate (%)	**93**		

Source: own elaboration

The gate fees and revenues have been defined from information gathered during this study from literature review and information provided by operators. As for the gate fees, it was found that the charge per mattress applied by actual mattress treatment operators varies a lot, with lower values around EUR 5.5–6 and higher values up to EUR 16 per mattress, which correspond respectively to EUR 220–240 per tonne up to EUR 650 per tonne. Comparing these values with the current typical landfill gate fees and taxes, it is possible to see that even the lower values for mattress treatment gate fees are much higher than the highest landfilling costs per municipal waste, which are lower than EUR 160 per tonne of waste. As is shown in the following figure, such values cannot sustain a mattress disposal operation, but as an acceptable compromise, in our simulation we have assumed gate fees per tonne of waste ranging between EUR 240 and EUR 300. This requires specific intervention by national or regional governments in EU countries for promoting the applicability of mattress recycling, as highlighted in the Applicability section.



Source: EEA, 2013

Figure 3. Current typical landfill gate fees and taxes in EU countries

Also, the increase of the potential income from recovered materials is an important issue. The range of values assumed in the simulation are based on the reference literature and data provided by some interviewed operators, but currently the end markets for the materials recovered are highly volatile and more valuable products need to be developed to increase the market value of the materials, as highlighted as well in the Applicability section.

Based on the assumptions described above, the profit and loss accounts for the three different case studies have been simulated, calculating the expected annual revenues and expenditures, assuming investment costs ranging between EUR 30 000 for the low-capacity manual facility, EUR 400 000 for the medium-capacity and partially automated facility and EUR 2 million for the high-capacity fully automated facility, with amortisation periods of 5, 7 and 10 years respectively. The results of the simulation are shown in Table 5.

Table 5. Estimation of incomes and expenditures for the three case studies

Type of plant	Low capacity Manual	Medium capacity Partially automated	High capacity Fully automated
Plant capacity (t/year)	800	2 000	4 500
Plant capacity (mattresses/year)	32 000	80 000	180 000
Revenues from gate fees - Annual values (EUR/year)			
Min. gate fee (assuming EUR 6/mattress)	192 000.00	480 000.00	1 080 000.00
Med. gate fee (assuming EUR 6.75/mattress)	216 000.00	540 000.00	1 215 000.00
Max. gate fee (assuming EUR 7.5/mattress)	240 000.00	600 000.00	1 350 000.00

Type of plant	Low capacity Manual	Medium capacity Partiallyautomated	High capacityFully automated
Revenues from recovered materials - Annual values (EUR/year)			
Min. revenue values	54 720.00	136 800.00	307 800.00
Med. revenue values	72 664.00	181 660.00	408 735.00
Max. revenue values	88 920.00	222 300.00	500 175.00
Investment and operating costs			
Investment costs (EUR)	30 000.00	400 000.00	2 000 000.00
Annual amortisation (%)	20	14	10
Total annual amortisation (EUR/year)	6 000.00	57 142.86	200 000.00
Annual operating expenditures (EUR/year)	280 000.00	650 000.00	1 300 000.00
Total annual expenditure (EUR/year)	**286 000.00**	**707 142.86**	**1 650 000.00**

Source: own elaboration

As can be observed, the majority of income arises from the gate fee, while the revenues from recovered materials assume a certain relevance in the scenario with the maximum values. As for the expenditures, major costs are mainly determined by the plant operation, as the process is labour-intensive and does not require relevant investments, except in the case of the fully automated facility.

Based on the incomes and expenditures estimated, the net cash flow before taxes has been calculated for the three case studies, considering all possible combinations of the framework conditions. The results are shown in Table 6.

Table 6. Net cash flow before taxes estimated for the three case studies

LOW CAPACITY - MANUAL TREATMENT PLANT				
Net cash flow before taxes		Gate fee revenues		
		Min.	Med.	Max.
Material revenues	Min.	-EUR 39 280.00	-EUR 15 280.00	EUR 8 720.00

	Med.	-EUR [illegible]	26 664.00	
	Max.	-EUR [illegible]	42 920.00	
MEDIUM CAPACITY – PARTIALLY AUTOMATED TREATMENT PLANT				
Net cash flow before taxes		**Gate fee revenues**		
		Min.	**Med.**	**Max.**
Material revenues	**Min.**	-EUR 90 342.86	-EUR 30 342.86	EUR 29 657.14
	Med.	-EUR 31 838.00	EUR 14 517.14	EUR 74 517.14
	Max.	-EUR 4 842.86	EUR 55 157.14	EUR 115 157.14
HIGH CAPACITY – FULLY AUTOMATED TREATMENT PLANT				
Net cash flow before taxes		**Gate fee revenues**		
		min	**med**	**max**
Material revenues	**Min.**	-EUR 112 200.00	EUR 22 800.00	EUR 157 800.00
	Med.	-EUR 11 265.00	EUR 123 735.00	EUR 258 735.00
	Max.	EUR 80 175.00	EUR 215 175.00	EUR 350 175.00

Source: own elaboration

The net cash flow before taxes is always positive in the event that the maximum or medium value for the gate fee is applied (with the only exception being for the medium-capacity plant with minimum values of the revenues from recovered materials), while it is always negative or very low in the event that the minimum value for the gate fee is applied. Considering the best case for the three case studies (maximum gate fee and maximum material revenues) and assuming that the taxes would be about 30 % of the net cash flow, the following payback periods for the treatment plants can be estimated:

- low-capacity manual treatment plant: one-year payback period, as the investment costs are very low, with earnings after taxes of about EUR 30 000 per year;
- medium-capacity partially automated plant: five-year payback period, with earnings after taxes of about EUR 80 000 per year;

- high-capacity fully automated plant: eight-year payback period, with earnings after taxes of about EUR 245 000 per year.

These evaluations show that, in the best case scenario, all the types of facilities are financially viable. Sustainable economic performances are also achieved in two of the intermediate scenarios (maximum gate fee and medium material revenues; medium gate fee and maximum material revenues), with the most sustainable performance achieved in the case of the manual treatment plant, thanks to the very low investments required. This peculiarity, associated with the labour-intensive and unskilled work required, make this business particularly interesting for social economy networks, including charities or social economy companies.

As for the most technologically advanced plant solutions, the following conclusion can be drawn: the investments required for fully automated plants can be considered financially viable only where a relevant flow of end-of-life mattresses and a good price for the recovered materials can be assured. One possible way for the operators of the waste treatment facilities to achieve this can be the direct reprocessing of the recovered materials for producing secondary products, thus enhancing their added value.

Driving forces for implementation

The main driving forces for the implementation of this best practice are as follows:

- The problems caused by the high volume and difficult handling of mattresses in landfill sites, which are pushing landfill operators to impose bans, limitations or high gate fees for the acceptance of mattresses and box springs (ISPA, 2004, PSI, 2011).
- EU legislation targets for municipal waste recycling (> 50 % by 2020 according to the Waste Framework Directive, > 65 % by 2030 according to the proposal for the revision of the Waste Framework Directive introduced by the Circular Economy Package) and diversion away from landfilling (targets for reducing the amount of biodegradable municipal waste landfilled introduced by the EU Landfill Directive (1999/31/EC) and proposal for a binding target to reduce landfill to maximum of 10 % of municipal waste by 2030 introduced by the Circular Economy Package), and in some Member States also bans on the landfilling of high caloric waste that have been already introduced in Austria, Belgium, Denmark, Germany, Italy, Norway, Sweden and Switzerland (EBIA, 2014).
- The introduction of EPR schemes for mattresses, like the one introduced in France in 2009 for furniture, including mattresses, that set a target for increasing the recycling of furniture waste up to 45 % by 2015 (Des Abbayes C., 2015). In this EPR scheme, producers are responsible for organising and financing the system; for this purpose, 24 companies (12 retailers and 12 manufacturers) in 2011 founded Eco-mobilier[1], a state-approved, non-profit private cooperative, financed by a visible recycling fee, added to the price of products and clearly shown as a separate charge at the in-store point of sale and paid for by the consumer. The scheme recognises the eco-contribution for recycling (the fees recognised for mattresses in 2014 are shown in Figure 4), which helps make recycling a viable solution, and provides incentives to producers to redesign their products in order to improve the operational, economic and environmental performance of their end-of-life management.

Eco-contribution before tax per furnishing item*

PRODUCT TYPE	<= 120cm	> 120cm	Other
Slatted frame	€ 1,25	€ 2,08	Pair : € 2,50
Slatted bed base	€ 2,08	€ 3,33	Pair : € 4,17
Box springs	€ 2,50	€ 3,33	Pair : € 5,00
Mechanical/electric relaxation mattress	€ 4,17		Pair : € 8,33
All mattresses, including folding mattresses	€ 1,67	€ 3,33	
Baby bed base, futon bed base, bundle bed base, mattress topper and baby mattress			€ 0,83

* The eco-contribution scale is applicable for the year 2014

Source: Éco-mobilier, 2014

Figure 4. Recycling fees for bedding recognised by Eco-mobilier in 2014

The materials used in mattresses have value when separated and political drivers are pushing towards minimising waste sent to landfill and increasing recycling rates. These factors together provide a stimulus for this potential opportunity. But given the low economic margins of these activities and their limited economies of scale, it would be important to reinforce the driving conditions by setting adequate economic incentives in each EU country.

[1] More information at: http://www.eco-mobilier.fr/

Reference organisations

Reference organisations

Mattress treatment facilities are operative mainly in France, Belgium, the UK, the Netherlands and Spain. Reference organisations are identified as follows:

- Recyc-Matelas Europe (France and Belgium): they are industry leaders within the mattress recycling market sector in France (detailed case study description provided in Operational data).
- Ecoval plant(France): a mattress recycling facility that reprocesses the dismantled materials into new mattresses (detailed case study description provided in Operational data).
- RetourMatras plant (Netherlands): a fully automated mattress treatment plant in Lelystad, in the province of Flevoland (detailed case study description provided in Operational data).
- JBS Fibre Recovery (UK): JBS operates in the mattress recycling sector in the UK, from sites in Telford, Trowbridge and Bridgend. In May 2013, it was acknowledged at the Let's Recycle Awards for Excellence in Recycling, winning the Recycling Business of the Year award. More information is available on the company website: http://jbsrecyclingcouk.fatcow.com/new/?page_id=35.
- Furniture Recycling Group (UK): UK-based company that operates mattress recycling plants based in Lancashire and Derbyshire. More information is available on the company website: http://www.tfrgroup.co.uk/.
- Mattress treatment plants in Spain: mattress recycling facilities operated in Spain by Comsermancha (http://www.comsermancha.es/), Recicolchon (http://www.recicolchon.com/english/), and the German company Sutco Recyclingtechnik (http://www.sutco.de/en/plant-technology/sorting-of-mattresses/).

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