

Chain analysis RetourMatras

Alice Schimmelpenninck –
Sustainability Manager Renewi
alice.schimmelpenninck@renewi.com

Chico van Hemert – RetourMatras
chico.vanhemert@retourmatras.nl

Seleen Suidman - Projectmanager
+31 6 15 34 16 89
s.suidman@spaakcs.nl

Team:
Antonija Marjanovic
Ivano Pezzotta



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Table of content

1	Introduction	2
1.1	What is a chain analysis?	2
1.2	Activities Renewi Netherlands Holding b.v.	2
1.3	Goal of the research	2
1.4	Scope 3 emissions and selection of chain analysis	2
2	Identification of the chain	3
2.1	Background RetourMatras	3
2.2	Stakeholders in the chain	3
2.3	Steps in the chain – linear process (incineration)	4
2.4	Steps in the chain – RetourMatras (recycling)	4
3	Quantification of emissions	6
3.1	Emissions	6
3.2	Re-use	6
4	Reduction possibilities	7
4.1	Reduction possibilities within the process	7
4.2	Reduction possibilities up- and downstream of the process	7
4.3	Reduction possibilities within chain	8
4.1	Reduction prognosis	8



1 Introduction

In the context of achieving level 4 on the CO₂ Performance Ladder, Renewi analyses two GHG (Green House Gas) generating chains. This document describes the chain analysis of the process of RetourMatras. The report has been produced by Spaak Circular Solutions BV (hereafter: Spaak) on behalf of Renewi.

1.1 What is a chain analysis?

A chain analysis (NL: ketenanalyse) provides information about the CO₂ emissions of a certain product or service for the entire chain. This includes the life cycle of a product from the extraction of raw materials to the impact of the product's end of life, including options of recycling.

1.2 Activities Renewi Netherlands Holding b.v.

Renewi strives to be the leading waste-to-product company by contributing to a sustainable society for their key stakeholders: customers, employees, local communities and their shareholders. Renewi focuses on obtaining value from waste instead of incinerating or landfilling waste. Of the 15 million tonnes of waste processed annually, 90% is recycled or used for energy recovery. Renewi believes that this unique approach to waste-to-product is in line with social and regulatory developments. This approach also offers the most capital-efficient solution for effective recycling and waste management.

1.3 Goal of the research

The main objective for carrying out this chain analysis is to identify CO₂ reduction opportunities, define reduction targets and monitor progress. Based on the insight into Scope 3 emissions and this chain analysis, a reduction target is formulated. Within the CO₂ management system, that has been introduced, active efforts are made to reduce Scope 3 emissions.

Providing information to partners within Renewi's chain and sector – who are part of a similar chain of activities – is explicitly part of this chain analysis. Based on the results, Renewi will take steps to involve these partners in achieving the reduction targets.

1.4 Scope 3 emissions and selection of chain analysis

Renewi's business activities are part of a chain of activities. For example, raw materials, which are collected or acquired, first have to be produced – these are the 'upstream' emissions. Second, transportation, use and processing of delivered products or services use energy and emit GHGs – these are the 'downstream' emissions.

Renewi has chosen to do the chain analyses within the Product-Market Combination of 'Commercial Waste – Company'¹. Two chain analyses have been done concerning waste streams that are formed into new raw materials. This is a process in which Renewi specialises and which focuses on the circular economy.

This report describes the chain analysis of RetourMatras. The analysis compares two chains concerning mattresses.

¹ The underlying calculations can be found in Appendix 4.A.1. Scope 3 analyse – PMC – Renewi Netherlands Holding b.v. 2017

2 Identification of the chain

2.1 Background RetourMatras

RetourMatras is one of the few players on the mattress recycling market in the Netherlands. RetourMatras has at its core business the dismantling of used mattresses and recycling of the mattress components to semi-finished products which can be used in other industries for further upcycling. With their automated system more than 80% of the materials in mattresses can be reused as raw materials for other applications. In the Netherlands approximately 1.5 million mattresses are discarded on a yearly basis. RetourMatras has with their four facilities since 2021 the capacity to process 100% of the disposed mattresses in the Netherlands (Fig. 1).

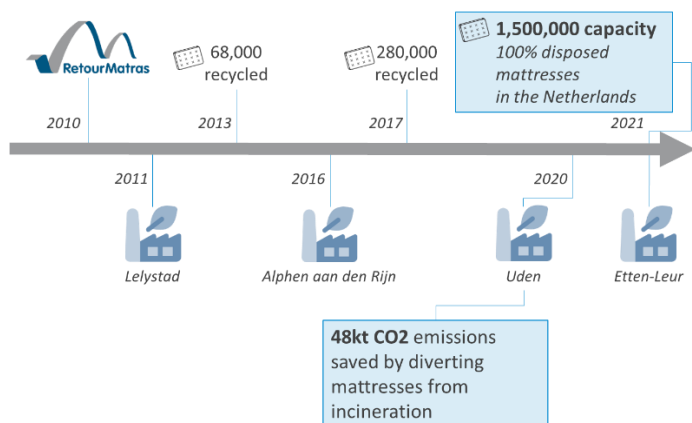


Figure 1: Development timeline of the recycling plants and their capacity.

On European scale it is over 30 million mattresses a year². Since March 2021, regulation has changed in the Netherlands in regard to the recycling standards of mattresses (Landelijk afvalbeheersplan (LAP3))³. To

² Europur, "The Netherlands: A world-leader in mattress recycling", press release Jan 2021

stimulate the transition to a circular economy, the incineration of mattresses is prohibited with the exception of highly contaminated material, which comes down to mattresses exposed to water. The prognosis is that regulation of other countries within the European Union will follow.

2.2 Stakeholders in the chain

The chain of RetourMatras, on which Renewi has influence as a 1/3rd shareholder, is depicted in Figure 2.

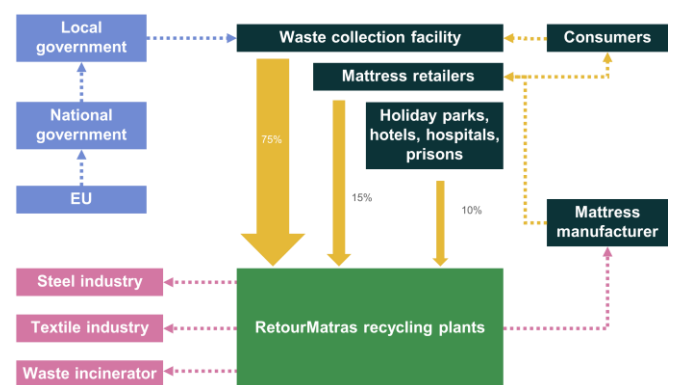


Figure 2: Stakeholder analysis of production and recycling chain for mattresses in the Netherlands.

Yellow arrows display the input routes for used mattresses and the pink arrows display the output of material streams after recycling. The 'blue' partners influence regulations and legislation. Renewi is thereby contributing to the chain with the transportation means.

RetourMatras gets all of the input material delivered by Renewi. 75% of the delivered mattresses comes from municipal waste collection facilities where RetourMatras offers their containers as collection points. Another 15% is collected by mattress retailers

³ Ministerie IenW, beleidstekst sectorplan LAP3, tweede wijziging (geldig vanaf 2 maart 2021)

as end-of-use offers for their customers and 10% is picked up at holiday parks, hotels, hospitals and prisons. Renewi handles all the logistical transportation from these suppliers to the recycling facilities of RetourMatras. Furthermore, transportation is needed downstream of the process for distribution of extracted mattress components to the corresponding recycling industries and rest waste incineration plants. The particular percentages of these transport movements for the output material are changing, not least because of developments towards a cradle-to-cradle approach of re-supplying mattress manufacturers with recycled foam material. Since legislation for recycling of mattresses has changed in the Netherlands and will supposedly change on European level, this chain stingingly complies at any given moment to accommodate the regulations.

2.3 Steps in the chain – linear process (incineration)

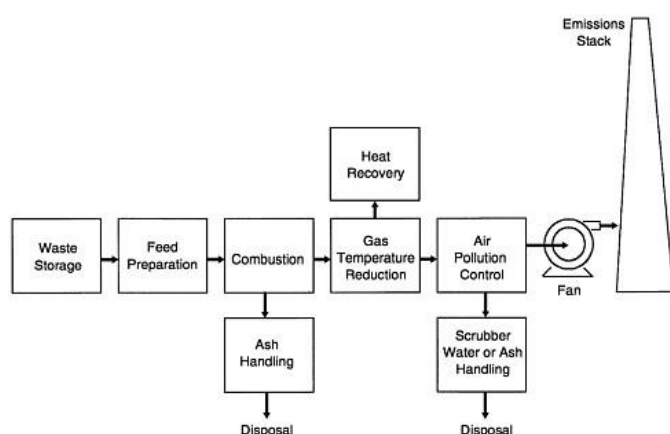


Figure 3: Schematic overview of a municipal waste incineration plant.⁴

⁴ National Research Council. 2000. Waste Incineration and Public Health. Washington, DC: The National Academies Press.

In the linear process, as was previously common, used mattresses end up in waste incineration plants as waste-to-energy application. Figure 3 depicts a schematic representation of such a plant.

After transport of municipal solid waste to an incineration plant, mattresses are typically shredded as part of the feed preparation to mix it with low-caloric materials for the combustion chamber.

Wet mattresses, which are not suitable for recycling since they pose a biohazard for the workers during manual extraction of materials. Also, they can combust spontaneously, which has led to severe fires at waste or recycling plants numerous times. The wet mattresses are considered low-caloric and can therefore be directly used in the incineration process (Information RetourMatras, 2016).

2.4 Steps in the chain – RetourMatras (recycling)

Recycling of mattresses requires a logistical set up to be able to deliver high-quality input tailored to capacity of the four different processing facilities of RetourMatras. Figure 4 shows a schematic representation of the process, which might vary slightly on the four different locations.

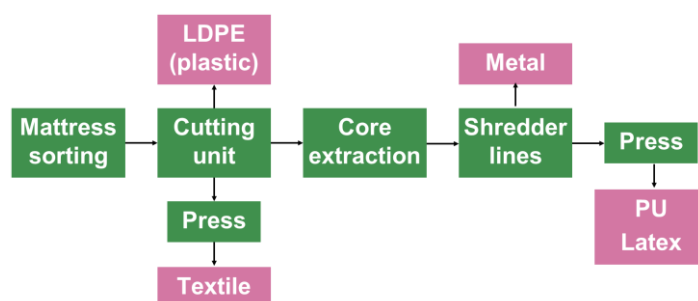


Figure 4: Schematic overview of the steps taken in the recycling line of RetourMatras.

The disassembly line of RetourMatras is unique due to the high level of automatization, which leads to a recycling rate of 85% of the materials. All sizes and compositions are suitable to be recycled in their facilities. After the separations and sorting of all material streams, they are pressed into bundles and are marketed as semi-finished products.

Out of the main waste streams from their process metal from the springs and textile from the ticking is sent to recycling facilities, HKS metals and Wolkat, respectively. Other developments are ongoing to reuse these materials as well as the mattress foams (PU and latex) in the production of new mattresses in the sense of a cradle-to-cradle approach.

3 Quantification of emissions

This chapter illustrates the total CO₂ footprint of the process of RetourMatras. The information on the detailed calculation can be found in the Environmental Impact Analysis done for RetourMatras by Spaak (February 2022). This information is confidential.

3.1 Emissions

The emissions were compared between the linear incineration of the same number of mattresses and the recycling process with a recycling percentage of 85%.

The direct emission of the linear incineration is 22.957 ton CO₂-eq per 15.930 ton of mattresses (production of RetourMatras 2021). This is equivalent to 1,44 ton CO₂-eq per ton of mattresses and 80 kg CO₂-eq per mattress. During this process almost 61.000 MWh of energy is generated.

The recycling process of RetourMatras emits 2.668 ton CO₂-eq on yearly basis (per 15.930 ton or 885.000 recycled mattresses in 2021). This is equivalent to 0,17 ton CO₂-eq per ton of mattresses and 9,3 kg CO₂-eq per mattress. Most of the emissions (90%) are generated by incinerating the non-recyclable waste. This is 15% of the current material streams. During the incineration process more than 5.300 MWh of energy is generated. Next to that, the process uses electricity to recycle the mattresses. This accounts for 10% of the emissions – 274 ton CO₂-eq per year (2021). Transportation is not included in the calculations, since the logistic movements are assumed to be similar for both the linear process as well as the

process of RetourMatras. The emissions of RetourMatras are equal to 12% of the emissions of the linear incineration process.

3.2 Re-use

Even though way more energy is generated by the linear process, the substitution of virgin materials has an even bigger positive impact on the environment. The process of RetourMatras generates material flows which can be re-used in other industries, like the textile or foam industry. These materials substitute virgin materials and by that avoid emissions. The avoided emissions contributed by RetourMatras are equal to more than 100.000 ton CO₂-eq a year.

4 Reduction possibilities

Based on the emissions calculated, reduction possibilities have emerged within the process of mattress recycling but also within the influence field of the whole chain, where Renewi and RetourMatras are main players.

4.1 Reduction possibilities within the process

With the four locations in the Netherlands, RetourMatras has become the frontrunner in the field. In 2020 already more than half of all discarded mattresses were processed by RetourMatras. In order to create more impact in CO₂ reduction, the incineration of mattresses needs to be reduced.

This can be done with utilizing the facilities to their full capacity. Some facilities have been in the start-up phase and are expected to run at full capacity in 2022. Another way to reduce incineration is to increase the recycling percentage per mattress.

RetourMatras is currently (Feb 22) building a plant on their Lelystad site, to chemically recycle the foam fraction. This process will result in virgin foam base material, which is applicable in the production of new mattresses.

Furthermore, RetourMatras is investigating more options to make the most out of the recovered materials. Through a newly developed dismantling and cutting line, it is possible to separate the zippers from the ticking, improving the ticking quality for recycling and creating another waste stream for downstream recycling.

On the energy level, improvements can be done for including more renewable energy sources for the

process. Besides the already used green energy delivered by their partner IKEA (through windmills), solar panels or reuse of waste energy could be possible points of improvement.

4.2 Reduction possibilities up- and downstream of the process

Upstream of the recycling process, the challenge lies in the delivery of input material within the acceptable standards. As stated above, mattresses that do not meet the requirements of cleanliness and dryness will not be recycled. Logistical considerations play a big role in the possibilities to optimize the chain for maximal CO₂ reduction. The number of transport movements can be reduced by two means:

1. by centralizing collection points
2. by maximizing the collection volume (mattresses per transporter)

Renewi as a B2B is already optimizing the collection routes from municipal waste collection as the main supplier of mattresses.

To enable civilians in urban environments to offer their mattress for recycling, RetourMatras is setting up a mattress pickup service with municipalities using small scale electrical busses in order to avoid unnecessary contamination on the streets when mattresses are discarded. This is still on pilot scale, but when expanded could lead to more CO₂ reduction, since recyclability of mattresses overall would be improved.

As for the collection volume, at the moment approximately 80 mattresses are collected per container. Experiments are ongoing where compresses are used (horizontally or vertically) to take 3-8 times more mattresses in one go. When applied broadly this can cut down the CO₂ emissions from transportation.

4.3 Reduction possibilities within chain

To create awareness of the challenges in the recycling processes and the overall benefits regarding the CO₂ emissions that benefit the whole chain, the manufacturers need to be involved to create easy to recycle products. With the know-how and technical advances in mattress recycling, RetourMatras can (and is) playing a role in advising on national (or even European) guidelines for recyclable compositions. A few changes could make a big difference in recyclability of mattresses:

1. **Use of unmixed foams.** Chemical recycling of PU foams is in development as well as recycling of latex. Mixtures of both are currently being used as bonded foam, which can be used as damping subfloor substituent.
2. **Alternative glue.** Layers of some mattresses are glued in such a way that dismantling becomes labor intensive. In communication with chemical producers, other options for the use of glue would lead to better recyclability.
3. **Use only polyester for ticking material.** Using one material for the entire ticking, including the textile and any attached buttons, zippers etc. would enable recyclability and reduce residual waste. Consumers preferences are of importance when it comes to textile choices, but some suppliers – like the hotel sector – show more interest in exploring this option for the sake of better recyclability.

All these developments will take time until new mattresses go through the development, production and use phase before the process of RetourMatras can benefit in terms of CO₂ emissions. Nonetheless, RetourMatras and Renewi see the importance of the collaboration within the chain in order to create impact for the circular economy.

4.1 Reduction prognosis

The optimisation of production with increased input material within the existing production capacity would lead to the following CO₂ emissions prognosis over five years:

Year	Input (mattress)	CO ₂ -emissions (linear) (ton)	CO ₂ -emissions RetourMatras (ton)
2020	750.000	19.455	2.261
2021	885.000	22.957	2.668
2022	950.000	24.643	2.864
2023	1.050.000	27.238	3.165
2024	1.150.000	29.832	3.467

Seleen Suidman – Head of Operations

+31 6 15 34 16 89

s.suidman@spaakcs.nl

Spaak Circular Solutions

KVK: 68426690

BTW: NL85 74 359 17 B01

Bank: NL50 TRIO 01 97 99 59 26

Adres

Vechtstraat 32-I

1078 RL Amsterdam

