Embraced

Establishing a multi-purpose biorefinery for the recycling of the organic content of Absorbent Hygiene Products waste in a circular economy domain

BBI JU

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EMBRACED PROJECT
FINAL REPORT
November 2022

From People Care to Planet Care

Closing the Loop for Absorbent Hygiene Products Waste

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Contents

A step forward for a Circular Bioeconomy in Europe

Started in June 2017, the EMBRACED project captures important economic, environmental, social and demographic dynamics.
The target of zero CO_2 emissions by 2050 and an economic growth that does not lead to increased resource depletion, together with development equity and inclusiveness, are the pillars of the European Green Deal launched in December 2019. Reducing emissions by 55% by 2030 poses an even more challenging target in the context of necessary recovery after the impact of the COVID-19 pandemic, the effects of rising energy and raw material costs, and the consequences of the conflict triggered by Russia in Ukraine. The latter objective finds its lines of implementation within the Fit for 55 package, presented by the European Commission in July 2014.
In this scenario, acting on the reduction of resource consumption in perspective of a circular bioeconomy represents the most advanced trend in the implementation of virtuous processes capable of recovering matter from critical fractions of waste to reintroduce it as a nutrient in further industrial cycles or to bring it back into the ecosystem. Waste generated from the use of sanitary absorbent products (AHP) still constitutes a significant fraction of municipal solid waste (estimated between 3 and 4%) destined for incineration or landfill, options that in the European waste treatment hierarchy are at the bottom of a priority scale dictated by sustainable development objectives. On the other hand, the consumption of AHP is also set to grow because of the demographic dynamics that are manifesting themselves as a long-term trend - albeit with due differences - within the member countries of the European Union, the associated EFTA countries, and the candidates for membership. The progressive extension of life expectancy - despite the halt imposed by the pandemic - associated with persistently low birth rates, defines a picture of a general ageing of the European population. According to data provided by Eurostat, between 2009 and 2019, the number of elderly people, i.e., over 65 years of age, increased by 2.9% of the total population. According to Eurostat projections, the ageing trend to 2100 will radically alter the age pyramid, which will shrink more and more at the centre and widen at the top, where the proportion of people aged 80 and over will also grow. The importance of developing circular industrial processes for AHP is therefore clear. The result achieved with the EMBRACED project provides an integrated supply chain model for the recycling of AHP waste, which starts from separate waste collection to valorise materials. These are then transformed into building blocks and polymers for applications in various sectors, from biomaterials to fertilisers. The whole process creates new employment opportunities that meet an inalienable need for development equity. This publication describes in detail the results achieved, thanks to the collaboration of a group of partners who are among the most qualified in their respective fields.

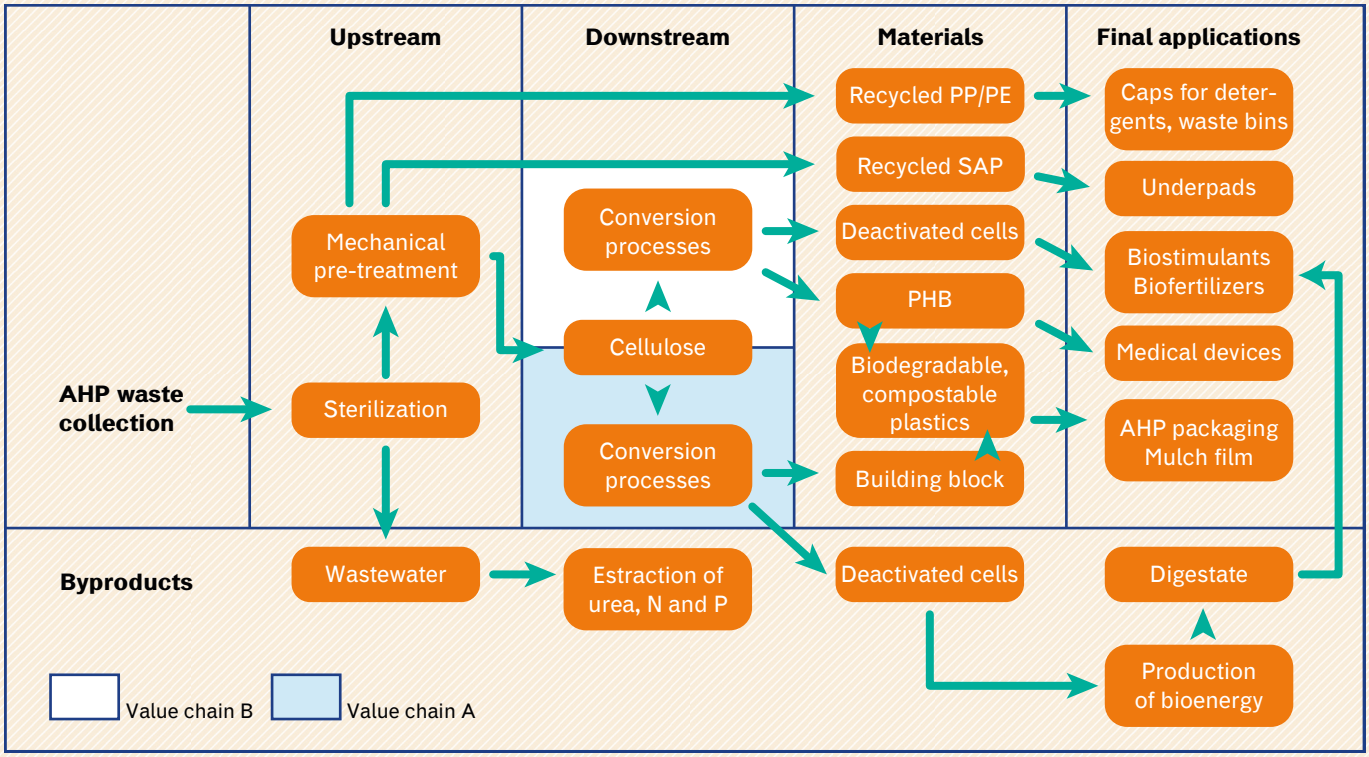
The biorefinery model

Absorbent Hygiene Products (AHPs) have become essential everyday products to society and their use has increased substantially. As with every consumer product, also AHPs end up in solid waste after their use. Today, they represent approximately 3-4% of the total municipal solid waste and are considered a non-recyclable fraction, which is usually incinerated or landfilled. Over the past 20 years there has been great progress by AHPs manufacturers to reduce the environmental impact of AHPs, for example, the average weight of baby diapers was reduced by uous research activity that aims at reaching breakthroughs in every field, the next step throgh the EMBRACED project is the further valorisation of the secondary raw material, with specific focus on the cellulosic fraction for the production of bio-based building blocks, polymers and fertilizers. EMBRACED will operate valorising all the fractions from the process, to obtain marketable end-products fully competitive in terms of cost, quality and sustainability. Importantly, the project will follow a circular economy approach, closing the cycle of raw materials and minimizing the use of primary resources, through the establishment of virtuous models of cooperation among all the involved stakeholders.

The EMBRACED biorefinery model (Scheme 1) can be divided in six main phases along the value chain:
• AHP waste separate collection by waste operators from households and Institutions and transport to the pre-treatment plant

Scheme 1 – EMBRACED biorefinery model. Circular Economy and Cascading Approach

• Pre-treatment plant, which allows the recycling of AHP waste for the recovery of cellulose, plastic and Super Absorbent Polymer (SAP)
• Value chain A: cellulose from the AHP waste pre-treatment is converted into bio-based building blocks used for producing bio-based and biodegradable materials for film applications
• Value chain B: cellulose from the AHP waste pre-treatment is converted into bio-based PHB to be used for several applications
• Application into final products: all the materials and by-products from the upstream and downstream processes for the production of the bio-based materials are further processed into end products
• Recovery of all by-products: also the plastic and SAP fractions obtained upstream from the AHP waste pre-treatment are valorised into marketable end-products, while the nutrients extracted from wastewaters are recycled and the cells recovered from the fermentation broths are further valorised into bioenergy and fertilizers.



Collecting AHP waste

Figure 1 – Smart Bins

We are living in a historical moment in which Europe is moving towards increasingly stringent recycling and circularity targets, and it is necessary to propose innovative recycling schemes also for waste streams that did not previously undergo any process. Regarding the implementation of AHP recycling, a crucial step is the establishment of waste collection services to ensure a stable input flow to the recycling plant. This waste stream is generated both by households and by other relevant producers, such as nursing homes or hospitals. Currently, AHP waste has been rapidly increasing and already accounts for 15 to 25% of residual waste in some territories. Let's begin with the first step of the process: the collection, how is it carried out?
At present, a variety of collection schemes can be applied to this waste stream, including door-to-door collection services, the use of street bins or smart bins placed at key locations and containers placed at municipal collection centres or at the sites of major producers. The service is generally provided to registered users and the

choice of collection scheme depends largely on the collection system in place for other waste streams.

Contarina waste collection in nursing homes and "door-to-door"

Contarina S.p.A carries out the waste collection in the 49 municipalities of the Priula Basin, located in the province of Treviso. Overall, the number of individuals that access the service is around 260,000 and a segment of the users benefits also from baby diapers and adult incontinence AHP collection. In this case, we are referring to families with young children and elderly people using adult incontinence absorbent products.

At the present time, there are two collection modalities for waste. Firstly, regarding non-residential users, Contarina has activated waste collection at nursing homes. In this instance, the service entails the collection directly in the place in question.

The collection frequency, at the 12 nursing homes served by Contarina, depends on the user's requirements. Moreover, the payment mode is the "Pay-as- you-throw" system, meaning that the amount paid by the user depends on the quantity of waste collected. In terms of quality, it is of high standards, with an impurity margin of less than 2%.

The second way of the collection is "door-to-door" modality which concerns household waste. In this case, the 120 liters gray bins are used, which are the same utilized for unsorted waste and can only be distinguished from the latter by a different label placed on the inside of the lid so that the operator and the user can recognize the waste type. Regarding the collection, in this instance, it is a monthly process.

A specific tariff is applied to this service, and it is characterized by a fixed yearly quota and a variable quota based on the number of times that the bin is emptied. Just like the collection system in nursing homes, the quality level of the waste collected with the "door-to-door" modality is high, with an impurity margin of less than 2%.

Smart Bins in Verona

A nappies' waste collection pilot was at first launched by P&G in Amsterdam in January 2019 and nine Smart Bins were installed in two neighborhoods of the City. Fater has replicated the innovative collection model by implementing a pilot test in the city of Verona, involving both the Municipality and the waste management company of the city called AMIA.

In January 2020, the beginning of the pilot phase, eight smart bins were installed around the city of Verona, in places easily accessible to users, such as supermarkets - thanks to a collaboration with Esselunga - and kindergartens. It is important to emphasize that, after a period of time, the stores were confirmed as the best locations for the Smart Bins compared to day cares and playgrounds.

The project is still ongoing with very successful results. Indeed, the bin is equipped with a technology that allows it to communicate via Bluetooth with an App, developed both for iOS and Android operating systems. However, the technological capabilities of this bin do not end there: it is powered by renewable energy and presents a system able to measure the weight of the waste delivered. Moreover, to avoid unpleasant smells in the locations in which these bins are positioned they are equipped with an odour containment system. Finally, in case of any malfunction, there is a remote monitoring system that allows waste operators to optimize the separate collection service.

Figure 2 – Contarina

A key feature turned out to be the "environmental incentivised" system. As the consumer disposes of the nappies via the Smart Bin, the latter will measure the weight of the waste and communicate it to the App which will then calculate the gifts for the consumer. These rewards are of various natures: vouchers for purchasing new nappies and prizes made with recycled materials. Furthermore, the App provides consumers with information on the environmental benefit of their gesture in terms of avoided CO_2 emissions and new products made through recycling. This environmental incentive provided positive feedback to consumers and revealed itself to be, as previously confirmed in the Dutch capital, an effective system.

Because of the positive results of the Smart Bins targeted at families with children, Fater decided to promote a dedicated service for the consumers of adult incontinence products, focusing especially on nursing homes for elderly people.

The main idea has been to offer a service covering at a competitive price the supply of new adult incontinence products and the collection, transport, and recycling of the used goods at their end of life. After a dedicated study has been carried out, which defined the main characteristics needed to make the project successful, such as the collection frequency or the types of containers, the official collection began in mid-April 2022.

The collected waste reached the target of approximately 6 tonnes per week and the quality control of the resource, carried out by Contarina, was positive.

It is safe to state the waste collected from non-domestic users in Italy is of excellent quality. The mass is made up of over 99% AHP, whilst the minimum percentages of error consist mainly of latex gloves, sanitizing wipes, and tissues normally used for the care of children and the elderly. All this waste, which with a circular perspective can be defined as a resource, will travel a long journey to become new final products obtained from recycled materials.

AHP waste pre-treatment

Figure 3 – AHP recycled plastic in sheets form
Figure 4 – Separation system

The first step of the biorefinery is currently implemented at Contarina's site with Fater Technology, in the province of Treviso and more precisely in Lovadina di Spresiano.
It is important to stress that the companies have defined a protocol for the quality assurance of the material that is conferred to the plant. The collected waste must have three characteristics. First, it must be packaged in transparent coloured bags, secondly, there has to be the absence of hazardous materials and lastly, the presence of non-targeted materials must reach a maximum of 2% in weight. Moreover, it is important to underline that the plant has a target of 10,000 tons/year of AHP waste, even though it is currently working at a lower capacity.
But how does this process work? And how are the main components of an AHP obtained?
Following are the steps of the process.

1. Storage of incoming waste
The trucks from the separate AHP collection unload the waste onto a conveyor belt, which transports it to an enclosed storage chamber designed to reduce the dispersion of odours as much as feasible.

2. Autoclave
The second step is the transportation of the AHP waste bags from storage to the autoclaves via a series of conveyor belts and cochlea. The autoclave is a jacketed metal tank where the combined action of rotation and temperature produces the total sterilisation of the products. The patented process of sterilisation within the autoclave does not require the pre-opening of the bags prior to autoclaving.

3. Shredder and buffer
Immediately after the autoclaving treatment, the AHP products are sent to a battery of shredders required to send the appropriate materials to the dryer and separators. The shredded material is then stored in a buffer unit and treated to eliminate any potential drug residues.

4. Dryer
The shredded material is then sent to the air dryer. The latter consists of five different 'floors' where the nappies are heated by hot air blowing from a heat exchanger and a battery of microwaves. Adequate heating of the material is essential to improve sorting efficiency. Finally, the exhausted air is directed to a scrubber to remove cellulose particles and other types of contamination.

5. Separation system
The air-dried diapers are sent by a cochlea to a battery of separators. The first two separate a mixture of cellulose/SAP from the plastic, while the third one separates the cellulose from the SAP. Sorting is performed mechanically, the material produced is stored in large bags, of about 1 tonne, and sent to the warehouse.

6. Optical separator
The plastics resulting from mechanical separation are sent to an optical separator, which selects PP and PE optically from PET and cellulose residues. Following separation from the remaining components, the plastics are pelletised in an optimised extruder.

A circular bioeconomy model for AHP waste

Towards final products: demonstration of two innovative value chains

Resources are limited and increasingly expensive. We need to use them in a sustainable and efficient way through rethinking the traditional model of production-consumption-disposal of products with a system-based approach, that means starting with renewable raw materials to produce manufactured goods which at the end of their lives will be converted into a new resource. The necessity to deploy new sustainable solutions with the highest circularity levels, while extracting maximum value from EU sourced renewable feedstocks to produce high value products is now more urgent than ever due to the disruption of global value chains determined by both the COVID-19 pandemic and the geopolitical tensions. Biorefineries are a valuable asset in this transformation.

In line with these objectives, the EMBRACED project has successfully demonstrated an innovative and unique integrated biorefinery transforming a feedstock widely available in any territorial context in the urban environment, i.e., Absorbent Hygiene Product (AHP) waste, into high value bio-based materials and products in the packaging and agricultural sectors. Two different value chains are exploited within the project. The value chains promote a replicable, circular, economically viable and environmentally sustainable model of biorefinery based on:

- valorisation of the cellulosic fraction of used absorbent hygiene products towards the production of bio-based and biodegradable products
- cascading approach, where side-streams from the bio-based processes are valorised to increase cost competitiveness and environmental sustainability
- circular economy approach, closing the cycle of raw materials and minimizing the use of primary resources, through the establishment of virtuous models of cooperation among all the involved stakeholders.

The continuous interactions among all project partners and their synergic know-how have revealed to be essential to find a solution to the identified technical challenges related to the innovativeness of the feedstock.

Value chain A: from cellulose to building blocks and polymers passing through fermentable sugars

Novamont, in collaboration with Fater and Contarina, has demonstrated an innovative value chain, successfully converting the cellulosic fraction recovered from AHP waste into sugars then used to produce via a biotechnological process bio-based building blocks for application into biodegradable and compostable bioplastics for different application sectors.

Efficient and sustainable protocols for converting AHP waste into bioplastic formulations have been validated through a virtuous integration of biotechnology and chemistry. The conversion of AHP waste cellulose into bio-based building blocks and polymers has been successfully accomplished at progressively increasing scales achieving good results in terms of yield and quality of biopolymers. Novamont has finally scaled-up the value chain processes at demo scale by completing the installation of the process units and their integration at Novamont's premises through its 3rd part Mater-Biotech located in Italy (Bottrighe, Veneto Region). The obtained biopolymers have been also successfully processed into the formulation of biodegradable and compostable biomaterials which have been

Figure 5 – Lab testing

Figure 6 – Novamont third party Mater-Biotech in Veneto Region
Figure 7 – Novamont's bio-based, biodegradable and compostable biopolymers

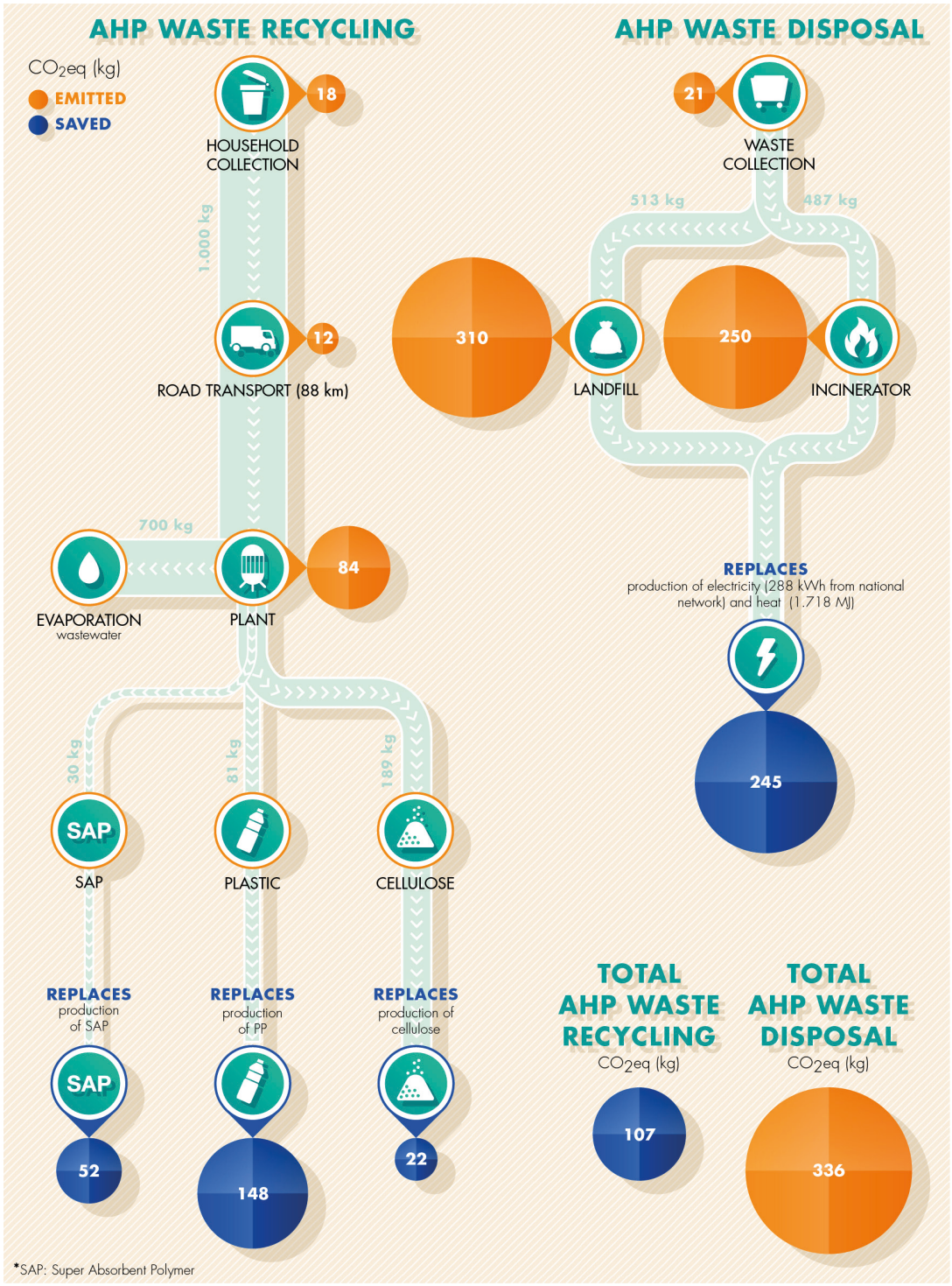
validated into films for non-food packaging applications as well as mulch (see article "Biopolymers and biomaterials applications" in Part 2 for further details).
Organic by-products and co-products obtained during the main steps of the value chain process have been also successfully validated for biogas production via bio-digestion in anaerobic conditions with performances comparable to those observed with other industrial feedstocks generally used for biogas production. As a further step for the valorisation of all the by-products from the value chain, Novamont has also evaluated the opportunity to valorise the solid fraction of digested sludge coming from the anaerobic digestion process via a composting process, demonstrating the possibility to obtain a high-quality compost compliant with the Italian limits currently applied to the compost obtained from the organic fraction of the municipal solid waste, to be used in improvement and regeneration of soil as final application.

Value Chain B: from cellulose to PHB passing through fermentable sugars
Starting from the conversion of AHP waste cellulose into sugars, already demonstrated in Value Chain A, Novamont has demonstrated also a second value chain, named Value Chain B, using this feedstock into a biotechnological process for the production of PHB, leveraging on its experience in the field. The protocol of the fermentation process to obtain PHB from the AHP waste cellulose sugars has been designed and implemented by Novamont at pilot scale, along with an environmentally friendly downstream process for PHB extraction and purification, with promising results in view of future developments. Also for this value chain, Novamont, in cooperation with the project partner Fertinagro, has evaluated the opportunity to valorise the co-products obtained from the biotechnological process for the formulation of plant bio-fertilizers and bio-stimulants (see article "Biofertilizers and biostimulants" in Part 2 for further details). PHB is also evaluated by the project partner Wittenburg for assessing the possibility to use it in medical applications, and by Novamont for developing further its biomaterials relying on the properties of this biopolymer for improving the biodegradation and disintegration rates of the materials.

Environmental performance of materials and products

The environmental performance of EMBRACED has been carried out considering a functional unit of 1 kg of the output materials and products and has been evaluated through a comparison with the performances of benchmark materials and products: recycled cellulose is compared with virgin cellulose; recycled plastic with virgin polypropylene granulate; recycled SAP with virgin SAP; polyesters and PHB with a polyester 100% fossil-based; biofertilizer with a nitrogen fertilizer. To easily compare the environmental impact of the different materials and products, the results of LCA are normalised and weighted to obtain one single score (LCA index) per material/product. The outcomes of this analysis are positive: the LCA index for all the bio-refinery materials and products show values always lower than the relative benchmarks, i.e., **the overall**

environmental impact of the EMBRACED materials and products is lower than that observed for the corresponding benchmarks. Regarding in particular the production of **bio-polyester** in Value Chain A and PHB in Value Chain B, in the project scenario based on the use of renewable sources for electric energy and biomethane produced by anaerobic digestion, the comparison shows very positive results, with a **decrease of "Global Warming Potential" (-84% for both materials) and "Resource use, fossils" (-41% and -54% respectively for polyester and PHB) compared to the fossil-based benchmark polyester.**
LCA analysis has been carried out also with a functional unit of 1 ton of AHP waste, only with reference to the pre-treatment phase. Based on the analysis, when renewable energy sources are used in the pre-treatment plant the **recycling of AHP waste is a carbon negative process,** thanks to the avoided production of virgin cellulose, plastics and SAP, i.e., the CO_{2eq} emissions saved are higher than those generated. **Compared to the landfill/ incinerator scenario, significant CO2eq savings are observed: -443 kg_{CO2eq}** (Scheme 2). If the energy used for the operation of the pre-treatment plant is recovered from an incineration plant, the CO_{2eq} emissions of the process amount to 66 kg per ton of AHP waste and the saving versus the landfill/incinerator scenario are equal to -270 kg_{CO2eq}.



Scheme 2

The industrial outcomes

Figure 8 & 9 – Filming

In the EMBRACED project, all the materials and by-products from the AHP waste pre-treatment plant (cellulose, SAP and plastic) and the biorefinery (biopolymers, biomaterials and process co-products) are further processed towards the validation into end products with increased sustainability, competitive cost and relevant market impacts. Within the first two years and a half of the project implementation, the validation into final products has been already finalized for the plastic fraction recovered by the pre-treatment plant, and results have been reported in the first project booklet. In the last two years of the project, the focus has been on the validation of the cellulosic fraction recovered from AHP waste pre-treatment into final products through the biorefinery processes, as described in the following articles.

Biopolymers and biomaterials applications

Within the EMBRACED project, Novamont has successfully demonstrated two new value chains where cellulose recovered through the AHP waste pre-treatment plant is further pre-treated by Novamont's process and then converted into second generation sugars, which are finally fermented to produce a key building block (Value Chain A) and PHB (Value Chain B). The building block and the polymer are then used for the production of bio-based compostable bioplastics that are validated into the formulation of films for packaging applications as well as mulch.
One of the applications of the new EMBRACED bioplastics is the packaging of the Absorbent Hygiene Products manufactured and commercialised by Fater, thus closing the loop of the project value chains and promoting a circular bioeconomy model, opening up new business perspectives for all the involved stakeholders (waste management operators, industrial producer of Absorbent Hygiene Products and chemical industries expert into bio-based processes) while providing environmental and societal benefits along the whole value chain.
Another application of the bioplastic formulations developed in EMBRACED is mulch film biodegradable in soil according to EN17033 for food crops protection in agriculture, thus enlarging the cross-sector interconnections developed with the project also to the primary sector. The mulch film obtained proved to be in line with the specifications defined for this type of application: tested in field for different cultivars (tomatoes, zucchini, peppers, strawberries, rooted cuttings), they have shown a suitable durability,

with a capacity of maintaining better properties for a longer time in comparison to benchmark products. Thanks to the biodegradability in soil, this application is a highly valuable solution for the environmental sustainability in the agriculture sector: at the end of the crop cycle mulching film does not have to be collected and disposed of, instead it is incorporated into the soil where it biodegrades, transforming into carbon dioxide, water and biomass.

For both selected applications the main technical requirements have been identified as well as the main benefits which would derive from the future potential marketability of these bioproducts in connection with AHP waste based biorefinery. The market opportunities for these bioproducts are indeed promising. Although currently bioplastics still represent less than 1% of the more than 367 million tons of plastic produced annually, contrary to a slight decrease in the overall global plastic production, the market for bioplastics has continuously grown. This development is driven by a rising demand combined with the emergence of more sophisticated applications and products. According to the latest market data compiled by European Bioplastics in cooperation with the nova-Institute, global bioplastics production capacities are set to increase from around 2.42 million tons in 2021 to approximately 7.59 million tons in 2026. Hence, the share of bioplastics in global plastic production will pass the 2% mark for the first time. Indeed, the production of biodegradable plastics is expected to increase to almost 5.3 million in 2026. In this favourable scenario, it is expected that Novamont could exploit its short-supply chain and favourable competitor landscape to gain relevant market share, also boosting the creation of new jobs along the value chain.

Biofertilizers and biostimulants

Fertinagro's role in the Embraced Project is to evaluate the use of raw material from PHB fermentation in the production of fertilizers. Therefore, the PHB fermentation exhausted cells received from Novamont were evaluated and a good nutritional content was founded; with high percentages of macro and micro nutrients that make this a good raw material for fertilizers production. Organic fertilizers are made up of two large groups: compost and biostimulants. Compost fertilizers are those that give structure to the soil and, biostimulants are a group made up of different materials that are characterized by promoting plant growth. Biostimulants are fertilizers with high added value and include amino acids, humic and fulvic acids, seaweed extracts, etc. To see the potential biostimulant capacity of exhausted cells from PHB fermentation, the amino acid composition was also evaluated. It was found that it has a relevant percentage of free amino acids, and some of them with relevance in plant nutrition and resistance to stress. So, the knowledge of amino acids composition will lead us to design a fertilizer focused on early stages of plant development and vegetative growth. In conclusion, these qualities make this raw material of value chain B from project a potential source of important amino acids in the design of fertilizers with relevance in the early biological plants cycle and biostimulant capacity.

Figure 10 – Mulch film

Dissemination activities

The dissemination activities were designed and carried out to reach different audience targets. In its final stages the communication and dissemination activities continued on the web and on social networks. Several social media accounts had been created in the project (Facebook, LinkedIn, and Twitter) for online dissemination, where ReteAmbiente as well as Novamont and Fater continued communicating the events organised by the project along with EMBRACED objectives and activities. Novamont organized communication and dissemination activities, including the last Open Demo Day in June 2022 at the site if its 3rd party Mater-Biotech located in Bottrighe, in Veneto Region (Italy) Furthermore, several events were organized or attended by the project partners as better outlined hereinafter. While ReteAmbiente continued supporting dissemination at events by contributing to the realization of posters for the dissemination events, Legambiente and Circe developed activities addressed to specific targets, like students and stakeholders. Below a timeline of the activities carried out by both the partners.

Legambiente's dissemination activities

Ecoforum Rifiuti Lombardia Milan (Italy) 28th November 2018

During the event which focuses on the best practices of sustainable waste management in Lombardy the EMBRACED project was presented. It was an opportunity to explain to the over 100 participants the objectives, expected results and actions of the project. Moreover, the submission of acceptability surveys on the social acceptance of the project's biobased products took place.

Ecoforum Rifiuti Rome (Italy) 26th-27th June 2019

The EMBRACED project has been presented during the Ecoforum on waste management organized by Legambiente at National level with a focus on the Italian End of Waste Decree for Absorbent Hygiene Products. During the event, Fater awarded Esa-Com, a waste management company in the Veneto Region, for their best practice in the collection of AHP waste.

Festambiente Rispescia (Italy) 14th-18th August 2019

The EMBRACED project has been presented during the annual eco festival organized in Tuscany (Italy). The event attracts every year thousands of citizens and tourists. During the event, Fater showcased a model of the EMBRACED pre-treatment plant for the recovery of cellulose, SAP and plastics from AHP waste. EMBRACED leaflets have been also distributed to the participants.

Ecoforum Nazionale Rome (Italy) 21st - 22nd October 2020

Legambiente organized with other partners the 7th edition of the EcoForum national conference on circular economy. Most of the interventions focused on the request for a national plan for the circular economy and the need that the PNRR should provide resources for the reconversion of obsolete industrial plants, incentivize companies committed to circularity, educate citizens, and support scientific research. On this occasion, the Embraced project was presented as a model of circular economy.

Figure 11 – Ecoforum rifiuti Roma

Ecoforum Nazionale
Rome (Italy)
6th-7th July 2020

During Ecoforum 2021 the Embraced project was presented as a model of development of the circular economy and good practice to be put into practice. Moreover, the discussions focused on Italy's need for plants to achieve "zero waste to landfill". The booklets and roll-ups of the project were exhibited during the national Ecoforum during which some speakers cited the example of the Embraced project.

Festambiente festival
Maremma (Italy)
19th–23nd August 2020
and
18th-22nd August 2021

The Embraced project was disseminated during the annual festival Festambiente organised by Legambiente in Maremma, Tuscany. Embraced dissemination material such as booklets and roll-ups were displayed in the Circular Economy Pavilion throughout the festival. About 5.000 people have been reached in 2021 and about 4.000 people have been reached in 2020.

Multidisciplinary seminar at the University of Padova
29th November 2021

Legambiente organised the 1st dissemination event "L'economia circolare va a scuola: opportunità e necessità per lo sviluppo dell'economia circolare in Veneto". It targeted the students at secondary schools and universities. About 15 people were present in the room and around 500 students connected. The Italian technical partners of the Embraced project showed their presentation to explain the principles of circular economy applied to the Embraced model.

Figure 12 – Seminar at Palermo University

Multidisciplinary seminar at the University of Palermo
17th May 2022

Legambiente organised the second dissemination event "Trattamento, valorizzazione e rigenerazione dei prodotti assorbenti per l'igiene (AHP): bioraffinerie, biotecnologie ed economia circolare". It targeted students at secondary schools and universities. About 106 people were presented in the room, while some were connected online. The students actively took part in the Q&A part with stimulating questions, coming out from the discussion.

Seminary at Cultural Yards in Zisa
17th May 2022

In the afternoon at Cultural Yards in Zisa Legambiente organized another seminary on the correct application of waste management for the transition to the circular economy: the recovery, recycling, and reuse of secondary raw materials from absorbent products in the circular economy model. There were also colleagues of Circe that talked about group dynamics in circular economy.

Circe's dissemination activities

Figure 13 – Workshop Zaragoza
Figure 14 – Seminar at Padua University

Complementary information was compiled from people participating in the EMBRACED dissemination events, as an additional source. Information was gathered through debates or quick surveys with the attendants.
The workshops have been carried out, involving different stakeholders, like public administrations and businesses, to identify the aspects that affect the social acceptance of bio-based products.

The methodology for workshops has been the same, with 3 different steps:
1) A brief introduction of the EMBRACED project and the products inside its scope.
2) The results from the consumer survey
3) A debate, to contrast the business/public administration approach with the consumers one; or delivery of a survey for the audience, in which respondents are asked to evaluate using a scale, from 0 to 5, how willing would they be to use and to buy the five EMBRACED products.

The survey has been conducted at two events, and all partners have committed to disseminating it during their events, as an interactive way of approaching the presentation of the project for the general public and experts in the field:
• II Edizione L'Economia Circulare Dei Rifiuti Lombardia (November 28th, 2018, Milano).
• Stakeholders Workshop, held during the Consortium Meeting (May 30th, 2018, Zaragoza)
Experts survey aimed at offering firsthand information on a European scope, about the different stages of the purchasing decision process, so that the consortium expertise could be widened by the insight of experts that are specialized in consumer preferences and habits and complete it with individual self-reported data. This has allowed having a broad picture of the moments in which the consumer can be influenced and, therefore, open the path towards the identification and building of market strategies that could be implemented with the aim of impacting different moments of the buying process.

The debates have been conducted in two events:
• CONAMA 2020 – National Environmental Spanish Congress 2021 - June 2nd, Madrid.
• Seminario Formativo: La corretta applicazione della gestione dei rifiuti per la transizione verso l'economia circolare - May 17th, 2022, Palermo.
• Stakeholders Workshop held online – June 28th, 2022.

Thanks to these discussions, it has been possible to see the real perspectives of the participants in the events, fostering a close environment to discuss some aspects of the EMBRACED project or other cases. To encourage discussion, some of the results of the consumer survey were shown at the workshops.

Communication activities

Edizioni Ambiente (then ReteAmbiente, company that incorporated and took up Edizioni Ambiente's tasks and actitives in the project) continued keeping track of EMBRACED partners activities on the website and updating it with the material sent by the different partners of the project. In this third period of time the website was visited by more than 2700 users. 19,81% were from Italy, 12,74% were from the United States whilst 8,65% were from the Netherlands. Most of the visits were from Milan, Rome, and Amsterdam. More than 87% of the visitors to the website were new visitors.

Regarding social media activity, ReteAmbiente continued communicating the available results of the project and some general information about EMBRACED on LinkedIn, Twitter, and Facebook. For the social media posts, material were provided by the different partners while ReteAmbiente proceeded to create both the copy and the graphics of the posts.

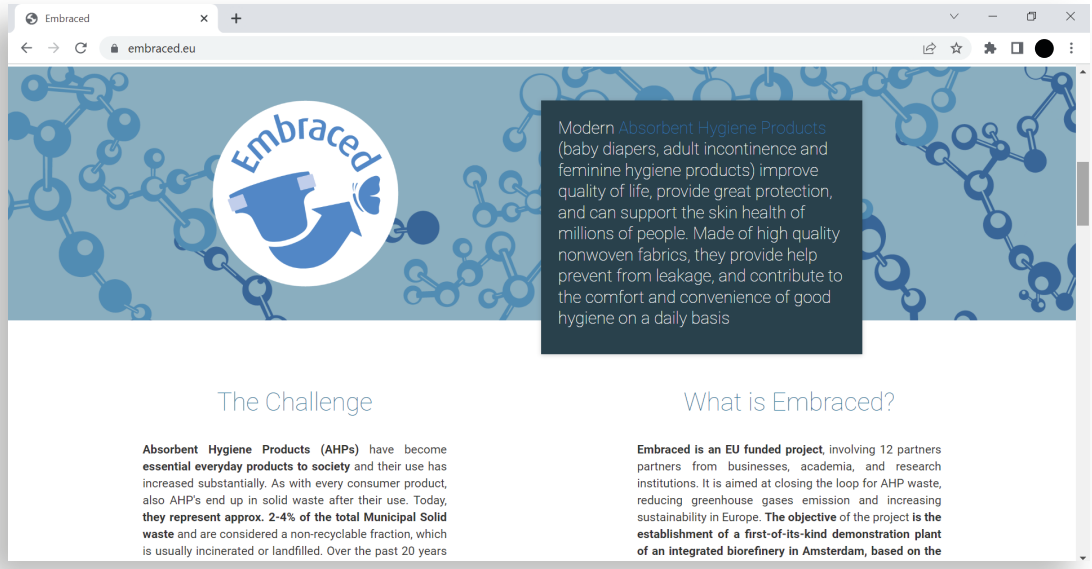
Moreover, Novamont's social (Facebook, Twitter, Linkedin, Instagram) and web (www.novamont.com) channels have been used to promote EMBRACED objectives, activities and events, as reported in the table below.

Fater Group website (www.fatergroup.com) also played a relevant role in delivering information to consumers about the experimental diapers' separate collection program in Verona.

Edizioni Ambiente constantly supported dissemination activities providing printed and digital copies of EMBRACED leaflet and booklet, as well as roll-up and other graphic materials.

Several articles about the project were published in both specialized and popular media, as well as news on local and national TV channels and websites.

Figure 15 – Cultural Yards in Zisa in Palermo
Figure 16 – www.embraced.eu



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FINAL REPORT
November 2022

From People Care to Planet Care

Website
https://www.embraced.eu/

Linkedin
https://www.linkedin.com/company/embracedproeu/

Facebook
https://www.facebook.com/embracedpro/

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