NCSH
Nordic Center for
Sustainable Healthcare

MEDI PLAST

FEASIBILITY REPORT

GREEN DESIGN IN SINGLE USE ITEMS:
THE CASE OF THE MEDIPLAST VOMIT BAG

Med finansiering från:
VINNOVA

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Introduction

Vinnova is Sweden's Innovation Agency with the mission to strengthen Sweden's innovation capacity and contribute to sustainable growth. With that purpose, the agency launched in spring of 2024 a call for projects to contribute to sustainable development in the manufacturing of pharmaceuticals and medical technology products.

Stiftelsen TEM vid Lund Universitet, represented by the Nordic Center for Sustainable Healthcare (NCSH) and Mediplast joined to present the project Green design in single use items. The case of the Mediplast Vomit bag. The aim of the project was to develop a feasibility study that will contribute to circular production processes and decrease the environmental impact of the product without sacrificing safety or quality.

The project had a duration of one year and included activities that engaged a group of different stakeholders from different sectors. This has produced a robust study that allows Mediplast to potentially modify a high impact product and to possible replicate the methodology with other products. The study also represents a methodology that can be imitated by companies and other actors in Sweden and thereby contributes to the innovation and sustainable production of medical products within the country.

The feasibility report is divided into four sections, the first is dedicated to present the boundaries and relevance of the project, the second presents the description of the product, the environmental impacts and the identification of opportunity areas for the product, the third part presents the prioritized scenarios for the redesign of the medical product, and finally in the fourth part the scenarios are presented and evaluated.

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I.Relevance of the project: **Single use items in the spotlight for Sustainable Healthcare**

The healthcare sector has a considerable impact on the environment as well as having a powerful role as an accelerator for the sustainability agenda.

On one hand, it produces around 4.5 % of the global GHG emissions, it intensively consumes single use items, impacts water bodies and generates enormous amounts of waste, some of toxic waste. On the other hand, it is a sector that plays a fundamental role on the social development of societies, and it connects relevant sectors such as academy, industry and healthcare workers. At a global level, the healthcare sector plays an important part in the development possibilities of any individual or society.

The positive impact of the healthcare sector can be accelerated by a combination of high-quality research, practical innovations, and the engagement of all levels of healthcare personnel. The complexity of tasks involved in the process implies a quest for new forms of collaboration. In this sense, this project represents one of the many avenues that can be taken to advance in this vision, as it involves multi-level collaboration between a company and a cross-sectoral network, in a process that involved academics, material specialist and others, to finally achieve a robust methodology to address the green design in single use items for the healthcare sector.

Text box 1. Mediplast

Mediplast is a Swedish company that specializes in manufacturing and distribution of medical supplies and equipment. It is certified to the international standards ISO 13485:2016 and ISO 14001:2015. A thoroughly documented Quality and Environmental Management System (QEMS) is implemented throughout the organization and serves as a guideline for all activities within the company.

Why a Vomit Bag?

For the purposes of the project the chosen product was the Vomit Bag from Mediplast. The reasons for working with this product are several, first is a single-use item of high demand which means an improvement could have a high impact, second it represents a good choice for testing and creating a methodology that could be scalable and replicable, and finally, it is a good example to create awareness about the importance of green design in healthcare products, no matter how simple the product is. The method developed in this project can be applied to different segments, functions and areas within the sector.

- During 2023, **12,784,000** pcs of the Vomit Bag were produced and sold by Mediplast.

This means that any change in materials, composition, structure or design, can have a direct and relevant impact on the amount of waste that is generated, the greenhouse emissions associated with energy for its production and the reduction of the financial costs associated with waste management.

In the case of Sweden, the importance can be even more relevant due the fact that the energy mix (with a green energy dominance) make the impact of single-use items more relevant. For example, according to recent research made in Intensive Care Units (ICU) in Sweden, the median climate impact of one inpatient day was 30 kg CO2eq. Approximately 63% (19 kg CO2eq could be attributed to single-use items [...] (Hemberg, 2025). These numbers show that the potential learnings of this project can be extremely significant for the sustainability agenda of Sweden.

- In Sweden the median climate impact of one inpatient day was 30 kg CO2eq. Approximately **63% (19 kg CO2eq could be attributed to single-use items.** (Hemberg, 2025)

Responding to this challenge, the project was built by identifying a set of strategic milestones that contribute to this final report.

The logic of the project follows the co-creation of a participatory multidisciplinary process, to identify and gather relevant data, to create and prioritize innovate in the ideas, and to include different areas of the company in a way to build ownership of the project and create a replicable methodology.

Each of the phases and milestones produced an activity with relevant results, and tangible outcomes which contributed to the final result.

Planning Workshop

- Defining the scope, project boundaries and the time frame of the different activities within the project.

LCA

- Analysis of the product, its components, materials and processes involved.
- Included a presentation of the results.

Prototyping workshop

- Development of potential changes and improvements of the product along the supply chain based on the inputs of the LCA.

Feedback Webinar

- Collection of internal and external expertise on potential product changes, which forms the basis for a feasibility study.

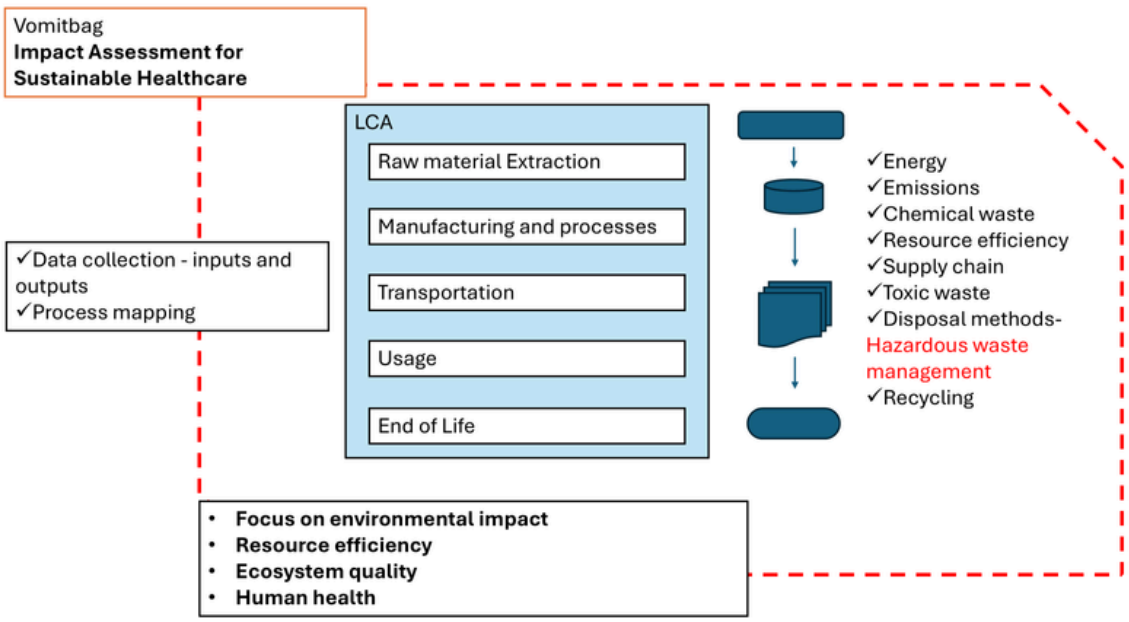
II. Boundaries and outreach purposes

The feasibility study started with setting a clear and collective definition of the purposes and boundaries of the project. .

The main goal was to have an effective analysis of the impact of sustainability measures without being too broad, nor too narrow, as well as to identify key processes, data and relevant variables to facilitate the scalability and replication of the methodology. The methodology responds not only to an engineering and material point of view of the product, but also to a sustainable healthcare perspective.

To initiate the first phase, a kick-off workshop was organized with participants from key areas of the company involved in the product. During the meeting, the group identified a range of potentially relevant information, established a calendar of activities, and outlined the upcoming milestones and tasks.

Figure 1 *- Vision of the data gathering for the project defined during the workshop*



This workshop discussed questions such as the reasons behind the project, how the results could be used, internally and externally, and the limitations of the project.

The workshop showed that the project is in line with the objectives of the company to be a sustainability leader. In this sense, the outreach of the project is multiple:

Internally of the company, the project was identified as a key possibility to learn from the process and to bring this knowledge to different areas of the company. This could improve other products and contribute to a common vision about the importance and the strategic value of sustainability.

Externally the project can have an impact on different levels. Firstly regional, as the project will serve to improve the way that Mediplast's sustainability commitment is communicated, especially with clients and buyers of the product, such as public tenders and hospitals in Sweden and other Nordic countries.

The NCSH, as a global cross-sectoral network, also have different approaches regarding the outreach and dissemination of the project. The first is at the National (Sweden) level. Being a project funded by Vinnova, the results of the project will be used to create awareness of the green design in the sector within the Swedish companies. It will also engage the healthcare institutions locally and the procurement processes, as more studies like this can lead to procurers being more informed to make sustainable decisions for purchasing single use items.

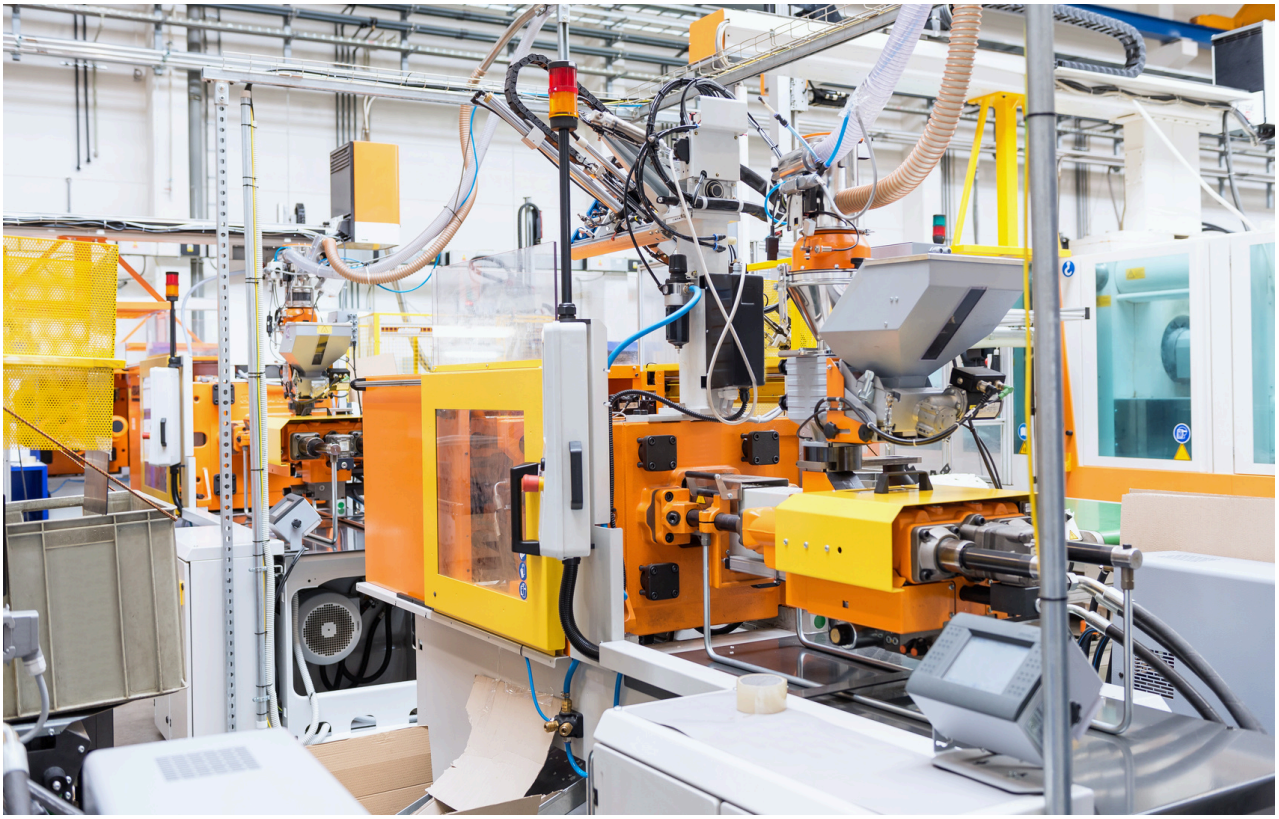
Text box 2. The Nordic Center for Sustainable Healthcare

The NCSH is a is a cross-sectoral network involving stakeholders, organisations, projects and expertise in the area of sustainable healthcare. The network includes companies, hospitals, regions, universities, NGOs, clusters from all over the world who shares the goal of creating a more sustainable healthcare sector. The goal is to make the knowledge and solutions more accessible and visible worldwide, forming an arena which generates collaborations, projects, business, knowledge and new innovative ideas.

The extensive network of NCSH across more than 25 countries will ensure the dissemination of the results of the project to relevant stakeholders. The project has engaged academic actors such as the Trinity College Dublin (TCD), and it has set a methodology that is already been used in an application for a Horizon project at European level. At the same time, the project will be presented at the **7th Nordic Conference for Sustainable Healthcare**, as an inspiration and a unique opportunity to present the results to a specialized audience from all over the world.

Finally, the methodology, including the definition of scope, the data gathering through LCA, prototyping workshop and feedback focus group has been systematized, and it is in the catalogue of services of the NCSH, available to any company globally.

Figure 2 *- Example of injection moulding machine*



III.The product: Description and overview of impacts

The Vomit Bag is a single-use product designed for hygienic collection and safe containment of bodily fluids, particularly vomit. Structurally, it is composed of two main components:

Figure 3 *- Mediplast's vomit bag*

(1) A rigid polypropylene (PP) ring, manufactured via injection moulding, which serves as a mouthpiece and provides structural integrity during use.

(2) A flexible polyethylene bag (LDPE), produced through blow moulding, which is attached to the ring to collect and retain fluids.

The entire unit is constructed from fossil-based plastic materials, specifically low-density PP and LDPE, making it lightweight and durable but also presenting environmental challenges at end-of-life. The average combined weight of a complete vomit bag (ring and bag) is approximately 18,2 grams. Following use, the vomit bag is classified as biohazardous waste, due to its potential contamination with bodily fluids, necessitating incineration under most healthcare waste management protocols. Production takes place in China, where electricity is predominantly sourced from coal-based grids, significantly increasing the emissions intensity of both the injection and blow moulding processes.

As was stated in the first workshop, in order to identify the best strategies to redesign the product there is the need to have information regarding material composition and the specific impacts on the environment of the cycle of the product, from production to waste. To assess this and identify impacts of potential changes, a Life Cycle Assessment (LCA)[1] was deemed the most effective tool..

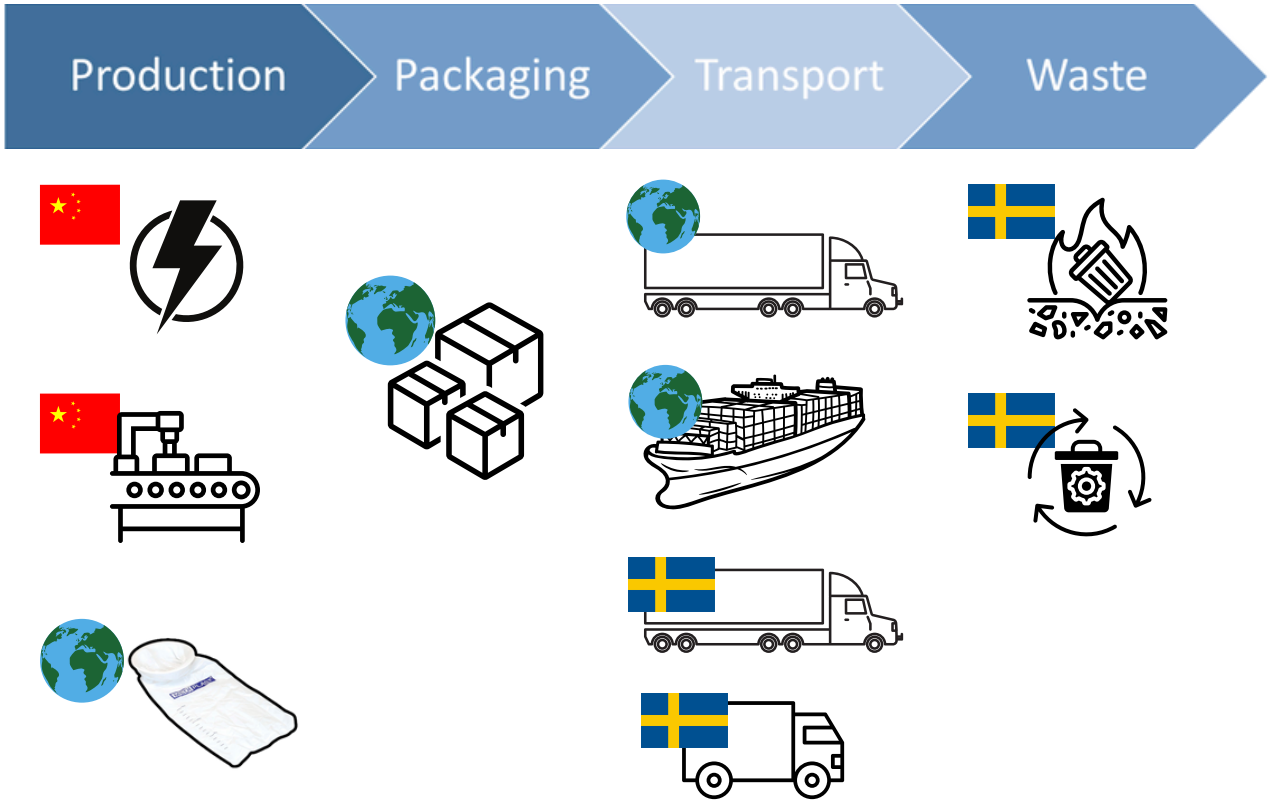
The LCA on the Mediplast vomit bag measured the overall environmental impact of the product and identified which supply chain activities are key contributors. The analysis evaluates the environmental impact of the product across its full life cycle — from raw material extraction to end-of-life disposal — using OpenLCAv2.0 software and the Ecoinvent v3.9.1 database. The LCA follows internationally recognized standards, including ISO 14040/44 and the European Commission's Product Environmental Footprint (PEF) guidelines.

By assessing the environmental and social implications across the whole supply chain, including manufacturing, transportation, packaging, and disposal, the report aims to pinpoint where potentially the biggest positive impact could be achieved and to provide practical recommendations that will be used in the next stage of the project: a prototyping workshop.

The system boundaries for this LCA considered environmental impacts across the full lifespan of each vomit bag. This includes raw material extraction and processing — specifically the fossil-based feedstocks used to produce the primary materials, polypropylene and polyethylene — along with transport, manufacturing, transportation, sterilisation and disposal.

[1] Life Cycle Assessment (LCA) is a standardized methodological framework used to evaluate the environmental impacts associated with all stages of a product's life from raw material extraction through manufacturing, distribution, use, and end-of-life disposal or recycling. It provides a comprehensive view of the inputs (e.g., energy, water, materials) and outputs (e.g., emissions, waste) across the product's lifecycle, enabling data-driven decision-making for sustainability improvements.

Figure 4 *- System boundaries*



The process begins in China, where the raw materials — polypropylene and low-density polyethylene (LDPE) — derived from fossil-based feedstocks are processed into plastic granulates. These materials undergo injection moulding (for the ring) and blow moulding (for the bag) using electricity primarily sourced from China's coal-dominated power grid, which significantly influences the product's carbon footprint.

Once manufactured, the vomit bags are packaged and palletised locally, then transported approximately 150 km by truck from the production facility in Nantong to the port of Shanghai.

They are then shipped via sea freight to Helsingborg, Sweden, covering a distance of about 12,680 nautical miles. From Helsingborg, the goods are moved by road freight (truck) to a warehouse in Malmö.

Distribution from Malmö to the final point of use in Sweden is included, based on PEF (Product Environmental Footprint) transport assumptions, which involve a 250 km round-trip by van. The final stage involves waste management, where the used vomit bags — considered biohazardous — are incinerated. The packaging components, such as cardboard and LDPE film, are assumed to follow Swedish recycling practices.

Key Findings

Main environmental impacts

The LCA results identify several significant contributors to the overall carbon footprint of the vomit bag. The full cradle-to-grave lifecycle of a single Mediplast Vomit bag results in an estimated 136,4 grams CO_2 equivalent emissions.

1 Production Phase

Main Environmental Hotspot

The production of the vomit bag itself is the most impactful stage, accounting for 86,1 grams CO_2e per unit. This includes emissions from: Material sourcing: the use of virgin fossil-based plastics — polypropylene and low-density polyethylene (LDPE) — contributes significantly, due to the extraction of crude oil or natural gas and subsequent energy-intensive processing into polymer pellets (52 grams CO_2e).Manufacturing processes: injection moulding (for the ring) and blow moulding (for the bag) are energy-intensive operations, particularly in China, where electricity is predominantly coal-based. These processes together contribute an additional 31,6 grams CO_2e.

2 Waste Disposal

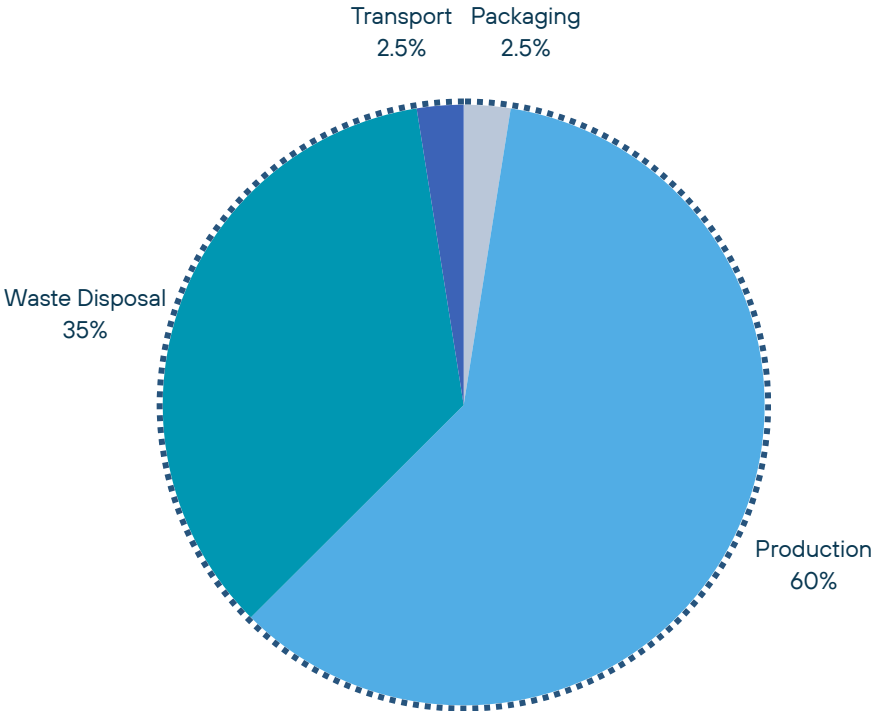
Second Largest Contributor

The vomit bag, classified as biohazardous waste, is incinerated after use, releasing 47,7 grams CO_2e. Because the product is made from fossil-based plastic, incineration results in the release of stored fossil carbon, further increasing its environmental burden.

3 Transport and Packaging

Third Largest Source of Impact

Emissions from transportation (3,5 grams CO_2e) and packaging materials (3,5 grams CO_2e) are relatively minor contributors. Transportation includes long-distance sea freight from China to Sweden, as well a regional road transport. Packaging consists of cardboard boxes and polyethylene film with pallets assumed to be reused five times before incineration.



The LCA reveals that the Mediplast vomit bag's environmental footprint is driven primarily by its reliance on virgin fossil-based plastic and energy-intensive manufacturing processes, particularly in regions with carbon-heavy electricity grids. Waste disposal via incineration of plastic materials further compounds its impact. Strategic changes in material selection, energy sourcing, and end-of-life treatment can significantly reduce the product's carbon footprint while maintaining its critical function in infection prevention and patient care.

The conclusions of the LCA produced several targeted actions that could significantly reduce the environmental impact of the Mediplast vomit bag:

- **Material Substitution**: Replacing virgin plastics with recycled content or transitioning to bioplastics or paper-based alternatives could dramatically reduce upstream emissions and avoid fossil carbon release during incineration.
- **Cleaner Energy in Manufacturing**: Contractual use of renewable electricity in production facilities, particularly in China, would substantially reduce emissions from the moulding processes.
- **Design for Disassembly or Compostability:** Redesigning the product to allow for easier separation of components, or using compostable materials, could open pathways for improved waste treatment options.
- **Improved Waste Management:** Exploring alternative end-of-life strategies, such as advanced recycling technologies or local sterilisation and reprocessing (where safe and regulatory-compliant), may help mitigate the impact of incineration.
- **Optimised Packaging and Logistics:** While less significant in overall impact, increasing the reuse cycles of pallets and exploring local manufacturing logistics efficiencies could offer marginal gains.

With the input from the LCA the next milestone was to turn the data and the results from the LCA into material for analysis, prioritize and collective multidisciplinary discussion on sustainability.

IV. Prioritizing and finding solutions

The aim of this next step in the project was to collect all information, prioritize possible improvement measures and discuss the implications for each of the identified courses of action. This prioritization included several levels of analysis, from vision to practice

The action planned for this step was a "Prototyping Workshop", a space where different functions of the company were present, as well as NCSH representatives and specialists from other sectors. The workshop used the inputs from the LCA, and other relevant information, to identify potential options for redesigning the product or its production process that can reduce the environmental impact and improve the sustainability of the company and the sector.

The workshop was facilitated by Together Tec, a Swedish organization specialized on long term solutions for sustainability. The participants had expertise of the product, but also of operative, commercial and marketing areas. Two external specialists were invited, one TCD researcher, who developed the LCA, and one material specialist from Norner, a leading industrial polymer R&D center for the polymer and plastics industry with over 40 years of experience. The knowledge provided by them was extremely valuable given that the purpose of the workshop was to introduce the participants to a general methodology and to explore different alternatives to improve the sustainability of the vomit bag.

The workshop contributed to building a common understanding about the concepts of sustainability and circular principles for design. The Circular Design Methodology was used, which is a holistic approach that goes beyond the product design to include processes, corporate policies, and the entire business model, to the working methods of the company, the NCSH and other actors who participated in the workshop, and finally, generated the concrete scenarios that constitute the main conclusions of the project.

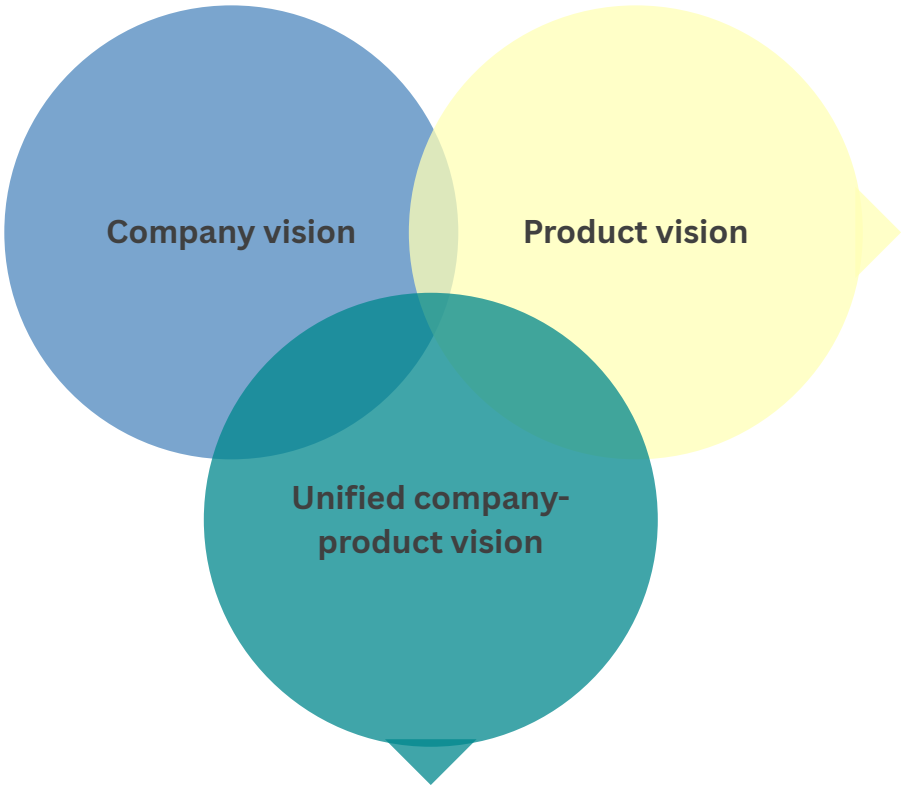
Circular mapping was the tool used to guide the process of prioritizing and identification of scenarios for redesigning the product. The product was analyzed across the system from 3 perspectives:

1) Material and product design
2) Process requirements
3) Supply chain management

The 3 perspectives build on common variables to develop robust and feasible high impact scenarios for the product.

Setting the vision

The first step was to define a common vision to align the transformation of the product with the business strategy and a broader vision of sustainability.



- Use the project results to position the Vomit Bag as a signature product on the commitment for improving the forms to be sustainable.
- A product characterized by a evidence based on materials and design.
- Include different levels of stakeholders such as the "Planet", healthcare personnel, waste managers.

- The Vomit Bag is a more sustainable product which contributes to the company leading the industry through products that excel in functionality, pricing, and sustainability.

After a unified vision was defined, a series of discussions between the participants took place. This was an intensive brainstorm following the three perspectives, 1) Material and product design, 2) Process requirements and 3) Supply chain management, to cluster the ideas and match with the methodology and the inputs from LCA.

Results of the participatory discussion

Material and product design	Process requirements	Supply chain management
• Switching to bio-based material/recycled material • Reintroducing scraped plastic in process • Use the same material for the ring and the bag • Reusable cup (metal) and cellulose bag/bowl • Design for recycling	• Evaluate to switch production to be more "local" • Asking the supplier to switch for green energy	• Automate the assembly process • Honey centrifuge to empty the vomit • Liquid collection, inspired by Serres NEMO • Wax impregnated cellulose/bamboo • Holes in the ring to reduce material • Neutralizing bio-hazard powder

Once the ideas were generated a second specialized methodology has been implemented, to identify the real possibilities of the company, having at the end the scenarios of:

- Switching (partially or totally) to bio-based material
- Switching (partially or totally) to recycled material
- Evaluate switching production to a closer location, potentially Europe

In all cases, consider reducing the amount of material on ring and bag.

These options were agreed as the most feasible solutions from the practical analysis of the company and influencing the most impact areas from the product: Energy and production (waste).

V. Scenarios and feasibility

Once the potential changes have been identified, the following step was a Feedback exercise, which include other type of actors who haven't been included before, such as healthcare professional, specifically related to public tenders and in general the process of getting new products and services to the hospital, and academic, in this case, systemic design professionals.

These specialists were added to the group of internal strategic areas from Mediplast, in total the potential changes received feedback from a procurement perspective, marketing perspective, hospital perspective, sustainability perspective, supply chain perspective and design perspective.

To consider:

- Single-use plastic reduces infection risks compared to reusable options like metal buckets.
- Mediplast acquired the existing bag designed by the supplier, resulting in limited control over its size and form
- Returning to reusable metal buckets contradicts the company's focus on single-use medical devices, reintroduces infection risks, and increases handling complexity for healthcare staff.
- The bag's design (no side seams, double-sealed bottom) reduces tearing.
- Nurses use also the bag for inducing vomiting and retrieving swallowed narcotics, ruling out compostable options while maintaining a "100% biodegradable" goal.
- A rigid ring is crucial for safe handling; a single reusable metal ring for multiple bags could be an alternative.
- The supply chain is complex, even for simple items like vomit bags, involving extensive travel despite boat shipping
- Customers and tenders are pushing the company to reduce carbon footprint and hospital waste.
- The company wants to stay ahead of competitors and act proactively. For example, they were the first to offer PVC-free products before regulations required it.
- The most important criterion for healthcare staff is that the MedTech equipment shows the best performance and is safe with respect to patients.
- Region Skåne, one of the main clients, has an environmental program with targets to increase the share of recycled material to at least 30% and reduce municipal waste from healthcare services by at least 40%, both by 2030 compared with 2019 levels.

A. Switching (partially or totally) to bio-based material

Main argument

Changing the material composition of the product (partially or totally) to bio-based materials would lead to an important reduction of the environmental impact of the product. In addition to environmental benefits, bio-based materials also offer positive marketing and public perception advantages. These can strengthen the product's appeal to consumers and improve its competitiveness in public tenders.

General considerations

- Using biobased materials is encouraged by the hospitals but only under condition that the MedTech equipment is safe with respect to patients, not too high cost and doesn't slow down the procurement process.
- A biodegradable bag would require a new manufacturer and an exploration of materials like sugarcane-based plastics.
- Fully biobased materials include PLA, PHA, or PBS, not just fossil-based equivalents.
- Switching to bio-based or recycled plastic won't significantly reduce the environmental impact if the bag is incinerated. However, using fully bio-based, non-plastic materials will lower the Global warming potential, Ecotoxicity impacts during incineration.

Pros	Cons
• In some procurement processes there are expressed political principles and policies that should be trying to find products based on recycled or biobased materials. • Competitors are launching products made of biobased materials and promoting circular solutions, increasing market pressure. • Bio-based material compared to plastics reduces emissions associated with incineration, the main contributor to product's global warming potential	• There are not many material suppliers that provide biobased (or recycled) materials. • There are not a lot of incentives to use/produce recycled/biobased material. • A cellulose bowl, as example of an alternative product, poses leak risks and performs poorly in landfills (methane emissions), despite lower GHG emissions from incineration.

B Switching (partially or totally) to recycled material

Main argument

Changing the material composition of the product (partially or totally) to recycled materials would have an important effect on the environmental impact associated with the product. Recycled materials also open up opportunities to explore circular solutions and close the loop within Mediplast's product lines. For example, using remnants of plastic from other production processes and with that reduce the costs of production of the product.

General considerations

- Some of our single-use products in hospitals are based on up to 100% recycled materials, but hardly any medical devices are recycled due to the need to specify traceability for input materials in production according to the MDR ordinance.

Pros	Cons
• In some procurement processes there are expressed political principles and policies that that promote products based on recycled or biobased materials. • Recycled materials not only as an input for the Vomit bag, but unused bags or production scraps, if any, could be recycled into other products. • Streamlining recycling processes can lower cost associated with waste management and material recovery. • By ensuring recycling, and using recycled instead of virgin material, the demand of new material decreases and lowers the GHG emissions from both production and incineration.	• The MDR ordinance restricts the use of recycled material. • Sourcing recycled/biobased materials and clean energy regionally is difficult and expensive due to limited number of suppliers.

C Evaluate switching production to a closer location, potentially Europe

Main argument

There is very little possibility of influencing the energy mix in the country of the current producer. Changing production to Europe for example, would make it possible to have more control over impacts associated with energy consumption. To relocate to a closer location the production could also make the supply chain more robust and resilient and reduce the emissions associated with transport. The impact could also benefit the region by contributing to the generation of jobs and increasing investments within the region. Finally, it could facilitate the implementation of circular economic strategies thanks to shorter supply chains.

General considerations

- There is no contractual requirement for the supplier to have clean energy.

Pros	Cons
• A focus on locally produced medical products may increase over time as Swedish healthcare providers are obliged to be more self-sufficient on a large number of medical products. • One of the main advantages with local production is resilience to potential supply chain disruption. This topic is increasingly a priority in Sweden and could be a mid-term perspective for ensuring the resilience of the healthcare sector.	• Collective demand for green energy can drive down costs (like EU renewables), allowing companies to negotiate with suppliers to balance costs with process improvements • Local production can reduce carbon footprint and supply chain complexity by minimizing transport but may require investments in factory re-tooling (equipping the factory with new or adapted machinery for injection, extrusion or blow molding).

Conclusion and Next Steps

The feasibility study has followed a co-designed methodology which has been implemented according to the original design plan of the project. The process has been successful with relevant learnings and outcomes that exceeded the initial expectations of the project.

Besides having a document with evidence and a process that could help the decision making of the company, the project has generated knowledge across different sectors which has been part of the process. The knowledge generated has been disseminated as part of the work of the NCSH in events in different European countries. The sustainability commitment of Mediplast has been recognized and it has generated incentives and awareness about the importance of including sustainability from the moment of design the medical products, especially single use items.

There are some practical steps that can be taken in order to better use the results of this report and to complement its results. For example, it is necessary to map existing suppliers of biobased and recycled materials, to evaluate costs, materials and others that can supply the production of the Vomit Bag.

The report can be used to evaluate the possibility to initiate a program based on circular economy principles that allows use of residuals from other products of the catalogue of Mediplast to the production of the Vomit Bag.

At the same time, it is recommended to implement market research that takes into consideration the willingness to pay vs sustainability from the customer's perspective. This can be complemented by a Marketing and awareness campaign, both internally and outside the company.

Finally, our ambition is that this project can be a platform for engagement between companies and procurers on how to improve sustainability, using the extensive NCSH network.

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