SEPTEMBER 2025

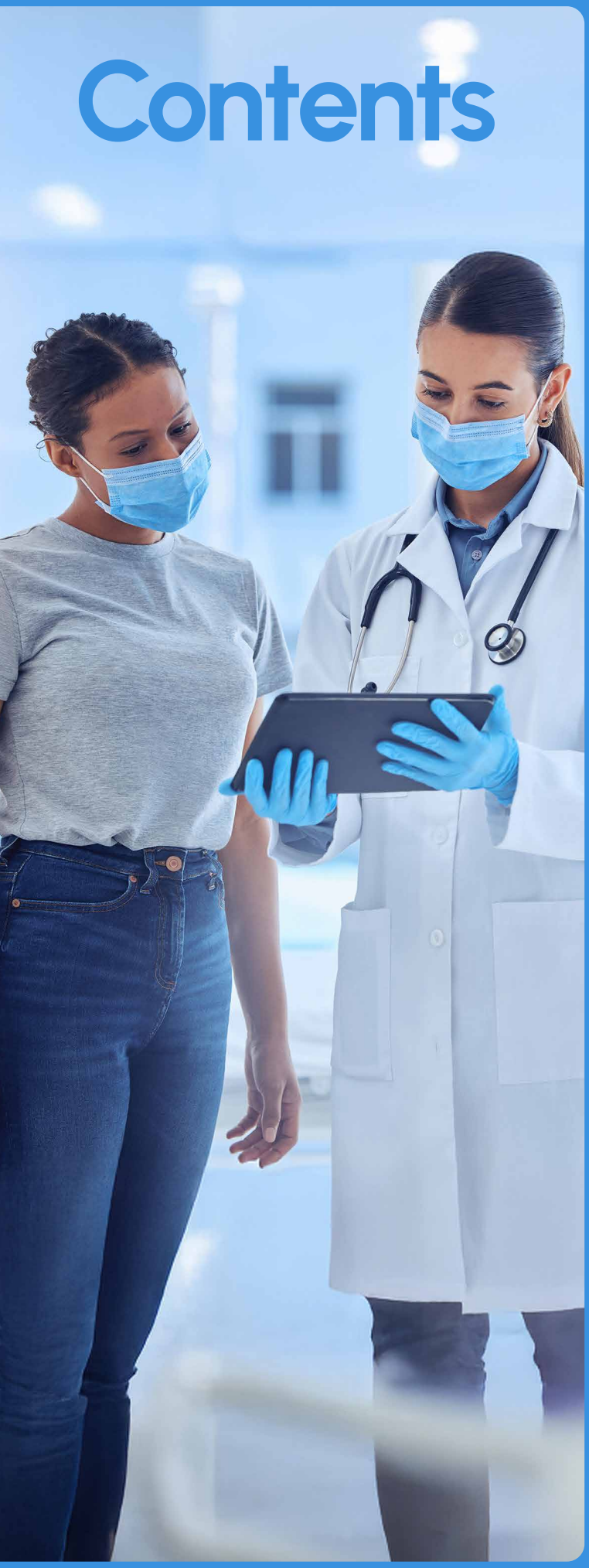
A prescription for change

Rethinking plastics use in healthcare to reduce waste, greenhouse gas emissions and costs

SYSTEMIQ

eunomia

Contents



Preface

Plastics have long stood as a symbol of progress in healthcare. Durable, sterile, and affordable, they have enabled safe and scalable care delivery in nearly every clinical setting, from advanced operating theatres to rural health outposts. But today, that advantage is a systemic vulnerability. As climate urgency mounts and resource constraints tighten, the healthcare sector is presented with a unique opportunity to become a steward of planetary health whilst not compromising on patient safety.

Healthcare is now one of the most plastic-dependent sectors – and one of the most overlooked in global circularity and decarbonization agendas – as it is often exempt from the sustainability standards and regulations applied to other industries. Plastic use continues to climb unchecked – escalating waste, straining local systems, and locking the sector into high-emission trajectories.

Yet the opportunity is clear. The healthcare sector is not starting from zero; around the world, hospitals are piloting reusable gowns and surgical trays, manufacturers are redesigning packaging for recyclability, and innovators are recovering hard-to-recycle waste streams. But these efforts remain fragmented and under-resourced, lacking a shared, scalable strategy.

This report fills that gap. It's the first systems-level assessment of single-use plastics in healthcare - integrating material flow modelling, scenario analysis, and real-world case studies to chart a strategic path forward. It demonstrates that deploying a suite of circular economy levers – (1) Refuse, Rethink, Reduce; (2) Reuse; (3) Substitute materials; (4) Improve recycling; and (5) Procure low-GHG emissions plastic – could cut single-use plastic demand by over 50%. It could also reduce associated greenhouse gas (GHG) emissions by nearly half and potentially deliver up to $18 billion (€15 billion) in system savings by 2040 – all without compromising patient care.

But solutions won't arise by default. Structural barriers – from data gaps and procurement rigidity to regulatory inertia – continue to inhibit progress. Overcoming them requires coordinated and sustained action: by governments, through updated regulations and incentives that reflect the need for action; by healthcare providers, by embedding circularity into operations; and by suppliers, with investments in innovation, transparency, and redesign. The global healthcare community is increasingly united in its call for action on plastic pollution. An open letter published by Health Care Without Harm, urging the phase-out of harmful plastics in healthcare, has been endorsed by over 48 million health professionals worldwide – a clear signal of the sector's growing resolve to address plastic pollution.

This report offers more than technical analysis. It provides the foundations of a strategic roadmap – grounded in data, informed by expert input, and shaped by real-world feasibility. It reveals that circular and low-GHG emissions solutions exist today. They are safe, viable, and increasingly cost-effective. What is missing is scale, coordination, and resolve. Whether you are a policymaker, a hospital leader, a clinician, or a manufacturer, you have a role to play. And the time to lead is now.

Let us reimagine a plastics system in healthcare that upholds not only the wellbeing of patients, but also the health of our planet – without compromising on one for the other. By acting decisively now – redesigning products, reforming procurement, investing in infrastructure, and enabling behavioral change – the healthcare sector can lead in building a plastics system that is resilient, decarbonized, and fit for the 21st century.

Yoni Shiran
Partner
Systemiq

Pallavi Madakasira
Managing Consultant
Eunomia

Will Clark
International Supply Chain Transformation Director, **Health Care Without Harm**

About this publication

About this study

Produced jointly by Systemiq and Eunomia with grant funding from Takeda Pharmaceuticals*, this study presents a data-driven vision of how to reduce greenhouse gas emissions and plastic waste from healthcare systems in Europe and North America. It quantifies the environmental and financial impacts of single-use plastics across seven high-volume product categories, identifies the systemic root causes driving current trajectories, and models systems-change scenarios supported by actionable industry interventions, policy levers, and real-world case studies. The research highlights the emissions, waste, and cost implications of inaction, as well as the potential for effective, safe, circular alternatives. With tailored data for North America (USA and Canada) and Europe (EU27 and UK), this report is designed to inform healthcare operators, policy makers, and supply chain leaders seeking practical solutions to decarbonize and modernize healthcare plastics.

SYSTEMIQ

eunomia

About Systemiq

Systemiq is a systems change company that works with businesses, policymakers, investors, and civil society organizations to reimagine and reshape the systems that sit at the heart of society – energy, nature and food, materials, built environment, and finance – to accelerate the shift to a more sustainable and inclusive economy. Founded in 2016, Systemiq is a certified B Corp with offices in Brazil, France, Germany, Indonesia, the Netherlands, the UK, and the USA. Find out more at www.systemiq.earth or via LinkedIn.

For questions and comments, please reach out to plastic@systemiq.earth

About Eunomia

Eunomia Research & Consulting, Inc. – established in 2001 – is a consultancy focused on accelerating the transition to a circular, decarbonized economy by working with governments, global brands, investors, and NGOs to align policy, infrastructure, and innovation. A certified B Corp with offices in the United States, United Kingdom, New Zealand, and Belgium, Eunomia delivers evidence-based solutions – powered by engineers, scientists, economists, policy strategists, and circular economy experts – that transform how materials, energy, and resources flow through society. Find out more at https://eunomia.eco/ or via LinkedIn.

For questions and comments, please reach out to healthcareplastics@eunomia-inc.com

Disclaimer

Responsibility for the information and views set out in this publication lies with the authors. Members of the Expert Panel or sponsors endorse the overall project approach and findings, but not all statements in this publication necessarily represent their views and they cannot be held responsible for any use which may be made of the information contained or expressed therein. Nothing in the report should be construed as implying new legal obligations or intended to explore individual approaches to, or involvement in, specific impacts; and nothing in the report should be deemed or construed as statements made individually by any member of the Expert Panel or sponsors.

Citation

If reproducing or referencing the content of this report, please use the following citation: *"Systemiq and Eunomia. (2025). A Prescription for Change: Rethinking plastics use in healthcare to reduce waste, greenhouse gas emissions and costs."*

Rights and permissions

* Takeda's involvement in this research was solely as a financial supporter. Takeda was not involved in the organizing of the research or the creation of this report.

Acknowledgements

Expert Panel

This report was made possible thanks to a grant from Takeda Pharmaceuticals and produced jointly by Eunomia and Systemiq, with support from a diverse group of experts and stakeholders committed to building a more sustainable and resilient healthcare plastics system.

A panel of experts representing different sectors and stakeholder groups across the value chain was assembled to ensure the directional relevance, practical feasibility, and cross-sector credibility of this study. Data on this topic is often fragmented, difficult to locate, and inconsistent. Convening this group of experts was our deliberate approach to foster cohesiveness and establish a consistent framework for defining the problem statements and envisioning innovative solutions. The Expert Panel reviewed all key assumptions and provided input into the methodology, system model, and conclusions. We are deeply grateful to all the organizations and individuals who contributed their time and deep content expertise to the process.

Expert Panel members endorse the overall project approach and findings, although specific statements made in the report do not necessarily reflect their individual views or those of the organizations they represent.

Mahmood Bhutta
Professor and Director
Green Healthcare Hub,
Brighton & Sussex Medical School, UK

Jason Fischer
Director of the Office of Sustainability
Houston Methodist, USA

Liam Hogg
Head of Greener NHS
NHS, UK

Nicole Hunfield
Associate Professor Sustainable Hospital Care, Chief Sustainability Officer Intensive Care Adults
Erasmus University Medical Center, NL

Rachel Meidl
Deputy Director and Fellow in Energy and Sustainability
Rice University's Baker Institute for Public Policy, USA

Project team

Systemiq

Daniel Barraclough
Lead Modeler and Analyst

Alexandre Harry
Project Manager and Lead Author

Yoni Shiran
Co-Lead, Systemiq

Eunomia

Simon Hann
Technical Lead

Iris Liu
Lead Healthcare Analyst

Zoë Hodges
Research Support

Pallavi Madakasira
Co-Lead, Eunomia

We wish to acknowledge the contribution of the following individuals who supported the team in developing this report:

Ben Dixon; Peter Goult; Philip Lake; Rafal Malinowski; Jason Martins; Trishla Shah; Rob Wilson, Belen Alvarez Guzman; Yashwini Selvaraj; Audra Jackson

Report design

Yesify

Contributors

We are further indebted to the following individuals who provided technical inputs, case study insights, and critical feedback that enriched the final output:

Sandra Alexander Project Manager, Single-Use Plastics Reduction, Canadian Coalition for Green Health Care;

Dr. Isabela (Cajiao) Angelelli Director of Clinical Operations, Pediatric Sedation Service, UPMC Children's Hospital of Pittsburgh;

Sally Beken Director, UK Circular Plastics Network UKCPN;

Joe Burton Sustainability Transformation Project Lead, UCLH NHS Trust;

Tatiana De Wee Circular Healthcare Programme Manager, Health Care without Harm;

Emily Carey Perez de Alejo Executive Director, Defend Our Health;

Loredana Fugaroiu Waste Management, NHS Epsom and St Helier;

Greg Giandomenico Director of Strategy, Veolia North America;

Kishor Gurung Facilities Assistant General Manager, St George's, Epsom and St Helier University Hospitals and Health Group;

Sam Hall Green Plan Director, NHS St George's;

Niels Hagenaars Director, Gupta Strategists;

Dr. Katherine Hofmann Sustainability Strategic Initiatives Manager, Eastman;

Nicolas Longhitano Project Manager, Polymeris;

Emily Littlewood Senior Net Zero Manager, NHS;

Clare Nash Head of Clinical Procurement, NHS Sandwell and West Birmingham;

Dr. Ganesh Nagarajan Senior Director of Plastics, Waste Management;

Ashley Perry Director of Hazardous Waste Services, Daniels Health;

Alexis Percival Environmental Technical Manager, NHS Yorkshire Ambulance Service;

Ramses Prado Mares Senior Performance Improvement Consultant, Providence Health Care;

Dr. Ted Schettler Science Director, Science and Environmental Health Network;

Tracy Taszarek Executive Director, Healthcare Plastics Recycling Council;

Dr. Gareth Thompson Clinical and Innovation Lead, Liverpool College Healthcare NHS Trust;

Linda Varangu Senior Advisor Climate Change, Canadian Coalition for Green Health Care;

Francesco Vasques Sustainability Programme Consultant, NHS;

Baptiste Verneuil Project Manager, The Shift Project;

David Walsh Operations Manager, Impact Recycling;

Guy Wing Head of UK Circular Projects, Sharpsmart.

Special thanks to **St. George's Hospital (London)** for their openness and collaboration in sharing insights from on-the-ground healthcare practice.

Executive summary

Plastic has become an integral part of modern healthcare across all settings, including hospitals, outpatient clinics, pharmacies, and long-term care facilities. From gloves and gowns to syringes and fluid bags, plastics enable hygienic, safe, and scalable care delivery across all levels of healthcare systems – from high-tech operating rooms in major hospitals to remote primary care clinics. Its durability, sterilizability, and low cost have made it the default material choice for countless single-use and multi-use applications since the 1990s, as infection prevention protocols and regulations (linked to HIV, hepatitis, and hospital-acquired infections) have driven a shift from reusable metals and textiles to sterile, single-use polymers.

But this reliance has also created a highly linear system that is increasingly costly for our healthcare systems. It is also environmentally unsustainable; plastic waste generated in healthcare settings is incinerated or landfilled in the vast majority of cases. According to the Healthcare Plastics Recycling Council, almost 15 million tonnes of healthcare plastics were produced globally in 2020[1], generating approximately 5% of total global plastic waste[i]. COVID-19 has exacerbated this trend, driving increases in personal protective equipment (PPE) and single-use medical items. At the peak of the pandemic, the production of PPE rose by 40%[2], with 129 billion masks and 65 billion gloves used monthly worldwide[3] and the consumption of PPE continued to remain elevated past this peak[4].

Despite growing public and regulatory scrutiny around plastic pollution, healthcare remains one of the few sectors largely exempt from plastic-related regulation, such as the Packaging and Packaging Waste Regulation (PPWR) in Europe[5] and ambitious bills like SB-54 in California[6]. Concerns over safety, regulatory standards, and performance requirements continue to slow innovation and restrict change.

This is not just a waste management issue; it is a climate issue. Virgin plastic production is a major source of GHG emissions, and our analysis shows that healthcare's plastic footprint does not align with a net zero pathway or with the 1.5°C climate target set out in the Paris Agreement. Some progressive actors are beginning to act: the National Health Service (NHS) England has committed to reach net zero direct GHG emissions by 2040 and cut 80% by 2028 – 2032[7]; Kaiser Permanente in the United States is targeting full value chain net zero by 2050[8]; and Medtronic, as part of its Scope 3 strategy, has exceeded its goal of reducing plastic packaging for specific product lines by 25% (approximately 130 tonnes)[9]. But such efforts remain fragmented and lack alignment in scope, metrics, and ambition.

Without systemic action, the negative impacts of single-use plastics in healthcare will become severe, with significant implications for waste, healthcare costs, GHG emissions, and public trust. While there is growing recognition that the healthcare sector should undergo a transition – toward a system that minimizes unnecessary plastic use, embraces reusable and recyclable solutions where safe and feasible, and reduces its reliance on virgin fossil inputs – there is no consensus on priority interventions or what their potential impacts could be.

> Without systemic action, the negative impacts of single-use plastics in healthcare will become severe, with significant implications for waste, healthcare costs, GHG emissions, and public trust

i In Breaking the Plastic Wave, an estimated 250 million tonnes of plastics were disposed of in 2020.

This report is a strategic analysis of single-use plastics in healthcare aimed at addressing these issues. Employing a broad product scope, cross-regional modelling, a long-term time horizon, and scenario-based systems analysis, this report provides a roadmap to help the healthcare sector align with climate goals and resource efficiency, while maintaining patient safety. It integrates diverse interventions – from material substitution and reuse to design for recycling and waste stream optimization – offering a shared fact base to support action across the healthcare value chain. It aims to address three key gaps in the current landscape:

- a lack of understanding of plastic volumes in healthcare,
- a fragmented approach to circularity initiatives, and
- a lack of shared vision across public and private sector actors on the future of plastic in healthcare.

The report focuses on the seven highest-volume single-use plastic product categories used in healthcare: tubing and fluid bags; gloves; rigid devices (syringes, venous blood collection tubes, urine sample tubes, and single-use infant bottles); rigid medical device packaging; Personal Protective Equipment (PPE); wipes; and pharmaceutical packaging. These categories are estimated to have a high share of plastic volume[ii] and offer the greatest potential for intervention. Our focus is Europe (EU27 + the United Kingdom) and North America (Canada and the United States of America) – two regions with high healthcare plastics consumption that are well positioned to lead the transition.

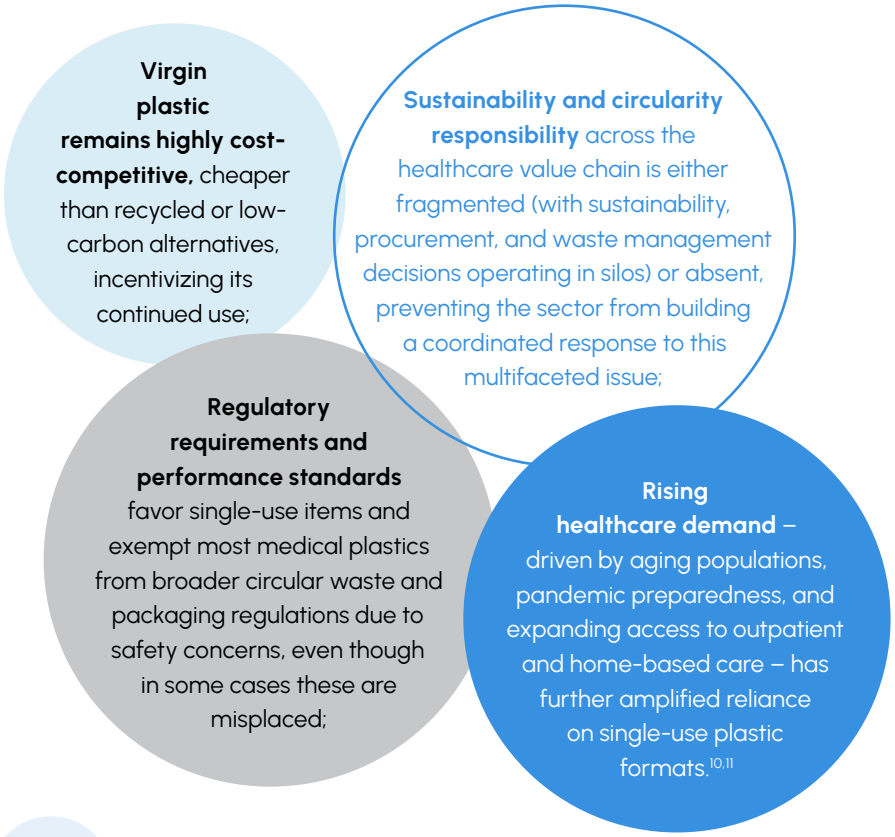
The report employed a systems-level approach, integrating material flow modeling with scenario-based analysis to assess the impact of ambitious and coordinated cross-sector action. A suite of circularity levers – from elimination and reuse to design for recycling and better end-of-life management – was identified and their combined effects were modeled through 2040, drawing on interviews, case studies, literature review, and stakeholder input.

This report aims to provide a first-of-its-kind view on accelerating circularity for single-use plastics in healthcare applications. The following chapters provide a deeper analysis: outlining the current linear trajectory of plastic use in healthcare, the impact of circularity interventions, and the structural transformation needed to achieve a more sustainable and resilient plastic system. This is not just a report on waste management – it is a call to reimagine how materials flow through our healthcare systems and to rethink the economic and environmental implications of the choices.

ii In Measuring and reducing plastics in the healthcare sector, disposable gloves, IV solution bags, disposable PPE, syringes and IV administration systems represented over 50% "of the total plastic used annually".

1 Under Business-as-Usual, the sector is misaligned with 1.5°C and waste reduction goals; single-use plastic waste and associated GHG emissions could grow by 35-40%, over 2023 levels, by 2040[iii]

The current trajectory of healthcare plastics is shaped by four interlocking structural forces;



This current single-use model introduces operational fragility and is not environmentally sustainable. Based on the model developed for this report, in 2023, the healthcare systems of Europe and North America generated around 2.1 million tonnes of single-use plastic waste from seven high-volume product categories across the value chain, as well as GHG emissions of approximately 9.3 million tonnes of CO_2e. Without significant intervention, this figure could rise to more than 2.9 million tonnes of single-use plastic annually by 2040. Plastic waste in Europe is expected to increase by 47%, and in North America by 28%, over the same period. This would result in an additional 3.6 $MtCO_2e$ of GHG emissions across the value chain annually and $21 billion (€18 billion) system cost[iv] (on top of the $56 billion (€47 billion) spent on these categories in 2023), reinforcing a linear system at odds with climate targets and institutional sustainability commitments.

2 Applying circular economy levers will significantly reduce plastic use by up to 53%, GHG emissions by up to 55%, and system costs by up to 24% by 2040

Five core circularity and decarbonization levers – **(1) Refuse, Rethink, Reduce[v]; (2) Reuse; (3) Substitute materials; (4) Improve recycling; and (5) Procure low-GHG emissions plastics[vi]** – can enable a shift toward a more circular and climate-aligned healthcare plastics system, without negative impacts on patient health or safety. Refuse, Rethink, Reduce would involve phasing out unnecessary products or components, such as redundant layers of packaging or over-used products like gloves or syringes. Reuse could introduce durable alternatives in clinical workflows for certain applications, such as reusable gowns and metal trays, where hygiene and performance standards can be maintained. Substitution could replace traditional plastics with alternative materials, including paper-based packaging or compostables, where contamination and performance risks are minimal. Recycling improvements would target product and packaging design for recyclability and expand the segregated collection and processing of non-infectious plastics. Finally, low-GHG emissions plastics[vii] or plastics that leverage Carbon Capture and Storage (CCS) could help reduce upstream carbon footprints where single-use formats are unavoidable.

Together, these interventions could reduce plastic waste by 53% by 2040 compared to Business-as-Usual (BAU), in a High-Ambition Scenario. This would represent 1.6 million fewer tonnes of waste per year and could avoid 7 million tonnes of CO_2e annually. Financially, the healthcare system could realize approximately $18 billion[viii] (€15 billion) in annual cost savings through reduced material purchasing, lower disposal costs, and reduced exposure to volatile fossil-based supply chains. Upstream measures deliver most of the impact, highlighting the importance of avoiding plastic use altogether, rather than focusing solely on waste treatment. The main report presents aggregated data; for regional results, please see supplementary "Regional Zoom" documents.

iii Note, the time period we are modelling for throughout this report is 2023 – 2040

iv System cost reflects the entire cost of producing, converting and disposing of the products within the system boundary of this report. Labor cost is not included during the 'use' phase of these products. In system-change scenarios, this includes the costs associated with enabling reuse systems, such as transportation and sterilization.

v Based on the 10R-Value hill framework that outlines the 10R Circular Economy strategies (Figure 2 of Huijben et al[12])

vi See definitions in Chapter 2. The terminology used aims to be consistent with the common 10R Circular Economy strategies. Some have been grouped for this report to simplify the analysis.

vii Defined in this paper as plastics produced using methods that result in lower GHG emissions compared to traditional fossil-fuel-based production, such as those made with Carbon Capture and Storage (CCS) technologies or biobased feedstocks.

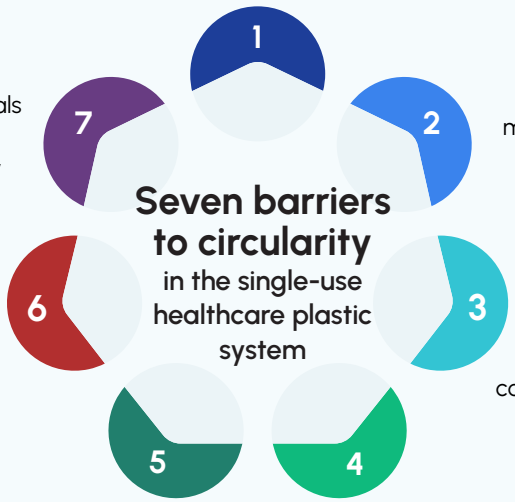
3 Seven system barriers are slowing down circularity in the healthcare sector

Despite the availability of effective solutions, the uptake of circular practices remains slow due to several system barriers identified during expert conversations:

Fragmented and siloed governance
Decentralized decision-making and siloed departments can prevent coordinated action and limit ability to scale successful pilots

Market failures and weak demand signals
Unclear demand and regulatory signals discourage suppliers from investing in circular design and recycling capacity

Data gaps and lack of transparency
The lack of standardized data on materials, waste, and GHG emissions hinders informed procurement and limits value chain visibility



Behavioral norms and operational culture
Infection control protocols, time pressures, and lack of formal support make sustainability initiatives difficult to embed in clinical routines

Short-term cost focus over lifecycle value
Procurement prioritizes low upfront costs, discouraging investment in more sustainable alternatives that carry higher initial costs

Infrastructure and investment gaps
Missing logistics, segregation systems, and funding prevent effective implementation of reuse and recycling models

Regulatory inertia and misaligned incentives
Outdated standards and exemptions for healthcare plastics block innovation and can limit the adoption of circular solutions

These barriers – spanning clinical risk perception, procurement rigidity, cost focus, waste regulation, infrastructure gaps, data limitations, and market misalignment – should be addressed simultaneously to enable meaningful and transformational change.

4 Decisive and coordinated action from all system actors is needed to drive change

To overcome these barriers, healthcare systems should invest in and focus on the foundational capabilities that enable transformation. Clear accountability structures are essential. Most institutions need dedicated leadership, cross-functional coordination mechanisms, and defined responsibilities for circularity within procurement and operational teams. Data infrastructure warrants coordinated investment and governance. Providers should adopt systems to track and reduce plastic use, procurement patterns, and waste flows at the product level, enabling targeted decision-making and transparent performance tracking.

In parallel, value-based procurement criteria should be embedded across all major purchasing processes. This includes factoring in lifecycle emissions, waste implications, and material circularity in tenders and supplier evaluations. Manufacturers would then be incentivized early to develop recyclable or reusable product alternatives. Clinical and operational teams should be equipped with training, decision-support tools, and protocols that allow them to adopt circular solutions safely and efficiently. Waste service providers could expand the infrastructure for decontamination and recycling. Governments can accelerate progress by updating waste and product regulations, supporting innovation, and creating financial mechanisms that reward circular performance.

Acting now is essential. Decisions on procurement, infrastructure, and product design made in the upcoming years will lock in emissions and material flows for years to come. This is an opportunity for the healthcare sector to lead on climate and resource stewardship while reinforcing its mission to protect human health and strengthen system resilience.[13,14]

Introduction

About this report

Report objectives

This report has three main objectives:

To produce a data-driven plastic flow model and scenario analysis for a significant share of the healthcare single-use plastics system that can inform strategies and resource allocation for all stakeholders in the value chain (private sector, public sector, and civil society), while highlighting the associated economic and environmental impacts.

To provide a suite of levers that could reduce plastic usage and / or decarbonize plastics within the healthcare system, supported by specific case studies that showcase high impact initiatives, technologies, and innovations. These examples highlight key success factors and explore pathways to scale across geographies and health systems.

To strengthen collaboration across industry, government, and civil society by enabling evidence-based dialogue to support shared strategies for achieving a better plastics system in healthcare.

Research questions

The report provides an evidence-based, data-driven, solution-focused approach to answer the following key questions;

1. What are the main sources of single-use plastic consumption in medical settings?
2. Where is the healthcare system headed in terms of plastic consumption, plastic waste, and GHG emissions if it continues along its current trajectory? And what are the associated economic and environmental impacts?
3. What levers and interventions can be deployed to decarbonize plastics in the healthcare system and advance its circularity?
4. What are the impacts of decarbonization on plastic waste, GHG emissions, and costs by 2040 under different levels of ambition?
5. What are the system-level barriers to enable transformative change of the healthcare industry towards more circular plastic use? And how can they be resolved?

Approach

Methodology, scenarios, and the underlying model

Three scenarios were developed to explore the potential impact of system interventions on healthcare plastic use, GHG emissions, and costs between 2023 and 2040. These are not forecasts, nor the only pathways forward, but illustrative scenarios that demonstrate what is possible under different levels of ambition and coordination.

Each scenario was constructed by identifying a set of circularity and decarbonization levers – (1) Refuse, Rethink, Reduce; (2) Reuse; (3) Substitute materials; (4) Improve recycling; and (5) Procure low-GHG emissions plastics – and modeling their impact on the system baseline. The potential of each intervention was assessed by combining available technical evidence with expert insights on real-world feasibility. Five key feasibility filters were considered: **cost-effectiveness, performance and safety standards, technological maturity, regulatory alignment, and ease of implementation in clinical workflows.** Only those solutions that met acceptable thresholds across all these dimensions are included in the analysis. This ensures that the modeled outcomes are not just technically possible, but also plausible within operational and institutional constraints. The scenarios were constructed by applying the systems change levers and then quantifying the maximum possible efficacy of these levers between 2023 and 2040. The three scenarios are:

Business-as-Usual (BAU)

A continuation of today's patterns. Plastic consumption grows steadily with rising healthcare demand. This scenario assumes no material changes to regulation, procurement, or clinical and waste management practices. Circularity initiatives remain fragmented and at small scale.

Moderate-Ambition Scenario

An improved future where healthcare systems pursue stronger circularity interventions, pushed by incremental rather than transformational regulatory improvements. Progress remains uneven and constrained by costs, institutional inertia, and limited technology deployment.

High-Ambition Scenario

A transformative future characterized by bold and coordinated policy and financing and procurement reform, along with behavior change at scale. Circularity becomes embedded in healthcare systems, and the sector achieves the maximum feasible reduction in plastic use and GHG emissions.

The study uses a simplified flow model based on Systemiq's previous work[ix] but adapted to the healthcare context. This approach was independently peer-reviewed when *"Breaking the Plastic Wave"* was published in the journal *Science*[17]. It relies on a system map, tailored to this report, to quantify plastic flows by plastic category and geographic region under different scenarios between 2023 and 2040. By overlaying cost and GHG emissions data, the potential environmental and financial implications of each scenario can be quantified, as explained in the Technical Appendix.

Because managing single-use healthcare plastics is complex, a unified systems model has been developed to bring together various consumption and disposal pathways. This model accounts for regional differences between Europe and North America while providing a common framework to analyze potential interventions based on specific uses and local contexts.

ix This study uses a simplified flow model based on Systemiq's previous work in "Breaking the Plastic Wave"[15] and "ReShaping Plastics"[16] reports.

Expert panel

With data on this topic often fragmented, inconsistent, or absent, the Expert Panel helped to build a cohesive framework for defining challenges and identifying solutions. The panel consisted of five specialists, including clinicians, hospital procurement leads, sustainability officers, polymer scientists, and waste management professionals from Europe and North America. The panel supported the research team throughout the project to test hypotheses, challenge assumptions, share data, and help evaluate the real-world feasibility of proposed levers. Their input ensured that the model is grounded in reality and balances both technical rigor and clinical practicality.

Regions

This study examined approximately 2.1Mt of single-use plastic deployed in healthcare across Europe and North America, of which Europe accounted for 0.9 Mt while North America accounted for 1.2Mt. These regions were chosen not only because they account for a significant share of global healthcare spending, but also due to relatively better availability and consistency of data compared to other parts of the world. While Europe and North America are presented as regional aggregates, this report acknowledges that diversity exists both between and within countries – from national procurement standards to hospital-level practices – and that levels of maturity, regulation, and waste management vary considerably. The report captures an indicative picture for these regions, recognizing that some systems lead the way while others lag behind.

Seven product categories in scope

The seven product categories included in this study were selected because they collectively represent a significant share[x] of single-use plastic demand in healthcare settings by mass. They span a wide range of applications, from direct patient contact and infection control to pharmaceutical distribution and sterile device packaging. Focusing on these categories ensures that the analysis highlights where action can have the greatest impact.

Fluid bags and tubing (23%) – Includes IV bags for fluids and medications, blood and plasma donation bags, and a range of associated tubing such as catheters, cannulas, and extension sets used in various procedures.

Gloves (21%) – Surgical and examination gloves, which are among the most commonly used single-use items in all clinical settings, essential for protecting both healthcare professionals and patients.

Rigid devices (15%) – Covers key high-volume rigid single-use items: syringes, venous blood collection tubes, urine sample tubes, and single-use infant bottles. Although many other single-use medical devices exist (e.g., specula), these four sub-categories were chosen for their high prevalence and material weight.

Device packaging (14%) – Sterile pouches, flexible films, and protective packaging that safeguard medical devices from contamination until the point of use.

PPE and related products (11%) – Includes gowns, aprons, surgical masks, surgical wraps, caps, and shoe covers used daily for infection prevention and control in hospitals, outpatient clinics, and care facilities.

Pharmaceutical packaging (8%) – Encompasses pill bottles and blister packs used for packaging of medicines in both inpatient and outpatient care.

Wipes (8%) – Single-use wipes used for patient hygiene, disinfecting surfaces, and cleaning medical equipment.

All references to plastic in this report refer to these seven categories only, unless explicitly stated otherwise. Each of these product categories is composed of highly diverse products (each hospital / trust having their own procurement criteria, with many different options to choose from). They also represent a range of polymers and end-of-life management pathways.

x In Measuring and reducing plastics in the healthcare sector, disposable gloves, IV solution bags, disposable PPE, syringes and IV administration systems represented over 50% "of the total plastic used annually".

Exclusions

Several important product groups were excluded to maintain a clear focus on the largest material flows:

Hybrid clinical-consumer items: Products like incontinence pads, diapers, baby wipes, and other hygiene-related single-use items represent a high volume and also have complex material compositions, which makes them difficult to recycle.

Home-based and other medical settings consumption: A large share of healthcare plastic use occurs outside clinical settings – from drug packaging to medical support items like gloves or test kits. As care increasingly shifts to outpatient and at-home environments, waste streams become harder to manage. Tailored interventions such as take-back schemes and design for recycling are essential to mitigate waste from at-home care. Innovations in digital health can also play a role in reducing overuse. Multi-use plastic products: Durable devices such as dialysis machines, monitoring equipment, and imaging machines represent a major pool of plastic use. These items often include embedded plastic components and require robust servicing protocols. Strategies like remanufacturing, repair and refurbishment, rental-as-a-service models, and design-for-longevity are needed to extend the lifecycle of these resources.

Non-medical single-use items in medical settings: Items such as cutlery, drinkware, and food containers used in hospital cafeterias, visitor areas, and patient wards typically fall outside clinical exemption frameworks. They can be targeted for rapid replacement, moving toward reusable plastic-free alternatives, but are not included in this analysis.

> "This report aims to provide a first-of-its-kind view on accelerating circularity for single-use plastics in healthcare applications"

Data limitations

Given the high level of uncertainty inherent in any exercise that takes a 15-year forward-looking view, significant margins of error must be assumed for the outputs, especially in the later years. This uncertainty has multiple drivers. For example: some levers may run into real-world barriers that are difficult to predict; the cost of certain technologies may vary significantly; policies may not be implemented as expected; required investments may not come to fruition; new pandemics and health crises may occur; and innovations in materials science may emerge. Despite this uncertainty, comparing scenarios demonstrates both the relative impact of different levers and the necessary pace of change.

The cost of inaction

The impact of single-use plastics in healthcare

Healthcare systems in Europe and North America are estimated to have generated almost 2.1 million tonnes[xi] of plastic waste in 2023 from just seven high-volume product categories. Without intervention, this figure could rise to above 2.9 million tonnes annually by 2040, with Europe and North America increasing their volumes by 45% and 28% respectively. Four structural forces underpin the growth of single-use plastic in healthcare in general and the use of virgin plastic in particular: the low cost of virgin plastic, clinical requirements and regulatory exemptions, fragmented institutional and system responsibility, and rising procedural and demographic demand.

This surge in plastic demand and waste could lead to an additional 3.6 $MtCO_2e$ per year by 2040. The economic burden would also be significant for an already strained sector, with a potential additional cost of $20 billion[xii] (€18 billion) just for these categories. Most of these costs come from upstream procurement and downstream incineration. Beyond cost and GHG emissions, rising plastic use weakens institutional resilience by increasing reliance on global supply chains (as many countries experienced during the COVID-19 pandemic) and public trust.

The sector faces a clear inflection point: continue on a linear path with escalating liabilities or begin transitioning toward circular and lower-emission alternatives.

01

xi Split as 1.2 million tonnes in North America and 0.9 million tonnes in Europe.
xii Based on model results. Assumes unchanged system cost per tonne of plastic between 2023 and 2040. Other assumptions (e.g., an increase of plastic consumption in both regions) can be found in the Technical Appendix.

How healthcare plastic waste is managed today

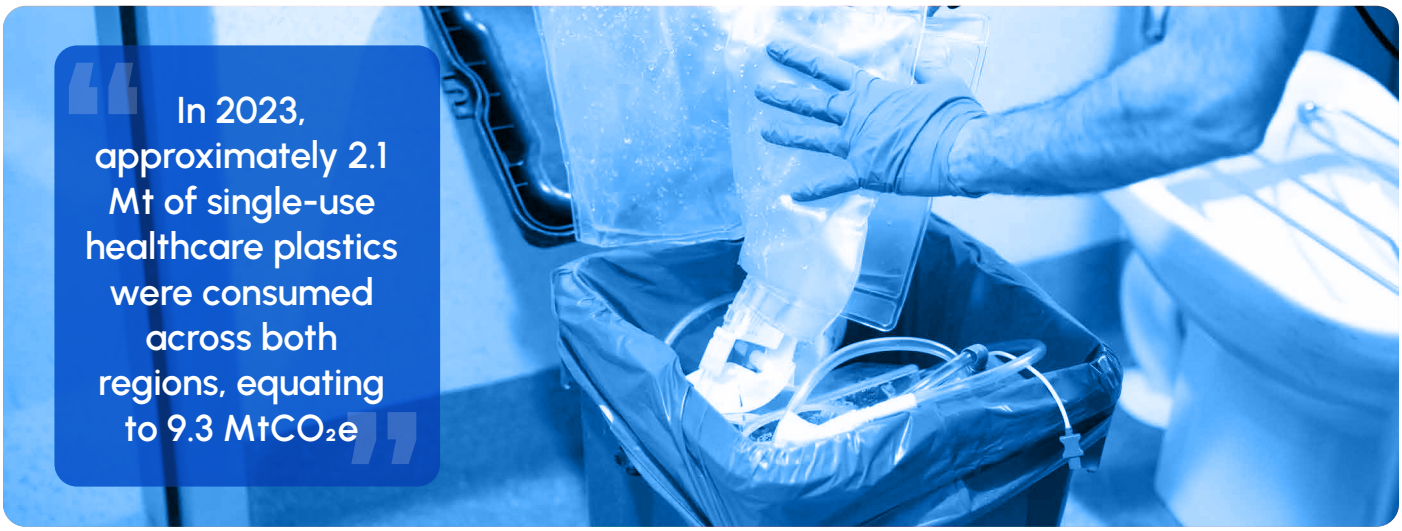
The waste management of single-use healthcare plastics is complex, inconsistent, and fragmented. A substantial share of healthcare plastics is classified as medical waste, subject to strict national and regional legislation in both geographies.[18],[xiii] This regulatory classification varies significantly depending on factors such as the material's potential for spreading infection, its contact with pharmaceutical substances, and whether it is a sharp or non-sharp item. For instance, an unused IV bag may be treated differently than one that has been used to deliver chemotherapy drugs. This complexity places a burden on frontline healthcare professionals – nurses, doctors, surgeons – who are urged to prioritize patient care over other factors. Expecting them to carefully sort materials into appropriate waste streams is unrealistic and not a practice that can be scaled.[19,20]

Most plastic waste generated in clinical settings is neither sorted nor recycled. In practice, many materials that are potentially recyclable are classified as clinical waste – regardless of actual contamination risk – and sent for incineration as a precaution, but because the system and existing policies do not provide clarity, capacity, or time to manage them differently. This results in the routine destruction of technically recyclable plastics and the irreversible loss of material value, as well as avoidable GHG emissions.

Each country – and often each healthcare facility – has a unique way of categorizing and managing plastic waste, driven by regulatory requirements and infrastructure capacity, both in North America and in Europe. Most single-use plastic waste in clinical settings flows through five main streams:

1. **High-temperature incineration (HTI) (>1000°C)** for infectious, cytotoxic, or hazardous waste.
2. **Low-temperature incineration (LTI) or energy-from-waste (EfW) (700–900°C)** for non-infectious medical plastics.
3. **Autoclave and landfill** in some jurisdictions, mainly for sterilized low-risk waste.
4. **Mechanical recycling** for clean, uncontaminated plastic – currently rare, often <5% of total waste.
5. **Landfill** for some low-risk or residual waste in North America.

Our analysis of these different pathways across both regions shows that the 2.1 Mt of single-use plastic demand equates to approximately 9.3 $MtCO_2e$ in 2023 (see Figure 1.2). Of this, approximately three quarters comes from upstream processes (plastic production and conversion). These GHG emissions increase linearly with consumption, as each item is used only once before being disposed of. Around 149 kt (13%) of total waste goes to high temperature incineration and 500 kt (36%) goes to low temperature incineration. Out of total waste, 47% is landfilled across both geographies; however, this number is made up entirely of end-of-life waste in North America, where landfill remains a primary disposal route compared to Europe. Financially, these product flows represent roughly $56 billion (€48 billion) in system costs – including $54 billion (€46 billion) in product procurement and €1 billion (€0.8 billion) in waste management. Even though clinical waste disposal – especially via high-temperature incineration or hazardous waste routes – can cost two to four times more than standard municipal waste disposal, 98% of total costs are linked to procuring items that are used only once before being incinerated or landfilled.



xiii In Measuring and reducing plastics in the healthcare sector[12], disposable gloves, IV solution bags, disposable PPE, syringes and IV administration systems represented over 50% "of the total plastic used annually".

xiv For example, in the U.S., regulated medical waste (RMW) is largely state-regulated by environmental and health departments, with federal guidance. Additionally, hazardous medical waste are regulated under the Resource Conservation and Recovery Act (RCRA).

xv For a detailed explanation of how estimations for GHG emissions were calculated, please see Technical Appendix section 2.4.

Today, seven product categories make up most single-use plastic consumption

FIGURE 1.1

Mass of single-use plastic waste of the healthcare single-use plastic system in 2023

Europe and North America, %

2.1 Mt total mass in system (in scope)

Most of associated GHG emissions and costs come from upstream processes

FIGURE 1.2

Total emissions of the healthcare single-use plastic system in 2023

Europe and North America, %

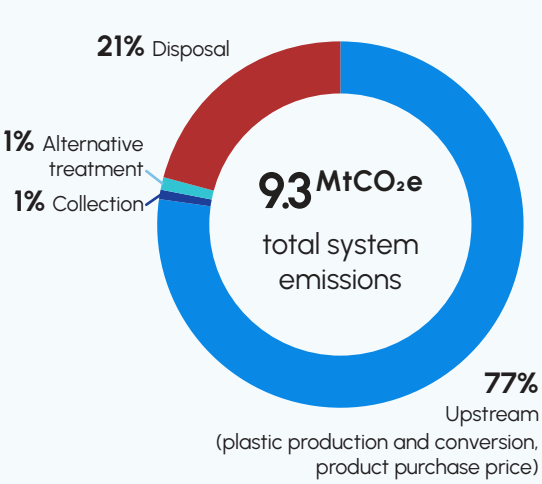
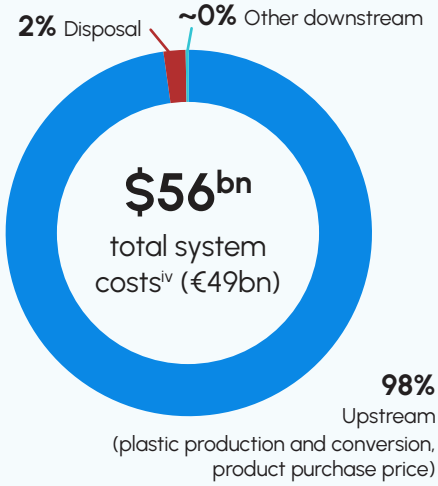


FIGURE 1.3

Split costs by lifcycle process step of the healthcare single-use plastic system in 2023

Europe and North America, %



vi System cost reflects the entire cost of producing, converting and disposing of the products within the system boundary of this report. Labor cost is not included during the 'use' phase of these products. In system-change scenarios, this includes the costs associated with enabling reuse systems, such as transportation and sterilization.

Four forces driving a surge in single-use healthcare plastic volumes

Plastic has become the default material as the result of a system shaped by decades of evolving healthcare practices, safety regulations, economic incentives, and supply chain dynamics. Our research, backed by conversations with experts, outlined four key structural and demand-side forces that drive continued growth in linear plastic consumption in healthcare:

1. **Cost competitiveness of virgin plastics** – Virgin plastics is significantly cheaper than recycled content or alternative materials. In price-sensitive healthcare systems, especially publicly funded ones, this cost differential strongly favors continued reliance on virgin inputs, and regulation does not do enough to level the playing field or to internalize the external costs of plastic.

2. **Regulatory exemptions and strict performance requirements** – Single-use plastic items are often preferred because they ensure sterility. Coupled with clinical conservatism and fear of unintended consequences, this makes piloting alternative materials or workflows challenging. These protocols are deeply embedded in clinical practice and regulation. Even when reusable alternatives exist, concerns around safety and regulatory compliance may limit their uptake. The COVID-19 pandemic accelerated demand for gloves, masks, gowns, and disinfecting products – many of which remain in widespread use across settings that previously used fewer single-use items (e.g., long-term care, outpatient clinics, even administrative areas). Regulations also require that any material potentially contaminated by biological fluids be handled as clinical waste, leaving little room for circular recovery in most settings. In the UK's NHS, less than 5% of plastic is recycled, even though nearly two-thirds of it is designed to be recycled as of 2020.[21] Due to these medical performance standards, liability concerns, and lobbying pressures, unlike in other sectors, healthcare plastics are also often excluded from certain requirements in plastic-related regulations such as the EU Packaging and Packaging Waste Regulation (PPWR), Extended Producer Responsibility (EPR) schemes, the Global Plastic Treaty or SB-54 (California) (for more details see Box 1.1). Recycled content in healthcare products is also subject to similarly stringent requirements as those for food contact applications, making its inclusion difficult to justify or manage in the absence of strong policy drivers.[22]

3. **A deeply fragmented landscape** – Responsibility for procurement, sustainability, infection control, clinical end-user requirements, and waste management is often divided across multiple departments – or outsourced entirely. This siloed structure means that no single actor has full visibility or accountability over material flows. It also means that opportunities for system-wide optimization can be missed, and efforts to drive circularity remain isolated and inconsistent. Without integrated governance, meaningful system transformation remains very challenging to implement. Some hospitals lack granular data on material consumption and waste generation by product category. In addition to this, procurement processes in large hospitals or health systems often span **5–10 year cycles**, with long-term supplier contracts that are hard to renegotiate. Budget structures typically prioritize upfront unit cost over long-term system value or sustainability performance.

4. **A set of structural demographic and therapeutic shifts** – Aging populations, the increasing prevalence of chronic diseases and expanding access to healthcare in middle-income countries could contribute to rising healthcare expenditure and overall plastic demand.[23–26] Older and sicker populations tend to require more interventions, medications, and single-use support items.[23] Growth in outpatient surgery[27] and pharmaceutical consumption[28] (especially in injectables or specialty drugs) could also significantly increase the use of healthcare plastics, like packaging (blister packs, pill bottles) and delivery components (syringes, tubes, bags).

In Europe, historical and projected growth in healthcare expenditures, surgical procedures, and clinical waste volumes suggest a potential growth rate of approximately 2.2% annually. In North America, the combination of outpatient and inpatient activity growth and higher population growth yields a slightly lower, but still significant, median annual growth rate of around 1.5%. These values are rough indicators of future plastic demand if no major changes are made, and they align with trends in healthcare demand over the past ten years. Detailed figures and sources are available in the Technical Appendix.

Using only these trends, the volume of plastic waste for the seven product categories could rise to nearly 3 million tonnes per year by 2040. Within this total, Europe could account for roughly 1.3 million tonnes annually by 2040 (+45% vs. 2023), while North America may contribute around 1.6 million tonnes (+28% vs. 2023). Combined, this represents an increase of 775,000 tonnes of additional plastic waste annually, or nearly 3,000 Olympic-sized swimming pools filled with compacted plastic waste.[xvi] In product terms, this would include the additional disposal of over 156 billion surgical gloves or 40 billion syringes each year – items that require energy-intensive production and pose major disposal challenges.

xvi Each pool being approximating 2,500 cubic meters, or ~250 tonnes.

Continuing historic trajectories would result in significant environmental, financial and social impacts

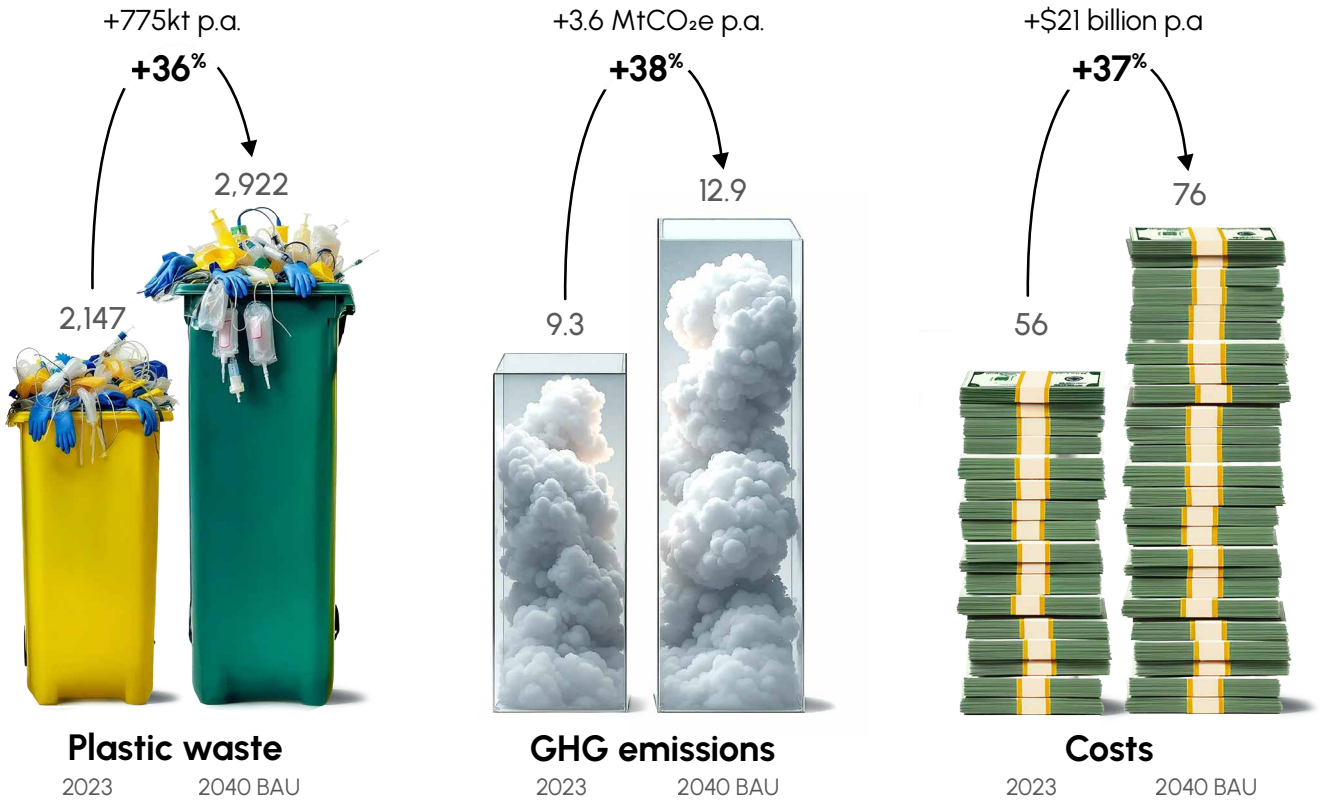
If the structural drivers outlined above continue to fuel plastic consumption growth over the next 15 years, Europe and North America are likely to experience a sustained increase in the production, use, and disposal of single-use plastics in healthcare by 2040. This surge would raise the direct environmental, social, and financial burden across health systems and communities. These regions, although economically advanced, already face challenges from procurement rigidity and limited plastic collection and recycling infrastructure. The trend they follow is likely to set a precedent – or a warning – for healthcare systems worldwide. While the environmental and financial implications manifest in obvious ways, the social burden is more nuanced. Historically marginalised communities with inadequate infrastructure are at increased risk of exposure to hazardous waste, compounding issues tied to environmental justice.

This growing waste stream is not solely attributable to the expansion of clinical activity. It is also driven by procedural norms, procurement incentives, regulations, and institutional path dependencies that favor disposability. Moreover, while this study focuses on Europe and North America, healthcare plastic consumption is expected to grow even more rapidly in emerging markets such as Asia, Africa, and Latin America, driven by rising income levels, population growth, expanding health care coverage, and large-scale infrastructure development. Waste management infrastructure is already under pressure in both regions. Before committing to additional large-scale investments in high-temperature incineration or other end-of-pipe solutions, the healthcare sector should address its structural dependence on single-use items...

In a Business-as-Usual scenario, plastic waste, GHG emissions and costs could grow by 35 - 40% by 2040

FIGURE 1.4

Evolution of single-use plastic waste (kt) and related GHG emissions ($MtCO_2e$) and costs ($ billion) in 2023 and in a BAU 2040 scenario in Europe and North America



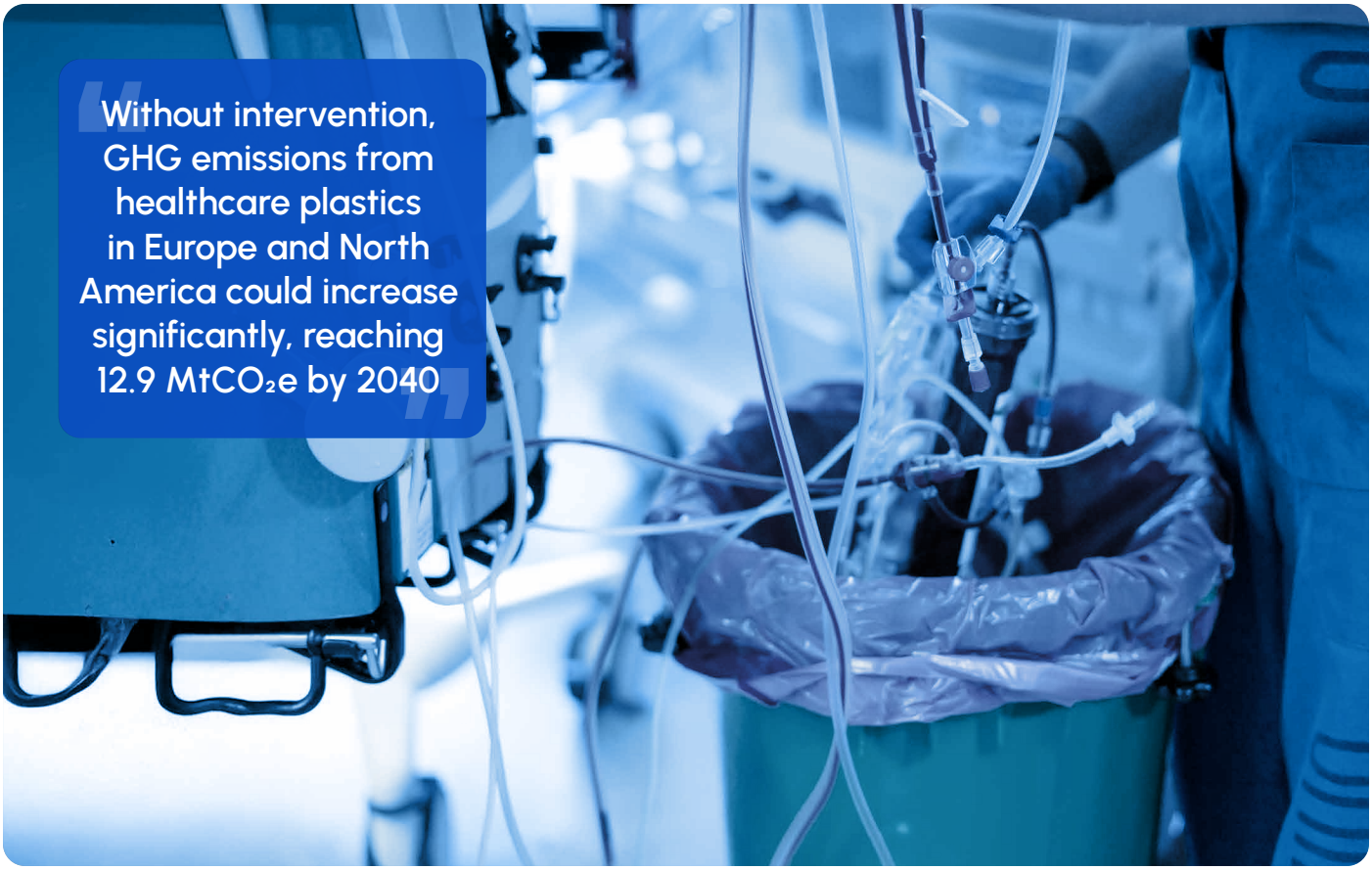
Environmental consequences of BAU

The environmental implications of continued growth in single-use healthcare plastics are both significant and multifaceted. Virgin plastic production and disposal accounts for over 5% of GHG emissions[29] and a share of this volume is linked to healthcare applications. Within the sector, plastic waste is typically either incinerated or landfilled – processes that further contribute to climate and environmental degradation. For example, NHS England reported 30,000 tCO_2e from waste-related emissions in 2018, equivalent to the annual emissions of over 7,000 passenger vehicles.[30] In 2023, the seven high-volume product categories examined in this report collectively contributed an estimated 9.3 $MtCO_2e$. Without intervention, GHG emissions from healthcare plastics in Europe and North America could increase significantly, reaching 12.9 $MtCO_2e$ by 2040 (see Figure 1.4) – equivalent to over three million gasoline-powered passenger vehicles driven for a whole year.[30] These estimates exclude additional emissions from planned expansions in plastic production capacity and the indirect climate impact of transporting products, many of which are manufactured and shipped globally.

End-of-life disposal compounds the environmental burden. Most healthcare plastic waste is incinerated – often at high temperatures – or landfilled, releasing additional GHGs, toxins, and particulate matter into the environment. While modern landfills and incinerators are subject to strict environmental regulations and advanced emissions controls in many regions, both remain end-of-life solutions that contribute to long-term environmental and economic burdens – releasing GHGs, consuming valuable materials, and often locking systems in linear waste pathways that hinder progress toward circularity. As clinical waste volumes rise, the strain on existing incineration and landfill capacity will intensify, particularly in jurisdictions already facing infrastructure limitations. In the absence of major investment in low-carbon disposal alternatives or regionally adapted recycling systems, healthcare systems will be increasingly locked into high-emissions, last-resort waste management pathways – especially in decentralized or home-based care contexts.

Plastic waste also contributes to other environmental hazards beyond climate impact. The generation and handling of medical plastics increases the risk of microplastic pollution, water contamination, and localized exposure to hazardous substances – affecting not only ecological systems but also workers and communities near waste facilities. There is also emerging evidence of patients' exposure to microplastics from medical devices.[31] These externalities are seldom reflected in traditional cost models but represent serious and growing liabilities for health systems. In parallel, the ongoing shift toward home-based and community care delivery increases the likelihood of improper waste segregation and handling – raising further concerns about environmental leakage and microplastic dissemination.

In sum, the environmental costs of inaction extend well beyond climate impacts, encompassing resource loss, infrastructure stress, and local ecological harm.



The financial and fiscal cost of inaction

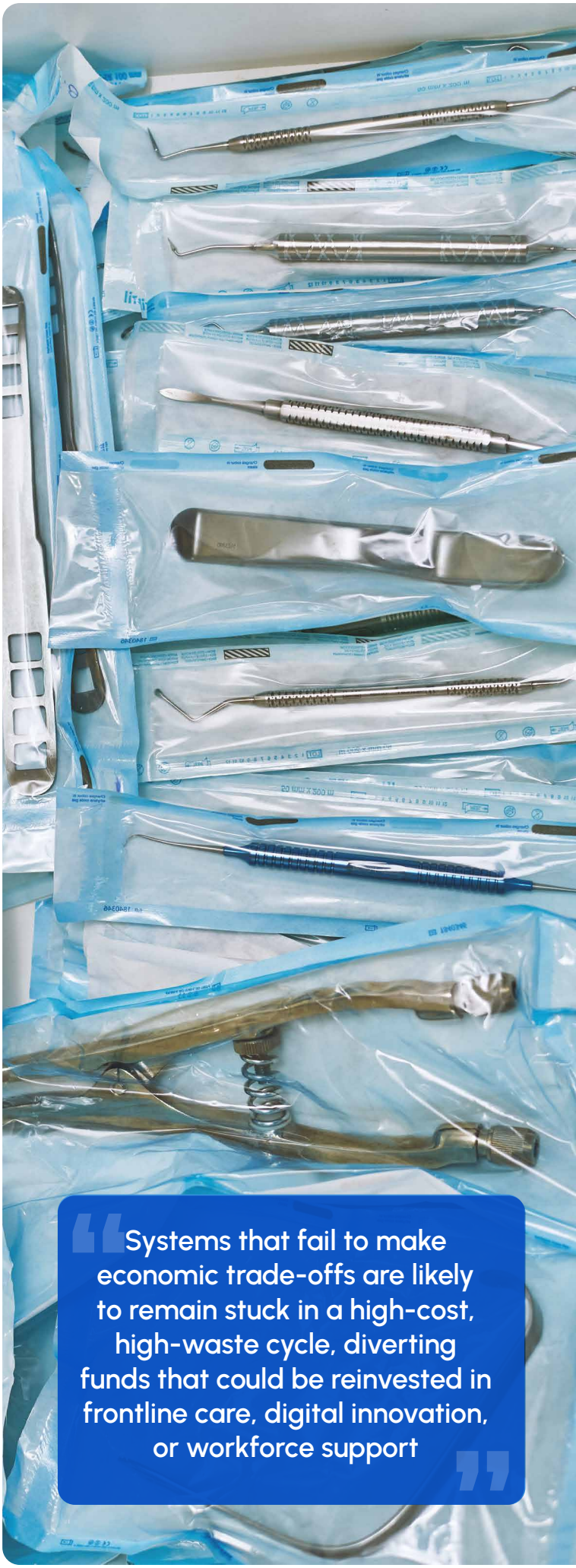
The healthcare sector is already under immense financial strain, and unmanaged growth in plastic waste threatens to exacerbate this crisis. In France, the national health insurance deficit is projected to exceed €11 billion ($13 billion) in 2024.[32] In the United States, healthcare expenditure is forecast to surpass $7 trillion (€6 trillion) by 2031[33], placing growing pressure on federal and state budgets. Against this backdrop, rising waste management costs and the potential future risk of litigation due to plastic use[34] represent an increasingly untenable burden.

In 2023, the total system cost associated with the seven product categories analyzed in this report is estimated at $56 billion (€48 billion). Looking ahead, the financial implications of BAU are steep. Based on model projections to 2040, the surge in plastic consumption and disposal could bring the annual total cost to $76 billion (€65 billion) (see Figure 1.4), with downstream disposal alone accounting for roughly $1.5 billion (€1.2 billion) annually (without accounting for potential cost-reduction countermeasures). This surge in cost would hit healthcare systems already grappling with budget deficits and will require either increased public spending or cuts elsewhere – most likely from frontline services, infrastructure, or workforce budgets.

The economic inefficiency of the current linear model also manifests in upstream purchasing. Single-use plastic items, though individually low cost, require repeated procurement, stockpiling, and disposal. Over time, this generates significant recurring costs. Meanwhile, investment in circular solutions – such as reusable products or closed-loop recycling infrastructure – can deliver long-term savings, particularly when waste and GHG emissions costs are internalized. Systems that fail to make these economic trade-offs visible are likely to remain stuck in a high-cost, high-waste cycle, diverting funds that could be reinvested in frontline care, digital innovation, or workforce support. The longer the system delays addressing its dependence on single-use items, the more it will pay – not only in waste fees, but in missed value and rising opportunity costs across the healthcare value chain.

A turning point for healthcare systems

Current approaches – rooted in minimizing upfront costs, departmental silos, and long-term procurement cycles – are incompatible with a sustainable, resilient healthcare future. These constraints underscore the urgent need for better system design – one that accounts for clinical realities, improves waste sorting infrastructure, and promotes upstream reduction and reuse. Without such change, the healthcare sector will continue to generate waste at a pace and scale that outstrips the capacity of existing management systems. By addressing the structural causes of plastic growth and shifting toward circular alternatives, the healthcare sector can become more sustainable, equitable, and resilient. The opportunity – and the imperative – is to shift from reactive disposal to proactive systems transformation.



> "Systems that fail to make economic trade-offs are likely to remain stuck in a high-cost, high-waste cycle, diverting funds that could be reinvested in frontline care, digital innovation, or workforce support"

BOX 1.1

Legislative review

Healthcare is one of the most regulated sectors in terms of product safety and hygiene, yet it is largely exempt from the most stringent plastic regulations emerging across Europe and North America. This lack of regulation could be the result of **high patient safety and sterility requirements** (single-use plastics prevent infection and ensure reliable product integrity in high-risk environments), **other existing regulatory constraints** (any material change may require re-certification by agencies), **limited alternatives** (reusable or recyclable options may not yet meet hygiene, performance, or scalability requirements) and the **waste management profile of these products** (most medical plastics are incinerated or disposed of through controlled channels, minimizing litter).

These exemptions reflect the complexity and criticality of medical products, but they are increasingly framed as temporary. While essential clinical uses remain protected, the policy landscape is shifting. Healthcare actors will be increasingly expected to eliminate non-critical plastic uses, contribute to national reduction goals, and prepare for a transition toward circular materials in packaging and beyond. Extended Producer Responsibility (EPR) and reporting obligations now include packaging from some clinical categories, even where design requirements are deferred. Regulations are starting to draw a line between essential medical items and avoidable plastics, such as food packaging and administrative supplies in hospitals. National strategies, particularly in France and Germany, anticipate that exemptions for medical packaging may be lifted post-2035, contingent on the development of safe materials and validated systems. Regulators can accelerate the transition towards a more circular system by defining essential versus non-essential healthcare plastics, with binding reduction targets for non-clinical applications; supporting procurement reforms that incorporate recyclability, reuse potential, and circular product design; and accelerating research and certification of medical-grade recycled polymers and safe reusable systems.

European Union and United Kingdom

The Packaging and Packaging Waste Regulation (PPWR), which came into force in 2024, sets strict recyclability requirements and recycled content targets from 2030.[35] Primary packaging for medicinal products and medical devices – such as blister packs, IV bags, and syringes– is exempt until at least 2035.[5] However, all packaging producers, including in healthcare, must comply with EPR and volume optimization rules.

The EU Single-Use Plastics Directive (SUPD) bans consumer items that are mostly likely to be littered, such as cutlery, stirrers, and straws. Given that healthcare-related plastics are much less likely to be littered, this Directive does not focus on restricting items in this setting.[36]

The regulation of healthcare waste disposal and segregation by individual member states leads to variations among EU countries.[37] France's Anti-Waste Law (loi AGEC) goes further: from 2025, single-use plastic food containers in public hospitals and care homes will be banned. However, this regulation targets foodservice-related plastics, not clinical single-use items.[38] The UK applies similar exemptions: medical packaging is excluded from the Plastic Packaging Tax, while plastic straws and cotton buds remain available for medical or disability use.[39,40]

The United States and Canada

The U.S. lacks strong federal regulation encouraging plastics circularity, but several states have introduced EPR and circularity laws. California's SB-54 mandates recyclability and EPR fees for packaging, but explicitly excludes packaging for medical devices, prescription drugs, and other FDA-regulated products.[6] Oregon (SB 582)[41], Maine (LD 1541)[42], and Colorado (HB 22-1355)[43] have adopted similar exemptions in their state-level EPR frameworks.

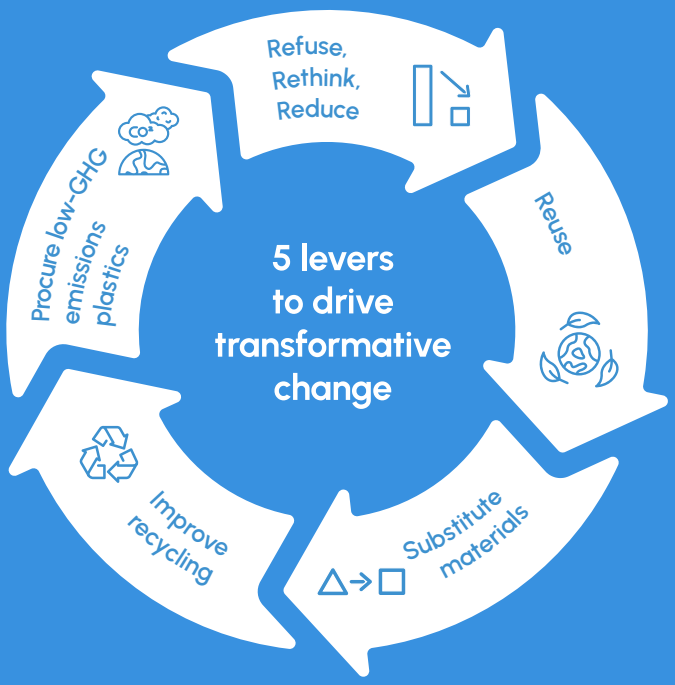
Local U.S. bans on plastic straws or bags almost always include exceptions for medical use – for example, allowing pharmacies to dispense prescriptions in plastic bags or enabling hospitals to provide bendable plastic straws upon request.

Canada's federal Single-Use Plastics ban covers bags, cutlery, and food containers but exempts flexible plastic straws for clinical use.[44] Hospitals and eldercare facilities can continue to supply these straws, while other banned items like cutlery or foodware must be replaced with reusable or non-plastic alternatives in healthcare foodservice, but not in clinical settings.

The path to recovery

Five levers to drive system change

The healthcare sector is at a critical turning point. Five core circularity and decarbonization levers – (1) Refuse, Rethink, Reduce; (2) Reuse; (3) Substitute materials; (4) Improve recycling; and (5) Procure low-GHG emissions plastics – can enable a shift toward a more circular and climate-aligned healthcare plastics system, without negative impacts on patient health or safety.



Refuse, Rethink, Reduce would involve phasing out unnecessary products or components, such as redundant layers of packaging or over/mis-used products like gloves or syringes. Reuse could introduce durable alternatives in clinical workflows for certain applications, such as reusable gowns and metal trays, where hygiene and performance standards can be maintained. **Substitution** could replace traditional plastics with alternative materials that have a better end-of-life – including paper-based packaging or compostables – where contamination and performance risks are minimal. **Recycling improvements** would target product and packaging design for recyclability and expand segregated collection and processing of non-infectious plastics. Finally, **low-GHG emissions plastics** made from renewable energy or leveraging CCS could help reduce upstream carbon footprints where single-use formats are unavoidable.

Together, these interventions could reduce plastic waste by from 26% (Moderate-Ambition Scenario) to 53% (High-Ambition Scenario) by 2040 compared to Business-as-Usual (BAU). This would represent 0.8 - 1.6 million fewer tonnes of waste per year and could avoid 2.5 – 7 million tonnes of CO_2e annually. Financially, the healthcare system could realize approximately $10 – 18 billion (€8 - 15 billion) in annual cost savings through reduced material purchasing, lower treatment and disposal costs, and reduced exposure to volatile fossil-based supply chains. Upstream measures deliver the greatest potential impact, underscoring the importance of reducing or avoiding plastic use when it makes sense to do so, particularly in cases where safe, effective, and lower-impact alternatives exist – rather than relying solely on end-of-life waste treatment.

02

A transformative future for the healthcare plastic system

The healthcare sector stands at a crossroads: continue on a path of growing dependence on single-use plastics, or turn toward a more resilient future that leverages circularity and innovation. A transformed system is possible, one in which single-use plastics are the exception, not the norm; where reusable solutions are safe and fully integrated; and where products are designed for minimal waste and full recyclability from the outset. In such a system, virgin plastics use and waste volumes are dramatically reduced, GHG emissions from incineration decline, and the sector contributes meaningfully to climate goals without compromising safety or care quality.

This vision is not just about waste reduction. It is about unlocking a new operating model for healthcare – one that is clinically robust, economically efficient, environmentally responsible, operationally resilient, and socially equitable, ensuring benefits are shared across communities, patients, and the workforce. To explore how this transformation might unfold, two distinct future scenarios have been modeled, a Moderate-Ambition Scenario and a High-Ambition Scenario.

> A transformed system is possible, one which contributes meaningfully to climate goals without compromising safety or care quality

Moderate-Ambition Scenario

A world of bold yet partial change. Policymakers advance some circularity mandates, and procurement starts to evolve. Reusables gain traction in select institutions, and recycling sees moderate investment. But structural inertia – fragmented governance, risk aversion, and siloed incentives – continues to limit scale and pace. Progress is real but uneven.

High-Ambition Scenario

A deeper, systemic shift. Regulations evolve to support circularity while maintaining safety. Procurement and reimbursement reward low-waste solutions. Clinicians adopt new protocols and drive innovation. Reusable and recyclable products become widespread. Industry scales sorting, reprocessing, and design improvements. Waste is systematically reduced at source, and materials are recovered at end-of-life. Healthcare leads in sustainable material use – cutting emissions, reducing waste, and boosting supply chain resilience. This is an ambitious yet achievable future, grounded in current innovations and scalable through strategic investment.

Regulations

Some regulatory progress occurs, but it is incremental. Most circular economy mandates still exclude healthcare plastics. There is growing interest in aligning with broader sustainability legislation (e.g., packaging rules, SUP bans), but exemptions for medical products persist.

Strong regulatory mandates are in place, including recycled content targets, circular design standards, and inclusion of healthcare in EPR and Deposit Return Schemes. Healthcare is no longer exempt from core sustainability legislation.

Procurement and leadership

Circularity is more actively pursued in hospitals or regions with engaged leadership or enabling funding. Uptake is voluntary and varies by geography and product category.

Circularity is linked to sustainability, and sustainability goals are embedded in procurement criteria. Public and private purchasers require suppliers to meet circularity thresholds. Contracts reward innovation and material transparency.

Economics and market signals

Operational and financial barriers remain. Healthcare providers and suppliers continue to prioritize unit cost over circular design or lifecycle value. Demand for recycled healthcare plastics is growing but still limited in scale.

Governments, hospitals, and waste managers invest heavily in circular infrastructure (e.g., reuse logistics, sterilization capacity, and advanced sorting technologies). These efforts are amplified by strategic partnerships across the entire plastics value chain, ensuring technical feasibility, material quality, and supply chain alignment. Market transformation funds and innovative payment models further improve the economic viability of circular systems, while consistent, cross-regional demand for recycled healthcare plastics drives long-term investment and scale.

Behavior and culture

Clinical norms evolve slowly. Some healthcare professionals (HCPs) adopt new behaviors around gloves, gown, or wipe use, but these practices are not yet mainstream. Education and guidance improve in certain pockets, but behavior change is not systemic.

HCPs are supported with mandatory training, institutional incentives, and infrastructure to adopt circular behaviors. A strong culture of clinical sustainability emerges.

Innovation and infrastructure

Some reuse and recycling pilots scale – particularly in high-resource settings and for product categories with favorable logistics. Technologies such as mono-materials or reusable containers exist but are not yet widely deployed.

Key enablers like mono-material products, tracking systems, and sterilization infrastructure scale up. Circular business models such as reuse and take-back become standard. Infrastructure links hospitals, suppliers, and recovery partners.

Scaling interventions across five key levers could reduce plastic waste by 53% and associated GHG emissions by 55% by 2040

Solving the problems laid out in Chapter 1 and reducing the dependency on single-use plastic in healthcare would require implementing interventions across the full plastics lifecycle, from cradle to grave. Circular economy strategies can be applied across various settings (hospitals, general practitioner clinics, pharmacies, etc.) and plastic product categories (e.g., fluid bags, syringes, PPE) and enabled by different types of intervention, such as behavioral change, procurement decisions, innovations, and new technologies.

The five circularity levers identified in this study could transform the healthcare sector and dramatically reduce the total volume of single-use plastic consumptions, GHG emissions, and costs.

Moderate-Ambition and High-Ambition scenarios could both generate outsized impact on waste, GHG emissions and costs by 2040

FIGURE 2.1

Mass of disposed waste (Landfill, HTI, LTI+EfW) per scenario

Single-use healthcare plastic system across Europe and North America, kt

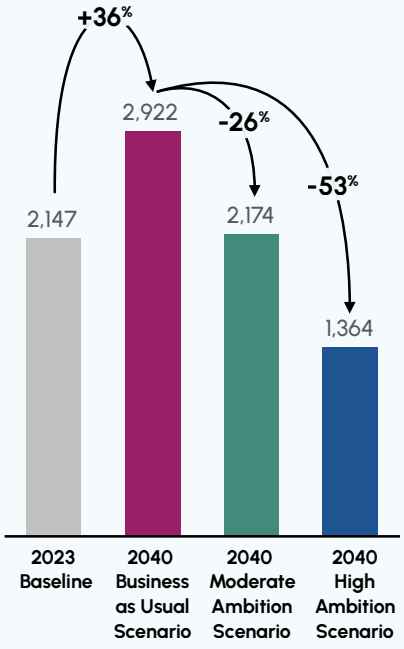


FIGURE 2.2

Total GHG emissions per scenario

Single-use healthcare plastic system across Europe and North America, $MtCO_2e$

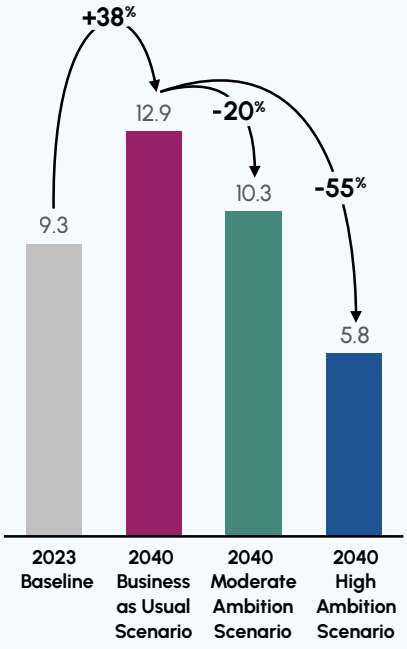
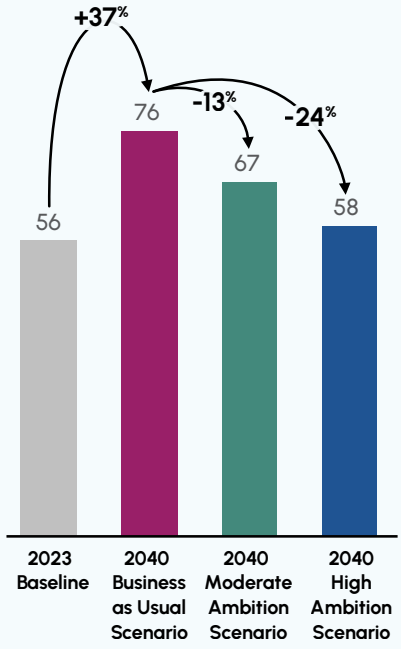


FIGURE 2.3

Total system cost per scenario

Single-use healthcare plastic system across Europe and North America, Billion USD



Note:

Landfill A waste disposal site where waste materials are buried in the ground, often in engineered facilities designed to limit environmental impacts such as groundwater contamination.

High-temperature incineration (HTI) A waste treatment process that involves the combustion of waste materials at very high temperatures.

Low-temperature incineration (LTI) A waste treatment process that involves combustion of waste at temperatures lower than high-temperature incineration.

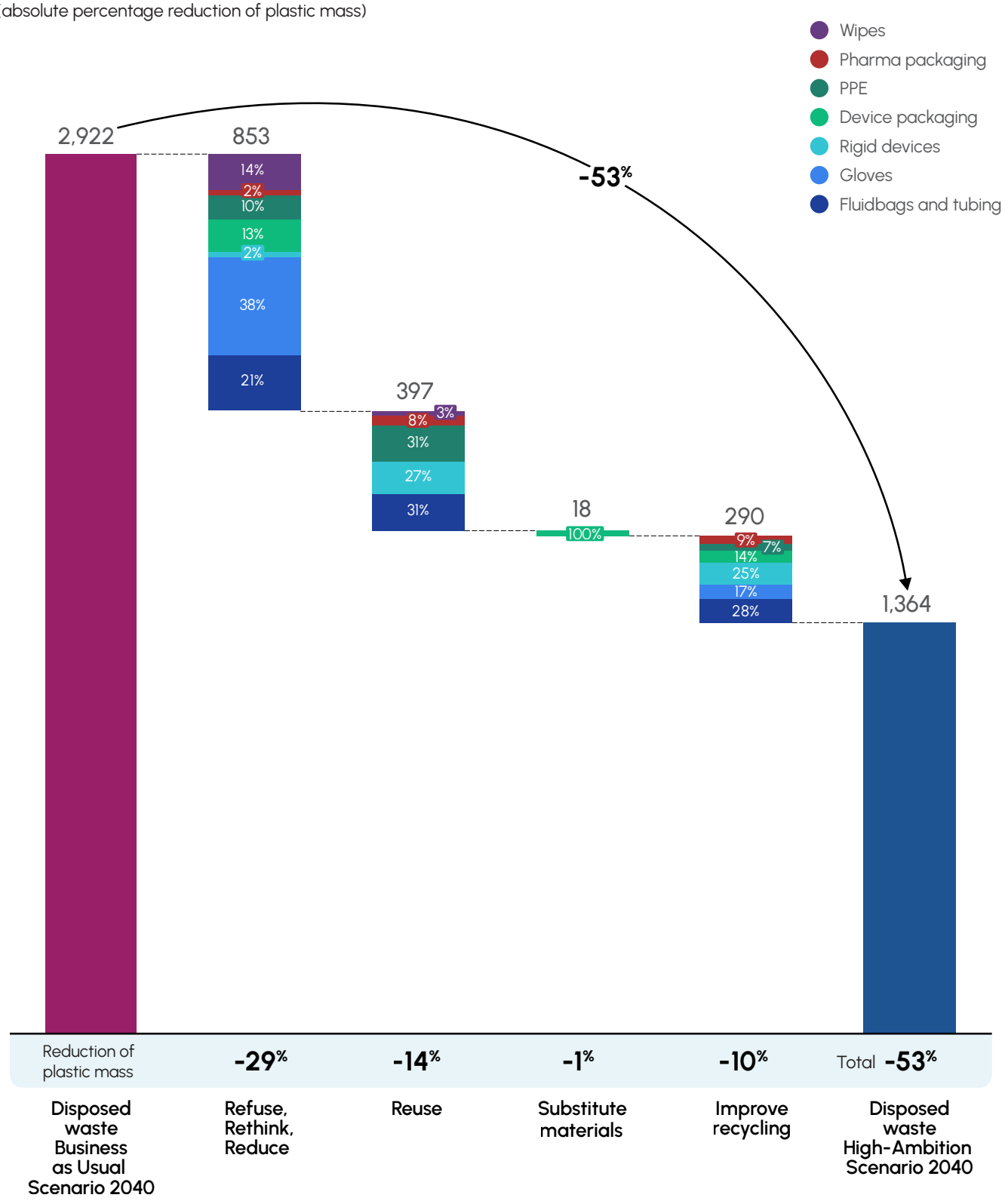
Energy from waste (EfW) A waste treatment process that involves incinerating waste (usually at low temperatures of 700–900 °C) to generate heat or electricity.

A High-Ambition Scenario could see a 53% reduction in disposed waste relative to BAU, of which three quarters comes from upstream measures

FIGURE 2.4

Physical fate of plastic waste from all product categories in a High-Ambition Scenario in 2040, including the percentage breakdown of circularity levers by product category

kt (absolute percentage reduction of plastic mass)

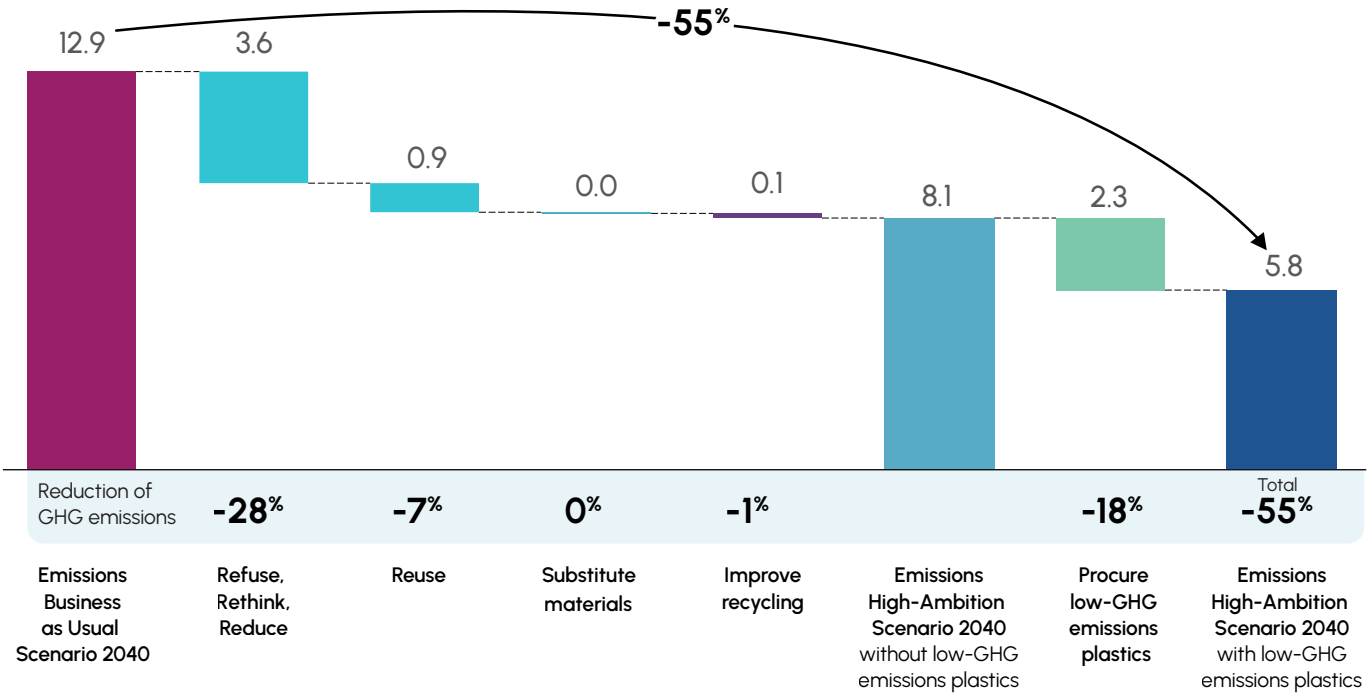


A reduction of 55% in GHG emissions relative to BAU is possible, with the highest potential in Refuse, Rethink, Reduce and a shift to low-GHG emissions plastics

FIGURE 2.5

GHG emissions of the single-use healthcare plastic system in a BAU versus High-Ambition Scenario 2040

$MtCO_2e$, absolute percentage reduction of GHG emissions

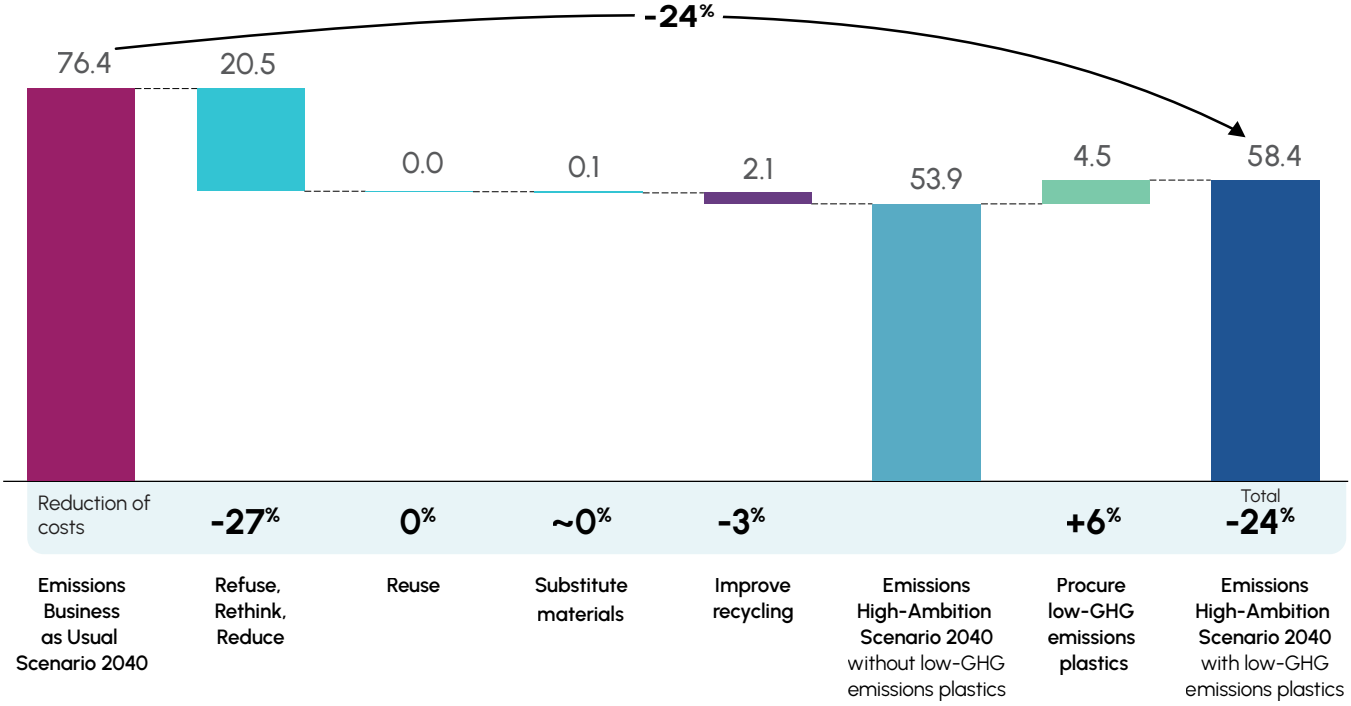


Total system costs could be reduced by 24% by 2040 relative to BAU, even after accounting for the increased cost of low-GHG emissions plastics

FIGURE 2.6

Total costs of the single-use healthcare plastic system in a Business as Usual Scenario versus High-Ambition Scenario 2040

Billion USD (absolute percentage reduction of costs)



1. Refuse, Rethink, Reduce

Avoid, minimize, and rethink applications related to plastic use

While some single-use plastic items may be essential for sterility and safety, a significant share is used unnecessarily or even goes directly to waste. This lever targets those avoidable uses, turning off the tap of excess consumption. To be implemented successfully, it may require significant supply chain innovation and behavioral change from healthcare practitioners. This lever encompasses some specific interventions, outlined below.

- **Eliminate directly** by removing products or practices that add little value to care. In the UK, standard infection control precautions mean that gloves should be worn when in direct contact with blood or bodily fluids. In recent decades, and exacerbated by the COVID-19 pandemic, glove use has increased to cover many patient interactions, often when not absolutely essential.[45,46] Campaigns promoting hand hygiene as an effective alternative have shown success in reversing this overuse.
- **Redesign for reduction** means improving product and packaging design to use less plastic. Medical devices are frequently over-packaged, with excessive layers or oversized formats. For instance, one study found that redesigning blister packs by moving the individual blisters closer together could save 37% of total plastic weight.[47]
- **Innovate** to shrink plastic footprints through smarter formulations or delivery methods. Concentrated drug solutions reduce IV bag size, while pre-filled syringes avoid the need for single-use vials. These innovations not only cut plastic but also reduce waste from unused doses.

By itself, this set of interventions could remove over 800 kt of plastic demand by 2040 in a High-Ambition Scenario – roughly 29% of total mass reduction and more than half of the 53% potential (see Figure 2.4). Reducing unnecessary glove use through targeted education on hand hygiene would be the largest contributor (see Figure 2.4 and the Case Study below). Overall, this lever could cut up to 3.6 $MtCO_2e$, mainly by avoiding the excess use of gloves, PPE, and wipes and redesigning packaging to use less plastic. GHG emissions would fall due to lower plastic production and less waste requiring disposal. For instance, avoiding 66 billion gloves could save 1.4 $MtCO_2e$ annually – 1.1 $MtCO_2e$ from production and 0.3 $MtCO_2e$ from end-of-life emissions. This illustrates how behavior-led interventions could deliver the largest climate impact. Cutting surplus IV bags, gloves, and wipes would also generate over half of elimination-related cost savings. These arise mostly from avoided virgin plastic production and conversion, with a smaller share from disposal. For example, eliminating IV bags could save $12 billion (€10 billion), nearly all from production, with only $0.3 billion (€0.2 billion) from reduced disposal.

The following case studies highlight how hospitals have implemented Refuse, Rethink, Reduce strategies to reduce waste in clinical settings.

REFUSE, RETHINK, REDUCE **CASE STUDY 1**

"Glove Smart" education campaign reduces inappropriate glove use by 53% in a Canadian hospital unit

CONTEXT St. Paul's Hospital's Cardiac Surgery Intensive Care Unit (CSICU) in Canada saw an increase in non-surgical glove usage following the COVID-19 pandemic, averaging 33,596 gloves per month in 2022. The inappropriate or unnecessary use of gloves contributes to avoidable waste, which has adverse impacts on environmental footprint and operational costs.[48]

INTERVENTION AND IMPACT The CSICU and the hospital's Waste Working Group launched an education-based pilot to reduce inappropriate glove usage. The initiative achieved a 53% reduction in non-surgical glove use over the six-month period, avoiding the use of 90,100 gloves and 2,342kg CO2e, exceeding the initial 10% reduction target. In addition, the pilot showed improved compliance with the health authority's standards for appropriate glove use. Median audit scores rose from 39% at baseline to 75% post-intervention, suggesting positive shifts in staff awareness and practices. A key lesson from the pilot was the value of staff champions who were willing to take initiative and support the pilot's rollout across the unit. Their engagement and leadership played an important role in building momentum and contributed to the success of this pilot.[48]

REFUSE, RETHINK, REDUCE **CASE STUDY 2**

Transitioning to prefilled syringes reduces emergency drug waste by 84% in a British hospital

CONTEXT At Manchester University NHS Foundation Trust in the UK, emergency drugs were traditionally drawn up in advance for use in operating theatres, leading to significant waste when unused doses were discarded. This practice resulted in waste of an average 585 syringes of emergency drugs per theatre per year, which sums to 6.1 kg of waste generated. The initial life cycle assessment showed the estimated life cycle GHG emissions (from production and disposal by incineration) of emergency drugs to be 34.2 kg/CO_2e.[49]

INTERVENTION AND IMPACT In 2023, the hospital implemented a shift to prefilled emergency drug syringes, which can be stored for future use if unopened. Following the intervention, 63% of operating theatres stopped drawing up emergency drugs in advance, reducing syringe waste by 84% (up to 93 syringes per operating theatre per year).

The environmental impact was also improved, with life cycle GHG emissions decreasing by 86% to 4.7 kg CO_2e. The initiative was supported by behavior change and procurement actions and demonstrated that prefilled syringes could also reduce the risk of medication errors. Although prefilled syringes may have a higher upfront cost, these may be offset by operational and safety benefits.[49]

84%
reduction in syringe waste
Manchester University NHS Foundation Trust case study

REFUSE, RETHINK, REDUCE **CASE STUDY 3**

Staff education and improved waste segregation reduces syringes and medication waste in a French hospital

CONTEXT At the University Hospital of Grenoble Alpes in France, an audit revealed that up to 75% of certain IV medications prepared in advance for surgeries were discarded unused and often improperly disposed of in general healthcare waste bins.

Across 119 procedures audited, this practice resulted in €171 lost and 3.41 liters of product wasted. When projected across the hospital's 25,000 annual procedures, this equates to an estimated €37,000 lost and 730 liters of product wasted.[50]

€37,000
lost IV medication annually
University Hospital of Grenoble Alpes case study

INTERVENTION AND IMPACT A 12-month quality improvement project was launched in September 2021 that introduced staff education, installing dedicated medication waste bins in the operating rooms, and using prefilled syringes for select medications. These measures significantly reduced unnecessary preparation and improved proper waste disposal. A follow-up audit confirmed reductions in both the volume of medications prepared and wasted, as well as improved compliance with proper disposal protocols.

Despite challenges such as limited space in the operating room and initial resistance to changing behaviors and practices, this project demonstrated that staff education and infrastructure changes (in this case, installing dedicated bins for appropriate waste segregation) can significantly reduce syringes and medication waste.[50]

2. Reuse

Reprocess the current product or substitute to another that is designed to be reusable

When elimination is not possible, moving away from single-use items to enable safe reuse (through product redesign, material upgrades, or system innovation) should be the priority, to keep materials in circulation and reduce demand for new plastic. Through good product design, efficient logistics, and proper decontamination, overall plastic consumption could be reduced significantly. Reuse comes in three main forms:

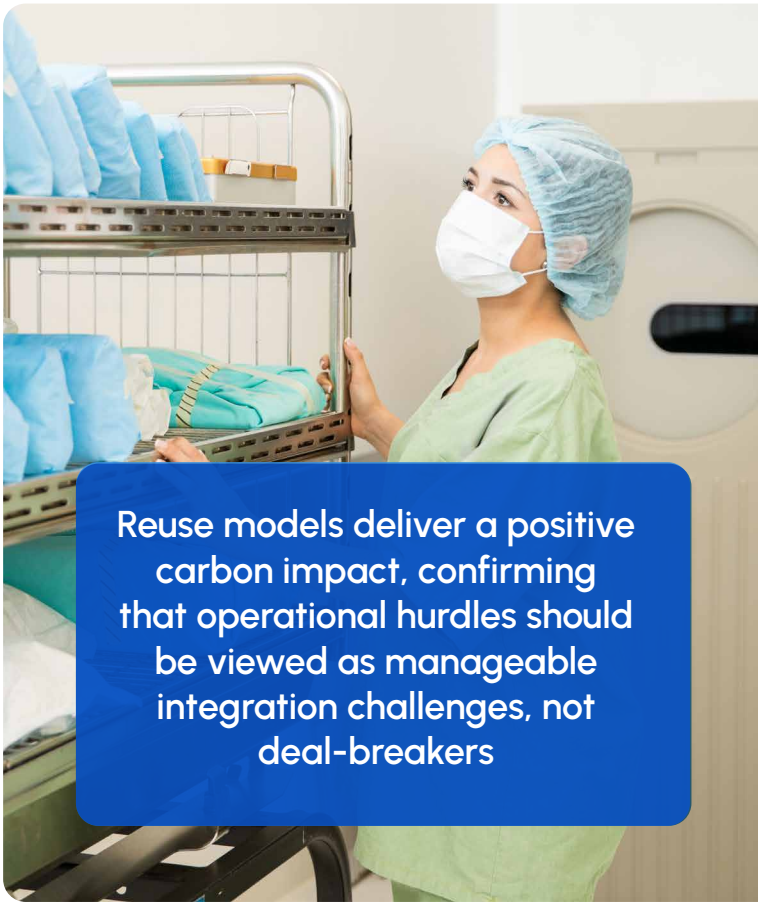
- **Reuse current single-use items** that may already tolerate cleaning and decontamination without redesign. Some products, like syringes and infant bottles, are treated as single-use in some countries and reusable in others, despite being identical. For example, the Maternity Unit at Clinical University Hospital Virgen de la Arrixaca in Spain uses reusable glass bottles to give breast milk to newborn babies[51], yet some neonatal units still rely solely on single-use plastic bottles.

- **Redesign for reuse,** when supported by lifecycle, clinical, and economic considerations. For example, items like gowns or infant bottles could be made from more durable plastic or non-plastic materials (e.g., switching gowns to a reusable material such as polyester and to glass for syringes) to hold up to several use cycles. This also includes rethinking the product entirely to enable reuse. For example, sterilization wrap could be replaced by sterile metal trays that provide the same level of protection and last hundreds if not thousands of cycles.

This lever could contribute to over 14% of the total reduction in single-use plastic mass, or just under 400 kt in a High-Ambition Scenario (assuming that up to 25% of these product categories could be shifted to re-use by 2040, and that these reusable products are durable enough to last tens of cycles before requiring disposal) (See Figure 2.4). Shifting to reuse will require a change in HCP attitudes and behavior, alterations to procurement practices, and the build out of adequate supporting services (e.g., transportation logistics, laundry facilities, sterilization facilities etc.). While in a Moderate-Ambition Scenario this transformation will likely happen over a longer period, in a high-ambition scenario, we assume that these initial hurdles can be overcome in the medium-term.

The contribution of this lever is also reflected in its impact on GHG emissions, removing a further 0.9 $MtCO_2e$, or 7% of total GHG emissions (See Figure 2.5). As with direct elimination, this primarily comes from both reduced plastic production and conversion upstream and reduced need for disposal downstream. There are operating emissions associated with enabling reuse systems, such as collecting, transporting, cleaning, and sterilizing these products. Even after accounting for these, reuse models deliver a positive carbon impact, confirming that operational hurdles should be viewed as manageable integration challenges, not deal-breakers. Estimating the cost savings linked to this lever is particularly challenging, as it depends on the available infrastructure and number of cycles of the reusable alternative. As limited data exists on the cost comparison of reusable medical products versus single-use medical products, the cost of a reusable product is assumed as equivalent to the cost of its single-use counterpart in the model.[xvii] Therefore, in a High-Ambition Scenario, there is no saving from switching to reuse (See Figure 2.6).

The following case studies highlight how hospitals have transitioned from single-use to reusable alternatives and the benefits that can be achieved through implementing these solutions.



xvii Most published analysis on the costs of reusable versus single-use equipment are too specific (in terms of geography or equipment) hence their exclusion from this report. One study does quote a 46% decrease in costs of converting from single-use to reusable equipment in Australia.[52]

REUSE **CASE STUDY 1**

Reusable alternatives to blue wrap and disposable trays can deliver environmental and efficiency gains

CONTEXT Single-use items in operating rooms contribute significantly to hospital waste, notably surgical blue wrap.[53] Similarly, single-use anesthesia trays can present opportunities for waste reduction.[54]

INTERVENTION AND IMPACT In 2023, UF Health Shands Hospital in the U.S. partnered with Ascendo Health to introduce an initiative transitioning from single-use blue wrap-covered trays to reusable rigid containers to reduce the use of blue wrap. UF Health Shands set a goal to convert 1,000 blue wrap-covered trays and, as of this report, has converted 713 trays, saving approximately 600 wraps per month or 7,200 wraps annually.

7,200
blue-wraps saved annually
UF Health Shands Hospital case study

This initiative reduced blue wrap waste and replaced the manual wrapping process with a more streamlined, reusable system. Although UF Health Shands reported a higher initial investment for reusable containers, the hospital also anticipates long-term savings from reduced blue wrap purchases, along with potential efficiencies in sterilization workflows enabled by the shift to reusable rigid containers.[53]

Similarly, in 2020, CHU Clermont-Ferrand in France implemented a 10-month initiative to assess the impact of replacing 15,500 disposable anesthesia trays that it was using annually with 125 reusable stainless-steel trays. This transition to reusable trays can reduce an estimated 391 kg of non-infectious healthcare waste annually.

The initiative was shown to improve operational efficiency without increasing staff workload by streamlining cleaning processes and eliminating the need to manage disposable tray inventory. Additionally, the hospital reported an estimated annual cost savings of €8,211 from reduced purchasing and waste management costs.[54]

€8,211
annual cost saving
CHU Clermont-Ferrand case study

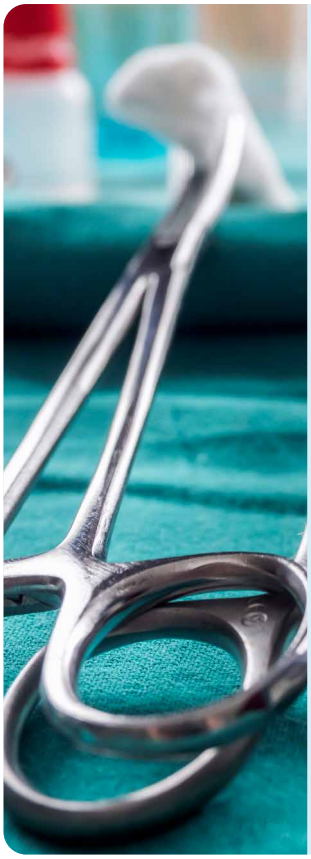
REUSE **CASE STUDY 2**

Reusable surgical masks prove feasible and lower impact in MSF pilot across Mozambique and Kyrgyzstan

CONTEXT Doctors Without Borders/Médecins Sans Frontières (MSF) has seen a tenfold increase in mask usage, from an estimated 50,000 masks per year in 2011 to over 500,000 masks in 2023. This increase in single-use PPE has raised concerns for MSF about harming the environment when providing healthcare services across its projects worldwide.[55]

INTERVENTION AND IMPACT In June 2023, MSF launched a pilot initiative in Mozambique and Kyrgyzstan to explore the feasibility of replacing single-use surgical masks with washable masks that could be reused up to 40 times. This pilot aimed to compare the environmental impacts of single-use and reusable masks and determine the logistical viability of using reusable masks across the diverse settings in which MSF operates. The life-cycle assessment found that the reusable masks outperformed the single-use masks in environmental impact and staff generally preferred using reusable masks. This pilot demonstrated that transitioning from single-use to reusable masks is operationally feasible and can reduce GHG emissions without compromising the quality of care or patient and staff safety.[55]

40X
increased lifespan of washable masks vs single-use
Médecins Sans Frontières case study



REUSE **CASE STUDY 3**

Transitioning to reusable pre-op sets reduces waste in surgical prep

CONTEXT Pre-operative skin preparation for certain surgeries commonly uses single-use foam swabs with plastic handles and double-wrapped plastic cups, generating a significant amount of packaging and plastic waste. At CHU Clermont-Ferrand in France, an average of 10,000 single-use pre-op sets are used annually.[56]

INTERVENTION AND IMPACT In 2019, CHU Clermont-Ferrand introduced a 13-month initiative to replace these single-use sets with reusable forceps and metal cups, which could be sterilized and integrated into the hospital's existing workflow. The transition to reusable alternatives is estimated to reduce 450 kg of non-infectious healthcare waste annually. Once the existing stock was depleted, the hospital discontinued orders for the single-use pre-op sets, eliminating the use of approximately 10,000 swabs and plastic cups per year. This also freed up storage space and reduced procurement and logistical tasks related to the distribution of the single-use pre-op sets. While the investment cost for reusable forceps and cups was €2,000 (including tax), CHU Clermont-Ferrand estimated €15,000 in savings from eliminating disposable swabs.[56]

450 kg
reducion in non-infectious healthcare waste annually
CHU Clermont-Ferrand case study

> "These case studies highlight how hospitals have successfully transitioned from single-use to reusable alternatives"

△→□ 3. Substitute materials

Replace plastics with other materials without compromising on safety and function

When neither elimination nor moving to reusable alternatives is possible, switching to thoughtfully designed lower-impact materials (e.g., fiber, compostables) can provide the same safety and performance, reduce associated GHG emissions, and improve downstream recyclability. An example of material substitution to reduce plastic use is Dignity Health's transition from plastic to paper-based needle counters for use in surgery, which reduced single-use plastic by by 9.1 tonnes (10 US/short tons).[57] Further, many medical devices are packaged in 100% plastic peel-pouches that could be replaced by paper alternatives. When deploying this lever, ensuring product sterility and protection is essential and cannot be compromised. Any non-plastic material must be able to provide the same level of performance as its plastic counterpart.

This lever is driven entirely by a shift towards paper-based device peel-pouches, with many paper manufacturers (e.g., Billerud, DuPont, Monadnock) now producing medical-grade kraft paper for this purpose. Alternative materials like fiber or compostables face uncertainties around performance (adequate sterilization) and infrastructure scalability, limiting its impact in the High-Ambition Scenario. As a result, substitution would contribute to 1% of total plastic mass reduction in the scenarios considered, and to only 0.04 $MtCO_2e$ or <0.5% of GHG emissions abatement, given the limited volume and similar emissions profiles of both materials. Even modest substitution efforts, when implemented thoughtfully and strategically, can strengthen system resilience and complement elimination and reuse strategies, serving both as a mitigation tool and a diversification hedge against material supply risks.

> "This lever is driven entirely by a shift towards paper-based device peel-pouches, with many paper manufacturers now producing medical-grade kraft paper for this purpose"

△→□ 4. Improve recycling

Enable both recycling pre- and post-patient interaction

While upstream levers (1) Refuse, Rethink, Reduce; (2) Reuse; (3) Substitute materials are preferred, where plastic and single-use formats remain, recycling can serve as a means to responsibly manage the residual stream of plastic waste, recover value, and reduce environmental impact at end-of-life. Some limited healthcare recycling pilots for clinical plastic products exist across Europe and North America. However, recycling is seldom prioritized because products are deemed too contaminated for recycling or are disposed of in incorrect waste management streams – even though, more often than not, products are recyclable. Two models can unlock progress on this front:

- **Set up dedicated recycling streams** for non-contaminated products like IV bags where they are adequately designed for recycling. This has proven successful in some hospitals (e.g., Northwestern Medicine, USA) that have set up dedicated recycling pilots for non-hazardous PVC IV bags that are not contaminated with residual pharmaceutical products (and therefore would have to be disposed of in an alternative waste stream).[xviii]

- **Implementing sterilize-and-sort approaches** can make mixed clinical waste recyclable. For example, UK-based Impact Recycling developed a proprietary sorting solution to process shredded, sterilized post-patient plastic waste and received £3 million ($4 million) in funding from the Sustainable Innovation Fund to recover plastics from this stream.[58] However, recycling clinical waste in this way will require substantial investment to build the appropriate capacity, as specific technologies are required to effectively sort and recycle. Implementing additional steps in the recycling process (such as sterilization) could also introduce new requirements and costs, which may shift the overall economics of recycling.

These two models will require a combination of chemical recycling and mechanical recycling technologies. Chemical recycling is most suited to sterilize-and-sort approaches for clinical waste due to the mixture of different plastic types and the potentially hazardous properties present. Because dedicated recycling streams will be one polymer type and non-contaminated, it is likely that these streams can be mostly enabled by open-loop mechanical recycling – meaning the recycled plastic will not return to the system as equivalent medical products. In North America and Europe, recycled content from mechanical recycling is generally not permitted in new medical products due to contamination risks with unintentionally added substances[22] and because it can struggle to meet specific performance and safety standards for medical use.[22] If regulations on the use of recycled content change, the impact on virgin plastic demand could be substantial. Scaling recycling will require better product design (e.g., clear labeling, mono-materials), improved segregation, and investment in specialized infrastructure.

IMPROVE RECYCLING **CASE STUDY 1**

Pilot project recycles over 5.4 tonnes (6 US/short tons) of PVC IV bags at U.S. hospital through cross-sector collaboration

CONTEXT IV bags are a major source of non-hazardous plastic waste in hospitals, and most of them end up in landfills due to limited recycling infrastructure. Recognizing this gap, Northwestern Medicine partnered with Baxter International Inc. to explore solutions for recycling used PVC IV bags.

INTERVENTION AND IMPACT In 2023, a pilot project was launched at Northwestern Memorial Hospital, part of the Northwestern Medicine health system, to collect and recycle non-hazardous PVC IV bags. They successfully diverted over 6 tonnes of waste from landfills and recycled more than 170,000 IV bags into industrial products such as floor mats and dock edging. The recycling process was integrated into existing clinical workflows without disrupting nursing operations and scaled from a single unit to multiple patient areas. Staff engagement and on-site logistics were key to operational success. Following this pilot, the hospital plans to continue the program and explore expansion across the health system.[59]

5.4 tonnes
of non-hazardous waste diverted from landfill
Northwestern Memorial Hospital case study

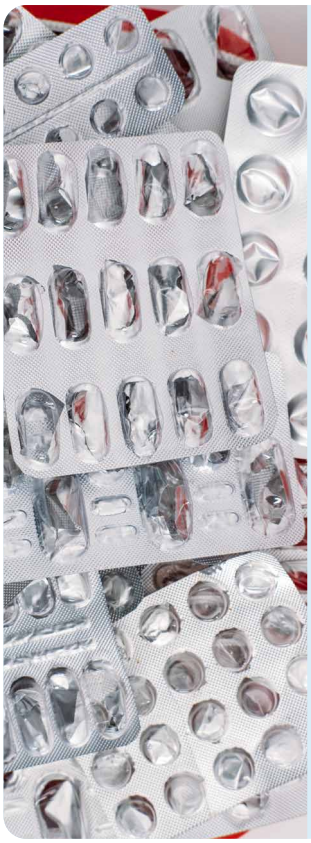
xviii It should be noted that whilst PVC is a technically recylable material, some recyclers view PVC as a contaminant because of its high chlorine content. As a result, PVC recycling often requires specialist management which can increase costs.

IMPROVE RECYCLING **CASE STUDY 2**

Advanced recycling pilot diverts 6,255kg of healthcare plastics from landfill

CONTEXT A portion of healthcare packaging is made from high-density polyethylene (HDPE) materials, such as Tyvek® which is used widely for sterile medical packaging. These materials are commonly landfilled due to limited recycling infrastructure and concerns about contamination risks.

INTERVENTION AND IMPACT In 2021, a U.S.-based university healthcare system collaborated with DuPontTM Tyvek® Healthcare Packaging and Freepoint Eco-Systems to introduce a plastics recycling program. Hospital staff received training through in-person and virtual sessions to ensure they segregate the appropriate plastic waste for this recycling stream. Freepoint provided composition analysis reports that showed contamination levels in the recycling stream and reminder emails were sent to staff. Over the first nine months, the program successfully diverted 6,255 kg of plastic waste from landfill. Collected materials were sent to Freepoint Eco-Systems and processed through advanced recycling technologies to break down the plastics into feedstock for new materials. The pilot demonstrated that with proper training, clear and frequent communication, and cross-value chain collaboration, healthcare facilities can increase plastic recovery and contribute to more circular material flows.[60]



IMPROVE RECYCLING **CASE STUDY 3**

Blister pack recycling initiatives improve pharmaceutical waste diversion in Australian hospitals

CONTEXT Medication blister packs are a common form of pharmaceutical packaging and are typically landfilled due to their multi-material composition and limited recycling options. These packs often contain both plastic and aluminum layers, making them difficult to recycle through standard hospital waste streams.

INTERVENTION AND IMPACT In 2023, Bathurst Hospital in Australia launched a pilot to recycle blister packs through Pharmacycle. Alongside collection and recycling, the team introduced short, consistent educational materials to raise staff awareness of pharmaceutical waste management. These were integrated into existing workflows. While the pilot was not cost-saving due to high recycling costs, it emphasized the role of staff education in improving waste segregation.[61]

Similarly, in 2024, Queensland Children's Hospital (QCH) introduced blister pack collection bins in all wards for use by staff and patients. In the first three months, 16,000 blister packs (24 kg) were collected for recycling through a partnership with Pharmacycle. This program was initially funded through QCH's Container for Change initiative, which raised funds by collecting and redeeming beverage containers through Queensland's deposit return scheme.[62] This program is currently ongoing.

Recycling (both mechanical open-loop and chemical) could divert an additional 10%, or nearly 300 kt, of single-use plastic from incineration or landfill - roughly the mass of 15 billion plastic bottles.[xix] This would involve setting up dedicated recycling for all categories (except wipes) and expanding post-patient recycling. These efforts would only abate about 0.1 $MtCO_2e$, or 1% of total GHG reductions, due to the emissions from collecting, sorting, and processing. In Europe, where incineration can cost $1,200/tonne (€1,000), recycling could halve disposal costs and recapture some material value. In North America, where landfill is cheaper, recycling might incur a small cost premium, but it would build resilience against future landfill restrictions and EPR fees.

xix Assuming a single plastic bottle weighs 20 grams

5. Low-GHG emissions plastics procurement

After applying all previous levers, a High-Ambition Scenario could reduce plastic waste by around 1,600 kt, assuming 100% fossil-based virgin plastic. Still, over 1,360 kt of plastic would be incinerated or landfilled each year, emitting 8.1 $MtCO_2e$. As a last resort, switching to low-GHG emissions plastics can reduce the footprint of unavoidable single-use items. Including carbon-intensity criteria in procurement decisions would send a strong demand signal to the plastics value chain. These technologies are in their infancy and currently expensive, but costs will likely drop with scale. They are not healthcare-specific technologies but should be considered within a broader plastics decarbonization and sustainability strategy for healthcare facilities. Low-GHG emissions plastics typically involve two main approaches:

- **Source products manufactured using abated fossil fuels (e.g., CCS),** by stipulating a ceiling for lifecycle GHG emissions per tonne of polymer. Here, abated fossil fuel plastic is typically derived from CCS technologies and improved upstream manufacturing, such as electrifying stream crackers. This report shows an example of how this may take place, but several different pathways and technology routes are possible.

- **Source products manufactured using biobased plastic as a feedstock,** focusing on plastics whose carbon originates from biomass. The most readily available technology for bio-based polyolefins (polyethylene and polypropylene) is the methanol-to-olefins (MTO) route[xx], which uses methanol rather than oil-derived ethylene as a feedstock.[63]

While this lever would not reduce total plastic demand, it has the potential to significantly lower the associated GHG emissions of the remaining demand. Any move to biobased plastic should be approached with caution more generally, as it may involve increased land use and other environmental trade-offs.[64] However, when taken in the context of the healthcare sector, where other measures have been exhausted and disposal is the only alternative, it is likely to be the most preferable option. This is particularly relevant in the healthcare sector, given the complexities of infection control for many items.

Given the lack of market drivers and upstream investment, it is unclear how much can and would shift by 2040; therefore, an indicative scenario has been created to demonstrate the likely impact of such a shift. In the High-Ambition Scenario, a shift of 75% of total plastic production to low-GHG emissions plastic for polyolefin products is modelled – 25% from abated fossil fuel production and 50% from biobased plastic. For non-polyolefin products (primarily PVC), a shift of 25% to low-GHG emissions plastics (made entirely of abated fossil fuels) is modeled. This reflects the additional challenges associated with decarbonizing the PVC value chain.

This scenario results in an additional 18% reduction from the residual GHG emissions after implementing Levers 1 through 4, falling from 8.1 $MtCO_2e$ to 5.8 $MtCO_2e$.

BOX 2.1

Regional differences

It is worth noting that whilst the results show an aggregated view between Europe and North America, GHG emissions reduction will be different between the two regions because of differences such as the most common method of residual waste disposal. As discussed, Europe prefers to use incineration with energy recovery – either low temperature or high temperature – to dispose of plastic medical waste. However, in North America, landfilling is the most common end-of-life pathway. This disposal preference leads to differing impacts when the low-GHG emissions plastic lever is used, due to variations in total GHG emissions depending on whether biobased plastics are incinerated or landfilled (see Figures 2.7 and 2.8).

Biobased plastics are wholly or partly derived from renewable biological sources such as crops, agricultural residues, or other plant-based materials, which absorb carbon dioxide (CO_2) from the atmosphere as they grow.

As a result, how biogenic carbon – that is, carbon originally absorbed by plants and embedded in the plastic – is accounted for is critical to assessing the true climate impact of these materials.

At end-of-life, the fate of this biogenic carbon depends on the waste treatment pathway:

If incinerated, the carbon that was originally absorbed by the biomass is released back into the atmosphere as CO_2. However, because this release occurs within a relatively short timeframe (typically within five years), it is often considered carbon neutral, assuming the biomass would have decayed and released the same GHG emissions naturally.

xx. Other biobased plastics are available in the market

If landfilled, the situation is different. In many modern, well-managed landfills, the conditions are such that the biobased plastic may degrade extremely slowly or not at all. This means the carbon taken from the atmosphere and locked into the plastic remains trapped underground for the long term. In this case, the carbon is effectively sequestered, or permanently stored, and the system can be credited with a climate benefit, as that CO_2 has been removed from the active carbon cycle.

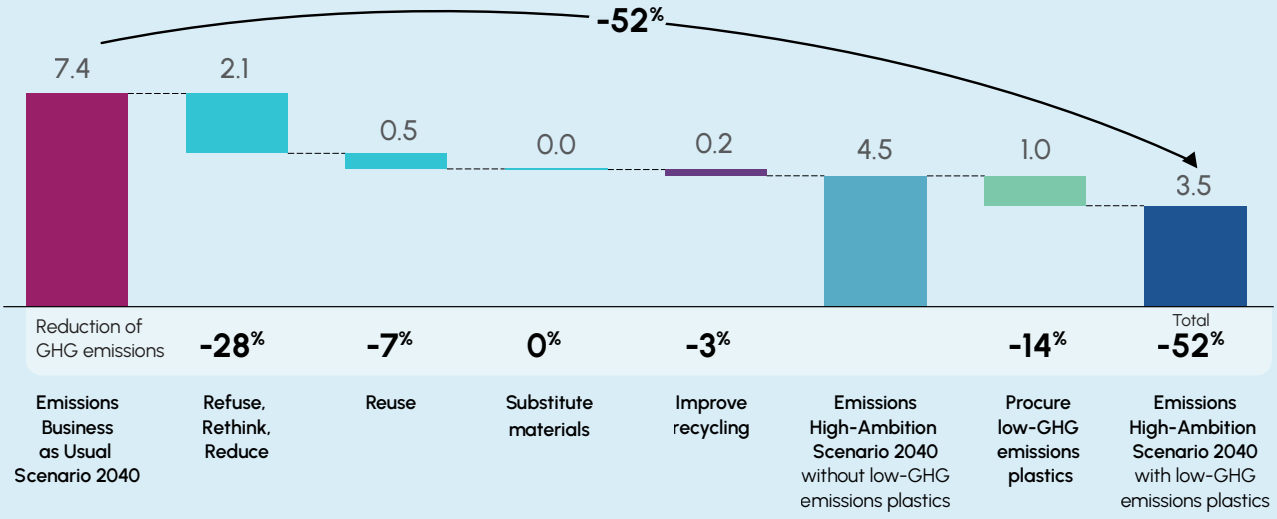
The result is that, regardless of the disposal method, the use of biobased plastics offers a GHG benefit compared to fossil-based plastics. Whether the carbon is returned to the atmosphere or stored long term, the overall impact is lower, depending on factors such as land use, energy sources, end-of-life treatment, and material efficiency, because the carbon originated from renewable sources rather than fossil fuels.

By 2040, in Europe, shifting to low-emission plastics could save an additional 14% of GHG emissions in a High-Ambition Scenario

FIGURE 2.7

GHG emissions of the single-use healthcare plastic system in a Business as Usual Scenario versus High-Ambition Scenario in Europe 2040

$MtCO_2e$ (absolute percentage reduction of GHG emissions)

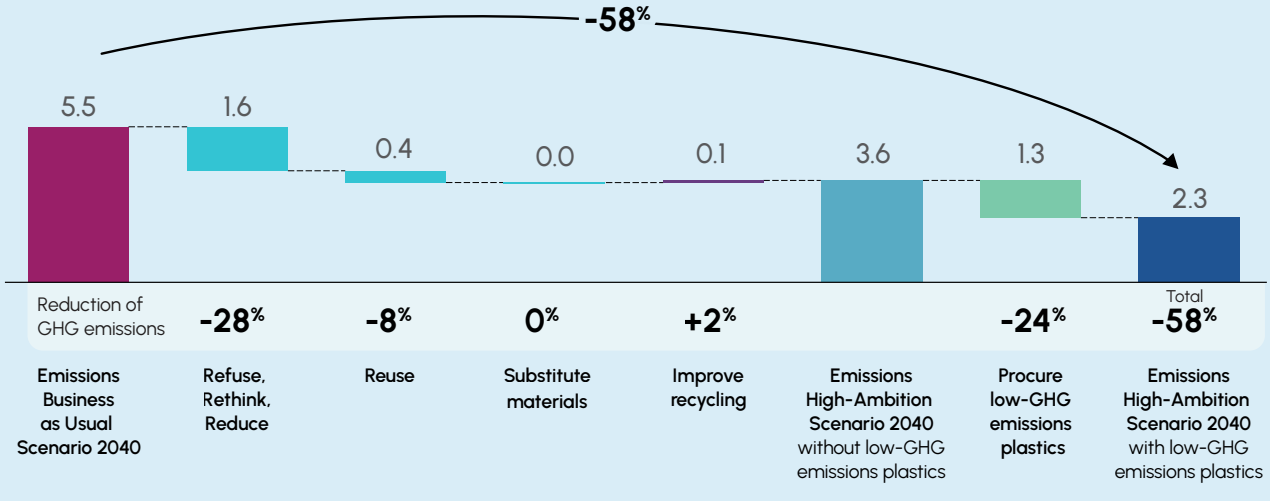


By 2040, in North America, shifting to low-emission plastics could save an additional 24% of GHG emissions in a High-Ambition Scenario

FIGURE 2.8

GHG emissions of the single-use healthcare plastic system in a Business as Usual Scenario versus High-Ambition Scenario in North America 2040

$MtCO_2e$ (absolute percentage reduction of GHG emissions)



By deploying all five levers, the healthcare sector could reduce disposed plastic waste by 53% in a High-Ambition Scenario – cutting annual waste to just over 1,360 kt by 2040, below the 2023 baseline of around 2,100 kt (with more than 80% of the reduction coming from Reduce, Rethink, Reduce, Reuse, and Substitute materials levers, reinforcing the importance of reducing consumption at the source). Even under a Moderate-Ambition Scenario, waste could fall by 26% to roughly 2,150 kt. This translates to avoiding or delaying over a decade's worth of the UK NHS's entire plastics footprint.[65] The climate benefits are equally compelling. These interventions could reduce sector-wide GHG emissions by up to 55% in a High-Ambition Scenario – equivalent to a 38% drop below 2023 levels, despite growth in clinical activity. Cost impacts could follow a similar pattern: while some downstream interventions require upfront investment, these may be outweighed by upstream savings. By 2040, the system could potentially save nearly $18 billion (€15 billion) annually, slashing almost half of projected spending on single-use plastics.

BOX 2.2

Cost implications of behavioral change interventions

Many of the circularity levers modelled in this report hinge on frontline staff altering day-to-day habits. For example:

i. swapping non-sterile gloves for alcohol hand-rub during low-risk patient contact;
ii. placing clean PVC IV-bags and tubing into the dedicated recycling containers rather than the clinical-waste bin; or
iii. returning reusable operating theatre gowns to the laundry bin instead of discarding single-use aprons.

Choices like these are often governed by organizational norms that lead to entrenched, learned human behaviors that are difficult to change.

Changing these norms to nudge HCPs into making the circular choice costs money. To roll out training, provide informative "how-to" reminder posters, send regular communications, and conduct periodic audit-and-feedback cycles could cost between **$60,000 – 80,000** (€50,000 – 70,000) per acute hospital in the first year.[xxi] Across all hospitals in Europe and North America, this equates to a **system-wide upfront investment of $0.5 - 1.5 billion (€0.4 - 1.3 billion)**. Crucially, this cost is not included in the quantitative model, but it is modest relative to the downstream savings unlocked by behavior change.

Even in these scenarios, the industry will not be on track to achieve net zero

Even in the High-Ambition Scenario, healthcare systems in Europe and North America will not be on track to achieve net zero by 2040. Our modeling shows that by 2040, even with the full implementation of circularity levers, approximately 1,300 kt of plastic waste could still be produced annually across the seven product categories. Of this, around 51% would be incinerated, resulting in an estimated 1 $MtCO_2e$ in GHG emissions. While this represents a significant improvement over the Business-as-Usual 2040 trajectory (-2.6 $MtCO_2e$), it is insufficient to meet net zero. It is also well below what is needed by the plastics industry more generally to meet long-term climate goals in line with the Paris Agreement, which requires the material sector(s) as a whole to be on a much steeper trajectory towards net zero than is currently expected.[66]

The results make clear that, while a robust package of circularity interventions can significantly reduce plastic waste and GHG emissions, these efforts alone are not enough. Several high-impact levers are outside the scope of this model – either due to limited data availability (e.g., substituting blister packs for pill bottles), current implementation barriers (e.g., using reusable gloves or switching from PVC to more recyclable materials for blister packs), or because they are not under the control of the healthcare sector. Nonetheless, they are essential for bending the curve of GHG emissions further. This section identifies and categorizes these levers, clarifying why they were not modeled and how they could amplify future impact.

xxi Based on a back-of-envelope calculation that considers likely average salary for a sustainability professional in a hospital or other healthcare setting.

Levers that were excluded from our analysis but should not be ignored

	Why it is excluded	Why it remains important
Decarbonization of manufacturing energy systems	Grid decarbonization is beyond the healthcare sector's control and varies by region. Procurement teams cannot enforce such changes.	Many plastic-related emissions (e.g., production, recycling, sterilization) are energy-intensive. As power grids decarbonize, plastics' emissions will decline.
Product manufacturing relocation	The model assumes global production. Localizing manufacturing was not modeled due to variability in trade, regulation, and feasibility.	Shifting production closer to demand or to low-carbon regions can reduce embedded emissions and improve supply chain resilience.
Reduced pharmaceutical and diagnostic consumption	Overuse is tied to broader clinical and system reform, making it hard to model. These changes are primarily health-driven.	Cutting unnecessary medications and diagnostics would lower demand for single-use plastics in packaging and delivery.
Compostable materials	Only viable when certified for clinical use and supported by dedicated collection and industrial composting facilities. Excluded due to segregation issues and limited composting infrastructure.	In non-critical uses (e.g., catering), compostables could divert waste if proper systems are in place and scaled across sectors.
Landfilling as an end-of-life option	Though less emission-intensive than incineration, landfill was excluded due to regulatory bans and long-term environmental risks.	Where incineration is lacking, landfill may cut emissions short-term, especially if methane capture systems are in place. However, leachate and methane risks prevent it from being a viable circularity strategy.

BOX 2.3

Implications for the PVC value chain

PVC is among the most difficult polymers to decarbonize upstream. Its production depends on chlorine and fossil carbon sources, with limited viable alternatives. Current average emissions are around 3.77 kg CO_2e per kg, but this conceals large regional differences. China, producing over 40% of global PVC, predominantly uses the calcium carbide (coal-based) route, which emits more than 7 kg CO_2e per kg – over three times higher than the ethylene-based route common in Europe and North America.[67] However, due to the lack of value chain transparency, it is unclear where exactly the healthcare sector procures most of its PVC; and therefore, in However, due to the lack of value chain transparency, it is unclear where exactly the healthcare sector procures most of its PVC from and therefore in the model created for this study, it is conservatively assumed PVC is all derived from US or European production and therefore in the model created for this study, it is conservatively assumed PVC is all derived from US or European production. Where the country of origin is specified, there are indications that relatively small volumes of healthcare items come from China. However, a significant proportion also originates from unknown sources.

The calcium carbide process is heavily reliant on coking coal, producing vast quantities of CO_2 and methane. Therefore, transitioning to the ethylene route would significantly reduce GHG emissions from Chinese PVC. However, this also needs to be combined with electrified steam crackers and low-carbon electricity, both of which require substantial infrastructure shifts.

A further decarbonization route is the use of bio-based ethylene, derived from bioethanol (as already proven in bio-PE and bio-PP). This offers a fossil-free pathway for roughly half of the PVC molecule. However, the other half, chlorine, cannot be bio-sourced and remains energy-intensive, as it is produced from salt via electrolysis. Trials of bio-based naphtha[68] also offer some promise as a fossil-free cracker feedstock, but these solutions are still niche, costly, and currently limited to high-end applications.

To put this transition in perspective, if the High-Ambition Scenario also included converting 50% of the remaining PVC to bio-based feedstocks, it would deliver a further **15 percentage point reduction** in GHG emissions from healthcare plastics.

Together, these levers provide a vital complement to the modeled interventions. Achieving a fully circular and low-GHG emission future for healthcare plastics will require deeper system alignment – not only across material and waste streams, but also across policy, innovation, behavior, and care delivery models. In the next phase of research, these areas warrant closer examination and integration into strategic roadmaps for transformation.

From intention to impact

Enabling system change in healthcare plastics

The ambitious vision described in this report will remain out of reach unless structural barriers to action are addressed and a coordinated effort is made across the healthcare value chain. Today, seven system barriers slow progress towards circularity: fragmented and siloed governance, lack of standardized and transparent data, procurement practices that prioritise short-term cost over lifecycle value, regulatory inertia, infrastructure and investment gaps, clinical culture and operational pressures hindering workflow changes, and weak market signals that limit the business case for circular products and recycling.

Today, seven system barriers slow progress towards circularity:

1. **Fragmented and siloed governance** across departments and institutions prevents system-wide strategization, coordination, and scaling of circularity initiatives;
2. **A lack of standardized, transparent data** on product materials, use, and waste flows hinders informed decision-making and benchmarking;
3. **Procurement prioritizes short-term cost over lifecycle value,** limiting the uptake of reusable or low-GHG emissions alternatives;
4. **Regulatory inertia and misaligned incentives delay market entry** for circular products and fail to incentivize innovation;
5. **Gaps in infrastructure and upfront investment** limit the deployment of reuse, recycling, and take-back systems;
6. **Clinical culture and operational pressures create resistance** to the workflow behavioral changes needed for sustainability; and
7. **Weak market signals and missing end-markets** undermine the business case for circular product development and recycling investments.

These barriers reflect a system optimized for linear, short-term efficiency – not circularity or long-term resilience.

Overcoming them requires a deliberate and coordinated response from everyone in the system. Hospitals and health systems should embed circularity into procurement criteria, invest in better data systems, and provide clinical teams with the training and protocols needed to operationalize change. Suppliers and manufacturers should be engaged to design lower-impact products. Governments have a vital role to play in updating regulations to mandate and promote circular practices while aligning financial incentives.

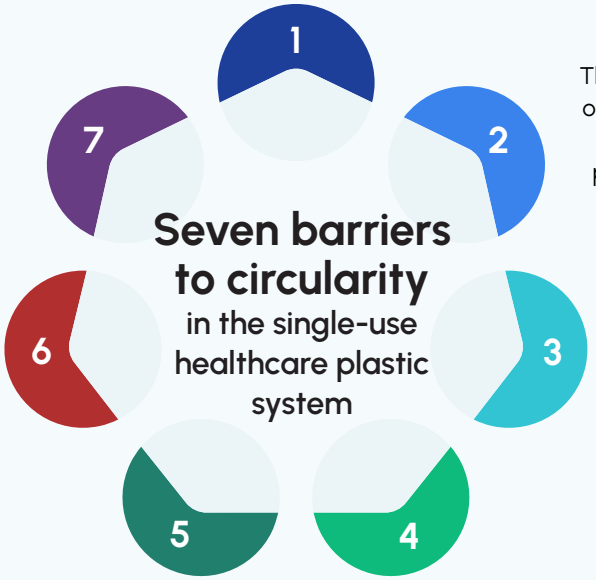
No single actor can drive change alone – but, through collective action, the system can be reoriented. The actions taken in the upcoming years will shape healthcare's material footprint for decades to come. This chapter outlines the cross-cutting capabilities and leadership commitments needed to unlock progress and ensure the healthcare sector becomes a driver of circularity and health, not a barrier to it.

03

Seven system barriers to circularity

Despite growing recognition of the environmental and financial toll of linear plastic use in healthcare, meaningful change remains constrained by a set of persistent structural barriers. These are not rooted in lack of awareness or intent, but rather in legacy systems designed for short-term cost control, operational efficiency, and risk avoidance. Overcoming them requires more than incremental improvements; it demands coordinated, system-wide shifts. Based on expert input, some of the most entrenched barriers include:

> "The environmental and financial toll of linear plastic use in healthcare is rooted in legacy systems designed for short-term cost control, operational efficiency, and risk avoidance"



Fragmented and siloed governance

Decentralized decision-making and siloed departments can prevent coordinated action and limit ability to scale successful pilots

Market failures and weak demand signals

Unclear demand and regulatory signals discourage suppliers from investing in circular design and recycling capacity

Data gaps and lack of transparency

The lack of standardized data on materials, waste, and GHG emissions hinders informed procurement and limits value chain visibility

Behavioral norms and operational culture

Infection control protocols, time pressures, and lack of formal support make sustainability initiatives difficult to embed in clinical routines

Short-term cost focus over lifecycle value

Procurement prioritizes low upfront costs, discouraging investment in more sustainable alternatives that carry higher initial costs

Infrastructure and investment gaps

Missing logistics, segregation systems, and funding prevent effective implementation of reuse and recycling models

Regulatory inertia and misaligned incentives

Outdated standards and exemptions for healthcare plastics block innovation and can limit the adoption of circular solutions

1 Fragmented and siloed governance

Healthcare systems are structurally fragmented, with hospitals and departments operating independently. This leads to considerable variation in sustainability practices, sometimes even within clinical units. Procurement, sustainability, clinical, and waste functions are typically siloed, with limited coordination or shared metrics. Circularity initiatives thus tend to be piecemeal – focused on a single product, lever, or department – and fail to scale beyond the initial context. This fragmentation prevents system-wide optimization, limits institutional learning, and makes it difficult to institutionalize and scale successful pilots.

2 Data gaps and lack of transparency

The sector suffers from a lack of standardized, granular, and accessible data on procurement volumes, material composition, waste generation, and GHG emissions. This is particularly problematic given the vast number of product references, even for simple items such as gloves or syringes, which can vary widely in materials, design, and environmental impact. Without product-level data or clear labeling, it becomes nearly impossible for procurement teams to assess environmental attributes or make informed comparisons. Most institutions do not track how non-hazardous or non-regulated waste streams are managed, nor do they receive reliable feedback from downstream partners. When data is available, it is often proprietary, scattered, or incompatible across systems.

3 Short-term cost considerations over lifecycle value assessment

Public and institutional procurement often prioritizes low upfront cost rather than total value across economic, environmental, and operational dimensions. This disincentivizes investment in reusable or lower-carbon alternatives that may carry higher initial costs but offer long-term environmental and financial benefits. Siloed budgeting and decision-making mean procurement teams may not coordinate with waste managers, sustainability leads, or clinicians when developing product specifications.

4 Regulatory inertia and misalignment of incentives

Regulations and approval pathways have not kept pace with innovation in circular design. Many safety and performance standards are still geared toward single-use formats, and liability frameworks remain unclear for shared-use or reprocessed products. As a result, even when alternatives exist, market entry can be delayed or blocked. For example, in the U.S., product manufacturers often request only single-use approval from the FDA (avoiding the longer processes linked to reusable approval, and in parallel selling more single-use items) and EPR policies often exempt healthcare packaging. In the EU, healthcare plastics are given extended timelines under the PPWR (see Box 1.1).

5 Infrastructure and investment gaps

Even where potentially recyclable products are used (e.g., rigid device packaging, pill bottles), they frequently end up in incineration or landfill due to lack of segregation infrastructure, reprocessing facilities, or take-back programs. Hospitals may lack dedicated bins and sufficient infrastructure, trained staff, or logistics systems to sort and store reusable or recyclable plastics.[20] Scaling circular solutions often requires upfront capital investments in equipment (e.g., sterilization systems), process redesign, staff training, and supply chain partnerships, and these costs can appear prohibitive – particularly in systems where the financial savings from reduced waste disposal or procurement are not immediately visible.

6 Behavioral norms and operational culture

Clinical professionals operate under high-pressure conditions, with limited time and significant patient safety responsibilities. Sustainability practices that require workflow changes, however minor, can be perceived as burdensome or risky. The legacy of infection control protocols, the ingrained culture of disposability, and the lack of training and leadership endorsement all contribute to inertia.

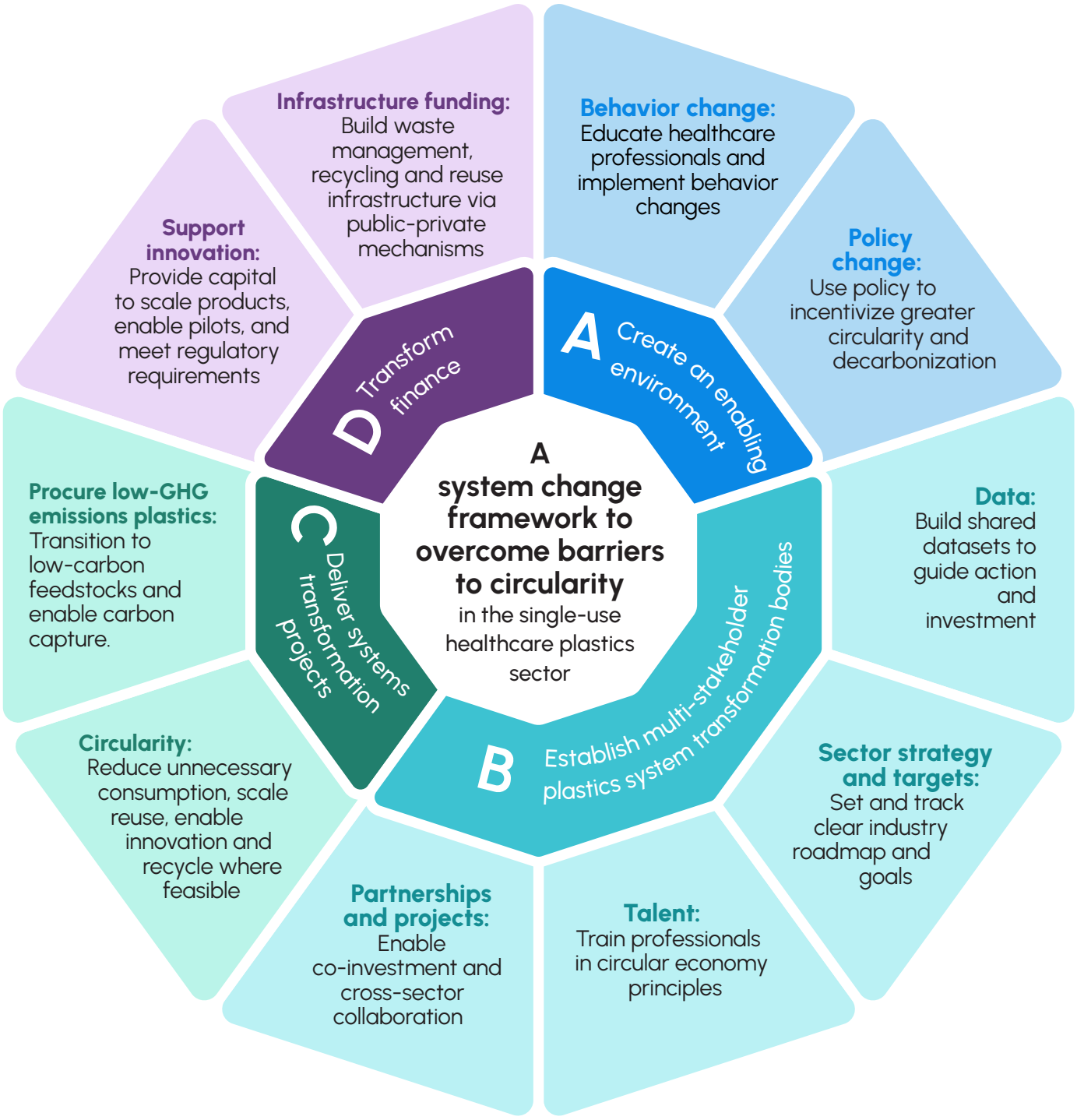
7 Market failures and weak demand signals

Recycled content from healthcare plastics is not widely used due to both supply-side constraints (e.g., contamination risks, lack of scale) and demand-side weaknesses (e.g., absence of end markets, limited procurement incentives). In turn, the absence of viable end markets undermines the business case for collection, segregation, and reprocessing, as manufacturers lack confidence that investments in circular design will be rewarded.

These system barriers are interlinked and mutually reinforcing. Addressing them requires a coordinated strategy that aligns incentives, builds capacity, and reimagines the rules and relationships that currently shape decision-making across the healthcare plastics ecosystem.

Everyone has a role to play

To lift these barriers, a shared system change capability framework should be adopted. This framework offers a structured view of the building blocks required:



Building these capabilities will require coordinated action across the value chain. However, healthcare lacks any intuitive sector nodes that can take the lead and orchestrate such change at scale. Establishing multi-stakeholder bodies is critical, even though not all stakeholders play the same role or carry the same weight. Healthcare providers and regulators are the primary drivers of change. Procurement actors, manufacturers, and waste management providers are essential to operationalize solutions at scale. Industry partners and civil society play supportive roles, and are less critical to amplify efforts and ensure accountability.

Healthcare providers and institutions (hospitals, clinics, long-term care centers) sit at the center of the healthcare plastics system. They are not only the primary users of plastic products, but also the institutions that are best placed to embed circularity into clinical and operational decision-making. Their influence spans across procurement, clinical behavior, waste segregation, and patient interaction.

Lead on behavior change: Change should happen at multiple levels: clinical protocols should be reviewed to identify unnecessary single-use items; facilities could be equipped with proper infrastructure (e.g. for sterilization, collection, or logistics of reusables); and sustainability criteria can be embedded into procurement tenders and supplier engagement. Training, feedback loops, and performance incentives should be provided to support behavioral change among frontline staff –doctors, nurses, and technicians – who are often willing but lack time, tools, or clarity.

Lead establishment of multi-stakeholder transformation bodies: Leadership teams within hospitals and health systems can elevate sustainability to a strategic priority. This means assigning clear accountability (e.g. chief sustainability officers or designated teams), identifying and understanding the obstacles and barriers to change, setting plastic reduction and waste targets, and ensuring sustainability is embedded into care quality metrics. This would also include establishing bodies (e.g., consortia, forums) and mechanisms for collaboration and knowledge-sharing across hospitals, health systems, and regions to support the construction of industry roadmaps and targets.

Support delivery system transformation projects: Healthcare providers can also act as living laboratories for innovation, leading or participating in initiatives that advance sustainable healthcare practices. For example, Fundación Valle del Lili in Colombia implemented various initiatives that included reprocessing medical devices and replacing single-use medical devices with reusable alternatives.[69] Pilot programs may test the safety and performance of reuse or substitution models. For example, Barnsley Hospital NHS Foundation Trust in the UK introduced reusable surgical caps and gowns and, after a successful pilot, was formally adopted.[70] Similarly, in the USA, UVA Health launched a pilot project using recyclable paper-based pill bottles in its outpatient pharmacy to explore a more sustainable alternative to plastic pill bottles.[71] When successful, these should be scaled across departments or shared with peer institutions. This involves creating a supportive environment, integrating sustainable practices into standard clinical processes and policies where feasible, and making sustainable alternatives the default where possible.

Regulators and governments are the second most critical enablers of system-wide transformation.

Lead on policy incentivization: They set the standards and incentives that shape the healthcare plastics system – directly, through regulation, and indirectly through funding, performance frameworks, and industrial policy. To unlock transformation, regulators could begin by clarifying and harmonizing definitions of clinical waste to facilitate the recovery and recycling of clean plastic waste (many product categories, such as device packaging, non-invasive devices, and PPE in low-risk settings, can be safely brought into regulatory scope without compromising patient care). Regulators should also embed circularity into procurement and product standards – for instance, by prioritizing the purchase of reusable products, mandating recyclability, or restricting problematic polymers for certain applications. Where appropriate, including the healthcare sector in existing legislative frameworks, such as state-wide EPR legislation with eco-modulation of fee structures, can motivate manufacturers to reduce environmental impacts through financial and regulatory incentives. Standard-setting bodies, such as Advancing Standards Transforming Markets International, the International Organization for Standardization, and Underwriters Laboratories, can also play an influential role in shaping policy by defining the technical specifications that underpin regulation changes.

Support establishment of multi-stakeholder transformation bodies: They can enforce more data transparency by setting sustainable procurement criteria for public hospitals and asking for proper labelling to prioritize products that are designed for reusability, recyclability, or reduced environmental impact.

Lead finance change: Importantly, regulation should be enabling as well as restrictive. This means providing safe harbors for pilot initiatives, funding de-risking programs, and building infrastructure to scale new solutions. Through national targets, green public procurement mandates, and innovation grants, governments can signal clear expectations to manufacturers and providers. By aligning health policy with environmental policy – such as embedding sustainability within national health system performance frameworks – they can create long-term institutional alignment. Regulators can also establish the right procurement frameworks to internalize lifecycle costs and create the right financial incentives for overall lower carbon footprints. In short, regulators could move from passive exemption to active stewardship – setting a coherent direction, addressing safety and sustainability in tandem, and ensuring that the healthcare plastics system evolves in line with public interest and planetary boundaries.

Procurement bodies (internal hospital procurement teams, regional authorities, and Group Purchasing Organizations (GPOs) in North America) act as powerful levers for demand-side change. They can create the conditions necessary to improve data transparency and build a longer-term view on costs, focusing on lifecycle value assessment (vs. purchase price). They can thus drive the adoption of circular alternatives by embedding sustainability criteria into tenders and evaluation processes. By aggregating demand across hospital groups or regions, procurement consortia can create the scale that manufacturers need to invest in product redesign (to include recycled content) or reuse logistics. This includes moving beyond unit-cost evaluations to incorporate lifecycle impact, end-of-life treatment, and packaging footprint into purchasing decisions. In the U.S., Vizient's Environmentally Preferred Sourcing (EPS) Program encourages suppliers to report product attributes aligned with environmental best practices.[72] These agencies are well-placed to standardize sustainable purchasing at scale and signal demand for reusable, recyclable, and lower-impact products.

Manufacturers and suppliers (such as device manufacturers, packaging providers, logistics firms, and product designers) should align product design and supply chain practices with emerging sustainability expectations. They should be incentivized to include proper labelling on their products, reduce unnecessary packaging, explore reuse business models, and increase product recyclability. Leading companies and organizations are already advancing solutions and developing recyclable device packaging[73], closed-loop PPE systems[74], and low-GHG emissions polymers[75] – but broader adoption will depend on demand signals from healthcare systems and regulators.

Waste managers and recyclers are needed to scale infrastructure for recycling, decontamination, and safe material recovery. Waste contractors should be engaged early in pilot design and supported through contracts that reward material recovery and environmental performance, not just volume-based disposal. Their ability to invest in infrastructure – such as autoclaving, chemical recycling, and mono-material sorting lines – is important to enabling the recovery of healthcare plastics. They play a critical role in scaling both the supply side and demand side of recycled content from healthcare plastics. In turn, the absence of viable end-markets undermines the business case for collection, segregation, and reprocessing. Manufacturers lack confidence that investments in circular design will be rewarded, while waste processors lack certainty that sorted materials will find buyers or achieve the value needed to justify processing costs.

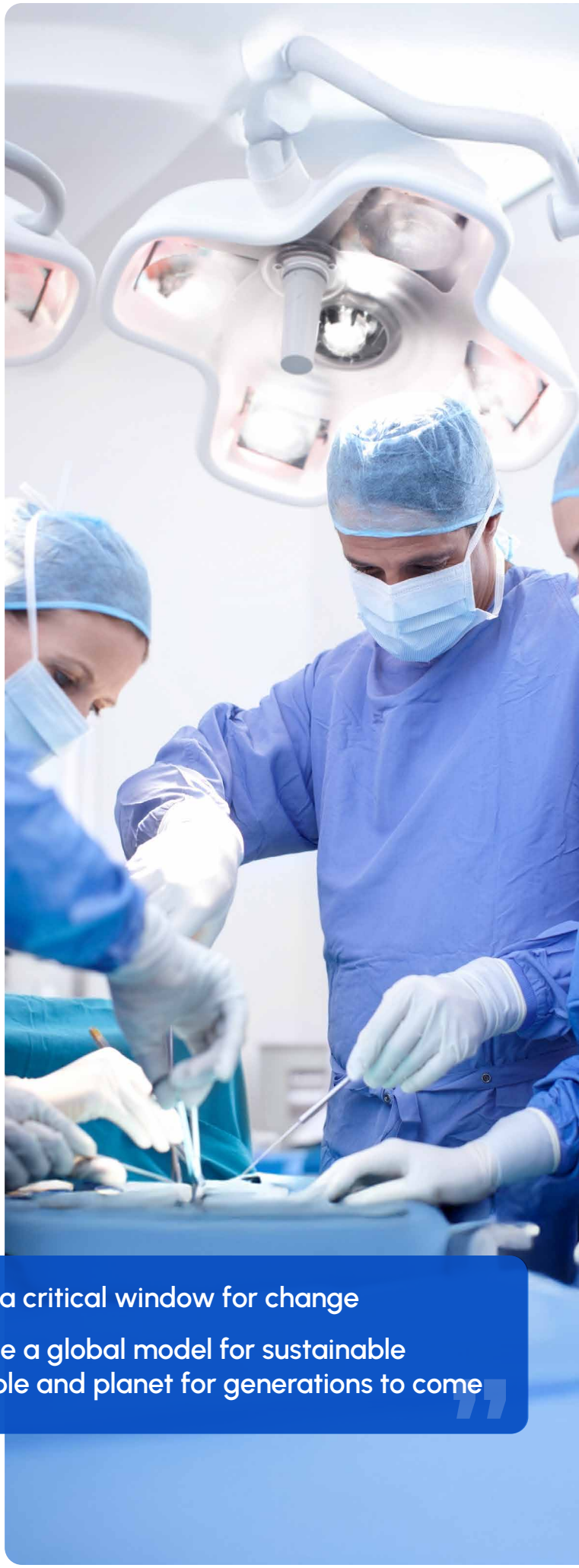
Industry platforms, NGOs, and civil society groups play a vital role in bridging gaps between stakeholders, building shared evidence bases, and keeping ambition levels high. Organizations like the Centre for Sustainable Healthcare, Health Care Without Harm, Practice Greenhealth, and l'Agence Nationale de la Performance Sanitaire et Médico-Sociale are already working to define best practices and connect pioneers. These platforms can coordinate pilot efforts, track progress, and advocate for alignment between health and environmental priorities. For instance, in 2024, a Health Care Without Harm open letter called on delegates of the UN Plastic Treaty to develop an ambitious and just treaty to end plastic pollution[76], including in the health sector. It has been signed by 63 health organizations that represent more than 18 million HCPs and over 1000 individuals.

Patients and the public, can also exert meaningful and indirect influence over healthcare plastics through their behavior, preferences, and trust in system safety. In home-care settings or outpatient clinics, their understanding and actions can influence how products are used and disposed of. Patients influence the acceptability of reused or recycled materials, participate in take-back programs, and handle the disposal of packaging for at-home care. Their trust in system safety and their willingness to change habits will be key to scaling circular practices beyond hospital walls. Clear guidance, accessible disposal channels, and public awareness campaigns are essential to support these groups in making informed, safe, and sustainable choices.

Why the time to act is now - seizing the opportunity

The next five years represent a critical window for change. Many of the solutions needed to enable a more circular approach to plastics in healthcare – whether through product design, infrastructure development, changes in procurement practices, systems innovation, or supportive policy – all require long lead times for capital investment, technological development, and institutional adoption. Delaying action will only increase the cost and complexity of future transitions, while continuing to entrench dependence on linear, fossil-based plastic systems.

Early movers are likely to benefit from long-term cost efficiencies, improved supply chain resilience, and stronger alignment with evolving regulatory and investor expectations. The healthcare sector is uniquely positioned to lead, not only because of its significant environmental footprint, but because of its mission to advocate for and safeguard human health and wellbeing. Its influence, scale, and moral authority are unparalleled. Aligning plastic use with its mission to protect and promote health is both a responsibility and an opportunity. If the sector acts collectively – with ambition, coordination, and clarity – it can become a global model for sustainable transformation, safeguarding both people and planet for generations to come.



> The next five years represent a critical window for change
>
> The healthcare sector can become a global model for sustainable transformation, safeguarding both people and planet for generations to come

Conclusion

Delivering the prescription: Turning vision into action

Among the many challenges facing the healthcare sector today, those posed by the linear consumption of plastic consumables have for too long remained ignored and unaddressed. Tackling these issues demands system-level transformation, visionary leadership, new business and regulatory models, and sustained collaboration across the value chain. From manufacturers and health providers to policymakers, all stakeholders need to act in unison if they want to reshape how plastics are produced, used, and managed in healthcare.

This report explores a data-driven, actionable vision to significantly reduce the volume of healthcare plastic waste and associated GHG emissions. It demonstrates that transformation is mostly not hindered by a lack of technical solutions, but rather by inadequate incentives and regulatory frameworks, fragmented governance, and underinvestment in circular practices and infrastructure. While the model includes a range of interventions that can cut GHG emissions and costs, these gains depend on strong political will, timely investment, and cross-sector commitment.

Crucially, this work is part of a broader and growing movement within the healthcare community. The publication of this report reflects a shared sense of urgency and ambition across industry leaders, public health institutions, and sustainability advocates. The conversations behind this study, and the alignment it represents, signal a nascent readiness to act decisively.

Many of the solutions explored require short-term to mid-term disruption to enable long-term resilience. This will demand leadership willing to confront entrenched practices, rethink procurement, and invest in new systems. But the rewards are substantial: a cleaner, more efficient, more trusted healthcare system equipped for the future.

The path ahead will be shaped by evolving technologies, policy shifts, patient needs, and environmental imperatives. But the message is clear: the next three to five years are critical to setting the sector on a sustainable trajectory. The more quickly and cohesively action is taken, the more likely that today's ambition can turn into tomorrow's reality. Healthcare has the moral authority, institutional scale, and societal trust to lead on this agenda. Now it must rise to the occasion, to build the right coordination bodies for a regenerative system that upholds both human and planetary health.

Appendix 1

Glossary

Alternative treatment For the purposes of this report, alternative treatment refers to the methods used to sterilize or render medical waste non-infectious, making it safe for disposal via low-temperature incineration or landfills. Common alternative treatments include autoclaving (steam sterilization), microwave technologies, and chemical disinfection.

Autoclave A device that sterilizes instruments or other objects using steam under pressure.[77]

Biobased plastics Plastics that are wholly or partly derived from renewable biological sources such as crops, agricultural residues, or other plant-based materials such as sugarcane, corn, and cellulose.[78]

Business-as-Usual (BAU) A scenario that assumes the current trends and practices continue without significant changes or new interventions. In this report, it represents a future scenario where plastic consumption in the healthcare sector grows steadily without major shifts in regulation, procurement, or waste management.

Carbon Capture and Storage (CCS) A technology that captures carbon dioxide (CO_2) emissions from new and existing industrial sources, such as power plants or factories, and stores the CO_2 emissions underground to prevent from entering the atmosphere.[79]

Chemical recycling A process that changes the chemical structure of plastic waste to convert it back into substances that can be used as raw materials for manufacturing plastics or other products.[80] This process is most efficient for clean and highly homogeneous waste streams. Part of the waste is converted into fuel.

Circular economy A system that is designed to keep resources in use for as long as possible, extract the maximum value from them while in use, and then recover and regenerate products and materials at the end-of-life.[81]

Circularity Circularity refers to the extent to which a system or a product aligns with circular economy principles (see definition of circular economy above).

Clinical waste Waste from healthcare or similar activities that is infectious, contaminated with certain medicines, or is a sharp or biological material containing a dangerous substance, as defined under the Controlled Waste Regulations in the U.K.[82]

Decarbonization The process of reducing carbon dioxide (CO_2) and other greenhouse gas (GHG) emissions.

Downstream In the context of the healthcare plastics value chain, this refers to processes that occur after a product has been manufactured and used, such as collection, sorting, recycling, and disposal (incineration or landfill).

End-of-life (EOL) management The processes and strategies used at the end of a product's useful life to manage its disposal, reuse, recycling, or recovery.

Energy from waste (EfW) A waste treatment process that involves incinerating waste (usually at low temperatures of 700–900 °C) to generate heat or electricity.

Extended Producer Responsibility (EPR) A policy approach where producers are responsible for their products over the entire product life cycle, including the post-consumer stage. An EPR policy may mandate producers to be responsible for organizing and financing the collection, sorting, and recycling or disposal of their products.[83]

Greenhouse Gas (GHG) emissions Gases in the Earth's atmosphere that trap heat, leading to the greenhouse effect and global temperature rise. Common greenhouse gases (GHGs) include carbon dioxide, methane, and nitrous oxide.

Healthcare settings Places where healthcare services are delivered, including but not limited to hospitals, urgent care centers, outpatient clinics, and long-term care facilities. For the purposes of this paper, our quantitative analysis focuses on a subset of healthcare settings that are defined in the Technical Appendix.

Healthcare professional (HCP) An individual who provides healthcare services, including but not limited to physicians, nurses, pharmacists, and other clinical staff involved in delivering patient care.

High-temperature incineration (HTI) A waste treatment process that involves the combustion of waste materials at very high temperatures. Only modern incinerators operating at temperatures between 850 – 1100°C and fitted with special gas-cleaning equipment comply with international emission standards for certain persistent organic pollutants (POPs) that form as by-products from combusting chlorine-containing medical plastics such as PVC IV bags.[84]

Landfill A waste disposal site where waste materials are buried in the ground, often in engineered facilities designed to limit environmental impacts such as groundwater contamination.

Life cycle assessment (LCA) A tool used to evaluate the potential environmental impacts of a product, material, process, or activity throughout its entire life cycle, from raw material extraction to disposal.

Linear system or Linear economy A system that follows a "take-make-dispose" approach, where resources are extracted to make products that are discarded after use. Products and materials in a linear economy are generally not sued to their full potential.[85]

Low-GHG emissions plastics Plastics produced using methods that result in lower GHG emissions compared to traditional fossil-fuel-based production, such as those made with Carbon Capture and Storage (CCS) technologies or biobased feedstocks. These plastics can have lower life cycle GHG emissions due to factors such as alternative feedstocks, cleaner production processes, and improved end-of-life outcomes.

Low-temperature incineration (LTI) A waste treatment process that involves combustion of waste at temperatures lower than high-temperature incineration.

Mechanical recycling A process that involves physically processing plastic waste (e.g., shredding or melting) to create new plastic products without significantly changing the chemical structure of the plastic polymer.

Mono-material Products or packaging made from a single type of material, which makes it easier to recycle. Mono-material products or packaging simplifies the recycling process and reduces contamination in recycling facilities.[86]

National Health System (NHS) The umbrella term for the publicly funded health systems in the United Kingdom.

Net zero Achieving an equal balance between the amount of GHG emissions going into the atmosphere and the amount removed from the atmosphere. Net zero by 2050 is recognized as one of the milestones for mitigating global warming, but as *cumulative GHG emissions* matter early action is crucial to avoid exhausting our carbon budget too soon.

Paris 1.5°C Target Limiting global warming to 1.5°C above pre-industrial levels to avoid the worst impacts of climate change. This target was established under the Paris Agreement and is now widely recognized as the benchmark for climate ambition, requiring rapid and deep reductions in global GHG emissions.

Personal Protective Equipment (PPE) Equipment worn to minimize exposure to hazards that cause workplace injuries and illnesses. This includes items such as gloves, masks, shoe covers, gowns, and aprons.

Post-patient waste Healthcare waste that is generated after direct patient contact, which could be subject to regulations and specific handling products depending on the contamination.

Polyvinyl chloride (PVC) A synthetic plastic polymer that is used in the healthcare sector. It is commonly found in IV bags, tubing, and other medical devices.

Recyclable (and Technically Recyclable) A material is recyclable if it can be reprocessed into products, materials, or substances for the original or other purposes.[87] A material is technically recyclable if it can be recycled under ideal conditions but may not be recycled in practice due to current system limitations.

Recycled content The proportion of recycled material (pre-consumer or post-consumer) in a product or packaging.

Reuse The practice of using an item again, either for its original purpose or for a different purpose.

Single-use plastics (SUPs) Plastic items that are designed to be used only once before being discarded. There is widespread use of single-use plastics across the healthcare sector. Common examples include syringes, gloves, and various sterile packaging.

Substitution (substitute materials) Replacing one material with another. For the purposes of this report, material substitution was focused on achieving lower environmental impact. For example, replacing plastics with paper or fiber.

Upstream In the context of the plastics value chain, this refers to processes that occurred before a product reaches the consumer. This may include raw material extraction, manufacturing, and production.

Virgin plastic Plastic produced from renewable (e.g., cellulose) or fossil-based (e.g., crude-oil, natural gas) feedstocks

Virgin Fossil Inputs This refers to the raw, non-renewable fossil-based materials extracted directly from the Earth, such as crude oil, natural gas, and coal, that are being used as feedstock for production of materials including plastics.

Waste segregation The process of separating the different categories of waste materials into the appropriate waste stream. This practice ensures that hazardous and infectious waste (e.g., regulated medical waste or clinical waste) are handled appropriately and in compliance with regulations. Proper waste segregation prevents contamination of non-hazardous waste streams (e.g., recycling stream).

References

1. Healthcare Plastics Recycling Council. Inspiring and Enabling Plastic Recycling Solutions in Healthcare. *https://www.hprc.org/.*

2. Shortage of personal protective equipment endangering health workers worldwide. *https://www.who.int/news/item/03-03-2020-shortage-of-personal-protective-equipment-endangering-health-workers-worldwide.*

3. Prata, J. C., Silva, A. L. P., Walker, T. R., Duarte, A. C. & Rocha-Santos, T. *COVID-19 Pandemic Repercussions on the Use and Management of Plastics. Environ. Sci. Technol.* 54, 7760–7765 (2020).

4. Department of Health and Social Care. Experimental Statistics – *Personal Protective Equipment Distributed for Use by Health and Social Care Services in England: Quarterly Update to 31 March 2023. HM Government https://www.gov.uk/government/statistics/ppe-distribution-england-quarterly-update-to-31-march-2023/experimental-statistics-personal-protective-equipment-distributed-for-use-by-health-and-social-care-services-in-england-quarterly-update-to-31-marc.*

5. European Parliament. *Packaging and packaging waste. https://www.europarl.europa.eu/doceo/document/TA-9-2023-0425_EN.html (2023).*

6. California Legislature. SB 54, *Plastic Pollution Prevention and Packaging Producer Responsibility Act (Chapter 75, Statutes of 2022). https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=202120220SB54.*

7. Greener NHS. *Delivering a net zero NHS. https://www.england.nhs.uk/greenernhs/a-net-zero-nhs/.*

8. Kaiser Permanente. California AB-1305: *Our Emissions Commitments and Disclosures. https://about.kaiserpermanente.org/expertise-and-impact/healthy-communities/improving-community-conditions/environmental-stewardship/ab-1305-emissions-disclosure.*

9. Medtronic. *Medtronic 2024 Impact Report. https://www.medtronic.com/content/dam/medtronic-wide/public/brand-corporate-assets/resources/2024-impact-report_corpmark_mdt.pdf.*

10. Health Care Without Harm Europe. *Towards plastic-free healthcare in Europe. https://europe.noharm.org/towards-plastic-free-healthcare-europe.*

11. Dongguan City Xiangwo Industry Co., Ltd. *Europe's Aging Population Fuels Boom in Disposable Medical Supplies Market. http://www.xwmedcare.com/europes-aging-population-fuels-boom-in-disposable-medical-supplies-market (2025).*

12. Huijben, J. et al. *Accelerating the transition from a linear to a circular healthcare sector: ESCH-R: study design and methodology. https://www.researchgate.net/figure/The-10R-value-hill-in-the-context-of-the-ESCH-R-project-This-figure-shows-the-various_fig2_390182329.*

13. NPR. *Health care has a massive carbon footprint. These doctors are trying to change that. NPR https://www.npr.org/2023/10/02/1202389187/hospitals-climate-change (2023).*

14. Clinicians for Climate Action. *Clinicians for Climate Action. University of Pittsburgh – School of Medicine https://www.c4ca.pitt.edu/.*

15. Systemiq Ltd. *Breaking The Plastic Wave: A Comprehensive Assessment of Pathways towards Stopping Ocean Plastic Pollution. Pew Charitable Trusts https://www.systemiq.earth/wp-content/uploads/2020/07/BreakingThePlasticWave_MainReport.pdf.*

16. Systemiq Ltd. *ReShaping Plastics: Pathways to a Circular, Climate Neutral Plastics System in Europe. https://www.systemiq.earth/wp-content/uploads/2022/05/ReShapingPlastics-v2.1.pdf.*

17. Lau, W. W. Y. et al. *Evaluating scenarios toward zero plastic pollution. Science 369, 1455–1461 (2020).*

18. Health Care Without Harm Europe. *Measuring and reducing plastics in the healthcare sector. https://europe.noharm.org/resources/measuring-and-reducing-plastics-healthcare-sector.*

19. Webb, C., Anguilano, L. & Schmidt Rivera, X. *A Pilot Study into the Use of Qualitative Methods to Improve the Awareness of Barriers to Sustainable Medical Waste Segregation within the United Kingdom's National Health Service. Sustainability 16, (2024).*

20. Healthcare Plastics Recycling Council. *Barriers to Recycling Healthcare Plastics. https://www.hprc.org/barriers-to-recycling-healthcare-plastics/.*

21. Rizan, C., Mortimer, F., Stancliffe, R. & Bhutta, M. F. *Plastics in healthcare: time for a re-evaluation. J. R. Soc. Med. 113, 49–53 (2020).*

22. Healthcare Plastics Recycling Council. *Circularity for Healthcare Plastics: The Challenges and Opportunities. https://www.hprc.org/circularity-for-healthcare-plastics/.*

23. Kallestrup-Lamb, M., Marin, A. O. K., Menon, S. & Søgaard, J. *Aging populations and expenditures on health. J. Econ. Ageing 29, 100518 (2024).*

24. Chen, J., Zhao, M., Zhou, R., Ou, W. & Yao, P. *How heavy is the medical expense burden among the older adults and what are the contributing factors? A literature review and problem-based analysis. Front. Public Health 11, 1165381 (2023).*

25. Hacker, K. *The Burden of Chronic Disease. Mayo Clin. Proc. Innov. Qual. Outcomes 8, 112–119 (2024).*

26. United Nations. *Chronic diseases taking 'immense and increasing toll on lives', warns WHO. https://news.un.org/en/story/2023/05/1136832 (2023).*

27. Giese, C., Richie, T. & Kopaskie, K. 2024 *Impact of Change® Forecast Highlights. https://vizientinc-delivery.sitecorecontenthub.cloud/api/public/content/47212a11b76244d2b3bc7f0e0db086e5 (2024).*

28. IQVIA Institute for Human Data Science. *The Global Use of Medicines 2024: Outlook to 2028. https://www.iqvia.com/insights/the-iqvia-institute/reports-and-publications/reports/the-global-use-of-medicines-2024-outlook-to-2028 (2024).*

29. Karali, N., Khanna, N. & Shah, N. *Climate Impact of Primary Plastic Production. (2024).*

30. U.S. Environmental Protection Agency (EPA). *Greenhouse Gas Equivalencies Calculator. https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator.*

31. Tarafdar, A., Xie, J., Gowen, A., O'Higgins, A. C. & Xu, J. *Microplastic Transfer into the Bloodstream from Intravenous Fluid Infusion*

Systems. SSRN Scholarly Paper at https://doi.org/10.2139/ssrn.4709116 (2024).

32. Assurance Maladie. *Améliorer la qualité du système de santé et maîtriser les dépenses. (2024).*

33. KFF Health News. *US Health Care Spending Forecasted To Top $7.2 Trillion By 2031. https://kffhealthnews.org/morning-breakout/us-health-care-spending-forecasted-to-top-7-2-trillion-by-2031/ (2023).*

34. Food Packaging Forum. *Plastics identified as source of legal liability. https://foodpackagingforum.org/news/plastics-identified-as-source-of-legal-liability (2022).*

35. Council of the European Union. *Regulation of the European Parliament and of the Council on Packaging and Packaging Waste, Amending Regulation (EU) 2019/1020 and Repealing Directive 94/62/EC. https://data.consilium.europa.eu/doc/document/PE-73-2024-INIT/en/pdf (2024).*

36. European Commission. *Single-use plastics. https://environment.ec.europa.eu/topics/plastics/single-use-plastics_en (2025).*

37. Healthcare Plastics Recycling Council. *Regulatory Barriers Related to Healthcare Plastic Waste Recycling in the EU. (2023).*

38. République Française. *Article 77, Loi n° 2020-105 du 10 février 2020 relative à la lutte contre le gaspillage et à l'économie circulaire.*

39. HM Government. *Check which packaging is not subject to Plastic Packaging Tax. GOV.UK https://www.gov.uk/guidance/check-which-plastic-packaging-is-exempt-from-plastic-packaging-tax (2022).*

40. HM Government. *Single-use plastics bans and restrictions. https://www.gov.uk/guidance/single-use-plastics-bans-and-restrictions (2024).*

41. Oregon Department of Environmental Quality. *Rule Concept: Clarifications and Exemptions to the Definition of a Covered Product. (2024).*

42. Maine State Legislature. *Committee Amendment to H.P. 1146, L.D. 1541 'An Act To Support 10 and Improve Municipal Recycling Programs and Save Taxpayer Money'. https://legislature.maine.gov/legis/bills/getPDF.asp?item=3&paper=HP1146&snum=130 (2021).*

43. Colorado General Assembly. *Producer Responsibility Program for Statewide Recycling Act (HB22-1355). (2022).*

44. Government of Canada. *Single-use Plastics Prohibition Regulations. SOR/2022-138 (2024).*

45. Wilson, J., Bak, A. & Loveday, H. P. *Applying human factors and ergonomics to the misuse of nonsterile clinical gloves in acute care. Am. J. Infect. Control 45, 779–786 (2017).*

46. Lalakea, M. L., Noel, J. E. & Meiklejohn, D. A. *Reducing Glove Overuse in Outpatient Specialty Clinics: Cost Reduction and Environmental Benefit. OTO Open 9, e70103 (2025).*

47. Falconnier-Williams, O. C., Taeschner, W., Hille, A., Falconnier, A. D. & Haefeli, W. E. *Untapped options to reduce waste from blister packaging for tablets and capsules. Eur. J. Clin. Pharmacol. 80, 151–161 (2024).*

48. Prado Mares, R. Glove Smart Project at the CSICU. (2024).

49. Clayton-Smith, M., Kendall-Smith, A. & Clarke, T. *The Environmental Benefits of Using Prefilled 'Emergency' Drugs. (2023).*

50. Agence Nationale d'Appui à la Performance (ANAP). *Moins de médicaments intraveineux préparés et non utilisés au CHU de Grenoble. (2024).*

51. Health Care Without Harm. *Sustainable Food Contact Materials in the European Healthcare Sector. https://europe.noharm.org/sites/default/files/documents-files/6814/2021-07-01-Sustainable-food-contact-materials-in-the-European-healthcare-sector.pdf.*

52. McGain, F., Story, D., Lim, T. & McAlister, S. *Financial and environmental costs of reusable and single-use anaesthetic equipment. Br. J. Anaesth. 118, 862–869 (2017).*

53. Ascendo Health. *Wrapping Up Waste: Transition from Disposable Wraps to Reusable Rigid Containers at UF Health. https://www.ascendcohealth.com/wrapping-up-waste-transition-from-disposable-wraps-to-reusable-rigid-containers-at-uf-health/.*

54. Agence Nationale d'Appui à la Performance (ANAP). *Des plateaux inox réutilisables d'anesthésie aux blocs du CHU Clermont-Ferrand. (2024).*

55. Doctors Without Borders USA. *How to provide health care without harming the environment. https://www.doctorswithoutborders.org/latest/how-provide-health-care-without-harming-environment.*

56. Agence Nationale d'Appui à la Performance (ANAP). *Des pinces et des cupules métalliques aux blocs du CHU Clermont-Ferrand. (2024).*

57. NewGen Surgical. *Dignity Health achieves 10 ton milestone of eliminating single-use plastic using plant based clinically designed products for the O.R. https://newgensurgical.com/dignity-health-achieves-10-ton-milestone-of-eliminating-single-use-plastic-using-plant-based-clinically-designed-products-for-the-o-r/ (2020).*

58. Impact Recycling. *Impact Recycling receive funding from UK Research & Innovation's Sustainable Innovation Fund (SIF). Impact Recycling https://impact-recycling.com/news/impact-recycling-winner-of-sustainable-innovation-fund-sif/ (2021).*

59. Baxter International Inc. *Baxter Advances First Intravenous (IV) Bag Recycling Pilot for U.S. Hospitals. https://www.baxter.com/baxter-newsroom/baxter-advances-first-intravenous-iv-bag-recycling-pilot-us-hospitals (2023).*

60. DuPont. *University healthcare system conducts plastics recycling pilot. https://www.dupont.com/knowledge/university-healthcare-system-conducts-plastics-recycling-pilot.html (n.d.).*

61. Agency for Clinical Innovation. *Medication blister pack recycling program. Agency for Clinical Innovation (ACI) Innovation Exchange Agency for Clinical Innovation (ACI) https://aci.health.nsw.gov.au/ie/projects/medication-blister-pack-recycling-program (2024).*

62. Queensland, C. H. *Landmark blister package recycling scheme introduced at Queensland Children's Hospital. Children's Health Queensland https://www.childrens.health.qld.gov.au/about-us/news/latest/QCH-blister-package-recycling-scheme (2024).*

63. Systemiq Ltd. *Fossil Free Plastics: Driving Clean Industrial Leadership in Europe. https://www.systemiq.earth/downloads/Systemiq-Fossil_Free_Plastics-EN.pdf (2025).*

64. Brizga, J., Hubacek, K. & Feng, K. *The Unintended Side Effects of Bioplastics: Carbon, Land, and Water Footprints. One Earth 3, 45–53 (2020).*

65. Shiva, F., Castillo Castillo, A. & Black, B. *The plastic pandemic: could the environmental impact of the NHS response to*

covid-19 be reduced? The BMJ Opinion https://blogs.bmj.com/bmj/2020/12/08/the-plastic-pandemic-could-the-environmental-impact-of-the-nhs-response-to-covid-19-be-reduced/ (2020).

66. Eunomia Research & Consulting Ltd. *Is Net Zero Enough for the Materials Sector? Zero Waste Europe https://zerowasteeurope.eu/wp-content/uploads/2022/11/Is-Net-Zero-Enough-for-the-Materials-Sector-Report-1.pdf (2022).*

67. Eunomia Research & Consulting Ltd. *Decarbonisation Pathways in Aluminum vs. Competing Materials. International Aluminium Institute https://international-aluminium.org/wp-content/uploads/2025/04/IAI-Eunomia-Material-Pathways-Final-v4.0-1.pdf (2024).*

68. INEOS Inovyn. *BIOVYNTM. https://www.inovyn.com/about/biovyn/.*

69. Fundación Valle del Lili. *¡FVL pionera a nivel mundial en la reducción de plásticos en el sector salud! Fundación Valle del Lili https://valledellili.org/fvl-pionera-a-nivel-mundial-en-la-reduccion-de-plasticos-en-el-sector-salud/ (2023).*

70. NHS Barnsley Hospital NHS Foundation Trust. *Eco-Friendly Surgical Caps and Gowns Benefit Patients, Staff and the Environment | Barnsley Hospital NHS Foundation Trust. https://www.barnsleyhospital.nhs.uk/news/eco-friendly-surgical-caps-and-gowns-benefit-patients-staff-and-environment (2023).*

71. UVA Health. *UVA Health Pharmacy Begins Using Recyclable Paper Pill Bottles. UVA Health Newsroom https://newsroom.uvahealth.com/2025/04/22/uva-health-pharmacy-paper-pill-bottles/ (2025).*

72. Vizient, Inc. *Environmentally Preferred Sourcing Program. https://vizientinc-delivery.sitecorecontenthub.cloud/api/public/content/7c94afc1f373471eae981544710a589e (2020).*

73. Amcor. *Innovation in recyclable high-barrier laminates for medical devices. https://www.amcor.com/insights/blogs/recycle-ready-high-barrier-laminates-for-medical-devices (2025).*

74. Kent Waddington. *Towards a Safe, Secure and Sustainable Reusable PPE System- Canadian Coalition for Green Health Care. The Canadian Coalition for Green Health Care https://greenhealthcare.ca/towards-a-safe-secure-and-sustainable-reusable-ppe-system/ (2024).*

75. TekniPlex. *TekniPlex Healthcare Becomes First to Introduce Medical-grade, ISCC PLUS-certified Bio-based PVC Compounds Equivalent to Conventional PVC. TekniPlex https://tekni-plex.com/en/articles/tekniplex-healthcare-becomes-first-to-introduce-medical-grade-iscc-plus-certified-bio-based-pvc (2024).*

76. Health Care Without Harm. *Open letter from health professionals on the plastics treaty. https://global.noharm.org/focus/plastics/open-letter (2024).*

77. Centers for Disease Control and Prevention. *Glossary. Infection Control https://www.cdc.gov/infection-control/hcp/disinfection-sterilization/glossary.html (2024).*

78. European Commission. *Biobased, biodegradable and compostable plastics. https://environment.ec.europa.eu/topics/plastics/biobased-biodegradable-and-compostable-plastics_en (2025).*

79. U.S. Environmental Protection Agency (EPA). *Carbon Dioxide Capture and Sequestration: Overview. https://19january2017snapshot.epa.gov/climatechange/carbon-dioxide-capture-and-sequestration-overview.*

80. Plastics Europe. *Chemical recycling. https://plasticseurope.org/sustainability/circularity/recycling/chemical-recycling/.*

81. Ellen MacArthur Foundation. *What is a circular economy? https://www.ellenmacarthurfoundation.org/topics/circular-economy-introduction/overview (n.d.).*

82. NHS England. *NHS clinical waste strategy. NHS clinical waste strategy https://www.england.nhs.uk/long-read/nhs-clinical-waste-strategy/.*

83. Organisation for Economic Co-operation and Development (OECD). *Extended Producer Responsibility. https://www.oecd.org/en/publications/extended-producer-responsibility_67587b0b-en.html (2024).*

84. World Health Organization (WHO). *Health-care waste. https://www.who.int/news-room/fact-sheets/detail/health-care-waste (2024).*

85. Ellen MacArthur Foundation. *What is the linear economy? https://www.ellenmacarthurfoundation.org/what-is-the-linear-economy.*

86. Plastics Europe. *Mechanical recycling. https://plasticseurope.org/sustainability/circularity/recycling/mechanical-recycling/ (2023).*

87. European Commission. *Definition of recycling. https://joint-research-centre.ec.europa.eu/projects-and-activities/less-waste-more-value/definition-recycling_en.*

A presciption for change

Rethinking plastics use in healthcare to reduce waste, greenhouse gas emissions and costs.

A Prescription for Change presents an evidence-based roadmap for transforming the global healthcare plastics system. Building on the analytical foundations of "Breaking the Plastic Wave" and "ReShaping Plastics," this report quantifies the economic, environmental, and operational impacts of seven high-volume single-use plastic categories across Europe and North America. It evaluates five strategic levers for circularity and decarbonization across three scenarios.

The research integrates material flow modeling, cost and emissions analysis, and real-world case studies to provide a clear view of both the cost of inaction and the opportunity of system-wide change. A diverse Expert Panel comprising leaders from clinical practice, procurement, waste management, policy, and manufacturing ensured the practicality and scientific rigor of the findings.

This report is designed to guide policymakers, healthcare executives, procurement consortia, manufacturers, and civil society leaders with the data, scenarios, and strategic direction needed to align healthcare plastics use with climate targets, resource efficiency, and patient safety.

For further information see www.systemiq.earth/a-prescription-for-change or contact plastic@systemiq.earth

or see https://eunomia.eco/reports/a-prescription-for-change
or contact healthcareplastics@eunomia-inc.com

SYSTEMIQ

eunomia