BELGIAN ROADMAP FOR HEALTH CARE DECARBONISATION

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This work is the result of a collaboration between Health care Without Harm (HCWH) Europe, ARUP and the health and environment administrations of the National Environment and Health Action Plan:

- FOD Volksgezondheid, Veiligheid van de Voedselketen en Leefmilieu
- Departement Zorg
- Departement Omgeving
- Leefmilieu Brussel
- Vivalis
- Agence Wallonne pour une vie de qualité (AViQ)
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Executive summary

This report presents a decarbonisation roadmap for the national health system of Belgium. It has been prepared in alignment with the standardised methodology for producing such roadmaps published by HCWH and as part of their Operation Zero programme. This work is a part of the National Environment-Health Action Plan (NEHAP) and has been conducted under the guidance of the FPS Public Health, Safety of the Food Chain and Environment, and supported by the regional administrations of Environment and Health (Departement Zorg en Omgeving, Vivalis, Brussel Leefmilieu, Service Public de Wallonie, Agence pour une Vie de Qualité, Ministerium der deutschsprachigen Gemeinschaft).

Through this process, the first detailed assessment of the greenhouse gas (GHG) emissions associated with health sector operations in Belgium has been produced, with this analysis being followed by an exploration of future emissions scenarios and the actions that can be taken to transition to low-carbon delivery between now and 2050. This analysis provides a template for future action, showing what is possible for the sector through concerted climate action. Realising this change will require ongoing commitment and a consolidated approach from policymakers and system administrators.

Key findings from this analysis include:

- In 2022, Scope 1, 2, and 3 emissions for the health sector totalled 9,901 ktCO_2e (kilo tonnes of carbon dioxide equivalent). This corresponds to an emissions intensity of 0.16 kgCO_2e/EUR. Based on this analysis, health care makes up 5%[i] of Belgium's total consumption-based emissions.

- Within this footprint, Scope 1 emissions comprise 11% of the total, while Scope 2 emissions contribute 3% and Scope 3 emissions account for 86%. Within Scope 3, Purchased Goods account for 63% of total emissions, with Pharmaceuticals (31%), Medical Equipment/Instruments (14%), and Food/Catering (8%) comprising over half of the total emissions within Purchased Goods.

- When expected increases in health sector spending and decarbonisation trends for key industries across the global value chain are incorporated into a Business-As-Usual (BAU) future emissions scenario, sectoral emissions are projected to increase by over 60%. This runs counter to the imperative to rapidly reduce emissions to align with national and international policy.

- In producing this decarbonisation roadmap, 16 decarbonisation interventions have been identified and their potential modelled through scenario analysis. These interventions target decarbonisation opportunities across health care's operations, direct supply chain, and wider value chain.

- The decarbonisation interventions explored during this analysis seek to address emissions across health care's operations and supply chain, and are grouped according to three pathways: Pathway 1 covering emissions associated with sector facilities and vehicles, Pathway 2 covering action with direct suppliers, and Pathway 3 addressing actions that can lead to change across the wider value chain. Action in each of these pathways will be key to ensuring scope 1, 2, and 3 emissions are addressed.

- The interventions modelled in this analysis have the potential to reduce sector emissions by 73% in 2050 relative to a business-as-usual scenario where sector-wide action on emissions is not taken. However, the analysis suggests residual emissions for the sector of 4,323 kt CO_2e will remain, which is 44% of current emissions. The interventions explored through this analysis have not been exhaustive, and further action to identify and realise opportunities will be required.

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[i] Based on consumption-based emissions data from 2021[14], the most recent available year of data. A consumption-based emissions approach should be used to ensure a like-for-like comparison.

1. Contents

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1. This study: introduction and background

The climate crisis is increasingly recognised as a health crisis, prompting urgent calls across the global health sector to reduce emissions and build resilience. With health care systems worldwide contributing 4-5%[1] of global emissions, Arup and Health Care Without Harm (HCWH) have worked with representatives of the Belgian health and environment administrations to explore sectoral emissions and future trends and identify a roadmap to decarbonisation. This report provides a summary of the findings achieved through this research, and the next steps that the sector can take to manage GHG emissions associated with its operation.

1.1 Introduction to report

Through quantitative analysis and modelling, this project has for the first time provided a detailed picture of the GHG emissions associated with health care delivery in Belgium. Building on this to explore future emissions trends and intervention opportunities to reduce emissions, a roadmap for decarbonisation has been developed.

This report provides a summary of the inputs and methodology used in conducting this analysis, as well as key findings and recommendations for the system. It is accompanied by a technical annex that provides more detail on the approach, assumptions, and limitations associated with this analysis as well as providing results and values from figures in this report in tabular format.

This report is structured as follows:

- Section 1 introduces the report, summarises Belgium's policy background, and describes the link between this report and the Health Care Without Harm (HCWH) methodology.
- Section 2 outlines the methodology for developing the evidence base of the decarbonisation roadmap, detailing the calculation of baseline emissions, analysis of future emission trajectories, application and evaluation of reduction actions, and documentation of assumptions and limitations.
- Section 3 presents the findings of the analysis, including the baseline emissions, the projected emissions trajectories and a reduction trajectory 'zone', and the emission reduction scenarios and a decarbonisation roadmap demonstrating how health sector interventions can mitigate emissions.
- Section 4 highlights in more detail the interventions across three decarbonisation pathways and identifying priority actions for aligning the sector with a net-zero transition.
- Section 5 provides some concluding remarks and observations based on the modelling and analysis undertaken through this work.

1.2 Policy background

Belgium has committed to integrating climate resilience within its health sector, driven by the growing recognition of climate change's impact on public health. Belgium has established comprehensive frameworks at both national and regional levels, such as the National Energy and Climate Plan (NECP)[2] and the National Environment and Health Action Plan (NEHAP3)[3], integrating climate adaptation into health care planning. NEHAP, which focuses on the period 2023-2029, is a key strategy connecting health and environmental policies, prioritising actions like alternative plastic or chemical waste from the health sector, reducing greenhouse gas emissions, and supporting vulnerable groups disproportionately affected by climate change. These ambitious goals align with Belgium's commitments to the European Green Deal and the Paris Agreement, striving for a transition to low-carbon, resilient health care systems through multi-level collaboration and sustainable practices across sectors.

Belgium's decarbonisation ambitions align with broader national and regional emissions reduction policies, including the EU's Fit for 55[4] and the European Green Deal[5] 55% reduction of greenhouse gas emissions by 2030 compared to 1990 levels. These policies emphasise significant reductions in emissions through energy efficiency, clean transport, and renewable energy. Regional initiatives, such as the Wallonia Plan Air Climat Énergie (PACE) 2030[6], the Flemish Energy and Climate Plan 2021-2030[7], and the Brussels Air Climate Energy Plan (PACE)[8], further support localised health care and climate synergies. Belgium's federal structure means regions play a pivotal role in implementing climate-health policies. Flanders, Wallonia, and Brussels-Capital each have specific climate and health initiatives including three individual climate plans for the NECP, tailored to their unique environmental and socio-economic contexts. Regional adaptation plans allow for flexible, locally tailored climate actions in health care.

1.3 The Health Care Without Harm (HCWH) Operation Zero Methodology

The HCWH (Health Care Without Harm) methodology and national health system decarbonisation support programme, Operation Zero, are designed to guide national and regional health authorities in reducing health care emissions to align with the goals of the Paris Agreement[9]. The methodology provides a framework for measuring and managing emissions across the health care sector, covering direct emissions from facilities (scope 1), indirect emissions from energy use (scope 2), and wider emissions throughout the supply chain (scope 3). By adopting a consistent approach, health care institutions can establish a carbon footprint baseline, identify emissions hotspots, and develop tailored decarbonisation pathways. The ultimate objective is to create a standardised approach that health care systems worldwide can implement, improving the strategic allocation of resources and policy development to meet emissions reduction targets.

The goals of this methodology are to enable health care systems to calculate their collective carbon footprint, implement effective decarbonisation strategies, and contribute equitably to global climate objectives. By integrating emissions reduction targets into health care practices, HCWH seeks to mitigate the health impacts of climate change, which the sector both addresses and contributes to. The programme emphasises a globally scaled approach to emissions budgets, ensuring each country’s health care sector takes appropriate responsibility based on its development stage and historical emissions. With guidance on actions like stakeholder engagement, setting baselines, projecting future emissions, and measuring progress, the HCWH methodology aims to foster climate-smart health care that supports universal health coverage and minimises environmental impact.

2. Approach: developing an evidence base

The approach taken to developing the evidence base underlying this roadmap is shown in Figure 1; beginning with calculating current emissions associated with the system (step 1), followed by analysing future emissions trends and emissions reduction actions (steps 2-4), the final step is to document the findings of this process in a sectoral decarbonisation roadmap.

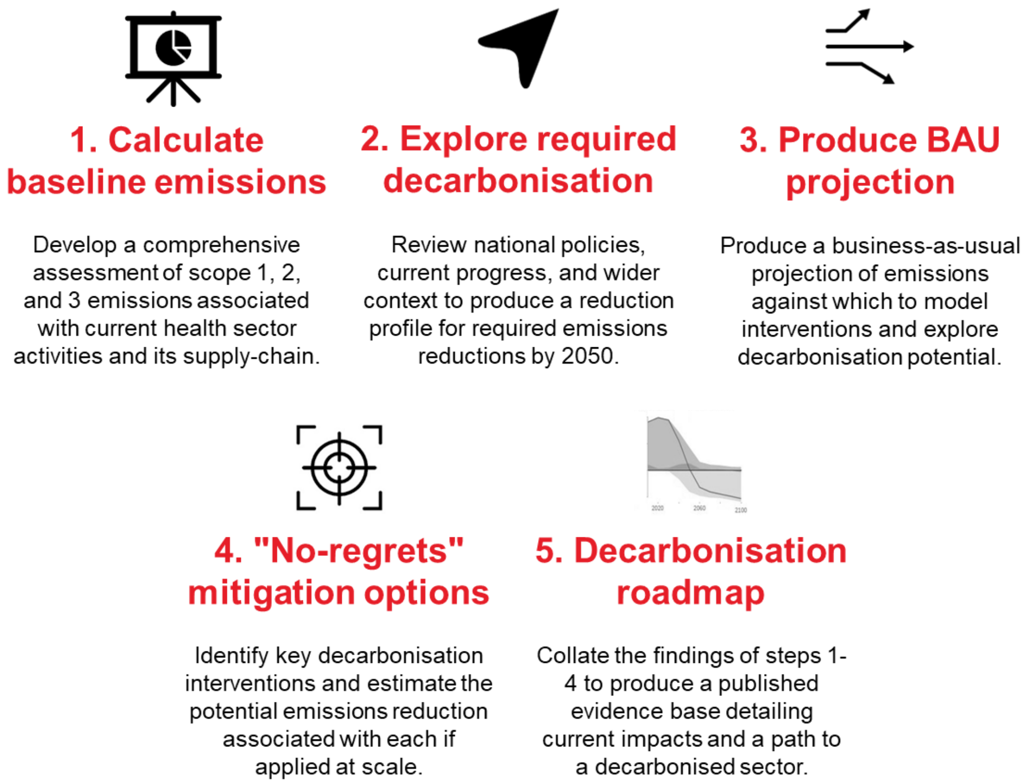

Figure 1: Process for producing a decarbonisation roadmap for the Belgian health system.

The following sections summarise the process followed in delivering this approach, with further detail available in the technical annex to this roadmap.

1.4 Setting a baseline: understanding current emissions

Health Care Without Harm's guidance document "Designing a Net Zero Roadmap for Health care: Technical Methodology and Guidance"[9] was used to develop Belgium's health sector emissions baseline. By following this methodology, this study provides a consistent approach with other national health systems.

Belgium's baseline was created using a hybrid method, combining top-down expenditure data from the national health system with bottom-up data reflecting specific health sector activities. This hybrid approach blends the broader scope of top-down methods with the precision of detailed bottom-up data to ensure a more comprehensive and accurate emissions baseline.

Environmentally Extended Input-Output (EEIO) analysis was employed to produce a sector-wide footprint for Belgium's health care sector. The approach is built upon the use of global Input-Output (IO) models and expenditure data to provide insights on emissions associated to the health sector's financial activities. Where detailed data on specific activities and processes within the Belgian health system were available, such as energy use for hospitals, this data was introduced to the model to provide greater accuracy for these emission mechanisms.

1.4.1 Data sources for baseline model

The baseline model was produced using a mixture of published environmental and economic data, and information gathered from stakeholders across the Belgian health system. Expenditure data was retrieved from sources like the OECD and the Belgium Federal Planning Bureau, while emissions are calculated using EXIOBASE and UK DESNZ conversion factors, with Belgium-specific factors for energy sourced through the European Energy Agency and the International Energy Agency. A summary of the main data sources used is provided in Table 1 of the technical annex to this report.

1.4.2 Approach to calculating current emissions

Expenditure profiles for health care providers were developed to model the distribution of spending across the supply chain and associated emissions. Bespoke profiles were sourced from data holders reflecting Hospitals and Residential Facilities, while other provider profiles were approximated using national statistics data as expenditure profiles were not identified during the data collection process. Spend-based emission factors were then paired with these data to estimate emissions.

Bottom-up data for electricity, natural gas, and metered dose inhaler (MDI) usage was integrated into the top-down emissions estimates to develop a hybrid model, prioritising high-quality bottom-up data for significant emissions sources. Where both data types were available, less precise expenditure-based figures were excluded.

Results were reported following HCWH Methodology to facilitate comparability between other similar baselines and roadmaps, whilst considering data availability and inclusion. Emissions figures are consolidated into the three scopes defined by the Greenhouse Gas Protocol (GHGP): Scope 1, Scope 2, and Scope 3.

1.5 Future trajectories: estimating future emissions and required level of mitigation

The 2022 emissions inventory serves as the base year from which the business-as-usual (BAU) scenario is projected. The resulting scenario serves as the trajectory against which the modelled impacts of emissions reductions actions can be assessed. As outlined in the HCWH methodology[9], these projections consider the emissions baseline, expected health care demand growth, and anticipated decarbonisation rates in global industries

1.5.1 Developing a BAU scenario

The most viable option for forecasting health care demand growth to 2050 was found to be using health sector expenditure projections. Public expenditure forecasts on health expenditure were available for Belgium through 2070 (expressed as a percentage of GDP).[10] This data was utilised in tandem with GDP forecasts from the IMF[11] to proxy the growth in activity within the sector through 2050, resulting in an estimated 89% growth from 2022 to 2050.

Global decarbonisation assumptions were sourced from the Transition Pathway Initiative's (TPI) “Sectoral Decarbonisation Pathways” (V4.0), based on International Energy Agency (IEA) data. These scenarios focus on high-emitting sectors such as air travel, automotive, and electricity utilities, reflecting broader decarbonisation trends impacting health care's footprint. As more detailed data becomes available, the assumptions and data used in the BAU scenario can be updated.

The annual rates of expenditure growth derived from the IMF, which are assumed to reflect demand for activities within the health sector, were applied to the base year emissions figures across various reporting categories to yield an emissions scenario reflecting only demand growth. MDIs were excluded from this process due to concerns about inconsistent underlying assumptions with the wider growth forecasts.

National, international, and Paris pledges scenarios were prioritised to reflect current decarbonisation commitments. The most recent scenarios were mapped to EXIOBASE emission factors, producing a dataset of 200 product factors annually through 2050 to represent changes in emissions intensity across key industries. TPI’s pathways reflect a global scale, except for the electricity utilities sector, where European data was used for this project. A Belgium-specific grid intensity forecast was excluded from this analysis as it was deemed more optimistic than other trends being modelled.

1.5.2 Representing the required level of decarbonisation

This roadmap has not established a definitive emissions reduction target for the sector. Instead, it introduces a reduction trajectory 'zone' developed to provide an indication of the scale of reductions required to align with broad targets in place across EU and Belgium climate policy. This serves as a reference, helping stakeholders interpret the roadmap's findings and understand the scale of required action. It is recommended that health policymakers within Belgium and its federal regions, together with key stakeholder groups, work to develop a health care specific target decarbonisation trajectory to build on this initial exploration of the change required.

The proposed reduction trajectory 'zone' is a compilation of two reduction trajectories for both 2030 and 2050, creating a defined 'zone' of emissions reductions. The reduction trajectory 'zone' utilised for Belgium's health sector includes the following thresholds:

- 26% emissions reductions by 2030 (compared to a 2022 base year) [ii]. This value would align with the level of decarbonisation targeted in the updated Belgian National Energy and Climate Plan (2021-2030)[2].
- 55% emissions reductions by 2030 (compared to a 1990 base year)[12]. This value would align with the level of decarbonisation targeted in the European Green Deal[5] and the EU's 'Fit for 55'[4].
- 86% emissions reductions by 2050 (compared to a 2022 base year)[iii]. This value would align with the level of decarbonisation targeted in Belgium's Roadmap for the Net-Zero Government Initiative[13].
- 100% emissions reductions by 2050 (compared to a 2022 base year, effectively achieving net-zero)[12]. This value would align with the level of decarbonisation targeted in the European Green Deal[5] and the EU's 'Fit for 55'[4].

[ii] These equate to a ~47% emissions reduction target by 2030 from a 2005 base year, when normalised by nationally reported emissions values to EEA. Source: "EEA greenhouse gases – data viewer: Total greenhouse gas emissions and removals of the EU, based on data reported by EU Member States under the EU Governance Regulation."

[iii] These equate to a ~90% reduction target by 2050 from a 2005 base year, when normalised by nationally reported emissions values to EEA. Source: "EEA greenhouse gases – data viewer: Total greenhouse gas emissions and removals of the EU, based on data reported by EU Member States under the EU Governance Regulation." Given that the regions have varying percentages, 90% reflected a median value among them.

1.6 Interventions: scenarios for sectoral decarbonisation

To better understand the Belgian's health sector's ability and approach for reducing emissions by 2050, a model was developed to assess the impacts of various decarbonisation interventions against baseline and business-as-usual (BAU) emissions trajectories. A list of decarbonisation interventions was refined and applied to the emissions baseline and BAU projected emissions considering the global decarbonisation trajectory. This list was based on evidence from stakeholders in Belgium, desk-based research, and sector-specific opportunities identified based on the project team's past experience.

1.6.1 Framing interventions

When modelling how these interventions result in future emissions scenarios, each measure has been applied in a cumulative manner, starting with interventions aligned with the three decarbonisation pathways introduced in HCWH's Global Roadmap for Health Care Decarbonisation[9]:

- **Pathway 1:** Decarbonize health care delivery, facilities, and operations. Health care delivery and operations are at the core of the sector's climate footprint. Health care providers everywhere must take on their greenhouse gas emissions and implement interventions that will ultimately fully decarbonize every aspect of health care delivery and its supporting functions while maintaining and improving patient care. Interventions in this pathway focus on reducing fuel consumption and energy use across health care operations.

- **Pathway 2:** Decarbonize health care's supply chain. More than 70% of health care's climate footprint comes from "Scope 3" emissions, much of which originate in the global supply chain. This supply-chain spans both Pathway 2 and Pathway 3; with Pathway 2 focussing on tier 1 suppliers and elements where health providers have greater influence to apply decarbonisation initiatives. Health systems can use procurement decisions to demand the decarbonization of their own supply chain. At the same time, health care manufacturers and suppliers must take immediate action on emissions.

- **Pathway 3:** Accelerate decarbonization in the wider economy and society. Every aspect of the health care supply chain and delivery is reliant on other industries that provide energy, chemicals, building materials, packaging, infrastructure, transport, food, and more. Wider societal decarbonization is crucial to the health sector achieving zero emissions, while also more broadly protecting the health of people and the planet from the impacts of climate change. Pathway 3 reductions are reliant on across the full supply chain. Advocacy and adoption of joined up standards across end consumers can influence these emissions; however, the power of health providers to enforce these interventions is lower than actions included under Pathway 2.

Based on these definitions, a decarbonisation roadmap is established through first applying Pathway 1 interventions, followed by Pathway 2, and finally Pathway 3. The full list of interventions considered is provided in Table 1, including a description of the actions grouped under each intervention category and the pathway under which each intervention is applied.

Table 1: Interventions considered in developing a sectoral decarbonisation roadmap

Pathway	Intervention category	Description
1	Building fabric efficiency improvements	These improvements focus on engineering solutions to enhance the efficiency of buildings, therefore reducing energy demand for heating and cooling. This includes insulating walls, roofs, floors, and investing in high-efficiency glazing (glass).
1	Building systems optimisation	Involves upgrading and optimising a building's operational systems (e.g., HVAC, lighting, energy management) by using smart technologies and advanced controls (e.g. programmable thermostats).
1	Electrification of heating	Involves replacing fossil fuel-based heating (natural gas, oil, coal) with electric heating technologies. This could include heat pumps, electric boilers, or other electric heating systems.
1	Electrification of fleet vehicles	Involves transitioning the health sector's fleet to fully electric vehicles. This includes ambulances, and other vehicles owned and operated by health care providers.

Pathway	Intervention category	Description
1	Onsite renewables or power purchase agreements	Provision of renewable electricity to power health care facilities and vehicles. This can take the form of onsite renewables, or power purchase agreements (PPAs) and other contracting mechanisms that can be utilized to secure renewable energy from external sources.
2	Optimised use of pharmaceuticals	Implementing strategies to reduce the over-prescription and unnecessary use of pharmaceuticals within the health care system.
2	Prioritising low carbon pharmaceuticals suppliers	Prioritising low carbon suppliers involves requesting Environmental Product Declarations (EPDs) or sustainability data during the procurement process for pharmaceuticals, aiming to aid selection of lower carbon alternatives.
2	Shift to low carbon inhalers	Transitioning from traditional propellant inhalers to low carbon inhalers. This can take the form of dry powder products in the near term, and in the longer term include the non-GHG based propellant systems currently under development.
2	Extending the lifespan of medical equipment	Extending the lifespan of electrical products to reduce consumption of new equipment. More proactive maintenance schemes, as well as prioritising suppliers offering longer warrantees and servicing can contribute to longer service lives for products.
2	Prioritising low carbon medical equipment suppliers	Engaging with key suppliers of medical equipment to ensure that carbon associated with products is a key consideration in procurement. Through requesting Environmental Product Declarations and other information when selecting products and suppliers, procurement teams can select suppliers with lower emission products.
2	Reduce food waste	Focuses on minimising the amount of waste from unconsumed meals within the health care sector, involving implementing practices to improve meal planning, portion control etc.
2	Reduce meat consumption	Reducing the emissions intensity of meals served in a health care setting through transitioning away from high-emission, red meats, to more plant-based and low emission offerings that still provide the required nutrients to recovering patients and staff.
2	Prioritising re-usable products	Transitioning from disposable medical instruments and garments to reusable options that can be effectively decontaminated and sterilized.
2	Reducing embodied carbon in construction	Switching to low-carbon materials and improving material efficiency during construction and renovation of health facilities.
3	Supplier decarbonisation standards	Mandate that suppliers have validated Science Based Target aligned decarbonisation strategies consistent with achieving net zero by 2050. If suppliers adopt and deliver against these targets, decarbonisation progress can be driven across the full health care value chain.

1.6.2 Applying interventions in the roadmap model

To model each intervention and its impact on emissions, two key parameters were defined:

1. **The intervention threshold**: the scale of emissions reduction that can be achieved through the application of actions attributable to the intervention.
2. **The intervention adoption rate**: the timeline over which the intervention is to be implemented. These rates have been modelled using an end-year where the intervention is fully applied, with an S-curve to represent the rate at which progress is made between the start- and end-years.

Data on intervention potential decarbonisation thresholds and feasible adoption rates were sourced from the Belgian team, publications and case studies sourced from organisations such as the NHS, and through consultation with Arup and HCWH subject matter experts. Please see the accompanying technical annex for more detail on the assumptions made when framing interventions.

1.7 Assumptions and limitations

In developing the analysis presented in this roadmap, there are a number of assumptions and limitations associated with this work. A full discussion of these is presented in the accompanying technical annex to this report.

Table 2: Summary of main assumptions and limitations

Analysis area	Assumption or limitation	Description
Setting a baseline	Use of expenditure-based approaches to estimate emissions.	Expenditure based approaches using emissions factors derived from Environmentally Extended Input Output models were widely used in baseline preparation. These models have a number of well documented limitations, such as assumed product homogeneity within emissions factor categories, and uncertainties in underlying data. Despite these limitations, these approaches are widely used and adopted in the literature, and often present the best approach to estimating emissions that would not otherwise be quantifiable due to a lack of data.
	Data uncertainties	In developing the baseline model, data from a number of sources was used as detailed in Section 1.4.1. In some cases, this data was incomplete, or only available for certain facility types or regions. This necessitated the use of some proxies and scaling to account for data gaps and means that some aspects of the footprint were estimated with greater certainty than others. Most proxies for disaggregating regional activity and expenditures rely on population proportions, assuming consistent health care services and facility distribution across regions. Due to inconsistent facility data, a sector-wide regional expenditure breakdown was not feasible, and a proxy was used to ensure credible regional reporting.
	Pharmaceutical emissions factor	The Belgium specific emission factors developed in this analysis using the EXIOBASE dataset did not provide a specific pharmaceutical factor, with these products classed under a broader "chemicals" emissions factor. Due to the lower volumes, and higher costs, associated with pharmaceuticals, it was deemed that this factor is unrealistically high for this class of goods. As a result, a pharmaceutical specific emissions factor for the United Kingdom was used for pharmaceutical purchases across the Belgian health system.
	Capital investments / construction	The expenditure used to cover overall health sector activities, sourced from the OECD, does not identify investment in capital projects in the health system as part of the sector activities. Construction of new hospitals and other related activities should be considered as part of the health sector's emissions. It is not clear where investment in such projects is accounted for within the health sector, but future analysis should include these emissions within sectoral emissions reporting.
Future trajectories	Static structure of economy and supply chains	The projection is based on a static model of the economy from 2022; no changes in the structure of the economy are considered. It is therefore a projection, not a prediction, and is just one of an undeterminable number of possible emissions futures and as such provides only a guide to how the sector can decarbonize at pace
	Background economic decarbonisation	To model a BAU trajectory for health system emissions between now and 2050, the expected decarbonisation of key supply chain industries has been represented in alignment with current policy/ Nationally Determined Contributions (NDC) commitments. This is not an exhaustive exploration of current decarbonisation commitments across the health supply chain and has focussed on high emitting industries such as electricity production.
	Consistent growth	The projected growth of the health sector assumes all parts of the system grow at a consistent rate within Belgium as overall investment in the sector increases.
	Future burden of disease	The model does not account for changing health demands (for example, changed distribution of infectious diseases) or changing the health cost base (from climate shocks e.g., higher insurance, more frequent extreme weather).
Interventions	Decarbonisation actions	The mitigation actions modelled in this study are not exhaustive. The projected estimates of avoided emissions are therefore likely to be underestimated.

3. Findings: a roadmap towards net zero

This section details the findings of the analysis conducted in this study; beginning with the baseline sector emissions and current impacts, before introducing projected changes in emissions over time and a reference scenario showing the scale of reductions required, this concludes with the emission reduction scenarios and decarbonisation roadmap showing how health sector action can mitigate emissions.

1.8 Belgium’s current health care emissions

Results reflecting the emissions baseline derived for the 2022 reporting year are captured in the tables and figures in the following section.

1.8.1 Health sector emissions by scope

Figure 2 illustrates the breakdown of emissions for Scopes 1, 2, and 3. In 2022, emissions for the health sector totalled 9,901 ktCO_2e (kilo tonnes of carbon dioxide equivalent). Pharmaceuticals comprised to the largest proportion of national-level emissions (30.8%), followed by Business Services (16.4%), and Medical Equipment/Instruments (13.6%).

The emissions intensity for Belgium’s health sector is 0.16 kgCO_2e/EUR. Hospitals had the highest emissions intensity of any health care provider, at 0.23 kgCO_2e/EUR.

Belgium’s total 2021[iv] consumption-based GHG emissions footprint was 199,640 ktCO_2e.[14] The Belgian health sector therefore represents 5% of total Belgian emissions.

[iv] Data from 2021, the latest available year for consumption-based emissions, was utilised instead of 2022.

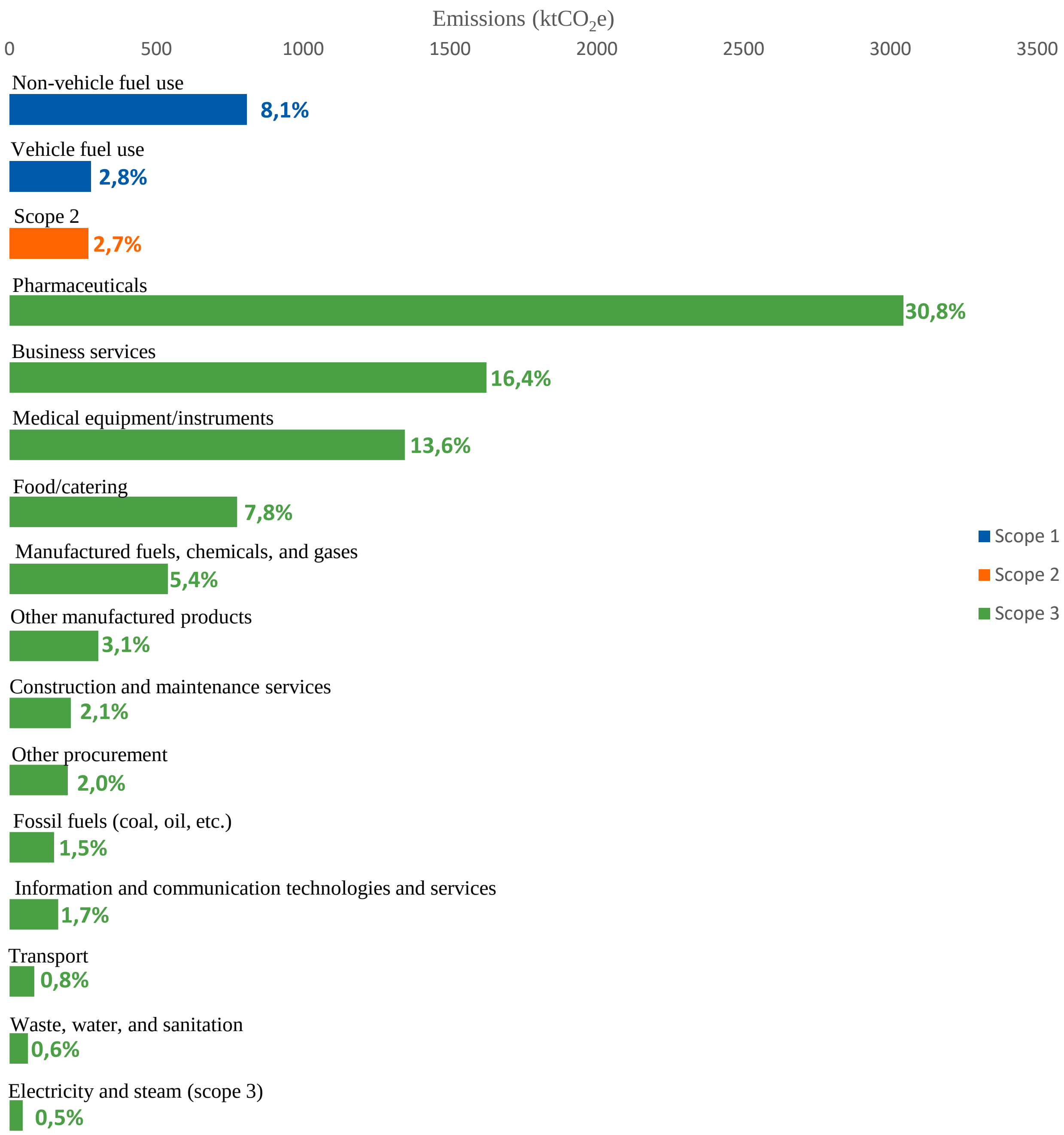

Figure 2. National health sector emissions, including breakdown of Scope 3 emissions

Key findings:

- Scope 1 emissions comprise 11% of the total footprint, while Scope 2 emissions contribute 3% and Scope 3 emissions account for 86%.
- Within Scope 3, Purchased Goods account for 63% of total emissions, with Pharmaceuticals (31%), Medical Equipment/Instruments (14%), and Food/Catering (8%) comprising over half of the total emissions within Purchased Goods.

1.8.2 Health sector emissions by health care providers

Figure 3 illustrate the breakdown of Belgium's total (scope 1, 2, and 3 emissions) between each health care provider included within the scope of the baseline.

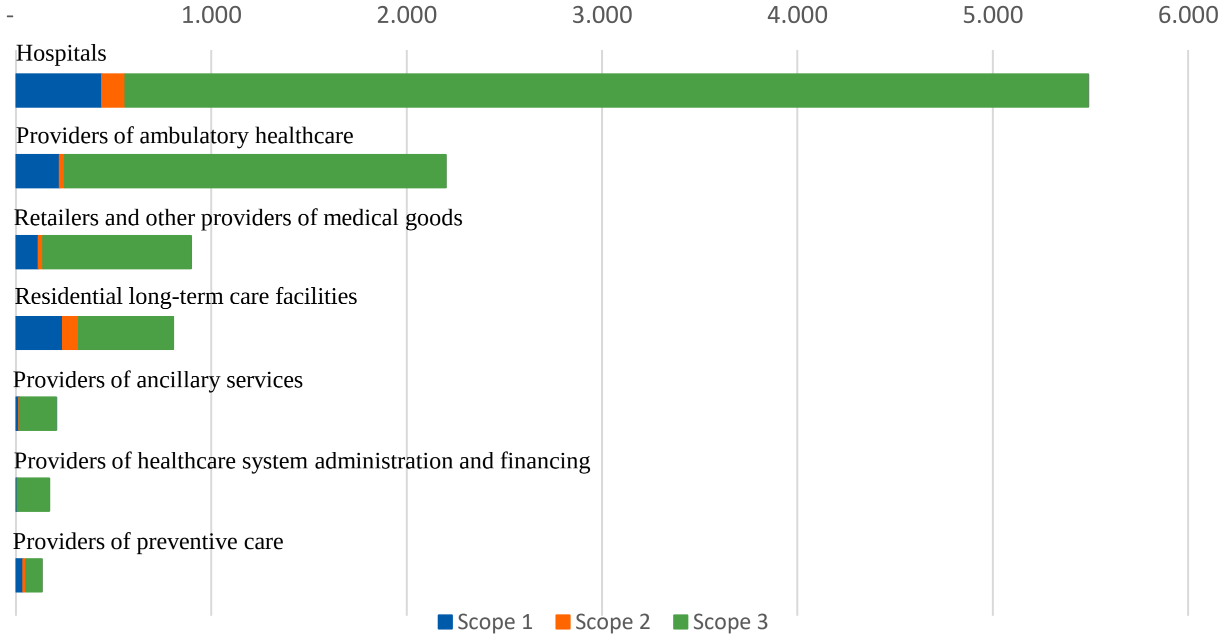

Figure 3. Nation-wide emissions by health care providers

Key findings:

- 'Hospitals' are the largest contributors to total emissions, accounting for 55% (5,488 ktCO_2e) of the total emissions among health care facilities. This is followed by 'Providers of ambulatory health care' with 22% (2,201 ktCO_2e) of the emissions and 'Retailers and other providers of medical goods' which account for 9% (897 ktCO_2e) of the total emissions.
- In contrast, 'Providers of preventive care' and 'Health care system administration and financing' have the smallest shares, contributing only 1% (133 ktCO_2e) and 2% (170 ktCO_2e) respectively.
- The relative proportion of national-level emissions associated with each health care provider is heavily influenced by the relative proportions of expenditure allocated towards each health care provider. Differences in emissions intensity highlight the relative difference between the nature of activities and their corresponding emissivity within each health care provider. 'Hospitals' have the highest emissions intensity (0.23 kgCO_2e/EUR) while 'Providers of health care system administration and financing' has the lowest (0.07 kgCO_2e/EUR).

1.9 Business-as-usual emissions trajectory and the scale of mitigation required

The "Business as Usual" (BAU) emissions scenario has been designed to illustrate the potential growth in Belgium's health sector emissions where emissions mitigation measures are not adopted. The approach outlined in Section 1.5 predicts a 61.6% increase in sectoral emissions (green line), considering both anticipated growth in sector activity and trends surrounding wider economic decarbonisation. When only anticipated sector growth is considered, an 88.4% increase in emissions is anticipated (blue line). The dotted area indicates the required reduction trajectory 'zone' developed to provide an indication of the scale of reductions required to align with broad targets in place across EU and Belgium climate policy. These trajectories can be seen in Figure 4.

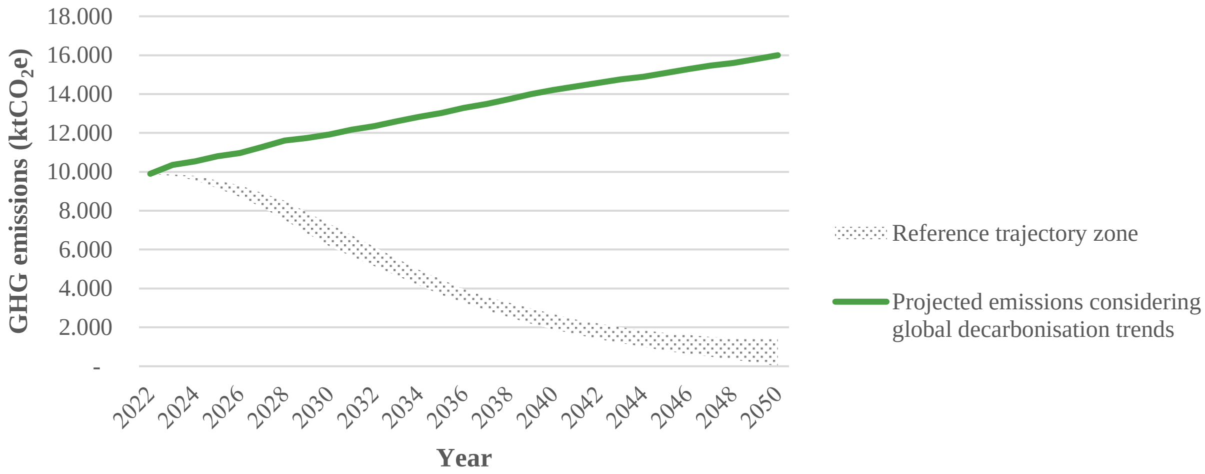

Figure 4. Comparison of projected emissions and required reduction trajectory 'zone'

1.10 Emissions reduction scenarios

Through analysing the scale of emissions reduction potential for key decarbonisation interventions across the health system, emissions reduction scenarios have been developed which, taken together, provide a roadmap towards a net-zero aligned health system in Belgium.

1.10.1 Interventions modelled

Table 3 provides a list of decarbonisation interventions that were applied to the emissions baseline and BAU projected emissions considering global decarbonisation trajectories.

Table 3. Decarbonisation interventions applied to emissions baseline and BAU trajectory

Scope and % of current emissions	Intervention category	Intervention threshold (%)	Intervention timeline	Approach to deriving intervention threshold and timeline
Scope 1 - Buildings (8.1%)	Building fabric efficiency improvements	Improve building fabric efficiency improvements reducing energy demand by 20%	Fully applied by 2050	Due to the more complex energy demands of hospitals (e.g., medical equipment, ventilation), the potential savings from fabric efficiency improvements are lower compared to other building types, such as housing. While housing may see 30-50% reductions[15], hospitals are estimated to achieve 15-25% reductions in energy demand from these improvements.
	Building systems optimisation	Improve building systems optimisation reducing emissions by 20%	Fully applied by 2050	Studies indicate that optimizing building systems and how buildings are used can result in carbon emission reductions ranging from 10.85% to 38%[16] compared to the conventional system. A 20% reduction is deemed a realistic estimate for hospitals, which require more complex energy demands than most other types of buildings.
	Electrification of heating	Full electrification or a 100% transition from fossil-fuel-based heating	Fully applied by 2050	Some Belgian hospitals, particularly in Flanders, have committed to more aggressive targets, such as eliminating fossil fuels by 2035[17]. Belgium's National Energy and Climate Plan (NECP) 2021-2030[2] sets a broader target for the elimination of fossil fuels by 2050, including non-renewable gas.

Scope and % of current emissions	Intervention category	Intervention threshold (%)	Intervention timeline	Approach to deriving intervention threshold and timeline
Scope 1 – Vehicles (2.8%)	Electrification of inter-site vehicles	Transition 100% of inter-site vehicles to electric vehicles	Fully applied by 2050	The UK government has pledged to ban the sale of new petrol, diesel, and hybrid vehicles by 2040, while Belgium, as part of the EU, aims for a similar commitment by 2035[18]. Considering a lagged effect in the transition and continued reliance on the existing fleet, full electrification of the health sector's fleet would most likely be achieved by 2050.
Scope 2 (2.7%)	Onsite renewables or power purchase agreements	Source 100% of electricity from renewable or zero carbon sources	Fully applied by 2050	100% represents the possibility of a full transition to zero carbon energy, achieved through onsite generation or power purchase agreements.
Scope 3 – Pharmaceuticals (30.3%)	Optimised use of pharmaceuticals	Reducing excess pharmaceuticals purchased by 20%	Fully applied by 2050	A joint report estimate that 30-50% of medicines are not used and therefore wasted[19]. This model assumes Belgium implements policies and prescriptions practices that lead to halving of this waste.
	Prioritising low carbon pharmaceuticals suppliers	Transition to greener procurement of pharmaceuticals, reducing the emissions intensity of pharmaceuticals by 10%	Fully applied by 2030	Reduction of 10% emissions in pharmaceuticals procurement by seeking out suppliers that publish EPD data (by 2030 before wider trends in procurement).
Scope 3 – MDI (0.4%)	Shift to low carbon inhalers	Transition to lower carbon inhalers reducing emissions intensity of inhalers by 90%	Fully applied by 2040	Ongoing work from manufacturers (GSK, AstraZeneca) to replace GHG propellant that would reduce carbon by 90%[20]. Alongside, EU agreement in 2023 to phase out all consumption of Hydrofluorocarbons (HFCs) by 2050 has also hastened the pace of change.[21]
Scope 3 – Medical equipment/ instruments (13.6%)	Extending the lifespan of medical equipment	All medical equipment kept for a 25% extended lifespan	Fully applied by 2050	Through proactive maintenance and prioritisation of more durable / repairable products, extend average lifespan of medical equipment by 25%
	Prioritising low carbon medical equipment suppliers	Prioritisation of lower carbon suppliers reducing the emissions intensity of medical equipment by 10%	Fully applied by 2030	10% reductions can be achieved by making more informed decisions around procurement. (Asking for Environmental Product Declarations (EPDs), choosing products with lower emissions etc.)
Scope 3 – Food/ catering (7.8%)	Reduce food waste	Reduce excess purchase of food by 21%	Fully applied by 2050	A Belgian study from the Federal Government indicates 41% of meals go unconsumed[22]. A halving of this waste to 21% is modelled. Some excess capacity is assumed to remain to ensure no shortages caused through reduced provision.

Scope and % of current emissions	Intervention category	Intervention threshold (%)	Intervention timeline	Approach to deriving intervention threshold and timeline
	Reduce meat consumption	Reduce meat consumption/ purchase by 9%	Fully applied by 2050	The 9% emissions reduction estimated through this intervention is calculated based on the impact of serving vegetarian meals (estimated to have a 61% lower impact)[23] one day a week.
Scope 3 – Manufactured fuels, chemicals, and gases (5.4%)	Reduce excess purchases	Reduce excess purchase of manufactured fuels, chemicals, gases	Fully applied by 2050	Reduce purchases of manufactured fuels, chemicals, gases by 10%. This includes buying less, comparing suppliers and switching suppliers.
Scope 3 – Other manufactured products (3.1%)	Reducing single-use instruments and garments	Reduce single-use products reducing emissions by 10%	Fully applied by 2050	A shift to multi-use products and buying 20% less of single-use products is estimated to offer a potential 10% reduction in emissions.
Scope 3 – Construction and maintenance services (2.1%)	Material efficiency in construction of new hospitals	Improve material efficiency in new construction reducing emissions by 67%	Fully applied by 2050	Arup analysis on embodied carbon reduction measures estimated potential yearly emissions reductions for construction of 27% by 2030 and 67% in annual emissions by 2050.
Scope 3 (86.4%)	Supplier decarbonisation standards	Transition to sustainable suppliers could reduce emissions for purchased goods and services by 63%	Fully applied by 2050	Assuming that 70% suppliers successfully achieve the 90% emissions reduction target included within the Science-Based Target initiative (SBTi) guidelines.

1.10.2 Reduction scenario outputs

In 2022, emissions for Belgium's health sector equalled 9,901 ktCO_2e. Without action, emissions are projected to rise to 16,000 ktCO_2e by 2050. However, after the identified decarbonisation interventions are fully applied, emissions for Belgium's health sector are estimated to be 4,323 ktCO_2e in 2050. This represents a 73% emissions reduction compared to the predicted emissions in 2050 under a BAU scenario.

Figure 13 and Figure 14 illustrate the emissions trajectory between 2022 and 2050, the impacts of each individual decarbonisation intervention. The 'supplier decarbonisation standards' intervention is most impactful, achieving 43% emissions reductions, as compared to the projected emissions in 2050 without application of any decarbonisation interventions.

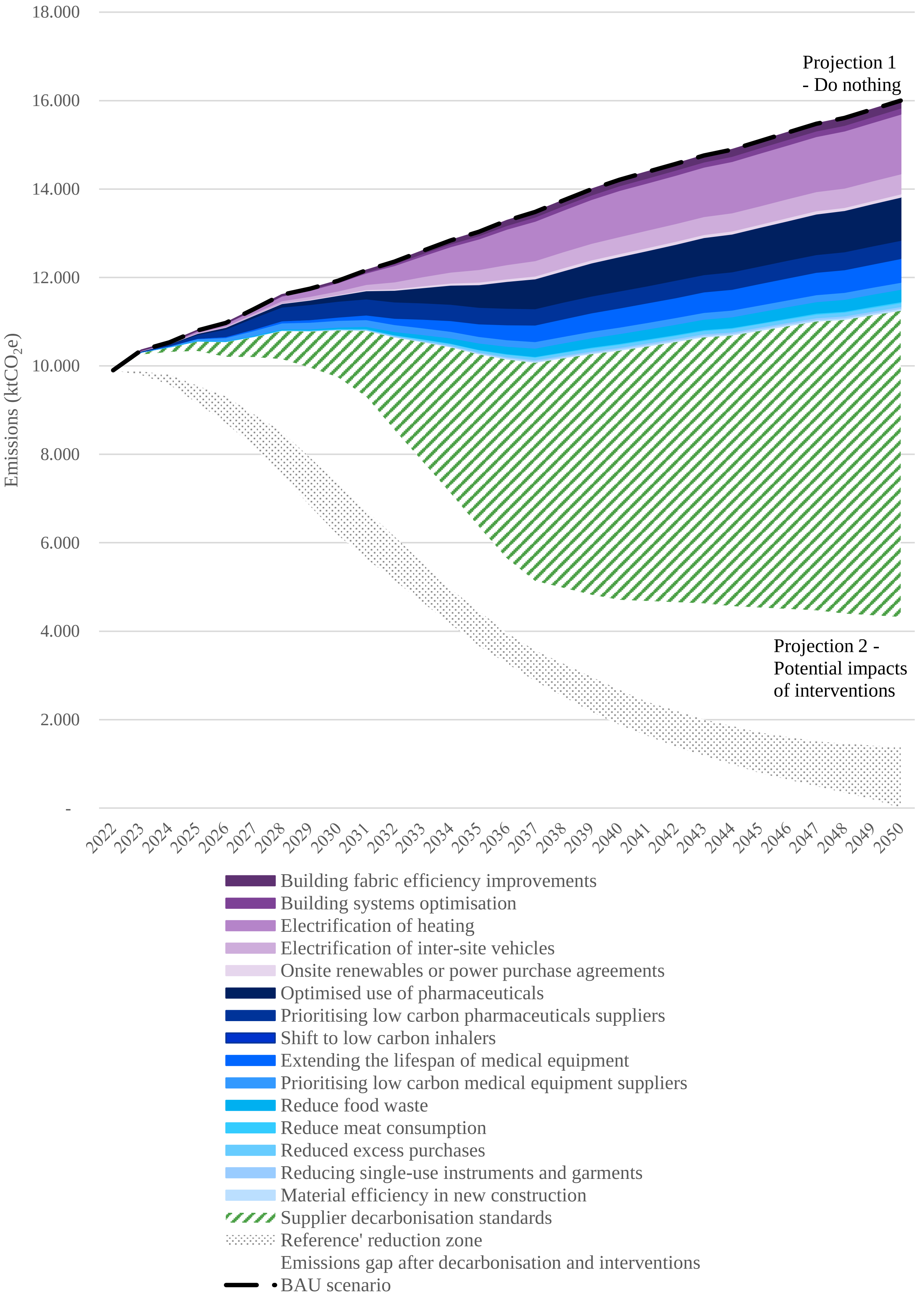

Figure 5. Sector emissions trajectory and impacts of individual decarbonisation interventions

1.10.3 Residual emissions in 2050

Following the application of the decarbonisation interventions included in this analysis, this analysis remaining emissions within the sector in 2050 are estimated to be **4,323 ktCO_2e**. While these interventions lead to a 73% reduction in sector emissions intensity in 2050, there remains further work to do beyond that considered in this study for the sector to reach zero emissions.

Closing this emissions gap may be undertaken through a number of means:

- **Explore the potential to reduce health care demand through public health approaches**

  While this roadmap has considered how the sector can decarbonise aspects of current operations, a number of wider interventions can look at more systemic approaches to reducing sectoral emissions. Measures that reduce the burden of disease lead to reduced demand for health services. There is therefore a strong sustainability argument to promoting public health measures that address the causes of preventable ill-health: vaccination, exercise, policies addressing obesity and tobacco consumption, etc.

  The *Global Roadmap for Health Care Decarbonisation*[24] undertook a high-level exploration of the potential decarbonisation impact of public health initiatives focused on improved air quality, reducing obesity, reduced red meat consumption, and cutting tobacco use. This work found that there is significant potential for reduced emissions from the sector through reducing the prevalence of chronic diseases and the resulting demand for treatment and care. Such decarbonisation measures have not been included in this analysis due to the significant uncertainties and lack of evidence around the scale of emissions reduction potential for each.

- **Increase the level of ambition for interventions**

  The interventions applied in this analysis may in some cases underestimate the scale of opportunity. In adopting and applying such measures across the Belgian health system, it may be possible to increase the ambition and impact of these measures and therefore achieve greater levels of emissions mitigation than those predicted in this paper. This will become clearer as action is taken and feedback is received from those tasked with enacting these changes.

- **Identify further actions and interventions for emissions hotspots**

  The interventions and actions described in this analysis represent a non-exhaustive list of high-impact measures which can lead to change across the wider health system. Within health care delivery there will be many, smaller and more targeted, measures that can be taken to reduce emissions. Potential actions to improve the sustainability of specialisms within clinical practice can be screened by experts in each field. Through conducting reviews in this form across the entire health sector, it can be expected that significant further decarbonisation can be achieved.

  Additionally, ongoing data collection and monitoring of health care delivery can enable more accurate tracking of emissions and more detailed analysis of emissions reduction opportunities. As work is undertaken to understand emissions at the facility, network, or regional level, further opportunities not identified through this broad, national, analysis may present themselves.

- **Embrace new and emerging low-carbon technologies**

  Between now and 2050, it is to be expected that the technologies and treatments available to health care providers and professionals will evolve significantly. This development will lead to new sustainability challenges and opportunities that it is not possible to model at the time of writing. Through an ongoing carbon measurement and management approach that is integrated into health policy and planning in Belgium, further opportunities to improve services and decarbonise can be identified and actioned across this timeframe.

- **Source robust carbon offsets and carbon removals to balance residual emissions**

  Where it is not possible to fully reduce emissions associated with health care operations and the supply-chain, residual emissions may be offset through the procurement of high-quality and validated offsets and carbon removal schemes.

4. Analysis: next steps and implementation

Following the production of emissions reduction scenarios and a roadmap towards net zero emissions for the Belgian health system, this section explores findings in more detail. Interventions and their potential are explored in line with the three decarbonisation pathways, leading to the identification of priority next steps for the sector as it seeks to align with a net-zero transition. The HCWH Road Map[24] details three pathways to deliver health care decarbonisation leading toward zero emissions, resilient health care sector. These pathways have been used to further interpret results

1.11 Pathway 1: Decarbonise health care delivery, facilities, and operations

Facility and operational interventions can reduce Belgium's health care scope 1 and 2 carbon footprint by 99% in 2050 relative to a BAU scenario. These interventions focus on decarbonising energy sources, optimising building systems, transitioning to low-carbon transport, and increasing use of renewable energy.

By reducing the emissions they are directly responsible for, and putting themselves on a trajectory to zero emissions, hospitals and health systems will not only prevent carbon dioxide entering the atmosphere, but also directly protect public health from climate change (and air pollution). Health care systems must take cost-effective action to move toward zero emissions energy, buildings, travel and transport, waste management, as well as low emission pharmaceuticals, sustainable food services, and more.

A summary of the broad range of interventions considered that decarbonise the health care's own operations is presented in Figure 6. This includes reductions of emissions from building fabric efficiency improvements for hospitals (8%), building systems optimisation for hospitals (6%), electrification of heating (62%), electrification of inter-site vehicles (20%), and onsite renewables or power purchase agreements (3%). This leaves 1% of residual emissions.

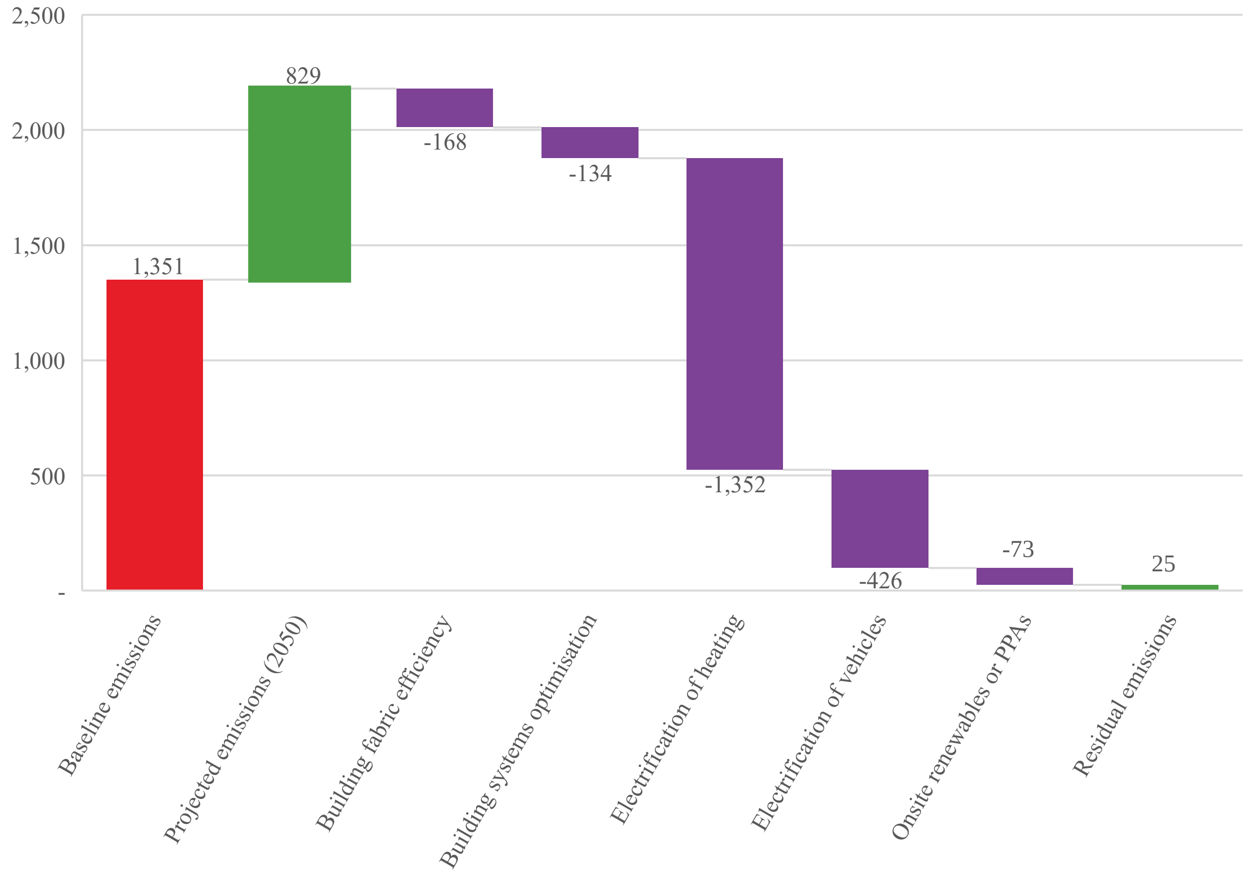

Figure 6. Pathway 1 interventions to reduce health care delivery, facilities, and operations emissions (unit: $ktCO_2e$)

Of the interventions explored through this analysis, the greatest impact is seen through electrification of heating and electrification of fleet vehicles. The potential offered by optimisation of building systems, and improvements to fabric, is predicted to have a lower individual carbon impact but still plays a key role in decarbonisation. As economies transition away from fossil fuels, the demand for electricity is set to substantially increase, putting pressure on grid infrastructure capacity. As a result, it is critical that electrification is accompanied by energy efficiency improvements to reduce pressure on electricity sources and ensure demand can be met.

While this analysis has explored the potential carbon reductions to be achieved through the interventions explored, further analysis of the financial considerations associated with implementing these changes is required. In general, measures that reduce demand for energy and improve efficiency should be prioritised before adopting more costly and disruptive interventions. With many of these measures, the costs and payback periods vary, some measures can lead to immediate cost savings, while others will offer returns over 5-10 years, and some require capital investment which will not be recouped. Recognising that budgets for a low-carbon transition need to translate to maximum emissions mitigation, low-cost interventions need to be applied at scale while higher-cost measures are applied where they will have the biggest impact.

For the health system, an added complication for estate decarbonisation planning is the logistics associated with implementing measures. Upgrades to building systems and fabric, and electrification of heating systems, can be highly disruptive. By the nature of the sector, there is often not readily available excess capacity in which to host services displaced by retrofit programmes. The logistics associated with such change and imperative to ensure continued provision of care will provide a practical limitation on the pace of change. This further supports the need to prioritise measures around efficiency and optimisation that are less disruptive to day-to-day operation and target other measures at the worst performing facilities.

This analysis has highlighted the potential of this suite of interventions when applied at the national scale. Due to the cost and practical implications associated with some of these measures, and the complex nature of building systems, the implementation of these measures should be planned at the local or regional level. This can allow for the performance of individual facilities to be considered, appropriate actions to be identified for each, and schedules of work to be put in place.

1.12 Pathway 2: Decarbonise health care's supply chain

This analysis has shown that 86% of Belgium's health care's climate footprint is made up of Scope 3 emissions associated with purchased goods and services. Interventions focussed on decarbonising the health care supply chain spans both Pathway 2 and Pathway 3. Pathway 2 considers actions that target the immediate supply chain, where the sector wields more influence, with interventions including quantifying the direct emissions that can be reduced from the sourcing electricity from the grid, as well as production, packaging, and transport of products used in the health sector. Pathway 3 considers the economy-wide potential decarbonisation achieved through supply chains aligning with rigorous standards and procurement protocols.

Belgium's health sector can influence the carbon impact of purchased products necessary to the delivery of care, by demanding the decarbonisation of its supply chain and ensure reductions from the production, transport, consumption, and disposal of health care products purchased. At the same time, manufacturers and suppliers of pharmaceuticals, medical equipment, food, building materials, and vehicles must also establish their own road maps toward zero emissions.

A summary of the interventions considered that decarbonise the health care's supply chain is presented in Figure 7. This includes reductions of emissions from 'Optimised use of pharmaceuticals' (7%), 'Prioritising low carbon pharmaceuticals suppliers' (3%), and 'Extending the lifespan of medical equipment' (4%). After the interventions in Pathway 2, there will be 81% of residual emissions.

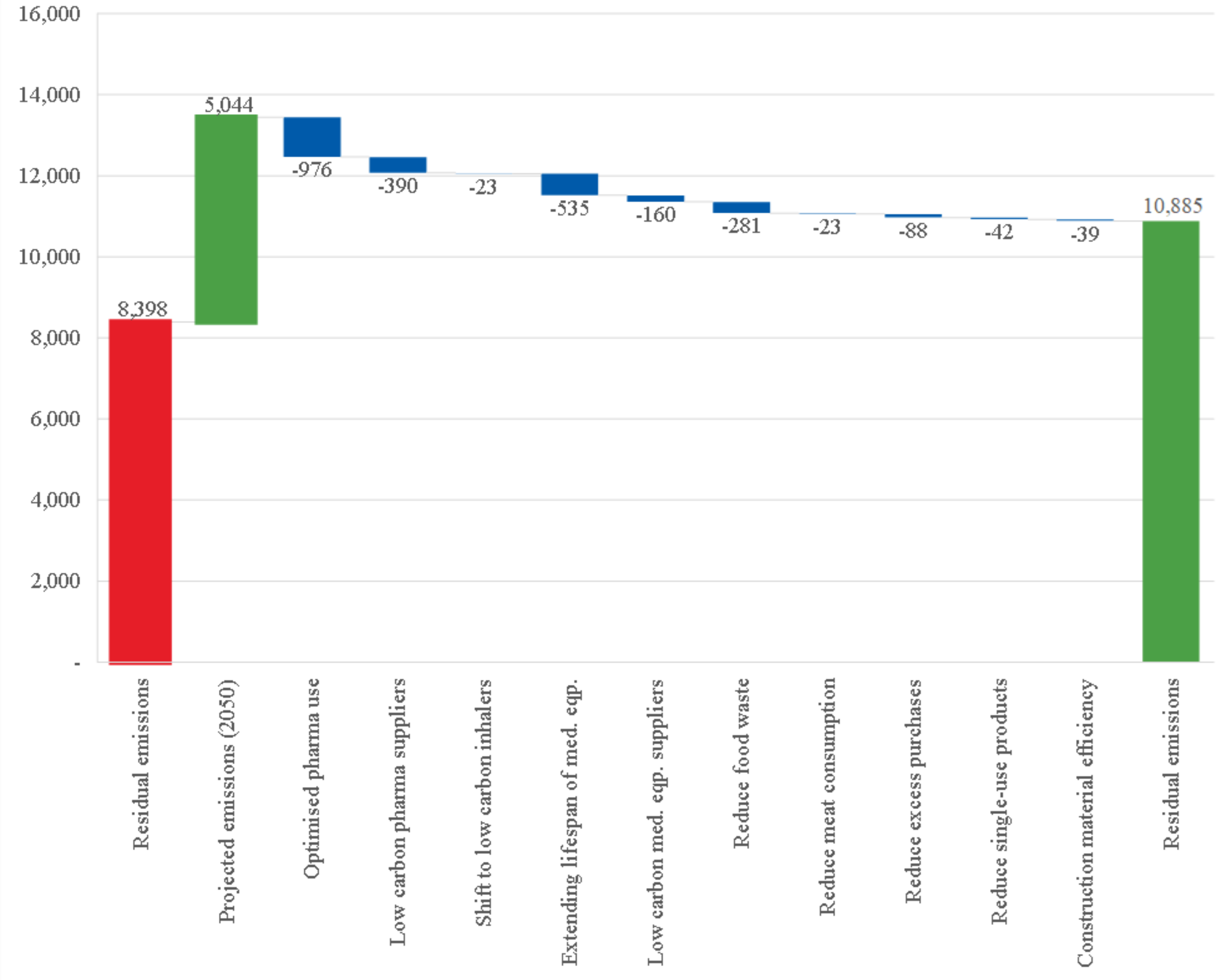

Figure 7. Pathway 2 interventions to reduce supply chain emissions (unit: ktCO_2e)

The interventions explored under this pathway broadly fall under two categories: making informed procurement decisions to prioritise low-carbon alternatives to existing products; and reducing overconsumption through efficient health delivery. The first category relies on integrating information on product and supplier sustainability into supplier engagement and onboarding processes to provide procurement teams with the data required to make informed decisions. The second relies on establishing best-practice approaches to reduce over-prescription of pharmaceuticals, or plate waste in hospitals, and the wider roll out of learnings to enable wider change across the system.

1.13 Pathway 3: Accelerate decarbonisation in the wider economy and society

Wider societal decarbonisation is crucial to the health sector achieving zero emissions. Every aspect of the health care supply chain and delivery is reliant on industries that provide energy, chemicals, building materials, packaging, infrastructure, transport, food, and more. Carbon emissions from these sectors, fuelled primarily by a global economic system and grid infrastructure based on the combustion of coal, oil, and gas, are the main driver of the climate crisis.

The intervention modelled against this pathway has focussed on the wider impacts across the value chain that can be achieved through rigorous procurement standards applied by the end consumer of products: the health system. While the sector can drive change, the extent to which suppliers achieve targets is unknown. This intervention was found to be the most impactful of all those considered in this analysis based on the threshold modelled which assumed 70% of suppliers meet their targets. Figure 8 shows how this value changes should this proportion of successful suppliers change, with attainment of 50% and 90% shown. It is imperative that the sector does everything within its power to adopt and promote standards that mandate this level of emissions reduction from suppliers; however, given the limited ability to enforce this change it is clear the sector cannot rely on its supply chain to achieve the required level of decarbonisation. This further underlines the importance of measures included under Pathway 1 and 2.

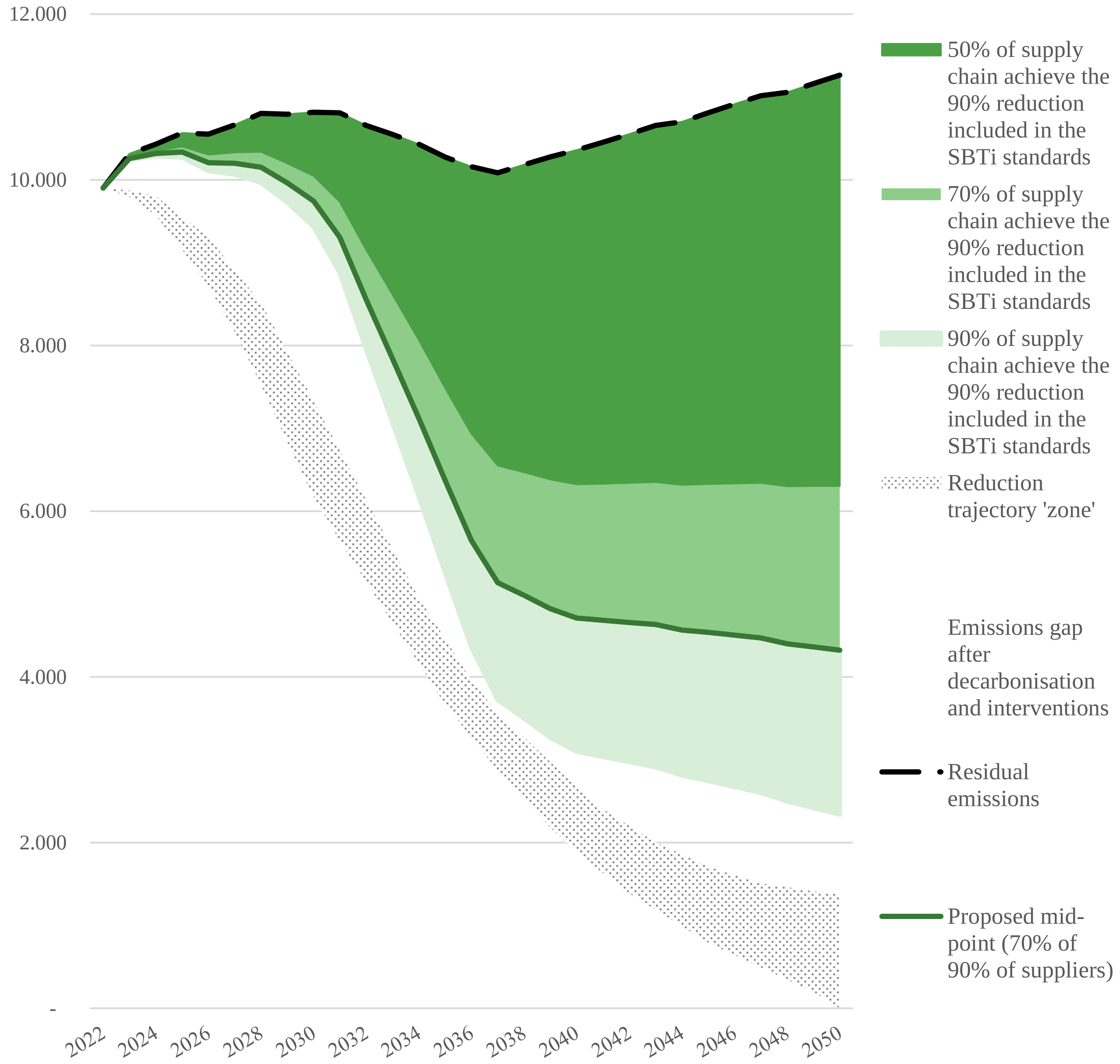

Figure 8. Pathway 3 interventions options to reduce supply chain emissions (unit: $ktCO_2e$)

5. Concluding remarks

There is a clear need for change in the Belgium health sector. Emissions from the sector contributed 5% of national consumption-based emissions and without concerted action from policymakers and the wider sector emissions can be expected to increase by 62% by 2050. As the European Union, and national and federal governments within Belgium, adopt increasingly ambitious decarbonisation targets and policies across the wider economy, health care will need to play its part in the transition to a low-carbon economy. While the sector is not currently subject to its own binding targets and regulation in Belgium, there is an increasing adoption of such approaches across the global health system. It is recommended that policymakers and health experts within Belgium work to establish clear roles and responsibilities within the wider national transition planning.

This roadmap explores for the first time what is possible for a Belgium health system embarking on a transition to low-carbon delivery; showing the potential of a few high-impact interventions to transform health care delivery while continuing to deliver for patients and communities. The solutions and changes modelled in this analysis are high-level, exploring the scale of opportunities and seeking to support prioritisation of action and identification of low-hanging fruit. Successful delivery of a transition aligned with the evidence presented here will be dependent on continual review and refinement of approaches, and the translation of these broad recommendations into actionable programmes at a range of level. While this study takes a macro, system-wide view of the opportunity, delivery will be reliant on action taken at the facility, network, and regional levels. It is therefore key to build capacity and provide tools, guidance, and support, to those working to enact change across the health system.

While the majority of sector emissions are associated with the supply-chain, there are significant mitigation opportunities to be taken through acting on emissions associated with operating facilities and vehicles, the Pathway 1 actions described in this roadmap. These are emissions directly within the control of the sector, which this roadmap shows can be effectively decarbonised through optimisation, electrification, and refurbishing facilities. While the overall costs of such a transition can seem prohibitive, phasing the rollout across the sector and aligning with existing refurbishment and upgrade schedules can improve value for money. The performance, and associated emissions, for health facilities will vary widely based on age, location, use, and other factors. It is recommended that a review of energy performance across existing health assets is conducted to help prioritise the rollout of retrofit and electrification upgrades. When looking to transition electric vehicle fleets, phasing upgrades to align with existing vehicle renewal timelines will be beneficial.

The sector's direct suppliers, both in and outside of Belgium, provide the goods and services within which the majority of the sector's emissions are embodied. Interventions targeting emissions associated with this group are covered under Pathway 2 in this roadmap. While many of these emissions occur far upstream, suppliers are required to account for and report on these impacts with an increasingly onerous regulatory landscape. A huge uptick in product-based reporting through Lifecycle Analysis and publication of Environmental Product Declarations is underway which will provide the health sector with a wealth of data on the impacts associated with different health products. This information can enable informed choice around the products and services being purchased by health providers enabling the selection of lower impact products in day-to-day health care delivery. For this to work, clear standards and guidance will be needed by procurement teams, and data on the environmental impacts associated with suppliers and their products gathered. Where goods and services are overconsumed, or wasted, through existing health care operating models there is an opportunity to save money and carbon. Reviewing overprescription, and plate-waste in health settings has the potential to lead to significant savings.

Globalised supply-chains and the sector's high consumption of pharmaceuticals, medical devices, and other equipment, mean that the majority of emissions associated with the sector are distributed across complex, cross-border, and multi-tier value chains. As a result, for the sector to reach net zero, it is reliant on systemic decarbonisation across the global economy. As explored under Pathway 3 in this roadmap, the extent to which organisations achieve net zero targets through initiatives such as the Science Based Targets initiative will be crucial. While ultimately this is not something that the sector can control, due to its size and profile, health care has significant buying power and influence. Through the development of clear and ambitious procurement standards and processes that reward best-practice in its supply-chain, and consistent and loud advocacy for economic transition, the Belgian health sector can add its weight to a global push for decarbonisation. If tier 1 suppliers are able to pass on required standards to their suppliers, and in turn have these standards passed up the entire value chain, the standards demanded by the end consumer – the health sector – can be hugely influential in driving decarbonisation. Aligning with health sectors in other countries, both within the EU, and more broadly, can further amplify this message. Belgium therefore has an opportunity to show leadership in this important push for a low-carbon health care value chain.

Taken together, the findings presented in this roadmap show that change is possible if action is taken now to establish a cohesive and systemic approach to managing this transition. Such an approach begins with aligning with wider government policies around decarbonisation, establishing clear approaches for monitoring progress and collecting data on sector performance, and prioritising the high-impact intervention areas presented in this analysis.

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