GREENHOUSE GAS EMISSIONS OF THE BELGIAN HEALTH CARE SECTOR

Photo by Piron Guillaume on Unsplash

HEALTH & ENVIRONMENT

Health Care Without Harm

ARUP

THIS REPORT WAS MADE POSSIBLE BY:

THE BELGIAN NATIONAL ENVIRONMENT-HEALTH ACTION PLAN (NEHAP) (LEEFMILIEU-GEZONDHEID.BE)

HEALTH CARE WITHOUT HARM EUROPE (EUROPE.NOHARM.ORG)

ARUP (ARUP.COM)

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)
- Service public de Wallonie
- Ministerium der deutschsprachige Gemeinschaft

Contents

Tables

Figures

Glossary

Terminology	Definition
Ancillary services	Providers of ancillary services including those involved in patient transportation, medical and diagnostic laboratories, and other related services
Ambulatory care	Providers of ambulatory health care including medical practices, dental practices, other health care practitioners, ambulatory health care centres, and family planning centres
Direct and indirect emissions	Direct emissions (Scope 1) are from sources owned or controlled by the health sector. Indirect emissions (Scope 2 and Scope 3) are a consequence of activities of the health sectors that are owned or controlled by another entity
GHG footprint	Emissions footprint estimates are calculated based on the consumption of all goods and services by the health sector, including direct emissions (scope 1), indirect emissions from the purchase of electricity, heating, cooling and steam (scope 2), and indirect emissions associated with the supply chains of purchased goods and services (scope 3)
GHG Protocol	Internationally accepted greenhouse gas (GHG) accounting and reporting standards for business and government
HCWH Methodology	Health Care Without Harm's Designing a Net Zero Roadmap for Health care: Technical Methodology and Guidance report
Health care sector	This report leverages the WHO definition of the health sector which includes all goods and services used for prevention, treatment, rehabilitation and care, as well as the administrative and investment costs of health care facilities
Medical goods providers	Retailers and other providers of medical goods including pharmacies, retail sellers and other suppliers of durable medical goods and medical appliances, all other miscellaneous sellers and other suppliers of pharmaceuticals and medical goods
Preventative care	Providers of preventative care including information, education and counselling facilities, immunisation facilities and healthy condition monitoring facilities
Scope 1 emissions	Direct emissions associated with the combustion of fossil fuels in health care facilities or from the operation of fleet vehicles. (Other on-site emissions, like fugitive emissions from refrigerants, anaesthetics or on-site waste treatment are also classified as scope 1.)
Scope 2 emissions	Indirect emissions associated with the generation of purchased electricity, heat or steam
Scope 3 emissions	Indirect emissions related to an organisation's activities but generated from sources outside of its ownership and control
Well-to-tank emissions	"Well-to-tank" emissions are a subset of Scope 3 emissions that reflect emissions associated with the upstream activities used to generate a fuel. These include activities such as fuel extraction or mining, refining of fuels, transport of fuels to location of purchase, etc. "Well-to-tank" emissions exclude emissions associated with the actual combustion of a fossil fuel which are classified as direct, scope 1 emissions
System administration	Providers of health care system administration and financing including government health administrations, social health insurance agencies, private health insurance administration and other administration agencies
"Top-down" data	This approach uses estimates from open datasets, such as national health expenditure data, to derive specific values
"Bottom-up" data	This approach involves collecting detailed data directly from specific sources or activities, such as energy use and transport

Acronyms

Abbreviations	Full text
CO_2e	Carbon Dioxide Equivalent
EF	Emissions Factor
EUI	Energy Use Intensity
GHG	Greenhouse Gas
GHGP	Greenhouse Gas Protocol
WTT	“Well-to-Tank”
EEIO	Environmentally-Extended Input-Output
EE MRIO	Environmentally Extended Multi-Regional Input-Output
IO	Input-Output
OECD	Organisation for Economic Cooperation and Development
DESNZ	UK Department for Energy Security and Net Zero
HCWH	Health Care Without Harm
WHO	World Health Organisation
MDIs	Metered-Dose Inhalers
RFI	Request for Information

Introduction

1.1 Context and background

To support targeted action on greenhouse gas emissions (GHG), Belgium has sought to compile a baseline emissions inventory reflecting the health care sector's annual direct and indirect GHG emissions. The completion of Belgium's health GHG emissions inventory for 2022 marks the first full scope 1-3 emissions inventory for the country.

The emissions baseline developed has been prepared in accordance with the approach and best practices described in the "Designing a Net Zero Roadmap for Health care: Technical Methodology and Guidance" document published by Health Care Without Harm[1].

The development of an emissions baseline, or "carbon footprint" will enable key stakeholders within Belgium's health care landscape to identify the sector's most important GHG emissions sources and provide a foundation upon which a business-as-usual (BAU) emissions trajectory, emissions reduction targets, future emissions scenarios, and emissions reduction actions can be built (as illustrated in Figure 1).

Figure 1. Process and key steps to develop a data-driven net zero decarbonisation strategy

1.2 Structure of this report

This Emissions Baseline Report presents the emissions baseline relevant to the development of the National Net Zero Roadmap for the Health Sector in Belgium (the 'Roadmap').

Together, the policy landscape review, emissions baseline, BAU trajectory, emissions reduction targets, future emissions scenarios and emissions reduction actions developed through this project will help shape the Roadmap to achieve steep emissions reductions in alignment with its national decarbonisation aspirations.

This report is divided into eight key sections, providing a comprehensive overview of the methodology used to model the emissions baseline, the results and implications of the emissions baseline, and a basis for future reporting and progress tracking towards emissions reduction.

Section 1 (i.e. this section) provides an overview of the background, context and structure of this report.

Section 2 provides an overview of the approach used to model the emissions baseline, including the definition of the baseline boundary, the data collection and processing approach, model development, reporting of results from the model outputs, and verification and checks of the results.

Section 3 includes an overview of the results of the emissions baseline of Belgium's health care activities for 2022. Results are broken down into different emissions source categories, with findings contextualising how results should be interpreted and identifying emissions "hot spots" that are recommended to be prioritised in future decarbonisation planning. Tabular results detailing the emissions baseline captured in this report are provided in the Excel document *'GHG emissions of the Belgian health sector_overview results'*.

---

[1] Health Care Without Harm (2022) Designing a net zero roadmap for health care: Technical methodology and guidance | Health Care Without Harm (noharm.org)

Section 4 provides an analysis of the uncertainties and limitations of the emissions baseline approach, highlighting assumptions and limitations of the methodology, as well as the justifications and impacts to consider for interpreting results.

Section 5 discusses recommendations to improve the data quality of the baseline in future years. As this year is the first time Belgium has undergone the data collection, management, and accounting processes to develop an annual carbon footprint for the sector, there are a number of measures which may be taken to improve the process and quality of results in future reporting years. This section identifies the most impactful recommendations to help Belgium improve the precision, quality and completeness of its baseline and streamline data collection in future reporting years.

Section 6 discusses next steps for the project, following the calculation of an emissions baseline for Belgium's health sector.

A.1 contains the nature of source data used to derive emissions for each emissions reporting category, within each health care provider.

A.2 displays a summary of data sources used in the emissions footprint, with rankings on the data quality and completeness (low to high) and notes to accompany the data source utilised.

A.3 provides a more detailed descriptions of the methods employed within the model development.

Approach

This section outlines key steps in the process used to develop Belgium's national-level emissions baseline for the health sector.

1.3 Overview of the methodology

Health Care Without Harm's "Net Zero Roadmap Methodology" was used in the development of Belgium's emissions baseline. This methodology represents sector best practice and enables better comparability of results with other global health sector actors that have deployed similar methodologies.

Belgium's health sector emissions baseline was derived using a "hybrid" approach, leveraging and combining both top-down expenditure datasets covering the national health system and bottom-up data reflecting more granular activity within the health sector. A hybrid approach combines elements of top-down and bottom-up methods to build on the respective advantages, enabling the development of an emissions baseline that is comprehensive and "zero-leakage" (i.e. captures data within the entire system boundary), while also utilising more granular, precise bottom-up data where available.

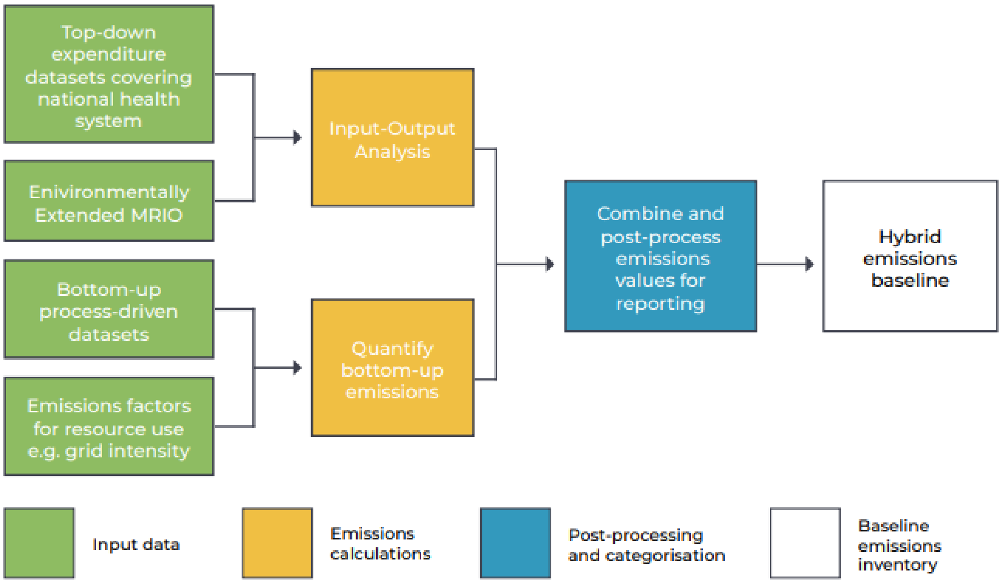

Figure 2. Hybrid approach utilised to develop the emissions baseline[2]

A top-down method enables comprehensive quantification of the emissions of large areas of economic activity where detailed and consistent activity-level data is lacking. This method relies on expenditure data which is more readily available at scale. Emissions estimates derived through a top-down approach, however, are typically less precise than emissions estimates derived through a bottom-up approach, as national-level expenditure data is often not granular enough to understand the types of specific activities that expenditure is allocated towards.

A bottom-up approach combines reported resource consumption or activity data with corresponding emissions factors. "Bottom-up" typically yield more accurate and precise results. However, sourcing bottom-up data can be highly onerous, especially when trying to capture activity for a large scope with many emissions sources and stakeholders. This approach also has an increased risk of "leakage" – that is a footprint can be underestimated if all activities within the entire system within a boundary are not fully captured through data collection, and incorporated into the footprint. Accordingly, the HCWH Methodology does not recommend an entirely bottom-up approach for emissions baselines for health care sectors. "Bottom-up" data, however, when

---

[2] "Designing a Net Zero Roadmap for Health care: Technical Methodology and Guidance." Health Care Without Harm. 2022. (Page 29) https://europe.noharm.org/sites/default/files/documents-files/7186/2022-08-HCWH-Europe-Designing-a-net zero-roadmap-for-health care-web.pdf

used to supplement top-down emissions in a "hybrid" model serve to increase the granularity and precision for emissions sources where robust data is available.

1.4 Boundary scoping

The project scope and baseline boundary were defined collaboratively with the Belgium team based on how Belgium intends to leverage this baseline, best practices described in the HCWH Methodology, and data availability.

System boundary:

Based on discussions with the Belgium team, it was deducted that an emissions baseline capturing all health care providers which Belgium's federal and regional authorities (including both the regions and the communities) have influence over would be valuable to understand the sector's emissions impacts and policy implications associated with those impacts. Accordingly, a broad definition of the health care sector was selected as the system boundary, including:

- Hospitals,
- Residential long-term care facilities,
- Providers of ambulatory health care,
- Providers of ancillary services,
- Retailers and other providers of medical goods,
- Providers of preventative care, and
- Providers of health care system administration and financing.

Table 1 (overleaf) provides additional detail on the specific types of facilities and activities classified within each of these health care providers (based on classifications from OECD/Eurostat/WHO). Activities in the "rest of the economy" and "rest of the world" outside of those covered in the list above were determined to be out of scope.

Emissions sources:

All material direct (i.e. scope 1) and indirect (i.e. scope 2 and 3) emissions sources were considered and incorporated into the baseline, where quality data was available. This reflects both emissions that the sector is assumed to have a direct influence over, like the energy consumption of its facilities, and those that are out of its direct control, like emissions generated by suppliers from which it procures goods and services from. Capturing emissions associated with the source categorisations included in the HCWH methodology was prioritised throughout the data collection and model development processes.

Geography:

All regions and sub-regions within Belgium are included within the scope of this footprint. The baseline was developed to reflect the national-level footprint. However, results can also be explored at the regional level (i.e. reflecting Flanders, Brussels, and Wallonia) to facilitate easier uptake of the results and findings within each region.

Base year selection:

A base year acts as a reference year against which future emissions estimates can be benchmarked against and can serve as the starting point for future decarbonisation road mapping exercises.

2022 was selected as the "base year" as this was assessed to be the most recent year for which key top-down and bottom-up data was available for. Namely, 2022 is the most recent year for which a national-level figure reflecting Belgium's total health care sector expenditure is available from OECD - Health expenditure and financing[3].

[3] OECD (2024) OECD Data Explorer • Health expenditure and financing *(Data extracted on 01/06/2024)*

Table 1. Breakdown of health care provider classifications utilised in footprint scoping[4]

Hospitals	Residential long-term care facilities	Providers of ambulatory health care	Providers of ancillary services	Retailers and other providers of medical goods	Providers of preventative care	Providers of health care system admin. and financing
General hospitals Mental health hospitals Specialised hospitals (other than mental health hospitals)	Long-term nursing care facilities Mental health and substance abuse facilities Other residential long-term care facilities	Medical practices Offices of general medicine Offices of medical (including mental) specialties Dental practice Other health care practitioners Ambulatory health care centres Family planning centres Ambulatory mental health and substance abuse centres Free-standing ambulatory surgery centres Dialysis care centres All other ambulatory centres Providers of home health care services	Providers of patient transportation Medical and diagnostic laboratories Other providers of ancillary services	Pharmacies Retail sellers and other suppliers of durable medical goods and medical appliances All other miscellaneous sellers and other suppliers of pharmaceuticals and medical goods	*No specified facility/activity types provided in provided classifications, but this can include including information services, education and counselling facilities, immunisation facilities and healthy condition monitoring facilities.*	Government health administrations Social health insurance agencies Private health insurance administration Other administration agencies

[4] Classifications primarily derived from classifications by OECD/Eurostat/WHO: in "A System of Health Accounts" (2011) report. Table 6.2 (page 130)

1.5 Data collection and processing

Data requests (consolidated into Requests for Information (RFIs)) were developed by the Arup team and disseminated to stakeholders across the country by the Belgium team. The RFIs captured all of the types of information surrounding emissions activities sought. Data reflecting aggregate expenditure data and aggregate energy consumption data for each health care provider at the national- and regional-levels were communicated to be of highest priority.

As the only expenditure data initially received reflected hospitals, the delivery team returned to the Belgium team and key data holders to see if any expenditure data reflecting other singular or sub-sets of health care providers could be provided (though this data is considered to be of lower quality than aggregate data).

Other regional level-data was provided to the Arup team. This data was utilised if it was deemed to have a reasonable level of quality and if it could be extrapolated to other regions (if data in the other regions was unavailable). Data provided by Belgium stakeholders was utilised and assumed to be accurate, unless otherwise noted. Some follow-ups between the Arup team and data holders help clarify limitations of certain data sets and confirm assumptions. Not all data received was suitable for inclusion in this assessment.

1.6 Model development

The methods selected were based on anticipated data availability and approach recommendations outlined in the HCWH Methodology. The model developed to execute this approach and used to process, calculate and consolidate the emissions footprint was built in MS Excel.

The model was developed using both top-down and bottom-up approaches as shown in Figure 3.

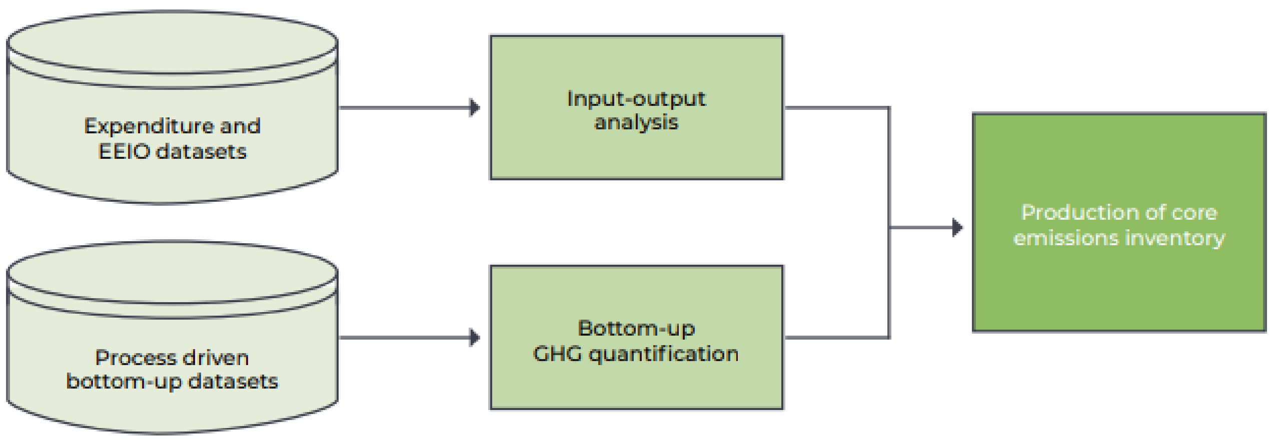

Figure 3: Approach utilised to develop a hybrid emissions inventory using top-down expenditure-based and bottom-up process-based methods

1.6.1 Converting top-down expenditure data into emissions estimates

A top-down methodology which utilised 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 data to provide insights on emissions associated with products, industries, and their value chains, with information on the financial activities within the sector providing a description of the nature of sectoral operations and procurement practices.

Identifying high-level sector expenditure

Expenditure data for Belgium's health care providers were taken from OECD Data Explorer – Health expenditure and financing[5]. At the time of writing, an estimated total expenditure for 2022 was available. The

[5] OECD (2024) OECD Data Explorer • Health expenditure and financing (Data extracted on 01/06/2024)

2021 percentage breakdown of health care providers was used with the 2022 estimated total to disaggregate expenditure data across all health care providers.

Overview of OECD Data Explorer

The OECD Data Explorer is a platform provided by the Organisation for Economic Co-operation and Development (OECD) that allows users to find, understand, and use a wide range of data. All data, reports, and analysis in all formats are available under an open license, allowing users to freely use, translate, and share the Organisation's work.

OECD's 'Health expenditure and financing' data source is a joint OECD, EUROSTAT and WHO Health Accounts SHA Questionnaires (JHAQ) and WHO Global Health Expenditure Database for 7 countries. The data is classified by ICHA-HC: Classification of health care providers (see SHA 2011, Chapter 6). This data is aligned with the definition of the health sector used by the WHO.

Generating emissions factors

Emissions factors tied to product-based expenditure for Belgium were derived using the EXIOBASE 3 environmentally extended multi-regional input-output (EE MRIO) tables[6]. EXIOBASE 3 provides year-specific tables for 44 countries, including Belgium. EXIOBASE 3 was chosen as it provides up to date (latest model year 2022) coverage of environmental impacts across 200 product types within the Belgium economy. Other available models such as the World Input Output Database only provide data up to 2014. EXIOBASE 3 is also suitable because the available years matched the baseline year and it comprises sectoral information, with data on economic sectors and their environmental impacts, which allows for consistent emissions modelling at the health care provider level across different parts of the economy.

Overview of EXIOBASE

EXIOBASE is a global, detailed EE MRIO dataset. It was developed by harmonising supply-use tables for a large number of countries, estimating emissions and resource extractions by industry based on a wide range or sources, and combining this into a consistent global dataset. The resulting model can be used for the analysis of environmental impacts associated with the final consumption of product groups and industries.

EXIOBASE was developed during the European Union Seventh Framework Program project DESIRE (Development of a System of Indicators for a Resource efficient Europe) and is maintained by an international research team. The dataset is widely used across industry and academia for environmental accounting and research purposes.

The Belgium-specific product-by-product EXIOBASE 3 version 3.8.2 data was downloaded and PyMRIO EE MRIO analysis tools[7] were used to translate environmentally extended input-output models (EE IOT), which account for all upstream emission with a product, and expenditure data in basic prices into emission factors per Euro spent.

Calculating emissions

An understanding of how the expenditure is allocated towards emissions-generating activities is essential to derive emissions figures from high-level sectoral expenditure figures. As activities associated with each of the seven health care providers included in the baseline's scope are assumed to differ considerably, the differing

[6] Stadler, Konstantin, Wood, Richard, Bulavskaya, Tatyana, Södersten, Carl-Johan, Simas, Moana, Schmidt, Sarah, Usubiaga, Arkaitz, Acosta-Fernández, José, Kuenen, Jeroen, Bruckner, Martin, Giljum, Stefan, Lutter, Stephan, Merciai, Stefano, Schmidt, Jannick H, Theurl, Michaela C, Plutzar, Christoph, Kastner, Thomas, Eisenmenger, Nina, Erb, Karl-Heinz, Tukker, Arnold. (2021). EXIOBASE 3 (3.8.2) [Data set]. Zenodo. https://doi.org/10.5281/zenodo.5589597

[7] pymrio (N/A) Working with the EXIOBASE EE MRIO database — pymrio 0.6.dev documentation

supply-chains of these provider types were captured through development of expenditure profiles for each health care provider that capture the proportionate spending on activities within each health care provider.

Bespoke expenditure profiles were sourced from data holders reflecting Hospitals and Residential Facilities. The derivation of expenditure-based emissions values associated with these two health care providers are detailed in Appendix section A.3.1. Representative expenditure profiles reflecting Ambulatory Care, Ancillary Services, Medical Goods Providers, Preventative Care and System Administration were not identified during the data collection process, so an alternative approach using data from Belgium's national statistics agency was used to derive a representative "expenditure profile" or breakdown of associated activity within the sector. These methods are detailed in Appendix section A.3.2.

Proportionate activity expenditure for each health care provider was applied to the annual total expenditure (i.e. OECD data) to approximate annual spending figures associated with a range of activities within each health care provider. The EXIOBASE emission factors were then paired with associated expenditure to derive emissions estimates. Emissions results were aggregated based on the nature of their associated activity and grouped into the reporting categories reflected in the baseline results.

1.6.2 Deriving emissions estimates from bottom-up activity data and integration with top-down emissions data to develop a "hybrid" baseline

The following bottom-up data sources reflecting real activity within the health care sector were leveraged and incorporated into the final "hybrid" emissions baseline:

- Electricity and natural gas consumption across health facilities
- MDI usage

Emissions associated with each of these sources were derived from activity data and activity-based emissions factors. These derivation methods are detailed in Appendix sections A.3.3 and A.3.4.

Data provided covering these emissions sources was of medium- or high-quality, and both energy-related emissions and emissions associated with MDIs were anticipated to contribute significantly to the national-level footprint. Accordingly, incorporating this bottom-up data was prioritised.

Where both bottom-up and top-down emissions figures reflecting the same emissions sources were available, the figure deemed to be less precise (typically expenditure-based figure) was deducted or excluded from the final baseline.

A figure estimating emissions associated with Hospitals' employee commuting was also derived using bottom-up data. However, this figure was excluded from the final baseline, as no other information was found to proxy employee commuting emissions associated with other health care providers and as employee commuting patterns are expected to differ considerably between regions and facilities of different sizes. This figure and more information can be found in Section A.3.4.1.

1.6.3 Post-processing of emissions derivations from top-down approach

Adjustments were made to top-down derived emissions figures reflecting energy consumption and pharmaceutical procurement to help improve the precision of the associated emissions derivation methods and incorporate scope 1 emissions that are not captured in emissions factors (EFs) from EXIOBASE. Post-processing measures are described in more depth in Appendix section A.3.5

1.7 Results validation and verification

Throughout the model development, selection of data sources, approaches, assumptions and "sense checks" were discussed and selected collaboratively amongst the delivery team. Results have been reviewed according to Arup's Quality Assurance processes, with results and reporting checked by the project manager, and signed off by the project technical director.

1.8 Reporting the results

The reporting categories used to capture results and differentiate emissions associated with different sources were based on those in the HCWH Methodology[8] to facilitate comparability between other similar baselines and roadmaps, whilst considering data availability and inclusion. Data outputs and reporting categories were further classified to be the most actionable for key user groups in the Belgian health sector and in alignment with Belgium's low-carbon health care aspirations (e.g. regional-level data outputs).

Table 2 summarises the reporting categories utilised in the results within Section 0 and details the types of emissions sources included within each category. Note that these definitions outline the type of emissions sources that fall under the scope of each categorisation, however, there may be gaps (i.e. data gaps) between the scope of emissions included within these categorisations and the emissions sources reflected in the data sources leveraged. For instance, expenditure reflecting major building construction projects was not captured in the source data utilised, despite this falling within the definition of scope of "construction and maintenance services."

Emissions figures are consolidated into the three high-level scopes defined by the Greenhouse Gas Protocol (GHGP):

- Scope 1 – Direct emissions associated with the combustion of fossil fuels in health care facilities or during the operation of fleet vehicles[9]
- Scope 2 – Indirect emissions associated with the generation of purchased electricity, heat or steam
- Scope 3 – Indirect emissions related to an organisation's activities but generated from sources outside of its ownership and control

---

[8] "Global road map for health care decarbonization: A navigational tool for achieving zero emissions with climate resilience and health equity." Health Care Without Harm. https://health careclimateaction.org/roadmap

[9] Other on-site emissions, like fugitive emissions from refrigerants and anaesthetics or on-site waste treatment are also classified as scope 1 emissions. However, these other emissions sources are data gaps of this analysis.

Table 2. Reporting categories definitions

High-level outputs	Emissions source categorisations	Definition of emissions source(s)
Scope 1	Stationary fuel combustion	Use of on-site fuels (e.g. in boilers, heating systems, backup power generation etc.)
	Mobile combustion	Fossil fuel use in vehicles
Scope 2	Electricity purchased	Generation of electricity consumed (excl. any power generated on-site)
	Purchased steam, heating or cooling	Emissions from the generation of steam or district heating/cooling services (excl. on-site generation)
Purchased goods	Food/catering	Food, catering services and related products (e.g. cutlery)
	Manufactured fuels, chemicals, and gases	Upstream emissions of purchased chemicals (e.g. soaps, detergents) and gases used in a health setting
	Medical equipment/instruments	Purchased medical instruments and equipment
	Other manufactured products	Purchased products including textiles, machinery, vehicles, and electrical equipment
	Pharmaceuticals	Pharmaceuticals (including metered dose inhalers)
	Other procurement	Goods purchased in bulk through wholesalers and intermediaries
Purchased services	Business services	Professional services (e.g. legal, accountancy, consultancy etc.) and facilities services (e.g. cleaning services).
	Construction and maintenance services	Construction of buildings and infrastructure, repair and installation of machinery and equipment, construction materials, and buildings maintenance
	Information and communication technologies and services	IT and communication products and services, including computers, computer systems/ programming, telecoms, IT repair and publishing activities
Fuel- and energy-related activities	Electricity and steam (scope 3)	Upstream emissions associated with electricity and steam usage (e.g. transmission and distribution losses, well-to-tank emissions, etc.)
	Fossil fuels (coal, oil, etc.)	Upstream emissions associated with the production of fossil fuel products for uses including boilers, generators, and vehicles. These emissions reflect those generated in the production of these fuels (e.g. extraction, refinement, transport etc.) and does not include emissions from the combustion of fuels which are captured within Scope 1
Transport	Transport	Transport funded by the health care sector, including business travel, logistics, internal transport, transport of patients funded or provided by the health care sector
Waste, water, and sanitation	Waste, water, and sanitation	Water supply, treatment, and sewerage; waste disposal and recycling.

Emissions baseline results

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

1.9 Health sector emissions by scope

Table 3, Figure 4, Figure 5, and Figure 6 illustrate 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[10] consumption-based GHG emissions footprint was 199,640 ktCO2e[11]. The Belgian health sector therefore represents 5% of total Belgian emissions.

Table 3. Health sector emissions by scope

	Emissions ktCO_2e	Share of total emissions, %
Non-vehicles fuel use	806	8.1%
Vehicles fuel use	277	2.8%
Scope 1	**1,084**	**10.9%**
Scope 2[12]	**269**	**2.7%**
Pharmaceuticals[13]	3,045	30.8%
Business services	1,625	16.4%
Medical equipment/instruments	1,346	13.6%
Food/catering	775	7.8%
Manufactured fuels, chemicals, and gases	539	5.4%
Other manufactured products	303	3.1%
Construction and maintenance services	208	2.1%
Other procurement	198	2.0%
Information and communication technologies and services	166	1.7%
Fossil fuels (coal, oil, etc.)	152	1.5%
Transport	84	0.8%
Waste, water, and sanitation	63	0.6%
Electricity and steam (scope 3)	45	0.5%
Scope 3	**8,549**	**86.4%**
Scope 1, 2, and 3 Total	**9,901**	**100.0%**

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

[11] Our World in Data (2022) Belgium: CO_2 Country Profile - Our World in Data

[12] Over 99% of scope 2 emissions in this footprint are from electricity consumption. The remaining scope 2 emissions reflect purchased steam.

[13] Emissions associated with Metered Dose Inhalers (MDIs) captured within Pharmaceuticals categorisation: 44ktCO_2e – approximately 0.4% of total footprint.

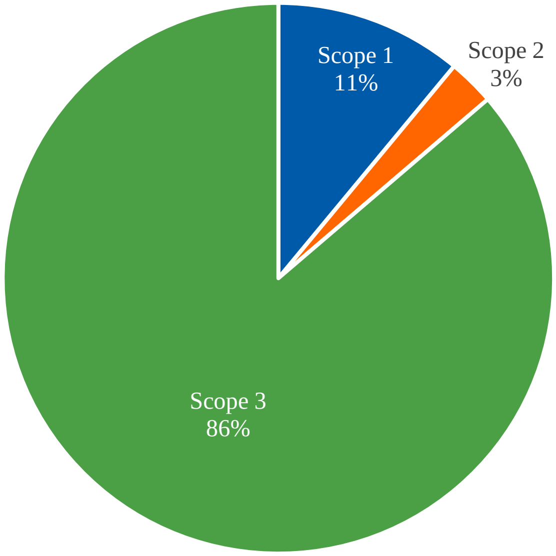

Figure 4. Breakdown of national health sector emissions between Scopes 1, 2 and 3

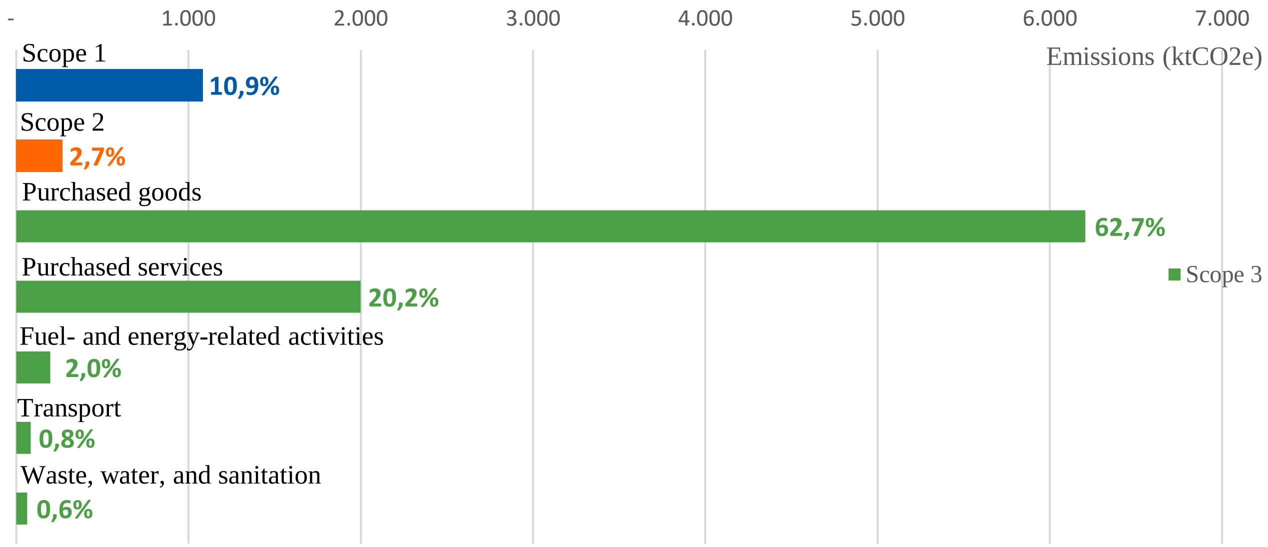

Figure 5. High-level categorisation of national health sector emissions

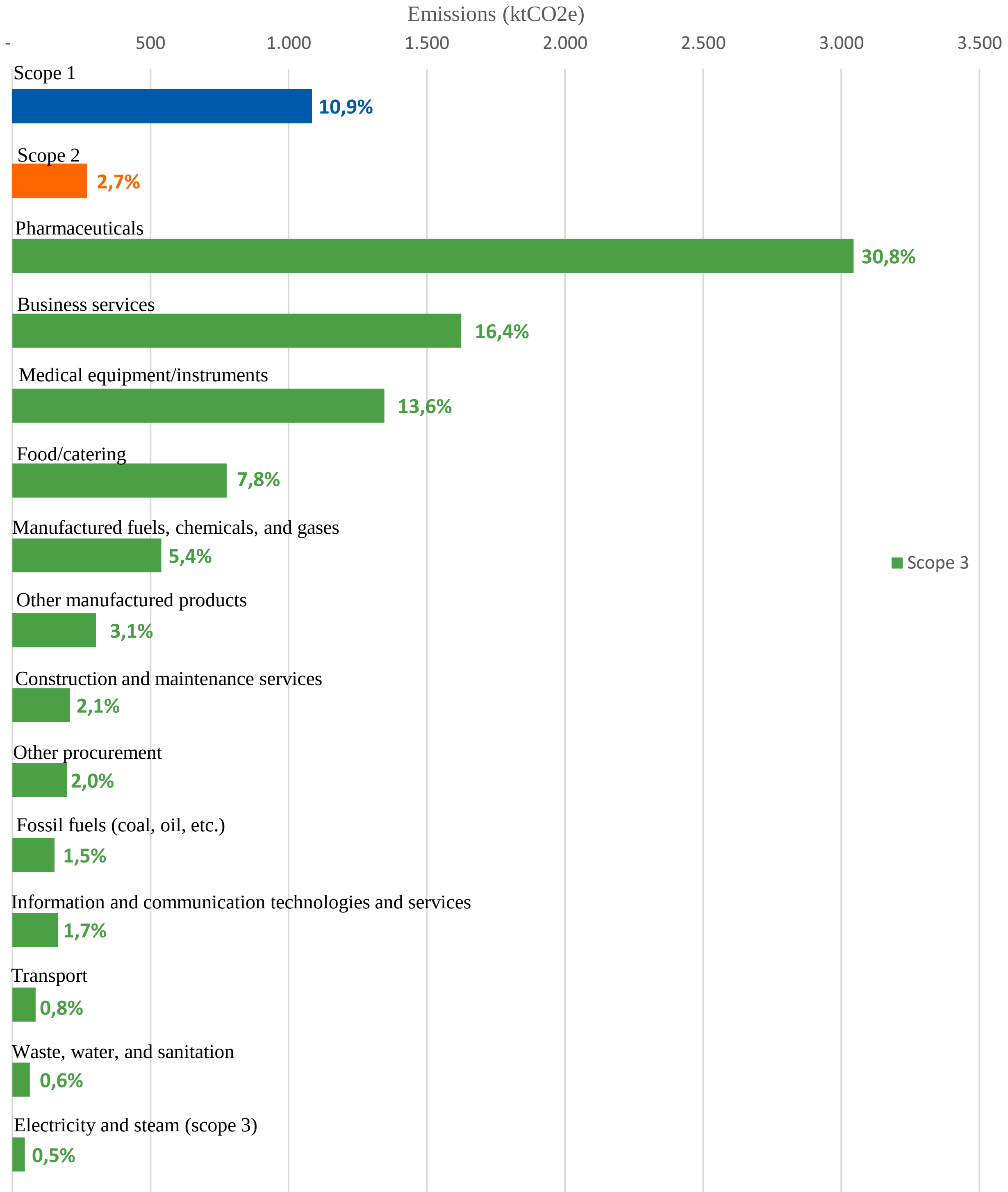

Figure 6. National health sector emissions, including breakdown of Scope 3 emissions

Key findings:

- Scope 1 emissions comprise 11% of the total footprint's emissions, 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.

1.10 Health sector emissions by health care providers

Table 4 and Figure 7 illustrate the breakdown of Belgium's emissions between each health care provider included within the scope of the baseline.

Table 4. Health sector emissions by health care providers

Health care providers	Total emissions ($ktCO_2e$)	*% of total emissions*	Expenditure (Million EUR)	*% of national expenditure*	Emissions intensity ($kgCO_2e$/EUR)
Hospitals	5,488	*55%*	€ 23,532	*39%*	0.23
Residential long-term care facilities	804	*8%*	€ 6,879	*11%*	0.12
Providers of ambulatory health care	2,201	*22%*	€ 17,924	*30%*	0.12
Providers of ancillary services	207	*2%*	€ 1,719	*3%*	0.12
Retailers and other providers of medical goods	897	*9%*	€ 6,331	*11%*	0.14
Providers of preventive care	133	*1%*	€ 1,161	*2%*	0.11
Providers of health care system administration and financing	170	*2%*	€ 2,548	*4%*	0.07
Sector-wide	**9,901**		**60,096**		**0.16**

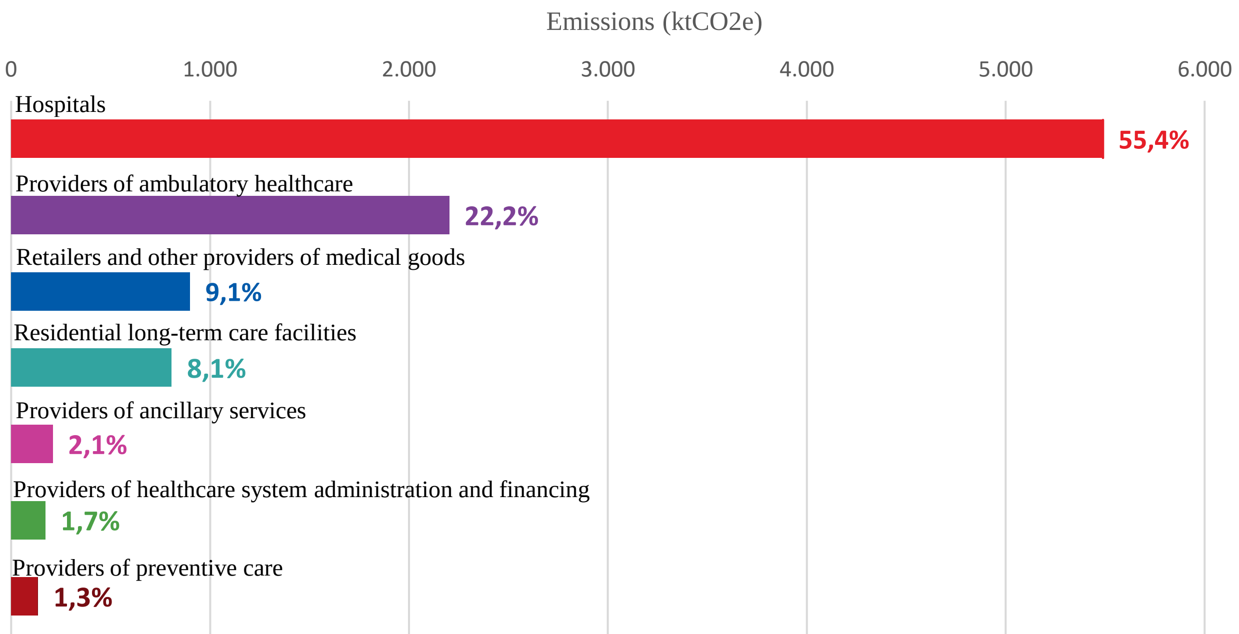

Figure 7. Nation-wide emissions by health care providers

Table 5 and Figure 8 to Figure 14 provide breakdowns of the emissions calculated for each type of health care provider considered in this study.

Table 5. Breakdown comparison between different approaches and health care providers

High level scope categories	Hospitals	Residential long-term care facilities	Providers of ambulatory health care	Providers of ancillary services	Retailers and other providers of medical goods	Providers of preventive care	Providers of health care system administration and financing
Scope 1	8%	30%	10%	8%	13%	28%	5%
Scope 2	2%	10%	1%	2%	3%	11%	<1%
Purchased goods	79%	42%	46%	47%	45%	9%	15%
Purchased services	8%	10%	38%	38%	33%	44%	75%
Fuel- and energy-related activities	2%	7%	1%	0%	3%	6%	<1%
Construction and maintenance services	1%	0%	2%	2%	2%	1%	2%
Transport	<1%	0%	2%	2%	1%	2%	3%
Waste, water, and sanitation	<1%	1%	1%	1%	1%	<1%*	<1%*
Total	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*

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).

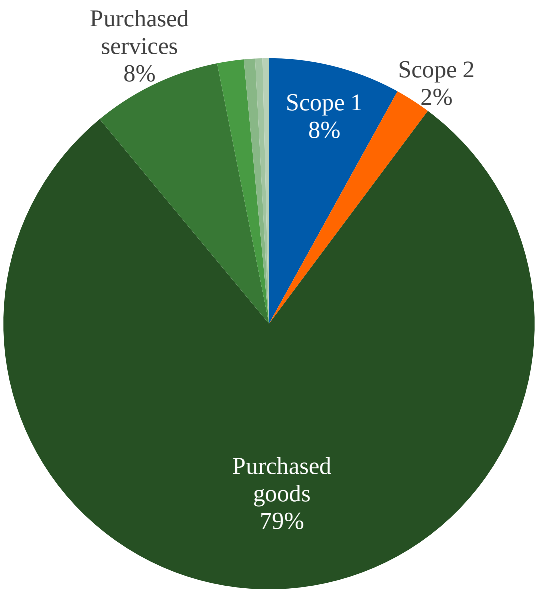

Figure 8. National-level emissions breakdown of Hospitals

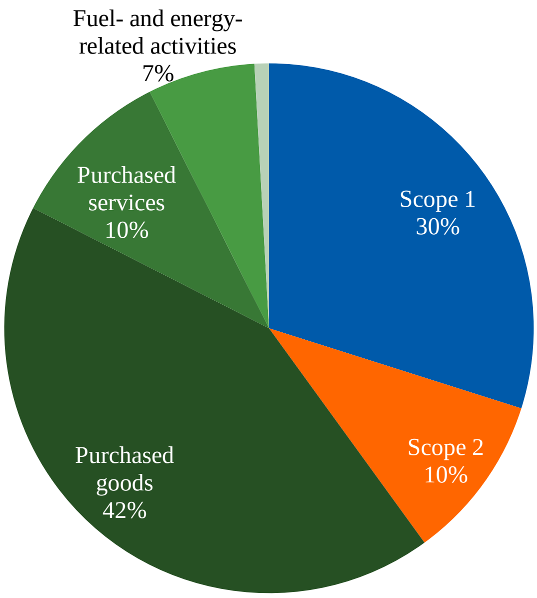

Figure 9. National-level emissions breakdown of Residential long-term care facilities

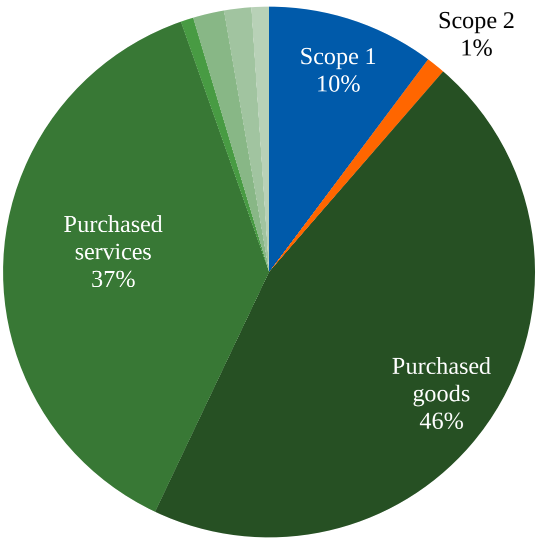

Figure 10. National-level emissions breakdown of Providers of ambulatory health care

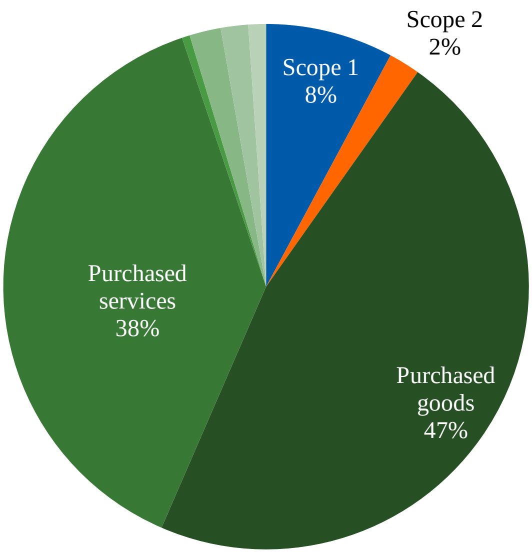

Figure 11. National-level emissions breakdown of Providers of ancillary services

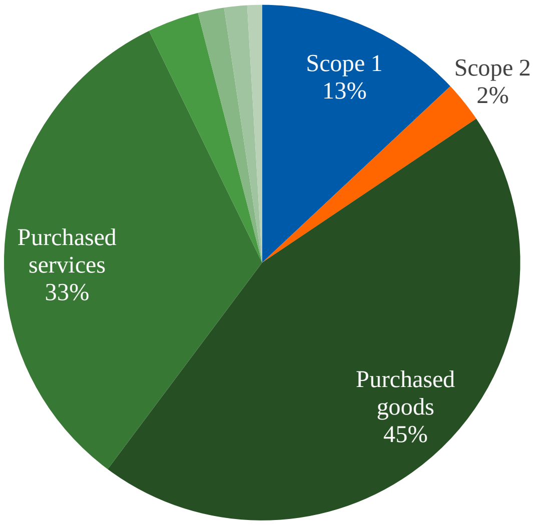

Figure 12. National-level emissions breakdown of Retailers and other providers of medical goods

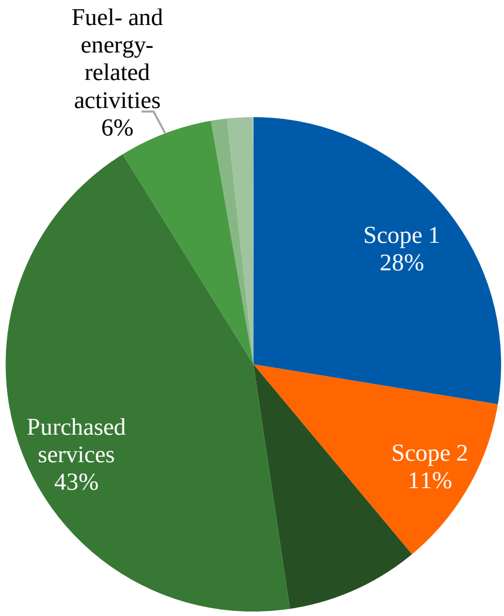

Figure 13. National-level emissions breakdown of Providers of preventive care

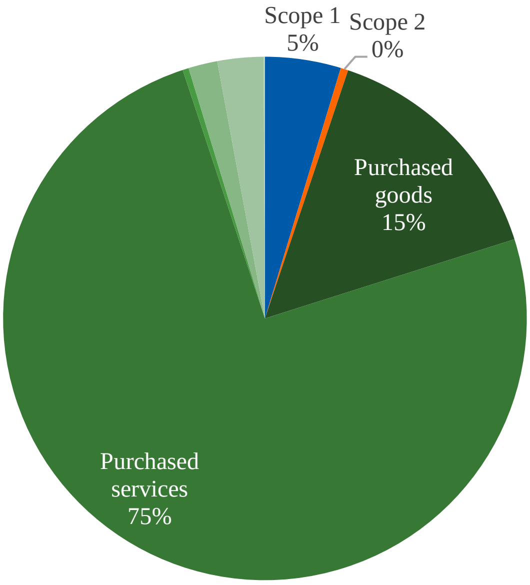

Figure 14. National-level emissions breakdown of Providers of health care system administration and financing

Key findings from comparing the percentage breakdown of different approaches and health care providers:

- Purchased goods account for the largest share of emissions in most health care providers, particularly for Hospitals (Figure 8) where it accounts for 79% of emissions.
- ‘Providers of preventive care’ (Figure 13) and ‘Health care system administration and financing’ (Figure 14) had the highest proportion of emissions from Purchased Services.

- Scope 1 and 2 emissions are generally low across most health care providers.

'Residential long-term care facilities' (Figure 9) and 'Providers of preventive care' (Figure 13) have significantly higher proportions of their emissions profiles associated with energy consumption.

- Figure 10), 'Providers of Ancillary Services' (Figure 11), and 'Retailers and other providers of medical goods' (Figure 12) have similar emissions breakdowns, as emissions (excluding those associated with energy and metered dose inhalers) are derived from the same source data reflecting sector activity.

Note: Differing approaches used to derive top-down emissions figures for each health care provider limit the efficacy of comparison between emissions and emissions intensity figures of different health care providers. These limitations are further detailed in Section A.3.2.

1.11 Health sector emissions by region

Table 6 and Figure 15 illustrate the breakdown of Belgian health sector's emissions by Belgium's three regions.

Table 6. Total health sector emissions

Region	Total Emissions (ktCO_2e)	% of Total Emissions	*% Population*
Wallonia	3,125	31.6%	*31.6%*
Brussels	1,057	10.7%	*10.6%*
Flanders	5,719	57.7%	*57.8%*
Total	**9,901**		

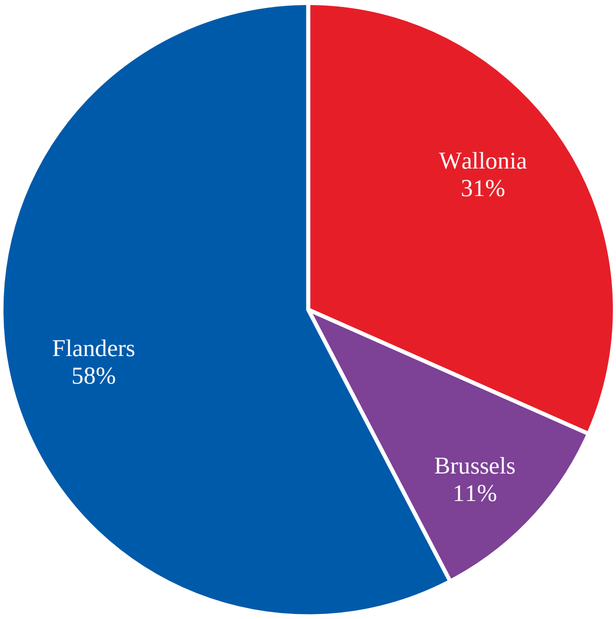

Figure 15. Health sector emissions, by region

Key findings:

- The emissions split among the regions closely aligns with their respective population splits, with only minor differences in percentage points. These results suggests that each region's emissions are roughly proportional to its population size, with variations of 0.1% - 0.2% across the regions. However, this is due to the utilisation population-based proxy methods to disaggregate nation-level results. (This limitation is further detailed in Section 0). The only regional differences captured in the source data utilised in the final baseline surrounded bottom-up electricity and natural gas consumption.

1.12 Benchmark comparisons

Table 7, Figure 16 and Figure 17 illustrate the emissions comparison with Netherlands and Germany. Emissions for the Dutch and German health care sector were conducted using EXIOBASE input-output analysis and health care expenditure data from Statistics Netherlands[14] and German Federal Statistics Office[15]. Comparing Belgium to the Netherlands is highly feasible due to the similarities in their economic, geographic, and demographic profiles, as well as utilising similar methodologies to calculating sectoral footprint.

Table 7. Benchmark comparisons, Netherlands, and Germany

	Belgium	Netherlands	Germany
Expenditure (Million EUR)	60,096	92,515	414,000
Emissions (ktCO_2e)	9,901	17,575	68,000
Emissions intensity (kgCO_2e/EUR)	0.16	0.19	0.16
Emissions per capita (kgCO_2e)	855	1,001	817

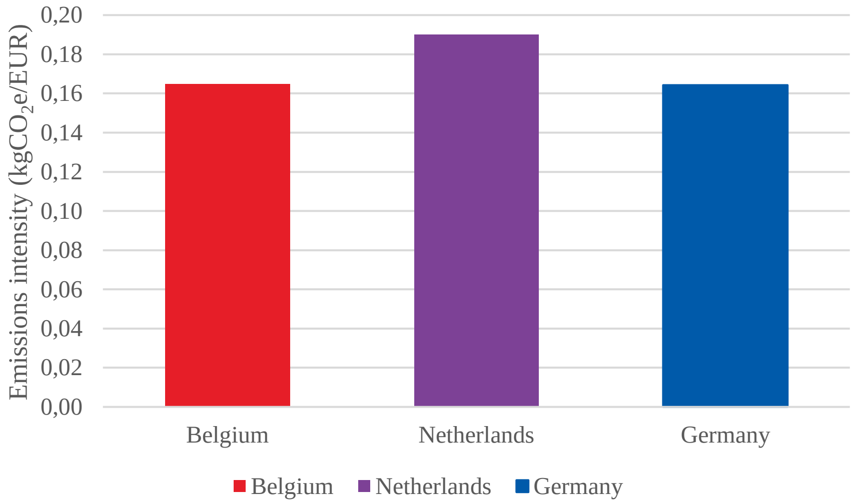

Figure 16. Emissions intensity (kgCO_2e/EUR) comparison with the Netherlands and Germany

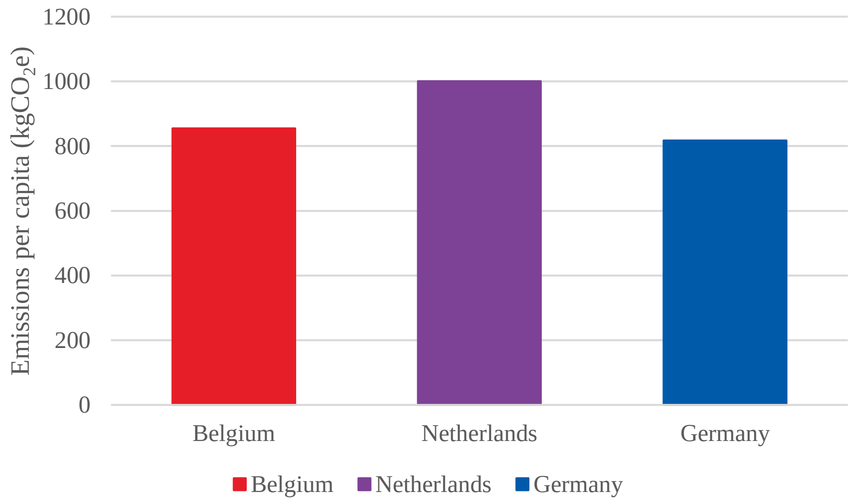

Figure 17. Emissions per capita (kgCO_2e) comparison with the Netherlands and Germany

[14] Steenmeijer, Rodrigues, Zijp, Waaijers-van der Loop (2022) The environmental impact of the Dutch health-care sector beyond climate change: an input–output analysis - The Lancet Planetary Health

[15] Pichler, P. P (2022) Sachbericht zum Projekt: Evidenzbasis Treibhausgasemissionen des deutschen Gesundheitswesens GermanHealthCFP (bundesgesundheitsministerium.de)

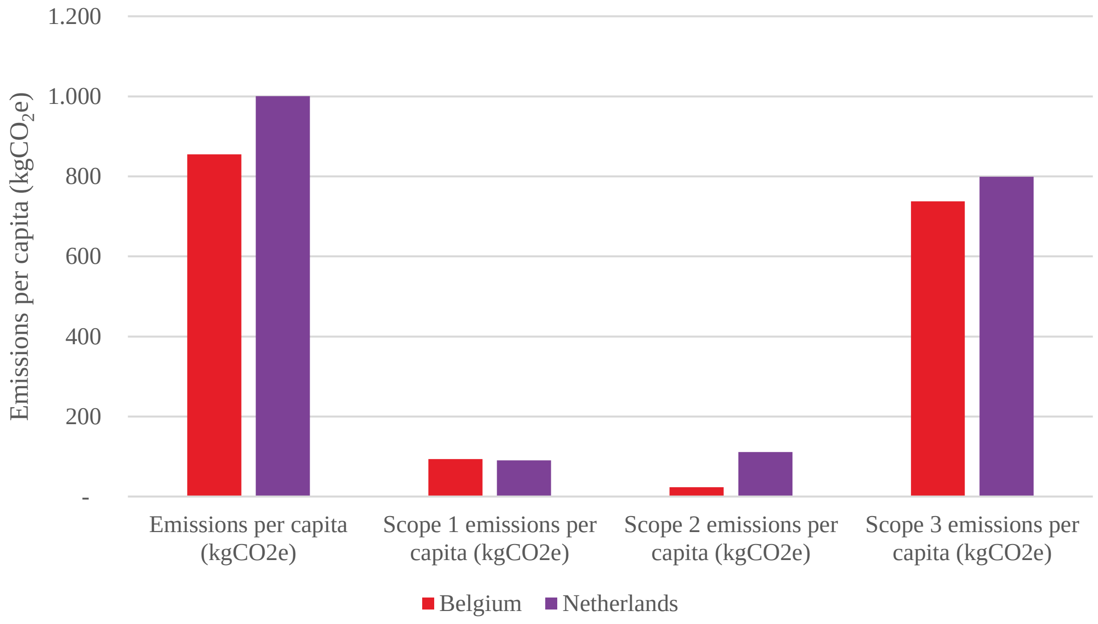

Figure 18. Scope 1, 2, 3 emissions per capita comparison with the Netherlands

Key findings:

- The emissions intensity ($kgCO_2e$/EUR) and emissions per capita ($kgCO_2e$) is lower in Belgium compared to the Netherlands.
- The emissions intensity ($kgCO_2e$/EUR) is similar between Belgium and Germany. The emissions per capita ($kgCO_2e$) is higher in Belgium compared to Germany.
- Compared to the Netherlands, the scope 1 emissions per capita is similar, whilst scope 2 and scope 3 emissions per capita is lower in Belgium.

Uncertainties and limitations

In producing this baseline footprint and preparing the basis upon which future decarbonisation potential will be modelled, it was necessary to make a number of assumptions to respond to data gaps, uncertainties in model inputs and limitations of the modelling approach.

There are several broad assumptions and limitations which are foundational to the footprint and should be considered in the interpretation and application of its results. These assumptions provide the basis for the overall model and should be clearly communicated as part of any externally published outputs. In Table 8 below, 'Degree of uncertainty' ranks the level of uncertainty associated with the assumption and/or source data. It reflects the extent to which the assumption or limitation can be considered reliable and accurate for use in the emissions baseline. Impact on total results ranks the extent to which an assumption or limitation will influence the overall footprint. The ranking identifies which assumptions or limitation have the most significant variabilities and effect on the results.

Table 8. Main assumptions and limitations underpinning the emissions baseline

Assumption / limitation	Justification	Degree of uncertainty	Impact on total results
Different approaches were used to calculate emissions for health care provider types. For instance, Hospitals and Residential Facilities emissions were based on actual expenditure profiles, while other health care providers expenditure profiles were proxied.	Deploying different approaches for different health care providers, in certain instances, has enabled the inclusion of higher quality data for some sector-sectors while ensuring that health care providers lacking data can be captured within the baseline.	Medium	Medium
Majority of proxies to disaggregate activity and expenditure figures by region are based on proportionate population. This assumes that each region provides similar health care services and have similar numbers of facilities within each health care provider, relative to population.	A breakdown of sector-wide expenditure by region was not identified. Bottom-up data sources capturing facility counts within each region appear to be inconsistent in terms of scope/inclusion and categorisation. It was decided this proxy could provide regional reporting and focus in a consistent and credible manner.	Medium	Low
2022 was selected as a base year. However, data provided for this project ranged from 2019 to 2023. The baseline assumes that all sector activity in 2019, 2020, 2021 and 2023 is highly similar to activity in 2022.	Utilising only data provided reflecting 2022 activity would significantly limit available methods. For instance, the Residential Facilities expenditure profile provided reflects 2023 data. Most of the footprint was calculated using data for the 2022 base year so this will have limited impact.	Low	Low
Emissions factors from EXIOBASE 3 represent averages for certain product types and do not differentiate for different emissions intensities for comparable products from different producers.	Use EXIOBASE 3 emissions factors deemed best available approach, especially as no source data provides any information reflecting supplier selection. Future, detailed, assessments may utilise product specific impact data.	Medium	Medium
Belgium-specific emissions factors from EXIOBASE 3 reflect products procured in Belgium (i.e. not goods procured outside of the country).	Assuming materials are procured locally deemed best available approach. The factors are regionally valid for each area of health provision and will be representative of products purchased either in the country in question or wider region.	Low	Low
OECD spending data does not differentiate between operational expenditure on health delivery and capital investments in health infrastructure (i.e. major construction). This funding may fall into different areas of investment.	This footprint therefore represents the operational footprint of the health system. Additional analysis will be needed to incorporate capital investments in this analysis. Carbon management approaches will differ between operations and capital investment meaning this assessment is valid and actionable.	Low	Low

Recommendations to improve data quality of sector footprint in future years

There are a range of improvements surrounding data availability and collection that could enhance the precision of the emissions baseline and consistency of health care providers' emissions outputs. The recommendations captured below reflect improvements that are suspected to have a high impact on the precision and overall quality of the baseline. **Identification of emissions profile for each health care provider within the footprint boundary**

A limitation of this baseline comes from the different datasets used to develop an emissions profile for each health care provider. This has led to differing levels of certainty around model outputs, which limits in the comparability of results between health care providers. Identifying and applying an emissions profile for each health care provider within the footprint boundary based on actual spending activity within the health care provider (instead of using proxy profiles) would streamline the methods deployed, enabling more reliable comparisons of emissions outputs between health care providers.

To improve the reliability of the emissions baseline, as more facilities capture and publish their emissions, these can be incorporated into emissions measurement at the regional and national level. Further, the potential of open data for deriving emissions footprints can enhance transparency, consistency, and accessibility of emissions data calculations. However, to ensure the quality and comparability of emissions profiles, it is essential to establish data standards and implement robust data governance practices.

Regionally disaggregated expenditure data

In this baseline, proportional emissions classified within each region are nearly identical to the relative population split between regions. This is primarily due to population being used to as the main proxy method to disaggregate emissions derived from the national-level to the regional-level. As the majority of emissions values originate from national-level expenditure data, identifying a more detailed breakdown of health care provider expenditure by region would produce a baseline that captures more variation between regional activity and spending. A shift towards more granular, regional expenditure data would provide greater transparency and understanding of the emissions calculation process, split between regions.

Reliable counts of facilities within each region and health care provider

Identifying reliable facility counts within each region and health care provider will enable greater extrapolation of bottom-up data from one region to another, from a singular or subset of facilities within a health care provider to the entire health care provider, and (where reasonable) from one health care provider to another. Reliable facility counts will further enable stronger data quality checks and facilitate (where reasonable) scaling of incomplete data sets.

Pharmaceuticals emissions factor

The emissions factor applied to pharmaceutical expenditure has a significant impact on the magnitude of the total sector footprint. Further research to identify a more precise expenditure-based emissions factor reflecting pharmaceutical procurement within Belgium could enhance the precision of the baseline considerably.

Anaesthetic usage

Anaesthetics are a scope 1 emissions source specific to the health sector that have a high global warming potential and have a significant impact on the environment. For instance, anaesthetic and analgesic practices are estimated to comprise 2% of the UK's National Health System's emissions footprint.[16] Identifying a reliable sector-wide figure capturing anaesthetic usage (disaggregated from other non-emissive pharmaceuticals) would help fill a significant data gap in the footprint.

Other scope 1 emissions sources also represented data gaps in this baseline assessment. These include emissions associated with refrigerant leakage from facilities and on-site waste treatment (e.g. incinerators in hospitals). Identifying data that reflects these sources could further improve the quality and coverage of the baseline's scope 1 emissions included in the footprint.

Patient travel

Though most patient travel (to and from health care facilities) sits outside of the health system's expenditure, its associated emissions are considerable given magnitude of services and appointments provided annually to accommodate the health needs of an entire population. The health care system and organisations can influence emissions associated with patient travel by providing more remote/"tele-health" services, providing services closer to patients' homes, and incentivising the use of less emissive transport modes (e.g. cycling, public transport etc.) Accordingly, collecting data to quantify emissions associated with patient travel can contextualise the potential emissions reductions that could be achieved by exerting influence over this emissions source.

---

[16] "Putting anaesthetic emissions to bed: commitment on desflurane." National Health Service England. (2023). https://www.england.nhs.uk/blog/putting-anaesthetic-emissions-to-bed/#:~:text=Anaesthetic%20and%20analgesic%20practices%20account,emissions%20associated%20with%20this%20specialty.

(*Note: some patient travel data was captured in the Hospitals expenditure profile. This, however, is only expected to account for subsidised patient travel services – a small proportion of total patient travel emissions.*)

Major construction activities

One significant data gap in the baseline surrounded the inclusion of data in expenditure profiles reflecting major construction and other capital projects. As the construction of new facilities are often accounted for separately from operating expenditures, identifying expenditure sources inclusive of both spending types can be a challenge. As the construction of new facilities may be the most significant and emissive data gap within capital goods, identifying expenditure data covering the major projects or the construction of new buildings at both the health care provider level and a regional- or national- level could help account for a considerable data gap.

Transition to a sustainable health care system

It is necessary to expand the current emissions footprint into a holistic sustainability strategy in future assessments. The Belgian Health Care Knowledge Centre (KCE) is working on identifying indicators to assess the environmental sustainability of the Belgian health system. Furthermore, models using EXIOBASE 3 can be expanded to include other impact categories in addition to GHG emissions, such as land use, total waste generation, blue water consumption, and abiotic material extraction. These additional impact categories have been calculated by the Dutch health sector, highlighting a broader approach to sustainability assessment within health care systems.

Establishing data standards and implementing more robust data governance practices may help to both streamline the data collection process and improve the availability of quality data (particularly bottom-up data). A detailed organisation and stakeholder mapping exercise may serve as a helpful preliminary step in supporting such efforts by helping to identify potential data holders and build a clearer understanding of current and future data availability.

Next steps for the project

An emissions baseline provides the foundation upon which to anticipate future emissions and understand the impact that decarbonisation measures will have on the sector's total footprint.

In the next steps of the project, a BAU scenario will be developed, using the 2022 baseline as its frame of reference. This scenario will incorporate assumptions surrounding the change in activity (i.e. growth) of Belgium's health sector and anticipated changes in the carbon intensity of certain activities that are expected to occur regardless of any major interventions from the health sector (e.g. electric grid decarbonisation).

Current and planned mitigation measures and programmes being employed to decrease carbon emissions will be applied to the BAU scenario (where quantifiable) to next illustrate how Belgium's health sector's footprint is likely to change if all planned actions are taken. This modelling in combination with the BAU scenario, will provide the "current trajectory" of the sector's emissions.

Next, a set of decarbonisation interventions – additional to those currently underway or planned for – will be developed in collaboration with the Belgium team and modelled against the current trajectory to create a "decarbonisation roadmap". This will allow Belgium stakeholders to understand the magnitude of impact of certain interventions, chart a course and strategy towards decarbonisation within its health sector, and set targets to achieve this strategy.

A.1 Source data type, by emissions category

Table 9 captures the nature of source data used to derive emissions for each reporting category within each health care provider.

Table 9. Nature of emission sources and methods of derivation used for each reporting category, by health care provider

Reporting Categories		Sub-Sectors						
		Hospitals	Residential Facilities	Ambulatory Care	Ancillary Services	Medical Goods Suppliers	Preventative Care	System Administration
Scope 1	Stationary fuel combustion	*	*	*	*		*	*
	Mobile fuel combustion							
Scope 2	Electricity	*	*	*	*		*	*
	Steam							
Scope 3	Pharmaceuticals							
	Business services							
	Medical equipment/instruments							
	Food/catering							
	Manufactured fuels, chemicals, and gases							
	Other manufactured products							
	Construction and maintenance services							
	Other procurement							
	Fossil fuels (coal, oil, etc.)	*	*	*	*		*	*
	Transport							
	Infos and comms. technologies and services							
	Waste, water, and sanitation							
	Electricity and steam (scope 3)	*	*	*	*		*	*

Key

Expenditure-Based (Bespoke Sub-Sector Profile)		Data Gap	
Expenditure-Based (IO Model-Derived Profile)		Post Processing-Applied	
"Bottom-Up" Data		Bespoke Regional-Level Data	*
Split cells indicate that source data from two sources of differing natures were added together in the final baseline.			

A.2 Summary of data sources and corresponding data quality and completeness

Table 10 ranks the data quality and completeness for each scope and category applicable for this reporting year from low to high. Data quality reflects how precisely the data provided can be converted into emissions figures. For instance, product- or material-specific data will typically yield more accurate emissions estimates than expenditure-based data. Data completeness indicates the comprehensiveness of relevant activities within the Belgian health sector reflected in the data provided.

Table 10. Data quality and completeness by data source and health care provider

Data Type	Data Source	Year	Data Quality	Data Completeness	Notes
Expenditure data & other sources leveraged in derivation of expenditure profiles	OECD national expenditure for health care providers	2022	High	High	• 2022 estimated data • Expenditure profiles were scaled to OECD national expenditure to ensure consistency and accuracy of expenditure values
	Hospitals Expenditure Profile	2022	Medium	High	• FINHOSTA, 2022 Hospital expenditure data
	Residential Facilities Expenditure Profile – from singular senior living and care centre	2023	Medium	Medium	• Operating costs of a senior living and care centre facility in the German Speaking Community
	Belgium Federal Planning Bureau annual input-output table[17]	2020	Medium	Medium	• 'Heath activities' sector utilised to proxy expenditure profile for Ambulatory Care; Ancillary Services and Providers of Medical Good • 'Legal and Administration services' utilised to proxy expenditure profile for System Administration and Preventive Care • 'Social work services' sector utilised to estimate the percentage of Residential Facilities' expenditure spent on salaries
Bottom-up data provided	Flanders' electricity and natural gas consumption[18]	2023	High	High (Assumed)	• Data provided included all health care provider types except for Medical Goods Providers • Some data included appeared to be outside of project scope (e.g. home health care provided by individuals outside of the health sector) and was excluded from the final footprint
	Brussels' electricity and "combustibles" consumption[19]	2022	Medium	High (Assumed) for Utilised Hospital Data Low/ Medium (Assumed) for Un-utilised Sub-sectors	• Only data reflecting Hospitals used in final footprint, as Residential Facilities and Ambulatory Care figures suspected to be incomplete (i.e. suspected to not covering the bulk of region's facilities) • "Combustibles" assumed to reflect primarily natural gas.

[17] Federal Planning Bureau (2020) Federal Planning Bureau - Databases - Input-Output Tables 2020

[18] Data sources provided: "p6082 ELE Fluvius 2023_zorg" & "2023_aardgas_zrog"

[19] Data source provided: "RAPP_CPUB_Stava datacollective - WG Low Carbon_2024"

Data Type	Data Source	Year	Data Quality	Data Completeness	Notes
	Emissions associated with MDI usage from national-level F gas study"[20]	2022	Medium	High	• Annual national-level emissions figure (CO_2e) provided
	Employee commuting data *(reflecting a singular facility)*	2023	Medium	Low (For Entire Sub-Sector) High (For Singular Facility)	• Data reflects employee commuting trends of singular hospital within the German-Speaking Community • Captures tiers of distances from employees' homes to workplace • Captures breakdown of typical transport modes utilised • Hospital has ~600 employees
Emissions factors	EXIOBASE industry output[21]	2022	Medium	Medium	• EXIOBASE factors provide averaged spend-based emissions factors for 200 broad product types in the Belgian economy
	UK DESNZ "Conversion factors 2023: full set (for advanced users) "	2023	Medium	High	• UK-specific factors • Utilised in bottom-up energy calculations, energy-related post processing and derivation of employee commuting figures
	Electricity (Generation)	2022	High	High	• Belgium-specific factor • European Energy Agency (accessed through Climatiq)
	Electricity (WTT)	2022	High	High	• Belgium-specific factor • International Energy Agency (accessed through Climatiq)
	DEFRA spend-based emission factors from "UK Footprint Results 1990-2020", produced by the University of Leeds (2020).	2020	Medium	High	• Emissions factor utilised reflects "Basic pharmaceutical products and pharmaceutical preparations" • Emissions factor manipulated to reflect 2022 year (considering inflation). • Emission factor adjusted to reflect EUR instead of GBP
Proxy Metrics	Flanders and Brussels population data[22]	2022	High	High	• Population data, according to Belgian National Register and official statistics
	Wallonia population data[23]	2022	High	High	• Population data, according to Belgian National Register

[20] Source file and link: "Update of the national emission inventory of ozone depleting substances and fluorinated greenhouse gases (1990 – 2022): Final report," https://www.cnc-nkc.be/en/reports

[21] *Derived from EXIOBASE 3: EXIOBASE 3 (zenodo.org)*

[22] Provincies.incijfers.be (2023) provincies.incijfers.be - Dashboard - Population - Aalst

[23] STATBEL (2023) Statbel, the Belgian statistical office | Statbel (fgov.be)

Data Type	Data Source	Year	Data Quality	Data Completeness	Notes
	Regional- and national-level hospital counts[24]	2019	Medium	High (Assumed)	• Though bottom-up emissions source data not leveraged from this data source, the regional and national level hospital counts included were used to proxy the emissions associated with employee commuting of Hospitals.

[24] Stathosp bank data, date 06 05 2024; Data and Strategic Information Service, FPS Public Health, Food Chain Safety and Environment, Belgium.

A.3 Detailed methodology

This section provides more granular descriptions of the methods employed in four key components within the model development:

1. Derivation of expenditure profiles from "real" health care provider-specific spend data (Section A.3.1)
2. Derivation of representative expenditure profiles from IO model outputs (Section A.3.2)
3. Derivation of emissions from bottom-up energy data (Section A.3.3)
4. Derivation of emissions from other bottom-up sources (Section A.3.4)

A.3.1 Expenditure profiles based on real spend data

Bespoke, real expenditure data were utilised for Hospitals' and Residential Facilities' expenditure profiles. and scaled to reflect national health care provider expenditure data derived from OECD's 'Health expenditure and financing' data.

A.3.1.1 Expenditure profile derivation

Expenditure profiles capturing spend data that reflect the activities of a health care provider were provided for Hospitals and Residential Facilities. The provided Hospitals data reflected consolidated costs of all hospitals across Belgium. The Residential Facilities profile provided reflected the annual expenditure of a singular residential senior living and care centre, as no aggregate regional- or national-level data reflecting this health care provider type was identified.

The provided expenditure data for Hospitals and Residential Facilities were each scaled up to mirror the total OECD national expenditure associated with each health care provider. This scaling helps to ensure alignment with national economic indicators and consistency of top-level national expenditure figures.

Non-emissive expenditure like salaries, taxes, and reimbursements need to be accounted for in the scaling of expenditure profiles, so that the appropriate amount of top-level expenditure is assumed to generate emissions. The Hospital expenditure profile appeared to include these salary costs which were removed from the scaled expenditure profile.

The utilised expenditure data provided for a singular Residential Facility did not include costs associated with salaries. To account for salary costs in the scaling of the Residential Facility source data, a proportion of salary to non-salary costs was approximated and derived from a Belgium-specific national-level input-output model. The most representative sector relating to Residential Facilities in the IO model is the "Social Work Services" column. The proportion of domestic output and imports total output (basic prices) within the Social Work Services sector was used to approximate the proportion of health care provider expenditure associated with salaries when scaling the expenditure profile.

A.3.1.2 Data sources and key assumptions

As reflected in Table 10, the expenditure profiles used for Hospitals reflected aggregate national-level expenditure data of hospitals across Belgium. The data source provided a considerable level of detail on the types of activities with allocated funding. The expenditure profile leveraged for Residential Facilities reflected annual operating costs of a senior living and care centre facility in the German Speaking Community. The Belgium Federal Planning Bureau annual input-output table was utilised to estimate the amount of expenditure associated with salaries within Residential Facilities to enable the Residential Facilities expenditure profile to be scaled appropriately.

Table 11 further details key assumptions used in these derivations and any significant limitations of the approach.

Table 11. Expenditure profiles generated from "real" spend data: assumptions/limitations

Assumption/ limitation	Justification	Degree of uncertainty	Impact on total results
Expenditure data for a single facility is leveraged and scaled to reflect all residential facilities in Belgium.	No national- or regional-level aggregate expenditure data was identified for residential facilities. Leveraging medium- to high-quality data reflecting a singular facility was deemed to be more representative of Residential Facilities' activities than using an IO-based approach to proxy entire profile.	Low/ Medium	Medium
Proportion of expenditure on salaries modelled from data reflecting 'Social work services' for Residential Facilities.	'Social work services' sector determined to be the most reflective sector within Belgium's national IO model of sectors available for activities within Residential Facilities.	Medium	Medium
'Social work services' input-output table categories % breakdown from 2020 data source used to proxy the breakdown for 2022.	The latest available data reflecting 'Social work services' sector in Belgium's national input-output table was 2020. 2020 data assumed to serves as a reasonable proxy for 2022 to enable analysis.	Low	Low

A.3.2 Expenditure profiles proxied through IO model analysis

An alternative approach was employed to create representative expenditure profiles for the health care providers for which no expenditure profiles based on real data were provided. This approach leverages Belgium's Federal Planning Bureau Annual Input-Output table[17] and proxy emissions profiles for Ambulatory Care, Ancillary Services, Medical Goods Providers, Preventative Care and System Administration.

A.3.2.1 Emissions derivation approach

Two sectors from Belgium's national Input-Output (IO) table were used to derive proxy expenditure. The 'Health activities' sector was used to reflect activities and proportionate expenditure of the Ambulatory Care, Ancillary Services and Medical Goods Providers health care providers. The 'Legal and Administration services' sector was used to reflect the System Administration and Preventative Care health care providers. The percentage breakdown of IO product categories for the health and administration services IO sectors are derived from Belgium's domestic spending profile. This is scaled to include both domestic and imported purchases. The percentage breakdowns are applied to the OECD national expenditure for the corresponding health care provider, resulting in a scaled expenditure profile.

Non-emissive expenditures, such as salaries, taxes, VATs are embedded within the economic transactions captured by input-output models in addition to the technical coefficients. Deriving a ratio of domestic transactions and imports to total output allows us to isolate and utilise only the emission-generating expenditure accurately. Non-emission-generating expenditures, such as salaries, taxes, and reimbursements, are removed from the final expenditure calculations.

IO product categories are mapped to EXIOBASE product categories to ensure consistency between the different health care providers. Following this, EFs from EXIOBASE were applied to the scaled expenditure profile to derive emissions figures.

A.3.2.2 Data sources and key assumptions

Table 12 further details key assumptions used in these derivations and any significant limitations of the approach.

Table 12. Expenditure profiles proxied through IO model analysis: assumptions / limitations

Assumption/ limitation	Justification	Degree of uncertainty	Impact on total results
Belgium's national input-output table used to proxy expenditure profiles for health care providers without provided "real" expenditure data. Both emission and non-emission-generating expenditure (salary, taxes etc.) as a percentage of total output for 'Health activity' and 'Administration services' sectors.	No other method identified to proxy national-level expenditure profiles for five health care providers through a consistent approach. Input-output tables provide an overview of economic transactions across various sectors. This approach has been used by the NHS in early iterations of their modelling and reporting of emissions.	Medium	Medium/High
The 'Health activities' sector is used to derive a proxy expenditure profile for multiple health care providers. Accordingly, these health care providers will appear to have the same types of and proportionate spending on activities, though this is not accurate in reality. In the same vein, the 'Legal and administration services' sector is used to derive the expenditure profile of multiple health care providers.	Where data for these health care providers are not available, the closest relevant sector in Belgium's input-output table that each health care provider relates to is used to calculate the output breakdown.	Medium	Medium/High
Proportion of expenditure on salaries proxied based on ratio of domestic outputs and imports to total output (basic prices) in IO table.	Non-emissive expenditures, such as salaries, taxes, VATs are embedded within the economic transactions captured by input-output tables. Deriving a ratio of domestic outputs and imports to total output (basic prices) allows us to isolate and utilise only the emissive expenditure accurately. This approach was similarly used to proxy the proportion of total expenditure on salaries for Residential Facilities.	Low	Low

A.3.3 Bottom-up energy data

As energy consumption represents a sizable and important emissions source within the health care sector, bottom-up data reflecting energy consumption was processed and integrated into the emissions baseline, where quality data was available. Proxy methods were also employed to extrapolate regional data from Flanders to fill data gaps in the other regions' available bottom-up energy data. This bottom-up data allowed for greater certainty in tracking these emissions than that offered by top-down spend based methods.

A.3.3.1 Emissions derivation approach

Aggregate data provided by Flanders for Hospitals, Residential Facilities, Ambulatory Care, Ancillary Services, Preventative Care, and System Administration; and data provided by Brussels for its Hospitals at the facility-level were used to derive emissions figures reflecting natural gas and electricity consumption for the associated health care providers.

Data provided by Brussels' also included Residential and Ambulatory Care facilities. However, the figures provided were suspected to only cover a subset of facilities within the region's health care providers, as they appeared to be significantly lower than expected. Accordingly, this data was not leveraged in the baseline.

Flanders' data for Residential Facilities, Ambulatory Care, Ancillary Services, Preventative Care, and System Administration was extrapolated based on the relative population of each region to derive proxy figures for Wallonia's and Brussels' associated energy consumption within these health care providers. Flanders' data for Hospitals was also extrapolated based on relative population to derive figures for Wallonia's hospitals.

A.3.3.2 Data sources and key assumptions

As outlined in Table 13 the electricity and natural gas consumption data provided and utilised for Flanders reflected all health care provider types, except for Medical Goods providers. The data provided by Brussels' captured Hospitals, Residential Facilities, and Ambulatory Care. However, only the data reflecting Brussels' Hospitals was utilised, as the other datasets were suspected to be incomplete. Emissions factors utilised to derive scope 2 and scope 3 emissions from electricity were specific to Belgium, while emissions factors reflecting natural gas consumption were leveraged from a UK-based source.

Table 13. Utilisation of bottom-up energy data: key assumptions and limitations

Assumption / limitation	Justification	Degree of uncertainty	Impact on total results
Assumption that leveraged source data captures entire health care provider within region (e.g. provided data reflecting "general hospitals", "geriatric hospitals", "specialised hospitals", "psychiatric hospitals", and "other hospitalisation services" covers energy consumption from all hospital activity within Flanders).	Data holders did not flag any data gaps, and "back of the envelop" data quality and high-level comparison checks performed.	Medium	Medium
Flanders' electricity and natural gas consumption data used to proxy figures for Residential Facilities, Ambulatory Care, Ancillary Services, Preventative Care, and System Administration in Brussels and Wallonia; and Hospitals in Wallonia (based on relative population).	Assumption that facilities within the same health care provider in each of the three regions have similar EUI and that the relative number of facilities in each region is similar to each region's relative population size.	Medium/ High	Medium / High
Brussels data provided captures the energy consumption of "combustibles" (i.e. natural gas and other fossil-based fuels). All "combustibles" assumed to be natural gas in emissions calculations.	Correspondence with data holders affirmed that the vast majority of the "combustibles" captured reflect natural gas. No information available to disaggregate natural gas from any other fuels captured in the provided figures.	Low	Low
Electricity consumption data provided reflects grid-purchased electricity (e.g. excludes any electricity generated and consumed from on-site renewable energy).	No data reflecting/indicating any non-grid purchased energy provided.	Low	Low
UK-based EFs used to derive emissions associated with natural gas.	Natural gas fuel used (and its associated carbon intensity) and upstream operations associated with natural gas and its distribution assumed to be similar between the UK and Belgium.	Low	Low

A.3.3.3 Remaining gaps in data coverage

No regional or national-level data provided captured energy consumption covering 'Retailers and Other Providers of Medical Goods'. Accordingly, the energy figures derived from the top-down expenditure-based approach were used to reflect energy consumption associated with this health care provider for each region in the final footprint.

No comprehensive bottom-up data was provided for fuel, heating/cooling/steam, or other energy sources aside from electricity and natural gas. Extrapolating annual vehicle fuel use for each region's hospitals from a singular hospital in Wallonia's annual diesel consumption was considered. However, upon further examination, the figure provided for this facility appeared to be low compared to the amount of mobile fuel consumption expected for a "typical" hospital within Belgium. Accordingly, top-down expenditure-based data reflecting hospitals' vehicle fuel consumption was utilised in the final footprint. Recommendations to increase the availability of quality bottom-up data are outlined in Section 5.

A.3.4 Other bottom-up data

In addition to using bottom-up electricity and natural gas data (detailed in Section A.3.3), bottom-up data reflecting direct emissions from MDIs was incorporated into the sectoral footprint. Emissions from hospitals' employee commuting were also calculated using bottom-up data provided. However, this emissions figure reflecting employee commuting was excluded from the final baseline, as no other information was found to proxy employee commuting emissions associated with other health care providers and as employee commuting patterns are expected to differ considerably between regions and facilities of different sizes.

A.3.4.1 Emissions derivation approach

Calculation methods are described for both emissions sources below. As the top-down emissions baseline did not capture any source data reflecting MDI usage, the bottom-up derived figures were added to the top-down baseline, and no emissions derived through the top-down approach were replaced or subtracted.

MDIs

A publicly available national-level figure reflecting the annual emissions released from the direct use of MDIs was disaggregated by region based on population. All emissions associated with MDIs are captured under the Medical Goods Providers health care provider and are consolidated under "Pharmaceuticals" emissions source categorisation within scope 3.

Employee commuting

Data reflecting commuting patterns from an employee survey from a singular facility in the German-Speaking region within Wallonia was processed and used to proxy emissions associated with employee commuting for that facility and to for all hospitals across Belgium. These figures, however, were excluded from the final baseline, as no other information was found to proxy employee commuting emissions associated with other health care providers and as employee commuting patterns are expected to differ considerably between regions and facilities of different sizes.

To derive an emissions estimate for annual commuting emissions of the singular hospital, distributions of employee distances from work were applied evenly to the breakdown of commuting modes selected by respondents and employee count. EFs corresponding to each of these modes were applied next to derive daily commuting emissions for the hospital. These results were extrapolated to reflect a full year of commuting-related emissions for the hospital (assuming 250 working days per year and no teleworking).

Emissions derivations for this facility were then extrapolated to cover all of Wallonia, assuming each hospital within the region have identical commuting emissions. This data was further extrapolated to the other regions, based on relative hospital count.

Annual **employee commuting emissions for the singular hospital that provided data are estimated to be 0.24 ktCO$_2$e.** If this figure is extrapolated to a national scale (based on regional hospital counts), **employee commuting of all hospitals across Belgium is estimated to generate 39.4 ktCO$_2$e annually**. However, employee commuting patterns may differ considerably between regions and facilities. (Greater data availability reflecting employee commuting patterns across different health care provider types would be needed to more accurately estimate employee commuting emissions across the sector.)

A.3.4.2 Data sources and key assumptions

As outlined in Table 10, the MDI national-level figure utilised was taken from a national-level F gas study. Emissions figures associated with employee commuting were derived from data from a singular hospital within the German-Speaking Community's survey information (e.g. tiers of distances from homes to the facility, modes of transport utilised etc.) and UK-based emissions factors.

Table 14 further details key assumptions used in these derivations and any significant limitations of the approach.

Table 14. Utilisation of other bottom-up data: key assumptions and limitations

Assumption / limitation	Justification	Degree of uncertainty	Impact on total results
Emissions associated with MDI usage classified entirely under Medical Goods Providers health care provider; and assumed to be even distributed by population amongst regions.	In reality, MDIs are likely used and/or issued in other health care providers (e.g. Hospitals, Residential Facilities). However, there is no available data to disaggregate the national level figure between health care providers. Further, a large proportion of MDI usage assumed to occur outside of health care facilities.	Medium	Low
Employee commuting trends of singular facility in German-Speaking region assumed to be representative of hospitals across Belgium.	No other data source to proxy hospitals' employee commuting emissions available. In reality, there will be differences between employee commuting between facilities and between regions. For instance, Brussels is likely to have a greater uptake of public transportation than Wallonia and Flanders. Hospitals' employee counts and average distances travelled to work may also differ considerably.	Medium	Medium
UK-based EFs for "average car", "average local bus" used to derive emissions associated with employee commuting.	Fuel use and fuel economy for an "average car" and an "average local bus" assumed to be similar between the UK and Belgium.	Low	Low

A.3.5 Post-processing of emissions derivations from top-down approach

Adjustments were made to top-down derived emissions figures reflecting energy consumption and pharmaceutical procurement help improve the precision of the associated emissions derivation methods and incorporate scope 1 emissions that are not captured in EFs from EXIOBASE.

Accounting for combustion of direct fossil fuel usage

Emissions factors from EXIOBASE 3 reflect the upstream or "well-to-tank" emissions associated with extracting, refining, and transporting fuels to the end users but do not capture the direct emissions (i.e. scope 1 emissions) associated with the combustion of fossil fuels.

To capture scope 1 emissions associated with the direct use of fossil fuels, a ratio of upstream emissions (i.e. "well-to-tank" emissions) to direct, combustion-related emissions were derived from a UK Government emissions intensity dataset published for every fossil fuel source included in the footprint. These ratios were applied to each fossil fuel-based energy source included in the top-down approach to quantify an estimate of direct emissions.

The indirect emissions derived from the direct application of the original EXIOBASE EFs are reflected in the baseline as well, captured under the scope 3 "fossil fuels (coal, oil etc.)" reporting category.

Disaggregation of scope 2 and scope 3 emissions associated with electricity and steam consumption

Emissions factors from EXIOBASE 3 reflect the consolidated indirect emissions associated with electricity and steam consumption (i.e. scope 2 emissions and upstream scope 3 emissions). To disaggregate emissions figures derived from EXIOBASE EFs, an approximate proportion between the emissions corresponding to the use of any fossil fuels in the generation of electricity and steam (i.e. scope 2) and those reflecting upstream "well-to-tank" emissions and emissions associated with energy losses during transmission and distribution (i.e. indirect scope 3 emissions) were derived for both energy and steam. This proportion was applied to each initial emissions output derived from expenditure-based and the use of an EXIOBASE EF associated with electricity and steam to disaggregate the scope 2 and scope 3 emissions. These proportions were derived from detailed emissions factors from the UK Government emissions intensity dataset, as this source provides a breakdown of upstream emissions for these two energy sources.

The scope 2 emissions are captured in the baseline's "scope 2" reporting category. The indirect scope 3 emissions are reflected in the "electricity and steam (scope 3)" reporting category.

Adjustment to emission factors associated with pharmaceuticals

The EXIOBASE EF associated with "Chemicals nec" is inclusive of upstream emissions of both pharmaceuticals and other types of chemicals. High-level desk research performed for this project suggested that the EXIOBASE "Chemicals nec" EF likely considerably overestimates emissions associated with pharmaceuticals. As a substantial proportion of the sector's expenditure is associated with medicine and pharmaceuticals, using an overestimated emissions factors can inflate the emissions baseline considerably.

To derive emissions figures associated with pharmaceutical expenditure, this baseline employs a UK-based EF associated with "basic pharmaceutical products and pharmaceutical preparations" (adjusted for inflation to reflect the 2022 reporting year) in lieu of the EXIOBASE factor associated with chemicals. This adjustment was made to increase precision surrounding the largest emissions source within the entire sector, despite its divergence from the rest of the footprint's methods. More granularity in EXIOBASE emissions factors categories, a Belgium-specific pharmaceutical emissions factor, or another more reliable emissions factor reflecting pharmaceuticals would be needed to improve the pharmaceutical estimation for all health care providers across Belgium.

A.3.5.1 Data sources and key assumptions

As outlined in Table 10, UK-based emissions factors from DESNZ were used to derive the proportions between scope 1 and scope 3 emissions for fossil fuels and the proportions between scope 2 and scope 3 emissions for electricity and steam use. DEFRA spend-based emission factors from "UK Footprint Results 1990-2020", produced by the University of Leeds (2020) were used to source an emissions factor reflecting "Basic pharmaceutical products and pharmaceutical preparations". The availability of a Belgium-specific emissions factors dataset that includes scope 1 and scope 3 emissions from fossil fuels, scope 2 and scope 3 emissions from electricity and steam and pharmaceuticals would help improve the estimations for these categories for all health care providers across Belgium.

Table 15 further details key assumptions used in these derivations and significant limitations of the approach.

Table 15. Post-processing: key assumptions and limitations

Assumption / limitation	Justification	Degree of uncertainty	Impact on total results
UK-based pharmaceuticals emissions factor reflecting "Basic pharmaceutical products and pharmaceutical preparations" assumed to be more reflective of emissions from pharmaceutical consumption in Belgium than the Belgium-specific EXIOBASE emissions factor reflecting "Chemicals nec" (after adjustment for inflation).	The categorisation from the UK-based source is more reflective of the product/activity. Desk research supported supposition that EXIOBASE "Chemicals nec" emissions factors overestimates emissions associated with pharmaceuticals in other countries.	Medium	Medium
UK-based EFs used to proxy the ratio between scope 1 emissions and scope 3 emissions for a range of fossil fuels.	Fuel types and upstream activities associated with fossil fuel sources assumed to be similar between the UK and Belgium.	Low	Low
UK-based EFs used to proxy the proportional breakdown between the scope 2 and scope 3 components for both electricity and steam use.	Electricity and steam generation and distribution assumed to be similar between the UK and Belgium.	Low	Low