



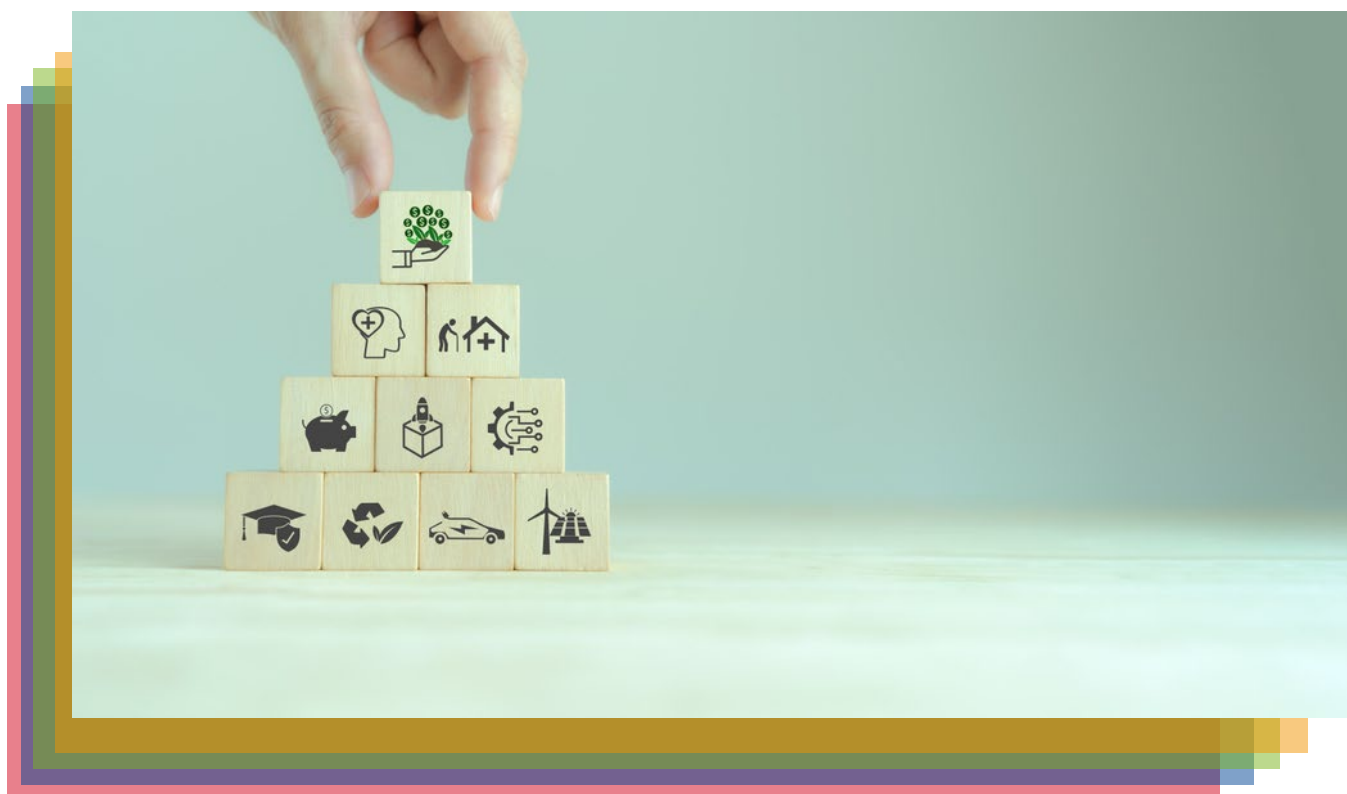
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SUPPLEMENT – LITERATURE

HEALTH SYSTEM PERFORMANCE ASSESSMENT (HSPA): A FIRST STEP IN THE ASSESSMENT OF ENVIRONMENTAL SUSTAINABILITY



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All experts consulted within this report were selected because of their involvement in the topic. Therefore, by definition, each of them might have a certain degree of conflict of interest to the main topic of this report.

Membership of a stakeholder group on which the results of this report could have an impact: David Grimaldi (The Shifters Belgium asbl, a volunteer organization, has no personal commercial ties. There is no financial impact from the KCE's work, but an 'intellectual' impact), David Hercot (On a voluntary basis, collaborator with the Anthropocene Observatory and Health for Future Belgium)

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Disclaimer:

- The external experts were consulted about a (preliminary) version of the scientific report. Their comments were discussed during meetings. They did not co-author the scientific report and did not necessarily agree with its content.
- Subsequently, a (final) version was submitted to the validators. The validation of the report results from a consensus or a voting process between the validators. The validators did not co-author the scientific report and did not necessarily all three agree with its content.
- Finally, this report has been approved by common assent by the Executive Board.
- Only the KCE is responsible for errors or omissions that could persist. The policy recommendations are also under the full responsibility of the KCE.

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■ APPENDICES – IDENTIFICATION OF TOPICS AND SELECTION OF INDICATORS

APPENDIX 1. REVIEW OF THE INDEXED SCIENTIFIC LITERATURE

Appendix 1.1. Search strategy

Table 1 – Search strategy in Ovid(MEDLINE)

Database: Ovid MEDLINE(R) and Epub Ahead of Print, In-Process, In-Data-Review & Other Non-Indexed Citations, Daily and Versions <1946 to August 08, 2024>

Search Strategy:

-
- 1 "Delivery of Health Care"/ (123412)
 - 2 *Health Care Sector/ (4205)
 - 3 *Ambulatory Care Facilities/ (11748)
 - 4 *Hospitals/ (53360)
 - 5 *Laboratories/ (17538)
 - 6 *Pharmacies/ (7975)
 - 7 *Physicians' Offices/ (1087)
 - 8 *Rehabilitation Centers/ (4318)
 - 9 *Residential Facilities/ (3401)
 - 10 *Emergency Medical Services/ (36928)
 - 11 ""Health Services for the Aged"/ (14142)
 - 12 *Mental Health Services/ (31487)
 - 13 *Hospitalization/ (48025)
 - 14 *Nursing Care/ (24754)
 - 15 *preventive health services/ (9149)
 - 16 *Palliative Care/ (36484)
 - 17 *Ambulatory Care/ (20947)
 - 18 *Long-Term Care/ (11244)
 - 19 *Pharmaceutical Services/ (8144)
 - 20 *Primary Health Care/ (56853)
 - 21 *Digital Health/ (138)
 - 22 *Telemedicine/ (35040)
 - 23 *Prescription Drugs/ (5380)



- 24 *Drug Therapy/ (23383)
- 25 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 (553952)
- 26 health system?.ti,kf. (21039)
- 27 healthcare system?.ti,kf. (5805)
- 28 health care system?.ti,kf. (7547)
- 29 hospital*.ti. (402048)
- 30 care facilit*.ti. (7200)
- 31 pharmaceutical*.ti. (38070)
- 32 drug*.ti. (490128)
- 33 health facility.ti,kf. (1441)
- 34 health facilities.ti,kf. (4424)
- 35 health sector.ti,kf. (1744)
- 36 health services.ti,kf. (46986)
- 37 Pharmaceutical Services.ti,kf. (794)
- 38 Primary Health Care.ti,kf. (20714)
- 39 healthcare sector.ti,kf. (401)
- 40 health care sector.ti,kf. (327)
- 41 (healthcare adj3 delivery).ti,kf. (2018)
- 42 (health care adj3 delivery).ti,kf. (13753)
- 43 healthcare industry.ti,kf. (264)
- 44 telemedicine.ti,kf. (20581)
- 45 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33 or 34 or 35 or 36 or 37 or 38 or 39 or 40 or 41 or 42 or 43 (1031580)
- 46 25 or 45 (1453633)
- 47 exp Climate Change/ (33998)
- 48 Greenhouse Effect/ (6272)
- 49 Environmental Pollutants/ (47697)
- 50 exp Waste Management/ (107515)
- 51 Gases/ (24347)
- 52 *Air Pollution/ (33689)
- 53 *"Environmental Restoration and Remediation"/ (7173)
- 54 *Waste Products/ (3939)
- 55 *Water Pollution/ (9029)
- 56 exp environmental pollutants/ (373775)



57 47 or 48 or 49 or 50 or 51 or 52 or 53 or 54 or 55 or 56 (517362)

58 global warming.ti,kf. (3722)

59 environmental impact?.ti,kf. (4633)

60 environmental sustainability.ti,kf. (1582)

61 carbon footprint?.ti,kf. (1447)

62 waste.ti,kf. (47045)

63 pollution*.ti,kf. (60675)

64 particle*.ti,kf. (98761)

65 carbon emission?.ti,kf. (3088)

66 gas emission?.ti,kf. (2936)

67 environmental footprint?.ti,kf. (257)

68 net zero.ti,kf. (371)

69 biodiversity.ti,kf. (16304)

70 low carbon.ti,kf. (1323)

71 58 or 59 or 60 or 61 or 62 or 63 or 64 or 65 or 66 or 67 or 68 or 69 or 70 (235670)

72 57 or 71 (672848)

73 46 and 72 (13065)

74 ((systematic review or systematic literature review or systematic scoping review or systematic narrative review or systematic qualitative review or systematic evidence review or systematic quantitative review or systematic meta-review or systematic critical review or systematic mixed studies review or systematic mapping review or systematic cochrane review or "systematic search and review" or systematic integrative review).ti. not comment.pt. not (protocol or protocols).ti. not medline.st.) or (Cochrane Database Syst Rev.ja. and review.pt.) or systematic review.pt. (319535)

75 meta-analys*.ti. (208811)

76 meta-analysis.pt. (205870)

77 exp Technology Assessment, Biomedical/ (12416)

78 health technology assessment.ti,kf. (3103)

79 HtA.ti,kf. (941)

80 74 or 75 or 76 or 77 or 78 or 79 (450175)

81 73 and 80 (152)

82 limit 81 to yr="2015-Current" (138)



Table 2 – Search strategy in Embase

Embase session results (9 Aug 2024)

No.	Query	Results
#74	#73 NOT ('conference abstract'/it OR 'conference paper'/it OR 'conference review'/it)	61
#73	#72 AND [2015-2024]/py	111
#72	#71 NOT [medline]/lim	132
#71	#70 AND ('meta-analysis'/exp OR 'meta-analysis' OR 'systematic review'/exp OR 'systematic review')	419
#70	#68 AND #69	27621
#69	#21 OR #41	4389943
#68	#53 OR #67	855047
#67	#54 OR #55 OR #56 OR #57 OR #58 OR #59 OR #60 OR #61 OR #62 OR #63 OR #64 OR #65 OR #66	215284
#66	'low carbon':ti	1024
#65	biodiversity:ti	8541
#64	'net zero':ti	242
#63	'environmental footprint\$':ti	195
#62	'gas emission\$':ti	2316
#61	'carbon emission\$':ti	2245
#60	particle*:ti	94106
#59	pollution*:ti	51136
#58	waste:ti	51138
#57	'carbon footprint?':ti	101
#56	'environmental sustainability':ti	1005
#55	'environmental impact\$':ti	3945
#54	'global warming':ti	1739
#53	#42 OR #43 OR #44 OR #45 OR #46 OR #47 OR #48 OR #49 OR #50 OR #51 OR #52	736846
#52	'water pollutant'/mj	21015
#51	'water pollution'/mj	29007
#50	'hospital waste'/exp/mj	2398
#49	'waste'/mj	4521
#48	'ecosystem restoration'/mj	4096
#47	'air pollution'/mj	55026
#46	'gas'/de	48312



#45	'waste management'/exp	244983
#44	'pollutant'/exp	431821
#43	'greenhouse effect'/de	19477
#42	'climate change'/exp	69109
#41	#22 OR #23 OR #24 OR #25 OR #26 OR #27 OR #28 OR #29 OR #30 OR #31 OR #32 OR #33 OR #34 OR #35 OR #36 OR #37 OR #38 OR #39 OR #40	1365413
#40	telemedicine:ti	14091
#39	'healthcare industry':ti	274
#38	('health care' NEAR/3 delivery):ti	2890
#37	(healthcare NEAR/3 delivery):ti	1390
#36	'health care sector':ti	324
#35	'healthcare sector':ti	388
#34	'primary health care':ti	11856
#33	'pharmaceutical services':ti	681
#32	'health services':ti	25046
#31	'health sector':ti	1784
#30	'health facilities':ti	2843
#29	'health facility':ti	1234
#28	drug*:ti	670035
#27	pharmaceutical*:ti	61992
#26	'care facilit*':ti	8622
#25	hospital*:ti	552712
#24	'health care system\$':ti	8067
#23	'healthcare system\$':ti	6540
#22	'health system\$':ti	19385
#21	#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11 OR #12 OR #13 OR #14 OR #15 OR #16 OR #17 OR #18 OR #19 OR #20	3453906
#20	'drug therapy'/exp/mj	933636
#19	'prescription drug'/exp/mj	4263
#18	'telemedicine'/exp/mj	39339
#17	'digital health'/exp/mj	954
#16	'primary health care'/exp/mj	76526
#15	'long term care'/exp/mj	103919
#14	'ambulatory care'/exp/mj	19412
#13	'palliative therapy'/exp/mj	53198



#12	'preventive health service'/exp/mj	13466
#11	'nursing care'/exp/mj	26176
#10	'hospitalization'/mj	51578
#9	'mental health service'/exp/mj	35505
#8	'elderly care'/exp/mj	45636
#7	'rehabilitation center'/mj	4648
#6	'pharmacy (shop)/exp/mj	52675
#5	'laboratory'/exp/mj	37882
#4	'hospital'/mj	94166
#3	'outpatient department'/mj	19178
#2	'health care facilities and services'/exp/mj	2509647
#1	'health care delivery'/mj	67267

Appendix 1.2. Flow charts and summary tables

Appendix 1.2.1. Studies on the carbon footprint of the health system

The flow chart is in the scientific report.

Table 3 – Impact categories in reviews on the carbon footprint of the health system

<i>First Author (publication year)</i>	<i>Setting</i>	<i>Impact categories (unit of measure)</i>
<i>Steenmeijer et al. (2022)¹</i>	Health system	- GHG emissions, in kilotonnes (kt) Carbon Dioxide (CO₂) equivalent (eq) - Blue water consumption, in cubic megameter (Mm³) - Abiotic material extraction, in kt - Land use, in square kilometer (km²) - Total waste generation, in kt
<i>Malik et al. (2021)²</i>	Health system	- GHG emissions, in kt CO₂ eq - Water use, in megalitre (ML) - Total waste generation, in tonnes (t)
<i>Lenzen et. (2020)³</i>	Health system	- GHG emissions, in megatonnes (Mt) CO₂ eq - Particulate matter, PM₁₀ or less, in Mt - Air pollutants: nitrogen oxides (NO_x Footprint, in kt) and sulphur dioxide (SO₂ Footprint in Mt) - Malaria risk, in million people, - Reactive nitrogen in water, in Mt - Scarce water use, in teralitre (TL)
<i>Eckelman et al. (2020)⁴ and Eckelman et al. (2018)⁵</i>	Health system	- GHG emissions - Health damages (in DALYs) from GHG and non-GHG emissions in air, soil, and water, for the following impact categories = cancer and non-



		cancer toxicity, disease from exposure to respirable organics and inorganics (PM), and skin cancer from ozone layer depletion)
<i>Eckelman et al. (2016)</i> ⁶	Health system	• Global warming: GHG emissions in kg CO₂ eq ; • Acidification potential, in kg SO₂-eq; • Particulate matter (PM), in kg PM_{2.5} eq; • Eutrophication potential; in kg nitrogen equivalents (N eq) • Ozone depletion potential, in kg trichlorofluoromethane (CFC-11) eq; • Photochemical oxidation potential (smog formation), in kg ozone (O₃) eq; • Ecotoxicity potential, in 2,4-dichlorophenoxyacetic acid (2,4-d) eq; • Human health cancer effects, in kg benzene eq; • Human health non-cancer effects, in kg toluene eq
<i>Tennison et al. (2021)</i> ⁷ <i>Nansai et al. (2020)</i> ⁸ ; <i>Weisz et al. (2020)</i> ⁹ ; <i>Karliner et al. (2019)</i> ¹⁰ ; <i>Pichler et al. (2019)</i> ¹¹ ; <i>Wu (2019)</i> ¹² ; <i>Malik et al. (2018)</i> ¹³ ; <i>SDU (2016)</i> ¹⁴ ;	Health system	GHG emissions, in kilotonnes of CO ₂ eq
<i>Keller et al. (2021)</i> ¹⁵	Hospitals	16 environmental impact categories: • Global warming: GHG emissions in kg CO₂ eq; • Acidification potential, in moles of hydrogen ion equivalent (mol H⁺ eq); • Particulate matter (PM), in disease included; • Ozone depletion potential, in kg trichlorofluoromethane (CFC-11) eq; • Ozone formation, in kilograms of Non-Methane Volatile Organic Compounds equivalent (kg NMVOC eq) • Ionising radiations, in kilobecquerels of Uranium-235 equivalent (kBq U-235 eq) • Eutrophication, Freshwater, in kilograms of Phosphorus equivalent (kg P eq) • Eutrophication, Marine, in kilograms of Nitrogen equivalent (kg N eq) • Eutrophication, Terrestrial, in moles of Nitrogen equivalent (mol N eq) • Human Toxicity, cancer, in number of cases • Human Toxicity, non-cancer, in number of cases • Freshwater Ecotoxicity, Potentially Affected Fraction of species per cubic meter per day (PAF.m³.day) • Land use, in dimensionless unit (Pt) • Water use, in cubic meters of water deprived (m³) • Resource use, fossil fuels, in Megajoules (MJ)



		Resource use, minerals and metals, in kilograms of Antimony equivalent (kg Sb eq)
<i>Nicolet et al. (2022)</i> ¹⁶	Primary care	GHG emissions, in kilotonnes of CO ₂ eq

Appendix 1.2.2. Studies on interventions related to building and energy use

Figure 1 – Flow chart on “building and energy use”

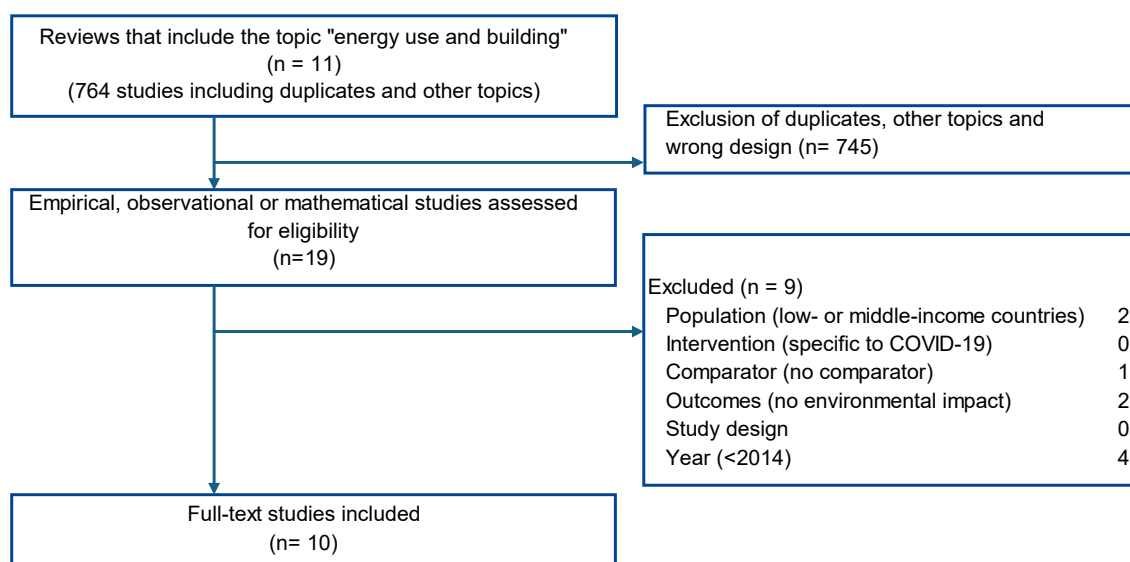


Table 4 – Studies on building and energy use

First author (year, country)	Intervention	Results	Impact
Turning off devices			
<i>Woolen USA</i> ¹⁷ (2023,	Switching MRI unit to off mode or power-save mode for 12 hours overnight	Off mode: Annual savings of 12.3–21.0 MW-hours and 8.7–14.9 tonnes of CO ₂ eq per unit (-25% and -33%). Power-save mode: saving an additional 8.8–11.4 MW-hours, and 6.2–8.1 tonnes of CO ₂ eq per year for 12 hours overnight per unit.	+
<i>Brown Canada</i> ¹⁸ (2022,	CT scanner powered down during overnight and Sunday	Saving of approximately 14 000 kWh over one year (95% confidence interval 13 899 kWh-14 464 kWh)	+
<i>Büttner Germany</i> ¹⁹ (2021,	Turning off workstations during out-of-hours periods	Annual savings of 3.2 tonnes of CO ₂ eq for 227 workstations	+
<i>McGain Australia</i> ²⁰ (2017,	Switching off idle sterilisers	Savings of ~70 kWh of electricity per day (21 457 kWh for 304 days, own calculation)	+
<i>McGain Australia</i> ²¹ (2016,	Strategy 1: Switching off idle sterilisers Strategy 2: Switching off one steriliser at 10 am	Strategy 1: Reduction of 79 tonnes of CO ₂ emissions per year for four steam sterilisers and reduction of 1004kl water use per year	+



	and a second steriliser at midnight	Strategy 2: Reduction of 35.8 tonnes CO ₂ per year for four steam sterilisers and reduction of 456kl water use per year	
Burke Ireland ²² (2015,	Turning off ancillary electrical equipment, lighting, desktop and workstation during out-of-hours periods	Annual savings between 6656 kWh and 27 542 kWh	+
McCarthy Ireland ²³ (2014,	Education, audit and feedback to turn off devices when not in use	Education and audit has no significant effect	No
		Turning off desktop computers and communications system overnight and/or at weekends could reduce annual emissions of CO ₂ eq equivalent to over 10 passenger cars in a radiology department.	+
Health records			
Garcia-Berna (2021, Spain) ²⁴	Promoting sustainable practices for health records development	Elements such as complex patient portals' designs increase energy consumption	+
Building and materials			
Prada (2020, Romania) ²⁵	Promoting more efficient energy class A buildings compared to class C and D buildings	Annual savings between 1020 and 1432 tonnes CO ₂ eq per hospital	+
Botejara-Antúñez (2023, Spain) ²⁶	Promoting heating, ventilation and air conditioning (HVAC) duct types with a favourable environmental impact	Aluminium HVAC duct type with helical steel wire reinforcement and fibreglass insulation had the best environmental results but are too vulnerable to be suitable for healthcare building. Duct type of copper sheeting with rock wool insulation had the second most favourable environmental impact and is suitable for healthcare building.	+



Appendix 1.2.3. Studies on interventions related to transport and mobility - Teleconsultations

Figure 2 – Flow chart on “teleconsultations”

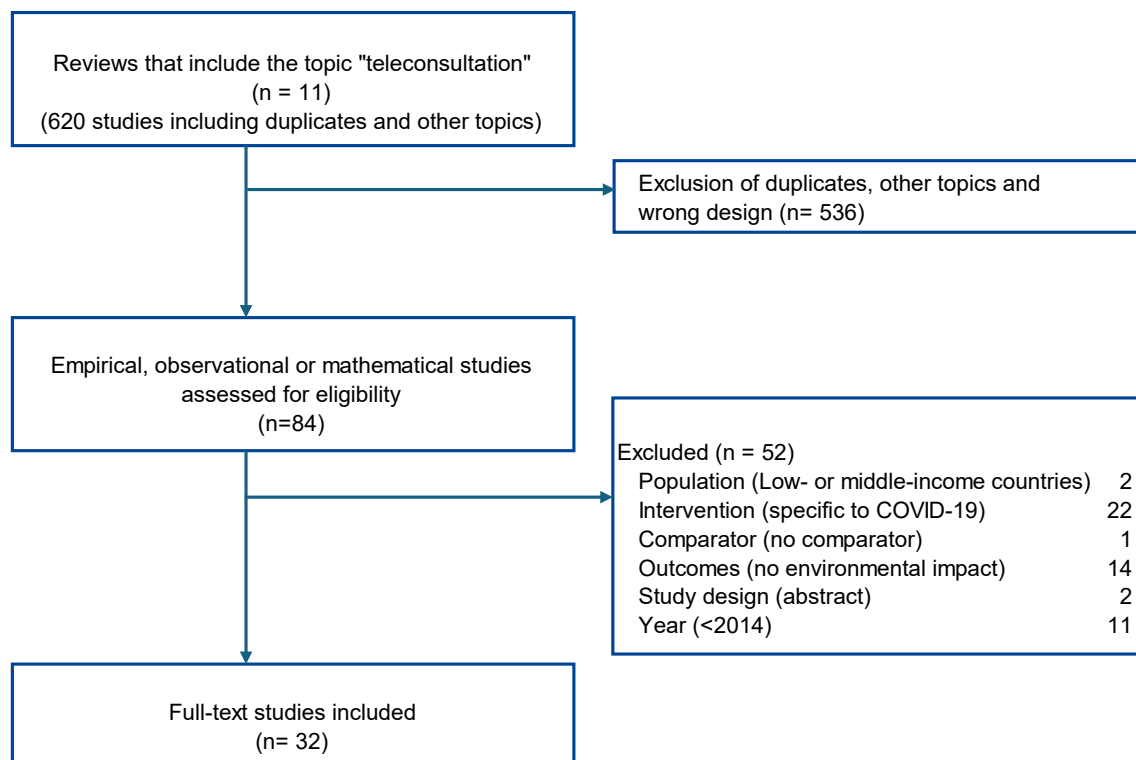


Table 5 – Studies on teleconsultations

	Intervention	Input: Average kg CO ₂ eq per km	Input: Kg CO ₂ eq per teleconsultation for teleconsultation material	Input: Average distance saved per teleconsultation	Output: Average kg CO ₂ eq saved per teleconsultation	Negative impact of unnecessary teleconsultations	Impact
<i>Studies based on avoided distance only (n=29)</i>	Teleconsultations	0.27 (range: 0.04 -1.59 kg CO ₂ eq/km)	Not taken into account	260 km (range: 15km - 1387 km)	80 kg CO ₂ eq (range: 0.9 - 372 kg CO ₂ eq)	Not taken into account	+ (*)
<i>Studies including the impact of teleconsultation material (n=4)</i>	Teleconsultations	0.23 (range: 0.10-0.52 kg CO ₂ eq/km)	0.014 and 8.43 kg CO ₂ eq per TC	355 km (range: 84 - 879 km)	67 kg CO ₂ eq (range: 14 and 177 kg CO ₂ eq)	Not taken into account	+ (*)
<i>Belgian report (n=1)</i>	Teleconsultations	0.218 kg CO ₂ eq/km	0.003 – 0.05 kg CO ₂ eq per TC	Two scenarios: 5.89 km and 14.50 km	1.3-3.2 kg CO ₂ eq	Not taken into account	+ (*)

(*) But overall impact unknown as the negative impact of unnecessary teleconsultations was not taken into account



Appendix 1.2.4. Studies on interventions related to transport and mobility – Proximity of the supply

Figure 3 – Flow chart on “proximity of healthcare supply”

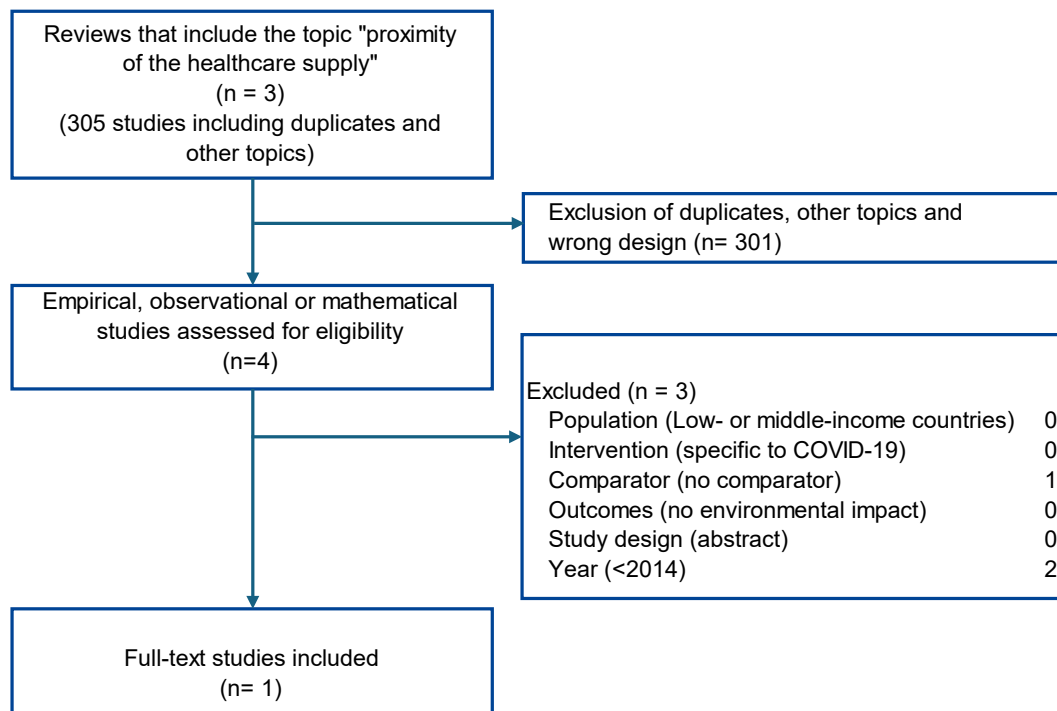


Table 6 – Studies on the proximity of the supply

First author (year, country)	Intervention	Results	Impact
Duane (2014, Scotland) ²⁷	Selecting the closest site (for dental care)	-210 tonnes CO ₂ eq	+

Appendix 1.2.5. Studies on interventions related to transport and mobility – Green healthcare fleet

Figure 4 – Flow chart on “green healthcare fleet”

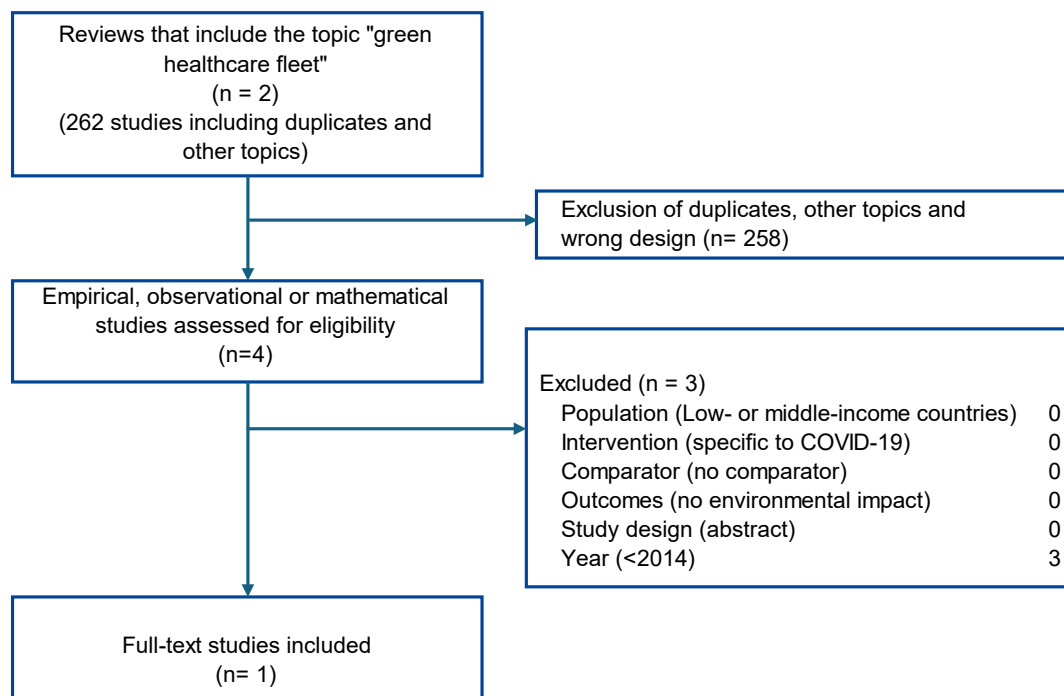


Table 7 – Studies on a green healthcare fleet

First author (year, country)	Intervention	Results	Impact
Keil (2022, Germany) ²⁸	Switching the German healthcare fleet from fuel to diesel vehicle	-2 592kg CO ₂ eq per year	+
	Switching the German healthcare fleet from fuel to electric vehicle	Between -9 715 and - 11 285kg CO ₂ eq per year	+



Appendix 1.2.6. Studies on interventions related to medical products – high carbon inhalers

Figure 5 – Flow chart on “medical products – high carbon inhalers”

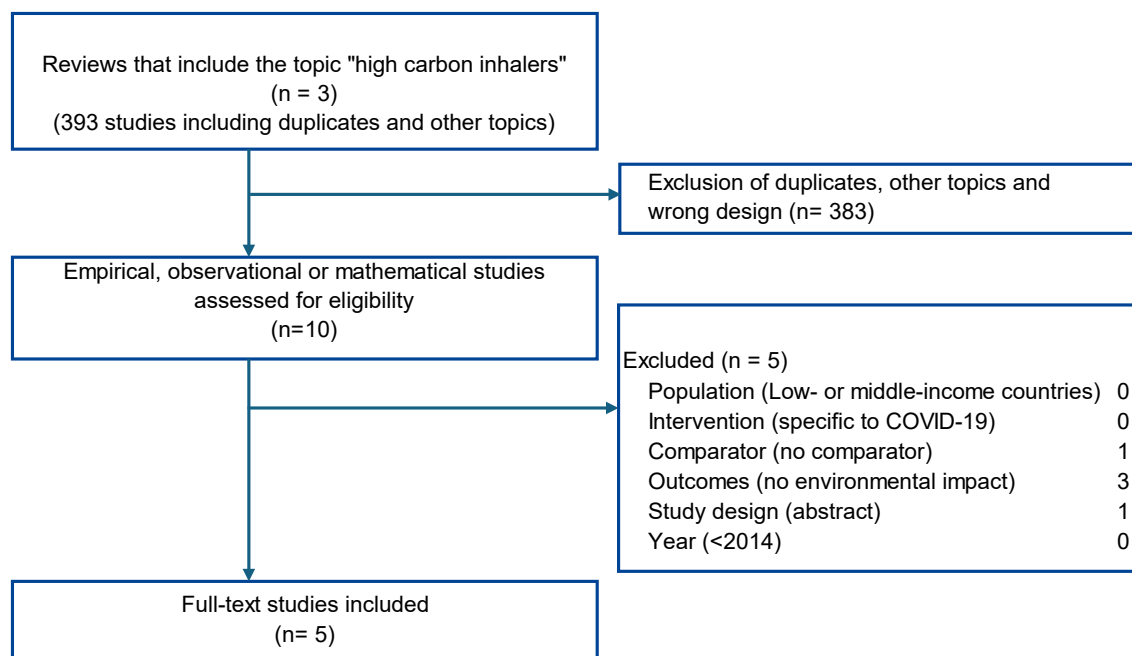


Table 8 – Studies on medical products: high carbon inhalers

First author (year, country)	Use (% of all inhalers)	Annual impact, kt CO ₂ eq (%)	Intervention (impact)
Nagasaki (2023, Japan) ²⁹	- pMDI: 22.6% - DPI: 69.5% - SMI: 7.9%	- pMDI: 184.0 kt (90.9%) - DPI: 18.5 kt (9.1%) - SMI: 0 - Total: 202.5 kt CO₂eq	10% replacement of pMDI by DPI would reduce emissions by 6.7% (+) 10% replacement of pMDI by new pMDI (HFA-152a) would reduce total emissions by 8.4% (+)
Owens (2023, Ireland) ³⁰	- MDI: 59% - DPI – SMI: 41%	- MDI: 52.95 kt (97%) - DPI-SMI: 1.82 kt (3%) - Total: 54.77 kt CO₂eq	No intervention was tested but the study also highlight the important impact of MDI.
Ten Have (2022, The Netherlands) ³¹	- pMDI: 49.6% - DPI-SMI: 50.4%	Total: 90 kt CO₂eq	Replacement of pMDI by DPI-SMI if feasible (not always feasible) would reduce emissions by 70% (+)
Wilkinson (2019, England) ³²	- MDI: around 70% - DPI-SMI: around 30%	MDI: 635 kt CO₂e	10% replacement of MDI by DPI would save 58 kt CO₂ eq annually (and 288 kt CO₂ eq if 50%) (+)
Pernigotti (2021, UK, Italy, France,	pMDIs: between 37.3% (Italy)	pMDI: between 170 kt (93.7%, Italy) and 1200 kt (98.4%, UK)	Forced switching from pMDI to DPI-SMI (excluding SABA inhaler) would reduce emissions by 64-71%



Germany and Spain ³³	- and 69.6% (UK) - DPI-SMI: between 30.4% (UK) and 62.7% (Italy)	DPI-SMI: between 12kt (6.3%, Italy) and 24kt (5.3%, Germany)	(clinically feasible switching: 20-35%) (+) - Replacement of current pMDI by new pMDI (HFA-152a) would reduce emissions by 68-84% (excluding SABA) and by 82-89% (including SABA) (+) - Minimising SABA inhalers use would reduce emissions by 17%-48% (+) - A recycling of all inhalers could theoretically reduce end-of-life emissions by 100% (+)
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DPI = dry powder inhaler; pMDI = pressurised metered-dose inhaler; SMI = soft mist inhalers; SABA: Short-Acting Beta-2 Agonist

Appendix 1.2.7. Studies on interventions related to medical products – High carbon anaesthetic gases

Figure 6 – Flow chart on “medical products – high carbon anaesthetic gases”

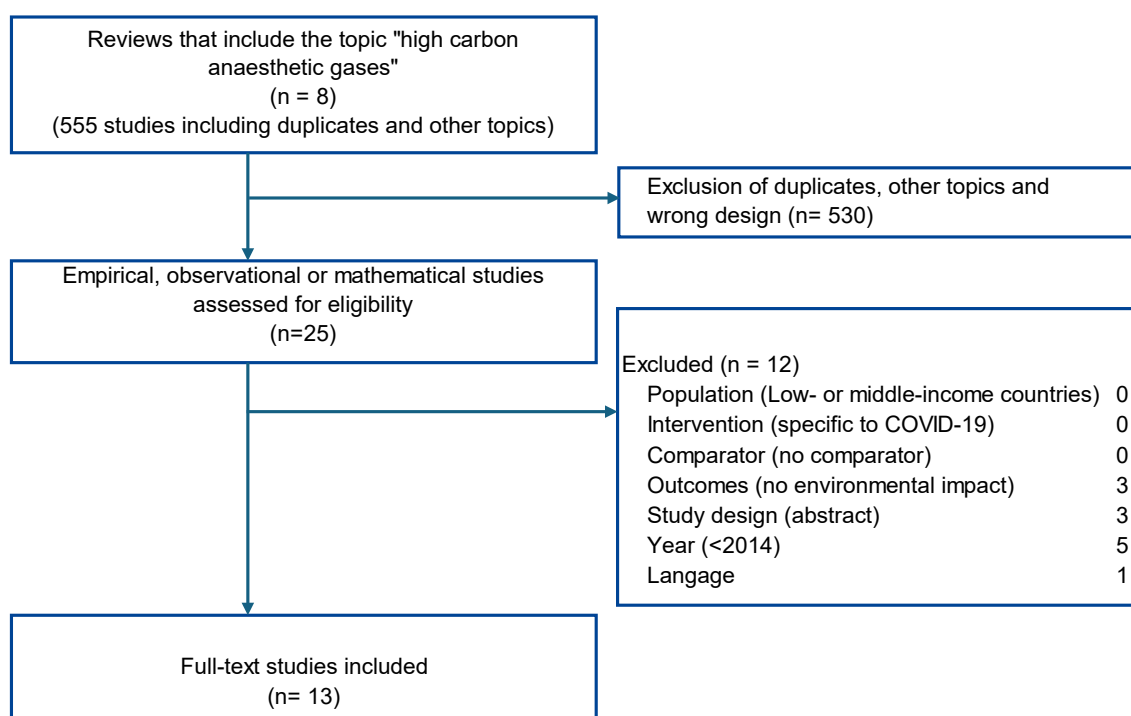




Table 9 – Studies on medical products: high carbon anaesthetic gases

First author (year, country)	Intervention	Results	Impact
Ang (2023, Singapore)	Quality project to reduce the median usage of desflurane by 50% (by volume), and reduce the number of theatre cases administering desflurane by 50% in a large tertiary teaching hospital	> 840 tonnes CO ₂ eq saved per year	+
Carter (2019, UK)³⁴	Education to increase low-flow anaesthesia and encourage isoflurane use (remove of sevoflurane vaporizer)	18% reduction in volatile gas bottles ordered and 25% decrease in total expenditure on volatile agents despite an increase in theatre activity	+
Chambrin (2023, France)³⁵	Education to decrease desflurane and sevoflurane use and increase propofol use + set up of sustainable anaesthesia groups	90% reduction of CO ₂ eq over 100 year. The carbon footprint of sevoflurane and desflurane started decreasing, with a slope changing from -0.27 (95% CI -1.08 to 0.54) tonnes CO ₂ eq / month to -14.16 (95% CI, -16.67 to -11.65) tonnes CO ₂ eq / month during the first education period and kept decreasing, with a slope of -7.58 (95% CI, -13.74 to -1.41) tonnes CO ₂ eq / month during the second education period.	+
Davies (2023, Australia)³⁶	Replacing desflurane and isoflurane anaesthesia with low-flow sevoflurane anaesthesia or propofol TIVA anaesthesia in one large tertiary hospital	Replacing desflurane and isoflurane with low flow sevoflurane would save approximately 257 773 kg CO ₂ eq for the year Replacing desflurane and isoflurane with propofol TIVA anaesthesia would save approximately 270 474 kg CO ₂ eq for the year	+
Davies (2023, Australia)³⁷	Reducing desflurane use in 15 departments	Reduction of 592 364 kg CO ₂ eq per year	+
Glenski (2020, USA)³⁸	Education to increase use of low-flow anaesthesia and decrease sevoflurane use in a tertiary paediatric center	Reduction of 28.5 Mt CO ₂ eq per year	+
Hu (2021, UK)³⁹	Different scenario on the use of inhaled anaesthetic gases (desflurane, sevoflurane and isoflurane) and intravenous propofol; on the use of vapor-capturing technology; and on the use of nitrous oxide	Desflurane has the highest carbon footprint in all scenarios and propofol has the lowest carbon footprint. The impact of sevoflurane is not smaller than that of desflurane in most scenarios unless nitrous oxide is not used as the carrier gas and sevoflurane is not manufactured by tetrafluoroethylene. Avoidance of using the intermediate tetrafluoroethylene can significantly reduce the carbon footprint of sevoflurane by 84%.	Desflurane (-) Sevoflurane (-) Propofol (+) Vapor capturing technology (+) Modern manufacturing process (+)



		Use of modern manufacturing processes reduces carbon footprint; Utilising vapor capturing technology (VCT), particularly when nitrous oxide is used as a carrier gas, can significantly reduce carbon footprint, with highest impact on desflurane. Vapor-capturing technology can recycle 70% of the anaesthetic gas once in its life.	
Patel and Smith-Steinert (2021, USA)⁴⁰	Education on sustainable use of inhaled anaesthetics and remove of desflurane vaporisers from anaesthetic machines in the Midwestern United States	-1301 t CO ₂ eq per year (-77%) after education and additional reduction of 370 t CO ₂ eq per year after removal of desflurane vaporisers (-99%)	+
Richter (2020, Germany)⁴¹	Education on sustainable use of inhaled anaesthetics and remove of desflurane vaporisers from anaesthetic machines in one department	-271.8 t CO ₂ eq per year (-88%)	+
Zuegge (2019, USA)⁴²	Education on flow rate reduction and on using sevoflurane over desflurane	-105 kg CO ₂ eq per case (-64%) and -2865 t CO ₂ eq per year	+
MacNeil (2017, Canada, USA, UK)⁴³	Comparisons of anaesthetic practices between 3 hospitals including desflurane use	Preferential use of desflurane resulted in a ten-fold difference in anaesthetic gas emissions between hospitals.	Desflurane has a negative impact (-)
McGain (2021, Australia)⁴⁴	Comparison of three anaesthetic protocol: 1) general anaesthesia (Sevoflurane or Propofol), 2) spinal anaesthesia and 3) general and spinal combined.	The carbon footprint of the three protocols were similar: 1) 14.9 (95% CI, 9.7 to 22.5) kg CO ₂ eq; 2) 16.9 (95% CI, 13.2 to 20.5) kg CO ₂ eq; 3) 18.5 (95% CI, 12.5 to 27.3) kg CO ₂ eq	No differences
Weinberg (2014, Australia)⁴⁵	Comparison of 3 anaesthetic gases (desflurane, sevoflurane and isoflurane) during 7 years in 65 hospitals	Total t CO ₂ eq: 37 000 tonnes of CO ₂ eq over the study period, with isoflurane contributing 6%, sevoflurane 17%, and desflurane 77% of this total. The use of isoflurane decreased over time.	Desflurane has a negative impact (-)



Appendix 1.2.8. Studies on interventions related to sustainable food

Figure 7 – Flow chart on “sustainable food”

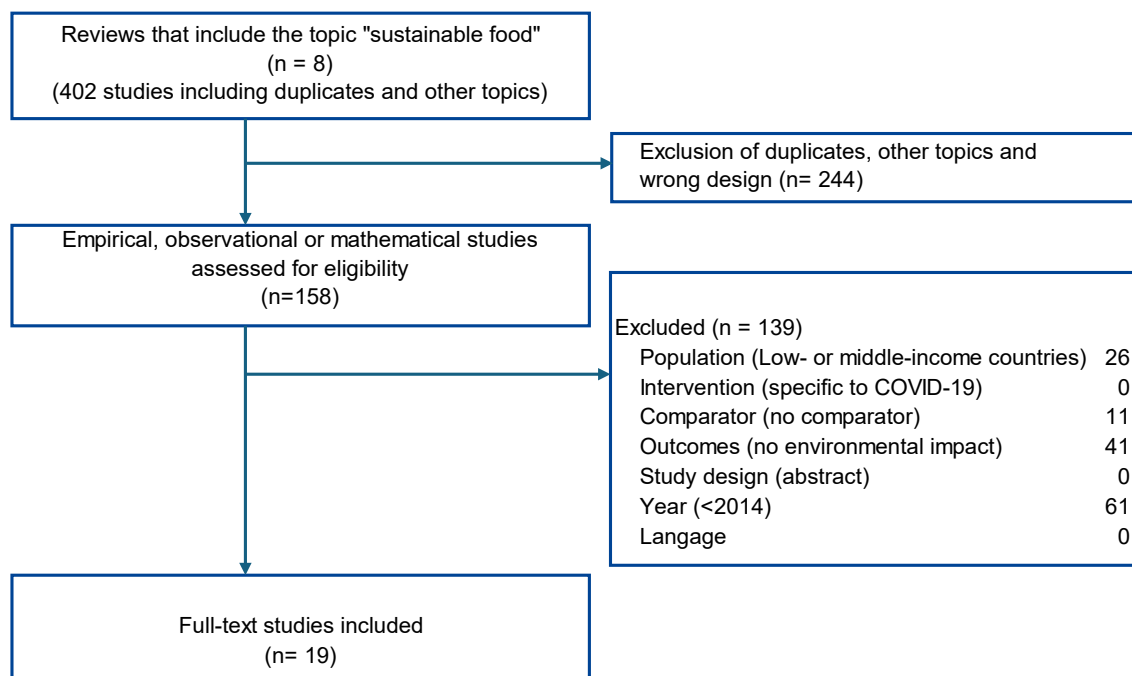


Table 10 – Studies on sustainable food

Intervention	Number of studies	Impact	Details
Interventions to reduce waste			
Improving appearance	1	No significant impact	Mold puree vs non-mold puree: No significant difference in median plate waste: -126 g (P=0.09) (Farrer 2016, Australia)⁴⁶
Improving taste – quality	1	Positive impact (+)	Innovative cooking techniques improving taste and quality vs traditional cooking: -5.9, -12.8, and -8.9 percentage points of food waste for the first course, the main course and the side respectively (P<0.05) (Piciocchi 2022, Italy)⁴⁷
Allowing choices (e.g. menu, room service, bedsize ordering system)	7	Mixed impact	- No significant difference in daily plate waste (3 studies): - Choice menu vs Basal diet: No significant difference in % of plate waste per patient per day (p-value > 0.05) (Paiva 2022, Spain)⁴⁸ - Bedsized terminal meal ordering vs Paper menu: -1 % of daily plate waste (p-value = 0.75) (Barrington 2018, Australia)⁴⁹ - Free choice menu vs fixed menu: No significant difference in total food waste overall (p-value = 0.25). Per type of meal: only significant difference for the lunch: - 10.5 percentage points in plate waste per meal during lunch (p-value = 0.0005) (Dynesén 2021, Denmark)⁵⁰



			- Positive impact on waste in 4 studies: - Room service vs traditional service: - 13 (study 1 in a public facility) and -17 (study 2 in 2 hospitals) percentage points in total mean plate waste (p-value < 0.001) (McCray 2018, Australia)^{51, 52} - Bedsized terminal meal ordering vs traditional service: -4 percentage points in total mean plate waste in 1 hospital (p-value < 0.001)⁵³ - Cook-fresh, on-demand room service vs bought-in, thaw-retherm foodservice: Reductions in plate waste (15% vs 40%) and production waste (5.6% vs 15%, p-value < 0.001) (Neaves 2022, Australia)⁵⁴
Allowing size reduction	1	Positive impact (+)	Trolley meal system allowing to select portion sizes: Positive relationship between meal portion size and plate waste (p-value = 0.002) (Ofei 2015, Denmark)⁵⁵
Mix of strategies	4	Positive impact (+)	- Food waste management scheme: reduction by 16.9% in overall food waste (Meier 2021, Germany)⁵⁶ - Waste management strategy: between -2% and -30 % food waste reduction according to the strategy (Dias-Ferreira 2015, Portugal)⁵⁷ - Multiple actions programme: No significant impact on total food waste but significant decrease by 17% in plate waste (p-value = 0.014). (Strotmann 2017, Germany)⁵⁸ - Multiple strategies related to parenteral nutrition bags (redistributing unused bags, stock bag rotation, etc.): 34% reduction in bags wasted per year (Allan 2018, UK)⁵⁹
Other			
Improving disposal	1	Positive impact (+)	Recycling and composting reduce GHG emissions by 189 025 kg CO₂e (64% reduction) per year in one hospital (Thiel 2021, USA)⁶⁰
Promoting sustainable diet (e.g. vegetarian meals)	4	Mixed impact (Vegetables: positive impact on CO ₂ eq/plate but negative impact on plate waste)	- Meat-containing meals : 604 g CO₂ eq per plate) vs vegetarian meals : 357 g CO₂ eq / plate; mean difference 240 g CO₂ eq / plate, p-value < 0.001) (Berardy 2022, USA)⁶¹ - High protein diet = 8112 kg CO₂ eq/daily diet, normal basal diet = 5083 kg CO₂/daily diet and liquid diet = 1652 kg CO₂ eq/daily diet (Nabipour Afrouzi 2023, Spain)⁶² - A Mediterranean diet is associated with lower environmental impact than diets with more meat, in particular red meat. Menu for high protein diet has higher footprint than a regular full ward diet. The liquid antidiarrhea diet (no food, fluids only) had the least carbon footprint (Vidal 2015, Spain)⁶³ - Vegetable and potatoes have higher rate of plate waste (55%) than pasta/rice (38.5%) and meat/fish (39.7%) (Schiavone 2019, Italy)⁶⁴



Appendix 1.2.9. Studies on interventions related to waste management and circular economy - reusable vs single-use medical devices

Figure 8 – Flow chart on “reusable vs single-use medical devices”

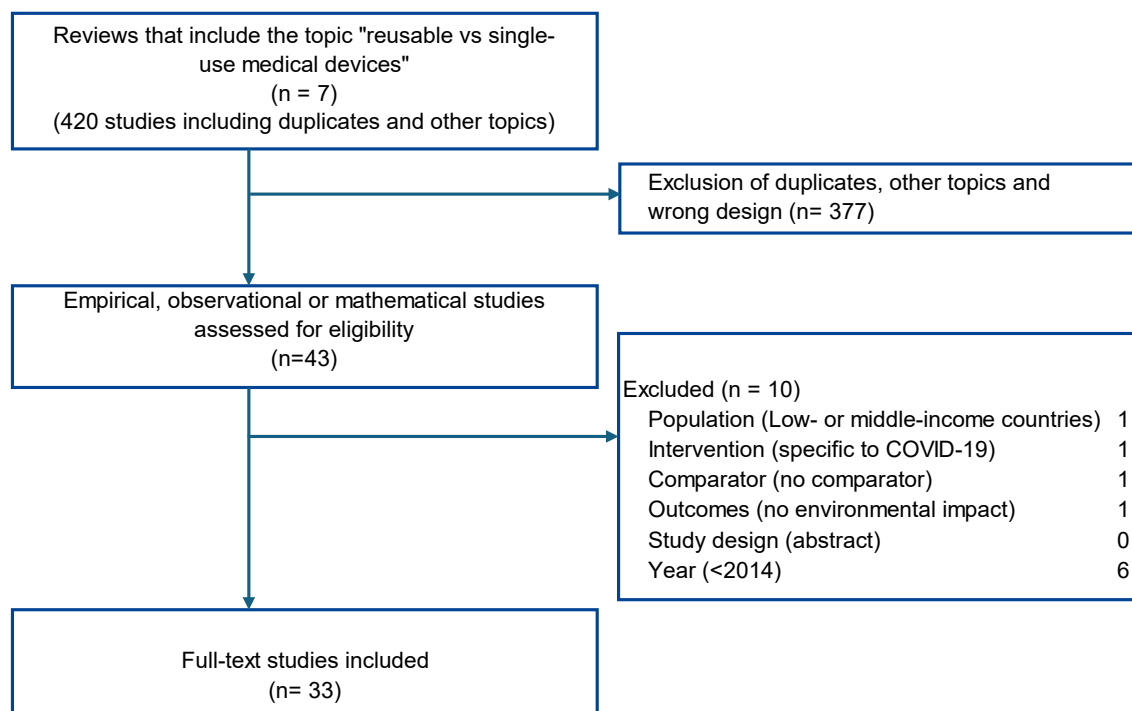


Table 11 – Studies on single-use versus reusable medical devices

Type of devices	Nb Studies	Impact of using reusable devices	Details of results and interventions (reusable versus single-use)
Flexible endoscope	8	Mixed impact	Positive impact (4 studies): - Flexible cystoscope: -1.87 kg CO₂ eq per use (lifespan reusable device = 3920 uses) (Kembel 2023, USA)⁶⁵ - Flexible bronchoscope: - 2000 kg CO₂ eq per device lifelong (lifespan reusable device = 2000 uses) (Bringier 2023, France)⁶⁶ - Flexible bronchoscope: -110 kg CO₂ eq per device lifelong (lifespan reusable device = 450 uses) (Duijndam 2022, The Netherlands)⁶⁷ - Flexible duodenoscope: Between -34.76 and -69.97 kg CO₂ eq per procedure (lifespan reusable device = 650 uses) (Le 2022, USA)⁶⁸ Negative impact (4 studies): - Flexible ureteroscope: +0.04 CO₂ eq per use, (lifespan reusable device = 180 use, with repair every 16 uses) (Davis 2018, Australia)⁶⁹ - Flexible cystoscope: +1.02 CO₂ eq per use + Negative impact on mineral resource depletion, ecotoxicity, acidification, and eutrophication (but only comparing the disinfection reprocessing of reusable cystoscopes with the complete lifespan of the single-use cystoscope) (Baboudjian 2022, France)⁷⁰ - Flexible bronchoscope: +1.3 CO₂ eq per use (Sørensen 2018, Denmark)⁷¹ - Flexible cystoscope: +1.82 kg CO₂ eq per use and +45.2 g of waste per use (P<0.0001) (lifespan reusable device = 1220 uses) (Hogan 2022, Denmark)⁷²
Anaesthetic equipment, Laryngoscope blades and handles	2	Mixed impact	Mixed impact (1 study): - Various scenarios regarding reusable vs single-use of breathing circuits, face masks, laryngeal masks airways, laryngoscope handles, laryngoscope blades, and video-laryngoscopes: Between -4773 and + 480 kgCO₂ eq per year according to the scenario and the country power source mix; and increase in water use from 34.4 to 90.6 kilolitres per year (McGain 2017, Australia)⁷³ Positive impact (1 study): - Reusable vs single-use laryngoscope blades and handles: Between -1.54 and -0.16 kgCO₂ eq per use, according to the type of single-use device material (plastic or metal) and the level of disinfection (low disinfection, high disinfection, or steam sterilisation) (Sherman 2018, USA)⁷⁴
Laparoscopic or endoscopic	3	Mixed impact	Positive impact (2 studies):



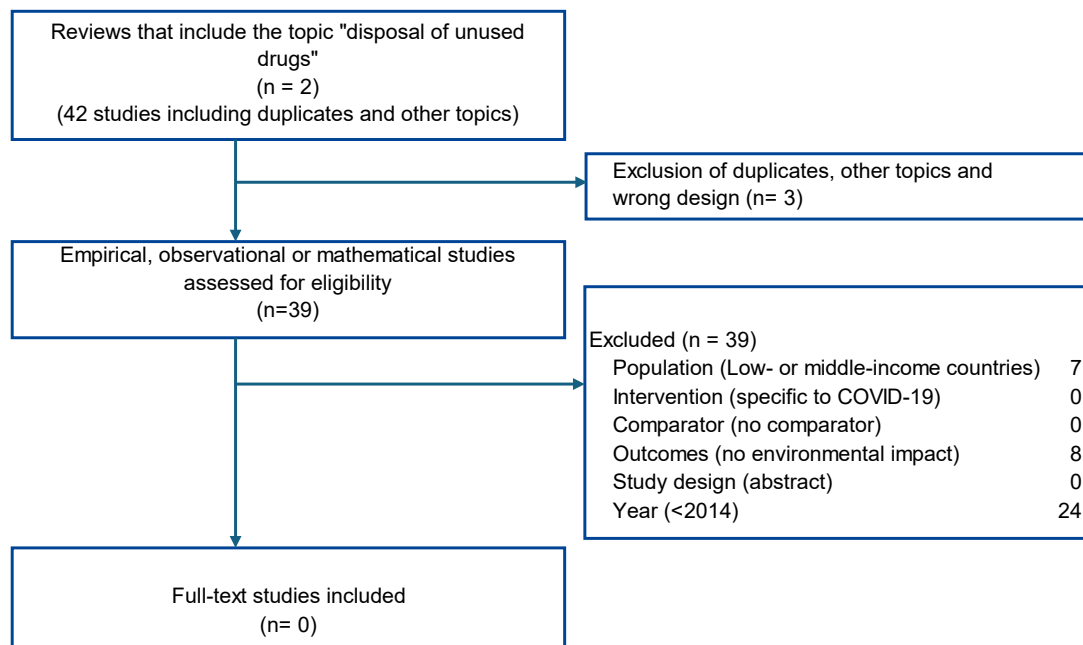
trocars systems			- Trocar system for laparoscopic cholecystectomies: -2.56 kg CO₂ eq per procedure (lifespan reusable trocars = 500 uses) (Rizan 2022, UK)⁷⁵ - Trocar system for laparoscopic cholecystectomies: - 446 kg CO₂ eq per device lifelong (lifespan reusable trocars = 500 uses) (Boberg 2022, Sweden)⁷⁶ Negative impact (1 study): - Endoscopic trocar system: Results in favour of single-use, except if the sterilisation process is optimised (based on graphs) (Unger 2016, USA)⁷⁷
Other laparoscopic material	2*	Positive impact (+)	Positive impact (2 studies): - Laparoscopic scissors and clips: Between -2.1 and -0.76 kg CO₂ eq per procedure (lifespan reusable trocars = 500 uses) (*) Study also mentioned in "trocars" (Rizan 2022, UK)⁷⁵ - Laparoscopic appendectomy set: - 431.6 kg CO₂ eq per year (-62%) (Labib 2023)⁷⁸
Specula	4	Positive impact except worst case	Positive impact (3 studies) - Reusable vs single-use vaginal specula: Between -11.1 and -11.8 kg CO₂ eq per device lifelong (lifespan reusable device = 20 uses)(Donahue 2020, USA)⁷⁹ - Stainless-steel reusable speculums versus single-use acrylic speculums: -1894 kg CO₂ eq per device lifelong (lifespan reusable device = 5 years)(Rodriguez Morris 2022, USA)⁸⁰ - Reusable metal speculum vs single-use fossil plastic speculum and single-use biobased plastic speculum: -0.17 (fossil plastic) and -0.01 (biobased plastic) kg CO₂ eq per use (Snijder 2022, The Netherlands)⁸¹ Mixed impact (1 study): - Reusable stainless steel specula vs single-use specula made of fossil-based ABS, bio-based PLA, or ethylene oxide sterilised single-use specula: Between +0.023 kg CO₂ eq (worst case) to -0.28 kg CO₂ eq per use (best case) (Lifelong of reusable specula = 500 in the base case and 50-1000 in scenario analysis) + Environmental impacts that were not positive for reusable specula: Mineral resource scarcity (kg Cu eq), Stratospheric ozone depletion (kg CFC11 eq), Ionizing radiation (kBq Co-60 eq), Marine eutrophication (kg N eq), Terrestrial ecotoxicity (kg 1,4-DCB), Human carcinogenic toxicity (kg 1,4-DCB), and Land use (m2a crop eq). (Demarré 2023, Belgium)⁸²
Textiles (Gowns)	4	Positive impact (+)	- Reusable versus single-use surgical gowns: -1079 kg CO₂ eq for 1000 uses (lifespan of the reusable textile = 60 uses) (Vozolla 2020, USA)⁸³ - Reusable versus single-use isolation gowns: -92 kg CO₂ eq for 1000 uses (lifespan of the reusable textile = 60 uses) (Vozolla 2018, USA)⁸⁴ - Reusable versus single-use cleanroom coveralls: Between -703 and -195 kg CO₂ eq according to the single-use material for 1000 uses (lifespan of the reusable textile = 50 uses, 3 studies) (Vozolla 2018, USA)⁸⁵

			Reusable versus single-use surgical gowns: Positive impact based on graphs (Bijleveld 2022, The Netherlands)⁸⁶
Blue wraps – surgical packaging	3	Positive impact (+)	- Reusable rigid sterilization containers vs single-use blue wraps: -1584 kg CO₂ eq per device lifelong (lifespan of the reusable device = 5000 uses, a minimum of 98 uses is required to have a positive impact) (Friedericy 2021, The Netherlands)⁸⁷ - Reusable aluminium containers vs single-use polypropylene blue wraps: -446000 kg CO₂ eq per 100 sets used daily over 10 years (Stiegler 2016, USA)⁸⁸ - Reusable surgical pack compared to single-use surgical pack: -6% (-229·205 kg CO₂ eq per year in one hospital department) (Jabouri 2022, UK)⁸⁹
Sharp containers	2	Positive impact (+)	- Reusable vs single-use sharp containers: -3 267 400 kg CO₂ eq per year, for 40 trusts (lifespan of the reusable containers = 18 years) (Grimmond 2021, USA)⁹⁰ - Reusable vs single-use sharp containers: -162 400 kg CO₂ eq per year for 5 hospitals (lifespan of the reusable device = 26.4 years, study 2) (Mc Pherson 2019, USA)⁹¹
Several medical devices	1*	Negative impact (-)	Reusable vs single-use arthroscopic shavers, compression sleeve, endoscopic trocars, ligasures, pulse oximeters, scissor tips, ultrasonic (harmonic) scalpels: Results in favour of single-use, except if the sterilisation process is optimised (based on graphs) (*) Study also mentioned in “trocars” (Unger 2016, USA)⁷⁷
Dental burs	1	Mixed impact	Reusable vs single-use dental bur: Between -0.77 kg CO₂ eq per device lifelong (optimal sterilisation) (lifespan of the reusable dental bur = 30 uses) and negative impact (less optimal sterilisation) (Unger 2014, USA)⁹²
Incontinence Underpads	1	Positive impact (+)	Reusable vs single-use incontinence underpads: Percentage reduction: -61% of GHG emissions, -71% of total natural resource energy consumption, -57% of blue water consumption and -97% of solid waste. (Griffing 2023, USA)⁹³
Blood pressure cuffs	1	Positive impact (+)	Reusable vs single-use blood pressure cuffs: between -9.6 and -0.5 kg CO₂ eq per day (lifespan of the reusable device = 1095 uses) (Sanchez 2020, USA)⁹⁴
Bedpans	1	Negative impact (-)	Reusable vs single-use bedpans: Single-use allows between 30% and 50% reduction in GHG emissions + Negative impact on aquatic eutrophication, terrestrial eutrophication, acidification, and ozone formation (Sørensen 2014, Denmark)⁹⁵
Laryngeal mask airways	1	Positive impact (+)	Reusable vs single-use laryngeal mask airways: No details on kg CO₂ eq - Positive impact on human health, ecosystems and resources (Liang 2019, Sweden)⁹⁶
Surgical stapling systems	1	Positive impact (+)	Reusable vs single-use surgical stapler: No details on kg CO₂ eq - reduction of waste between -0.29 and -608 kg (Meissner 2021, Germany)⁹⁷



Appendix 1.2.10. Studies on interventions related to waste management and circular economy – disposal of unused drugs

Figure 9 – Flow chart on “disposal of unused drugs”



Appendix 1.2.11. Studies on interventions related to waste management and circular economy - other

Figure 10 – Flow chart on “waste management - other”

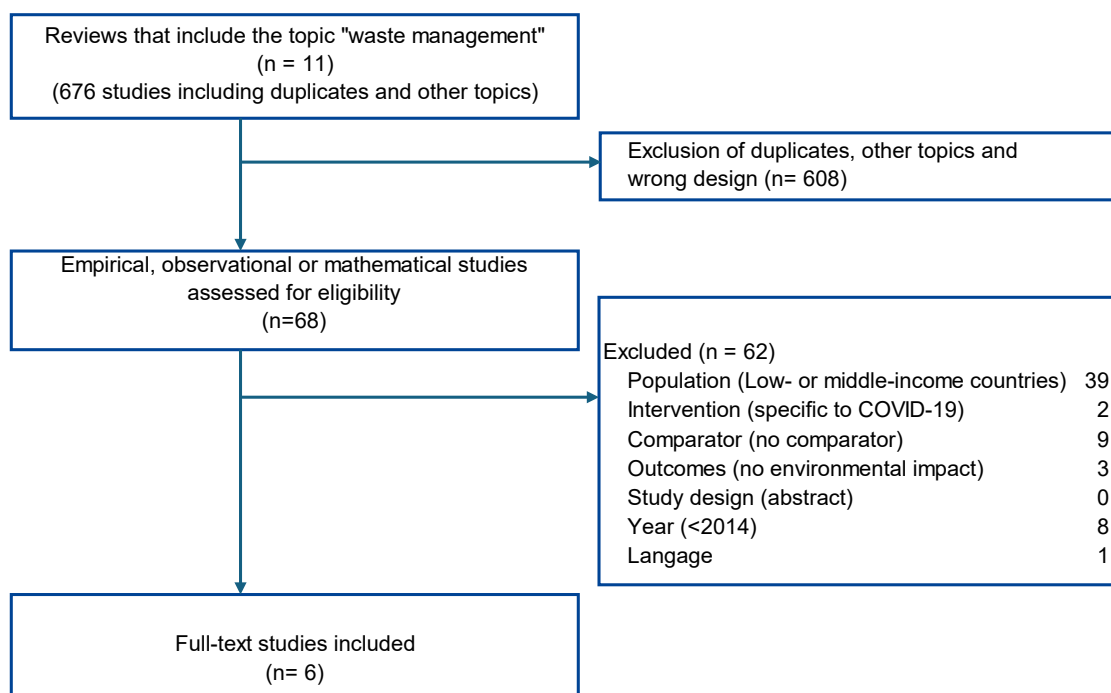


Table 12 – Studies on other waste management interventions

First author (year, country)	Intervention	Results	Impact
<i>Zlaugotne Latvia</i> ⁹⁸ (2022,	Vacuum autoclaves, autoclaves with integrated shredding, batch wise microwaves, continuous microwave, frictional heat, treatment and incineration technologies and chemical treatment with sodium hypochlorite-based technology.	Autoclave with integrated shredding and sodium hypochlorite-based technology were the two best alternatives (based on a multicriteria decision analysis including environmental aspects)	Autoclave (+)
<i>Rizan (2022, UK)</i> ⁹⁹	Different processes for instrument packaging and decontamination	Packaging: Aluminium containers : 77 g CO₂ eq/instrument and 2252 g/set; Tray wraps : 66 g CO₂ eq/instrument and 1918 g/set); Individually wrapped instrument: 189 g CO₂ eq (but if <11 instruments are required, individually wrapped items are preferable to opening another set); Decontamination: High-temperature incineration of waste: increased the carbon footprint of single-use packaging by 33–55%; Recycling of waste reduced it by 6–10%; The carbon footprint can be reduced through maximizing the loading of decontamination machines and processing instruments in sets in tray wraps.	Individually wrapped instrument (-) High-temperature incineration (-) Recycling (+)
<i>Rizan (2021, UK)</i> ¹⁰⁰	Recycling, low temperature incineration with energy from waste, autoclaving + low temperature incineration with energy from waste, high temperature incineration	Recycling : 21–65 kg CO ₂ eq; Low temperature incineration with energy from waste: 172–249 kg CO ₂ eq; autoclaving + low temperature incineration with energy from waste: 569 kg CO ₂ eq; high temperature incineration: 1074 kg CO ₂ eq/ t	Recycling (+) High temperature incineration (-)
<i>Rizan (2022, UK)</i> ¹⁰¹	Repairing surgical scissors (after 40 uses)	No repair: 70.3 g CO ₂ eq/use Onsite repair: 56.3 g CO ₂ eq/use Offsite repair: 57 g CO ₂ eq/scissor use	+
<i>Stone Canada</i> ¹⁰² (2017,	Education on waste management + increasing	Reduction of the amount of waste going to the landfill to a 48% level	+



	the number of recycle stations		
<i>Cunha Neves (2023, Portugal)¹⁰³</i>	Education on waste management, recycling implementation and relocation of landfill and medical waste bins	-138.8 kg CO ₂ eq (-31.6%) in one month. Annual reduction: 1665.6 kg CO ₂ eq	+

Appendix 1.2.12. Studies on interventions related to low value care

Figure 11 – Flow chart on “low value care”

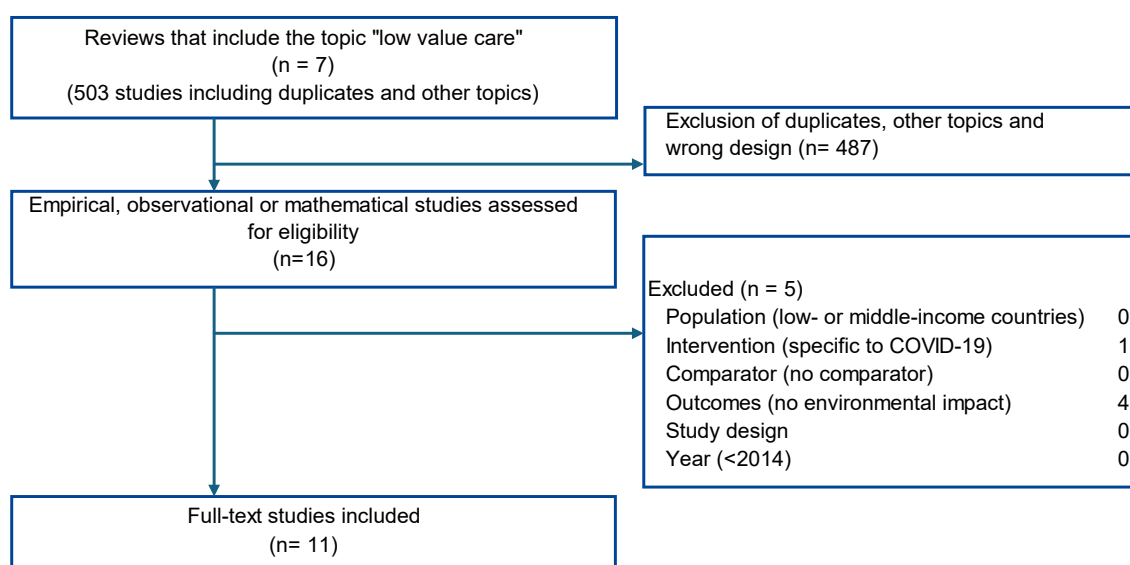


Table 13 – Studies on low value care

Interventions	Nb studies	Impact
<i>Avoiding unnecessary blood - pathology testing</i>	5	- Unnecessary vitamin D testing: 28 576 kg (base case) and 42 012 kg (sensitivity analysis) CO₂ eq over a 12-months period (Breth-Petersen 2022, Australia)¹⁰⁴ - Unnecessary bloodwork for patients with uncomplicated acute surgical conditions: 0.974 kg CO₂ eq per patient (Spolayo 2023, Canada)¹⁰⁵ - Unnecessary biochemistry samples requested on a paediatric cardiology ward: 17.8 tonnes kg CO₂ eq over a 32-month period (Regan 2018, UK)¹⁰⁶ - Reduce non-urgent pathology testing to 2 days per week and, on other days only if essential: -132 kg CO₂ eq over a 5-month period (McAlister 2023, Australia)¹⁰⁷ - Unnecessary pre-operative testing: 18.07 kg CO₂ eq per patient (Wang 2021, USA)¹⁰⁸
<i>Avoiding ineffective diabetes care</i>	2	Good management (HbA1c of 6.5%) vs poor management (HbA1c of 8.4%): -11 kg CO₂ eq/year per patient (Gadegaard 2015, UK)¹⁰⁹

		Reducing HbA1c by 1%: 12% (patients on first-line medical therapy) and 9% (patients on third-line therapy) reduction in CO₂ eq/patient (Fordham 2020, UK)¹¹⁰	
Avoiding inappropriate use of short-acting b2- agonist (SABA)	1	Reducing short-acting b2- agonist (SABA) overuse (≥ 3 SABA canisters/year): Between -669 and -1106 tonnes of CO₂ eq / 10 000 persons per year according to asthma severity (Alzaabi 2023, 22 countries)¹¹¹	+
Avoiding unnecessary flupentixol decanoate injections	1	Flupentixol decanoate injections according to best practice (i.e. 50 mg every 4 weeks) instead of current practice (average dose of 46 mg per week): -168 kg CO₂ eq per patient per year (Maughan 2016, UK)¹¹²	+
Avoiding unnecessary biopsy	1	Performing 100 000 fewer unnecessary biopsies would avoid 8.1 million kg CO₂ eq. Per 100 000 patients, the use of prostate MRI to triage prostate biopsy and guide targeted biopsy cores would save the equivalent of 1.4 million kg of CO₂ eq emissions.(Leapman 2023, USA)¹¹³	+
Avoiding unwarranted clinical variation in the use of MRI and CT	1	Potentially avoidable emissions: between -2046 and - 175 120 tonnes of CO₂ eq per year (Furlan 2023, in 7 countries)¹¹⁴	+

Appendix 1.2.13. Studies including other comparison of interventions”

Figure 12 – Flow chart on “other comparison of interventions”

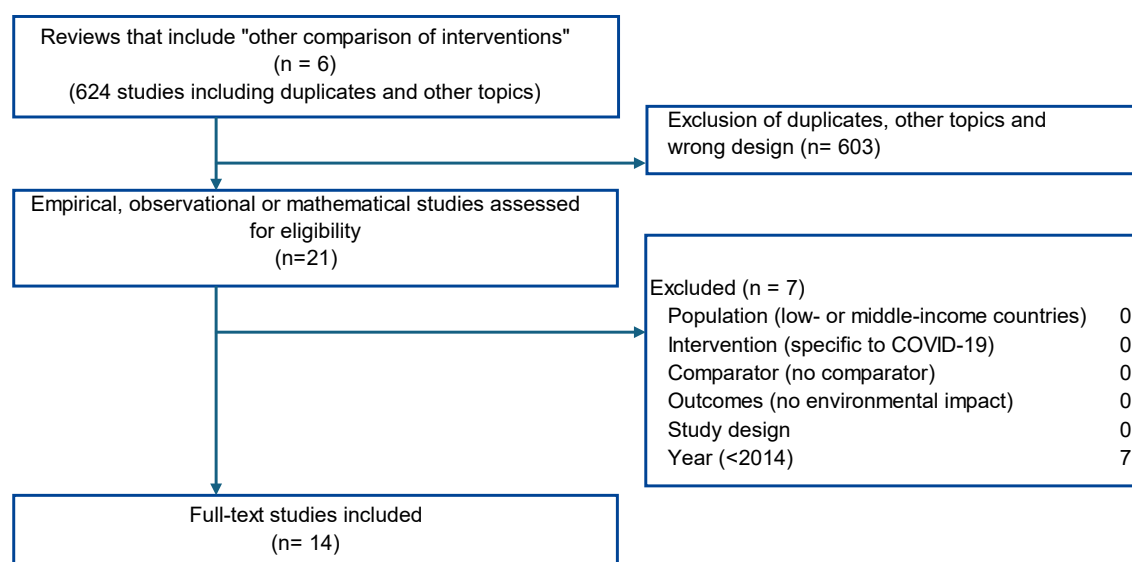




Table 14 – Studies on comparison of specific health interventions

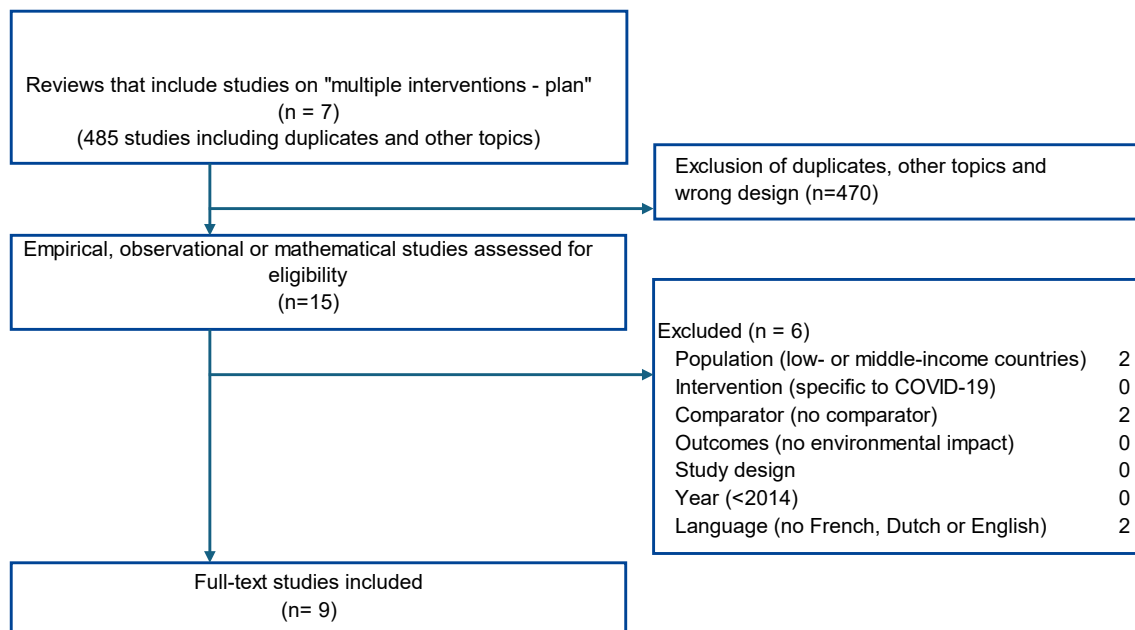
Interventions	Nb studies	Impact
<i>Medical imaging (MRI, CT, etc.)</i>	3	- Mean CO₂ eq emissions were 17.5 kg/scan for MRI (-); 9.2 kg/scan for CT; 0.8 kg/scan for CXR; 0.5 kg/scan for MCXR; and 0.5 kg/scan (McAlister 2022, Australia)¹¹⁵ - Mean energy consumption per examination over 1 year was 1.2 kWh for CT and 19.9 kWh for MRI (-) (Heye 2020, Switzerland)¹¹⁶ - Ultrasound emitted fewer CO₂ eq in production and use phases (0.5 and 0.65 kg/examination) than CT (4.0 and 2.61 kg/examination) or MRI (6.0 and 13.72 kg/examination) (-).¹¹⁷
<i>Comparison of pathology testing</i>	2	Between 0.5 and 538 g CO ₂ eq/test (McAlister 2020 and 2021, Australia) ^{118, 119}
<i>Day care surgery vs inpatient surgery</i>	1	Day care (+) vs inpatient surgery: - 217 599 kg CO ₂ eq / year (Phull 2023, England) ¹²⁰
<i>Robotically-assisted laparoscopy, laparoscopy and laparotomy</i>	1	Robotically-assisted laparoscopy procedure has a carbon footprint of 40.3 kg CO ₂ eq/patient, which represents a 38% increase over that of laparoscopy (29.2 kg CO ₂ eq/patient) and a 77% increase over laparotomy (+) (22.7 kg CO ₂ eq/patient). (Woods 2015, USA) ¹²¹
<i>Single-dose intraoperative targeted radiotherapy (TARGIT) vs external beam whole breast radiotherapy (EBRT)</i>	1	TARGIT had lower CO ₂ eq emissions (+) than EBRT: 24.7 kg vs 111 kg CO ₂ eq (Coombs 2016, UK) ¹²²
<i>Biopsy with 1 vs 3 specimen jar</i>	1	Biopsy with 1 specimen jar had a better carbon impact (+) than with 3 specimen jar: 0.29 kg CO ₂ eq vs 0.79 kg CO ₂ eq (Gordon 2021, USA) ¹²³
<i>Applying fluoride varnish (FV) at a separate appointment or not</i>	1	Applying FV in dental practice during an existing appointment had the lowest environmental impact in all 16 categories (+), followed by FV application in schools. FV application at a separate dental practice appointment had the highest impact in all categories (Lyne 2022, UK) ¹²⁴
<i>Stretchable and rigid electronics cardiac monitoring devices</i>	1	The stretchable cardiac monitoring device has lower environmental impacts (+) in all eighteen (18) impact categories compared to the rigid device (Kokare 2022, Sweden) ¹²⁵
<i>Packaging options for contrast media delivery: polymer bottle vs glass bottle</i>	1	The polymer bottle has lower impacts in all other categories that are considered (ranging from 24 to 43%)(Dhaliwal 2014, USA) ¹²⁶
<i>Alternative Trastuzumab dosing schedules</i>	1	Adoption of both 6-month adjuvant trastuzumab and once every 4-week trastuzumab dosing would reduce GHG emissions by 4.5%, 18.7%, and 14.6% in the neoadjuvant, adjuvant, and metastatic settings, respectively (Jacobson 2023, USA) ¹²⁷
<i>Social support-based interventions vs traditional mental health treatments</i>	1	Primary care-based social prescribing program for mental health patients result in lower GHG emissions compared to cognitive behavioral therapy or antidepressants but if emissions of the service itself are taken into account, the



intervention is associated with an increased carbon footprint per patient.(Maughan 2016, UK)¹²⁸

Appendix 1.2.14. Studies on interventions related to multiple interventions and plans

Figure 13 – Flow chart on studies with multiple interventions or plan



For these studies, only topics were investigated (no summary tables).



Appendix 1.2.15. Studies on interventions related to research

Figure 14 – Flow chart on HTA

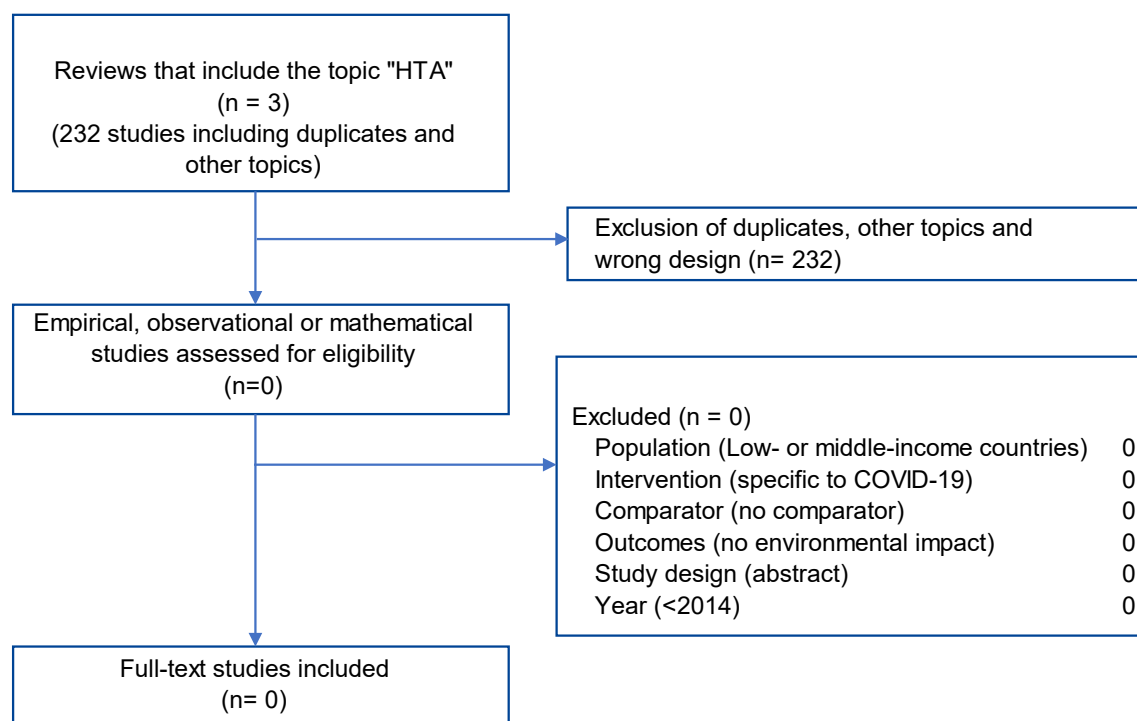
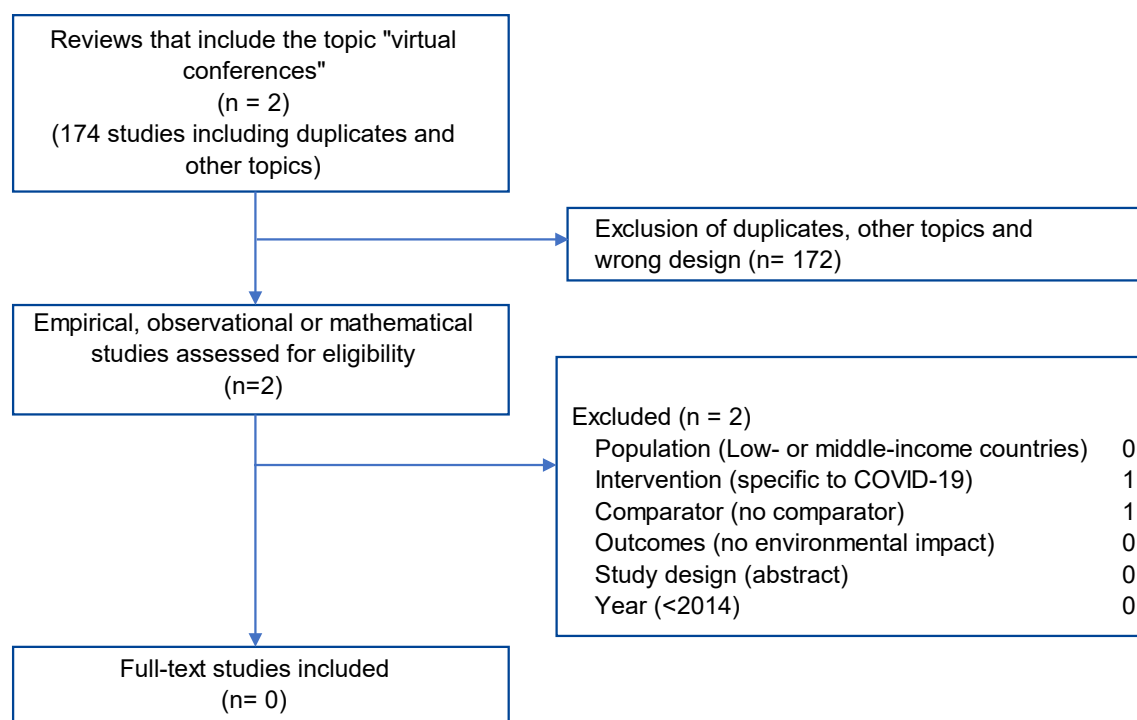


Figure 15 – Flow chart on virtual conferences



APPENDIX 2. REVIEW OF EXISTING DATA AND INVESTIGATION OF OTHER RELEVANT SOURCES

Table 15 – Databases and national plans investigated

	URL	Organisation	Contact person or details
National and regional databases, reports and contacts			
Belgium	https://www.environnement-sante.be/sites/default/files/public/content/Operation%20Zero/GHG%20emissions%20of%20the%20Belgian%20Health%20care%20sector.pdf	NEHAP, HCWH and Arup	Report: Greenhouse gas emissions of the Belgian health care sector Contacts: Bram Lefever, Judith Lambert, Sara Dethier
	https://www.environnement-sante.be/sites/default/files/public/content/Operation%20Zero/Belgian%20roadmap%20for%20health%20care%20Decarbonisation.pdf	NEHAP, HCWH and Arup	Report: Belgian roadmap for health care decarbonisation
	https://www.health.belgium.be/fr/sante/organisation-des-soins-de-sante/hopitaux/systemes-denregistrement/stathosp	FPS Public Health	Annual hospital statistics (STATHOSP) Contacts: Bram Lefever, Judith Lambert
	https://www.health.belgium.be/fr/professionnels/professionnels-sante/sante-humaine/organisation-soins-sante/organisation-financement-hopitaux/finhosta	FPS Public Health	Financial, staff and organizational data of hospitals (FINHOSTA)
	https://atlas.ima-aim.be/databanken/?rw=1&lang=nl	IMA-AIMatlas	
	https://www.plan.be/en/data/physical-energy-flow-accounts-2008-2022	Federal planning bureau	Environmental economic accounts collected by the Federal planning bureau and submitted to Eurostat in line with European Regulation No 691/2011 contact: Jehan Charlier
	https://www.plan.be/en/data/air-emissions-accounts-2008-2022		
	https://www.plan.be/en/data/environmental-goods-and-services-sector		
	https://www.plan.be/en/publications/environmental-taxes-economic-activity-2008-2022		
	https://www.plan.be/en/publications/economy-wide-material-flow-accounts-2008-2023		
	https://www.plan.be/en/data/environmental-protection-expenditure-accounts		
	https://www.plan.be/en/data/energy-outlook-belgium-towards-2050-may-2024	Federal planning bureau	Energy and environment related data
	https://www.plan.be/en/data/input-output-tables-2020-bis		
	https://www.plan.be/nl/publicaties/de-koolstofvoetafdruk-van-de-belgische-gewesten		



	https://www.indicators.be/en/t/SDG/	Federal planning bureau	Sustainable development indicators
	https://statbel.fgov.be/en/themes/energy	Statistics Belgium	Energy and environment related data
	https://economie.fgov.be/nl/themas/energie/energie-cijfers		
	https://statbel.fgov.be/en/themes/environment/land-use		
	https://statbel.fgov.be/nl/themas/data/lab/geografische-indelingen#news	Statistics Belgium	Geographic proximity
	https://www.cerac.be/en	Climate Risk Assessment Center	
	https://cdr.eionet.europa.eu/be/eu/govreg/inventory/envzfqsrw/NIR_2024.pdf	Several Federal and Regional agencies, e.g. National Climate Commission; Belgian Interregional Environment Agency; VITO; SPF Public Health	Inventories: - Belgian GHG emission inventory (Table2(II)B-Hs2 - 2F4) - Belgian inventory of ozone depleting substances (section 4.7.1, Appendix A3 and A4)
	https://cdr.eionet.europa.eu/be/eu/govreg/inventory/envzfqsrw/index_html?&page=1		
	https://www.cnc-nkc.be/sites/default/files/report/file/final_public_report_2023.docx		
	https://catalog.hda.belgium.be/	Health Data Agency	
	https://pharma.be/nl/diensten/vervallen-en-ongebruikte-geneesmiddelen	Pharma.be	Disposal of Pharmaceuticals Contact: Marie Vande Ginste
	https://www.acerta.be/nl/in-de-pers/recordaantal-werknemers-pendelt-met-de-fiets-naar-het-werk	Acerta	Commuting survey Contact: Tanne Somers
	https://mobilit.belgium.be/nl/duurzame-mobiliteit/enquetes-en-resultaten/federale-enquete-woon-werkverkeer/verslagen-van-enquetes	SPF Mobility	Commuting survey
	https://www.irceline.be/en	Belgian Interregional Environment Agency (IRCEL - CELINE)	
	https://www.biodiversity.be/	Belgian biodiversity platform	
	https://www.sciensano.be/nl/keywords/environment	Sciensano	
Flanders	https://www.vlaanderen.be/veka/energie-en-klimaatbeleid-in-cijfers	Vlaams Energie- en Klimaatagentsch (VEKA)	Data on energy consumption and energy efficiency Contacts: Wim Lameire, Kaat Jespers, David Broods
	https://www.vlaanderen.be/veka/energie-en-klimaatbeleid-in-cijfers/vlaamse-energiebalans		
	https://apps.energiesparen.be/energiekaart/vlaanderen/EPC-groot-niet-residentieel-gemiddeld		
	https://apps.energiesparen.be/energiekaart/vlaanderen/EPC-groot-niet-residentieel-label-verdeling		

https://www.vlaanderen.be/green-deal-duurzame-zorg	Departement Zorg	Information on initiatives to reduce environmental footprint of healthcare sector (Green Deal Duurzame Zorg) Contact: Sofie Desmet
https://departementwvg.be/sites/default/files/media/documenten/3_1_VEB%20energiescans%20en%20klimaatsubsidies%20DEF.pdf	Vlaams Infrastructuurfonds voor Persoonsgebonden Aangelegenheden (VIPA)	Data on energy reduction initiatives for care providers Contacts: Hannah Bohez, Frédérique Vander Elst
https://www.departementzorg.be/one-stop-shop-energieaudits		
https://www.departementzorg.be/nl/vlaamse-klimaatsubsidies		
https://ovam.vlaanderen.be/studies-en-cijfers-afval	Openbare Vlaamse Afvalstoffenmaatschappij (OVAM)	Data on waste Contacts: Astrid De Man, Mieke Vervaeke
https://ovam.vlaanderen.be/cijfers-huishoudelijk-afval		
https://ovam.vlaanderen.be/bedrijfsafvalstoffen		
https://www.vmm.be/data/milieudata	Vlaamse Milieu Maatschappij (VMM)	Data on various environmental pressures, pollution and emissions Contact: Arnout Pottier, Wim Gabriëls
https://vmm.vlaanderen.be/publicaties/medicijnen-in-de-waterketen-resultaten-verkennend-onderzoek-in-de-periode-2014-2016		
https://vmm.vlaanderen.be/feiten-cijfers/water		
https://vmm.vlaanderen.be/feiten-cijfers/lucht/overzicht-per-vervuilende-stof/stikstofindicator-stikstofdepositie		
https://vito.be/nl/kennispunt-water/socio-economisch-belang-van-water-vlaanderen-2020	Vlaamse Instelling voor Technologisch Onderzoek (VITO)	Data on water use and quality Contact: Dirk Halet
https://ovam.vlaanderen.be/input-output-analyse-helpt-evoluties-vlaamse-materiaalvoetafdruk-te-verklaren	Vlaamse Instelling voor Technologisch Onderzoek (VITO) and Monitor circulaire economie Vlaanderen	Data on environmental footprints and emissions Contacts: Pieter Fonteyn, Maarten Christis
https://ovam.vlaanderen.be/het-vlaamse-milieu-input-output-model		
https://cemonitor.be/analyses/		
https://atmosys.vito.be/en/products-and-services/emission-modelling		
Ecotoxicity lab	Ugent	Tool on ecotoxicity of pharmaceuticals in surface water Contacts: Matthieu Gallin and Karel De Schampelaere



	https://www.vlaanderen.be/inbo/publicaties/de-impact-van-vlaanderen-op-de-biodiversiteit-in-de-wereld-op-zoek-naar-indicatoren	Insituut voor natuur- en bosonderzoek - biodiversiteit	
	https://www.vlaanderen.be/statistiek-vlaanderen/ruimtegebruik/landgebruik	Statistics Flanders	Data on land use
	https://provincies.incijfers.be/databank	Provincies.incijfers.be	
Wallonia	https://energie.wallonie.be/fr/l-energie-en-wallonie.html?IDC=8228	Energie Wallonie	Data on energy use
	https://energie.wallonie.be/fr/bilans-energetiques-wallons.html?IDC=6288		
	https://environnement.sante.wallonie.be/home/experts/plan-envies.html	Service public de Wallonie	Data on various environmental pressures
	https://environnement.sante.wallonie.be/home/experts/portefeuille-d-actions-envies/plan-envies.html		
	https://etat.environnement.wallonie.be/home/categories.html		
	Direction des Eaux de surface		
	https://www.spge.be/	Société Publique de gestion des eaux	Data on water use and quality Contact: Sven Abras
Brussels	https://www.vivalis.brussels/fr/categories-des-etudes-de-lobservatoire	Observatoire de la Santé et du Social de Bruxelles - Capitale	Contact: Joël Girès
	https://environnement.brussels/citoyen/outils-et-donnees/etat-des-lieux-de-lenvironnement/eaux-usees-epuration	Bruxelles Environnement	Data on various environmental pressures Contact: Alice Thienpont, Jules Hammenhecker
	https://www.peb-epb.brussels/pub-frontoffice/pages/anybody.xhtml		
	https://ibsa.brussels/themes/environnement-et-energie	Institut Bruxellois de Statistique et d'Analyse	Energy and environment related data
	https://leefmilieu.brussels/burgers/tools-en-data/het-milieu-stand-van-zaken	Leefmilieu Brussel	Data on various environmental pressures
	https://leefmilieu.brussels/burgers/tools-en-data/het-milieu-stand-van-zaken/energie-stand-van-zaken		
International databases, reports and contacts			
International	https://ec.europa.eu/eurostat/data/database	Eurostat	Sector-specific data on environmental pressures, emissions and expenditures from environmental economic accounts in line with European Regulation No 691/2011
	https://www.eea.europa.eu/en/datahub	European Environmental Agency	Datahub
	https://www.eea.europa.eu/en/analysis/publications/zero-pollution		Pollution-related information

	https://www.eea.europa.eu/en/topics/in-depth/water		Water-related information
	https://www.eea.europa.eu/en/analysis/indicators		Environmental indicators
	https://cdr.eionet.europa.eu/be/eu/govreg/inventory/		Greenhouse gas emissions inventories
	https://data-explorer.oecd.org/	OECD	Data Explorer
	https://www.who.int/data/gho/data/indicators/indicators-index	WHO	The global health observatory - Indicators index
	https://www.who.int/health-topics/air-pollution#tab=tab_1		
	https://iris.who.int/bitstream/handle/10665/373837/9789240081888-eng.pdf	WHO	Operational framework for building climate resilient and low carbon health systems
	https://www.interregeurope.eu/daphne	Interreg Europe	DAPHNE project on decarbonising healthcare in EU regions
	https://ourworldindata.org/	Our World in Data	
	https://unfccc.int/	United Nations Climate Changes	
Action plans and reports in a selection of countries (France, UK, Ireland, and the Netherlands)			
UK	https://www.england.nhs.uk/greenernhs/wp-content/uploads/sites/51/2020/10/delivering-a-net-zero-national-health-service.pdf	NHS	Report: Delivering a 'Net Zero' National Health Service Contact: Robin Simpson and Zuleika Henderson;
	https://www.nhs.uk/access-our-data-products/epact2/dashboards-and-specifications/respiratory-carbon-impact-dashboard	NHS	Dashboard: NHS Respiratory - Carbon Impact dashboard
The Netherlands	https://open.overheid.nl/documenten/ronl-51c2b590d6878dd8196afed9eb55f4339c446f2c/pdf	Minister van Volksgezondheid, Welzijn en Sport, Minister voor Klimaat en Energie, Minister van Infrastructuur en Waterstaat, Minister voor Volkshuisvesting en Ruimtelijke Ordening	Multiple reports, initiatives, and monitoring tools supporting improved environmental sustainability in the healthcare sector Contact: Karin Hek
	https://www.nivel.nl/nl/project/groene-behandelkeuzes-door-huisartsen-monitoren-en-stimuleren	NIVEL	
	https://www.nivel.nl/nl/nieuws/stimuleren-van-groene-behandelkeuzes-nivel-ontwikkelt-feedbackmodule-voor-huisartsen	NIVEL	
	https://www.milieubarometer.nl/nl/branchegemiddeldes/zorg/	Stichting Stimular	



	https://www.greendealduurzamezorg.nl/files/eindrapport-monitor-duurzame-zorg-2022-aef.pdf	Ministerie van Volksgezondheid, Welzijn en Sport (opdrachter)	
France	https://www.entreprises.gouv.fr/files/files/Entites/CNI/2023/2023-12-feuille-de-route-decarbonation-pharma.pdf	Ministère de l'Économie, des Finances et de la Souveraineté industrielle, énergétique et numérique. Direction générale des Entreprises	Roadmaps to improve the environmental sustainability of the healthcare and pharmaceutical sectors
	https://sante.gouv.fr/IMG/pdf/dp_pess.pdf	Ministère de la Santé, des Familles, de l'Autonomie et des Personnes handicapées	
Ireland	https://www.hse.ie/eng/about/who/climate-and-health/hse-climate-action-strategy-2023-50.pdf	Health Service Executive (HSE)	Roadmap for the Climate Action Strategy (2023–2050)
	https://www.hse.ie/eng/about/who/climate-and-health/hse-infrastructure-decarbonisation-roadmap.pdf	Health Service Executive (HSE)	

APPENDIX 3. LONG-LIST OF INDICATORS SENT TO EXPERTS

In this section, you can find the long list of indicators sent to experts, including the indicator name, the unit of measure and the data source. It should be noted that additional information were sent to experts, including the frequency of data collection, the latest year of data available, the geographical level, the availability of EU data, the disaggregation possible, and other further information (such as methodology). The amount of information was too large to be reported here but it can be provided under demand.

Appendix 3.1. Overall

Table 16 – Overall indicators (long-list)

Indicators	Units	Data source
GHG Emissions		
<i>Annual total direct and indirect emissions (scope 1, 2 and 3) in healthcare sector</i>	ktCO ₂ e	Greenhouse gas (GHG) emission inventory of the Belgian healthcare sector
<i>Annual direct emissions (scope 1) in healthcare sector (on-site fuel combustion, fleet vehicles)</i>	ktCO ₂ e	
<i>Annual indirect emissions from upstream and downstream organizational activities (scope 3) in healthcare sector</i>	share of total emissions (%)	
<i>Annual direct emissions (scope 1) in healthcare sector (on-site fuel combustion, fleet vehicles) - production perspective</i>	ktCO ₂ e g or kg per capita	Air emission Accounts (AEA) from Eurostat, Federal planning bureau
<i>Annual direct emissions (scope 1) in healthcare sector (on-site fuel combustion, fleet vehicles) - consumption perspective</i>	ktCO ₂ e	FIGARO (Full International and Global Accounts for Research in input-Output) footprints in Eurostat
GHG Emission intensity		
<i>Greenhouse Gas Emission intensity: Annual direct emissions (scope 1) in healthcare sector per euro value added or per euro production output</i>	kgCO ₂ e/EUR	Emissions: Air emission Accounts (AEA) from Eurostat, Federal planning bureau Economic parameters from National Accounts
<i>Direct and indirect emission intensity: Annual total direct and indirect emissions (scope 1, 2 and 3) in healthcare sector per euro expenditure</i>	kgCO ₂ e/EUR	Expenditure data: system of health accounts (SHA) Emissions: Greenhouse gas (GHG) emission inventory of the Belgian healthcare sector
Other emissions and emission intensity		
<i>Annual emissions of acidifying gas in healthcare sector</i>	ktSO ₂ e g or kg per capita	Emissions: Air emission Accounts (AEA) from Eurostat, Federal planning



Acidifying gas emission intensity: Annual emissions per euro value added or per euro production output	kgSO2e/EUR	bureau Economic parameters from National Accounts
Ozone precursor emissions	ktNMVOCe g or kg per capita	
Ozone precursor emission intensity: Annual emissions per euro value added or per euro production output	kgNMVOC/EUR	
Fine particulate matter emissions	Tonnes g or kg per capita	
Fine particulate matter emission intensity: Annual emissions per euro value added or per euro production output	kg/EUR	
Economic impact		
Production, value added in environmental goods and services sector related to healthcare sector investments	million euro % of GDP	Environmental Goods and Services Sector Accounts from Eurostat, Federal planning bureau
Employment in environmental goods and services sector related to healthcare sector investments	full-time equivalent (FTE)	
Environmental taxes paid by the healthcare sector (energy tax, pollution tax, resource tax, transport tax)	million euro	Environmental Taxes from Eurostat, Federal planning bureau
Green space		
Average percentage of urban green space within 300m distance from healthcare facilities in European cities, 2021	Percentage	European Environment Agency (EEA)
Research		
Percentage of health technology assessments (HTAs) assessing the environmental impact	Percentage	Identified in literature

Appendix 3.2. Building and energy management

Table 17 – Indicators on building and energy management (long-list)

Indicators	Units	Data source
Energy consumption		
Annual energy consumption in healthcare sector	GWh or TJ	Identified in literature Energy data: Eurostat, Federal planning bureau, Statbel, Regional administrations
Annual fossil energy consumption in healthcare sector		
Annual natural gas consumption in healthcare sector		
Annual electricity consumption in healthcare sector		
Energy intensity		
Energy intensity in healthcare sector: Annual energy consumption per euro expenditure	kWh/€ or MJ/€	Expenditure data: system of health accounts (SHA) Energy data: Eurostat, Federal planning bureau, Statbel, Regional administrations
Fossil energy intensity in healthcare sector: Annual fossil energy consumption per euro expenditure		
Electricity intensity in healthcare sector: Annual electricity consumption per euro expenditure		

Annual energy consumption in hospital by floor surface	kWh/m²	Question expected in STATHOSP survey at hospital level by FPS health
GHG Emissions		
Annual direct emissions associated with the combustion of fossil fuels in healthcare sector (scope 1, on-site fuel combustion) and indirect emissions associated with the generation of purchased electricity, heat or steam (scope 2)	ktCO2e share of total emissions (%)	Greenhouse gas (GHG) emission inventory of the Belgian healthcare sector
Annual indirect emissions associated with the generation of purchased electricity, heat or steam (scope 2) in healthcare sector		
Annual direct emissions associated with the combustion of fossil fuels in healthcare sector (scope 1, on-site fuel combustion)		
Annual indirect emissions from upstream and downstream organizational activities (scope 3) related to building and energy management		
GHG Emission intensity		
Direct and indirect emission intensity: Annual direct emissions associated with the combustion of fossil fuels in healthcare sector (scope 1, on-site fuel combustion) and indirect emissions associated with the generation of purchased electricity, heat or steam (scope 2) per euro expenditure	kgCO2e/EUR	Expenditure data: system of health accounts (SHA) Emissions: Greenhouse gas (GHG) emission inventory of the Belgian healthcare sector
Indirect emission intensity: Annual indirect emissions associated with the generation of purchased electricity, heat or steam (scope 2) per euro expenditure		
Direct emission intensity:Annual direct emissions associated with the combustion of fossil fuels in healthcare sector (scope 1, on-site fuel combustion) per euro expenditure		
Renewable energy		
Percentage of energy consumption covered by renewable energy	Percentage	Question expected in STATHOSP survey at hospital level by FPS health
Percentage of healthcare and social care facilities with on-site renewable energy production	Percentage	Flemish Energy and Climate Agency (VEKA)
Total installed renewable energy capacity in healthcare and social care facilities	kW or kW per m²	
Actions		
Percentage of hospitals investing in zero- or low-emission buildings and infrastructure	Percentage	Question expected in STATHOSP survey at hospital level by FPS health
Total hospital investments in zero- or low-emission buildings and infrastructure	EUR	
Percentage of healthcare facilities conducting energy audit/scan since 2018	Percentage	Flemish Infrastructure Fund for Person-related Matters (VIPA), Flemish Energy and Climate Agency (VEKA)
Estimated energy reductions from proposed measures in energy audits/scans since 2018	GWh	
Estimated CO2 emission reductions from proposed measures in energy audits/scans since 2018	Tonne/year	
Percentage of healthcare facilities receiving energy-related investment subsidies since 2018	Percentage	
Total amount of subsidies for energy-related investments in healthcare facilities since 2018	Percentage	Identified in literature Flemish Energy and Climate Agency (VEKA)
Average energy score of healthcare and social care facilities	kWh/m²	
Percentage of healthcare and social care facilities meeting energy label E or better	Percentage	



Appendix 3.3. Medical products

Table 18 – Indicators on medical products (long-list)

Indicators	Units	Data source
GHG Emissions		
<i>Annual greenhouse gas emissions from metered dose inhalers (MDI) (scope 3)</i>	Tonnes, ktCO ₂ e	Belgium's greenhouse gas inventory Belgium's inventory of ozone depleting substances
<i>Annual greenhouse gas emissions from nitrous oxide (N₂O) anaesthetic gas (scope 1)</i>	Tonnes	Belgium's greenhouse gas inventory
<i>Annual indirect emissions from upstream and downstream organizational activities (scope 3) related to pharmaceuticals</i>	ktCO ₂ e	Greenhouse gas (GHG) emission inventory of the Belgian healthcare sector
<i>Annual indirect emissions from upstream and downstream organizational activities (scope 3) related to medical equipment and instruments</i>	share of total emissions (%)	
Consumption of anaesthetics		
<i>Annual volume of high-impact anaesthetic gases: desflurane, isoflurane, and sevoflurane</i>	liter	Identified in literature Supplier data: IQVIA MIDAS
<i>Annual volume of high-impact anaesthetic gas: desflurane</i>	liter	
<i>Annual volume of nitrous oxide (N₂O) anaesthetic gas</i>	liter	
<i>Annual volume of propofol used in anaesthesia</i>	liter	
<i>Percentage of hospitals using vapor-capturing technology</i>	Percentage	Identified in literature
<i>Percentage of hospitals using system control (e.g. End-Tidal Control) to manage the flow of anaesthetic gases</i>	Percentage	Identified in literature
Green pharmaceuticals		
<i>Percentage of low-carbon inhalers (dry-powder inhalers (DPIs) and soft-mist inhalers (SMIs)) among all inhalers</i>	Percentage	Identified in literature Consumption data: Intermutual Agency (IMA-AIM), Technical cel (TCT)
<i>Percentage of high-carbon pressurized metered-dose inhalers (pMDIs) among all inhalers</i>		
Actions		
<i>Percentage of hospitals with guidelines for sustainable procurement of pharmaceutical products</i>	Percentage	Question expected in STATHOSP survey at hospital level by FPS health

Appendix 3.4. Sustainable food

Table 19 – Indicators on sustainable food (long-list)

Indicators	Units	Data source
GHG Emissions		
Annual indirect emissions from upstream and downstream organizational activities (scope 3) related to food and catering services	ktCO2e	Greenhouse gas (GHG) emission inventory of the Belgian healthcare sector
Food waste		
Annual food waste in hospitals and residential care	Tonnes	Identified in literature Material Information system (MATIS) operated by the Flemish public waste agency (OVAM)
Percentage of annual food waste in hospitals and residential care that is composted		
Annual food waste in hospitals	Tonnes	Identified in literature Question expected in STATHOSP survey at hospital level by FPS health
Consumption		
Annual food consumption in hospitals	Tonnes	Identified in literature Question expected in STATHOSP survey at hospital level by FPS health
Percentage of annual food consumption coming from local or sustainable sources	Percentage	
Actions		
Percentage of hospitals with a program or strategy on sustainable food	Percentage	Question expected in STATHOSP survey at hospital level by FPS health
Percentage of hospitals collecting data on food consumption		



Appendix 3.5. Transport and mobility

Table 20 – Indicators on transport and mobility (Long-list)

Indicators	Units	Data source
GHG Emissions		
Annual direct emissions associated with the operation of fleet vehicles (scope 1) in healthcare sector	ktCO2e share of total emissions (%)	Greenhouse gas (GHG) emission inventory of the Belgian healthcare sector
Annual indirect emissions from upstream and downstream organizational activities (scope 3) related to transport	ktCO2e share of total emissions (%)	
Energy consumption		
Annual transport fuel consumption in healthcare sector	GWh or TJ	Energy data: Eurostat, Federal planning bureau, Statbel, Regional administrations
Commuting		
Average commute distance among healthcare sector employees	km	Federal commute surveys by FPS Mobility and Transport
Percentage of healthcare sector employees that commute by bike, foot, or public transport	Percentage	
Percentage of healthcare sector employees occasionally or structurally working remotely	Percentage	Question expected in STATHOSP survey at hospital level by FPS health
Percentage of hospital employees that commute by car	Percentage	
Percentage of hospital employees that commute by electric car		
Actions		
Percentage of electric or zero-emission ambulances in the total ambulance fleet	Percentage	Identified in literature
Percentage of electric or zero-emission vehicles in the healthcare fleet	Percentage	Identified in literature Question expected in STATHOSP survey at hospital level by FPS health

Appendix 3.6. Waste management

Table 21 – Indicators on waste management (long-list)

Indicators	Units	Data source
GHG Emissions		
Annual indirect emissions from upstream and downstream organizational activities (scope 3) related to waste, water, and sanitation	ktCO2e	Greenhouse gas (GHG) emission inventory of the Belgian healthcare sector
Household waste		
Annual volume of household pharmaceutical waste returned to pharmacies	Tonnes kg per inhabitant	Identified in literature Pharma.be (Umbrella organisation for pharmaceutical sector) Flemish public waste agency (OVAM)
Business waste		
Total annual primary waste in the healthcare sector (including pharmacies, laboratories, and medical sector)	Tonnes	Flemish public waste agency (OVAM)
Total annual medical, pharmaceutical, and laboratory primary waste		
Annual plastic waste in healthcare sector	Tonnes	Material Information system (MATIS) operated by the Flemish public waste agency (OVAM)
Annual paper waste in healthcare sector		
Annual non-sorted residual waste in healthcare sector		
Annual medical care waste in healthcare sector		
Annual pharmaceutical and disinfection waste in healthcare sector		
Annual medical imaging waste in healthcare sector		
Annual laboratory waste in healthcare sector		
Percentage of annual waste in healthcare sector that is incinerated without energy recuperation		
Percentage of annual waste in healthcare sector that is dumped in landfill		
Percentage of annual waste in healthcare sector that is recycled or reused		
Annual waste in hospitals	Tonnes	Question expected in STATHOSP survey at hospital level by FPS health
Annual infectious waste in hospitals		
Annual hazardous waste (excluding infectious waste) in hospitals		
Actions		
Percentage of hospitals using reusable surgical gowns	Percentage	Identified in literature
Percentage of hospitals using reusable surgical wraps	Percentage	Identified in literature
Percentage of hospitals with a designated person or team responsible for implementing a strategy on waste recycling, waste reduction, or circular economy	Percentage	Question expected in STATHOSP survey at hospital level by FPS health



Appendix 3.7. Water management

Table 22 – Indicators on water management (long-list)

Indicators	Units	Data source
Emissions to surface water		
Annual (gross or net) emissions of heavy metals to surface water (arsenic, cadmium, chromium, copper, mercury, nickel, lead, zinc)	kg	Flanders Environment Agency (VMM)
Annual (gross or net) emissions of nutrients to surface water (nitrogen, phosphorus)	Tonnes	
Annual (gross or net) emissions of oxidised organic matter to surface water (biochemical oxygen demand, chemical oxygen demand)	Tonnes	
Annual (gross or net) emissions of suspended solids to surface water	Tonnes	
Annual emissions of pharmaceutical substances to surface water	* Number or percentage of measurement points with concentrations above the detection level * Number or percentage of measurement points exceeding the Predicted No-Effect Concentration (PNEC) value * Number of measurement points classified as hotspots, where multiple pharmaceutical substances exceed PNEC or detection levels	Flanders Environment Agency (VMM)
Hazard/risk surface water		
Hazard potential of pharmaceutical consumption in surface water	g/PNEC	Consumption data: Intermutual Agency (IMA-AIM), Technical cel (TCT) PNEC, PEC, and ecotoxicological data: Ugent (Karel De Schamphelaere, Matthieu Gallin)
Environmental risk of pharmaceutical substances in surface water	PEC/PNEC	
Water consumption		
Annual water consumption in healthcare sector	m ³ EUR m ³ /EUR value added m ³ /employment	Identified in literature Flemish institute for technological research (VITO)
Actions		
Percentage of hospitals with specific guidelines or policies for water treatment	Percentage	Question expected in STATHOSP survey at hospital level by FPS health



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