

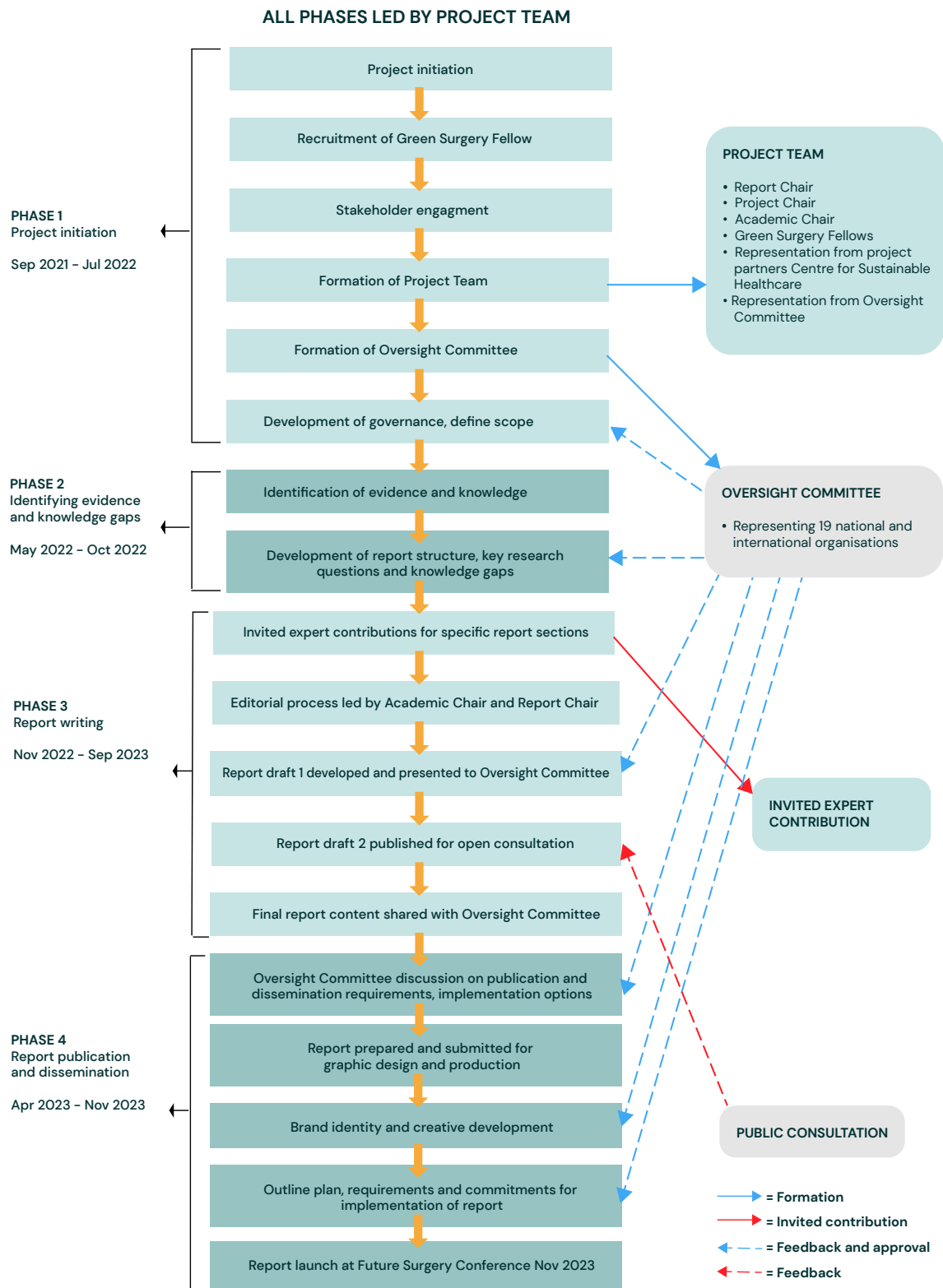
Appendix

Refer to main report for references.

Appendix 1: Process for developing the report

Appendix Figure 1 outlines the process taken for the development of the report. Please see report for full list of contributors.

Appendix Figure 1: Process and timeline for developing the report



Appendix 2: Evaluating the financial spend on surgical care

Analysis was led by Chantelle Rizan. We would like to thank Vimaladipa Tennison and Hasina Begum (NHS England) who assisted in providing data, alongside those who helped code data; Pinky Kotecha, Ardra Rahalakshimi, Gulz Dhanova, Radhika Patel, and William Wilson.

This analysis relates to report Section 1.2.

Methods:

The NHS England national cost collection dataset (financial year 2019/2020) was used as the basis for calculation.⁴⁰ This accounts for acute, community, ambulance, and mental health providers (totalling £72.6 billion), but excludes primary care, or 'non-clinical support activities' (relating to organisations not performing clinical activities such as NHS England, Health Education England, NHS Improvement, and NHS Digital). The dataset includes around 4,000 listed activity types, which were assigned to surgical specialties (or as non-surgical) by at least two individuals (PK, AR, GD, RP, WW), based upon NHS main specialty codes.⁴⁶⁶ This was cross-referenced by CR against the most commonly treatment specialty code assigned to healthcare resource groups (HRGs; clinically similar treatments), based on all recorded patient episodes in NHS England for financial year 2021/22 (derived from Hospital Episode Statistics data). Any discrepancies in specialty coding were resolved by CR.

To estimate the carbon footprint of surgical care, the proportion of NHS England financial spend (including acute, community, ambulance and mental health providers) relating to surgical specialties was applied to the 16.3 million tonnes of CO₂e previously estimated to be associated with these areas (2019).²² This estimate was used to determine the average carbon intensity of surgical care per person in the population in England based on 2019 national population data, and applied to population estimates for Northern Ireland, Scotland, and Wales.⁴⁶⁷ To determine the amount of woodland creation that would need to be planted to sequester the greenhouse gas emissions associated with surgical care in the UK, we used the UK Environment Agency report on potential carbon offsetting approaches.⁴⁶⁸

Results:

Summary results are presented in section 1.2 of the report, and detailed in Appendix Table 1.

Limitations:

This estimate is limited by the assumption that the proportion of financial spend associated with surgical care is representative of associated greenhouse gas emissions, and at this scale is a reasonable assertion. The surgical specialty financial spend is likely an underestimate, as we were unable to assign imaging, pathology, and high-cost drugs to surgical specialties (a proportion of which will relate to surgical care). It is also limited by hospital coding of specialty for activities, although this was minimised through manual coding of data. The extrapolation of the carbon footprint of surgical care across other UK nations assumed the same average carbon intensity of surgery per person.

Appendix Table 1

Specialty		First appointment	Follow up appointment	Outpatient procedure	Day case	Elective inpatient	Non-elective long stay inpatient admissions	Non-elective short stay inpatient admissions	Regular day or night admissions	Total for specialty	Proportion of total NHS England spend: £72,548,346,803 (%)
Cardiothoracic surgery	Number of episodes	54,719	123,489	261	2,117	29,635	12,203	4,335	8	226,767	
	Spend (£)	16,631,701	28,924,546	76,860	3,822,824		45,138,241	45,138,241	8,127	£618,403,370	0.85%
Dentistry	Number of episodes	125,667	239,512	382,909	13,713	72	25	1,048		762,946	
	Spend (£)	23,566,670	42,016,312	64,226,091	9,421,282	85,392	25,661	490,199		£139,831,606	0.19%
General surgery	Number of episodes	1,727,975	2,298,944	223,271	1,015,502	236,001	380,658	616,718	8,970	6,508,039	
	Spend (£)	276,531,639	312,146,038	50,016,901	808,031,516	1,004,569,089	1,320,534,168	470,263,636	3,043,787	£4,245,136,774	5.85%
Neurosurgery	Number of episodes	123,992	210,274	10,704	10,320	23,163	12,871	5,403	124	396,851	
	Spend (£)	28,721,825	36,998,995	2,972,158	15,632,512	204,208,841	149,114,222	35,028,342	66,971	£472,743,865	0.65%
Obstetrics and Gynaecology	Number of episodes	1,717,915	3,357,537	2,028,237	195,331	90,146	395,378	823,965	14,795	8,623,304	
	Spend (£)	302,483,650	452,059,891	316,626,904	218,997,263	355,936,250	1,672,451,496	885,180,218	7,320,456	£4,211,056,129	5.80%
Ophthalmology	Number of episodes	1,322,714	3,406,464	2,966,432	525,167	14,810	2,106	12,039	34	8,249,766	
	Spend (£)	168,778,347	339,684,516	376,997,570	516,135,590	44,693,539	12,982,877	20,904,187	39,240	£1,480,215,866	2.04%

Oral and Maxillofacial Surgery	Number of episodes	583,376	719,653	527,327	178,432	11,127	3,386	7,574	18	2,030,893	
	Spend (£)	85,853,368	88,999,724	89,282,950	159,540,080	51,364,146	15,342,937	12,449,686	24,644	£502,857,535	0.69%
Otolaryngology	Number of episodes	600,911	903,468	1,041,753	147,240	60,043	20,617	64,095	582	2,838,709	
	Spend (£)	73,766,077	99,567,675	132,221,936	228,866,808	258,012,056	61,042,971	39,907,616	121,934	£893,507,073	1.23%
Paediatric surgery	Number of episodes	87,396	116,866	143	10,002	3,681	1,261	1,277	1	220,627	
	Spend (£)	14,787,081	16,452,309	41,294	17,950,415	17,745,837	10,768,439	3,847,581	2,009	£81,594,966	0.11%
Plastic surgery	Number of episodes	267,748	565,520	1,539,162	244,457	15,266	8,223	71,654	3,515	2,715,545	
	Spend (£)	36,673,985	63,903,200	246,402,170	205,673,317	70,770,271	38,203,625	72,827,820	1,225,186	735,679,573	1.01%
Trauma & orthopaedics	Number of episodes	2,253,640	3,847,809	423,288	297,171	204,166	197,666	171,120	3,200	7,398,060	
	Spend (£)	312,223,386	468,631,559	68,066,354	533,339,971	1,329,635,203	1,362,627,652	338,248,922	1,084,147	£4,413,857,194	6.08%
Urology	Number of episodes	608,454	1,356,293	629,320	331,033	117,252	77,444	197,054	5,299	3,322,149	
	Spend (£)	77,769,677	145,470,291	105,710,995	293,824,200	446,269,960	214,640,862	135,101,342	1,170,306	£1,419,957,633	1.96%
Vascular surgery	Number of episodes	216,017	261,098	2,300	31,779	15,894	7,687	3,155	56	537,986	
	Spend (£)	40,234,371	38,161,496	500,011	45,548,457	111,607,624	78,680,558	18,852,798	67,828	£333,653,143	0.46%

Total surgical	Number of episodes	9,690,524	17,406,927	9,775,107	3,002,264	821,256	1,119,525	1,979,437	36,602	43,831,642	
	Spend (£)	1,458,021,778	2,133,016,552	1,453,142,194	3,056,784,234	4,255,675,519	5,099,439,226	2,078,240,589	14,174,636	£19,548,494,727	26.95%
Non-surgical	Number of episodes	13,911,504	30,312,273	3,508,809	2,877,035	357,269	2,867,410	4,343,815	294,575	58,472,690	
	Spend (£)	2,214,258,50	3,862,304,571	498,431,949	1,722,775,634	1,179,108,240	8,931,724,466	2,992,711,628	110,914,212	£21,512,229,201	29.65%
Total surgical and non-surgical	Number of episodes	23,602,028	47,719,200	13,283,916	5,879,299	1,178,525	3,986,935	6,323,252	331,177	102,304,332	
	Spend (£)	3,672,280,280	5,995,321,123	1,951,574,143	4,779,559,868	5,434,783,759	14,031,163,691	5,070,952,216	125,088,847	£41,060,723,928	56.60%

Appendix 3: Commentary on evidence for higher carbon footprint associated with reusable products when compared with single-use equivalent

	Product	Carbon footprint per case of single-use (X%) relative to reusable (100%)	Source	Comment
Australian energy source assumed	Anaesthetic equipment	97%	McGain et al.(2017) ³⁵⁵	Australian study, assuming coal-based electricity. Where remodelled processes using US and UK/European energy sources, reusables lower carbon footprint compared with single-use (48-84% reduction respectively)
	Central venous catheter insertion	34%	McGain et al. (2012) ³⁵⁶	Australian study, assuming coal-based electricity. Assuming US or European electricity (higher proportion of renewables) reduced carbon footprint of re-processing of reusables by 33-50%
	Ureteroscope	99%	Davis et al.(2018) ³⁵⁷	Australian study (likely to have assumed coal-based electricity)
	Cystoscope	57%	Hogan et al.(2022) ³⁵⁸	Methodological flaws highlighted in letter to editor including over-estimates of carbon footprint associated with energy consumption. ³⁶¹ Subsequent response from authors indicates Australian electricity modelled (despite predominantly Irish author group) and decontamination washer- disinfectant machine duration assumed to be 1 hour ⁴⁶⁹ (despite Olympus ETD-Double cycle modelled reported elsewhere at 35 minutes) ⁴⁷⁰ If UK energy assumed at 35 minutes, (assuming other study parameters correct), ³⁵⁸ carbon footprint of reusables would be 55% that of single-use.
Questionable methodological assumptions		67%	Baboudjian et al.(2022) ³⁶⁰	Lack of transparency <ul style="list-style-type: none"> No inventory data (unable to determine material or energy flows assumed) Characterisation factors not listed (e.g. unable to determine energy source assumed) No breakdown of results (e.g. unable to determine contribution of PPE and transportation versus cleaning chemicals) <ul style="list-style-type: none"> Appears to have assumed PPE changed for re-processing of every scope (listing 4 pairs nitrile gloves, 1 pair neoprene glove, apron), and that reprocessing unit 500km away

Questionable methodological assumptions	Bronchoscope	55%	Sørensen et al.(2018) ⁴⁷¹	Assumed scopes re-processed individually and that PPE changed for every scope (listing 2 face shields, 2 gowns, 3 pairs latex gloves and 2 shoe covers per bronchoscope). Where modelled ≥2 reusable bronchoscopes re-processed together, carbon footprint of reusables less than single-use equivalents
	Spinal fusion set	15%	Leiden et al. (2020) ³⁶⁰	Compared multiple reusable instruments (45kg) to heavily consolidated single-use set (2kg). Likely that if similarly consolidated reusable set developed this would have lower carbon footprint

Appendix 4

Reported financial savings from green strategies in surgical care, based upon a review of the pubmed database and grey literature. Savings are estimated, except when asterisked*, where they are actual. HVAC = Heating, Ventilation, and Air Conditioning, GIRFT = Getting It Right First Time, GBP = Great Britian Pounds, EUR = Euros, USD = US Dollars, CAD = Canadian Dollars, AUD = Australian Dollars

Intervention	Year	Saving	Unit	Country	Reference
Remote consultation / information					
Emailing pre-procedure leaflet	2022	GBP 1,497	Annual, NHS Trust	UK	https://sustainablehealthcare.org.uk/sites/default/files/impact_report_-_gloucestershire.pdf
Fuel cost from telehealth	2022	EUR 47,838	Annual, hospital	Spain	https://www.cell.com/heliyon/pdf/S2405-8440(22)01100-8.pdf
Telehealth follow-up after knee and shoulder intervention	2022	EUR 76.52	Per case	Germany	https://www.jmir.org/2022/11/e42839/
Urology patient virtual clinic	2021	GBP 25.91*	Per patient	UK	https://publishing.rcseng.ac.uk/doi/full/10.1308/rcsann.2021.0097
Eliminate duplicate reports in endoscopy unit	2019	GBP 3,357	Annual, NHS Trust	UK	https://sustainablehealthcare.org.uk/sites/default/files/attachments/final_impact_report_barts_health_green_ward_competition_june_2019.pdf
Telemedicine in remote orthopaedic consultations	2019	EUR 18,616	300 consultations	Norway	https://www.jmir.org/2019/2/e11330/
Automated telemonitoring of infection after joint replacement	2019	USD 153,800	Annual, hospital	USA	https://www.liebertpub.com/doi/full/10.1089/tmj.2017.0325
Telerehabilitation after arthroscopic subacromial decompression	2018	EUR 67.45	Per case	Spain	https://journals.sagepub.com/doi/full/10.1177/13576333X17723367

Telemedicine follow-up	2018	GBP 325,000-973,000	Annual, NHS Region	UK	https://www.strategyunitwm.nhs.uk/sites/default/files/2018-11/180813_Economic%20Impact%20of%20OP%20Appointments%20for%20WM%20CCGs_FINAL.pdf
Digital perioperative assessment	2018	GBP 96,000	For every 5,000 patients	UK	https://transform.england.nhs.uk/key-tools-and-info/digital-playbooks/perioperative-digital-playbook/Making-digital-preoperative-assessment-the-default-at-South-West-London-Elective-Orthopaedic-Centre/
Virtual rehabilitation after knee replacement	2017	USD 2,745*	143 cases	USA	https://journals.lww.com/jbjsjournal/fulltext/2020/01150/ef-fects_of_virtual_exercise_rehabilitation_in_home.2.aspx
Videoconferencing rehabilitation after knee replacement	2015	CAD 263*	Per case	Canada	https://www.jmir.org/2015/3/e83
Virtual follow-up after knee replacement	2014	CAD 10.91*	Per case	Canada	https://www.sciencedirect.com/science/article/pii/S0883540314002344
Telemedicine patient consultation	2010	CAD 109,042*	6 months, hospital	Canada	https://www.liebertpub.com/doi/full/10.1089/tmj.2010.0057
Telephone clinic after carpal tunnel decompression	2008	GBP 45,958	Two years, hospital	UK	https://journals.sagepub.com/doi/full/10.1177/1753193408090124
Teleconsultation for orthopaedic patients	2002	EUR 2,620*	100 patients	Finland	https://journals.sagepub.com/doi/abs/10.1177/1357633x0200800507

Changing pathways / care					
Reducing same-day surgery cancellations	2022	GBP 6,307	Annual, NHS Trust	UK	https://sustainablehealthcare.org.uk/sites/default/files/impact_report_-_the_christie.pdf
Overtime costs due to no bed confirmation	2022	GBP 712.64	Per Patient	UK	https://sustainablehealthcare.org.uk/sites/default/files/impact_report_-_the_christie.pdf
Identifying patients at high risk of fracture in oncology ward	2022	GBP 3,500	Annual, NHS Trust	UK	https://sustainablehealthcare.org.uk/sites/default/files/impact_report_-_the_christie.pdf
Local vs general anaesthesia inguinal hernia repair	2021	GBP 15,984	Annual, NHS Trust	UK	https://sustainablehealthcare.org.uk/news/2021/10/introducing-team-5-green-surgery-challenge
Green patient pathway for carpal tunnel decompression	2021	GBP 12,641	Annual, NHS Trust	UK	https://sustainablehealthcare.org.uk/news/2021/10/introducing-team-4-green-surgery-challenge
Use of sevoflurane over desflurane	2021	USD 100,000	Annual, hospital	USA	https://www.mdpi.com/2077-0383/10/6/1306
Streamlining peri-operative care pathway for spine surgery	2019	USD 9,074*	18 months, hospital	USA	https://journals.lww.com/spinejournal/FullText/2019/07010/Enhanced_Periooperative_Care_for_Major_Spine.15.aspx
Patient flow facilitation in ophthalmology outpatients	2019	GBP 10,000	Annual, NHS Trust	UK	https://sustainablehealthcare.org.uk/sites/default/files/attachments/final_impact_report_barts_health_green_ward_competition_june_2019.pdf
Surgical approach and anaesthetic modality in carpal tunnel release	2017	USD 3.6 billion	Over 10 years, nationwide	USA	https://journals.sagepub.com/doi/full/10.1177/1558944716643276
Streamlining hand surgery care pathway	2016	USD 13,250*	1099 cases	USA	https://www.sciencedirect.com/science/article/pii/S0363502317304100

GIRFT pathway efficiency in orthopaedics	2012-2017	GBP 696 million	Five years, nationwide	wUK	https://gettingitrightfirsttime.co.uk/wp-content/uploads/2020/02/GIRFT-orthopaedics-follow-up-report-February-2020.pdf
Reducing material use					
Reducing anaesthesia emissions	2023	USD 110,000	Annual, hospital	USA	https://www.sciencedirect.com/science/article/abs/pii/S0022346823000362
Reducing unnecessary blood tests	2023	CAD 5,235	83 patients	Canada	https://bmjopenquality.bmj.com/content/bmjqir/12/3/e002316.full.pdf
Reducing transfer sheets in endoscopy	2022	GBP 2,160	Annual, NHS Trust	UK	https://sustainablehealthcare.org.uk/sites/default/files/impact_report_-_hywel_dda.pdf
Reduced paper reports in endoscopy	2022	GBP 548	Annual, NHS Trust	UK	https://sustainablehealthcare.org.uk/sites/default/files/impact_report_-_swansea_bay.pdf
Carbon neutral pulsatile lavage system in joint replacement	2022	GBP 6,175	Annual, NHS Trust	UK	https://sustainablehealthcare.org.uk/sites/default/files/impact_report_-_gloucestershire.pdf
Reduced prophylactic inkopad use in endoscopy	2022	GBP 891	Annual, NHS Trust	UK	https://sustainablehealthcare.org.uk/sites/default/files/impact_report_-_gloucestershire.pdf
Changing Size G nitrous oxide cylinders to Size E on	2022	GBP 1,681	Annual, NHS Trust	UK	https://sustainablehealthcare.org.uk/sites/default/files/impact_report_-_the_christie.pdf

Waste from unused instruments in hand surgery	2022	USD 2193*	6 months, hospital	USA	https://journals.sagepub.com/doi/full/10.1177/15589447221084011
Reformulating surgery instrument sets	2022	USD 45,719	Annual, hospital	USA	https://www.sciencedirect.com/science/article/pii/S0002961022006675
Streamlining surgical trays	2022	288,338	3 years, hospital	USA	https://jamanetwork.com/journals/jamaotolaryngology/article-abstract/2789931
Irrigation management system in urology	2022	GBP 800*	Per list, NHS Trus	UK	https://docs.google.com/document/d/16LlwfttTST-l8ppAx-pHkG7l8vbTVrUBI/edit
Replacing CO2 insufflation in laparoscopic appendicectomy	2021	GBP 78,000	Annual, NHS Trust	UK	https://sustainablehealthcare.org.uk/news/2021/10/introducing-team-2-green-surgery-challenge
Reducing urinary catheterisation in laparoscopic appendicectomy	2021	GBP 1,128	Annual, NHS Trust	UK	https://sustainablehealthcare.org.uk/news/2021/10/introducing-team-2-green-surgery-challenge
Eliminating second group and save test in laparoscopic cholecystectomy	2021	GBP 3,000	Annual	UK	https://sustainablehealthcare.org.uk/news/2021/10/introducing-team-3-green-surgery-challenge
Eliminating group and save tests in laparoscopic appendectomy	2021	GBP 3,821*	6 months, NHS Trust	UK	https://docs.google.com/document/d/1ygxgj4RZVHJU-KXX-F2kje8LQZnwlNsnp/edit

Reducing ethyl chloride spray for testing spinal/epidural blocks	2020	GBP 4,827	Annual, NHS Trust	UK	https://sustainablehealthcare.org.uk/sites/default/files/impactreport_dorsetbournemouth_green_ward_competition.pdf
Reduce excessive CO2 in endoscopy	2020	GBP 1,226	Annual, NHS Trust	UK	https://sustainablehealthcare.org.uk/sites/default/files/impactreport_frimley_health_green_ward_competition_2020.pdf
Switching to waterless scrub technique	2020	USD 280,000-348,000	Annual, per theatre	USA	https://jamanetwork.com/journals/jamaophthalmology/article-abstract/2761765
Minimal custom pack design and local anaesthetic hand surgery	2019	USD 125*	Per Case	USA	https://journals.sagepub.com/doi/full/10.1177/1558944717743595
Reduce unnecessary GA and IV sedation during cataract surgery	2019	GBP 40,872	Annual, NHS Trust	UK	https://sustainablehealthcare.org.uk/sites/default/files/attachments/final_impact_report_barts_health_green_ward_competition_june_2019.pdf
Reducing nitrous oxide use in anaesthesia	2019	GBP 529	Annual, hospital	UK	https://sustainablehealthcare.org.uk/sites/default/files/attachments/rde_green_team_impact_report_2019_final.pdf
Reducing desflurane use	2019	USD 25,000	Per month, hospital	USA	https://journals.lww.com/anesthesia-analgesia/Full-Text/2019/06000/Provider_Education_and_Vaporizer_Labeling_Lead_to.34.aspx
Reducing wasted devices in theatre	2018	EUR 100,000	Annual, hospital	France	https://www.sciencedirect.com/science/article/pii/S1743919118305338

Minimal custom instrument packs for wide awake hand surgery	2017	USD 125*	Per Case	USA	https://journals.sagepub.com/doi/full/10.1177/1558944717743595
Reducing unused disposable instruments in neuro	2017	EUR 27,299*	53 procedures	Netherlands	https://link.springer.com/article/10.1007/s00701-017-3366-y
Streamlining instrument sets and theatre waste in plastic and hand surgery	2015	USD 41,844	Annual, 3 hospitals	USA	https://journals.sagepub.com/doi/abs/10.1177/229255031502300409
Reducing disposal equipment in laparoscopic cholecystectomy	2015	USD 33,000	Annual, hospital	USA	https://www.sciencedirect.com/science/article/pii/S0002961014006047
Education for surgeons to reduce instruments in laparoscopic appendectomy	2015	USD 200,000	Annual, hospital	USA	https://www.ingentaconnect.com/content/wk/dcr/2015/00000058/00000011/art00018
Washing anaesthesia breathing circuits less frequently	2014	AUD 5,219	Annual, hospital	Australia	https://associationofanaesthetists-publications.onlinelibrary.wiley.com/doi/full/10.1111/anae.12563
Converting from soap to alcohol-based waterless scrub	2013	USD 2,000	Annual, hospital	USA	https://journals.sagepub.com/doi/abs/10.1177/000313481307900708
Installation of fluid management system in theatre	2010	USD 86,460	Annual, hospital	USA	https://practicegreenhealth.org/sites/default/files/upload-files/gor_fullset_webmaterials.pdf

Fluid management system	2010	USD 7,200*	Annual, hospital	USA	https://practicegreenhealth.org/sites/default/files/upload-files/gor_fullset_webmaterials.pdf
Surgical pack reformulation	2010	USD 116,215	Annual, hospital	USA	https://practicegreenhealth.org/sites/default/files/upload-files/gor_fullset_webmaterials.pdf
Reduce water waste during surgical hand scrubbing	2009	USD 1,962*	Annual, hospital	USA	https://www.sciencedirect.com/science/article/abs/pii/S107275150900828X
Changing water delivery method for surgical scrubbing	2008	GBP 90,000	Annual, 2 hospitals	UK	https://www.sciencedirect.com/science/article/pii/S0195670108002417
Fluid management system	2007	USD 10,000	Annual, hospital	USA	https://practicegreenhealth.org/sites/default/files/upload-files/gor_fullset_webmaterials.pdf
Reuse of medical products					
Reusable laryngoscope blades	2023	EUR 5,783	Annual, hospital	France	https://www.sciencedirect.com/science/article/pii/S235255682300084X
Repairing surgical scissors	2022	GBP 0.46*	Per use	UK	https://link.springer.com/article/10.1007/s11367-022-02064-7
Reusable named surgical theatre caps	2022	GBP 25,000	Annual, NHS Trust	UK	https://docs.google.com/document/d/18SfKM6pw7Khkqs-bhNthDlkGoVyhyVHDD/edit

Replacing disposable shorts in endoscopy	2022	GBP 7,180	Annual, NHS Trust	UK	https://sustainablehealthcare.org.uk/sites/default/files/impact_report_-_gloucestershire.pdf
Electrophysiology catheter remanufacturing	2022	GBP 24,220*	Annual, NHS Trust	UK	https://docs.google.com/document/d/1S2lQme9NE5KzKA-pOAFNEAVYSBYnGwdwO/edit
Reusable versus single-use theatre pack in skin cancer surgery	2022	GBP 7.22*	Per pack	UK	https://academic.oup.com/bjd/article-abstract/186/4/735/6705828
Reusable flexible cystoscopes	2022	EUR 4*	Per case	Denmark	https://www.liebertpub.com/doi/full/10.1089/end.2022.0201
Electrophysiology catheter remanufacturing	2022	GBP 102,048*	Annual, NHS Trust	UK	https://docs.google.com/document/d/1Sox-z7_19gKxkSq5emGKAzOiEjmE35_Du/edit
Harmonic scalpel remanufacturing	2022	GBP 13,189*	Annual, NHS Trust	UK	https://docs.google.com/document/d/1P37WLNhgMhvb-n9uqfvyCUEJFKpjfkZ8h/edit
Electrophysiology catheter remanufacturing	2022	GBP 26,029*	Annual, NHS Trust	UK	https://docs.google.com/document/d/1yIU42sAJEZ5BoK-VO-gIBSuzVqzEOEyKU/edit
Replacing single-use instruments in laparoscopic appendicectomy	2021	GBP 34,400	Annual, NHS Trust	UK	https://sustainablehealthcare.org.uk/news/2021/09/introducing-team-1-green-surgery-challenge

Replacing single-use instruments in laparoscopic appendectomy	2021	GBP 9,567	Annual, NHS Trust	UK	https://sustainablehealthcare.org.uk/news/2021/10/introducing-team-2-green-surgery-challenge
Hybrid versus single-use instruments in laparoscopic cholecystectomy	2021	GBP 151*	Per case	UK	https://link.springer.com/article/10.1007/s00464-021-08728-z
Reusable vs disposable surgical gowns	2021	GBP 118.52*	8 weeks, 2 theatres	UK	https://sustainablehealthcare.org.uk/news/2021/10/introducing-team-5-green-surgery-challenge
Repair of surgical steel instruments	2021	EUR 39,184*	6 months, 3 hospitals	Netherlands	https://www.sciencedirect.com/science/article/pii/S2352550920313701
Reprocessing FFP2 face masks during COVID-19	2021	EUR 0.15*	Per unit	Netherlands	https://www.nature.com/articles/s41598-021-97188-5
Reusable versus disposable blood pressure cuffs	2020	USD 42.78	Per use	USA	https://www.sciencedirect.com/science/article/pii/S092134491930549X
Reusable versus single-use disposable laryngoscope blades	2018	USD 180,000 - 265,000	Annual, hospital	USA	https://journals.lww.com/anesthesia-analgesia/full-text/2018/08000/life_cycle_assessment_and_costing_methods_for.22.aspx
Health equipment amnesty programme	2018	GBP 608,500	Per month, NHS Trust	UK	https://www.rcplondon.ac.uk/projects/outputs/less-waste-more-health-health-professionals-guide-reducing-waste

Reusable versus single-use anaesthetic equipment	2017	> AUD 30,000	Annual, 2 hospitals	Australia	https://academic.oup.com/bja/article/118/6/862/3828038
Replacing disposable theatre foam padding with reusable gel pads	2013	> USD 50,000	Annual, institution	USA	https://journals.sagepub.com/doi/abs/10.1177/000313481307900708
Reprocessing seven medical devices	2013	USD 520,000	Annual, hospital	USA	https://www.sciencedirect.com/science/article/pii/S0959652615010756
Switch to reusable isolation gowns	2012	> USD 1.1 million	2 years, hospital	USA	https://practicegreenhealth.org/tools-and-resources/ron-ald-reagan-ucla-medical-center-reusable-isolation-gowns
Reusable versus disposal laryngeal mask airways	2012	USD 4	Per unit	USA	https://journals.lww.com/anesthesia-analgesia/full-text/2012/05000/comparative_life_cycle_assessment_of_disposable.22.aspx
Reusable versus single-use central venous catheter insertion kits	2012	AUD 2.3	Per unit	Australia	https://journals.lww.com/anesthesia-analgesia/fulltext/2012/05000/A_Life_Cycle_Assessment_of_Reusable_and_Single_Use.23.aspx
Reprocessing medical devices	2010	USD 17.6 mil	Annual, 163 hospitals	USA	https://practicegreenhealth.org/sites/default/files/upload-files/gor_fullset_webmaterials.pdf
Reprocessing medical devices	2010	USD 400,000	Annual, hospital	USA	https://practicegreenhealth.org/sites/default/files/upload-files/gor_fullset_webmaterials.pdf

Reusable gowns and textiles in theatre	2010	USD 38,349	Annual, hospital	USA	https://practicegreenhealth.org/sites/default/files/upload-files/gor_fullset_webmaterials.pdf
Switch to reusable sharps containers	2010	USD 11,000	Annual, hospital	USA	https://practicegreenhealth.org/sites/default/files/upload-files/gor_fullset_webmaterials.pdf
Switch to reusable sharps containers	2010	USD 13,000	Annual, hospital	USA	https://practicegreenhealth.org/sites/default/files/upload-files/gor_fullset_webmaterials.pdf
Reusable ultrasonic shears for laparoscopic bariatric surgery	2010	USD 15,163*	7 months, hospital	USA	https://link.springer.com/article/10.1007/s11695-008-9723-4
Switching from single-use to reusable anaesthetic drug tray	2010	AUD 0.67*	Per unit	Australia	https://journals.sagepub.com/doi/abs/10.1177/0310057X1003800320
Reprocessing medical devices	2008-2010	USD 235,803	3 years, hospital	USA	https://practicegreenhealth.org/sites/default/files/upload-files/gor_fullset_webmaterials.pdf
Reprocessing medical devices	2008	USD 496,123	Annual, hospital	USA	https://practicegreenhealth.org/sites/default/files/upload-files/gor_fullset_webmaterials.pdf
Reprocessing medical devices	2008	USD 1.4 million	Annual, institution	USA	https://pubmed.ncbi.nlm.nih.gov/18972859/

Reusable instrument set in laparoscopic cholecystectomy	2005	EUR 420*	Per procedure	Germany	https://link.springer.com/article/10.1007/s00464-003-9232-4
Sterilisation					
Switching from blue wrap to hard cases for sterilisation	2012	USD 51,000	Annual, hospital	USA	https://journals.healio.com/doi/abs/10.3928/01477447-20120525-39
Rigid reusable containers to sterilise surgical instruments	2010	USD 29,843	Annual, hospital	USA	https://practicegreenhealth.org/sites/default/files/upload-files/gor_fullset_webmaterials.pdf
Switch to reusable containers	2008	USD 100,000	Annual, hospital	USA	https://journals.lww.com/frontiersonline/Citation/2008/07000/Greening_Healthcare__21st_Century_and_Beyond.6.aspx
Changing from blue wrap to rigid sterilisation containers	2006	USD 16,186*	Annual, hospital	USA	https://journals.lww.com/frontiersonline/Citation/2008/07000/Greening_Healthcare__21st_Century_and_Beyond.6.aspx
Changing from blue wrap to rigid sterilisation containers	2003-2010	USD 1 million	7 years, hospital	USA	https://practicegreenhealth.org/sites/default/files/upload-files/gor_fullset_webmaterials.pdf
Waste management					
Sterile water bottle recycling in endoscopy unit	2022	GBP 129.82	Annual, NHS Trust	UK	https://sustainablehealthcare.org.uk/sites/default/files/rcht_-_impact_report.pdf

Recycling blue wrap	2019	USD 174,240	Annual, hospital	USA	https://journals.lww.com/neurosurgery/Full-text/2019/09000/Greening_the_Operating_Room__Results_of_a_Scalable.17.aspx
Paper-based bin for medical waste disposal and incineration	2018	GBP 13,500	Annual, NHS Trus	UK	https://www.rcplondon.ac.uk/projects/outputs/less-waste-more-health-health-professionals-guide-reducing-waste
Recycling single use devices	2013	USD 4,000	Annual, institution	USA	https://journals.sagepub.com/doi/abs/10.1177/000313481307900708
Donating or redistributing used batteries	2019	USD 9,000	Annual, institution	USA	https://journals.sagepub.com/doi/abs/10.1177/000313481307900708
Reducing red biohazard bag waste	2013	USD 60,000	Annual, institution	USA	https://journals.sagepub.com/doi/abs/10.1177/000313481307900708
Reducing incineration of clinical waste from arthroplasty	2013	GBP 420,000	Annual, nationwide	UK	https://journals.sagepub.com/doi/abs/10.1177/175045891302300605
Appropriate waste segregation in theatre	2011	USD 576,024	Two years, institution	USA	https://www.anesthesiology.theclinics.com/article/S1932-2275(10)00121-7/fulltext
Decreased regulated medical waste generated by theatre	2010	> USD 15,000	6 months, hospital	USA	https://practicegreenhealth.org/sites/default/files/upload-files/gor_fullset_webmaterials.pdf

Decreased regulated medical waste generated by theatre	2010	> USD 89,000	Annual, hospital	USA	https://practicegreenhealth.org/sites/default/files/upload-files/gor_fullset_webmaterials.pdf
Theatre waste recycling	2010	USD 10,000	Annual, hospital	USA	https://practicegreenhealth.org/sites/default/files/upload-files/gor_fullset_webmaterials.pdf
Diverting surgical waste away from disposal	2010	USD 26,600	Annual, two hospitals	USA	https://aornjournal.onlinelibrary.wiley.com/doi/full/10.1016/j.aorn.2009.12.029
Theatre blue wrap recycling	2007-2010	USD 200,000	3 years, 45 theatres	USA	https://practicegreenhealth.org/sites/default/files/upload-files/gor_fullset_webmaterials.pdf
Single-stream recycling of non-hazardous surgical waste	2009	USD 4,670*	6 months, hospital	USA	https://pubmed.ncbi.nlm.nih.gov/22403961/
Recycling non-infectious theatre plastic waste	2009	AUD 1,040	Annual, hospital	Australia	https://pubmed.ncbi.nlm.nih.gov/19115664/
Estates and facilities					
Switching off eligible anaesthetic machines and gas scavenging pumps in theatres	2022	GBP 26,000	Annual, NHS Trust	UK	https://sustainablehealthcare.org.uk/sites/default/files/impact_report_-_swansea_bay.pdf

Improving Laminar Flow efficiency in emergency and orthopaedic theatres	2022	GBP 8,364	Annual, NHS Trust	UK	https://sustainablehealthcare.org.uk/sites/default/files/impact_report_-_gloucestershire.pdf
Theatre setback of HVAC	2022	USD 36,185	Annual, theatre	USA	https://www.sciencedirect.com/science/article/pii/S0195670122002286#bib58
Power down procedure, anaesthesia, theatre lights, equipment not in use	2013	USD 33,000	Annual, institution	USA	https://journals.sagepub.com/doi/abs/10.1177/000313481307900708
HVAC occupancy sensor installation in theatre	2010	USD 4,992	Annual, hospital	USA	https://practicegreenhealth.org/sites/default/files/upload-files/gor_fullset_webmaterials.pdf
Switching to LED lights and low mercury lamps	2010	USD 40,000	Annual, hospital	USA	https://journals.lww.com/nursingmanagement/full-text/2010/11000/Greening_in_healthcare.6.aspx
Increase theatre temperature from 64F to 70F to reduce patient warming devices	2010	USD 72,000	Annual, hospital	USA	https://practicegreenhealth.org/sites/default/files/upload-files/gor_fullset_webmaterials.pdf
Comprehensive retrofit of HVAC, lighting, building control system, plant	2010	USD 1.77 million	Annual, hospital	USA	https://journals.lww.com/frontiersonline/Citation/2008/07000/Greening_Healthcare__21st_Century_and_Beyond.6.aspx

Multimodal					
Energy saving interventions, recycling, reprocessing	2010	USD 5 billion	5 years, 18 hospitals	USA	https://www.greenribboncommission.org/wp-content/uploads/2016/01/bending_the_curve.pdf