



**Sustainable
Healthcare
Coalition**

Carbon Calculators for Healthcare: A Landscape Review

Ruth Chalke

August 2026

Disclosure: *The author of this review is an employee of an NHS Trust, seconded to the Sustainable Healthcare Coalition as part of a year-long NHS CSO Clinical Fellowship programme.*

Contents

1. Executive Summary	4
2. Introduction	6
Examples of Intended Users and Use Cases.....	8
Criteria definitions.....	9
3. Care Pathway Tools	10
3.1 Carebone	10
3.2 CARE pathways Environmental Sustainability Assessment (CARESA)	12
3.3 Clinical Activity Carbon Emissions Factors for Care Pathway Appraisal	14
3.4 Net Zero Health and Care Pathway Tool.....	16
3.5 Patient Care Pathway Carbon Calculator.....	18
4. Clinical Trials Tools	20
4.1 Greener Trials Toolkit	20
4.2 Industry Low Carbon Clinical Trials (iLCCT) Carbon Calculator	22
4.3 PPD Carbon Emission Calculator for Clinical Trials	24
5. Pharmaceutical Tools	26
5.1 ABPI Blister Pack Carbon Footprint Tool.....	26
5.2 ACS GCI PR PMI-LCA Tool.....	27
5.3 Medicine Carbon Footprint Database	29
6. Medical Technology Tools	31
6.1 Single-use vs. Reusable Carbon Footprint Calculator.....	31
7. Product-level Tools.....	33
7.1 Looper (NHS Scotland)	33
7.2 The Lancet MedZero.....	34
8. Healthcare Organisation-Level Tools	37
8.1 AKDN (Aga Khan Development Network) Carbon Management Tool	37
8.2 Climate Impact Checkup.....	38
8.3 SmartCarbon (Newcastle upon Tyne Hospitals NHS Foundation Trust).....	41
9. Specialty-specific Tools	43
9.1 Eyefficiency	43
9.2 General Practice Non-Clinical Carbon Calculator	45
9.3 In-Centre Haemodialysis (ICHD) Carbon Calculator	46
10. Project / Service Evaluation Tools.....	48
10.1 Sustainable Healthcare Impact Assessment (SHIA).....	48



11. Summary..... 50

12. References 52

Appendix 1..... 54

 Table of Tools for RAG-rating..... 54



1. Executive Summary

The growing demand for carbon accounting has driven a proliferation of carbon calculators – some extending beyond carbon to other environmental impacts – enabling organisations to calculate their overall carbon footprint or wider environmental impact. Given the number of carbon calculators now available, this landscape review assesses 21 tools, selected according to inclusion/exclusion criteria set out in the body of the report. The calculators (or tools) span eight levels of measurement across healthcare: care pathways, clinical trials, pharmaceuticals, medical technology, products, healthcare organisations, clinical specialties, and project/service evaluation. Each tool is reviewed against a consistent set of criteria to understand how well the current landscape serves the range of users and use cases now demanding carbon and other data from the health sector.

Tools vary widely in ownership, access model, development stage and scope. Based on this analysis, the findings suggest that the heterogeneity reflects a landscape responding to a rising demand from health systems for credible environmental impact data and is a signal of a field moving from early interest towards mainstream adoption, rather than a market failing to converge on a single solution.

Because target users and use cases differ so substantially (from clinicians identifying pathway hotspots and trialists footprinting research activity, to Trust Boards meeting statutory reporting duties), direct like-for-like comparison between tools would be inappropriate. No single tool can, or should, meet every need. The question is not which tool is best, but which tool fits the user's purpose, and whether its outputs can be trusted.

In some instances, tools may be complementary rather than competing, and organisations may benefit from using more than one in tandem to build a fuller picture. A Trust might, for example, use a specialty-level tool to identify hotspots within a specific clinical pathway, while separately using an organisational tool to meet statutory reporting duties – the two outputs serving different purposes rather than needing to be reconciled into a single figure. Similarly, a care pathway tool could be used alongside a product-level tool, where the pathway tool captures the footprint of care delivery as a whole and the product tool provides more granular, product-specific data that feeds into or refines one component of that pathway.

The review's overarching conclusion is that the value of this expanding landscape of tools depends less on which tool is used and more on the robustness and consistency of the method underpinning it. The Sustainable Healthcare Coalition's (SHC) emission factors are the most widely used single source in the care pathway and clinical trial categories, appearing in six of the tools reviewed (including SHC's own). UK government conversion factors (DEFRA/DESNZ/BEIS) and Ecoinvent also feature regularly across categories. This reflects shared data sources rather than a shared method: emission factors are inputs, and their selection is one methodological choice among several, not a proxy for methodological consistency overall. Several tools explicitly align with ISO 14040/44 and the GHG Protocol, but these standards permit a range of choices – for example on system boundaries, allocation, and cut-off criteria – which are justified through critical review or assurance rather than fixed by the standard itself. Alignment with these standards therefore does not imply that tools' methods are consistent with one another. Transparency also remains inconsistent across the landscape: emission factor sourcing, boundary definitions, and data quality assessment are variably disclosed, and some tools disclose little to nothing about their underlying method, which limits comparability and independent verification.

A single method cannot span every unit of analysis in this landscape, as care pathways, clinical trials, products, services and organisational assessments each require their own functional unit and boundary logic. This

review recommends a shared methodological core, rather than a single universal method, with variation around that core to accommodate the functional unit and boundary requirements of each use case. Specific choices in how the core is applied to particular use cases are not prescribed, since these will legitimately vary. Where that variation crosses into a genuinely different method, rather than a legitimate adaptation of a shared core, is not straightforward to determine, and is likely to remain a live question as the landscape matures.

The care pathway category presents the clearest opportunity for this convergence to go further, since these tools already share the same unit of analysis and, as this review finds, a substantial proportion of their emission factors. The barriers that remain are methodological rather than structural – differences in system boundaries, emission factor sourcing, allocation, and attributional versus consequential framing – and resolving these on a transparent, well-documented basis is where the value of a shared methodological core lies.

This core would need to meet the following criteria: an explicit standards basis, a documented emission factor hierarchy and provenance, defined boundaries and functional units, a stated data quality assessment, and transparent materiality thresholds. Of the care pathway tools reviewed, those with published methods meet these criteria most fully, but none meets all of them, and no tool in this category has yet been independently verified against them.

As this landscape continues to mature, the priority is not fewer tools, but greater methodological alignment – and a clearer understanding of where and why tools make different choices – underpinning the ones that exist. That alignment and understanding will determine whether the sector's growing investment in carbon measurement translates into meaningful decarbonisation. Aligned methods make tools' outputs comparable, or at minimum allow differences between them to be explained rather than left unaccounted for – enabling benchmarking across products and services, aggregation to system level, and credible procurement signals – and it is that comparability, rather than measurement alone, that ultimately drives reduction.

2. Introduction

Climate change is widely recognised as the single biggest threat to humanity, and the healthcare sector is a significant contributor to global carbon emissions, with contributions estimated at 4.6%.¹ The link between climate change and health is irrefutable and we already see the negative impact of climate change on human health, with increases in extreme weather events, poor air quality, increased risk of infectious diseases, and food and water insecurity. These impacts worsen health inequalities and undermine the core determinants of health² and so the healthcare sector has a responsibility to minimise environmental impact and mitigate further harm, while ensuring it continues to deliver high-quality, equitable care. Because of this healthcare-climate paradox, health systems across a wide range of areas – including care pathways, clinical trials, pharmaceuticals, medical technology and products, healthcare organisations, clinical specialties, and project and service development – have committed to decarbonisation, giving rise to the eight categories of measurement tool assessed in this review.

Care pathways account for a substantial share of healthcare emissions, with one estimate from the Sustainable Markets Initiative attributing around 45% of the total to **patient care pathways** (though the precise share depends on how pathway boundaries are drawn).³ Care pathways are the structured, multidisciplinary plans outlining the essential steps in a patient's care journey for a specific condition or procedure, from initial presentation through to outcome. By mapping care pathways, carbon hotspots can be identified and addressed, and alternative ways of managing conditions can be compared (e.g. different diagnostic routes or treatment regimens). Recommendations that follow often align with the three dimensions of the triple bottom line: financial savings, social value, and environmental benefit.

As the foundation of medical advancement, there is a need to measure the environmental footprint of **clinical trials**, which incorporates participant and staff travel, investigational product manufacture and distribution, trial-specific testing and monitoring, data management infrastructure, and site operations. This is a growing area of focus as trial sponsors, trial sites and Contract Research Organisations (CROs) are under increasing pressure from emerging regulations and sponsor ESG requirements to account for trial-stage emissions (separate from the footprint of the eventual marketed product or care pathway).

Pharmaceuticals and **medical technologies** are key outputs of clinical trials and healthcare innovation, and measuring their environmental impact typically follows LCA methodology across the **product's** life cycle; from raw material sourcing, manufacturing, and packaging through to distribution, use, and disposal. This produces a per-dose, per-course, or per-use carbon footprint that can feed into pathway-level assessments (e.g. comparing posology, delivery method, or single-use versus reusable devices). Measurement can also extend upstream to the supply chain, capturing the emissions embedded in procurement, production, and distribution – typically the largest share of a healthcare organisation's total footprint, given the scale and complexity of supplier networks providing everything from medicines and devices to consumables, food, and construction materials. This form of measurement aligns closely with Scope 3 emissions reporting in line with the GHG Protocol Corporate Standard⁴ and often relies on supplier-reported data, spend-based estimation, or environmentally extended input-output models where granular data is unavailable.

Measurement at the **organisational level** (i.e. hospital, trust, or health system) aggregates emissions across all three scopes: direct emissions (Scope 1), indirect emissions from purchased energy (Scope 2), and other indirect GHG emissions, such as those from the supply chain, and patient and staff travel footprint (Scope 3). This then produces an organisation-wide picture, often for regulatory disclosure or net zero target-setting.

At the level of specific **specialties**, environmental impact can be assessed within defined clinical areas such as general practice (GP), kidney care, or ophthalmology, capturing the resource use, care patterns, and pathway structures characteristic of that specialty. This allows for benchmarking and improvement efforts tailored to the specific pressures and opportunities within a clinical field, rather than relying on broader, condition-agnostic pathway data.

Finally, environmental impact measurement can be applied at the level of **project or service** evaluation and planning, supporting decision-making around proposed changes to service delivery, new care models, or capital investment, by allowing carbon impact to be assessed prospectively alongside clinical and financial considerations.

Each of these healthcare areas provides differing levels of granularity and context-specific evidence bases. As the need to measure healthcare's carbon impact grows, so too have the number of carbon calculators available to support this work. Given the varying needs of users and use cases, it is unrealistic to expect a single tool to meet all requirements. Rather, a range of tools can coexist, provided they are built on a consistent underlying methodological core and are supported by sufficiently robust data to ensure results are comparable and valid.

This review examines 21 healthcare-related carbon calculators spanning eight levels of measurement across the healthcare sector against a consistent set of criteria, in order to assess how each tool meets the needs of different users and where methodological alignment exists across the landscape. Many tools have their origins in the UK, and some remain UK-specific, however the review also includes global tools that are serving wider audiences and building momentum in measuring the environmental impacts of healthcare.

Tools were included if they were: designed to calculate GHG emissions (CO₂e) – as a minimum – from any of the following healthcare-related scopes: patient care pathways, clinical trials, pharmaceuticals, medical technologies, products and services, organisations, specialties, or projects; sufficiently accessible to assess their purpose, usability, scope, strengths and limitations and, where available, their underlying methodology; and available, along with supporting documentation, in English.

Tools were excluded if they were: purely academic research outputs with no functional calculator (i.e. papers describing methodology only, with no usable tool); developed exclusively for non-European markets with no European emission factors or applicability; non-healthcare-specific LCA or carbon accounting tools; or general sustainability (ESG) reporting platforms that happen to cover healthcare as one of many sectors.

Examples of Intended Users and Use Cases

Users

Clinicians

Trust/ICB Board
members; service leads

Sustainability teams

Estates & facilities teams

Clinical transformation
teams

Travel & transport teams

Procurement; supply
chain

Commissioners

Academics; trialists;
researchers

Policy makers

Industry: pharma,
MedTech

HTA agencies

LCA analysts

Use cases

Identifying sustainability hotspots in the care pathway

Tracking the sustainability of a care pathway over time

Identifying opportunities/data to improve the sustainability of
the care pathway

Designing more sustainable care pathways and models of care

Informing discussion concerning the sustainability of a care
pathway

Modelling a change, modification or optimisation to an existing
care pathway

Modelling the impact of improved patient outcomes on
environmental impact measures through pathway redesign

Modelling impacts of climate change (e.g. heatwaves) on
patient outcomes (e.g. worsening renal function)

Tracking environmental impact over time

Providing environmental data when designing quality
improvement or 'triple bottom line' projects

Identifying pharmaceutical and prescribing hotspots

Reporting and benchmarking for Green Plans (NHS) and to
share best practice

Evaluating the Scope 3 emissions of suppliers

Criteria definitions

Owner	The organisation, company, or institution responsible for developing, maintaining, and holding intellectual ownership of the tool
Origin	The country or region in which the tool was developed, which may influence its underlying assumptions, emission factor sources, and regulatory alignment
Access	The means by which users can obtain or use the tool (e.g. open-access, subscription-based, licensed, or restricted to specific partners or members)
Status	The current stage of development or availability of the tool (e.g. live and operational, in beta test, in development, or discontinued)
Target users	The intended audience or user group the tool is designed to serve (e.g. clinicians, sustainability teams, procurement specialists, researchers, or organisations at large)
Use cases	The practical scenarios or applications for which the tool is intended to be used (e.g. benchmarking, procurement decisions, reporting, pathway redesign) as stated by the tool owner in publicly available documentation. Where a tool does not state its use cases, those inferred by the author from the tool interface and available materials are identified as such.
Primary function	The tool's core, defining purpose or capability
Secondary function	Additional capabilities the tool offers beyond its primary function, which may support but are not central to its core purpose
Scope	The breadth and type of activities, processes, or environmental impacts the tool is designed to capture. This may include: the specific stages or elements of a care pathway/product lifecycle covered; and the type and category of emissions assessed
Methodology	The underlying calculation approach, models, or standards the tool applies to generate its outputs (e.g. activity-based, process-based LCA, input-output modelling, or hybrid)
Source of emission factors	The origin and provenance of the emission factors used within the tool's calculations (e.g. internal, proprietary or government datasets, Ecoinvent, DEFRA)
Boundary conditions	The defined limits of what is included or excluded within the tool's assessment (e.g. system boundaries, functional units, life cycle stages covered such as cradle-to-gate, cradle-to-grave or use-phase)
Transparency	The degree to which a tool discloses its methodology, the provenance and values of its emission factors, and its assumptions, such that an independent reader can scrutinise and, where inputs permit, verify its results. Because some inputs are legitimately proprietary or licensed, transparency is assessed across distinct dimensions (method, source, provenance, factor values, underlying data) rather than as a single pass/fail: a tool may be highly transparent on method while more limited on the provenance or values of individual factors.
Strengths	The advantages or areas of good practice identified in the tool relative to its stated purpose and comparable tools
Limitations	The identified gaps or constraints of the tool that may affect the reliability, applicability, or interpretation of its outputs
Planned development	Any disclosed future updates, enhancements, or expansions intended for the tool

3. Care Pathway Tools

3.1 Carebone

Owner

Assistance Publique-Hôpitaux de Paris (AP-HP); largest university hospital network in Europe.

Origin

France

Access

Free under non-commercial purposes under CC BY-NC-ND (Creative Commons Attribution-Non-Commercial-No Derivatives). Commercial use requires a licence from AP-HP. [Tool, methodology](#), emission database and appendices available in French and English ([Carebone](#)).

Status

Live, Excel spreadsheet, stated as 'constantly evolving and improving', version 54 (June 2026)

Target users

Carebone states the tool is aimed at all healthcare professionals (domestically and internationally). Their introductory video states that at AP-HP it is being used by doctors, paramedics, pharmacists and purchasing agents.

Use cases

Stated use cases are to compare the footprint of alternative care options to inform clinical and operational decisions (e.g. IV vs. oral, reusable vs. single-use); and to recognise professionals' decarbonisation efforts to spread good practice – underpinned by a shared, openly licensed emission-factors database promoting a common methodology across institutions.

Primary function

To estimate the carbon footprint of healthcare products, medical devices, procedures, medications, and care pathways in order to support changes in practices and objectively assess the benefits of appropriate care.

Secondary function

To provide healthcare professionals with environmental insights to help them choose between two care alternatives and select the most sustainable option.

Scope

Includes: hospital consultations, surgery and procedures; diagnostics (imaging, biological tests); hospitalisation (medicines, devices, sterilisation, cleaning/disinfection, laundry, staff travel and food, building energy); discharge medications; and patient transport. Pharmaceuticals and medical devices are explicitly included, though warehouse emissions are covered only for drugs (based on PAS 2090 data), not medical devices.

Excludes: community-based healthcare; fixed assets (except essential equipment such as imaging scanners); support functions (procurement, HR, finance, technical services); upstream anaesthetic gas processes (manufacturing, distribution); plant construction and personnel; and medical device warehouse emissions.

Methodology

Explicitly uses a simplified LCA methodology to evaluate GHG emissions and waste generation. Carebone encourage users to adopt a common methodology. The '[Carbon Footprint Estimation Toolkit of a Patient Pathway: Methodological Guide, version 52](#)' is free to download.

Source of emission factors

Follows ISO 14040 and ADEME's BEGES framework. API factors draw from published LCAs and industry reports (EcovaMed, ABPI, Indian clearance dossiers, ACS); where unavailable, molecules are scored on complexity, origin, production conditions and volume for a low/medium/high proxy. Excipient quantities come from SPCs or standard ratios; transport assumes API production in Zhejiang, shipping via Basel, distribution via AGEPS. Devices are assumed to be made in Jiangsu, China, with mass from data sheets or geometric modelling. Procedure-level data combines user-entered activity with pre-calculated emission factors, defaulting to standardised assumptions where data is unavailable (consultation times, staff travel/meals, energy/cleaning/sterilisation ratios), with some elements fixed or excluded (e.g. anaesthetic gases set to zero). Results mix measured data and structured approximation.

Boundary conditions

Pharmaceuticals: The functional unit is the smallest dispensable unit (tablet, vial). Covers API manufacture, excipients, packaging, transport, energy, and material losses; excludes drug end-of-life and upstream anaesthetic gas production. Medical devices: The functional unit is the smallest device unit (carbon-per-use for reusables). Covers material extraction/processing, manufacturing, multi-level packaging, transport, energy, sterilisation, and end-of-life for both device and packaging. Medical procedures: Covers staff commuting/meals, consumables, drugs/anaesthesia/gases, devices/instruments, reagents, equipment (manufacturing and use energy), cleaning/sterilisation/laundry, transport, building energy, water, and PACS digital storage. Patient care pathways: Covers consultations (30/60 min), imaging, tests, procedures, treatments, travel, and hospitalisation days (by department, incl. energy, staff, meals, laundry).

Transparency

Emission factors include source, uncertainty score, and SAP/CIP13/manufacture references (where available), plus date and Carebone version. Users select a collection methodology per entry; the tool auto-calculates overall uncertainty by combining emission factor uncertainty (default 50%) and activity data uncertainty (5% supplier data, 20% weighing, 40% defaults, up to 100% broad ratios) to produce an estimate best read as a range, not a precise figure.

Contains 4 hidden ratio tabs (energy/data storage) and 27 emission factor tabs (24 hidden, 3 shared/traceable for pharmaceuticals, devices, procedures). Inputs are colour-coded: white (user data), light yellow (defaults), dark yellow (formulas). Unknown APIs get a subjective 1-3 rating from user research. Transparency is limited by explicit exclusions (upstream anaesthetic gas production, pharmaceutical end-of-life, most fixed assets) due to insufficient data/ methodology.

Strengths

High transparency in method, emission factor sources, and assumptions. Captures direct medical impacts and indirect systemic factors (travel, room operations, laundry), with procedure-level breakdowns of consumables, pharmaceuticals, devices, reagents, cleaning/ sterilisation, energy/water, and digital storage. Missing data is addressed via built-in estimation matrices (mass-estimation for devices/tablets, a 4-criteria rubric for unknown APIs), with defaults highlighted and replaceable by local data. Tracks the full cradle-to-grave medication lifecycle, including upstream supply chains, compounding energy ratios, and production material losses. Context-specific factors make it adaptable across settings, aiming to empower clinicians to lead ecological projects.

Limitations

Difficult and time-intensive to use, requiring sustainability expertise and strong Excel skills. As a simplified LCA toolkit, accuracy relies heavily on generalised assumptions (e.g. geometric estimates for devices, default 71% mass ratios for excipients), and the transport module uses rigid default routing (e.g. Asia-to-Europe via ship/truck) unless manually overridden. Many defaults are AP-HP-specific (transport, building energy, staff ratios), limiting transferability to other contexts like the NHS without adjustment. High accuracy without proxies still needs granular manufacturer data that can be hard to obtain. French/English only may limit access.

Planned development

Described as a constantly evolving tool: AP-HP staff regularly update the emission factors database as new footprint calculations are validated; a training course is in development to help users navigate its complexity; and an online version is planned to improve usability.

3.2 CARE pathways Environmental Sustainability Assessment (CARESA)

Owner

AstraZeneca

Origin

UK / global, in collaboration with Maverex

Access

Will be free, open access online. Email caresa@maverex.com for access to beta-testing site.

Status

In beta-testing development phase, planned launch autumn 2026

Target users

The CARESA web page states that health system stakeholders are invited to beta test the tool, and that the tool will provide policymakers with the evidence to support pathway redesign. A recent update includes 'expert' and 'assist' modes, the latter of which guides users with less experience through the pathway and allows for auto-population.

Use cases

Stated use cases are: modelling care pathways using patient-population healthcare visit and resource-use data, quantifying impact as GHG emissions, water use, and waste across any disease area or geography; comparing a pathway with and without a clinical intervention/scenario to show how better outcomes reduce environmental footprint, supporting hotspot identification and pathway redesign.

Primary function

To build patient care pathways and quantify their overall environmental impact, supporting materiality assessments and identifying hotspots.

Secondary functions

To model the impact of pathway redesign/interventions on environmental impacts and generate evidence on optimising care to support system sustainability goals.

Scope

Combines multiple data sources to calculate the environmental impact of care pathways, measured as CO₂e, waste, and water (plus other environmental impacts, providing users have the data); allows users to structure care pathways using healthcare visits and resource data from patient populations; includes intervention-level modelling; designed for use across all disease areas and geographies.

Methodology

No explicit reference to the underlying methodology on the AstraZeneca website or CARESA beta-testing site, however a commentary written by Maverex (who provide the strategic modelling and technical expertise for the tool) stated that it is 'built on the SHC pathways guidance, providing a structured framework for modelling care pathways and their environmental impacts'.⁵

Source of emission factors

Each 'environmental input' (i.e. activity or module) is referenced with a link, author, date and geographical filter. SHC emission factors are used (see 3.5), and many of the global inputs are from a modelling study (funded by AstraZeneca) to estimate healthcare-related environmental impacts of chronic kidney disease. The paper used Ecoinvent, ReCiPe 2016, LCA for Experts (formerly GaBi) and country-specific inputs from a targeted literature review. The tool is supplemented with emission factors published by other groups through a targeted literature review. The tool also allows users to build a personal library of emission factors.

Boundary conditions

There is no publicly available published guidance on boundary conditions.

Transparency

Each environmental input has a linked reference. Where factors derive from proprietary databases such as Ecoinvent, licensing terms restrict publication of full derivation detail.

Strengths

It is a flexible tool, allowing users to add their own modules or create copies of existing modules that are editable. There is an expanding and global set of emission factors. It has a scenario function in which interventions can be modelled to demonstrate environmental impacts. It enables a collaborative approach as pathways can be shared with, and edited by, colleagues. Results include CO₂e, water and waste, are presented in multiple formats (including heat maps, tree maps, bar charts and tables) and can be exported as PDF or Excel.

Limitations

Due to the tool being in development, many of the limitations will have been addressed by the time it goes live. The platform is not always intuitive: the expert mode requires a deep level of understanding and familiarisation with each mapping element of the tool; and the assist mode does not always auto-populate relevant or essential activities. Editing and duplicating activities can be confusing and therefore lead to errors in results. Enhanced guidance on creating scenarios is lacking. There is room for error as there are no prompts for common activities/hotspots (e.g. patient travel) and the module nomenclature can be unclear. Modules are difficult to filter, and some modules use the same emission factors under different names (e.g. telehealth/ GP/ specialist visit/ outpatient) which can be misleading. Some of the environmental inputs (in addition to the SHC ones discussed above) are quite

old (2011). Results graphs / outputs need clearer labelling so users can identify each element. English-language-only provision could restrict access for non-English speakers.

Planned development

Development continues in beta-testing phase and feedback is being sought from test users and incorporated into updates. No further roadmap detail is given beyond the beta-testing invitation and a [contact email](#) for demonstrations/support.

3.3 Clinical Activity Carbon Emissions Factors for Care Pathway Appraisal

Owner

Greener NHS

Origin

UK, NHS England

Access

Restricted to NHS staff via the [FutureNHS Knowledge Hub](#)

Status

Version 1.0 published April 2024. Functional as a reference model dataset containing multi-category operational carbon calculation factors and two care pathway examples.

Target users

Target users are not explicitly stated. The tool states that its factors enable users ‘to apply a consistent set of metrics for care pathway appraisal,’ supporting estimates of how high-level changes may affect the overall carbon footprint, and explicitly notes it is not intended for clinical decision-making. Given that access is restricted to NHS staff, it appears to be aimed at any NHS staff member seeking to map a patient population or disease pathway and identify clinical activity carbon hotspots.

Use cases

The stated purpose is to give ‘a rough estimate of the carbon impact of healthcare delivery for a given patient population or disease profile across a clinical pathway or service, and help identify clinical activity carbon hotspots.’ Users map pathway activities, assign volumes and NHS-derived carbon factors, and sum these to approximate total footprint. Stated applications include: estimating how high-level pathway changes might affect footprint; identifying hotspots to prioritise during pathway design or redevelopment; and flagging where more detailed, self-collected footprinting is needed. The tool is explicitly a screening-level instrument, not a substitute for granular, activity/treatment/product-level footprinting.

Primary function

To provide a consistent set of emission factors assigned to clinical activities for evaluating and appraising patient care pathways across NHS services, and to help identify clinical activity carbon hotspots.

Secondary functions

To provide examples (cataract surgery and virtual ward) of how to map patient care pathways (including comparing standard of care to a service-level change), how to assign activity-level emission factors, and how to

identify potential carbon savings. Provides granular travel emission factors (by activity type and mile), and average travel distances (by specialty and geographical location).

Scope

Covers general practice, outpatient activity, A&E, acute care admissions and bed days (low and high-intensity, elective and non-elective), surgical procedures, mental health, community and home care, digital, pharmaceuticals, consumables, equipment, and travel.

Methodology

Explicitly states the carbon factors have been taken from various sources with different research methodologies and publication dates. No reference to the methodology that sits

behind the care pathway mapping tab.

Source of emission factors

Carbon factors are taken from a variety of sources: NHS England modelling, National Travel Survey 2019, PSSRU 2019, Secondary Uses Service (SUS) data, Sustainable Healthcare Coalition (SHC; see 3.5), DESNZ, Healthcare LCA, and published papers.^{6,7}

Boundary conditions

As carbon factors are taken from different source, different boundary conditions will have been applied. There is an 'additional information' tab that explains to users the GHG Protocol scopes and the NHS Carbon Footprint and Footprint Plus.

Transparency

The tool is transparent about the limitations inherent in its carbon factors. These arise both from aggregating sources with differing research methodologies and publication dates, and from underlying data quality issues, including gaps in scope coverage and data age. The tool clearly states that users should read the inclusion and exclusion criteria carefully and consider these when interpreting results, and that results are only a rough estimate and so should not be used directly for clinical decision-making.

Strengths

Useful to have collated common activity-based carbon factors in one place with clear inclusion/exclusion criteria and 'notes' to consider. The example pathways are helpful in guiding users through the mapping process. Travel factors broken down by activity (e.g. to GP, A&E, community appointment etc), by mile (for patients, staff and visitors), and average distances by specialty and by geography are useful, particularly as travel is a common hotspot. Requires only basic volumetric data (e.g. number of appointments or bed days) to create high-level models.

Limitations

It is a database of emission factors (limitations detailed above) rather than a calculator, and it is not open access (only available to NHS staff). As there is no 'calculator' function, the onus is on users to undertake calculations which introduces room for error (missing activities, miscalculations etc). It relies on generic national averages rather than precise, medical product inventories. English-language-only provision could restrict access for non-English speakers.

Planned development

The tool states it is a 'live document and will be updated as new information becomes available'. It states the Greener NHS team review emission factors periodically to ensure the best available scientific GHG emissions



and activities are reflected and that, as a minimum, government GHG factors and clinical activity level carbon footprinting will be updated annually.

3.4 Net Zero Health and Care Pathway Tool

Owner

NHS Arden & GEM (Greater East Midlands) Commissioning Support Unit (CSU) – in partnership with Anaplan, Mitie and SHC

Origin

UK, NHS-facing, not publicly open-access. Commercial solution co-developed with industry.

Access

Paid subscription model (www.ardengemcsu.nhs.uk)

Status

Inactive. It was offered in prototype stage to NHS organisations wanting to progress sustainable healthcare innovation, however its licence was not renewed due to CSU decommissioning.

Target users

The tool states it is aimed at healthcare commissioners and providers who must ‘report their annual carbon emissions to NHS England’ and, more broadly, at Trusts/organisations wanting to be at the forefront of sustainable healthcare innovation. The introductory video states it is for managers, clinicians and decision makers.

Use cases

Explicitly stated applications include: GHG emissions calculations (Scopes 1-3) within care pathways and services; carbon footprint mapping with cost comparison (carbon intensity per £ and per patient); ‘predictive analytics’ via scenario modelling to assess how proposed pathway interventions would change emissions; and ‘real-time monitoring’ of progress against decarbonisation goals, combined with a broader benefit-realisation methodology spanning clinical quality, population outcomes, resource efficiency, carbon reduction and social innovation. It is explicitly intended to support streamlined NHS England compliance reporting and to add to existing service transformation plans, rather than be a standalone calculator.

Primary function

Help NHS organisations meet Net Zero compliance and reporting duties (Carbon Reduction Plans, SECR) by identifying carbon hotspots and inefficiencies. Organisations input activity data, to generate carbon footprint tracking and analysis across integrated care pathways.

Secondary functions

Provides predictive, scenario-based modelling for care pathway changes (e.g. virtual consultations, new digital services), evaluating carbon impact alongside clinical quality, outcomes, resource efficiency, and social innovation (rather than in isolation). It also provides cost comparison outputs, showing carbon intensity per £ and per patient.

Scope

Covers Scopes 1-3 across primary & community care, specialist clinical pathways (cardiology, oncology, respiratory), emergency & ambulance services, hospitals and facilities. Calculates a carbon emissions profile for every stage of the healthcare journey from diagnosis to discharge. Data includes consumables, equipment, food, travel, energy, water, waste and cleaning.

Methodology

Generic reference to adopting a 'global standard for calculating GHG emissions.' The tool states it has undergone independent peer review from SHC, but with no explicit reference to the guidance or methodology document specifically.

Source of emission factors

Emission factors from Mitie (undisclosed) and SHC (see 3.5), with cost data from NHS England.

Boundary conditions

Evaluates Scopes 1-3 emissions at a pathway level, with carbon intensity mapped per £ spent and per patient. Boundary calculations cover facilities (energy, water, waste), clinical materials (medicines, liquids, drugs), equipment manufacturing/use, and transport. However, available web pages don't specify functional unit definitions, patient volume assumptions, or how pathway boundaries are standardised across clinical contexts.

Transparency

SHC peer-reviewed the tool, but public-facing pages do not disclose emission factor sources, GHG accounting standards, allocation methods, or uncertainty ranges, and no explicit methodological basis is stated.

Strengths

Scopes 1-3 coverage across care pathways with built-in scenario modelling and predictive analytics for prospective pathway design, not just retrospective reporting. Its multi-dimensional benefit framework looks beyond carbon alone and considers clinical and social value. It supports real-time monitoring with £ and carbon per patient outputs, useful for commissioners. It helps meet reporting obligations (SECR, ESOS, TCFD, CRP) and Green Plan targets, reduces admin burden via a plug-and-play activity data system, and allows filtering by region, ICS, provider, pathway, section, or time period, plus manual entry of emission factors. It quantifies ROI by linking carbon reductions to cost savings (e.g. up to 15% energy reductions and 20% resource efficiency gains) to build the financial case for green interventions.

Limitations

Inactive (only reached prototype stage so modelling and benchmarking capabilities constrained). Requires paid licence and implementation fees. Is built at system level (e.g. ICB) and so less relevant for community services. Emission factor provenance isn't publicly disclosed, limiting independent verification, and its ambitious benefit framework (six domains, 30+ measurement areas) may be resource-intensive to populate consistently, with real-time insight quality dependent on local NHS data digitisation. Its strong NHS-specific focus may limit comparability with international benchmarks or ISO 14040/44-aligned LCA methodologies. It also relies on disparate, unquantified manufacturer data across the life sciences sector, with no clear approach to handling proxy data gaps – a limitation for Scope 3. English-language-only provision could restrict access for non-English speakers.

Planned development

The web page describes the tool as a 'prototype' that has undergone independent peer review by the Sustainable Healthcare Coalition (SHC) and been tested across a number of pathways, but states the developers

are ‘looking for more partners to help refine the tool before we move on to the next stage of development’. Anaplan verbally confirmed the tool is currently unavailable due to CSU decommissioning.

3.5 Patient Care Pathway Carbon Calculator

Owner

Sustainable Healthcare Coalition (SHC)

Origin

UK, 2015, developed in conjunction with the NHS Sustainable Development Unit (precursor to Greener NHS Team); surgery module updated in 2024.

Access

Free, open access, online (www.carepathwaycarbon.org)

Status

Active, established tool. Planned update 2026 and ongoing.

Target users

The tool states it is aimed at ‘anyone interested in understanding the sustainability of health and care systems’ (including patients, clinicians, healthcare providers, policy makers, regulators, commissioners, suppliers, sustainability practitioners, and academics).

Use cases

SHC specifies that the tool allows users to input care pathway data to obtain an estimated total carbon footprint, thus appraising the relative materiality of different activities, and guiding users to where greatest opportunity exists for reducing the carbon footprint of care.

Primary function

To enable a rapid, consistent, activity-based estimation of the environmental sustainability of care pathways to support decision-makers in their choices related to improving the performance of models of care.

Secondary function

Promotes the patient care pathway approach and can be used to quantify the environmental sustainability of new and emerging care pathways.

Scope

GP consultation, emergency department (A&E) visit, low-intensity bed day, high-intensity (ICU) bed day, diagnostics (MRI non-contrast scan, CT scan, chest/mobile chest x-ray, ultrasound), surgical procedure, anaesthetic/medical gases (with/without desflurane), consumables (carpal tunnel decompression, inguinal hernia repair, knee arthroplasty, laparoscopic cholecystectomy, tonsillectomy), patient travel (self-travel to GP/elective care, non-emergency/emergency ambulance), patient self-management workshop, utilities (electricity and fuel kWh, fuel type).

NB. pharmaceuticals are excluded from the built modules as these are condition-specific, but users can enter additional data to cover medicines and other activities not included (up to 5 additional modules under ‘Other’).

Methodology

Explicitly underpinned by SHC's '[Care Pathways: Guidance on Appraising Sustainability](#)' with accompanying [Method document](#) that was separated into a standalone document in 2026.

Source of emission factors

Each emission factor is dated and the geographical location and clinical setting identified in a published emission factors table. Company reporting factors for energy, waste, water, and transport are from BEIS government GHG conversion factors (now DESNZ); estates data is from ERIC; and travel data from National Travel Surveys. LCA data for high impact medical modules (e.g. bed day, diagnostics, gases) were generated by ERM (Environmental Resource Management) using the Ecoinvent database and LCA software for manufacture of materials/packaging and equipment. The surgical procedure module was updated in 2024 and uses BEIS data (as above) plus emission factors sourced from literature^{6,8} for anaesthetic gases and consumables.

Boundary conditions

The data utilises a life cycle approach that includes manufacture of consumables, equipment and medical gases, energy use, staff commuting, waste and water. Data was collected from a variety of sources utilising different research methodologies within healthcare systems across the globe. For additional information outlining the scope of the data including inclusion/exclusion criteria, assumptions and limitations, the original published sources can be reviewed in the environmental impact table or the guidance documentation.

Transparency

The methodology for deriving the emission factors is publicly published and the [database](#) is freely available on the website, including sources. Where factors derive from proprietary databases such as Ecoinvent, licensing terms restrict publication of full derivation detail.

Strengths

It is free to use and is supported by published, open access [Method & Guidance](#) documents. It has a transparent emissions database and can identify hotspots in care pathways. It is user friendly as it guides users through each selected module, giving regular prompts for common hotspots, e.g. patient travel, consumables, utilities. Individual modules can be imported or exported with .json files and results can be exported to Excel via email.

Limitations

Many of the emission factors are old (~2015) and from single sites or specialisms, which may limit their utility due to factors such as the carbon impact of grid electricity having fallen sharply in that time, and the lack of generalisability or representatives across geographies and clinical conditions. There is a lack of flexibility in editing/saving modules and pathways, and users can experience difficulties when importing/exporting data and resetting the calculator. The results lack the detail that may be required for reporting (e.g. travel is not reported separately, low and high intensity admissions are reported as 'inpatient bed', and any additional activities added by users are reported as 'other') and only CO₂e is reported. Outputs are unlikely to meet the requirements of all users listed on the website. English-language-only provision could restrict access for non-English speakers.

Planned development

No explicitly stated development plan, however, work is being undertaken by SHC's Patient Care Pathway Consortium to update, internationalise and expand emission factors for common activities.

4. Clinical Trials Tools

4.1 Greener Trials Toolkit

Owner

CiCT (Enabling Lower Carbon Clinical Trials) initiative developed by members of the Medical Research Council and the National Institute for Health and Care Research (MRC-NIHR) Trials Methodology Research Partnership (TMRP) Greener Trials Group from the Institute of Cancer Research and University of Liverpool.

Origin

UK, academic/publicly funded. Developed by academic and clinical trialists within the MRC-NIHR TMRP Greener Trials Working Group (a sub-group of the Trial Conduct Working Group), led by teams at institutions such as the University of Liverpool and the Institute of Cancer Research Clinical Trials & Statistics Unit (ICR-CTSU).

Access

Free; interim excel spreadsheet available on request (email cict-icrctsu@icr.ac.uk); online version in development as part of a multi-institution Wellcome Trust-funded project.

Status

Active development of online tool

Target users

The stated users are publicly funded trialists.

Use cases

It explicitly states the use case of the tool is to quantify the carbon footprint of publicly funded clinical trials, to inform future lower carbon trial design. It is intended to inform sustainable decision-making in the design of clinical trials, rather than to calculate absolute footprints of trials or compare environmental performance between trials.

Primary function

To serve as a digital tool and open-access framework that calculates and quantifies the carbon emissions generated by publicly funded clinical trials.

Secondary functions

To provide users with potential evidence-based mitigation strategies for activities footprinted within their trial; to collate inventory data and carbon footprinting results as part of the Greener Trials Data Consortium; to collate a publicly accessible database of emission factors required for the footprinting of publicly funded trials; to provide user training through monthly global carbon footprinting drop-in clinics; to supply trialists with supporting documentation (e.g. data collation worksheets and activity data questionnaires).

Scope

Explicitly publicly funded clinical trials. Collates carbon footprint data across trials. Identifies emission hotspots to inform mitigation strategies. Supports UK/international researchers to identify efficiencies/commonalities and consider country-specific emission factors strategy.

Methodology

Explicitly states that all required calculations and emission factors as well as details of limitations or assumptions are published in the freely available NIHR-funded 'Enabling Lower Carbon Clinical Trials' [method](#). Updates to the method are managed on the TMRP Greener Trials [website](#).

Source of emission factors

The main sources used are LCA ($\pm$ validation) such as Ecoinvent V.2.2, UK government GHG conversion factors, SHC care pathway carbon calculator factors, and publications of LCAs of specific products/processes. Also engages with international and local sustainability registries to identify region-specific emission factors (e.g. adaptations in South Africa).

Boundary conditions

Targets trial-specific conduct parameters, tracking operational emissions across distinct trial interventions and activities. Key behavioural boundaries include mode of transport to work, homeworking vs. office hours, online vs. face-to-face meetings, cameras on/off energy burdens, and letters vs. texts for participant recruitment.

Transparency

Published [guidance and methodology](#) available. The tool employs an open-access, publicly accessible, annotated, and referenced database of publicly funded clinical trial activities and emission factors curated by the Greener Trials project.

Strengths

Designed specifically from the ground up for the nuances of academic, publicly funded trial designs. It integrates behavioural science to support stakeholder engagement and features a strong global training support network (e.g. drop-in clinics and a data consortium that oversee the addition of trial footprinting results to a database made available to the research community via data access requests). Publicly published guidance and methodology.

Limitations

Online tool is not yet live. It relies on ongoing data collation from diverse therapeutic areas to expand its reference database and requires active user consent and data access requests to build a shared data repository, making its growth and representativeness unpredictable and potentially uneven. English-language-only provision could restrict access for non-English speakers.

Planned development

States the group is developing an online, free to use, open-science, eco-design Greener Trials Toolkit that will automate clinical trial carbon footprinting calculations. Stated plans include: refining and expanding the footprinting guidance; building the evidence base to identify hotspots; adding further activities and modules as knowledge around LCA increases.

4.2 Industry Low Carbon Clinical Trials (iLCCT) Carbon Calculator

Owner

Sustainable Healthcare Coalition (SHC) in collaboration with iLCCT consortium partners, including the Pistoia Alliance, pharmaceutical industry members (including members of the SMI Health Systems Task Force), academic partners and technical partner ERM.

Origin

UK/international

Access

Free, open access (<https://clinicaltrialcarbon.org/>)

Status

Live, since early 2025

Target users

Explicitly states it is for ‘anyone interested in the sustainability of health and clinical research’: trial sponsors, clinicians, commissioners, suppliers, sustainability practitioners, policy makers, regulators, academics.

Use cases

It states that the calculator assesses a clinical trial's carbon footprint, reporting overall emissions and carbon intensity per participant while identifying hotspots across trial design, operation, and management. It functions as a decision-support tool, letting users run ‘what if’ scenario comparisons to prioritise reductions, and is designed to be used alongside the broader Clinical Trials Assessment Framework rather than as a standalone measure.

Primary function

To be a decision-support tool, helping trial teams understand the relative scale of their emissions, identify carbon hotspots, and prioritise areas for reduction across the design, management, and operation of a trial.

Secondary functions

To provide granular reports detailing carbon footprints per participant and percentage breakdowns for specific activities (e.g. trial site staff travel by transport type). It also features an export function to save/modify trial configurations for scenario planning. The calculator's outputs can feed into Scope 3 emissions disclosures (GHG Protocol), but results need to be documented transparently alongside their assumptions, emission factors, and data quality limitations. For higher-stakes disclosures, where regulatory or investor scrutiny is likely, teams should pair the calculator with the full Assessment Framework or commission a formal LCA.

Scope

Uses a stepwise process to sum carbon from separate activities (modules) associated with the design, management and operation of individual clinical trials to estimate overall carbon footprint in kgCO₂e.

Methodology

Explicitly states the calculator uses the carbon footprint methodology and data from the Clinical Trials Carbon Footprinting framework, consisting of Method and Guidance documents.

Source of emission factors

Utilises primary, secondary, proxy, and default data values (e.g. participant and staff travel modes and distances). The weight and materials of trial kits for various IMPs have been estimated from assessments available through collaboration partners to generate a default carbon emission factor for trial kits. The emission factors database is updated annually.

Boundary conditions

Aligned with the International Standard for LCA (ISO 14040/44) and the GHG Protocol (Product Life Cycle Accounting and Reporting Standard). It tracks various separate activity modules tied to the design, management, and operation of a trial. The activity-based methodology draws on publicly available emission factors, making it accessible for trial teams without dedicated sustainability expertise. Boundaries are detailed in the [Guidance](#) and [Method](#) documents.

Transparency

The tool is supported by publicly available Guidance and Method documents, calculation logic and table of emission factors (including sources of emission factors, assumptions and important exclusions). It openly addresses varying data types (primary vs. secondary/proxy) and what they mean for result confidence and uncertainty. As with other tools in this landscape, this transparency applies most fully to the sourcing and values of emission factors rather than to the derivation of individual default factors: where defaults are constructed from partner-supplied assessments (e.g. the trial-kit emission factor) or drawn from commercial LCA databases, the underlying calculation breakdowns are not independently reproducible, in line with standard licensing and data-sharing terms.

Strengths

Supporting Guidance and Method document freely published. Transparency of emission factor sources, assumptions and exclusions. Allows flexible levels of assessment depending on data availability (high-level via secondary defaults, detailed via primary data, or mixed hybrid appraisals). It highlights carbon hotspots in percentage breakdowns to show areas for targeting decarbonisation. It includes an assessments comparison feature which allows users to compare two assessments – useful during the trial planning/design phase to compare possible carbon reduction strategies.

Limitations

Relies heavily on data inputs that present real-world collection challenges. Results may have varying levels of confidence/uncertainty depending on the reliance on default or proxy data. English-language-only provision could restrict access for non-English speakers.

Planned development

No explicit forward-looking roadmap is stated. The site documents past development through version-by-version release notes, but these describe completed updates rather than announced future plans. The FAQ states that emission factors may become more refined as the field develops. Ongoing user feedback via an in-tool feedback form is encouraged.

4.3 PPD Carbon Emission Calculator for Clinical Trials

Owner

PPD (Pharmaceutical Product Development), the clinical research business of Thermo Fisher Scientific

Origin

Global, CRO-owned. Developed and launched by Thermo Fisher Scientific as a corporate sustainability initiative to advance eco-responsibility and awareness across the clinical development ecosystem.

Access

Open access, free, online (<https://carboncalculator.ppd.com/>)

Status

Active; launched at Climate Week in New York City in Sep 2025, and then online in Oct 2025.

Target users

Stated to be for biopharmaceutical companies and research sponsors.

Use cases

The tool is stated to provide an evidence-based framework for assessing emissions across each study phase, to be used prospectively in planning-stages. The tool is explicitly stated to help users: identify high-impact carbon hotspots; compare study designs for CO₂e efficiency; and implement strategies to lower emissions. It cites decentralised/hybrid trial models as examples of design changes the tool can help evaluate.

Primary function

To estimate, understand, and reduce the environmental impact of research by providing an evidence-based framework that quantifies CO₂e emissions across study activities.

Secondary function

To highlight specific areas of high impact (hotspots) to assist users in applying targeted emission-lowering strategies while maintaining quality and compliance.

Scope

Assesses emissions from multiple sources including investigational product manufacturing, patient travel, lab sample processing and site operations. Breaks down emissions by activity to enable sponsors to identify carbon hotspots and compare different study designs for CO₂ efficiency. Applied across global clinical research pipelines, mapping individual trial activities. The calculator automatically distributes sites and patients globally based on historical data for that therapeutic area.

Methodology

There is no publicly accessible, published or peer-reviewed methodology document for this tool. Public-facing materials describe it as an open-access tool offering an 'evidence-based framework' for assessing emissions across every phase of a study, but the underlying technical documentation, emission factor sourcing, and any independent validation are not disclosed. It is unclear whether this reflects a proprietary methodology or simply the absence of a published technical document. Contact sustainability_ppd@thermofisher.com for more information.

Source of emission factors

Not publicly disclosed.

Boundary conditions

No public methodology; described as an 'evidence-based framework' covering investigational product manufacturing, patient travel, lab sample processing, and site operations. Does not appear to address Scope 3 emissions from supply chains beyond direct trial operations.

Transparency

Poor as not publicly disclosed. Unable to view underlying data sets, equations, emission factor sources, functional units, patient/participant volume assumptions, system boundary, or verification protocols.

Strengths

Open access. Provides a structured, multi-phase framework covering manufacturing to site operations. Helps drive data-backed choices in the early trial design phases.

Limitations

No published methodology, no reference to standard databases and transparency is poor. English-language-only provision could restrict access for non-English speakers.

Planned development

No specific development roadmap is disclosed, although Thermo Fisher state the goal is to help practitioners 'identify key areas where we can work together to decarbonise'.

5. Pharmaceutical Tools

5.1 ABPI Blister Pack Carbon Footprint Tool

Owner

Association of the British Pharmaceutical Industry (ABPI), developed by The Carbon Trust

Origin

UK, 2023

Access

Free to download via the [ABPI website](#), subject to reading and acknowledging their specific terms and conditions for internal business use.

Status

Launched 2023; not actively maintained ('last reviewed 2022', 'next review 2025').

Target users

It states its intended users are employees, professional advisers and contractors of UK pharmaceutical companies, with ABPI member companies being the primary user base.

Use cases

The tool's stated aim is to 'provide a quick approximation of the carbon impacts of pharmaceutical tablets in blister packs,' supporting internal evaluations, hotspot identification for individual products, and portfolio screening to prioritise detailed footprinting and carbon reduction work. It also helps engage stakeholders in discussions on product carbon impacts.

Primary function

To provide a quick approximation of the carbon impacts of pharmaceutical tablets in blister packs.

Secondary function

To engage stakeholders in broader discussions around the carbon impacts of products.

Scope

Specific to pharmaceutical tablets in blister packs within the UK pharmaceutical market.

Methodology

The documented methodology is embedded within the tool itself rather than published as a separate, standalone document. The Carbon Trust is the named methodological author, but it does not appear to be externally peer-reviewed or independently validated.

Source of emission factors

API emission factors are based on statistical assessment of 29 APIs, previously footprinted, and shared by pharmaceutical manufacturers. Users are encouraged to use their own calculated emission factors for APIs and excipients, to allow for greater confidence in the results. Data quality is assessed using the GHG Protocol Product Standard.

Boundary conditions

Covers cradle-to-gate life cycle stages including material inputs (API and excipients), formulation, and the packaging process. It provides options for downstream distribution, retail, use, and end-of-life outputs, though these can be excluded or defaulted depending on user assessment.

Transparency

Clearly states there is variability in the quality of input data, and it therefore has inherent limitations as to the precision of results derived. An uncertainty range is provided for all emission factors and results are quoted within ranges. Individual manufacturer source data points for the statistical model are kept confidential and not publicly visible.

Strengths

Provides a fast, standardised baseline approximation without requiring full, complex LCA. Developed using industry data validated by the Carbon Trust.

Limitations

Limited precision due to variability in input data quality. Results are quoted in wide ranges rather than precise figures, making it unsuitable for direct product-to-product marketing comparisons. The tool does not appear to be regularly updated. English-language-only provision could restrict access for non-English speakers.

Planned development

No specific development roadmap described, apart from a scheduled review cycle: 'Last reviewed date: 01 July 2026' and 'Next review date: 01 July 2029', suggesting a periodic (~3 yearly) review cycle.

5.2 ACS GCI PR PMI-LCA Tool

Owner

ACS GCI PR (American Chemical Society Green Chemistry Institute Pharmaceutical Roundtable)

Origin

US, but used internationally

Access

Open-access and publicly [available to download](#). Member companies can also deploy private, firewalled versions.

Status

Fully functional as an Excel template, with ongoing efforts to transition it to a web-based or software application.

Target users

No explicitly named target user, but a more generic disclaimer 'to inform and guide users towards greener and more sustainable synthetic routes...critically accessed by experts of any institute using it', implying an audience of process chemists/chemical engineers.

Use cases

Stated to be a 'high-level estimator of Process Mass Intensity (PMI) and environmental life cycle information', customisable across linear and convergent small-molecule API synthesis processes. It displays the contribution

of steps and raw materials to PMI and six LCA indicators in tabular and graphical form. Framed as ‘a useful high-level calculator’, intended for early-stage route screening and comparison rather than definitive or regulatory-grade LCA.

Primary function

To serve as a high-level estimator that combines Process Mass Intensity (PMI) with simplified LCA metrics per kilogram of target product, allowing chemists and engineers to measure, benchmark and reduce the environmental impact and material use of synthesising small-molecule APIs.

Secondary functions

Providing automated hotspot reporting (breakdowns by process steps or unique material classes) and self-error-checking troubleshooting notifications to prevent data-entry mistakes.

Scope

Tailored for linear and convergent synthetic processes primarily focused on the manufacture of small-molecule APIs.

Methodology

The tool has a clearly referenced and published peer-reviewed [methodology](#)⁹ behind it.

Source of emission factors

It predominantly uses the Ecoinvent database (v 2/2.2). For organic reagents that are not on Ecoinvent, multipliers are augmented via average organic solvent data (iGAL-aligned) or AstraZeneca’s ‘SMART Tool’ (non-iGAL-aligned).

Boundary conditions

A streamlined cradle-to-gate boundary spanning raw material inputs, common solvents, and reagents used across all defined process synthesis steps up to the final packaged step.

Transparency

Explicitly references the named developer (ACS GCI PR), the named data source with version number (Ecoinvent v2.2), the named secondary source for one category of factors (AstraZeneca’s ‘SMART Tool’), a peer-reviewed paper describing the underlying approach, and an explicit disclaimer on appropriate use.

Strengths

Combines PMI directly with environmental LCA factors. Uses widely recognised, reliable ecoinvent datasets. Features built-in, automated graph dynamics and a self-troubleshooting notification engine to flag logical errors.

Limitations

Built as an Excel file, which creates data limitations, version control issues, and a lack of smooth functionality. Performance can be sluggish during calculations or when executing graph macros. Hardcoded reliance on older Ecoinvent v2 data. English-language-only provision could restrict access for non-English speakers.

Planned development

No specific development roadmap stated; only a blog post describing the PMI-LCA tool as part of a broader suite of metrics the Roundtable is developing to advance decision making in development of greener synthetic processes.

5.3 Medicine Carbon Footprint Database

Owner

EcovaMed (French LCA consultancy)

Origin

France. The early methodology and clinical data sets were built in collaboration with French healthcare institutions published in two peer-reviewed journals.^{10,11} However, they operate internationally (Europe, India, China, North America) to provide LCA data for pharmaceutical ingredients, medicines, medical devices and healthcare pathways.

Access

Ecovamed's offering is largely commercial, however, the Medicine Carbon Footprint Database is free for hospital medical doctors or pharmacists engaged in the 'eco-design' of clinical pathways / prescriptions. An annual subscription is required for all other stakeholders.

Status

Live and actively expanding; it currently covers a subset of oral and injectable medicines from the French pharmacopoeia, with full pharmacopoeia coverage planned as a second phase.

Target users

Stated as hospital doctors and pharmacists (primary, free tier); 'other stakeholders' such as pharmaceutical companies, regulatory bodies, consultancies (paid tier).

Use cases

The stated use case is to support healthcare pathways' eco-design by giving doctors, pharmacists, wholesalers, and purchasers access to medicine carbon footprint data so they can adjust their practices accordingly.

Primary function

Providing pre-calculated, searchable carbon footprints for individual medicines, broken down by raw materials, manufacturing, and distribution.

Secondary functions

Supplying assessed uncertainty ranges alongside each figure; offering bespoke sub-category data (e.g. API-level footprints) on request.

Scope

Cradle-to-pharmacy-gate GHG emissions (CO₂e) for oral and injectable medicines. Excludes pharmacy-level, patient travel, and end-of-life emissions.

Methodology

Hybrid life cycle assessment: bottom-up process LCA for 37 reference APIs, extrapolated via a validated statistical model across the full medicine range; described in a peer-reviewed paper.¹⁰

Source of emission factors

The methodology paper combines five distinct named databases/sources (Exiobase 3.8.2, Ecoinvent v3.9, ADEME Base Empreinte®, IPCC AR6 characterisation factors, CDP-disclosed corporate data) plus original primary LCA data for APIs, with source attribution given for each sub-component of the model.

Boundary conditions

Boundary is cradle-to-pharmacy-gate which includes API production, excipients, packaging, manufacturing, transport/storage, and corporate overhead emissions (R&D - Research & Development, and SG&A - Selling, General, and Administrative). Excludes pharmacy dispensing, patient travel, and medicine end-of-life.

Transparency

The database has a publicly published, peer-reviewed methodology paper with full source disclosure. Results and data access agreements are available to academic teams. Database entries are not independently peer-reviewed. Where factors derive from proprietary databases such as Ecoinvent, licensing terms restrict publication of full derivation detail.

Strengths

Broad medicine-level coverage of the full French oral and injectable pharmacopoeia. Its predictive model is built from 37 real process LCAs and validated to a strong degree of accuracy ($R^2=0.91-0.95$), with every medicine accompanied by a calculated uncertainty range rather than a single unqualified figure. Reinforced by cross-validated corporate emissions data, explicit disclosure of known edge cases (e.g. atypical APIs), and a fully published, peer-reviewed methodology. Free access for hospital doctors and pharmacists also ensures the data reaches the clinicians best placed to act on it.

Limitations

Currently France-specific pricing/sourcing data, and use of Exiobase spend-based factors, while limited, still carries sensitivity to pricing/currency distortions and is less physically granular than full LCA. It may misestimate atypical medicines (e.g. fermentation-based APIs). Free access is uneven – restricting access to hospital doctors and pharmacists, limits the ability of the wider sustainability community to scrutinise or build on the medicine-specific emission factors. French/English language only is a potential access limitation.

Planned development

Stated development is planned in two steps: first covering carbon footprints (with uncertainty and a breakdown by raw materials, manufacturing, and distribution) for oral and injectable medicines of the French pharmacopoeia, then expanding to the full pharmacopoeia, with tailor-made sub-category data (e.g. API-level footprints) available on request.

6. Medical Technology Tools

6.1 Single-use vs. Reusable Carbon Footprint Calculator

Owner

EcovaMed (French LCA consultancy)

Origin

France – developed by Ecovamed, with support from five hospital partners, including CH Versailles and Georges Pompidou European Hospital; part of the AP-HP network Pharmacy Department.

Access

Ecovamed's offering is largely commercial, however, the [single-use vs reusable device calculator](#) is free and open access with no login or subscription required.

Status

Live as version one, with a more comprehensive methodology report available on request and further development planned.

Target users

Stated as freely accessible to all users.

Use cases

Stated to be comparing the carbon footprint of a specific single-use vs. reusable medical device to inform procurement or pathway design decisions.

Primary function

Calculating and comparing the carbon footprint of a single-use device against a reusable equivalent, via steam sterilisation.

Secondary functions

Breaking down results by contributing process (device manufacture, pre-disinfection, washing/disinfection, autoclave sterilisation) so users can see which stage drives the footprint.

Scope

GHG emissions (CO₂e) only; limited to steam sterilisation (excludes hydrogen peroxide, ethylene oxide, and manual/semi-manual washing methods).

Methodology

The single-use vs reusable device calculator has a brief methodology publicly available on the website. It blends two different levels of methodological rigor: granular, bottom-up process modelling for washing/sterilisation (electricity, water, equipment construction, staff commuting, consumables, packaging, fill rate), combined with a top-down Environmentally Extended Input-Output (EEIO) approach for device manufacture. It references a more comprehensive methodology report, only obtainable by direct request to Ecovamed.

Source of emission factors

The calculator relies on Exiobase, 2022 (a spend-based, environmentally-extended multi-regional input-output database) for device manufacturing, adjusted by a complexity/value multiplier, with process-level detail for

sterilisation. No stated emission factor source for utilities/consumables in the sterilisation process. Further details may be included in the comprehensive methodology that is not publicly available.

Boundary conditions

Covers device manufacture through to sterilisation/reuse cycle; includes end-of-life for single-use devices only (reusable device end-of-life is explicitly excluded as assumed negligible).

Transparency

Developers and supporting institutions named, data source (Exiobase) cited with version year (2022), and known limitations (EEIO uncertainty, asymmetric end-of-life treatment) openly disclosed. Full technical methodology report not yet published; available only on request.

Strengths

Granular process modelling for sterilisation (rare inclusion of embodied equipment carbon and staff commuting); transparent about its own uncertainty trade-offs; free and easy to use for a narrowly-scoped comparison.

Limitations

Its use of Exiobase (EEIO) spend-based factors, while limited, still carries sensitivity to pricing/currency distortions and is less granular than a full LCA. Asymmetric end-of-life treatment could understate reusable device impacts, and the tool is restricted to one sterilisation method only. Its carbon-bias potentially oversimplifies other impacts like biodiversity loss or aquatic ecotoxicity. The publicly available methodology lacks details, and transparency stops short with no public algorithm or factor tables for the calculator itself. The tool requires detailed device-level knowledge (e.g. main material, manufacturing origin, price, sterilisation location and process, solution quantities, batch sterilisation capacity, and packaging type/weight), which may limit ease of use. French/English language only is a potential access limitation.

Planned development

An extension to include other sterilisation methods (e.g. hydrogen peroxide, ethylene oxide, manual/semi-manual washing) is stated as a future direction; currently available via direct consultation.

7. Product-level Tools

7.1 Looper (NHS Scotland)

Owner

Developed by the product and engineering company, Looper

Origin

Developed in response to the Scottish Government's CivTech Challenge 10.9 and accelerated through a £9 million Scottish Government AI funding round.

Access

Deployed as a Software-as-a-Service (SaaS) application. It is available to public sector teams (i.e. NHS Scotland) and to external healthcare manufacturers and suppliers ([Looper](#)).

Status

Live (since CivTech Demo Day, May 2025). It was piloted with key clients, and the circularity models were stress-tested in live NHS healthcare environments.

Target users

Stated to be healthcare product manufacturers, suppliers and procurement teams.

Use cases

The platform is described as a digital circular data platform that transforms how organisations collaborate to identify, evaluate, and implement circular economy opportunities, enabling teams to quantify circularity benefits, identify resource optimisation opportunities, and formalise circular procurement proposals with confidence.

Primary function

An AI-powered planning tool that helps NHS Scotland reduce waste and emissions by quantifying circular economy opportunities across products and materials.

Secondary functions

Serves as a circular data platform and potential marketplace mechanism that allows suppliers to collaborate with public sector buyers. Users can inform their decision-making by running scenario analyses in the Looper Playground.

Scope

Focuses explicitly on the Scope 3 supply chain, product LCA, and circular economy metrics of physical healthcare materials, equipment, and assets.

Methodology

No published, peer-reviewed, or standalone methodology document available, and underlying LCA/emission factor sourcing, calculation logic, and AI methodology are undisclosed.

Source of emission factors

Powered by a proprietary internal database that integrates tens of thousands of dedicated carbon footprint data points (approx. 24,000 foundational data points initially) mapped against user-uploaded raw material and processing logs.

Boundary conditions

Spans full product life cycle boundaries, modelling carbon metrics from raw material extraction and product manufacturing choices through to operational reuse and disposal pathways. It is aligned with international standards such as ISO 14067, the GHG Protocol Product Standard, and PAS 2050.

Transparency

No publicly published methodology. The system asks questions about supply chain data without compromising the commercial confidentiality of third-party suppliers. The confidence score applied to every row of data shows users how reliable it is. It openly states that Looper-AI is used to fill data gaps.

Strengths

Looper's architecture addresses industry's historical reluctance to share product-level bills of materials or composition data by creating a secure environment where suppliers can verify compliance without exposing IP. It uses advanced AI to fill data gaps and enable predictive modelling of strategic supply changes, cutting data collection time by roughly 80%. Working across sectors (construction, textiles, medical devices) gives it valuable data lineage, and it balances carbon accounting with broader circular economy principles like waste reduction and reuse feasibility. It's also embedded directly into public health infrastructure through backing and deployment with NHS Scotland.

Limitations

Looper acknowledges that although the localised data pool is substantial, because it is a scaling platform it requires continuous supplier expansion to maximise coverage across complex healthcare inventories. There are no publicly available validation or benchmarking studies against verified LCAs. Drawing on a recent pre-print study, limitations to AI integration in LCA also carries risks around transparency, accountability and reproducibility.¹² English-language-only provision could restrict access for non-English speakers.

Planned development

Stated next steps are to open the platform to healthcare suppliers immediately after Demo Day; to continue developing, stress-testing and scaling the circularity-modelling engine within the CivTech project with NHS Scotland; and, once proven in live use, to raise growth capital to drive wider rollout.

7.2 The Lancet MedZero

Owner

The Lancet

Origin

Lancet MedZero exists as a collaboration between *The Lancet*, the Health Intervention and Technology Assessment Program Foundation of Thailand, the National Institute for Environmental Studies of Japan, Northeastern University, USA, the National University of Singapore, the University of Birmingham, and The University of Melbourne, Australia.

Access

Free, global, open access, online (www.medzerocarbon.com)

Status

Active, launched May 2026. The concept was introduced in *The Lancet*, Nov 2025.¹³

Target users

Stated as ‘anyone working at the intersection of sustainability and healthcare’: clinicians, academics, HTA, procurement, health system leaders, policymakers, industry partners, funders, journals.

Use cases

Explicitly states use cases per group: clinicians (lower-carbon clinical decisions, quality improvement, pathway redesign); academics (incorporating carbon data into clinical, health system, and public health research); HTA and procurement (sustainable procurement policy and economic evaluations); health system leaders and policymakers (strategy, planning, baselining, national policy); industry partners (developing/benchmarking products and supply chains); funders and journals (sustainability: research grants, papers, strategic investment).

Primary function

To decarbonise the global healthcare sector by providing transparent, high-quality data-driven carbon analytics for pharmaceuticals, medical and surgical devices, and pathology and imaging services.

Secondary functions

To bridge the data gap that prevents healthcare systems from reaching net-zero emissions; to educate and build carbon literacy across the health sector; to support integration of sustainability into national health policies and regulation.

Scope

A global, open-access carbon analytics database covering pharmaceuticals, medical/surgical devices, and pathology/imaging services, taking a full cradle-to-grave approach. It uses a hierarchical mix of process-based, parametric (covering the WHO Essential Medicines List: 1,578 formulations, 736 medicines), and MRIO modelling to generate product-level footprints at global scale, spanning individual products through to system-wide health system baselining.

Methodology

MedZero applies an iterative, hierarchical methodology depending on data quality (RAG-rated). These tiers apply to the cradle-to-factory-gate stages of the life cycle; transport, use, and disposal are modelled using a consistent parametric approach across all three tiers. **Green:** Process-based LCA, using openLCA and Ecoinvent (v3.11, 2026), characterised via ReCiPe 2016 (Hierarchist). High-volume clinical products are validated through commissioned audits. Peer-reviewed data (sourced via HealthcareLCA) is remodelled for consistency and re-run through ReCiPe 2016 via Ecoinvent 3.11. **Amber:** A parametric model estimates pharmaceutical footprints from active ingredient, formulation, and dose. **Red:** Multi-Regional Input-Output (MRIO) modelling using GLORIA v60 (164 countries/regions) provides system-wide coverage for products lacking detailed process data, tailored to the emissions profile of the specific health system's national economy. **Transport, use, and disposal (all tiers):** A separate parametric model scales impacts by product weight, adjusting for country-specific grid intensity and waste routes. Transport uses trade-weighted country-pairing (EMERGING v2.5 MRIO) with PAS 2090 default distances/modal splits and Ecoinvent processes. Use-phase modelling covers steam sterilisation, laundering, and powered-product energy use.

Source of emission factors

Each product includes a linked data source for traceability. Emission factors draw from named sources by tier: Ecoinvent (v3.11) for process-based/parametric modelling; PAS 2090 for pharmaceutical and transport defaults;



EMERGING v2.5 for trade-weighted transport routing; GLORIA v60 for MRIO-derived factors; and HealthcareLCA to identify peer-reviewed studies (inventory data extracted directly from the literature).

Boundary conditions

Material and manufacturing include raw material extraction, processing, and upstream supply chain transport to the factory gate (but excludes packaging for data consistency). Transport covers distribution from factory gate to the healthcare provider only. Use and disposal models active operation only and assumes all waste is treated and disposed of in the country of use.

Transparency

MedZero publicly discloses its methodology, data source hierarchy, named databases, a per-product traffic-light quality rating, and a review/verification process – though this covers methodology and tiering rather than full peer review of individual entries. It's developing a W3C PROV-based framework for machine-readable provenance metadata per estimate. Where factors derive from proprietary databases, licensing restricts publishing full derivation detail.

Strengths

It helps close the data gap for medical product carbon footprinting. Outputs are customisable to clinical context and broken down by materials, manufacturing, transport, and waste disposal. The platform integrates process-based LCA, parametric and MRIO modelling hierarchically, aligned with the GHG prioritisation protocol. MRIO-derived factors are bespoke to each country of consumption, rather than applying high-income (typically UK) spend factors universally – better reflecting the macroeconomic differences that vary systematically across economies. AI-driven searches match products by meaning rather than exact wording, while UNSPSC codes keep entries standardised and comparable. Peer-reviewed LCA data is checked by at least two technical experts (plus 5% spot checks), and bespoke audit data is modelled independently by two partner organisations. The methodology covers key assumptions.

Limitations

Comparability is limited by differing assumptions: MRIO reflects average sector-level intensities rather than product-specific processes (a useful proxy pending better data); packaging is excluded throughout; and results differ from source publications due to standardisation, final-form manufacturing inclusion, and differing impact assessment methods. Country-specific MRIO factors (see strengths) may still carry residual bias from input-output balancing artefacts in smaller economies. Entries lack formal peer review by The Lancet, and product-level estimates, though precise-looking, rest on proxies and assumptions. Only CO₂e is reported, and English-only provision may limit access for non-English speakers.

Planned development

Stated as: expanding parametric modelling to cover all pharmaceuticals lacking published LCA data; exploring AI/automation to accelerate data collection; a fusion layer to reconcile differing estimates into a single value with an uncertainty envelope; value-of-information methods to prioritise future analytical effort; an open submission pathway for industry/external data providers; regular academic publications for ongoing scientific review; and, longer-term, support for healthcare-specific Product Category Rules and wider provision of primary LCI data and Environmental Product Declarations to guide product redesign and benchmarking.

8. Healthcare Organisation-Level Tools

8.1 AKDN (Aga Khan Development Network) Carbon Management Tool

Owner

Co-developed by the Aga Khan Health Services and The Aga Khan University (both members of the AKDN)

Origin

Designed specifically for use in low- and middle-income countries (LMIC) – particularly in Asia, Africa and the Middle East – though adaptable globally.

Access

Freely available on completion of a short [online request form](#).

Status

Operational, updated annually, current version V1.8.1

Target users

Explicitly states the intended users to be healthcare facility managers, Ministry of Health, and research institutions, such as universities.

Use cases

The tool states it supports carbon footprint calculation across healthcare and other sectors, drawing on international standards (GHG Protocol) and automatically organising data by Scopes 1-3 to avoid double counting. It includes features to track the costs and impacts of making changes, and covers supply chain-related emissions, including innovations in supply chain accounting based on suppliers' own sustainability efforts. It supports multi-level use, accepting data from up to 30 sites, buildings, or campuses per country, and provides visual graphics to help identify emissions hotspots and guide corrective action.

Primary function

Acts as an all-in-one resource to convert operational health service data into GHG equivalents (tCO₂e) across Scopes 1-3, using data freely accessible in all countries to ensure accessibility to LMICs.

Secondary function

Financial cost and tracking of carbon interventions and tracking of organisational sustainability action plans over time.

Scope

Covers Scopes 1-3, including direct and indirect utilities (grid/renewable electricity, liquid/solid fuels, gas cylinders, heating, water consumption); travel and logistics (owned/leased vehicles, road/rail/air staff business travel, hotel stays, contractor logistics); clinical and supply chain (anaesthetic gases, MDI/DPI respiratory inhalers, construction materials, tiered procurement categories).

Methodology

A published, peer-reviewed article describes a 4-tiered hybrid approach developed using the international GHG Protocol, with emissions tracked across Scopes 1-3. It was field-tested across 8 LMICs in South and Central Asia and East Africa.

Source of emission factors

Predominantly UK government datasets (i.e. DEFRA), supplemented by the United Nations Framework Convention on Climate Change (UNFCCC) 2019 Combined Margin Average Factor for grid electricity, and the Intergovernmental Panel on Climate Change (IPCC) waste guidelines.

Boundary conditions

Restricted to 30 sites/buildings/campuses within one country per workbook file. The workbook is designed to sort data into the standardised GHG Protocol Scopes 1-3 to establish an organisational baseline or annual carbon accounting report.

Transparency

Openly references emission factor sources (i.e. DEFRA, UNFCCC, IPCC, US EPA). Uses colour-coded input/output designations and calculates a 'weighted data quality score' for data integrity verification.

Strengths

RAG-rated by colour (red/amber/green) to highlight carbon hotspots. Flexible currency settings supporting 23 pre-populated local currencies or user-defined alternatives. Sophisticated Tier 3 supplier mapping to refine financial spend data into actual supplier carbon intensities.

Limitations

Excel spreadsheet; not an online calculator. Resource-dependent (time and knowledge) as users need to complete the accompanying training (estimated 2.5 hours), digest the workbook and gather comprehensive data across multiple tabs. High dependency on UK-based DEFRA proxies, which is likely to result in inaccurate operational realities, particularly in LMICs. High-level procurement analysis (Tier 2) is directional rather than definitive without manual supplier inputs. Separate workbooks are required if an organisation's boundaries cross multiple nations. English-language-only provision could restrict access for non-English speakers.

Planned development

The tool does not specify a fixed development schedule of its own, but its underlying emission factors are refreshed as source data updates: the UK DEFRA dataset is updated annually, and the tool's factors are updated accordingly; workbook guidance was last revised 1 December 2023. Users are also advised to consider sourcing annually updated independent grid emissions data from the International Energy Agency – currently the most accurate available source, though access may require a paid licence. More broadly, the developers state they are 'continually making refinements with new data and based on users' feedback,' and invite feedback and requests for updated versions via healthcarbonfootprint@akdn.org.

8.2 Climate Impact Checkup

Owner

Health Care Without Harm (HCWH)

Origin

Global; strong European presence

Access

The tool is currently only accessible in the offline (Excel) format. Members of HCWH's Global Green and Healthy Hospitals (GGHH) network can [download the offline spreadsheet](#) from their account's 'Resources' section. For non-members it is publicly available on the [HCWH website](#). It is also available for the [ATACH community of practice](#), and for healthcare and sustainability professionals who enrol in their [online course](#). A cloud-hosted online benchmarking application is in development (projected completion Q3 of 2027); exclusive to GGHH members.

Status

Actively used worldwide in over 33 countries. HCWH has worked on implementing the tool in public facilities in Laos, Indonesia, India, Nepal, Colombia, and Caribbean countries.

Target users

The tool states users may include: health care facilities (public and private); sub-national (city, state or provincial) health care systems; private and charitable health care systems; national ministries of health; and research institutions.

Use cases

Stated use cases include: helping global healthcare institutions estimate their GHG footprint (providing a starting point to measure and manage emissions, support mitigation goals, and develop action plans regardless of facility location); facilitating integration of these actions with other environmental strategies such as sustainable procurement.

Primary function

To serve as a specialised GHG calculator that measures a healthcare facility's annual carbon footprint by converting local activity data into tonnes of CO₂ equivalent.

Secondary functions

Providing analytical graphics, emission hotspots, benchmarking metrics (namely emissions per patient, emissions per bed), and hosting a community peer network with discussion forums to share mitigation advice.

Scope

Whole-facility GHG footprints (Scopes 1-3); healthcare-specific categories including anaesthetic gases and inhalers; emission factors per country for over 200 nations and territories; all aligned with the GHG Protocol.

Methodology

No standalone peer-reviewed methodology paper; instead, documentation of the method (described as a hybrid approach, combining bottom-up and top-down calculations to quantify GHG emissions across Scopes 1-3 of the GHG Protocol) is in FAQ pages.

Source of emission factors

Standardised national/subnational emission databases spanning more than 200 nations and territories. For Scope 3 procurement and extra supply chain modelling, the tool maps economic expenditures against World Input-Output Database (WIOD) datasets filtered across 11 distinct healthcare categories to prevent double-counting.

Boundary conditions

Facility-level operational boundary tracking direct energy combustion, fleet transport, waste treatment, subnational electricity grids, sector-specific healthcare metrics (anaesthetic gases, inhalers), and multi-category vendor supply chain expenditures.

Transparency

Aligns directly with the international GHG Protocol and explicitly details its data categorisation matrices (e.g. grouping WIOD spend data into specific healthcare clusters like pharmaceuticals or medical equipment). Emission factors are fully referenced, versioned and available in the offline tool, and also downloadable from a Technical FAQ document.

Strengths

Tailored to the healthcare sector by factoring in specific clinical emissions like anaesthetic gases and metered-dose inhalers. Features highly localised electricity factors for over 200 countries. Has a large adoption base (>650 institutions). HCWH provides online and in-person training sessions to upskill healthcare staff and they support members with technical queries. The tool and guidance documents have been translated from English into Spanish, Laotian, Japanese, Bahasa and traditional Mandarin.

Limitations

While highly informative as an overarching tracker, successful data collection (particularly for users new to emission footprinting) can initially require in-depth staff training. The training includes 13 online classes and clarifies complex data gathering across diverse hospital departments, making it resource-intensive and reliant on staff continuity, with turnover risking loss of the specialist knowledge needed for consistent data collection.

Planned development

The team confirmed that HCWH continually gathers user feedback, and the tool is currently being updated with a stated timeline for releasing an updated offline spreadsheet with the latest emission factors being Q3 of 2026. No public roadmap is stated.

8.3 SmartCarbon (Newcastle upon Tyne Hospitals NHS Foundation Trust)

Owner

SmartCarbon Ltd

Origin

UK; predominantly commercial platform. Newcastle upon Tyne Hospitals (NUTH) took part in a Local Enterprise Partnership funded project to co-develop and pilot a customised, healthcare-specific version of the existing SmartCarbon Calculator.

Access

Fee-based, different tiers (e.g. Lite or full access) (<https://www.smartcarboncalculator.com/>)

Status

Fully operational and designated as a mandatory five-step framework requirement for Newcastle Hospitals' suppliers.

Target users

The bespoke, healthcare-care-sector version of the tool specifically states it is designed to engage and support suppliers.

Use cases

Stated as measuring, reporting, and reducing full carbon footprints (Scopes 1-3), including supply chain impact. Uses ~6,500 UK Government emissions factors plus bespoke options ('Working From Home' and healthcare sector-specific factors). Outputs are aligned to the NHS Net Zero Plan, GHG Protocol, and SECR Regulations. The optional supplier dashboard calculates supply chain emissions via a combination of spend-code factors and direct supplier-reported data, and is explicitly stated to complement the emerging NHS Evergreen Supplier Framework and other procurement initiatives.

Primary function

To accurately measure, track, and report an organisation's full operational footprint alongside its complex NHS Carbon Footprint Plus (which includes third-party supply chain emissions).

Secondary functions

Providing interactive analytical graphs, supplier dashboards and audit trails for external verification, and generating compliance-ready reports (e.g. SECR and Carbon Reduction Plans)

Scope

Captures Scopes 1-3 of the GHG Protocol, with deep-dive granularity into supply chain procurement, purchased goods, and operational healthcare services.

Methodology

No standalone, published, or peer-reviewed methodology available; instead, there is a disclosed methodological approach: UK government emission factor-based, GHG Protocol-aligned commercial platform with credible institutional backing and external verification claims.

Source of emission factors

Uses 6,500 UK Government emission factors, augmented by bespoke healthcare sector-specific factors and lifestyle options (e.g. working from home). Their supplier dashboard calculates supply chain emissions using spend code factors and direct reporting.

Boundary conditions

Covers full organisational boundaries including direct site operations, building energy, business travel, waste streams, and upstream Scope 3 Category 1 emissions (purchased goods and services).

Transparency

It provides a visible audit trail that external verifiers can easily review for annual accounts, and segregates spend-based estimations from direct supplier-reported data.

Strengths

Successfully transitions procurement tracking from inaccurate, purely spend-based emission equations to actual, performance-based carbon reporting from suppliers. Highly user-friendly, adaptable to complex organisational structures, and backed by robust training and consultancy packages. Multi-award-winning framework (e.g. HSJ Towards Net Zero, Net Zero Innovation of the Year).

Limitations

Gathering initial Scope 3 footprint data may be a particularly resource-intensive task for small and medium-sized enterprise (SME) suppliers, who typically have less dedicated sustainability capacity, staff time, and technical expertise than larger organisations. Without structured support (such as direct webinars or step-by-step guidance) this data collection burden could disproportionately disadvantage smaller suppliers relative to their larger counterparts. English-language-only provision could restrict access for non-English speakers.

Planned development

States the pilot's bespoke calculator can be replicated for other sectors, e.g. local authorities, universities and the construction industry, but no specific development roadmap specified.

9. Specialty-specific Tools

9.1 Eyeefficiency

Owner

Co-developed by an international research team, with funding from the International Agency for the Prevention of Blindness (IAPB) and Standard Chartered Bank's 'Seeing is Believing' grant. The IP is owned by the Centre for Sustainable Healthcare.

Origin

Directly inspired by the low-carbon, highly optimised operational models of the Aravind Eye Care System in Southern India.

Access

Web-based [registration portal](#) with questions directed to thecatarapp@gmail.com. The tool consists of 2 elements: a time-and-motion app (which can also be accessed via the web portal) and a more static online sustainability questionnaire. Both are freely accessible.

Status

Operational; initially piloted in 2017 (4 sites across the UK, India and South Africa) and progressed through rounds of international beta testing (7 sites across different continents).

Target users

Eyeefficiency is currently in beta testing, restricted to 'sites that have been approached and signed up offline'. It explicitly states it is not yet intended for public use (pending funding to maintain it) though tool owners confirmed that interested providers can request access via the email above. Current users are therefore limited to study sites that have created a login and taken part in the Eyeefficiency project. The accompanying peer-reviewed article¹⁴ is more explicit about the intended target users: cataract surgical service providers, worldwide.

Use cases

Eyeefficiency states it is a universal LCA methodology and audit tool for cataract surgery, built to capture routine data on surgical productivity/throughput, solid waste, carbon, and cost together; explicitly framed as a 'triple bottom line' tool. The tool benchmarks the productivity, carbon and cost of the user against an average which is based on all the users who have used the tool.

Primary function

Acts as a specialised clinical care pathway auditing/benchmarking toolkit that evaluates the triple bottom line – productivity, carbon and cost – of cataract and intravitreal procedures.

Secondary function

Live time-and-motion tracking of operating theatre workflows, distinguishing active surgical duration from procedure turnover intervals, as improving patient flow improves productivity, efficiency and reduces costs.

Scope

Clinical material flows (consumption and cost of surgical procurement, disposable materials, pharmaceuticals, local energy metrics); patient schedules (travel, clinical appointments); direct waste (tracking / weighing medical waste generated in the operating theatre, per case).

Methodology

Detailed in a published, peer-reviewed article.¹⁴ EyeEfficiency applies a universal LCA methodology developed specifically for cataract surgery, using a hybrid approach that combines process-based LCA data with environmentally extended input-output (EEIO) inventories to estimate emissions across the surgical pathway. The methodology was validated against independent prior studies at two pilot test sites, and the authors explicitly note that the tool's carbon output is intended to provide order-of-magnitude accuracy for benchmarking purposes, rather than precise absolute measurement.

Source of emission factors

DESNZ carbon conversion factors database; existing peer-reviewed academic literature and healthcare LCA studies mapping medical supply chain footprints; database from Small World Consulting, Exiobase; and local grid factors (e.g. US EPA) in combination with countries grid mix as reported by the World Bank.

Boundary conditions

Restricted to the immediate cataract and intravitreal care pathway. Data capture is concentrated around discrete surgical observation windows (e.g. patient on table, drape on, first incision, incision closed), typically tracking a sample of 1 week or 30 consecutive surgeries per site. For the time-and-motion part of the tool, the patients flow of a theatre list is captured. For the sustainability reporting, the whole pathway is taken into account, including pre-and post-surgery appointments.

Transparency

The tool's carbon conversion logic is directly adapted from peer-reviewed LCA studies, with underlying assumptions on material weights, grid factors, and manufacturing footprints publicly accessible in the literature. GHG emissions from medical supplies were estimated using EEIO analysis, an inherently generic approach reflecting the substantial gaps in global supplier footprint data at the time. To address these gaps, the tool transparently combines direct measurements with generalised background data from academic articles – a hybrid LCA approach.

Strengths

The tool successfully integrates live mobile workflow data collection with back-end environmental accounting, and its built-in instructions eliminate the need for external sustainability consultants. Has proven useful in revealing significant variation between centres, with real-world use uncovering substantial differences in waste and carbon efficiency between surgical services performing the same procedure.¹⁵

Limitations

Highly reliant on a designated 'point person' to manually press timestamps and weigh physical waste bags after sessions, which leaves data completeness and accuracy vulnerable to human error, staff availability, and workload pressure. Dependent on evolving medical procurement databases, which face challenges due to gaps in global supplier footprint data. Supply emissions are estimated solely based on supply costs and are greatly influenced by the lack of transparency further up the supply chain. English-language-only provision could restrict access for non-English speakers.

Planned development

Stated plans in a peer-reviewed paper include re-evaluating and streamlining user inputs to reduce site drop-off without sacrificing report accuracy; building backend statistical methods to enable automated, anonymised cross-site comparison; supporting expanded individual site reports as well as broader regional benchmarking and policy development.¹⁵

9.2 General Practice Non-Clinical Carbon Calculator

Owner

Developed by a UK-based GP (founder of SEE Sustainability), in association with SHC and ERM, and with funding from Boehringer Ingelheim.

Origin

Launched in 2021, to provide an accessible way for UK primary care facilities to measure emissions in line with the NHS's overarching net-zero ambitions.

Access

Free, open access for any UK general practice (GP) (www.gpcarbon.org). Additional carbon footprinting information and FAQs available on the [SEE Sustainability website](#).

Status

Active, established online tool.

Target users

Explicitly stated as UK GP practices. The LinkedIn post (17/11/21) that announced the tool's launch stated intended users to be 'all primary care staff - GPs, practice managers, PCNs, CCGs, ICSs – clinical and non-clinical, sustainability managers etc'.

Use cases

The stated use cases are to measure and identify the non-clinical GHG emission hotspots from running a practice (and produce a carbon equivalent footprint) using data from a full calendar year, entered across four sections: energy, travel, services used, and goods/equipment bought. It's explicitly positioned to help practices produce a decarbonisation plan and to help practices score points in the Zero Carbon section of the RCGP's Green Impact for Health toolkit.

Primary function

To provide an estimated carbon footprint of a GP practice's calendar year of operational records.

Secondary function

To generate local results and provide an option to share an anonymous data summary with SEE Sustainability to support aggregated sector research.

Scope

Specifically covers the non-clinical components of primary care (which represent roughly 40% of primary care's total environmental impact according to The Lancet Planetary Health). It is divided into 4 sections: energy, travel, business services, and procurement. Clinical prescribing footprints (e.g. inhalers, medications) are excluded.

Methodology

No published or citable methodology document identified.

Source of emission factors

The SEE Sustainability FAQ page states 'the most recent government conversion factors as well as conversion factors from academic research' are used, however no formal reference or links are provided. ERM confirmed emission factors were taken from UK government BEIS (formerly the Department for Business, Energy and Industrial Strategy; now under DESNZ) GHG conversion factors for company reporting.

Boundary conditions

Covers the local, non-clinical operational boundaries of individual GP practices over a complete calendar year. Maps building utility bills, staff/patient travel, and general vendor service or asset expenditures.

Transparency

There is no published source of emission factors, linked methodology, system boundary, data quality assessment or update/versioning assessment.

Strengths

Fills a gap by targeting the non-clinical footprint of a GP practice without placing a massive workflow burden on clinical staff. Lets users select between quick/broad estimates or highly detailed ledger data entry depending on records available. Directly integrates with the widely recognised Green Impact for Health primary care framework. Protects data privacy as no data is transmitted or stored on external servers without explicit consent.

Limitations

By excluding clinical prescribing and medicines, it omits the largest overall contributor (~60%) of a primary care medical footprint. Because data is saved locally, users cannot switch computers mid-calculation without losing progress. English-language-only provision could restrict access for non-English speakers.

Planned development

Not under active development: maintained as a resource. The SEE Sustainability website which hosts the tool states it is taking a break from Jan 2026.

9.3 In-Centre Haemodialysis (ICHD) Carbon Calculator

Owner

Sustainable Healthcare Coalition (SHC). AstraZeneca funded its development but has no influence over inputs or outcomes.

Origin

SHC partnered with the Green Nephrology Group at Newcastle upon Tyne Hospitals NHS Foundation Trust (NUTH) in 2019 to footprint their haemodialysis care delivery.

Access

Free, open access (<https://ichdcarbon.org/>)

Status

Active, established online tool.

Target users

Explicitly stated as in-centre haemodialysis (ICHD) service centres/units, globally.

Use cases

Stated to be a free online carbon footprint calculator that measures overall footprint and carbon intensity per patient session, identifying GHG emission hotspots from running a haemodialysis unit. Users can run 'what if' scenario analyses by editing inputs after an initial assessment. The tool explicitly supports dual Scope 2 reporting

(location-based and market-based) in line with GHG Protocol guidance, and is positioned to help units identify carbon hotspots to prioritise for reduction efforts.

Primary function

To convert a full calendar year of dialytic activity data into actionable carbon equivalent metrics.

Secondary functions

To provide built-in currency and regional grid emission factors. To securely transmit anonymous reports to SHC to guide broader renal sector research.

Scope

Clinical care delivery categories, split into general clinic characteristics, patient/staff travel, pharmaceuticals, consumables, unit equipment, building utilities, and medical/general waste processing.

Methodology

Specialty-specific tool built directly on SHC's Care Pathway LCA methodology.

Source of emission factors

Company reporting factors for energy, waste, water, and transport are from BEIS government GHG conversion factors (now DESNZ). ERM generated emission factors using Ecoinvent and LCA software for the manufacture of materials/packaging and equipment.

Boundary conditions

Covers the local ICHD service footprint over a calendar year, tracking inputs from manufacture, through service delivery to disposal. If users do not have data for all inputs, generic pre-set proxies can be used.

Transparency

Clear provenance (SHC, NUTH) and explicit methodological basis (SHC), however no named source for emission factors, published dataset, ISO 14040/44 or third-party critical review reference. Where factors derive from proprietary databases such as Ecoinvent, licensing terms restrict publication of full derivation detail.

Strengths

Created to address one of the most resource-intensive and environmentally impactful areas of chronic disease management, identifying hotspots and guiding users to reduce their service impacts. Results are localised by accommodating country-specific currencies and power grid variables.

Limitations

Relies on user's manual records, therefore if data is missing, generalised default proxies are used which lowers the overall accuracy of results. Data is stored in the local computer browser, so if users change devices or clear caches, it will delete calculation progress. English-language-only provision could restrict access for non-English speakers.

Planned development

No explicit development roadmap is stated; maintained as a resource.

10. Project / Service Evaluation Tools

10.1 Sustainable Healthcare Impact Assessment (SHIA)

Owner

Care Without Carbon (CWC; sustainability partnership team) and Sussex Community NHS Foundation Trust (SCFT)

Origin

Developed at SCFT using QI principles, the tool embeds systemic environmental impact screening into standard NHS clinical design, business modelling, and service modification processes across the region – prompting and measuring sustainability impacts throughout clinical project work.

Access

Available online for Sussex NHS staff, with a corresponding offline Excel toolkit for other NHS staff/partners (shia.carewithoutcarbon.org/). Users must have an NHS email to register.

Status

Active, operational. Online version launched 2026. The tool is being embedded into project governance and service evaluation processes across the Sussex Integrated Care System (ICS).

Target users

Explicitly stated to be for NHS organisations in Sussex and Surrey (currently).

Use cases

The tool states it guides users through their project's sustainability impact via a broad set of questions, identifying good practice and improvement opportunities. It scores performance against CWC's Sustainable Healthcare Principles and flags top risks and benefits, while its carbon calculator component shows carbon savings or 'hotspots', enabling users to target improvements and track progress. A results dashboard lets users browse other projects and see organisational progress toward sustainable healthcare.

Primary function

It scores projects across their 3 Sustainable Healthcare Principles (healthier lives, streamlined processes and pathways, respecting resources) to identify areas for improvements and track progress over time.

Secondary functions

An optional carbon calculator estimates emissions variations from changes in healthcare activities, travel, and resource consumption. It also operates as an educational tool to foster awareness, and guide users to spot opportunities for carbon reductions.

Scope

Formatted around 3 Sustainable Healthcare Principles: Healthier Lives (preventative care / wellbeing), Streamlined Processes & Pathways (minimising waste and duplication), and Respecting Resources (low-carbon treatments/supply chain). Covers Scopes 1-3 emissions by capturing changes to onsite building energy and use of medical gases; purchased electricity, utility grid consumption; resource use, procurement, waste generation, and staff travel.

Methodology

No publicly published or peer-reviewed methodology document but the tool is based on Care Without Carbon's three 'Sustainable Healthcare Principles' (themselves based on principles of sustainable clinical practice originally developed by the Centre for Sustainable Healthcare). It is a principles-based, qualitative/self-assessment screening tool rather than a quantitative LCA calculator.

Source of emission factors

UK government GHG conversion factors (e.g. DESNZ, DEFRA); the Centre for Sustainable Healthcare's 'Carbon Footprinting for Healthcare'; Greener NHS dashboard; the National Atmospheric Emissions Inventory.

Boundary conditions

Explicitly restricted to Sussex and Surrey NHS staff and care networks. It evaluates discrete project/team-level operational modifications rather than national-level healthcare modelling. Primarily constrained to localised Scope 1, 2, and selective Scope 3 operational activities (e.g. staff car mileage, units of healthcare delivery, and waste/resource reductions).

Transparency

Project inputs, operational scope, methodologies, source of emission factors and documented outcomes are visible to any authorised user across the regional healthcare network to ensure cross-trust collaboration and shared data integrity.

Strengths

Highly accessible and requires no prior sustainability expertise. Users can produce results in 10-15 minutes through quick, guided steps. Promotes bottom-up engagement by giving frontline staff direct access to carbon accounting, embedding sustainability into existing processes like business cases and QI workflows. Highlights co-benefits such as how reducing waste and duplication can improve financial efficiency and patient care. Functions as a shared repository, allowing teams to clone successful projects and avoid duplicating modelling work.

Limitations

Online version limited to Surrey and Sussex NHS staff. Offline version more user-intensive. Relies on manual, self-reported data entry (pre and post implementation), creating potential for data-quality variations and slips in status tracking or long-term project drift. The quantitative carbon calculator is optional, so some projects may bypass objective footprint metrics. English-language-only provision could restrict access for non-English speakers.

Planned development

No stated development roadmap. FAQs say that data 'can be used by the CWC team for monitoring and evaluation purposes', but nothing explicit on tool development.

11. Summary

This report demonstrates the diversity of clinical carbon calculators in the current landscape; indeed, there will be others that are seeking to aid the decarbonisation of healthcare but that didn't meet the inclusion criteria for this report. The 21 tools reviewed in this report reflect the various use cases and target users the landscape serves.

While SHC emission factors are adopted by many of the care pathway and trial calculators (CARESA, Clinical Activity Carbon Emissions Factors for Care Pathway Appraisal, Net Zero Health and Care Pathway Tool, Patient Care Pathway Carbon Calculator, Greener Trials Toolkit, and iLCCT Carbon Calculator), there is less convergence around a shared methodological core. Only CARESA, SHC's own Patient Care Pathway Carbon Calculator, and jointly produced ICHD Carbon Calculator explicitly reference the SHC method as underpinning the tools.

Broadening the lens across the remaining healthcare categories reveals distinct methodological trends tailored to specific operational scales. In the pharmaceutical and product categories (e.g. Medicine Carbon Footprint Database, The Lancet MedZero), the landscape is shifting from resource-intensive, process-based LCAs toward predictive parametric modelling and Multi-Regional Input-Output (MRIO) data to rapidly close global carbon data gaps. At the product and supply chain level, emerging platforms like Looper demonstrate the growing role of AI and circular economy metrics, though this introduces new trade-offs between algorithmic automation and verification transparency.

Meanwhile, organisational and specialty-specific tools (e.g., Climate Impact Checkup, Eyeefficiency, ICHD Carbon Calculator) highlight a practical trade-off between accessibility and precision. These tools frequently rely on spend-based EEIO proxies or generic national conversion factors to lower data-entry barriers for clinical and administrative staff. While effective for identifying operational hotspots and driving local quality improvement, their reliance on high-level regional defaults limits their utility for granular product-to-product or facility-to-facility comparisons or for strict regulatory disclosures.

Within each category, progress could be accelerated through tools converging on a shared methodological core. This could be achieved within the care pathway category: it already shares the same unit of analysis; the tools share a substantial proportion of their emission factors; and several tools are supported by published method documentation. The task is to agree the criteria that a shared core must meet - an explicit standards basis, a documented emission factor hierarchy and provenance including construction method and independent verification, defined boundaries and functional units, a stated data quality assessment, and transparent materiality thresholds - and to assess candidate methods against them openly, acknowledging where existing tools do not yet fully meet this bar.

Reaching a shared consensus around transparency would also be beneficial. The definition used in this report reflects how far a tool sets out its methodology, the origin and values of its emission factors, and the assumptions underpinning its results, so that an independent reader has enough information to examine and, where the inputs allow, confirm what the tool produces. Since some inputs are legitimately proprietary or licensed, this is not judged as a single overall pass or fail, but is viewed across separate aspects such as method, data provenance, factor values, and underlying data. A tool might be entirely open about its method while disclosing less about the specific values or sources of individual factors. This limitation is not confined to any single tool, applying equally to the many tools which draw, in part, on proprietary or licensed datasets that cannot be broken down for public disclosure.

Data accuracy is a limitation even in well-regarded tools. Several calculators reviewed, including SHC's Patient Care Pathway Carbon Calculator (whose factors are reused across several of the tools reviewed) and CARESA,

rely on emission factors from 2011-2015. Results should therefore be interpreted as directional rather than precise, and reinforces the case for the continuous, consortium-led emission factor updating already underway through the Greener Trials Data Consortium and SHC's Patient Care Pathway Consortium.

Tool longevity is a risk, separate from methodology. The Net Zero Health and Care Pathway Tool's decommissioning demonstrates that even a well-conceived, multi-partner tool can be lost when institutional or commercial backing changes. Some other tools remain in beta (CARESA, and the online version of the Greener Trials Toolkit) or are dependent on a single organisation's continued investment. Sustainability of the tools themselves, not just of the methodologies behind them, should be a factor when selecting any tool for long-term or repeated use.

Taken together, these findings reinforce the review's central conclusion: the differences between these 21 tools are, for the most part, appropriate reflections of different users and use cases, not evidence of a fragmented or failing landscape. What determines whether this diversity of tools ultimately serves the healthcare sector well is the extent to which it continues to converge on shared, transparent, and regularly updated methodological core – or, where tools legitimately diverge, the extent to which those differences are understood and explained – a direction on which this review's recommendations aim to build.

12. References

- 1 Romanello, M., Napoli, C.D., Green, C. *et al.* (2023) 'The 2023 report of the Lancet Countdown on health and climate change: the imperative for a health-centred response in a world facing irreversible harms', *Lancet*, 402(10419):2346-2394. Available at: [www.thelancet.com/journals/lancet/article/PIIS0140-6736\(23\)01859-7/abstract](http://www.thelancet.com/journals/lancet/article/PIIS0140-6736(23)01859-7/abstract) (Accessed: 12/01/26)
- 2 World Health Organization (2023) *Climate Change*. Available at: www.who.int/news-room/fact-sheets/detail/climate-change-and-health (Accessed: 12/01/26)
- 3 Sustainable Markets Initiative (2022) *Decarbonising Patient Care Pathways: How Choices in Patient Care Can Drive Reductions in Carbon Emissions*. Available at: <https://a.storyblok.com/f/109506/x/88fe7ea368/smi-hstf-pcp-whitepaper.pdf> (Accessed: 15/07/26)
- 4 WBCSD/WRI (2004) *Greenhouse Gas Protocol: a Corporate Accounting and Reporting Standard (Revised Edition)*. Available at: <https://ghgprotocol.org/corporate-standard> (Accessed: 13/08/26)
- 5 Nicholson, L., Pooley, N., Skeldon, G. *et al.* (2026) 'The Increasing Value of Environmental Sustainability Assessments in Healthcare Policy and Technology Evaluation', *Applied Health Economics and Health Policy*, 24:443-447. Available at: <https://link.springer.com/article/10.1007/s40258-026-01034-6#citeas> (Accessed: 15/07/26)
- 6 Rizan, C., Lillywhite, R., Reed, M., Bhutta, M.F. (2023) 'The carbon footprint of products used in five common surgical operations: identifying contributing products and processes', *Journal of the Royal Society of Medicine*, 116(6):199-213. Available at: <https://pmc.ncbi.nlm.nih.gov/articles/PMC10331364/> (Accessed: 20/05/26)
- 7 Sutton-Parker, J. (2022) 'Determining the impact of information technology greenhouse gas abatement at the Royal Borough of Kingston and Sutton Council', *Procedia Computer Science*, 203:300-309. Available at: www.sciencedirect.com/science/article/pii/S1877050922006433 (Accessed 22/07/26)
- 8 Hu, X., Pierce, J.M.T., Taylor, T., Morrissey, K. (2021) 'The carbon footprint of general anaesthetics: A case study in the UK', *Resources, Conservation and Recycling*, 167:105411. Available at: www.sciencedirect.com/science/article/pii/S0921344921000185 (Accessed: 22/07/26)
- 9 Rose, H.B., Kosjek, B., Armstrong, B.M., Robaire, S.A. (2022) 'Green and sustainable metrics: Charting the course for green-by-design small molecule API synthesis', *Current Research in Green and Sustainable Chemistry*, 5(100324). Available at: www.sciencedirect.com/science/article/pii/S2666086522000662 (Accessed: 16/07/26)
- 10 Piffoux, M., Le Tellier, A., Taillemite, Z., *et al.* (2024) 'Carbon footprint of oral medicines using hybrid life cycle assessment', *Journal of Cleaner Production*, 475. Available at: <https://www.sciencedirect.com/science/article/pii/S0959652624030257?via%3Dihub> (Accessed 17/07/26)



- 11 Taillemite, S., Fenelon, M., Scherlinger, M., Piffoux, M. (2026) 'Carbon Footprint of Antibody-Based Drugs and Biologics Using Hybrid Life Cycle Assessment', *Clinical Pharmacology & Therapeutics*, 120:236-244. Available at: <https://ascpt.onlinelibrary.wiley.com/doi/10.1002/cpt.70301> (Accessed 22/07/26)
- 12 Kumar, M., Patouillard, L., Donaldson, A., Cornago, S. (2026) 'Artificial intelligence meets LCA: a critical analysis from technical, ethical, and organizational perspectives', *Research Square, pre-print*. Available at: www.researchsquare.com/article/rs-9984806/v1 (Accessed: 16/07/26)
- 13 Watts, N., Andrew, T., Bagenal, J. *et al.* (2025) 'The Lancet MedZero: carbon analytics for health care, by health care, at scale', *The Lancet*, 407:205-207. Available at: [www.thelancet.com/journals/lancet/article/PIIS0140-6736\(25\)02280-9/abstract](http://www.thelancet.com/journals/lancet/article/PIIS0140-6736(25)02280-9/abstract) (Accessed: 01/07/26)
- 14 Thiel, C.L., Cassels-Brown, A., Goel, H., *et al.* (2020) 'Utilizing off-the-shelf LCA methods to develop a 'triple bottom line' auditing tool for global cataract surgical services', *Resources, Conservation and Recycling*, 158(104805). Available at: www.sciencedirect.com/science/article/pii/S0921344920301269 (Accessed: 17/07/26)
- 15 Goel, H., Wemyss, T.A., Harris, T., *et al.* (2021) 'Improving productivity, costs and environmental impact in International Eye Health Services: using the 'Eyeefficiency' cataract surgical services auditing tool to assess the value of cataract surgical services', *BMJ Open Ophthalmology*, 6(1). Available at: <https://bmjophth.bmj.com/content/6/1/e000642> (Accessed: 17/07/26)



Appendix 1

Table of Tools for RAG-rating

The tables below set out key measurement criteria for each tool, provided for quick reference should it help with rating or comparison.

Care Pathway Tools

	Access	Source of EF*	Usability	Transparency	Scope
Patient Care Pathway Carbon Calculator					
CARESA					
Carebone					
Clinical Activity Carbon EF* for Care Pathway Appraisal					
Net Zero Health and Care Pathway Tool**					

Clinical Trials Tools

	Access	Source of EF*	Usability	Transparency	Scope
Industry Low Carbon Clinical Trials (iLCCT) Carbon Calculator					
Greener Trials Toolkit					
PPD Carbon Emission Calculator for Clinical Trials					

Pharmaceutical Tools

	Access	Source of EF*	Usability	Transparency	Scope
ABPI Blister Pack Carbon Footprint Tool					
ACS GCI PMI-LCA Tool					
Medicine Carbon Footprint Database					

Medical Technology Tool

	Access	Source of EF*	Usability	Transparency	Scope
Single-use vs. Reusable Carbon Footprint Calculator					



Product-level Tools

	Access	Source of EF*	Usability	Transparency	Scope
The Lancet MedZero					
Looper (NHS Scotland)					

Healthcare Organisation-Level Tools

	Access	Source of EF*	Usability	Transparency	Scope
Climate Impact Checkup					
SmartCarbon (NUTH)					
AKDN Carbon Management Tool					

Specialty-specific Tools

	Access	Source of EF*	Usability	Transparency	Scope
In-Centre Haemodialysis (ICHD) Carbon Calculator					
General Practice Non-Clinical Carbon Calculator					
Eyefficiency					

Project / Service Evaluation Tools

	Access	Source of EF*	Usability	Transparency	Scope
Sustainable Healthcare Impact Assessment					

*EF (emission factor)

** Decommissioned

RAG-rating	Score
	0-1
	2-3
	4-5
Unknown	/

