For people, for planet

Environmentally sustainable health research

Recommendations for good practice in the UK and the US

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The report was prepared by a group of interdisciplinary researchers, convened by the Academy of Medical Sciences (UK) and the National Academy of Medicine (US). The report and its findings reflect the collective work and opinions of the group's members, along with the available evidence on the subject matter.

All web references were accessed in August 2025.

Contents

Message from the Academy Presidents

The UK Academy of Medical Sciences and the US National Academy of Medicine share a longstanding partnership and commitment to working together to achieve our missions of improving national and global health.

We are proud to see the results of our latest collaborative project, which looks to address one of the most pressing global health challenges, climate change and its impact on health. This report has been produced by a group of talented and inspiring future research leaders from the UK and the US, who embarked on a joint policy initiative to develop recommendations to improve the environmental sustainability of health research in the US and the UK. By leading this initiative, our future researcher leaders have developed vital policy and leadership skills throughout the course of the project, which has been wonderful to see and stands them in good stead for future endeavours.

Harnessing the skills and expertise of our future research leaders and amplifying their voices on climate change and health was a commitment we made in our 2022 joint statement to bring leadership and influence in responding to the climate emergency. This joint initiative is evidence of action on our commitments to addressing climate change and our shared drive to bring our leadership and networks of experts together to address global health challenges. It also demonstrates our commitment to supporting our researchers in their career development and to build leadership capacity across diverse disciplines to shape the future of medical research.

We believe the best research relies on international links and US-UK collaborations in medical science have long been a driving force in global scientific progress. It is inspiring to see how our two cohorts of researchers have connected and worked together from across the globe and different scientific and medical disciplines to produce such a comprehensive and important output.

We hope this is only the start of their working together and that the connections made in this UK-US collaboration will continue to foster and grow long into the future.

Professor Victor J Dzau, MD
President, National Academy of Medicine (US)

Professor Andrew Morris CBE FRSE PMedSci
President, Academy of Medical Sciences (UK)

Foreword

It is with great pleasure that we introduce this important landscape review and policy report on the environmental sustainability of health research.

The advancement of human health through scientific research is a pillar of modern civilisation, enabling humans to live longer, better, and more meaningful lives. Health research – whether conducted in the laboratory or community, by private companies or academia – brings us new life-saving treatments and powerful preventive healthcare, as well as informing impactful policies that give rise to healthier societies.

This noble pursuit of knowledge in the service of humanity nevertheless does create environmental impacts, contributing to one of the greatest threats to human health: climate change. It is therefore imperative to recognise and measure the impact of health research on the environment and to drive systematic progress toward minimising negative effects.

The UK Academy of Medical Sciences and the US National Academy of Medicine are committed to addressing the challenge climate change presents to health, including the incongruity between the incredible benefits delivered by health research and its environmental impact. The Academies brought together a bi-national group of 16 interdisciplinary researchers to participate in this innovative project with the goal of investigating and making policy recommendations on the environmental sustainability of health research. Our group members brought expertise and ideas not only from our respective home countries, but also from deep individual experience of conducting research around the world.

From March 2024 to September 2025, we had the distinct pleasure of co-leading this brilliant and passionate group, across time zones and through highly consequential geopolitical events. Particularly in the US, the rapidly changing landscape for governmental science funding and uncertainty over future support added another layer of complexity to considering how to make health research more environmentally sustainable. Despite these challenges, the importance of the work fuelled our group to identify opportunities to effect lasting, systemic change in our sector. In addition, the Academies aimed to create professional connections among these distinguished research leaders; indeed, these relationships have already resulted in new avenues of scientific collaboration and publication.

This investigation leverages the comparison of two different health research systems, and of two countries, the US and UK, that apply different approaches to ensuring the environmental sustainability of health research. We identify and highlight recommendations for each country that scientists, leaders, and policymakers can choose to apply, whether through structural or grassroots approaches to change.

At the time we convened our group, several guidelines had recently been published by various organisations that are leaders in the area of sustainable health research. This report builds upon and extends that work, both geographically across nations as well as spanning scientific disciplines, in order to facilitate wide-reaching action.

We thank the President of the Academy of Medical Sciences Professor Andrew Morris and National Academy of Medicine President Dr Victor Dzau for their vision for and support to this successful transatlantic partnership, as well as Professor Tom Solomon and Dr Carlos Del Rio. With special thanks to Dr Melissa Simon and Professor Paula Williamson for providing expert steer and wisdom throughout this project. We also extend our gratitude to Dr Abigail Bloy, Annabel Miller, and Chris Hanley for their help in co-ordinating the project.

We hope the recommendations set out in this report will help catalyse a collective endeavour to focus on the health research cycle and how, at each stage, this research can be conducted in more environmentally sustainable ways. We invite our scientific colleagues globally to engage with and actively implement these recommendations to help ensure a healthier future for all of us, and for future generations.

Ying Goh

Physician, former Public Health Director of the City of Pasadena and former Senior Policy Adviser to Vice President Kamala Harris

Julia Wilson

Director of Strategy, Partnerships and Innovation, Wellcome Sanger

Acknowledgements

Our special thanks to Paula Williamson FMedSci and Dr Melissa Simon for their expertise and guidance in the production of this report.

We would like to thank the following people who have engaged with the group of researchers on multiple occasions throughout the process and whose contributions have helped to inform the development of this report:

- **Dr Susan Simon** (UKRI)
- **Dr Jennifer Ekelund** (National Institute for Health and Care Research (NIHR))
- **Dr Sophia Lentzos** (NIHR)
- **Kerry Garfitt** (Wellcome Trust)
- **Dr Andrea Hodgetts** (Laboratory Efficiency Assessment Framework (LEAF), University College London)

We would also like to thank the following people for engaging with the authors during the development of this report:

- **Dr Kate Bazin** Kings College London
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- **Sarah Grimshaw** Health Research Authority
- **Martin Farley** UKRI
- **Dr Michael Inouye** University of Cambridge
- **Emmie Mediate**
- **Jonathan Patz**
- **Dr Julie L. Swann** North Caroline State University
- **Lena Thomas** My Green Lab

- **UK Research & Development (UKRD)** – the UK's community of health and care research and development leaders.
- **The Doctoral Training Partnership cohort of students** training for PhDs in trials methodology as part of the Trials Methodology Research Partnership (TMRP) established by the Medical Research Council and NIHR, together with their supervisors.

In addition, we would like to thank Professor Tom Solomon FMedSci and Dr Louise Wood FMedSci for their contributions to the project.

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Preface

The authors

This report is the work of 16 interdisciplinary researchers, selected by the UK Academy of Medical Sciences and the US National Academy of Medicine to participate in a joint policy initiative on climate change and health. The researchers represent a broad range of disciplines and sectors within the health research sector, and are based across the UK, US and Hong Kong. Further information about the authors can be found in Table 1 below.

The authors were supported in their work by Dr Melissa Simon (Vice Chair for Research, Department of Obstetrics and Gynecology, Northwestern University) and Professor Paula Williamson FMedSci (Professor of Medical Statistics, University of Liverpool), whose expertise, leadership and contributions were invaluable in their role as Programme Leads.

The authors were also supported in their work by staff from both National Academies, including by Chris Hanley and Gregg Margolis from the National Academy of Medicine and Abigail Bloy, Annabel Miller and Alex Hulme from the Academy of Medical Sciences.

Table 1: Profiles of the report's authors

Name	Job title	Organisation	Specialism
Ying-Ying Goh MD, MS (US Co-chair)	Former Public Health Director of the City of Pasadena and former Senior Policy Adviser to Vice President Kamala Harris		Public health and health policy
Dr Julia Wilson (UK Co-chair)	Director of Strategy, Partnerships and Innovation	Wellcome Sanger	Strategy, policy, partnerships and innovation leadership
Dr Peter Bannister	Managing Director Honorary Chair in Regulatory Science and Innovation	Romilly Life Sciences University of Birmingham	Medical devices, artificial intelligence (AI), regulatory science, sustainability and net zero engineering
Dr Amy Booth	Clinician-Researcher	University of Oxford	Sustainable healthcare, pharmaceutical supply chain sustainability
Dr Claire D. Bourke	Senior Lecturer	University of Glasgow	Translational immunology, maternal and child health, health inequalities
Dr Alice M. Bowen	Senior Lecturer in Chemistry and Royal Society Dorthy Hodgkin Research Fellow	University of Manchester	Electron paramagnetic resonance spectroscopy
Dr Samuel Cai	Lecturer	University of Leicester	Environmental epidemiology

Name	Job title	Organisation	Specialism
Dr Kai Ning Cheong	Associate Consultant at Hong Kong Children's Hospital Honorary Clinical Assistant Professor	University of Hong Kong, The Chinese University of Hong Kong	Paediatric immunology and rheumatology, global maternal and child health, health equity
Dr Ehsan Hoque	Professor	University of Rochester, NY	AI, human-centric computing
Dr Jerreed D. Ivanich	Assistant Professor	University of Colorado	Indigenous health
Dr Deepa J Arachchillage	Consultant Haematologist, Honorary Senior Lecturer and Medical Research Council (MRC) CARP Fellow	Imperial College London and Imperial College Healthcare NHS Trust	Haemostasis and thrombosis
Dr Ruth Payne	Senior Clinical Lecturer and Honorary Consultant Microbiologist	University of Sheffield	Clinical vaccine trials and infection
Dr Jenny Rivers	Director of Research and Development	Barts Health NHS Trust	Research and innovation leadership, clinical trials, multi-disciplinary research programme management
Dr Chinmoy Sarkar	Associate Professor	Department of Urban Planning and Design, The University of Hong Kong	Healthy cities, environmental epidemiology, socio-spatial health inequities, urban health policy
Dr Allison Squires	Professor of Nursing	Rory Meyers College of Nursing, New York University	Health services research, global health, immigrant health
Dr Y. Tony Yang	Endowed Professor and Associate Dean	The George Washington University	Health policy and law, infectious diseases and vaccines, substance abuse, pharmaceutical regulation

Background and process

Over a period of 15 months, the authors collaborated online and in person to jointly define the focus of the initiative and to produce this report, as the final output of their work. The focus of the report is a series of policy recommendations that aim to improve the environmental sustainability of health research in the UK and in the US.

There is limited data on the environmental impact of health research and the data that exists primarily focuses on laboratory studies and clinical trials, which form only a part of the health research landscape. Where data exists, it indicates that health research has a significant impact on the environment. Consequently, there is a substantial need to embed environmental sustainability across all types of health research to create a health research sector that meets the needs of both people and planet. There is increasing interest in this topic and this provides an opportunity for systematic, coordinated action to reduce the environmental impact of health research, increasing its sustainability and ensuring that it does not harm health or waste resources. This report draws on literature and stakeholder discussions to summarise the current knowledge of the environmental impact of health research and makes proposals to address the challenges and to foster a research landscape that is more sustainable.

This report builds on the report of the Academy of Medical Sciences' Enabling greener biomedical research workshop, which was jointly hosted by the Academy of Medical Sciences FORUM, the National Institute for Health and Care Research (NIHR) and the MRC. It also aligns with the aims and goals of the US National Academy of Medicine's Grand Challenge on Climate and Health. The initiative also acts upon a joint commitment on action on climate change and health made by both Academies in July 2022 to bring their leadership and networks together to address the challenge climate change presents to health.

Conduct of the study

The findings and policy recommendations presented in this report are based upon a scoping of the literature, workshop discussions, and conversations with key stakeholders and experts in the sector.

We have gathered evidence from a range of sources, including:

- Desk-based research (academic literature, policy documents, guidelines and white papers, stakeholder websites and reports, organisational carbon accounting)
- Conversations with key experts and stakeholders
- Group workshops
- Personal experience of implementing sustainable practice in research work

Structure of the report

This report covers a series of themes identified by the group during evidence synthesis and highlighted as key areas for action.

Each theme examines the current context, and the challenges of and opportunities for improving the environmental sustainability of health research in the UK and the US, and proposes a set of policy recommendations aimed at stakeholders in the sector.

Table 2: Themes and descriptions

Theme number	Theme title	Description of theme
THEME 1	Data, metrics and information availability	This theme explores the role of environmental impact data and metrics in fostering environmentally sustainable health research, identifies successes and challenges, and offers sector-wide recommendations.
THEME 2	Funding	This theme examines the current state of approaches funding organisations are taking to address sustainability in health research, the challenges faced, and the opportunities for improvement at the individual, institutional and funder levels.
THEME 3	Regulation	This theme examines the current state of regulatory approaches to sustainability in health research, the challenges faced, and opportunities for improvement.
THEME 4	Procurement and supply chain	This theme examines the environmental impact of procurement and supply chains in health research, the challenges and opportunities for sustainable procurement, unintended consequences of sustainable procurement practices that should be considered, and recommendations to drive sustainable procurement across health research supply chains.
THEME 5	Infrastructure	This theme explores the role of physical infrastructure, such as buildings, hardware and energy systems; electronic infrastructure, including digital platforms, software and algorithms; and service infrastructure on sustainable health research. A set of recommendations aimed at reducing environmental footprints is proposed.
THEME 6	Capacity building of researchers and organisations	This theme explores the current capacity of researchers to conduct sustainable research, and opportunities to increase this capacity.

Further outputs are in development at the time of publication of this report.

Introduction and summary

The primary message of this report is that the resource-intensive health research sector needs to take a concerted and collaborative effort to reduce its environmental impact and become more sustainable. Some individual researchers, research organisations, funders and businesses have developed or adopted policies to reduce emissions and other impacts, but progress has been sporadic. Sustainable practices will only spread across the whole sector when governments, regulators, funders, suppliers and research organisations work together in a decisive and coordinated way to bring about change.

The world faces multiple intersecting environmental crises – climate change, biodiversity loss, pollution, water scarcity – which all challenge the health of current and future populations.[1] To reduce the impacts of these environmental crises, including those on health, urgent action needs to be taken by every sector, at every level.

In health research, a step-change is needed to create a culture of sustainability. The sector should lead the way in efforts to reduce the impact of its work on the environment and to embody climate-conscious values and behaviour while continuing to fulfil its primary purpose of improving health for all.

Box 1: Defining environmentally sustainable health research

In the context of this report, environmental sustainability in health research means conducting research activities in ways that **minimise harmful environmental impacts**, primarily through reducing greenhouse gas (GHG) emissions (most often measured using the metric of carbon dioxide equivalent (CO_2e)), but also through optimising the consumption of energy and other resources, including water and materials, minimising waste generation, and adopting sustainable procurement and supply chain practices.

Sustainability encompasses the **environmental footprint of research infrastructure** (buildings, laboratories, and digital technologies), **research operations** (from laboratory activities to clinical trials), and **supporting systems** (procurement, transportation and data management).

The goal is to **enable research to contribute to, rather than detract from, global environmental goals**, while maintaining scientific rigour and innovation, and to safeguard environmental resources for the health and wellbeing of both current and future generations.

While we recognise the existence of multiple environmental crises, our report primarily focuses on climate change, which is currently the main priority in terms of sustainability among research organisations. Nevertheless, we aim to provide recommendations that support the development of a sustainable health research sector that reduces all adverse environmental impacts.

1. World Health Organization (2023). *Climate change* [web page]. https://www.who.int/news-room/fact-sheets/detail/climate-change-and-health

The impact of health research on the environment

While there is currently no overall estimate for the impact of the health research sector on the environment, studies suggest that individual types of health research, such as wet laboratory research, clinical research and computational research, have sizeable carbon footprints.[2,3] These types of health research have a significant environmental impact due to the energy-intensive nature of their infrastructure, the resources used, and the waste generated.[4]

Laboratory-based research – Laboratories have been shown to have some of the highest environmental impacts of any workspace, using 10 times more energy and 4 times more water than offices.[5] One US university estimated that its laboratories accounted for 40% of its energy use, but only 20% of its campus space.[6] Laboratories have a high carbon footprint, with a typical laboratory in the US estimated to generate 20 metric tons (or tonnes) of CO_2 per year.[7] Furthermore, a 2015 study estimated that, globally, laboratories could generate as much as 5.5 million metric tons of plastic waste per year.[8]

Clinical trials research – The environmental impacts of clinical trials can vary widely and can reach very high levels. Studies have shown that the carbon footprints of clinical trials can vary from very small volumes to around 2,500 metric tons for a major cardiovascular trial.[9,10]

Computational research – There is increasing awareness of the environmental impact of computational research, particularly high-performance computing (HPC), cloud computing and data curation. The carbon footprint of data storage for health research is substantial, with estimates suggesting that storage of 1 terabyte of data generates approximately 10kg CO_2 equivalent units per year (CO_2e/year),[11] with most clinical trials requiring study data be stored for decades. There is also concern around the rising impact of AI-based approaches in health research, due to energy demands, raw material use and electronic waste, although the potential efficiencies of using AI-based approaches that lead to reductions in other environmental impacts need to be considered.[12]

Other types of research – While there is emerging data on the environmental impact of certain types of research, gaps remain in terms of understanding and quantifying the environmental impact of broader categories of health research, such as implementation research, community health research and behavioural research. Challenges have been identified around the lack of standardisation of existing data for quantifying the environmental impact of health research due to differences in the way data is collected, measured and evaluated across different settings and contexts.[13] Furthermore, existing data focuses largely on quantifying the carbon emissions of research activities, rather than wider environmental impacts.

2. Sustainable Healthcare Coalition (no date). *How we calculated global clinical trial greenhouse gas emissions* [web page] https://shcoalition.org/low_carbon_clinical_trials/
3. Nature Computational Science (editorial) (2023). *The carbon footprint of computational research*. Nat Comput Sci **3**, 659. https://doi.org/10.1038/s43588-023-00506-2
4. Urbina M, Watts, A & Reardon, E (2015). Labs should cut plastic waste too. *Nature* **528**, 479. https://doi.org/10.1038/528479c
5. My Green Lab (no date). *About us* [web page] https://www.mygreenlab.org/about.html
6. Harvard Office for Sustainability (no date). *Sustainable labs* [web page] https://sustainable.harvard.edu/schools-units/sustainable-labs/
7. Nathans J & Sterling P (2016). *Point of view: How scientists can reduce their carbon footprint*. eLife **5**, e15928. https://doi.org/10.7554/eLife.15928
8. Greever C & Star S (2021). *Three strategies to make labs more sustainable*. Lab Manager, May 26. https://www.labmanager.com/three-strategies-to-make-labs-more-sustainable-25945
9. You F, *et al*. (2025). *Carbon emissions associated with clinical trials: a scoping review.* Journal of Clinical Epidemiology **181**, 111733. https://doi.org/10.1016/j.jclinepi.2025.111733
10. Mackillop N, *et al*. (2023) *Carbon footprint of industry-sponsored late-stage clinical trials*. BMJ Open **13(8)**, e072491. https://pubmed.ncbi.nlm.nih.gov/37604634/
11. Lannelongue L., *et al*. (2023). *GREENER principles for environmentally sustainable computational science*. Nat Comput Sci **3**, 514–521 (2023). https://doi.org/10.1038/s43588-023-00461-y
12. UNEP (2024). *AI has an environmental problem. Here's what the world can do about that*. https://www.unep.org/news-and-stories/story/ai-has-environmental-problem-heres-what-world-can-do-about
13. Goulão B, *et al*. (2025). *Measuring the environmental impact of health interventions in randomized controlled trials – A scoping review.* Journal of Clinical Epidemiology **183**, 111751. https://www.jclinepi.com/article/S0895-4356(25)00084-8/fulltext

Actions taken by the health research sector

Significant steps have already been taken by the health research sector in the UK and the US at the grassroots level to promote more sustainable research practices. These include the following: green accreditation schemes for laboratories, such as My Green Lab and LEAF - Laboratory Efficiency Assessment Framework; carbon monitoring and impact assessment tools for researchers, such as Green Algorithms and the Life-Cycle Assessment Tool; and information-sharing groups and networks, such as the Sustainable Health Coalition and The MRC-NIHR TMRP Greener Trials Working Group. A more extensive list of tools, resources, initiatives and networks on this topic can be found in Annex 3.

Many major pharmaceutical and MedTech organisations have signed up to the United Nations' Race to Zero campaign, which commits major sectors within the global economy to reaching net zero carbon emissions by 2050. This is the point where net emissions reach zero because any ongoing emissions are offset by removal of carbon from the atmosphere, for example through afforestation, carbon capture from industry, or direct air carbon capture. Many organisations and businesses have also implemented their own sustainable procurement strategies, some of which include efforts to increase the environmental sustainability of their research.[14] Within the academic research sector in both countries, there is evidence of action being taken at the institutional, departmental and individual researcher level, with laboratories signing up to the accreditation schemes listed above. This has largely been championed by individuals or teams working in academic institutions, rather than being a coordinated, sector-wide approach.

In the UK, there has been some top-down progress on, and a commitment to, improving the sustainability of health research, largely led by public and private health research funders. This includes the signing of a cross-sector Concordat for the Environmental Sustainability of Research and Innovation Practice, and a move by two funders, Wellcome and Cancer Research UK, to publish position statements on relevant topics and to include environmental sustainability assessment criteria in funding applications. In the US, one of the main national research funding bodies, the National Institutes of Health (NIH), hosts resources for researchers on green practices in laboratory settings.[15] However, wider national-level action and momentum from funders or other major stakeholders is not apparent. Progress in the US has also been affected by executive orders issued in 2025 that have shifted federal priorities, paused or reduced some funding, and resulted in the restructuring of climate, environmental and sustainability research funding across multiple agencies.

Globally, there has been little international action or commitment to improve sustainability in health research. One exception is a cross-European stakeholder alignment agreement, the Heidelberg Agreement, led by representatives from European multi-stakeholder groups, which seeks to ensure research funders take a proactive approach to promoting sustainability in scientific research.

Challenges and opportunities for progress

Despite the progress outlined above, major challenges remain, key among them being the availability and standardisation of information and methodologies used to quantify the impact of health research; the need to build the capacity of researchers and organisations in environmentally sustainable health research; and the time, cost and resources required to provide the necessary training.

A previous report by the Academy of Medical Sciences on enabling greener biomedical research identified the need for greater sharing of information and evidence on best practices in sustainable research.[16] While there has been an increase in the availability of tools such as carbon calculators to assess the carbon footprints of health research organisations, their accuracy and relevance can vary by national context, research institution and subject area. Quantifying the environmental impact of health research has been found to be time consuming, costly and labour intensive, mainly relying on the goodwill and motivation

14. My Green Lab (2024). *The carbon impact of biotech and pharma: Crossing the tipping point of industry transformation.* https://mygreenlab.org/the-beaker-blog/the-carbon-impact-of-biotech-and-pharma-crossing-the-tipping-point-of-industry-transformation/
15. National Institutes of Health (no date). *NIH Green Labs Program.* https://nems.nih.gov/green-teams/Pages/NIH-Green-Labs-Program.aspx
16. The Academy of Medical Sciences (2023). *Enabling greener biomedical research: FORUM workshop on Wednesday 15 March 2023.* https://acmedsci.ac.uk/file-download/61695123

of individual researchers. A UK report on sustainable laboratories by the Royal Society of Chemistry UK identified a strong appetite among researchers to reduce the environmental impact of their scientific work but noted that they face complex and context-specific barriers, such as limited time and money, organisational culture, knowledge gaps, and a lack of available data for making informed decisions.[17] Factors identified as important in building the capacity of the health research sector workforce for environmentally sustainable research include education and training opportunities, incentives, and networks for sharing good practice.

A joint report by Wellcome and RAND Europe called on the wider research community to organise sector-wide action to match the efforts being made by individual researchers and research organisations.[18] While evidence of motivation among, and action by, wider stakeholders has begun to appear, particularly among UK health research funders, greater commitments and more collaborative action are needed among all major stakeholders. This includes centralised and policy-driven strategies to develop and improve the infrastructure, procurement and supply chain approaches required for sustainable health research, as well as coordinated action by health research funders and regulators. This will need to be complemented by considerable research and investment in sustainable procurement, sustainable infrastructure, and the training of relevant personnel.

The importance of harmonising and coordinating approaches between different stakeholder groups, including funders and regulators, is a key finding in a recent Innovate UK report entitled 'Understanding current thinking around carbon emission impact assessment and clinical trials regulation', produced as part of the work of the MRC-NIHR Trials Methodology Research Partnership (TMRP) Greener Trials Group.[19] The report states that guidelines, approaches and commitments need to be aligned at a governance level by both funders and regulators, while ensuring they are relevant, applicable and viable in all research settings. At the same time, actions taken should avoid unintended adverse consequences. This is a particular challenge given the diversity of the sector and the wide range of settings in which health research is carried out. Recognising contextual challenges and health equity considerations will be important in any approach to making health research more environmentally sustainable across the sector. Standardised and comprehensive metrics are needed to consistently and accurately measure the environmental impact of health research across different organisations and research settings; to align sustainable infrastructure and procurement approaches; and to inform the development of regulatory frameworks and funding policies.[20]

This report is not the first to call for the health research sector to address climate change, but it is the first to examine how this can be achieved through collective and collaborative action by stakeholders at all levels of the health research system in the UK and the US. The need for such coordinated action has increased in the context of current political, funding and structural changes.

Note on the US landscape

This report was written in 2025, at a time of transition and significant changes for the US health research sector due to a series of presidential executive orders and legislative actions that have significantly reduced funding to major research universities and federal agencies, including the NIH, the National Science Foundation (NSF), and the Centers for Disease Control and Prevention (CDC). Major changes in the organisations of the US Department of Health and Human Services (HHS) have added even more uncertainty. hese federal actions have created challenges for those seeking federal research funding that includes costs associated with mitigating harmful impacts on the environment, especially the social cost of carbon. Acknowledging the shifting landscape at the time this report was created, any individual reviewing this report in the US should devote time to understanding the current regulations and potential barriers to obtaining federal research funding.

17. Royal Society of Chemistry (2022). Sustainable laboratories. https://www.rsc.org/policy-and-campaigning/environmental-sustainability/sustainable-laboratories
18. Wellcome Trust (2023). Advancing environmentally sustainable health research. https://wellcome.org/reports/advancing-environmentally-sustainable-health-research
19. Samuel G., et al. (2024). Understanding current thinking around carbon emission impact assessment and clinical trials regulation. MRC-NIHR Trials Methodology Research Partnership Greener Trials Group. https://www.methodologyhubs.mrc.ac.uk/files/5817/3097/0238/Understanding_carbon_emission_impact_assessment_and_clinical_trials_regulation_-_Inovate_UK.pdf
20. Medical Research Council (2024). MRC Landscape Review Transitioning to environmentally sustainable life science – challenges and opportunities. MRC Landscape Review Transitioning to environmentally sustainable life science – challenges and opportunities

State of play on sustainable health research in the UK and US

United Kingdom

As noted above, in the UK, severable notable reports on the environmental sustainability of the health research sector have been published,[21,22,23] which have helped to raise awareness of the challenges and to catalyse action among certain groups of stakeholders. Recognisable action has been taken at national, organisational and individual levels, including by health research funders, research organisations and individuals. However, while some individual funders have begun to set environmental policies for the work that they support, as yet no mandatory standards have been set by government or regulators for the sustainability of research.

The UK government has committed to reaching a net zero economy by 2050.[24] The National Health Service (NHS), which implements clinical research, has released a net zero strategy and green commitments, in line with its ambition to deliver the world's first net zero health service.[25] This includes sustainable procurement strategies. Greener planning strategies are being implemented through healthcare providers, including individual NHS trusts and sustainability is now considered at trust level in the Care Quality Commission (independent healthcare regulator) assessment framework (https://www.cqc.org.uk/guidance-regulation/providers/assessment/single-assessment-framework/well-led/environmental-sustainability)

Within the wider science sector, similar commitments have been made by UK Research and Innovation (UKRI), which has pledged to become net zero by 2040,[26] 10 years ahead of the national target, and many universities have also set their own targets to reach net zero, some as soon as 2030.[27] As noted, the UK research and innovation sector has co-developed a voluntary Concordat for the Environmental Sustainability of Research and Innovation Practice, which represents a shared ambition for the sector to produce and deliver research in a more environmentally sustainable way.[28] Signatories include universities, research institutes, non-governmental organisations and funding bodies. So far, these are all larger entities and there is not yet evidence of smaller funders taking policy action.

In terms of health research specifically, as mentioned above, funders have begun to set their own policies. Two major non-government health research funders, the Wellcome Trust and Cancer Research UK, have published environmental sustainability funding policies.[29,30] These policies set out expectations of researchers and organisations receiving funding with regard to making research environmentally sustainable, including minimum standards and requirements. These policies are relatively new and there is no information as yet on their effect in the sector.

21. The Academy of Medical Sciences (2023). *Enabling greener biomedical research: FORUM workshop on Wednesday 15 March 2023*. https://acmedsci.ac.uk/file-download/61695123
22. Royal Society of Chemistry (2022). *Sustainable laboratories*. https://www.rsc.org/policy-and-campaigning/environmental-sustainability/sustainable-laboratories
23. Wellcome Trust (2023). *Advancing environmentally sustainable health research*. https://wellcome.org/reports/advancing-environmentally-sustainable-health-research
24. Prime Minister's Office, 10 Downing Street (2023). *PM recommits UK to Net Zero by 2050 and pledges a "fairer" path to achieving target to ease the financial burden on British families* [press release] https://www.gov.uk/government/news/pm-recommits-uk-to-net-zero-by-2050-and-pledges-a-fairer-path-to-achieving-target-to-ease-the-financial-burden-on-british-families
25. NHS England (no date). *National ambition*. In: *Greener NHS* [web page] https://www.england.nhs.uk/greenernhs/national-ambition/
26. UKRI Net Zero Digital Research Infrastructure Scoping Project (2021) *UKRI Net Zero Digital Research Infrastructure Scoping Project* [web page]. https://net-zero-dri.ceda.ac.uk/
27. EAUC – The Alliance for Sustainability Leadership in Education (no date). *Race to Zero* [web page]. https://www.educationracetozero.org/
28. Wellcome Trust (2024). *Concordat for the Environmental Sustainability of Research and Innovation Practice*. https://wellcome.org/about-us/positions-and-statements/environmental-sustainability-concordat
29. Wellcome Trust (no date). *Environmental sustainability funding policy*. https://wellcome.org/research-funding/guidance/policies-grant-conditions/environmental-sustainability-funding-policy
30. Cancer Research UK (2024). *Policy on environmental sustainability of research*. https://www.cancerresearchuk.org/funding-for-researchers/applying-for-funding/policies-that-affect-your-grant/environmental-sustainability-in-research

While government funding bodies in the UK do not mandate environmental standards in research, they do produce resources and guidelines to support researchers and organisations to operate more sustainably. The NIHR, the largest funder of health and care research in the UK, has taken such steps through its Carbon Reduction Guidelines.[31] These provide a framework for identifying areas where research design can reduce waste without adversely affecting the validity and reliability of research. Meanwhile UKRI is developing a resource database (SPARKhub) that will provide researchers with tools, certification and guidance to design environmentally sustainable research and implement best practices in their projects.

At a regulatory level, the Health Research Authority (HRA) and the Medicine and Healthcare products Regulatory Agency (MHRA) have developed internal sustainability strategies and commitments.[32,33] However, at the time of writing, the environmental sustainability of health research is not covered in position statements and there is no evidence of regulators setting environmental requirements for health research but there is a commitment from the MHRA to engaging with interest groups such as the Sustainable Healthcare Coalition in reducing the negative impact.

Within the academic sector, many universities have adopted their own sustainability strategies and action plans, which focus on institutional goals and progress toward achieving net zero in terms of their impact and operations.[34,35] However, these plans do not always highlight sustainability in health research. Previous reports suggest action within institutions in the UK tends to be at the research group or individual researcher level and is linked to personal interest and motivations.[36,37] Often this is through laboratories signing up to accreditation schemes, such as LEAF, which was started by University College London, to help laboratories improve sustainability, efficiency and quality.[38] As at August 2025, more than 95 research institutions had signed up to LEAF globally.[39] Looking forward, as many universities receive support from non-government funders, it is possible that the emergence of policies such as those adopted by the Wellcome Trust and Cancer Research UK will encourage more coordinated action within academic institutions.

In the private sector, there is awareness among pharmaceutical companies of the environmental impact of research and development, predominantly clinical trials, as a result of global GHG emissions.[40] Many companies have introduced sustainability strategies and teams to implement them. AstraZeneca, as one example, has signed up to the My Green Lab initiative in the UK and globally to show its commitment to sustainability.[41] Many pharmaceutical and biotech companies in the UK also have internal sustainable procurement policies, although these are typically not mandated by industry or government policy.

At a community level, cross-sector groups and research networks have been established to collaborate, share knowledge, and build evidence on the topic, although mainly focusing on clinical trials. These include the Sustainable Healthcare Coalition,[42] the Laboratory Efficiency Action Network (LEAN)[43] and the MRC-NIHR TMRP Greener Trials Group.[44]

31. National Institute for Health and Care Research (2019). *NIHR carbon reduction guidelines*. https://www.nihr.ac.uk/about-us/what-we-do/key-initiatives/climate-health-sustainability/carbon-reduction-guidelines
32. NHS Health Research Authority (2024). *HRA environmental sustainability strategy – making environmental sustainability the norm*. https://www.hra.nhs.uk/about-us/governance/hra-environmental-sustainability-strategy-making-environmental-sustainability-the-norm/
33. Modern Humanities Research Association (no date). *Sustainability and the MHRA* [web page]. https://www.mhra.org.uk/about/sustainability
34. Universities UK (2024). *What can universities do after COP28?*. https://www.universitiesuk.ac.uk/latest/insights-and-analysis/what-can-universities-do-after-cop28
35. EAUC – The Alliance for Sustainability Leadership in Education (no date). *Race to Zero* [web page]. https://www.educationracetozero.org/
36. The Academy of Medical Sciences (2023). *Enabling greener biomedical research: FORUM workshop on Wednesday 15 March 2023*. https://acmedsci.ac.uk/file-download/61695123
37. Wellcome Trust (2023). *Advancing environmentally sustainable health research*. https://wellcome.org/reports/advancing-environmentally-sustainable-health-research
38. University College London (no date). *LEAF - Laboratory Efficiency Assessment Framework* [web page]. https://www.ucl.ac.uk/sustainable/take-action/staff-action/leaf-laboratory-efficiency-assessment-framework
39. *Ibid*.
40. Booth A, *et al*. (2023). *Pharmaceutical company targets and strategies to address climate change: content analysis of public reports from 20 pharmaceutical companies*. Int J Environ Res Public Health **20(4)**, 3206. https://pmc.ncbi.nlm.nih.gov/articles/PMC9967855/
41. The Academy of Medical Sciences (2023). *Enabling greener biomedical research: FORUM workshop on Wednesday 15 March 2023*. https://acmedsci.ac.uk/file-download/61695123
42. Sustainable Healthcare Coalition (no date). *Sustainable Healthcare Coalition* [web page]. https://shcoalition.org/
43. Laboratory Efficiency Action Network (no date). *About Lean* [web page]. https://www.lean-science.org/
44. Medical Research Council - Hubs for Trials Methodology Research (no date). *MRC-NIHR TMRP Greener Trials Working Group remit* [web page]. https://www.methodologyhubs.mrc.ac.uk/about/working-groups/trial-conductwg/tcwg-subgroup-greener-trials/

United States

In the US, there appears to be a more fragmented approach to environmentally sustainable health research. Action appears to be taken mainly at the grassroots and 'grass tops' level, with health research organisations, private organisations and individual researchers and research labs leading the way. There is little evidence of top-down action by funders, regulators or policymakers. Furthermore, while there is strong awareness of, and a movement toward, the decarbonisation of the healthcare system and sustainable healthcare in some quarters, few reports have been found which consider the issue.

At a national level, the US government has revoked its pledge to reach a net zero economy by 2050, by executive order. However, despite the US withdrawal from international agreements, a variety of legal constraints and economic factors may maintain movement toward net zero.[45]

Major government funding bodies for health research, including the NIH and the NSF, have developed their own internal sustainability implementation plans, covering sustainable supply chains and procurement, clean energy and waste reduction.[46,47] There is evidence of the NIH beginning to apply this approach to the research that they fund through the provision of guidance materials on green laboratories, which they host on their website,[48] as well as the incorporation of sustainability into some grant funding criteria.[49] However, this is not a standardise requirement, and it is unclear whether this approach has been fully implemented. Also, as noted above, federal administrative decisions in 2025 have reduced or redirected funding for research related to climate change, sustainable practices in health research, and other environmental initiatives.

From a regulatory perspective, bodies such as the Environmental Protection Agency and Food and Drug Administration (FDA) are exploring possible requirements for sustainable research practices, but no form of framework has been established.[50] Again, it is unclear how the federal administrative decisions of 2025 on climate research and related areas have affected progress among US regulators.

The private sector has taken some of the biggest steps in the US, with initiatives such as My Green Lab promoting sustainability certification for private research institutions in the US and across the world.[51,52] According to a 2024 report by My Green Lab, many large biotech and pharmaceutical companies are committed to the UN Race to Zero campaign, whereby organisations commit to science-based net zero targets. Furthermore, companies such as GSK, AstraZeneca, Pfizer, Moderna and Johnson & Johnson all have internal sustainable procurement policies to guide supply chain selection.[53] These policies are all voluntary, as there is no coordinated leadership or unified policy on sustainable procurement in the US.

Within academia, there is action at the institutional level, with some universities having their own sustainability plans and offices for sustainability. Some universities have specifically acknowledged the contribution of research labs to their carbon emissions, including Harvard University, which has published its own Sustainable Labs Guide and white papers on its progress.[54] US universities, including the University of Maryland School of Medicine and Emory University, have achieved Leadership in Energy and Environmental Design (LEED) Gold certification from the US Green Building Council.[55,56] Again, while there any many initiatives at the individual institution level, there is no form of coordinated approach to encourage universities to make their research more environmentally sustainable in the US.

As in the UK, the US has also seen the establishment of groups and networks set up to share knowledge and make progress toward decarbonisation of the health system. This includes the Institute for Sustainable Laboratories (2SL), and Future Earth, both of which are now global networks.

45. Yang TY (2025). *Climate realignment: the US shift and global implications*. The Lancet **405(10483)**, 972-973. https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(25)00320-4/fulltext
46. National Institutes of Health (2021). *2021 Sustainability Implementation Plan*. https://nems.nih.gov/Documents/NIH FY21 Sustainability Plan.pdf
47. National Science Foundation (2022). *Sustainability Report and Implementation Pla*n. https://www.sustainability.gov/pdfs/nsf-2022-sustainability-plan.pdf
48. National Institutes of Health (no date). *Sustainability at a glance* [web page]. https://nems.nih.gov/sustain/Pages/default.aspx
49. Kelesoglu N (2018). *The NIH has sustainability goals and considers laboratory efficiency to be an important part of grant application*s [blog post]. Labconscious. https://www.labconscious.com/blog/2018/11/8/nih-sustainability-betr-grants
50. US Food and Drug Association (2019). *Guidance document: adaptive design clinical trials for drugs and biologics guidance for industry* https://www.fda.gov/regulatory-information/search-fda-guidance-documents/adaptive-design-clinical-trials-drugs-and-biologics-guidance-industry
51. Seydel C. (2023). *Greening the lab*. Nat Methods **20**, 1449–1453. https://doi.org/10.1038/s41592-023-02024-5
52. My Green Lab (no date). *About us* [web page] https://www.mygreenlab.org/about.html
53. Booth A, *et al*. (2023). *Pharmaceutical company targets and strategies to address climate change: content analysis of public reports from 20 pharmaceutical companies*. Int J Environ Res Public Health **20(4)**, 3206. https://pmc.ncbi.nlm.nih.gov/articles/PMC9967855
54. Harvard Office for Sustainability (no date). *Sustainable labs* [web page]. https://sustainable.harvard.edu/schools-units/sustainable-labs/
55. Aziza J (2019). *University of Maryland research facility gains LEED Gold*. School Construction News, May 3. https://schoolconstructionnews.com/2019/05/03/university-of-maryland-research-facility-gains-leed-gold/
56. HOK (no date). *Emory University Health Sciences Research Building II Atlanta, Georgia* [web page]. https://www.hok.com/projects/view/emory-university-health-sciences-research-building-ii/

Values

In addition to the themes, the key messages, language and ideas explored in this report align with a set of values established by the authors in the early stages of their work.

These values were developed and are owned by the authors of this report and not the National Academies. They are seen as the guiding principles for the work behind the report, and are reflected and embedded in the policy recommendations made in the report. The values are the following:

1. **Health research can and should be made more sustainable to contribute to global development and to environmental and sustainability goals, as well as to serve its fundamental purpose of 'doing no harm' and improving health outcomes for all.**

2. **The primary purpose of health research must remain the improvement of human health and wellbeing and this should be supported and not adversely affected by efforts to reduce its environmental impacts.**

3. **Environmentally conscious values and sustainable research practices should be adopted by those working at all levels of the health research system. The greatest impact will only be achieved if everyone in the sector accepts joint ownership and responsibility for making health research more environmentally sustainable.**

4. **Stakeholders at all levels should communicate and share good practice in conducting research sustainably with fellow researchers and the public and, where possible, any barriers to sharing should be minimised or removed.**

5. **Decision-making on new initiatives within research institutions and by funders should be informed by dialogue with active researchers and institutions from a range of settings with different levels of capacity for sustainable research practice so that no one and no specific research area is left behind and initiatives and directives are co-created across the sector.**

6. **Flexibility within sustainability goals and practices should be encouraged to allow for contextual adaptations based on the socio-economic, cultural and environmental conditions of research settings.**

7. **Local researchers, policymakers and community representatives should all be involved in every stage of policy development to ensure its relevance and applicability.**

THEME 1: Data, metrics and information availability

Summary

This theme examines the use of data and metrics to quantify the environmental impacts of health research and offers recommendations for how these could be better used in the sector to catalyse more sustainable practice.

- There is limited quantification of environmental impacts in the sector, beyond measuring GHG emissions or carbon footprinting, reflecting the current limited demand for it from funders, regulators and governments.
- Quantification of emissions is important because the health research sector is a relatively large emitter, with impacts arising from both laboratory and clinical studies and rising impacts due to intensive computing use, including AI.
- The global health research sector lacks standardised tools for carbon footprinting.
- Quantifying the climate impacts of digital technologies, including AI, lags behind other health research activities.
- Current metrics and tools need ongoing refinement to improve accuracy, comparability and ease of use.
- Current carbon footprinting initiatives are labour intensive, limiting their scope.

Explainer of theme

Quantifying the environmental impact of health research is essential to enable researchers, institutions and funders to understand its environmental impacts and identify ways to improve sustainability.

Such quantification is particularly important in the health research sector as it has relatively high emissions, although these differ widely between projects. Carbon footprinting, which quantifies climate impact of health research activities as CO_2 equivalent units (CO_2e), whereby the emissions of other GHGs are converted into their CO_2 equivalents using factors based on their global warming potential, is currently the leading standardised metric within the sector and has been used to identify the substantial contribution of health research to climate change. As noted, a typical US life-science laboratory generates an estimated 20 metric tons of CO_2 per year and studies have found that the carbon footprint of clinical trials can vary from one metric ton of CO_2e associated with patients' travel to clinics in one case to 2,498 metric tons for a major pharmaceutical industry cardiovascular trial, roughly equivalent to six million miles driven in a gasoline-powered car.[57,58,59,60,61]

Key sources of emissions in health research include the intensive energy consumption of cold storage, transport in global supply chains and travel by researchers and patients.[62]

However, the carbon footprint of many research activities remains unmeasured and unknown and consistent measurement of emissions is needed to underpin action to reduce the impact.

57. Nathans J & Sterling P (2016). *Point of view: How scientists can reduce their carbon footprint*. eLife **5**, e15928. https://doi.org/10.7554/eLife.15928
58. You F, *et al.* (2025). *Carbon emissions associated with clinical trials: a scoping review.* Journal of Clinical Epidemiology **181**, 111733. https://doi.org/10.1016/j.jclinepi.2025.111733
59. Mackillop N, *et al.* (2023) *Carbon footprint of industry-sponsored late-stage clinical trials.* BMJ Open **13(8)**, e072491. https://pubmed.ncbi.nlm.nih.gov/37604634/
60. Griffiths J, *et al.* (2024) *Quantifying the carbon footprint of academic clinical trials: building the evidence base and hotspot identification.* Research Square. https://www.researchsquare.com/article/rs-4363597/v1
61. US Environmental Protection Agency (2024). *Greenhouse Gas Equivalencies Calculator.* https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator#results
62. Subaiya S, Hogg E & Roberts I (2011). *Trials* **12**, 31. https://trialsjournal.biomedcentral.com/articles/10.1186/1745-6215-12-31

Some progress has been made and studies have shown the potential for more. Indeed, recent analysis that has quantified the carbon footprint of clinical trials suggests that life cycle assessment of impacts can enable scientific aims to be achieved with a minimum of carbon emissions.[63,64] But such progress can only be made if the sector develops better tools to measure and quantify its emissions, with more sophisticated emission factors that provide accurate calculations of the emissions generated by the full range of research activities. This may require tools in addition to carbon footprinting to provide a complete picture and take into account other environmental impacts, from plastic waste to water consumption, which also need to be better measured and mitigated. Such tools then need to be accepted and adopted by the sector on a global level so that emissions can be measured and reported on a consistent basis as research organisations seek to lower them.

Context/state of play

The global context

Quantifying and reducing the climate impact of health research is part of a global effort across countries and industries that has been underway for decades and that was formalised in the 1990s with the founding of the UN Framework Convention on Climate Change (UNFCCC), now signed by 198 parties.[65] Throughout the process, data and measurement have been central to the drive to understand and limit emissions, with levels of emissions and goals expressed in numerical terms.

The Paris Agreement of 2015 set the goal of holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the increase to 1.5°C.[66] Based on analysis by the Intergovernmental Panel on Climate Change which assesses the science of climate change, the UN has stated that to keep global warming to no more than 1.5°C, emissions need to reach net zero emissions by 2050.[57] The UK and other countries have also adopted that target.

Climate change is being driven by the emission of GHGs from human activity. The Earth naturally emits and absorbs billions of metric tons of CO_2 every year, but human activity since the Industrial Revolution, and particularly since the late 20th century, has created a surplus of emissions (now approaching 60 billion metric tons per year) and disturbed the balance between the energy absorbed and the energy emitted by the Earth.[67]

This imbalance is termed radiative forcing (RF) and results in the average global temperature rising – as it has done by more than 1.3°C since pre-industrial times.[69]

The most abundant GHG is CO_2, which is released by fossil fuel use, deforestation, agriculture and other land use changes. Other GHGs include methane, nitrous oxide and fluorinated gases or F-gases.

In health research, CO_2 is the most prevalent GHG as it is emitted through the combustion of fuel for power, transport and heating. Some nitrous oxide is used as an anaesthetic and analgesic agent while some F-gases are present in laboratories in refrigerators, centrifuges, chemical analysers, sample preparation systems and elsewhere.[70,71]

63. Mackillop N, *et al*. (2023). *Carbon footprint of industry-sponsored late-stage clinical trials*. BMJ Open **13(8)**, e072491. https://pubmed.ncbi.nlm.nih.gov/37604634/; LaRoche JK, *et al*. (2025). *Climate footprint of industry-sponsored in-human clinical trials: life cycle assessments of clinical trials spanning multiple phases and disease areas*. BMJ Open. **15(2)**, e085364. https://pubmed.ncbi.nlm.nih.gov/39971605/
64. You F, *et al*. (2025). *Carbon emissions associated with clinical trials: a scoping review*. Journal of Clinical Epidemiology **181**, 111733. https://doi.org/10.1016/j.jclinepi.2025.111733
65. United Nations Climate Change (no date). *Parties to the United Nations Framework Convention on Climate Change* [web page]. https://unfccc.int/process/parties-non-party-stakeholders/parties-convention-and-observer-states
66. United Nations Climate Change (no date). *The Paris Agreement* [web page]. https://unfccc.int/process-and-meetings/the-paris-agreement
67. United Nations (no date). *Climate action* [web page].https://www.un.org/en/climatechange/net-zero-coalition
68. UNEP (2024). *Emissions Gap Report 2024: No more hot air … please! With a massive gap between rhetoric and reality, countries draft new climate commitments*. https://www.unep.org/resources/emissions-gap-report-2024
69. Department for Energy Security and Net Zero (2025). *Climate change explained*. https://www.gov.uk/guidance/climate-change-explained
70. Chakera A (2021). *Evidence-based policy report: reducing environmental emissions attributed to piped nitrous oxide products within NHS hospitals*. NHS Scotland. https://www.publications.scot.nhs.uk/files/piped-nitrous-oxide-products.pdf
71. MedTech Europe (2024). *MedTech Europe overview of Annex IV F-Gases uses in the EU fluorinated greenhouse gases regulation (EU) 2024/573 applying to medical technologies*. https://www.bivda.org.uk/Portals/0/documents/COVID/240906_MedTech%20Europe%20F-Gases%20Uses%20Annex%20IV_TRACK.pdf?ver=awPX7o8mKgqGiycuKlCGmg%3D%3D#:~:text=F%2DGases%20are%20used%20in,(EU)%202024/573.

Carbon footprinting

Organisations calculate and report their total emissions using carbon footprinting, sometimes referred to as carbon accounting or carbon reporting, which expresses their emissions using the CO_2e unit.

It is usually impossible to measure an organisation's actual emissions to the atmosphere and therefore various methods are used to estimate and calculate emissions, some based on physical assets and activities, others on spending or data provided by suppliers.[72]

Emission factors or carbon factors are used to calculate the emissions from a particular activity, such as energy usage, waste or transportation. These come from a range of sources. For example, the UK government publishes an annual set of factors for use by businesses in calculating and reporting their emissions.[73] The current factor for UK electricity usage, for example, is 0.177kg of CO_2e per kilowatt hour (kWh).[74]

Businesses and organisations use a range of tools and frameworks to report emissions. The 2001 GHG Protocol provides a framework for carbon accounting using CO_2e as the standard unit.[75] The GHG Protocol categorises GHG emissions into the following: scope 1, direct emissions; scope 2, indirect emissions from energy use; and scope 3, emissions from supply chains, product use, and investments – largely by suppliers and by customers.

97% of the 500 largest companies listed on US stock exchanges (S&P 500) reported on their environmental impact using the GHG Protocol in 2023[76] and it has also been adopted by UK and US healthcare systems and UK universities.[77,78,79]

The UK NHS has undertaken carbon accounting using the GHG Protocol since 1990 and uses the data to support cost-saving and sustainability initiatives, including modelling future carbon footprints that factor in the potential of new sustainability initiatives.[80] However, such reporting is largely limited to on-site scope 1 and 2 emissions, which are far exceeded by emissions due to less routinely quantified scope 3 activities.[81]

Many businesses report their emissions as part of the Carbon Disclosure Project, an independent global organisation that collects data using a standardised questionnaire.[82] Many large pharmaceutical companies disclose data via CDP, such as GSK, who say they use the feedback from CDP and other benchmarking reports *'to identify areas where we can further improve our performance'*.[83]

Sector emissions

As reported above, the health research sector has relatively high emissions. These emissions vary widely between different locations and projects. As well as a study showing that pharmaceutical business trials can have emissions as high as 2,500 metric tons, another analysis found that publicly funded trials can generate anything between 15 to 765 metric tons of carbon emissions per trial,[84] although higher figures have been reported for larger trials.

72. Bernoville T. (2024). *How to choose the best carbon accounting method for your company?* Plan A. https://plana.earth/academy/how-to-choose-best-carbon-accounting-method-company
73. Department for Energy Security and Net Zero and Department for Business, Energy & Industrial Strategy (2025). *Government conversion factors for company reporting of greenhouse gas emissions*. https://www.gov.uk/government/collections/government-conversion-factors-for-company-reporting
74. Colman M. (2025). *Carbon factors: A 2025 update.* Climate Essentials. https://www.climateessentials.com/articles/carbon-factors-a-2025-update
75. Greenhouse Gas Protocol (no date). *About us*. https://ghgprotocol.org/about-us
76. *Ibid*.
77. Ana A, *et al*. (2024). *Emissions disclosures and energy use reporting by hospitals in the United States* (NAM Perspectives. Discussion Paper). https://nam.edu/emissions-disclosures-and-energy-use-reporting-by-hospitals-in-the-united-states/
78. NHS England (2022). *Delivering a 'Net Zero' National Health Service*. https://www.england.nhs.uk/greenernhs/wp-content/uploads/sites/51/2022/07/B1728-delivering-a-net-zero-nhs-july-2022.pdf
79. Universities UK (2024). *What can universities do after COP28?* https://www.universitiesuk.ac.uk/latest/insights-and-analysis/what-can-universities-do-after-cop28
80. NHS England (2022). *Delivering a 'Net Zero' National Health Service*. https://www.england.nhs.uk/greenernhs/wp-content/uploads/sites/51/2022/07/B1728-delivering-a-net-zero-nhs-july-2022.pdf
81. Lenzen M, *et al*. (2020). *The environmental footprint of health care: a global assessment*. The Lancet Planetary Health **4**(7), e271-e279. https://www.thelancet.com/journals/lanplh/article/PIIS2542-5196(20)30121-2/fulltext
82. CDP (no date). Home page [web page]. https://www.cdp.net/en
83. GSK (2024). *Our position on environmental sustainability.* https://www.gsk.com/media/omzmvcnu/gsk-position-on-environmental-sustainability.pdf
84. Griffiths J, *et al*. (2024) *Quantifying the carbon footprint of academic clinical trials: building the evidence base and hotspot identification*. Research Square. https://www.researchsquare.com/article/rs-4363597/v1

Such studies have pinpointed key sources of emissions from trials. In terms of infrastructure, these include large laboratory equipment, including cold storage, as well as plastic waste.[85] Other studies identified 'carbon hotspots' that are responsible for 10% or more of the total carbon emissions from a trial. Many of these involve travel,[86] including commuting and air travel, transport of samples and supply chain transport.[87]

However, although the sector's impact is clearly significant, there are no standardised sector-specific tools, emission factors and methodologies health research organisations can use to routinely estimate or calculate the CO_2e levels of their activities. Some tools have been created and are used, but there is no global sector standard.

For advances to be made, consistent and standardised measurement of health research's environmental impact is needed, first to establish baseline emission levels and then to track efforts to reduce them.

Challenge 1: Lack of mandated carbon reporting

A primary reason for the lack of carbon quantification in health research has been the lack of pressure from governments, regulators and funders. Carbon accounting is not mandated for most health research institutions, unlike for some other types of organisations in the US and the UK.[88]

As a result, integrating environmental outcomes into clinical trial design, monitoring and reporting is uncommon.[89]

Recently, two major non-government health research funders in the UK, the Wellcome Trust and Cancer Research UK, have published policies that set out the expectation that organisations receiving funding will make their research environmentally sustainable.[90,91] Both funders' policies include requirements for emissions reporting but without specifying a particular model to follow.

Within a laboratory context, several accreditation programmes have been developed to recognise and encourage good practice, such as LEAF, a UK initiative led by University College London, and My Green Lab, a US non-profit organisation.[92,93] Both provide a hierarchy of accreditation (bronze, silver, gold) based on initial research practice and ongoing monitoring of improvements. Similar accreditation programmes for research involving clinical trials are less developed. To address this issue, the UK MRC-NIHR TMRP and the Enabling Lower Carbon Clinical Trials Project Group (CiCT) Project have developed standardised methods for mapping clinical trial activities, calculating emission factors, converting data into CO_2e levels and enabling researchers to carbon footprint their research.[94] There have also been independent efforts by AstraZeneca and other industry-led trial teams to quantify CO_2e.[95] Across the health research sector, current efforts focus on core trial activities but exclude key areas such as planning, funding, ethical and regulatory approvals, and laboratory sub-studies.[96] In the UK there is a move towards centralised certification and accreditation with the UKRI developing a resource database *(SPARKhub)*, providing researchers with tools, certification, and guidance to aid the design of environmentally sustainable research. This centralisation of resources will help to increase the capacity of researchers to consider environmental sustainability in both planning and undertaking their research activities (see Theme 6 of this report).

85. Subaiya S, Hogg E & Roberts I (2011). *Trials* **12**, 31. https://trialsjournal.biomedcentral.com/articles/10.1186/1745-6215-12-31
86. You F, *et al.* (2025). *Carbon emissions associated with clinical trials: a scoping review.* Journal of Clinical Epidemiology **181**, 111733. https://doi.org/10.1016/j.jclinepi.2025.111733
87. Griffiths J, *et al.* (2024) *Quantifying the carbon footprint of academic clinical trials: building the evidence base and hotspot identification.* Research Square. https://www.researchsquare.com/article/rs-4363597/v1
88. Department for Energy Security and Net Zero, Department for Environment, Food & Rural Affairs and Department for Business, Energy & Industrial Strategy (2019). *Environmental reporting guidelines: including streamlined energy and carbon reporting requirements.* https://www.gov.uk/government/publications/environmental-reporting-guidelines-including-mandatory-greenhouse-gas-emissions-reporting-guidance; Executive Order 14057 (EO 14057), EOP, 2021). https://www.fedcenter.gov/programs/eo14057/
89. Petersen JJ, *et al.* (2025). *Integrating environmental outcomes in randomised clinical trials: a call to action.* The Lancet 405(10477), 446-448. https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(24)02666-7/fulltext
90. Wellcome Trust (no date). *Environmental sustainability funding policy.* https://wellcome.org/research-funding/guidance/policies-grant-conditions/environmental-sustainability-funding-policy
91 Cancer Research UK (2024). *Policy on environmental sustainability of research.* https://www.cancerresearchuk.org/funding-for-researchers/applying-for-funding/policies-that-affect-your-grant/environmental-sustainability-in-research
92. University College London (no date). LEAF - *Laboratory Efficiency Assessment Framework* [web page]. https://www.ucl.ac.uk/sustainable/take-action/staff-action/leaf-laboratory-efficiency-assessment-framework
93. My Green Lab (no date). *About us* [web page] https://www.mygreenlab.org/about.html
94. Medical Research Council - Hubs for Trials Methodology Research (no date). *Enabling lower carbon clinical trials.* https://www.methodologyhubs.mrc.ac.uk/about/working-groups/trial-conductwg/tcwg-subgroup-greener-trials/enabling-lower-carbon-clinical-trials-cict-project
95. Mackillop N, et al. (2023). *Carbon footprint of industry-sponsored late-stage clinical trials.* BMJ Open **13(8)**, e072491. https://pubmed.ncbi.nlm.nih.gov/37604634/
96. Griffiths J, Fox L & Williamson PR (2024). *Quantifying the carbon footprint of clinical trials: guidance development and case studies.* BMJ Open **14**, e075755. https://bmjopen.bmj.com/content/14/1/e075755

Challenge 2: Lack of sector-specific tools to calculate emissions

As well as top-down strategic direction, progress also depends on having the right tools to undertake accurate carbon accounting. A report on a workshop co-hosted by the UK Academy of Medical Sciences, UK MRC and UK NIHR states: '*Decision-making can be hampered by the fact that the carbon impact of many research activities cannot be accurately quantified, making it difficult for researchers, purchasers, and funders to make comparisons, prioritise actions, or determine the impact of interventions.*'[97]

There are many obstacles to creating a dedicated toolbox for the health research sector. One is the bespoke nature of research projects, which makes standardised approaches difficult to implement. Metrics generated using different methods are often not comparable across research projects, institutions or countries.[98] Also, existing carbon footprinting tools have limitations and may not fully capture the broader environmental impacts of the sector, nor sufficiently motivate key stakeholders. Carbon footprinting of UK NHS activities is reliant on static financial assumptions and biased toward larger NHS facilities in England, with fewer insights from devolved NHS trusts in Scotland, Wales and Northern Ireland.[99] Top-down institution-wide carbon footprinting can also lack the granularity required to help research teams improve the sustainability of their operations.[100]

Serious efforts are now being made to overcome these hurdles. For example, the UK MRC-NIHR TMRP's programme for Greener Trials, launched in 2022, is providing guidance, tools and standardised methods to map clinical trial activities, calculate emission factors, convert data into CO_2e levels and enable researchers to carbon footprint their research.[101] Another tool is the Clinical Trial Carbon Calculator developed by the Sustainable Healthcare Coalition for pharmaceutical companies.[102] A report by RAND Europe identified 146 different tools and initiatives to help reduce the environmental impact of health research, including 25 measurement or efficiency tools. Integration of these tools for clinical trial research with existing tools for other types of research, including laboratory-based work and computationally intensive projects, is necessary to address the multi-disciplinary and interdisciplinary nature of health research. The methodology used needs to be extended to cover areas such as planning, funding, ethical and regulatory approvals, and laboratory sub-studies.[103] Costs from different procurement categories, mass of laboratory and computing equipment, and air miles for research-associated travel have all been suggested as more specific metrics to quantify day-to-day environmental impacts,[104] albeit these also suffer from a lack of standardised across the sector. While carbon footprinting provides valuable quantitative guidance for health research, more tangible metrics may be needed to justify public costs, engage new stakeholders, and motivate sustained commitment to reducing environmental impacts within and beyond the sector.

At the US National Academy of Medicine Climate Grand Challenge in April 2024, World Health Organization (WHO) special envoy Vanessa Kerry stressed the need to quantify the human impact of climate change: '*The health of humans, animals, our environment, our oceans are deeply intertwined, and all are imperilled.*' She said that progress on climate change should be tracked in terms of lives and livelihoods saved.[105]

Next steps need to include seeking to make such tools globally applicable, and working toward a global standard methodology for calculating emissions. Existing carbon calculators rely on the quality of available CO_2e data, which can vary by country, subject area and research institution. These tools need to be

97. Kelly FJ (2023). *How can we reduce biomedical research's carbon footprint?* PLoS Biol. **21(11)**, e3002363. https://pmc.ncbi.nlm.nih.gov/articles/PMC10642775/
98. Mariette J., *et al.* (2022). *An open-source tool to assess the carbon footprint of research.* Environmental Research: Infrastructure and Sustainability **2(3)**, 035008. https://iopscience.iop.org/article/10.1088/2634-4505/ac84a4
99. NHS England (2022). *Delivering a 'Net Zero' National Health Service.* https://www.england.nhs.uk/greenernhs/wp-content/uploads/sites/51/2022/07/B1728-delivering-a-net-zero-nhs-july-2022.pdf
100. Eckelman MJ, *et al.* (2024). *Guiding principles for the next generation of health-care sustainability metrics.* The Lancet Planetary Health **8(8)**, e603-e609. https://www.thelancet.com/journals/lanplh/article/PIIS2542-5196(24)00159-1/fulltext
101. Medical Research Council - Hubs for Trials Methodology Research (no date). *Enabling lower carbon clinical trials.* https://www.methodologyhubs.mrc.ac.uk/about/working-groups/trial-conductwg/tcwg-subgroup-greener-trials/enabling-lower-carbon-clinical-trials-cict-project
102. Clinical Trial Carbon Calculator (no date) *Clinical Trial Carbon Calculator.* https://clinicaltrialcarbon.org/
103. Griffiths J, Fox L & Williamson PR (2024). Quantifying the carbon footprint of clinical trials: guidance development and case studies. BMJ Open 14, e075755. https://bmjopen.bmj.com/content/14/1/e075755
104. Eckelman MJ, et al. (2024). *Guiding principles for the next generation of health-care sustainability metrics.* The Lancet Planetary Health **8(8)**, e603-e609. https://www.thelancet.com/journals/lanplh/article/PIIS2542-5196(24)00159-1/fulltext
105. Kerry V (2024). *Dr Vanessa Kerry's keynote speech at the launch of the Ocean Panel blue paper.* Seed Global Health. https://seedglobalhealth.org/2024/04/17/dr-vanessa-kerrys-keynote-speech-at-the-launch-of-the-ocean-panel-blue-paper/

refined and to integrate up-to-date, locally relevant conversion factors – for example, those that reflect the proportions of renewable energy within national and regional electricity mixes. Expanding the scope of carbon calculators to include greater breadth of activities, including scope 3 emissions for carbon accounting, would further support comparison across disparate health research sectors.

Challenge 3: Complexity of footprinting digital technologies and energy-intensive computing
A particular challenge for health and other researchers in calculating their environmental impact is the difficulty of measuring the footprints of intensive computer use. Digital platforms such as HPC and innovations driven by AI are a core part of health research and their use is rapidly expanding. In many ways, this development can be positive for the environment. Digital tools have enormous potential to reduce the environmental impact of health research through, for example, online communication platforms that reduce the need for research-related travel. Machine learning- and AI-based tools can increase the efficiency of data collection, prediction modelling, and integration into open access databases to support new in silico (computer-based) experiments on existing data, such as Alphafold, an AI tool for predicting protein structure.[106,107]

However, while these benefits are widely recognised, the environmental impact of using digital tools is only beginning to be appreciated. This is partly because the bulk of the environmental impacts of computational research occur off-site, such as in data centres and networks, which can make them less tangible compared to on-site activities. Global data centre workloads increased sixfold between 2010 and 2018.[108] AI use is of particular concern due to high energy consumption in the model training process,[109] raw material use, electronic waste, and water required for cooling data centres.[110] For example, a ChatGPT query uses 10 times the electricity of a Google search, with even higher demands for AI image-generation tools. Only 16% of UK respondents knew that using ChatGPT had an impact on the environment, highlighting the lack of awareness in this area.[111]

The carbon footprint of data storage for health research is also substantial, with estimates suggesting that storage of one terabyte of data generates around 10kg CO_2e/year, with most clinical trials requiring study data to be stored for decades.[112] While data storage has a significant carbon footprint, it can be limited through proper curation, easy retrieval and open access. This may negate the need for future studies if the data required to answer a question can be extracted from pre-existing sources, reducing the environmental impact. Consequently, incentives should be put in place to format stored data such that it can be easily accessed and searched by external researchers.

Given the mix of benefits and burdens, the net effect of the increasing use of computational research is hard to predict. Experts point out that the efficiency benefit of implementing AI-based approaches may also generate a 'rebound effect' whereby the research intensity – and therefore the carbon intensity – of health research could increase in line with wider adoption of such tools.

There is therefore an urgent need for evaluations of computational tools and data storage in health research to consider both their research benefits and their environmental impacts. In practical terms, there are also emerging solutions to reduce the environmental impact of advanced computing, including energy-efficient servers, high-performance parallel processors, graphics processing units (GPUs) and 'green algorithms', as covered in Theme 5 on infrastructure. These need to be supported as they could have a decisive effect as 'big data' processing in health research accelerates.

106. Kale AU (2024). *AI as a medical device adverse event reporting in regulatory databases: protocol for a systematic review.* JMIR Res Protoc. **13**, e48156 https://pubmed.ncbi.nlm.nih.gov/38990628/
107. EMBL-EBI (no date). *AlphaFold Protein Structure Database* [web page]. https://alphafold.ebi.ac.uk/
108. Lannelongue L., *et al.* (2023). *GREENER principles for environmentally sustainable computational science.* Nat Comput Sci **3**, 514–521 (2023). https://doi.org/10.1038/s43588-023-00461-y
109. Vincent J (2024). *How much electricity does AI consume?* The Verge, February 16. https://www.theverge.com/24066646/ai-electricity-energy-watts-generative-consumption
110. UNEP (2024). *AI has an environmental problem. Here's what the world can do about that.* https://www.unep.org/news-and-stories/story/ai-has-environmental-problem-heres-what-world-can-do-about
111. The Institution of Engineering and Technology (2024). *Simplistic searches on Large Language Models bad for the environment* [press release, November 29]. https://www.theiet.org/media/press-releases/press-releases-2024/press-releases-2024-october-december/29-november-2024-simplistic-searches-on-large-language-models-bad-for-the-environment
112. Lannelongue L., *et al.* (2023). *GREENER principles for environmentally sustainable computational science.* Nat Comput Sci **3**, 514–521 (2023). https://doi.org/10.1038/s43588-023-00461-y

International policies recognise the need for more sustainable AI practice: UNESCO's 2021 ethics recommendations for AI emphasise balancing innovation with environmental responsibility,[113] and both US and EU policies now include recommendations for mitigating AI's environmental effects.[114] Research-led initiatives are also developing context-relevant recommendations for sustainable computational and AI practices within health research.[115] Examples include the GREENER principles for sustainable computational science,[116] IET's best practice tips for LLM use, Massachusetts Institute of Technology's (MIT's) recommendations for reducing the carbon footprint of neuroimaging computing,[118] and Green DiSC accreditation for computational research.[119,120]

Challenge 4: Insufficient capacity

Even with greater pressure to implement measurement and better tools across all areas of health research, many organisations will remain hard-pressed to fulfil the task as quantifying the carbon footprint of research can be time-consuming, requiring tailored calculations for each study. Any drive for more reporting also needs to be aligned with the trend toward reducing bureaucracy in research on both sides of the Atlantic, with a government-commissioned report in the UK and the Federation of American Scientists saying researchers spend half their time on administration and calling for reform[121] (see Theme 2 for more detail).

If carbon accounting methods are going to be adopted they therefore need to be as smart, automated and light-touch as possible, using technology to enable researchers to make accurate calculations rapidly. Currently, many of the tools available are only applicable in specific and limited contexts, making it difficult for researchers to select the correct calculator or tool to calculate environmental impact. A variety of carbon calculators already exist for specific activities within health research, including the London School of Hygiene and Tropical Medicine's SCIF calculator for business travel, the Sustainable Healthcare Coalition calculator for clinical trials, the Green Algorithms calculator for computational research and GES 1point5, an open source web application based on French national CO_2e data that is designed to generate consistent metrics for international comparison.[122]

Research funders can also help organisations struggling to cope with footprinting by offering some funding to support improved calculation, monitoring and reduction of carbon emissions. Examples include UK NIHR commitments to climate, health and sustainability, 2024-2026; UK Wellcome's funding restructure in 2020; and the US Environmental Protection Agency Sustainability grants.[123]

Training will also be important to enable carbon footprinting to be carried out efficiently. (The training and capacity building of researchers and organisations in sustainability topics is covered in Theme 6 of this report.)

113. UNESCO (2021). *Recommendation on the ethics of artificial intelligence*. https://unesdoc.unesco.org/ark:/48223/pf0000380455/PDF/380455eng.pdf.multi
114. European Parliament (2024). *European Parliament legislative resolution of 13 March 2024 on the proposal for a regulation of the European Parliament and of the Council on laying down harmonised rules on Artificial Intelligence (Artificial Intelligence Act) and amending certain Union Legislative Acts (COM(2021)0206 – C9-0146/2021 – 2021/0106(COD)*. https://www.europarl.europa.eu/doceo/document/TA-9-2024-0138_EN.html; US Congress (2024). S.3732 - Artificial Intelligence Environmental Impacts Act of 2024. https://www.congress.gov/bill/118th-congress/senate-bill/3732/text
115. National Institutes of Health (2025). *Artificial intelligence in research: policy considerations and guidance*. https://osp.od.nih.gov/policies/artificial-intelligence#tab0/
116. Lannelongue L., *et al*. (2023). Fig. *1: GREENER principles for ESCS. In: GREENER principles for environmentally sustainable computational science*. Nat Comput Sci **3**, 514–521. https://www.nature.com/articles/s43588-023-00461-y/figures/1
117. The Institution of Engineering and Technology (2024). *Simplistic searches on Large Language Models bad for the environment* [press release, November 29]. https://www.theiet.org/media/press-releases/press-releases-2024/press-releases-2024-october-december/29-november-2024-simplistic-searches-on-large-language-models-bad-for-the-environment
118. Souter NE, *et al*. (2023). *Ten recommendations for reducing the carbon footprint of research computing in human neuroimaging*. Imaging Neuroscience **1**, imag–1–00043. https://direct.mit.edu/imag/article/doi/10.1162/imag_a_00043/118246/Ten-recommendations-for-reducing-the-carbon
119. Software Sustainability Institute (no date). *Green DiSC: a digital sustainability certification*. https://www.software.ac.uk/GreenDiSC
120. Software Sustainability Institute (no date). Green Disc Criteria Page. https://www.software.ac.uk/GDC090724
121 Zanini M (2025). *Measuring research bureaucracy to boost scientific efficiency and innovation*. Federation of American Scientists, July 7. https://fas.org/publication/measuring-research-bureaucracy/
122. Mariette J., *et al*. (2022). *An open-source tool to assess the carbon footprint of research*. Environmental Research: Infrastructure and Sustainability **2(3)**, 035008. https://iopscience.iop.org/article/10.1088/2634-4505/ac84a4
123. US Environmental Protection Agency (no date). *Sustainability research grants* [web page]. https://www.epa.gov/research-grants/sustainability-research-grants

Potential unintended consequences of expanding data and metric use

- Over-emphasising carbon footprint quantification could detract from allocating time and effort to implementing known sustainable research practices.
- Too great an emphasis on carbon footprinting could even shift priorities so that the direction of research is decided on the basis of emissions rather than scientific merit. It is important to retain perspective and ensure a proper balance is maintained between human health and sustainability.
- Rapidly evolving climate metric mandates from research institutions and funders have the potential to overburden researchers.
- Carbon footprinting could lead to funding imbalances whereby climate metrics are used for competitive assessment of grant applications, disadvantaging health researchers who are not already conversant with sustainability issues and organisations where relevant capacity and infrastructure are not well developed.
- Variations in national energy systems may disincentivise sustainable practices, fostering complacency where national/organisational footprints are comparatively low or disenfranchisement where national/organisational footprints are comparatively high.
- In the absence of equitable access to tools and metrics and training among researchers, disparities may develop in achieving sustainable health research goals across the sector. It may also be possible for researchers to optimise their work for easily measurable carbon metrics while ignoring harder-to-quantify but potentially more significant environmental impacts, thereby 'gaming the system'.

Solutions and recommendations

Recommendation 1: Utilise existing carbon footprint data to promote sustainable health research practices

a) **Make national and institutional carbon footprint data on health research accessible:** National health research bodies, funders and institutions should share their carbon footprint data, and should work toward this data being collected using standardised methods and shared on open access, centralised online platforms.

b) **Incorporate environmental impact metrics into health and related research curricula:** Health research educators should include data on the environmental impact of research activities in their teaching materials to raise awareness among health research trainees. Education and training on sustainable research, including environmental impact metrics, should be provided in all programmes that contain a research element, from undergraduate level upward. See Theme 6 on capacity building.

c) **Include an introduction to environmental impact metrics in staff and student inductions:** Research group leaders should present data on the environmental impact of research activities and highlight known context-relevant 'carbon hotspots' to new staff and students. See Theme 6 on capacity building.

d) **Adapt environmental impact data and metrics for optimal communication with policymakers and the public:** Health research communications teams should tailor metrics on the environmental impact of research activities to motivate stakeholders, considering both health and economic impacts alongside CO_2e.

e) **Review the use of digital tools, data storage and accessibility of research data:** The sector should maximise the use of data that is already collected and, where suitable pre-existing data exists, refrain from further data collection. It should also consider the useful lifetime of data in storage so that data is not stored unnecessarily.

Recommendation 2: Encourage carbon footprint consideration throughout health research projects

a) **Commit to carbon footprinting:** Research institutions should measure and monitor their carbon footprints, using CO_2e as the current gold standard metric.

b) **Provide equitable training to researchers on quantifying carbon footprints:** National health research bodies, funders and institutions should offer training on quantifying carbon footprints to enable equitable uptake, leveraging existing toolkits to support standardisation of methods across the health research sector. Training resources and existing toolkits should be shared and centralised to allow for frequent updates and to avoid duplication of effort. See Theme 6 on capacity building.

c) **Carbon footprint plans should become a component of health research assessment:** Funders and review boards should ask applicants to outline how they will monitor and minimise their research's carbon footprint, and should provide guidance and feedback in this area. Such requirements should be phased in gradually, with initial requirements limited to demonstrating that sustainable practice has been considered in project planning, building toward integrating carbon footprinting of planned research as capacity builds within the sector. Such changes should be introduced in consultation with health researchers to ensure that the pace of change does not outstrip capacity in the field. See Theme 2 on funding.

d) **Encourage the inclusion of carbon footprint data and sustainable research methods in health research publications:** Research publishers should ask for the inclusion of carbon footprint data (if available) and any practices employed to reduce the carbon footprint during implementation in the 'materials and methods' section of health research studies being submitted for publication.

e) **Include digital technologies and data storage in carbon footprinting exercises for health research:** Health research institutes and teams should broaden the scope of their current carbon footprinting exercises to include CO_2e generated by digital and computational technologies and their associated off-site emissions, particularly where such activities are identified as 'carbon hotspots'.

f) **Integrate environmental footprint assessment into institutional review board (IRB) processes:** IRBs should require researchers to assess their study's environmental impact –covering emissions, energy use, travel, resources, and data storage – and propose mitigation strategies. This should be reviewed alongside ethical and scientific considerations to ensure that environmental sustainability is part of responsible research conduct.

Recommendation 3: Expand support for carbon calculators and other quantitative tools applicable for sharing across health research contexts

a) **Develop funds and funding schemes to support accessible carbon footprinting tools:** Research funders should finance easy-to-use open access tools to quantify the environmental impact of health research activities.

b) **Share the data needed for carbon calculations:** Research institutions should collate and share up-to-date data for calculating carbon footprints and support the identification of 'carbon hotspots'. Ideally, data of this type should be held centrally so that it is easy to find and use.

c) **Support local and international collaborative efforts to standardise tools and carbon calculators:** Institutions and funders in the US, UK and beyond should encourage collaboration between health researchers to develop standardised quantitative tools, and should leverage support from specialists outside the health research sector where relevant.

d) **Promote the adaptability of quantitative tools for interdisciplinary, national and international contexts:** Health researchers should, where possible, make their tools open source and adaptable for use across different contexts, such as countries and research disciplines, as well as responsive to changes in policies or energy profiles.

THEME 2: Funding

Summary

This theme examines the current state of approaches by health research funders to addressing sustainability in health research, the challenges faced and the opportunities for improvement at the individual, institutional and funder levels.

- Health research funders can play a crucial role in driving sustainability in research organisations by setting priorities that include environmental factors and encouraging capacity building to address knowledge gaps.
- In the UK, health research funders have led the way, first by issuing position statements and commitments to improving the environmentally sustainability of health research, and second by starting to mandate good practice through the inclusion of environmentally sustainability criteria in funding applications. However, there remains a lack of sector-wide policies and standard guidance among funders in the UK and US.
- Health research funders need to work together to develop minimum standard guidance, funding assessment criteria and monitoring frameworks, as well as fostering and incentivising environmentally sustainable research practice across the health research sector.

Explainer of theme

Funding is a crucial influence on sustainability practices within health research as funders shape the priorities, feasibility and sustainability of health research. Funders set the agenda by determining which studies and projects receive funding. In addition, they have considerable latitude in determining how research is conducted in terms of how studies are structured, implemented and evaluated. Working together, funders and researchers have the potential to integrate environmental sustainability standards, capacity-building investments, and interdisciplinary collaborations that drive long-term impact. The role of funders therefore extends beyond financial support. In practical terms, they have the power to establish incentives, set or influence accreditation standards and ensure that sustainability is embedded in research practices. Without their buy-in, efforts to align health research with sustainability goals will remain fragmented, under-resourced and inequitable.

Context/state of play

Research funders play a role in driving sustainability by setting research priorities and identifying critical knowledge gaps and then directing funding toward organisations that assimilate these challenges and priorities in their research. Funders can also incentivise sustainable research practices, invest in training opportunities for researchers and coordinate the development of tools and resources.

In the UK, the research and innovation sector has developed a series of environmental commitments entitled the Concordat for the Environmental Sustainability of Research and Innovation Practice, which members of the research community can sign up to on a voluntary basis. This aims to ensure that the UK continues to deliver cutting-edge research but does so in a more environmentally responsible and sustainable way. More than 80 major UK funders, universities and other research organisations have signed the concordat, committing to work individually and collectively to ensure that the future design and practice of UK research and innovation is environmentally sustainable.

Individual funders and organisations are also developing guidelines and position statements on green practices within health research. As noted earlier, two UK-based funders, the Wellcome Trust and Cancer Research UK, have introduced environmental sustainability funding policies and position statements.[124]

Wellcome has set out expectations of the researchers and organisations it funds, requiring them to measure the environmental impact of their research, design their research in a sustainable way and embed sustainable research practices in their work. For example, all laboratory-based research must have a minimum level of accreditation offered by LEAF, My Green Lab or an equivalent by the end of 2025.[125] Cancer Research UK has outlined similar requirements for individual applicants and host institutions, as well as providing costing guidance that, for example, includes as an allowable cost 'Sustainable versions of materials and consumables, even if they are more expensive to purchase or dispose of'.[126]

In the US, prior to 2025, similar efforts were emerging in various funding streams at the federal level, such as those from the US Environmental Protection Agency,[127] the NIH,[128] and the NSF. Similar efforts are being made by non-profit and foundation agencies.[129] The NIH has its own internal sustainability strategy and Green Labs Program[130] to guide best practice in sustainability in laboratories and there was evidence in 2018 of sustainability being incorporated into grant assessment criteria.[131] However, there is no evidence of broader mandates among US health research funders to improve the sustainability of health research, or of a unified, national voluntary framework akin to the UK concordat described above. In addition, as mentioned above, federal administrative decisions in 2025 have reduced or redirected funding for research on climate change and related areas.

As mentioned in the introduction, in Europe, representatives from European funding agencies, research organisations, and nine different European countries have collaborated on the development of a multi-stakeholder alignment agreement, the Heidelberg Agreement, published in 2024. The Agreement calls for funders in Europe and beyond to set ambitious sustainability goals; share principles for approaching sustainability in research funding based on innovation, experimentation, partnership, diversity and co-creation; highlight the importance of sustainability in their schemes; and support the development and adoption of tools that help researchers to integrate sustainability into their work. Beyond this, international collaboration between funders is limited.

Currently, there is also limited international collaboration in sustainability in health research due to long-established barriers such as issues arising from national sovereignty and policy differences, funding and resource disparities, intellectual property and data sharing restrictions, ethical and regulatory incompatibilities and a lack of global governance in the field. Current geopolitical tensions and instabilities include the impacts of Brexit, changes of government in the UK and US, legacy global economic instability in the wake of the 2008 economic crisis, the ongoing impact of the COVID-19 pandemic, and global conflicts. These are adding further challenges for national funders who deliver research funding programmes using government funds and therefore need to align their priorities with those of the government of the day.[132] Despite these challenges affecting various stakeholders, progress toward achieving sustainability goals can still be made in the sector if willing funders and researchers enhance international research collaborations, cross-sector working and the sharing of data and best practice. There is also awareness among many funders that this is a new area for the health research funder community and that solutions should be co-created by funders and grant applicants to ensure buy-in and successful implementation.

124. University of Oxford (no date). *Concordat for the environmental sustainability of Health Research*. https://researchsupport.admin.ox.ac.uk/article/concordat-for-the-environmental-sustainability-of-research-and-innovation-practice
125. Wellcome Trust (no date). *Environmental sustainability funding policy.* https://wellcome.org/research-funding/guidance/policies-grant-conditions/environmental-sustainability-funding-policy
126. Cancer Research UK (2024). *Policy on environmental sustainability of research.* https://www.cancerresearchuk.org/funding-for-researchers/applying-for-funding/policies-that-affect-your-grant/environmental-sustainability-in-research
127. US Environmental Protection Agency (2014). *Getting to green: paying for green infrastructure – financing options and resources for local decision-makers.* https://www.epa.gov/sites/default/files/2015-02/documents/gi_financing_options_12-2014_4.pdf
128. National Institute of Environmental Health Sciences (2025). *NIEHS funding strategies* [web page]. https://www.niehs.nih.gov/grants-and-contracts/about/strategies#:~:text=Fiscal%20Year%202024,Superfund%20and%20Worker%20Training%20Programs
129. Bezos Earth Fund (no date). Home page. https://www.bezosearthfund.org/
130. National Institutes of Health (no date). *NIH Green Labs Program.* https://nems.nih.gov/green-teams/Pages/NIH-Green-Labs-Program.aspx
131. Kelesoglu N (2018). *The NIH has sustainability goals and considers laboratory efficiency to be an important part of grant applications* [blog post]. Labconscious. https://www.labconscious.com/blog/2018/11/8/nih-sustainability-betr-grants
132. Koslov M (2025). *Exclusive: documents reveal how NIH will axe climate studies.* Nature, May 8. https://www.nature.com/articles/d41586-025-01423-2

Key findings

As well as playing a key role by shaping funding priorities, controlling which organisations receive funding, and setting evaluation standards, funders can also facilitate the sharing of knowledge and best practice among researchers and organisations.

However, despite increasing evidence of some funders recognising their role in sustainable research, particularly within the UK context, there is a lack of sector-wide policies and an aligned approach, especially for research that does not take place in a laboratory setting.[133] The time and understanding required to integrate environmental assessments into grant applications forms a further barrier to the uptake of funds that require them. In the UK the effort to embed sustainability into health research has to be reconciled with a movement to reduce bureaucracy in research. For example, an independent review commissioned by the UK government in 2022 aimed to free researchers from 'unnecessary paperwork, arduous funding applications and research selection processes'.[134] The additional administrative burden for researchers was also cited by Members of the European Parliament (MEPs) who objected to the European Commission's recommendation that applicants for Horizon Europe, the EU's key funding programme for research and innovation, must prove that their research will not harm biodiversity and the climate.[135]

A Royal Society of Chemistry report into sustainable laboratories referred to both direct and indirect financial costs as barriers to sustainability-related changes in research. It said that sustainability-related changes may be unaffordable in small and medium-sized enterprises (SMEs) or resource-limited universities. This barrier exists across scales: from the costs of purchasing consumables and chemicals to longer-term investments in instruments, laboratory retrofits, buildings, facilities and training of staff.[136] However, as the UN noted in a landmark report in 2011, while environmentally sustainable practices may require upfront investments, they often lead to long-term cost savings through improved resource efficiency and reduced waste management expenses.[137] Perceptive funders are aware of this and can strategically allocate financial resources to support research that prioritises sustainability, incentivising best practices and ensuring sustainability becomes an integral part of funding schemes.

Furthermore, funders can foster capacity building in research by encouraging researchers to incorporate sustainability education into their teams and by supporting organisations that prioritises such capacity building. There is emerging evidence of UK government funders taking on this role, with UKRI currently developing a centralised and free to use resource platform and the NIHR providing carbon reduction guidance for researchers. Capacity building among researchers is further explored in Theme 6 of this report.

To gain buy-in and make progress, funders need to work with researchers and research organisations to agree standard requirements for environmentally sustainable research. Funders have the power to convene researchers, research organisations, and other relevant stakeholders to develop multi-stakeholder alignment on sustainability initiatives. Most importantly, for the system to work, funders need to agree on both national and international standards where collaborative funding schemes are in place.

133. Smith P, *et al.* (2025). *Advancing environmentally sustainable health research.* RAND Europe for the Wellcome Trust. https://cms.wellcome.org/sites/default/files/2023-08/Research_Sustainability_Report_RAND_Europe_August_2023.pdf
134. Department for Science, Innovation and Technology, UK Research and Innovation and Department for Business, Energy & Industrial Strategy (2021). *Review of research bureaucracy.* https://www.gov.uk/government/publications/review-of-research-bureaucracy
135. Naujokaitytė G. (2021). *MEPs decry inclusion of 'do no significant harm' principle in Horizon Europe.* Science | Business, September 23. https://sciencebusiness.net/news/horizon-europe/meps-decry-inclusion-do-no-significant-harm-principle-horizon-europe
136. Royal Society of Chemistry (2022). *Sustainable laboratories: a community-wide movement toward sustainable laboratory practices.* https://www.rsc.org/globalassets/22-new-perspectives/sustainability/sustainable-labs/sustainable-laboratories-report.pdf
137. UNEP (2011). *Towards a green economy: pathways to sustainable development and poverty eradication.* https://sustainabledevelopment.un.org/content/documents/126GER_synthesis_en.pdf

Unintended consequences and considerations

- Increased administrative burdens: In a complex sector it is possible that requirements from funders for sustainability in health research could increase the administrative burden for researchers and organisations.
- Increased financial pressures in low-resource settings: It may not be feasible for all potential applicants to reach the minimum levels of sustainability mandated by funding agencies. This could lead to a two-tier research system where only well-resourced institutions are able to meet sustainability requirements, exacerbating existing inequalities.
- Reduction in funds available directly for research: if additional funding for environmental sustainability is required, this could reduce funding for health research. Funding panels will need to balance ambitions to move toward net zero with the research priorities set by government (for national funders) or by the public (for charitable funders).
- Research with a potentially high and positive impact on health may not be funded if it is seen to have detrimental environmental impacts. Care must be taken not to exclude or underfund research that may have a relatively high short-term environmental impact but that offers significant long-term health – or indeed environmental – benefits. For example, the development of a pharmaceutical intervention that reduces the need for resource-intensive treatments or hospitalisations could ultimately result in a net positive environmental impact as well as a beneficial health outcome.
- Greenwashing incentives: Applications might include superficial sustainability claims without meaningful implementation.
- Innovation paralysis: An overly cautious approach to sustainability requirements could slow breakthrough health research.

Solutions and recommendations

Recommendation 1: Strengthen environmental sustainability standards in health research	
	a) **Set minimum aligned levels of accreditation:** Health research funders should move toward identifying and articulating minimum levels of accreditation that researchers and institutions should work toward to meet sustainability compliance. Domestically, health research funders should align their approaches by all asking for the same set of minimum standards.
	b) **Collaboratively develop minimum standard guidance:** Health research funders should collaborate with researchers and research organisations to develop minimum standard guidance that enables researchers to pursue environmental sustainability, bearing in mind possible unintended consequences for researchers and the health research community.
	c) **Include environmental impact assessments in grant applications:** Health research funders should consider including an environmental impact assessment in grant applications, as some already do, requiring researchers to outline their mitigation strategies for adverse environmental impacts. Additional bureaucracy in applications should be minimised and funders should commit to supporting applicants in providing a sustainability assessment, particularly researchers in lower-resource settings. To help minimise bureaucracy, funders should consider at which stage of a grant funding application to request any environmental impact and sustainability information.
	d) **Adapt environmental impact data and metrics for optimal communication with policymakers and the public:** Health research communications teams should tailor metrics on the environmental impact of research activities to motivate stakeholders, considering both health and economic impacts alongside CO_2e.

e) **Incentivise sustainable practices:** Health research funders should incentivise sustainable research practices by providing additional funding for incorporating sustainability assessments in grant applications. They could also permit a proportion of the grant funding to be used for training in sustainability or to actively reduce the environmental impact of a project. Incentives and recognition hould be provided to researchers for sharing environmental impact data collected for their work. For clinical research, these incentives could focus on the 'carbon hotspots', as identified earlier in the report. See Theme 1 on data.

f) **Set clear and realistic goals and establish shared principles between funders and research organisations:** Health research funders should work with researchers, research organisations and stakeholders to co-create clear and realistic sustainability goals and to share principles for approaching sustainability in research funding based on innovation, experimentation, partnership, co-creation and representation of broad perspectives.

g) **Promote transparency, accountability and measurable impacts:** Health research funders should promote the use of clear metrics and evaluation frameworks to track the environmental impact of funded projects. Health research funders should also encourage the dissemination of sustainable research practice knowledge that is generated by their funding recipients. While this can be communicated in academic journals, efforts should be made to ensure the information is freely available and accessible to all.

h) **Recognise and mitigate the impact of including environmental impact assessments on researchers in low-resource settings:** Health research funders should provide additional resources for smaller-scale settings and offer support that can be accessed centrally.

Recommendation 2: Foster sustainability education and capacity building in research

a) **Competitively recognise progress**: Progress toward sustainability among applicants should be assessed competitively by health research funders, using existing practices. This should cover carbon footprinting and energy consumption.

b) **Integrate sustainability education:** Health research funders should encourage senior researchers to integrate sustainability education into their teams, for example by outlining training plans in their grant applications and mentoring future researchers on best practices for reducing environmental impact.

c) **Highlight and actively promote sustainability and the development of tools:** Health research funders should publicly highlight the importance of sustainability in their funding programmes and support the development of tools that help researchers integrate sustainability into their work.

d) **Explore novel funding schemes:** Health research funders should explore novel funding structures to support projects that emphasise environmental sustainability and capacity building within the research sector. This should include projects that develop resources to assess, manage and train staff on the tools needed for understanding sustainability (see recommendation 3a in Theme 1).

e) **Promote the use of sustainable resources and approaches such as circular economy principles and life cycle costing:**[138] Health research funders can encourage researchers to reduce the environmental impact of their research by promoting the use of sustainable resources, minimising waste, and adopting environmentally friendly practices. This includes the use of circular economy principles in research and innovation, by promoting the reuse, recycling and responsible sourcing of materials. Furthermore, funders can promote the use of life cycle costing in research projects, ensuring that environmental costs are considered throughout the project life cycle.

138. Circular economy: an economic system based on the reuse and regeneration of materials or products, especially as a means of continuing production in a sustainable or environmentally friendly way. Life cycle costing: considering all the costs that will be incurred during the lifetime of the product or service; this includes the purchase price and all associated costs (delivery, installation, insurance, etc.), and operating costs, including energy, fuel and water use, spares, and maintenance.

Recommendation 3. Strengthen partnership working, including public–private partnerships and public/patient involvement in funding for environmentally sustainable research

a) **Encourage collaboration between public and private sectors:** Health research funders and umbrella organisations should encourage collaboration between government and private companies to strengthen and scale up the funding for environmentally sustainable research. Examples include initiatives such as the Greener NHS initiative to engage patients and the public in the NHS's effort to reduce the environmental impact of healthcare while improving patient health outcomes.[139,140]

b) **Develop joint policies between private and public funders:** Health research funders should develop joint policies to make sure that both public and private funders achieve at least the same minimum standards in environmentally sustainable research.

c) **Foster good practice and shared learning between private and public funders:** Health research funders can support and learn from organisations that advocate for stronger environmental protection and corporate accountability, in both the private and public sectors.

d) **Establish a coalition of funders:** For smaller health research funders who may not have the resources to provide advice or support, or processes to require or assess sustainability, we suggest forming a coalition of funders. Such a coalition could share expertise and hold centrally accessible resources for researchers, including advice on study design and public and patient involvement and engagement. In the UK this could be managed via the Association of Medical Research Charities, or it could involve large funders (such as UKRI, Cancer Research UK, Wellcome or NIHR) working with each other and with smaller funding bodies. In the US this could be managed via large independent philanthropic organisations such as the Gates Foundation or the Chan Zuckerberg Initiative.

e) **Showcase impact and build public support:** Health research funders should communicate with the public and decision makers to explain how the research they have funded has become more environmentally sustainable.

In conclusion, we ask health research funders to view environmental sustainability as a core component of delivering their organisational research goals and to support individual researchers and research organisations to deliver environmentally sustainable research. Moving forward, global alignment among funders will be crucial to embed sustainability as a core principle of health research worldwide.

139. NHS England (no date). *Greener NHS* [web page]. https://www.england.nhs.uk/greenernhs

140. Cameron G, Göpfert A & Gardner T (2021). *Going green: what do the public think about the NHS and climate change?* The Health Foundation. https://www.health.org.uk/reports-and-analysis/briefings/going-green-what-do-the-public-think-about-the-nhs-and-climate

THEME 3: Regulation

Summary

This theme examines the current state of regulatory approaches to sustainability in health research, the challenges faced, and opportunities for improvement.

- The integration of sustainability standards into regulatory frameworks could ensure research compliance with environmental goals while maintaining ethical and scientific integrity.
- New regulatory models should improve the sustainability of research without compromising safety or innovation.
- Strengthening monitoring and accountability mechanisms supports transparency and consistency in sustainability practices.
- Incentivising sustainable research through certifications and training programmes encourages compliance and innovation.
- Collaboration among stakeholders, including health research funders, regulators, institutions, and industry, is key to achieving sustainable regulatory frameworks.

Explainer of theme

Regulation plays a crucial role in guiding health research, ensuring that ethical, safety and scientific standards are met in studies conducted by both academic and industry research teams. With increasing global emphasis on sustainability, regulatory frameworks need to evolve to integrate environmental considerations into health research governance. Sustainable research regulation includes measures to reduce carbon footprints, optimise resource use, and encourage innovative research methodologies while maintaining scientific rigour in study design and analysis.

Leading regulatory bodies include the US FDA and the UK's MHRA. Oversight bodies such as the US Office for Human Research Protections (OHRP) and the UK's HRA, as well as funders and standard-setters (e.g. NIH, NSF, UKRI) shape practice through policy and funding criteria.

Context/state of play

Regulatory frameworks in both the US and UK are primarily designed to ensure research is conducted ethically, safely and effectively. Sustainability is a relatively new consideration and its integration into these frameworks is as yet inconsistent. In the US, regulatory oversight is primarily managed by agencies such as the FDA and NIH, which have begun incorporating sustainability into funding guidelines but lack a comprehensive, standardised regulatory approach. In contrast, the UK has seen broader approaches, such as the inclusion of sustainability requirements by some funders – see Theme 2 – and a commitment from UKRI to achieve net zero 10 years before the UK government's target date of 2050, but not specific actions or policy approaches from the main health research regulatory bodies.[141]

Challenges to incorporating sustainability requirements into regulation include their potential impact on innovation. However, regulations can support innovative research methods that drive both scientific progress and sustainability. Examples include adaptive trials, where early results are used to modify the design of the trial while it is in progress; decentralised trials, where activities take place away from traditional sites, sometimes in patients' homes; and the use of AI.

141. Wellcome Trust (no date). *Environmental sustainability funding policy.* https://wellcome.org/research-funding/guidance/policies-grant-conditions/environmental-sustainability-funding-policy

Optimising resource use through supply chains for required materials and improving access to investigational products can materially reduce environmental impacts. Examples include enabling the standard operating procedure-governed redistribution of already-released investigational medicinal products or placebos between nearby sites (only when it replaces a longer resupply or prevents near-expiry waste) or extending expiry dates where stability and safety data support this. The role of supply chains and procurement are further examined in Theme 4 of this report.

Smaller institutions often struggle with financial and technical capacity constraints, which could limit their ability to comply with evolving sustainability regulations. This is an area where larger organisations in industry may be well-positioned to take the first steps. Additionally, the absence of a range of standardised sustainability metrics makes it difficult to monitor and compare compliance across institutions, as discussed in Theme 1. Without clear incentives, regulatory compliance with sustainability goals may be deprioritised in favour of traditional research priorities.

Efforts are being made in both countries to address these issues. In the US, where research is primarily regulated by the FDA, NIH and NSF, while a comprehensive framework is lacking, there is some evidence of the NIH integrating sustainability into grant funding criteria[142,143] and of the FDA exploring regulatory pathways for research practices with the potential to improve sustainability, for example through the use of adaptive trial design.[144] Again, it is unclear how the federal administrative decisions of 2025 on climate research and related areas have affected progress among US regulators.

In the UK, the key regulators for health research are the MHRA and the HRA. Where human tissue is used in research, the Human Tissue Authority (HTA) is the regulatory body overseeing processes relating to its use and storage. The MHRA has committed to pursuing sustainability improvements, and encouraging stakeholders to consider and set out means to reduce the climate impact of their operations through scientific advice, assessments and innovation pathways.[145] However, it has not yet specified plans to integrate sustainability into regulatory pathways. The HRA and Human Tissue Authority (HTA) both include sustainability goals within their own organisations' scopes of practice, but have not yet brought out guidance or requirements for the researchers they regulate as part of their licensing requirements.[146]

A recent report by the MRC-NIHR TMRP Greener Trials Group which explored carbon impact assessment for clinical trials found that UK clinical trial regulation was '*lagging behind the growing interest in addressing the carbon impacts of clinical trials*' seen elsewhere. It added that greater coordination was needed between multiple groups, including researchers, funders, ethics committees, regulators and publishers.[147]

Key findings

Developing regulation to promote environmentally sustainable research faces several challenges. The absence of universal environmental sustainability regulations and standards creates inconsistencies in implementation across institutions and countries. Established regulatory processes tend to be slow to adapt to new sustainability requirements, leading to inertia in implementation. For example, the time required to process amendments to research study protocols – for example, to change freezer running temperatures from -70°C rather than -80°C, as recommended by LEAF – may delay the adoption of more sustainable research practices. Expediating or streamlining such processes so that sustainable practices can be implemented as soon as possible would be an effective way to prompt researchers to update their practices.

142. Kelesoglu N (2018). *The NIH has sustainability goals and considers laboratory efficiency to be an important part of grant applications* [blog post]. Labconscious. https://www.labconscious.com/blog/2018/11/8/nih-sustainability-betr-grants

143. National Institutes of Health (2024). *8.3.4 Procurement system standards and requirements*. In: NIH grants policy statement https://grants.nih.gov/grants/policy/nihgps/html5/section_8/8.3.4_procurement_system_standards_and_requirements.htm

144. US Food and Drug Association (2019). *Guidance document: adaptive design clinical trials for drugs and biologics guidance for industry* https://www.fda.gov/regulatory-information/search-fda-guidance-documents/adaptive-design-clinical-trials-drugs-and-biologics-guidance-industry

145. Modern Humanities Research Association (no date). *Sustainability and the MHRA* [web page]. https://www.mhra.org.uk/about/sustainability

146. Human Tissue Authority (2024). *HTA strategy 2024 to 2027.* https://www.hta.gov.uk/about-the-HTA/corporate-publications/business-plan-and-strategy/hta-strategy-2024-2027

147. Samuel G., et al. (2024). *Understanding current thinking around carbon emission impact assessment and clinical trials regulation.* MRC-NIHR Trials Methodology Research Partnership Greener Trials Group. https://www.methodologyhubs.mrc.ac.uk/files/5817/3097/0238/Understanding_carbon_emission_impact_assessment_and_clinical_trials_regulation_-_Inovate_UK.pdf

Regulation and regulatory guidance can promote best practice in research trials. In particular, prospective trial registration and timely public disclosure of results on official registries (although not publication in journals) are legally required in many settings (e.g. US FDAAA 801/42 CFR Part 11 and the NIH policy for NIH-funded trials; the EU's Clinical Trials Regulation via CTIS; and the UK HRA 'Make It Public' policy framework). These measures reduce research waste and the risk of duplicative studies. Conversely, gaps in registration and reporting hinder transparency and make it difficult to track sustainability progress.

Despite the challenges, there are opportunities to improve regulation for sustainability. Standardising sustainability metrics across regulatory agencies, both domestically and internationally, would be a major means of facilitating compliance and improving accountability. Developing flexible regulatory pathways, such as tiered requirements scaled to institutional size and capacity, would ensure that both large and small institutions can meet sustainability goals without undue burden. Expanding public reporting requirements can promote transparency and shared learning among research institutions, and integrating sustainability training into the requirements of regulatory frameworks can enhance compliance and capacity building for researchers and institutions. Greater coordination within and across key regulators is also needed to advance progress in this area.

Unintended consequences and considerations

- Overly stringent sustainability regulations may limit research opportunities, particularly in resource-limited settings, or counter other priorities for researchers, such as increasing access and opportunities for a wider population if this is associated with a higher environmental cost. Meanwhile, larger organisations with compliance capacity could gain unfair advantages.
- Diverting attention and resources to the regulation of environmental sustainability could compromise or slow down the development of medical innovations. Rigid frameworks might prevent novel research approaches that could have environmental benefits.
- Mandating sustainability reporting as a condition of regulatory approval and enforcement would require a significant investment in resources within regulatory bodies. The consequences in cases where research does not meet sustainability requirements would also need to be considered and clearly articulated.
- Regulatory disparities between the US and UK may create barriers to international research collaboration.
- Without adequate monitoring, sustainability mandates could lead to token compliance rather than meaningful change.
- Additional layers of regulation for environmental sustainability could extend already lengthy timelines and decrease the efficiency of regulatory systems. Associated delays to research starting could lead to wasted resources and shorter times for completing studies, encouraging researchers to work faster and in turn giving them less time to meet funding deadlines and therefore less time for considering sustainability.

Solutions and recommendations

Recommendation 1: Integrate sustainability into existing regulatory frameworks
a) **Revise research governance frameworks to include sustainability criteria:** Regulators should update existing frameworks to incorporate carbon footprint reduction and resource conservation requirements as standard assessment criteria.
b) **Expand environmental impact assessments (EIAs) to cover all research phases:** Regulatory bodies and environmental agencies should extend EIA requirements to throughout the entire research life cycle, ensuring alignment with global climate commitments.
c) **Develop flexible regulatory compliance pathways for smaller institutions:** Regulators should create streamlined compliance mechanisms for smaller research organisations that account for their resource constraints and capacity limitations, as well as considering the level of funding for the specific project and the level of risk. Compliance should be proportionally reviewed in relation to these factors.

Recommendation 2: Develop new regulatory models to support sustainable research

a) **Enable the use of innovative sustainable research techniques:** Regulators should establish frameworks that facilitate the adoption of adaptive trial designs, decentralised trials and AI applications that enhance sustainability where appropriate and when unintended consequences have been considered and mitigated.[148] Approaches such as the Centers of Excellence in Regulatory Science and Innovation (CERSIs) model, pioneered by the FDA and now used by the MHRA, provide opportunities to use cutting-edge technologies to advance regulatory science and speed up the development of therapeutics. The increased efficiency of these approaches is likely to improve the overall sustainability of the process, depending on the required resources and study designs.

b) **Establish sustainability reporting requirements for funded research:** Regulators and funders should implement shared dashboard systems that are accessible to research institutions, ensuring transparency and accountability while protecting sensitive information.

c) **Introduce tiered sustainability certification systems:** Regulatory bodies should develop progressive certification programmes that encourage and recognise incremental sustainability improvements across research organisations.

Recommendation 3: Strengthen monitoring, accountability and reporting systems

a) **Standardise sustainability metrics across research institutions and countries:** Regulatory bodies and policymakers should work with researchers, research organisations, funders and other relevant stakeholders to develop unified measurement standards for CO_2 and other GHG emissions, energy use, and waste generation, to enable meaningful international comparisons and to avoid barriers to international research collaboration. See Theme 1, Data and Information Availability.

b) **Work toward periodic sustainability reporting, with flexible pathways for smaller or less well resourced organisations:** Regulatory bodies should work toward mandating regular sustainability reporting as a prerequisite for ethical and regulatory approvals of research projects. Regulators should work with funders and researchers to develop flexible pathways for smaller or less well resourced organizations to ensure that sustainability reporting does not become a barrier to ethical and regulatory approval.

c) **Develop a digital, open access platform for sustainability data sharing:** Policymakers and regulatory bodies should create centralised online platforms for reporting and sharing sustainability data and innovative practices from research regulators across the research community.

148. Adaptive trial designs: Research approaches that allow for modifications to trial procedures based on interim data analysis, reducing waste by optimizing sample sizes, shortening study duration, and eliminating ineffective treatment arms early on. These designs ensure only necessary samples are collected and analyzed in a timely manner to reduce environmentally costly storage requirements. Decentralized trials: Studies conducted outside traditional research centers using technologies like telemedicine, wearables, and home visits, reducing travel-related carbon emissions, facility use, and resource consumption while increasing participant accessibility. AI applications: Machine learning and AI tools that optimize research efficiency through improved data analysis, predictive modeling, virtual screening, and simulation, reducing lab resources, energy consumption and waste while accelerating discovery timelines.

Recommendation 4: Incentivise compliance and innovation in sustainable research

a) **Provide targeted support to institutions to help them meet sustainability requirements:** Research funders and regulatory agencies should offer financial and technical assistance to help smaller institutions and companies comply with new sustainability standards.

b) **Recognise exemplary sustainable research practices:** Regulatory agencies and funders should establish certifications that highlight and reward outstanding sustainable research practices.

c) **Support adaptive regulatory updates based on implementation data:** Regulatory agencies should implement flexible mechanisms for updating regulations, including expediting study amendments that allow for sustainable research practices and regulations to evolve based on real-world implementation experiences and stakeholder feedback.

d) **Develop comprehensive sustainability training programmes:** Regulatory agencies and research institutions should work together to create specialised training curricula for researchers, ethics committees, and regulatory personnel to enhance capacity and ensure effective compliance with sustainability requirements.

THEME 4: Procurement and supply chain

Summary

- This theme examines the environmental impact of procurement and supply chains in health research and the challenges and opportunities for sustainable procurement. It covers unintended consequences that should be considered and makes recommendations to drive sustainable procurement across health research supply chains. Supply chain emissions account for a considerable proportion of overall health sector emissions. While emissions from the research sector supply chain are relatively small compared to those from healthcare generally, there is scope to reduce them through sustainable procurement practices.
- Sustainable procurement, the process of acquiring goods and services while minimising environmental, social and economic impacts, can help reduce health research supply chain emissions. Best practices in sustainable procurement, as implemented by leading research institutions, aim to reduce environmental harm through greater resource efficiency, responsible sourcing, and supplier engagement.
- Key challenges to sustainable procurement include global supply chain complexity and disruptions, regulatory and financial barriers, and a lack of transparency and inconsistencies in carbon measurement by suppliers.
- Major stakeholders need to support and implement sustainable procurement, in both the UK and US, including funding agencies, regulatory bodies, research institutions, industry partners and sustainability organisations.
- Cross-sector collaboration, policy alignment and research and investment in sustainable procurement and supply chain emissions reduction strategies are necessary among funding bodies, research institutions and industry partners to drive sustainable supply chains.

Explainer of theme

Procurement and supply chain management are critical components of health research, encompassing the purchase and use of laboratory equipment, clinical supplies, pharmaceuticals and infrastructure. These materials have a significant environmental footprint over their life cycles from production to disposal.[149] As efforts to improve environmental performance grow, procurement policies and practices must evolve to incorporate sustainability measures.

'Sustainable procurement' is the process of acquiring goods and services while minimising environmental, social and economic impacts. Sustainable procurement involves strategic planning to use and source materials responsibly, as well as engaging suppliers in sustainability initiatives. Leveraging sustainable procurement to promote environmentally responsible supply chain practices and reduce supply chain emissions requires collaboration among stakeholders, including funding agencies, policymakers and industry leaders.

Context/state of play

Existing research underscores the significant environmental impact of procurement and supply chains in health research. Studies indicate that supply chain activities contribute a considerable portion of emissions in healthcare.[150] For example, 62% of NHS emissions come from its supply chain nationally, while some local NHS trusts have even higher levels: for example, 74% of the emissions of Manchester University NHS

149. Health Care Without Harm (2019). *Health care's climate footprint report*. https://global.noharm.org/resources/health-care-climate-footprint-report

150. *Ibid*.

Foundation Trust are generated in the supply chain.[151,152] In the US, supply chain activities are thought to account for approximately 80% of healthcare sector emissions.[153] In the industry context, supply chains contribute a very large proportion of total pharmaceutical company emissions, with purchased goods and services being the predominant source.[154] Research estimates also suggest that approximately 25% of clinical trial supplies are never used, resulting in unnecessary waste and emissions.[155] NHS initiatives, such as the Your Medicines Matter campaign, have targeted procurement waste, addressing £300 million in annual medicines overspend through improved stock management.

Studies suggest that the contribution of the supply chain to health research emissions is smaller than for the health sector as a whole. As noted above, published footprints indicate that total trial emissions are typically in the tens to hundreds of metric tons CO_2e. Examples include 72 tons for CASPS, an international phase 2 trial of an investigational medicinal product with 47 participants, and 89 tons for PRIMETIME, a UK-based phase 3 non-investigational medicinal product trial with 1,962 patients. Dominant hotspots are clinical trials unit (CTU) energy use and commuting and trial-specific participant travel and assessments. By contrast, the trial supplies and equipment (supply chain) component is much smaller, with a median of approximately 1.16 metric tons CO_2e across 10 trials (interquartile range approximately 0.23–6.63 t).[156,157,158]

Data on the carbon footprint of supply chains in other types of health research other than clinical trials is lacking, as outlined in Theme 1.

Approaches to sustainable procurement vary between the UK and the US. The UK has adopted a more centralised and policy-driven strategy. The NHS Net Zero Supplier Roadmap mandates that suppliers align with net zero commitments, allocating 10% weighting for net zero and social value in all NHS procurements.[159] The US lacks a unified policy in this area, with sustainability efforts being implemented across organisations and NIH institutes, depending on individual leadership priorities and interests. There is evidence that, prior to 2025, the NIH had begun incorporating sustainability criteria into some grant funding requirements,[160,161] as well as outlining its own green procurement strategy,[162] but there is no standardised procurement framework across US stakeholders. As in the cases of funding and regulations, it is unclear how federal decisions made in 2025, which have reduced or redirected funding for research on climate change and other areas, may have impacted this progress. Regulatory bodies such as the Environmental Protection Agency and the FDA influence procurement regulations but do not yet impose strict sustainability mandates. Additionally, US federal executive orders issued in 2025 focused on procurement consolidation and streamlining, with an emphasis on deregulation and efficiency. These changes may affect sustainability efforts. The fragmented nature of US procurement policies also presents challenges for sustainable supply chains compared with the structured NHS approach in the UK.

151. Tennison I, *et al.* (2021). *Health care's response to climate change: a carbon footprint assessment of the NHS in England.* The Lancet Planetary Health **5(2)**, e84-e92 https://www.thelancet.com/journals/lanplh/article/PIIS2542-5196(20)30271-0/fulltext
152. Manchester University NHS Foundation Trust (2022). *Code green: Delivering net zero carbon at MFT* 2022–2025 https://mft.nhs.uk/app/uploads/2022/02/MFT-Green-Plan_V1.0.pdf
153. The Commonwealth Fund (2022). *How the U.S. health care system contributes to climate change.* Environmental Effects of Healthcare | Commonwealth Fund
154. edie (2024). *Scope 3 and ESG: tackling hidden emissions in the pharmaceutical industry.* https://www.edie.net/scope-3-and-esg-tackling-hidden-emissions-in-the-pharmaceutical-industry/
155. Clinigan (2023). *Sustainability in clinical trial supply chains: the shift from an ideal to an economic imperative* [blog post]. https://www.clinigengroup.com/insight/insights/2023/sustainability-in-clinical-trial-supply-chains-the-shift-from-an-ideal-to-an-economic-imperative/
156. Griffiths J, Fox L & Williamson PR (2024). *Quantifying the carbon footprint of clinical trials: guidance development and case studies.* BMJ Open **14**, e075755. https://bmjopen.bmj.com/content/14/1/e075755 (CASPS and PRIMETIME totals; PRIMETIME breakdown); Cranley D, *et al.* (2025). *Carbon footprint of a sample of clinical trials for people with neurological disorders: cross-sectional analysis.* BMJ Open **15(6)**, e090419.
157. Griffiths J, *et al*. What is the carbon footprint of academic clinical trials? A study of hotspots in 10 trials. BMJ Open. 2024;14(10):e088600 (Module medians including supplies & equipment).
158. Cranley D, *et al.* (2025). *Carbon footprint of a sample of clinical trials for people with neurological disorders: cross-sectional analysis*. BMJ Open **15(6)**, e090419.
159. NHS Innovation Service (no date). *Delivering a net zero, sustainable, health service. In: Commissioning and adoption* [web page]. https://innovation.nhs.uk/innovation-guides/commissioning-and-adoption/delivering-a-net-zero-health-service/
160. National Institutes of Health (2024). *8.3.4 Procurement system standards and requirements*. In: NIH grants policy statement https://grants.nih.gov/grants/policy/nihgps/html5/section_8/8.3.4_procurement_system_standards_and_requirements.htm
161. Kelesoglu N (2018). *The NIH has sustainability goals and considers laboratory efficiency to be an important part of grant applications* [blog post]. Labconscious. https://www.labconscious.com/blog/2018/11/8/nih-sustainability-betr-grants
162. National Institutes of Health (no date). *Green procurement*. https://nems.nih.gov/environmental-programs/Pages/Green-Procurement.aspx

Industry-led sustainable procurement initiatives exist but remain voluntary rather than mandated by government policy and regulation. For instance, pharmaceutical and biotech companies across both the UK and US, including GSK, AstraZeneca, Pfizer, Moderna and Johnson & Johnson, each have internal sustainable procurement policies that guide supplier selection, as well as various sustainable supply chain initiatives. For example, the ENERGIZE program, launched in 2021, is a global collaborative attempt to support pharmaceutical company suppliers in their renewable energy transition, with progress reports showing 35% renewable energy adoption among participating suppliers by 2024.[163] However, these efforts remain sporadic.

Key findings

Sustainable procurement has become a reality in some organisations. The NHS's Net Zero Supplier Roadmap is having an effect, while some organisations have joined initiatives such as University College London's LEAF. LEAF achieved total reported savings of £641,000 over a two-year pilot across all participating lab groups, with average annual savings of £3,700 per lab. The programme's sustainability actions were equivalent to eliminating 648 tons of CO2e annually.[164] Similarly, Harvard University has a comprehensive Sustainable Purchasing Guide that covers high-spend areas.[165]

However, these are small and early steps and sustainable procurement in health research faces several challenges in building scale. One of the primary obstacles is the lack of transparency and accessibility of environmental data from suppliers, exacerbated by the complexity of global supply chains. Without standardised metrics and reporting requirements, researchers struggle to assess the environmental impact of their procurement choices. Financial and regulatory barriers, particularly in lower-middle income settings, further complicate the transition to sustainable alternatives, as the lack of local manufacturers may necessitate international transit. Environmentally sustainable procurement options can be costlier, and existing regulations often fail to incorporate explicit sustainability considerations.

Both the US and UK have decentralised procurement at the institutional level, with UK universities and research institutes maintaining their own practices despite recent recognition of the need for greater collaboration and shared procurement frameworks.[166] The US lacks a unified, national procurement framework comparable to the UK's NHS-wide supplier requirements for sustainability, making cohesive strategies harder to implement across institutions and regions. This makes it difficult to implement cohesive sustainability strategies across different institutions and regions. Additionally, SMEs may face difficulties in meeting sustainability requirements due to limited financial and technical resources, raising concerns about equitable access to procurement opportunities.

Despite these challenges, significant opportunities exist to advance sustainable procurement practices. Aligning sustainable procurement policies and standards between the US and UK could enhance procurement efficiency and improve environmental impact tracking. Consistent procurement policies and standards could require suppliers to publish the environmental impact of their products and services, increasing transparency and allowing procurers to make informed decisions. Capacity-building initiatives, such as training programmes for researchers, procurement officials, and suppliers, could help integrate sustainable purchasing practices into standard procurement procedures. Technological advances, including AI-driven supply chain inventory management and logistics optimisation and blockchain for enhanced transparency, offer promising solutions for more sustainable procurement.[167,168,169] Financial incentives

163. Sustainable Health Care Coalition (no date). *Energize, a programme to increase access to renewable energy for pharmaceutical supply chains, launches at COP26* [blog post] https://shcoalition.org/energize-a-programme-to-increase-access-to-renewable-energy-for-pharmaceutical-supply-chains-launches-at-cop26/

164. Institute of Marketing (no date). *UCL Plastic Waste Innovation Hub.* https://www.instituteofmaking.org.uk/research/ucl-plastic-waste-innovation-hub

165. Harvard Office for Sustainability (no date). *Sustainable purchasing.* https://sustainable.harvard.edu/resources/sustainable-purchasing/

166. McIntyre F. (2025). *At a glance: the seven asks from UUK's efficiency report*. Research Professional News, June 25. https://www.researchprofessionalnews.com/rr-news-uk-universities-2025-5-at-a-glance-the-seven-asks-from-uuk-s-efficiency-report/

167. Naz F, *et al*. (2022). *Reviewing the applications of artificial intelligence in sustainable supply chains: Exploring research propositions for future directions.* Business Strategy and the Environment **31(5)**, 2400-2423. https://onlinelibrary.wiley.com/doi/full/10.1002/bse.3034?msockid=010cdacf15f8650b3c23ce0b14c064ba

168. Yadav A, Garg RK, Sachdeva A (2024). *Artificial intelligence applications for information management in sustainable supply chain management: A systematic review and future research agenda.* International Journal of Information Management Data Insights **4(2)**,100292. https://www.sciencedirect.com/science/article/pii/S2667096824000818

169. Cowell N. (2025). *AI powered supply chains: enhancing efficiency and sustainability* [blog post]. Fujitsu. https://corporate-blog.global.fujitsu.com/fgb/2025-02-03/01/

and government-backed support for sustainable procurement could also alleviate the financial burden on researchers and suppliers, facilitating the transition to more sustainable practices.

Unintended consequences and considerations

- **Greenwashing:** Misrepresentation or exaggeration of sustainability claims, known as greenwashing, remains a significant risk to correctly selecting sustainable suppliers. Implementing verification mechanisms, such as third-party audits and certification frameworks, can help ensure transparency and accountability.
- **Cost-induced research limitations:** Higher sustainable procurement costs could reduce the scope of research.
- **Variations in environmental regulations across countries:** Such variations, particularly in major manufacturing hubs, where standards may be more lenient, can influence supplier behaviour. As a result, sustainable procurement initiatives may inadvertently create or deepen market inequities.
- **Inequity:** Failure to address organisation size in sustainable procurement policies may generate inequities, for example the exclusion of SMEs due to financial or technical barriers.
- **Loss of a competitive edge due to supplier investment in sustainable practices:** This may be combated by targeted support programmes.
- **Reduction of supplier diversity:** Overly rigid sustainability criteria may also increase vulnerability to disruptions. To mitigate this, procurement strategies should be designed with built-in flexibility and support for supply chain resilience, as well as encouraging supplier diversification.
- **Quality–sustainability trade-offs:** Pressure to choose sustainable options might compromise research quality or safety.
- **Energy-intensive IT:** While digital and AI-driven tools can improve procurement planning and environmental optimisation, they also introduce new challenges, such as increased energy demand from data processing and storage. Ensuring that procurement strategies are both inclusive and environmentally responsible will be crucial in balancing these concerns.

Solutions and recommendations

Recommendation 1: Develop and embed sustainable procurement processes
a) **Minimise resource consumption through efficient research design and waste reduction:** Research organisations should implement strategies to minimise resource use by designing research efficiently, eliminating wasteful practices, and leveraging digital tools, drawing on reuse initiatives. Sharing resources, services and infrastructure across research institutions is another mechanism that can be used to minimise resource consumption.
b) **Promote sustainable materials and renewable resource use:** Research organisations should prioritise biodegradable, recycled or renewable materials in research operations and select renewable and sustainable sources of water and energy.
c) **Integrate environmental criteria into procurement decisions:** Research organisations and funding bodies should prioritise suppliers with strong sustainability commitments, using certifications like ISO 14001 or the NHS Net Zero Supplier Roadmap. Procurement processes should assess products and services across their full life cycle (cradle to grave), incentivising suppliers to publish their environmental impacts and remaining cautious of the potential for greenwashing. Leveraging purchasing power through shared procurement approaches across research institutions could drive action by suppliers. Procurement decisions should be continuously monitored to ensure that they drive environmental outcomes in practice.

Recommendation 2: Build capacity and foster an equitable and sustainable supply chain

a) **Support supplier transition to greener practices:** Research organisations, industry and suppliers should engage suppliers through training, incentives and collaboration programmes, drawing on models like ENERGIZE for supplier energy transitions.

b) **Train stakeholders in sustainable procurement practices:** Research organisations, industry and regulatory bodies should provide sustainability training to healthcare researchers and procurement staff, embedding sustainable procurement as a core organisational value, and increasing stakeholder capacity to make informed choices based on supplier environmental impact.

c) **Ensure supply chain resilience by encouraging diverse, smaller suppliers:** Policymakers and regulatory agencies should design policies that support SMEs and mitigate regional disparities by offering financial and technical assistance to help these suppliers meet sustainability standards.

Recommendation 3: Drive innovation through sustainable research and development

a) **Invest in technology to improve procurement sustainability:** Research institutions, industry, policymakers and funding bodies should support technological innovation in supply chain optimisation and sustainable manufacturing techniques to reduce environmental impacts across research supply chains.

b) **Advance research on sustainable research materials:** Research institutions, industry and funding bodies should explore alternatives, such as bio-based plastics, reusable glassware, and energy-efficient lab equipment, as well as considering reviving the use of non-disposable instruments through applying modern improvements.

c) **Leverage digital solutions responsibly:** Industry, suppliers and research institutions should adopt digital tools that increase supply chain efficiency while minimising their own environmental impacts, such as energy use from data centres.

Recommendation 4: Align policies and harmonise standards

a) **Embed sustainability in policy frameworks:** Policymakers and regulatory agencies should institutionalise sustainable procurement principles at national and international levels using governance tools such as the Advanced Energy Design Guides published by ASHRAE, an international society of heating, refrigerating and air-conditioning professionals, or similar energy efficiency frameworks.

b) **Standardise procurement practices across regions:** Policymakers, international organisations, research institutions and industry should harmonise sustainable procurement standards across countries such as the US and UK to enable cross-border collaboration and consistency.

c) **Balance regulation with access for all:** Regulatory agencies and policymakers should create frameworks that promote sustainability without excluding smaller or less well resourced suppliers, ensuring cost effectiveness.

Box 2: Energize, an example of supporting healthcare suppliers to access renewable energy

Energize is a collaborative initiative launched in 2021 by leading pharmaceutical companies to facilitate the adoption of renewable energy among their suppliers. Managed by Schneider Electric and endorsed by the Pharmaceutical Supply Chain Initiative (PSCI), the programme offers education and support to suppliers on renewable electricity procurement, aiming to reduce scope 3 GHG emissions within the pharmaceutical value chain. By providing resources on power purchase agreements (PPAs) and other renewable energy options, Energize enables suppliers, who may lack the internal expertise or resources, to participate in the renewable energy market. As at early 2025, the programme had expanded to include 24 sponsoring companies and had facilitated multiple multi-buyer PPA cohorts, collectively advancing the decarbonisation of the pharmaceutical supply chain.

THEME 5: Infrastructure

Summary

This theme examines the roles of physical infrastructure, such as buildings, hardware and energy systems; electronic infrastructure, including digital platforms, software and algorithms; and service infrastructure for sustainable health research. A set of recommendations aimed at reducing their carbon footprints is proposed.

- Ensuring health research is sustainable will require optimising physical, electronic and service infrastructure through adequate provisioning and retrofitting of existing research buildings, using design and planning to minimise or offset associated carbon footprints.
- Improving the environmental sustainability of physical research infrastructure should involve investing in net zero building practices in new and existing facilities and equipping them with energy-efficient systems, hardware and devices.
- Environmentally sustainable electronic infrastructures should be embraced, including digital technologies for health data management and research communication, decentralised virtual platforms, and green algorithms, sustainable AI and machine learning tools for research analysis.
- There is a need for equitable investments across the research life cycle, from the development of infrastructure to its operation and maintenance, to reduce carbon footprints.

Explainer of theme

Health research takes place in multiple institutions and settings, such as universities, clinical spaces, hospitals, commercial labs, the community (for example, schools and prisons) and private settings (for example, residential care homes). The sector relies on three interconnected critical infrastructure components for its functioning. Physical (or hard) infrastructure includes the buildings housing research institutions, and supportive hardware, computers, servers and IT equipment and energy systems. Electronic (or soft) infrastructure includes all digital and intangible infrastructure that enables clinical and health research data collection, such as the management and analysis tools used to operationalise health research. This includes digital platforms, software and algorithms. Lastly, service infrastructure includes the supportive structural infrastructure needed for the creation of trained workforces functioning within an efficient governance model, implementing sustainability principles within health research. This last component will be further explored in Theme 6 of this report, on training and capacity building of researchers and organisations. The first two components of infrastructure consume considerable energy for operations, and generate significant quantities of waste, while the third component requires investments in supportive infrastructure for training, capacity building, knowledge sharing and monitoring progress toward sustainable health research. As such, sustainable health research will require synergistic cross-sectoral approaches and related interventions to design, plan and maintain health research infrastructure to minimise or offset its carbon footprint.

Context/state of play

Health research can vary in terms of setting, nature, scale, duration and resources. Carbon footprints from health research can be attributed to the following: the use of resources for various research activities; waste generated; procurement; and transportation. Health research infrastructure comprises physical infrastructure (buildings, hardware, equipment and energy systems), electronic infrastructure (digital platforms, software and algorithms) and service infrastructure. These are all associated with considerable carbon impacts. Optimising this infrastructure can result in greener, sustainable health research.

As outlined in previous sections, health research facilities are energy intensive.[170] There is a need to design energy-efficient facilities to minimise environment impacts, predominantly in the carbon footprints of research spaces. Sustainable building concepts are extremely valuable in the retrofitting of existing health research facilities and the design of new ones. These include incorporating a mix of innovative active and passive building design approaches (see box 3 below), sustainable building materials and façade engineering. Green, renewable energy generation, such as solar, wind and hydropower, and energy-efficient technologies, can lower carbon footprints when integrated into existing or new facilities and should be retrofitted whenever possible.

Box 3: Descriptions of active and passive design approaches and building façade engineering

Active design approaches: Active design approaches use mechanical and electrical technologies to optimise heating, ventilation, air-conditioning (HVAC) systems, lighting, air quality and other building services applications. For example, solar panels, wind turbines and district heating can achieve indoor comfort and at the same time ensure sustainable energy usage.

Passive design approaches: Passive design approaches leverage local climatic and building conditions (such as building envelope, shape and orientation) to improve indoor comfort while reducing energy demand. These may include the use of natural ventilation, shading, thermal insulation or green roofs.

Building façade engineering: A building's façade is its exterior or the skin that controls the exchanges of energy between the internal and external environment. Façade engineering employs technologies to optimize the design and performance of building façades to optimise daylighting and heat exchanges during summers and winters.

The UK Green Building Council framework states that buildings can achieve net zero carbon throughout their life cycle – both in the construction and operational phases – by reducing construction impact, operationalising energy use, increasing renewable energy supply and offsetting any remaining carbon.[171] Concurrently in the US, the US Green Building Council's LEED programme offers a framework for achieving healthy, efficient and cost-effective green buildings, employing strategies impacting land, energy, transportation, water and waste.[172]

Echoing the urgent need to achieve net zero building standards in the healthcare sector, the UK NHS has provided technical guidance in its Net Zero Building Standard to support the development of sustainable, resilient and energy-efficient buildings.[173] This standard has been compulsory for all new NHS building projects and refurbishments since October 2023 onward. Nonetheless, implementing the standard in existing health research facilities remains a challenge. Typically, healthcare buildings are housed in old, poorly maintained assets and, according to the NHS Confederation, the estimated cost to eradicate the NHS maintenance backlog is £13.8 billion.[174] In the US, according to the Commercial Buildings Energy Consumption Survey of 2018, the healthcare sector accounts for 581 trillion British thermal units in major fuel consumption, with in-patient healthcare buildings being among the most energy intensive.[175]

170. Tozer L. (2023). *Science's carbon footprint: how health research can cut emissions.* Nature, August 21. https://www.nature.com/articles/d41586-023-02642-1#ref-CR1

171. UK Green Building Council (2019). *Net zero carbon buildings: a framework definition.* https://www.ukgbc.org/ukgbc-work/net-zero-carbon-buildings-a-framework-definition/

172. US Green Building Council (no date). *LEED Zero.* https://www.usgbc.org/programs/leed-zero

173. NHS England (2022) *NHS net zero building standard.* https://www.england.nhs.uk/wp-content/uploads/2023/02/B1697-NHS-Net-Zero-Building-Standards-Feb-2023.pdf

174. NHS Confederation (2024). *New backlog maintenance figures shows effect of starving NHS of vital capital.* https://www.nhsconfed.org/news/new-backlog-maintenance-figures-shows-effect-starving-nhs-vital-capital

175. US Energy Information Administration (2018). 2018 *CBECS survey data.* https://www.eia.gov/consumption/commercial/data/2018/

Similar efforts to transition toward net zero infrastructure have taken place across the health research sector, especially in universities and labs. According to UK's Higher Educational Statistics Agency (HESA), 141 universities – comprising 16,016 buildings – consumed 7003.7GWh of energy in 2022-23 (equivalent to the electricity needed to power about 1.4 million households for an hour), with just 116.6GWh of renewable energy generated on-site or off-site.[176] Several UK universities are leading the sector in designing, building and operating net zero research facilities. Notable examples include The Wave at the University of Sheffield, and the new campus of University College London, UCL East.[177,178] In the US, Emory University's Health Science Research Building II consumes 50% of the energy of an average research facility and features design solutions including green roofs, stormwater retention, grey water reuse, solar panels and on-site energy. It achieved LEED Gold certification from the US Green Building Council.[179] Another example is Health Sciences Research Facility III at the University of Maryland School of Medicine in Baltimore, which received LEED Gold certification for its sustainable design and construction in 2019.[180]

In terms of passive building design, ARUP's Net Zero Carbon Healthcare guide[181] says that this can be achieved through preventing excessive heat gains during summers by optimising building orientation and form and by reducing heat loss during winter through proper ventilation. Beyond the building level, the design of campuses of health research institutions such as universities, and the way they are integrated into cities, plays a significant role in minimising environmental costs, such as those associated with operations and transport.

Electronic (or soft) infrastructure includes digital platforms, software and algorithms that enable data collection, management and analysis. Research facilities also manage large datasets using energy-intensive processes. Specifically, the carbon footprints of computational health research are extremely high.[182] Environmentally sustainable health research entails a transition to energy-efficient hardware infrastructure (see Box 3).

Migration and automation from physical to virtual systems, such as decentralised clinical trials, electronic patient recruitment and testing, decentralised patient monitoring, remote research data collection and communication, can reduce resource use, requiring fewer staff and limiting the need to travel.

With the proliferation of digital technologies, decentralised digital clinical trials (DDCTs) have the potential to emerge as a faster, cost-effective and environmentally sustainable option. They are likely to improve accessibility for patients, whatever their place of residence or socio-economic background.[183] A recent analysis extrapolated estimations from approximately 15,000 clinical trials in Europe and reported potential savings of between around 41,000 and 66,000 metric tons of CO2 annually attributable to hybrid or digital trial designs, equivalent to planting millions of trees.[184] For reference, one ton of CO2 can be captured by approximately 50 trees in a year. It is noteworthy to mention that DDCTs are still at an early stage and evidence of their effectiveness is still emerging. Recommended guidance on the suitability of DDCTs should be considered alongside environmental considerations.[185] Recent evidence has suggested that patient participation is reduced in decentralised trials. This, alongside other unintended consequences, needs to be objectively evaluated and adequate design refinements incorporated. In the US, NIH leaders have urged

176. HESA (2025). *Table 2 - Energy.* https://www.hesa.ac.uk/data-and-analysis/estates/table-2

177. University of Sheffield (2024). *University of Sheffield's newest building awarded highest sustainability accreditation.* https://www.sheffield.ac.uk/news/university-sheffields-newest-building-awarded-highest-sustainability-accreditation

178. University College London (2023). *Sustainable buildings at UCL push boundaries on carbon performance.* https://www.ucl.ac.uk/sustainable-development-goals/case-studies/2023/dec/sustainable-buildings-ucl-push-boundaries-carbon-performance

179. HOK (no date). *Emory University Health Sciences Research Building II Atlanta, Georgia* [web page]. https://www.hok.com/projects/view/emory-university-health-sciences-research-building-ii/

180. Aziza J (2019). *University of Maryland research facility gains LEED Gold.* School Construction News, May 3. https://schoolconstructionnews.com/2019/05/03/university-of-maryland-research-facility-gains-leed-gold/

181. Pitman D & Rolf A (2020). *New zero carbon health care: a guide.* ARUP. https://www.arup.com/insights/net-zero-carbon-healthcare/

182. Nature Computational Science (editorial) (2023). *The carbon footprint of computational research.* Nat Comput Sci **3**, 659. https://doi.org/10.1038/s43588-023-00506-2

183. Inan OT, et al. (2020). *Digitizing clinical trials.* NPJ Digit Med. **3**, 101. https://pubmed.ncbi.nlm.nih.gov/32821856/

184. Kohl SH & Schmidt-Lucke C. (2023). *Clinical trials to go green–a sustainable argument for decentralised digital clinical trials.* PLOS Digital Health **2**, e0000366. https://journals.plos.org/digitalhealth/article?id=10.1371/journal.pdig.0000366

185. Directorate-General for Health and Food Safety (2022). *Recommendation paper on decentralised elements in clinical trials.* https://health.ec.europa.eu/system/files/2023-03/mp_decentralised-elements_clinical-trials_rec_en.pdf

trialists to adopt digital technologies to enhance the efficiency and quality of clinical trials. The NIH and NSF held a workshop on the subject in April 2019 in Bethesda, Maryland, bringing together US experts in clinical trials, digital technology and digital analytics.[186] Likewise, the National Academy of Medicine conducted a workshop in 2022 to consider a vision of clinical trial enterprise with digital technologies.[187]

The importance of digital infrastructure in promoting electronic testing and electronic recruitment in reducing carbon footprints has been acknowledged.[188] Decentralised virtual research platforms enable collaborative research among multiple research facilities and shared data analyses, reducing costs of computation and travel. One example is the Research Analysis Platform of UK Biobank, one of the world's largest virtual research platforms.[189] As noted above, with the proliferation of both high-speed computation and AI, computation health research is energy intensive; smart green algorithms are therefore increasingly important for minimising carbon footprints.[190]

Development of the above-mentioned hard and soft infrastructure should be complemented by considerable investment in the research workforce. Capacity building of the research workforce is further examined in Theme 6 of this report.

Key findings

Challenges:
Research infrastructure, including physical, electronic and service infrastructure, plays a pivotal role in achieving net zero or near net zero practices. However, there are some major challenges in achieving sustainable research infrastructure, which may hinder the overall progress of environmental sustainability in health research. A key challenge is the fact that long-term, strategic financial investment in both physical and electronic infrastructure at system levels is currently lacking and is needed to effectively support and promote sustainable health research. A transition toward sustainable research infrastructure can unlock many benefits for science, economy and the environment. This requires top-down approaches from governments, advanced techniques and ample public and private funding for designing research buildings and data centres, incorporating sustainable, energy-efficient hardware infrastructure and leveraging smart and green digital technologies to conduct and manage research. However, environmentally conscious values and environmental costs are not yet fully integrated into all provisions of infrastructure and the entire research cycle. In addition, there are challenges around ensuring optimal design and quality of research buildings and computing infrastructure, which will help establish long-lasting, energy-efficient research infrastructure and avoid unnecessary waste.[191]

Opportunities:

- **Implement net zero building design**
  The construction, operation and maintenance of research buildings and data centres often have substantial environmental impacts. There is now an opportunity to reduce these impacts significantly through sustainable building and energy practices. In the UK, some encouraging initiatives have emerged, such as the UK Net Zero Carbon Buildings Standard, which is a welcome first step toward ensuring net zero building design nationally.

186. NIH NHLBI (2019). *Digital clinical trials workshop: creating a vision for the future*. https://www.nhlbi.nih.gov/events/2019/digital-clinical-trials-workshop-creating-vision-future
187. National Academies of Sciences, Engineering, and Medicine (2022). *Envisioning a transformed clinical trials enterprise for 2030: proceedings of a workshop*. https://doi.org/10.17226/26349
188. Hoffmann J-M, Bauer A & Grossmann R (2023). *The carbon footprint of clinical trials: a global survey on the status quo and current regulatory guidance* BMJ Global Health **8**: e012754.
189. Bycroft C, et al. (2018). *The UK Biobank resource with deep phenotyping and genomic data*. Nature **562**, 203-209. https://doi.org/10.1038/s41586-018-0579-z
190. Lannelongue L., *et al*. (2023). *GREENER principles for environmentally sustainable computational science*. Nat Comput Sci **3**, 514–521 (2023). https://doi.org/10.1038/s43588-023-00461-y
191. Cornell University (2024). Report on the NSF Workshop on Sustainable Computing for Sustainability (NSF WSCS 2024), 10 July 2024. https://arxiv.org/abs/2407.06119

- **Prioritise digital technologies supported by energy-efficient hardware infrastructure that is associated with lower carbon footprints, to conduct health research and enhance scientific collaboration**
  There is an opportunity to use electronic infrastructure and digital platforms to conduct research and promote collaboration locally and globally. Better data usage, collection, and accessibility, and better translation of data between different organisations and locations, could be achieved through efficient, decentralised virtual platforms and cloud computing. However, risks will need to be managed, such as by providing equal access to digital platforms, preserving the privacy of sensitive data, and maintaining full cyber security.

Investments supporting the transition toward sustainable building practices and the adoption of digital technologies and decentralised platforms should be uniformly allocated to avoid inequities in uptake among research organisations.

Unintended consequences and considerations

- **Inequity:** Multi-level investments for sustainable health research are resource-intensive and time-consuming. As such, local, national and regional variations may emerge in time at an institutional level, especially in the development and uptake of relevant infrastructure. This may introduce inequity in progress, with institutions in resource-scarce settings making minimal progress.
- **Upgrade challenges:** Upgrading current research buildings and hardware may be challenging for some organisations and could risk producing a two-tier system. Advanced technologies and designs for carbon-proofing buildings are still in the early stages of development and upgrades will depend on the degree of adaptability of current stocks. If buildings are not amenable to retrofitting they may become redundant. Computation hardware scales up in processing speeds and sophistication every few years, requiring upgrades that leave existing hardware redundant and wasting resources. As such, principles of circular procurement should be applied throughout the life cycles of building and hardware infrastructure.
- **Digital exclusion from health research:** Across institutions and individuals, there remains significant disparity in access to advanced computing hardware infrastructure and software platforms, as well as digital training and literacy to operate them. Such digital divides, if not ameliorated in time, may have the potential to exclude some from health research.
- **Exclusion due to resource limitations:** At the level of individual researchers at different career levels and research teams, the constraints of time and workloads may introduce disparities in the levels of acquaintance with, and skills needed to work with, novel platforms and technologies that promote more sustainable health research.

Solutions and recommendations

Recommendation 1: Ensure adequate provision of physical infrastructure to effectively support, promote and sustain environmentally sustainable health research in the long term.	
	a) **Adopt and invest in sustainable building practices in research centres and facilities:** Government and health research organisations should invest in sustainable building practices in research centres through the use of innovative active and passive building design, sustainable building materials and the adoption of renewable energy and energy-efficient technologies. In low-resource settings, such investments should be costed within the centralised budgetary allocations of governments and public–private partnerships. Significant support will be required to overcome the technical, social and financial barriers encountered in operationalising such policies.
	b) **Incorporate sustainable hardware infrastructure within clinical data/research centres (see Box 4):** Health research organisations and governments should incorporate energy-efficient servers, high-performance parallel processors, and GPUs to manage the computational demands of AI and machine learning-enabled big data processing.

	c) **Incentivise top-down cross-sectoral investment in greener research campuses, communities, cities and infrastructure:** Governments and health research organisations should incentivise investments, such as in renewable energy, energy efficiency and advanced design, to create greener research communities in universities, other research organisations and cities.
Recommendation 2: Ensure adequate provision of electronic infrastructure to effectively support, promote and sustain environmentally sustainable health research in the long term	
	a) **Promote the considered use of digital technologies to facilitate migration to virtual electronic systems:** Health research funders, health research organisations and individual researchers should consider the use of electronic patient recruitment and testing, remote patient monitoring, decentralised research data collection and communication and, where appropriate guidance has been consulted, decentralised clinical trials.
	b) **Encourage the creation of secure and decentralised virtual platforms:** Health research organisations and individual researchers should encourage the creation of decentralised virtual platforms and cloud computing for collaborative data access, management and analysis. Such platforms are expected to reduce the need to travel, and optimise data sharing and usage, thereby reducing carbon impacts.
	c) **Adopt environmentally sustainable technological tools in health research:** Health research organisations and health research funders should adopt environmentally sustainable technological tools, including smart green algorithms, to minimise their carbon footprints.
	d) **Invest in a smooth and equitable transition to secure sustainable health research:** Health research funders, health research organisations and governments should invest in the development of standardised protocols for health research that account for sustainability, the incorporation of AI and machine learning tools in such protocols, open sourcing of algorithmic codes, and ethical codes of practice.
Recommendation 3: Ensure adequate provision of supportive service infrastructures to promote and sustain environmentally sustainable health research in the long term.	
	a) **Promote efficient and foresightful governance**: Health research organisations and government departments should incentivise, empower and financially support organisations to adopt sustainable cultures and physical infrastructure for conducting environmentally sustainable health research.
	b) **Design and enable effective procedures:** Health research organisations should monitor and manage water, waste and energy use during the conduct of research, with the aim of minimising negative environmental impacts.
	c) **Promote sustainable procurement:** Health research organisations should promote sustainable procurement via supply chains to reduce carbon emissions, conserve natural resources and protect biodiversity. See Theme 4.

Box 4: Description of environmentally sustainable hardware infrastructure

Toward environmentally sustainable hardware infrastructure for health research: Solutions are emerging to the growing environmental challenge posed by the use of energy-hungry computing in health research. With the proliferation of big data, the use of HPC hardware architecture with large central processing units (CPUs) and GPUs to run complex algorithms, including training machine learning, will be a new norm in health research. This hardware infrastructure is energy intensive and generates significant amounts of e-waste. There is understanding among researchers and industrial partners of the need to innovate toward energy-efficient computing research, through efficient power management and advanced cooling technologies for large servers in future health data centres. For example, Google's data centres use machine learning for more efficient cooling and use renewable energy to support their operations. They have achieved a power usage effectiveness (PUE), a metric of energy efficiency, as low as 1.12. For reference, a PUE close to 1.0 is considered ideal, with values above that indicating inefficiencies.daylighting and heat exchanges during summers and winters.

Green algorithms: A leading example of quantitative approaches in computational research is the Green Algorithms project, led by Dr Loïc Lannelongue and Prof. Michael Inouye, from the University of Cambridge (UK), which has generated a carbon calculator and HPC dashboard to facilitate carbon footprinting of almost any computational task. Speaking on behalf of the Green Algorithms team, Prof. Inouye said that quantification fosters personal responsibility within the computational research community, as well as motivating the organisational responsibility needed for sustained systemic change. Development of the Green Algorithms project is ongoing, and includes a Wellcome-funded multi-centre trial to quantify the effectiveness of Green Algorithms carbon reporting tools in reducing the environmental impacts of research computing conducted in six centres: the European Molecular Biology Laboratory at the European Bioinformatics Institute (EMBL-EBI) and the universities of Cambridge, Sussex, Manchester, Oxford and Exeter. Engagement is also taking place with industry stakeholders, including health research groups at AstraZeneca, to trial these approaches outside academic institutions. The latter has the potential to support cadres of sustainable software engineers, demonstrating the quantitative carbon and cost savings possible by implementing greener code and more sustainable computation at industrial scale. The existing curriculum in computer science could be revamped to include quantifying the environmental impact of computational research as an integral part of software engineering principles.

THEME 6: Capacity building of researchers and organisations

Summary

This theme examines the capacity of research organisations and researchers to conduct more environmentally sustainable health research. This includes developing and strengthening skills, knowledge, resources and processes. It looks at the challenges faced, sets out opportunities for improvement and makes recommendations for progress.

- Health research organisations should build centralised institutional capacity to support the individual capacity of their researchers to design and conduct research that is more environmentally sustainable.
- The main barriers to capacity building in research organisations and researchers include financial and resource constraints, including competing priorities, lack of training and a lack of standardised and consistent tools, resources and top-down guidance.
- Current approaches for expanding institutional and individual capacity to implement sustainable research practices in the US and the UK largely consist of accreditation schemes and frameworks, such as LEAF and My Green Lab, as well as access to a growing number of tools and resources and multi-stakeholder collaborative networks.
- Currently, there are no widely accepted or standardised frameworks that guide researchers or institutions, whether public or private, on how to systematically assess, monitor and reduce the environmental burden of their research activities. However, efforts are under way by UK funders to increase the capacity of researchers to conduct research in an environmentally sustainable way through the central collation of training tools and resources.
- Sustainability training and capacity building needs to be developed and scaled across research career pathways at all levels, beginning as early as undergraduate studies. To achieve this, major financial investment will be needed, alongside coordinated action and guidance from government, health research funders and research organisations.
- Collaboration and sharing of best practice, training materials and resources is needed across research organisations, research partnerships and international research collaborations to overcome barriers to adoption and to scale up capacity among researchers and research organisations.

Explainer of theme

Capacity building is the process of strengthening the abilities of individuals, organisations or communities to achieve their goals and to adapt to changing circumstances. It involves developing and strengthening skills, knowledge, resources and processes. In this context, the capacity to design and conduct sustainable research is defined as the ability of researchers to implement their studies with minimal environmental impact.

To expand the use of sustainable research practices, health research organisations will need to provide institutional support to increase the capacity of researchers, faculty and students to design and conduct sustainable research. As part of this process, individual researchers may need education, time and resources, such as guidance, staff engagement and funding.

Context/state of play

The ability to build capacity on environmentally sustainable health research is currently impeded by a lack of clarity on the skills, knowledge, resources and processes required for progress. There are no widely accepted or standardised frameworks that guide researchers or institutions, whether public or private, on how to systematically assess, monitor and reduce the environmental burden of their research activities. (See also Theme 1 on data, metrics and information availability.) This gap poses a challenge for capacity building, as institutions and researchers lack the technical knowledge, operational models and guidance needed to integrate environmental sustainability into the research life cycle. There is growing momentum to address this issue and provide institutional support, tools and collaboration platforms, especially in the UK,[192] although most training emphasises awareness over practical skills. Furthermore, many of the training and capacity-building initiatives focus on clinical trial and laboratory-based research, or on the use of carbon calculators, as described in Theme 1.

In the UK, institutional leadership on embedding environmental sustainability within health research has accelerated notably since early 2024. In March of that year, the NIHR launched its Climate, Health and Sustainability programme, which includes an explicit commitment to build capacity in sustainable research practices, such as climate-health awareness training, infrastructural decarbonisation, and funding for carbon reduction in clinical research environments.[193] This programme is complemented by bespoke guidance, such as carbon reduction guidelines and carbon footprint reporting protocols intended for adoption by NIHR-funded clinical teams.

Furthermore, UKRI is developing a resource database (SPARKhub) that will provide researchers with tools, certification and guidance to design environmentally sustainable research and implement best practices in their projects. While full details are not yet public, this indicates a move toward centralisation and standardisation of sustainability knowledge, with funders beginning to play a more active role in shaping research conduct. If successful, this model could be expanded across other funding bodies or regions as UKRI has been seeking a collaborative approach to governance of the resource.

Many research institutions have organisation-wide sustainability goals and practices but there is still scope to build capacity specific to ensuring sustainability in research. A 2023 RAND Europe report commissioned by the Wellcome Trust found that out of 37 general sustainability education programmes, those that covered research focused mainly on laboratory research.[194]

Practical tools and community-level training are also gaining traction. A key example is the Greener Trials Toolkit, jointly developed by the Institute of Cancer Research and the University of Liverpool, with NIHR backing.[195] This toolkit offers protocols for carbon footprint audits and has been piloted in upward of a dozen publicly funded trials, delivering actionable insights on areas like travel, energy usage, and supply logistics. Further, coalitions such as the Sustainable Healthcare Coalition’s Low-Carbon Clinical Trials working group and the NIHR-MRC TMRP provide forums for cross-sector learning, including webinars, workshops, and peer-led training designed to embed sustainability in clinical trial design and delivery. At the academic-institution level, University College London’s MRC Clinical Trials Unit has formally integrated sustainability into workplace operations, such as by earning a Green Impact Gold Award, implementing paper reduction and negotiating hybrid meeting infrastructure, while work continues on sustainability modules for clinical trial delivery.[196] There is also increased activity to integrate sustainability into teaching and learning for students, with the university embedding sustainability into the curriculum of the medical school. The University of Manchester is developing a sustainability risk assessment tool for undergraduate students to assess the environmental impact of experiments they will conduct, as part of the project ‘SOS’: Sussing Out Sustainability in Teaching Laboratories.[197]

192. National Institute for Health and Care Research (no date). *Climate, health and sustainability.* https://www.nihr.ac.uk/about-us/what-we-do/climate-health-sustainability

193. National Institute for Health and Care Research (2024). *Our commitments to climate, health and sustainability 2024-2026* mrctcenter.org+6nihr.ac.uk+6nihr.ac.uk+6

194. Smith P, *et al.* (2025). *Advancing environmentally sustainable health research.* RAND Europe for the Wellcome Trust. https://cms.wellcome.org/sites/default/files/2023-08/Research_Sustainability_Report_RAND_Europe_August_2023.pdf

195. Medical Research Council - Hubs for Trials Methodology Research (no date). *Enabling lower carbon clinical trials.* https://www.methodologyhubs.mrc.ac.uk/about/working-groups/trial-conductwg/tcwg-subgroup-greener-trials/enabling-lower-carbon-clinical-trials-cict-project

196. University College London (no date). *Our environmental commitment.* https://www.mrcctu.ucl.ac.uk/about-us/our-environmental-commitment

197. Royal Society of Chemistry (no date). *RSC awards more than £200,000 in latest round of Sustainable Laboratories Grants funding.* https://www.rsc.org/news/sustainable-labs-grants-round-2

In the US, activity has been similarly problem-oriented but it has been more discretionary in nature. The NIH has implemented a programme adapted from My Green Lab that has been adopted by public research institutions, such as the MIT Office of Sustainability.[198] The Multi-Regional Clinical Trials Center (MRCT) at Brigham and Women's Hospital and Harvard University recently completed a multi-stage exploration (2023-2024) of the environmental impacts of clinical trials, convening stakeholder scoping discussions and thematic analyses to identify priority areas such as standardised carbon footprint measurement and life cycle emissions reporting.[199] Their engagement with the MRC-NIHR TMRP Greener Trials group in July 2024 illustrates international collaboration in capacity-building efforts. While the MRCT's broader training platforms encompass essentials such as ethics and trial methodology, explicit sustainability-focused modules have yet to be integrated, though its existing infrastructure positions it well to do so.

Among US non-profits and industry stakeholders, emerging models offer additional training-oriented precedents. The Decentralized Trials and Research Alliance has helped embed remote and hybrid trials, which reduce GHG emissions by minimising travel demands. At the same time, pharmaceutical companies and contract research organisations, responding to the escalation in environmental, social, and governance (ESG) expectations, have begun developing internal training modules on supply chain sustainability, digital trial design, and operational carbon monitoring.[200]

A list of training and capacity-building resources for researchers on environmentally sustainable health research can be found in Annex 3.

Key findings

There is growing awareness and motivation among researchers regarding reducing the environmental impact of their work and seeking ways to make their research more sustainable.[201] These efforts should be recognised, harnessed and capitalised upon. Furthermore, the potential benefits of training researchers to design and conduct environmentally sustainable research are substantial. These include direct cost savings from reduced energy and material use, reputational gains for institutions committed to sustainability, and a lower overall environmental footprint of research activity. However, there remains a significant gap in institutional training and capacity building in regard to how to design and conduct environmentally sustainable research across the full research life cycle. While some top-down initiatives are emerging, particularly among UK funders, their scale and maturity vary, and in many cases, details remain limited or pending further announcement.

Efforts to improve sustainability in laboratory-based research are emerging, though they are still fragmented. Training in this domain generally focuses on reducing energy and water consumption, minimising waste, and promoting shared equipment use.[202] These efforts are largely decentralised, with individual institutions or research groups leading localised programmes. National tools and certification schemes, such as LEAF and My Green Lab, have helped to standardise some aspects of training, provide actionable guidance and measure progress. However, uptake is varied, and few institutions offer comprehensive or mandatory sustainability curricula. Researchers also rely on informal and heterogeneous sources of information, including open access resources from organisations such as the International Institute for Sustainable Laboratories and platforms like Lab Manager. The diversity of these training pathways suggests a need for more coordinated, standardised approaches, possibly led by national funders or regulatory bodies.

198. National Institutes of Health (no date). *NIH Green Labs Program.* https://nems.nih.gov/green-teams/Pages/NIH-Green-Labs-Program.aspx

199. The Multi-Regional Clinical Trials Center of Brigham and Women's Hospital and Harvard (no date). *Environmental sustainability in clinical trials.* mrctcenter.org

200. Pharmaceutical Supply Chain Initiative (2024). *Decarbonization playbook for the pharmaceutical industry.* https://pscinitiative.org/resource?resource=2573

201. Greever C, Ramirez-Aguilar K & Connelly J. (2020). *Connections between laboratory research and climate change: what scientists and policy makers can do to reduce environmental impacts*. FEBS Lett. **594**, 3079-3085. https://febs.onlinelibrary.wiley.com/doi/10.1002/1873-3468.13932

202. Royal Society of Chemistry (2022). *Sustainable laboratories: a community-wide movement toward sustainable laboratory practices.* https://www.rsc.org/globalassets/22-new-perspectives/sustainability/sustainable-labs/sustainable-laboratories-report.pdf

In the context of clinical research, the absence of formal sustainability training or capacity-building programmes is particularly stark. Although individual trial teams have identified areas where environmental impact can be mitigated, such as avoiding single-use plastics for participant incentives, optimising travel logistics for site visits and updating sample collection and storage practices, these considerations are not yet embedded in institutional guidance or ethics processes. Lessons from laboratory settings, such as the reuse of samples and minimising waste, may be transferable to clinical environments, but there is little structured effort to do so. The current lack of a shared evidence base, guidelines, or training infrastructure makes it difficult to assess institutional readiness or track progress toward more sustainable clinical research.

Similarly, standard practices on capacity building for sustainable computational health research are also very limited. There are some initiatives in the UK, such as the Green Algorithms initiative, covered above, which is one of the very few resources that provide webinar training and online calculating tools for researchers. There is an urgent need to increase capacity building in environmental sustainability for this specific type of health research, given the increasing use of energy-intensive digital technology in research.

More broadly, a key barrier across clinical, desk-based and laboratory-based health research settings is the lack of targeted training for the existing research workforce. Sustainability principles are not yet routinely incorporated into continuing professional development or mandatory training updates, which represents a missed opportunity to enable current staff to enhance their capabilities at all career stages. Education on sustainable research practices could begin at undergraduate level and continue through postgraduate and into professional levels at all career stages.[203] In the UK and US, precedents exist in other areas of universal research training, such as ethics, human subjects protections, and Good Clinical Laboratory Practice (GCLP).

Additionally, the role of teaching and mentorship must not be overlooked. There is little published evidence on how researchers are currently taught to design and conduct environmentally sustainable research, either within formal degree programmes or informal training pathways, such as the mentoring of early career researchers by more experienced staff members, as proposed in Theme 1. Although individual efforts to include sustainability in curricula or to develop courses specifically aimed at teaching sustainable research practices are taking place, current materials may not be suitable or sufficiently specific.[204,205,206,207] Addressing this on a significant scale will require collaborative efforts across institutions to co-develop standards, course materials, and implementation strategies that can be integrated into research training from early career through senior leadership.

To succeed, the implementation of sustainability in research will require additional capacity at all levels. Key challenges include identifying effective practices, directing financial and human resources to this purpose, and evaluating and maintaining these programmes. Efforts to bring about large-scale change would benefit from governmental investment and regulation across institutions and this may pose a challenge depending on political priorities.

Unintended consequences and considerations

- Costs: Capacity building may incur increased or unexpected cost and time requirements. Without corresponding policy changes, resource allocation, and institutional incentives, researchers may lack the support and resources needed to translate knowledge into action. Such financial barriers could be addressed by using existing training resources or external standardised training modules created by leading organisations and by institutions collaborating to share their resources and practices.
- There is potential for inequality where training initiatives are introduced unevenly, due to the cost and time requirements highlighted above. This could create divisions between sustainability-trained and traditional researchers. To prevent this, training needs to be widely available.

203. Royal Society of Chemistry (2022). Sustainable laboratories. https://www.rsc.org/policy-and-campaigning/environmental-sustainability/sustainable-laboratories
204. UCL Institute of Education (no date). *Teaching for sustainable futures*. https://www.ucl.ac.uk/ioe/departments-and-centres/ucl-centre-climate-change-and-sustainability-education/teaching-sustainable-futures
205. My Green Lab (no date). *My Green Lab® accredited professionals program*. https://mygreenlab.org/programs/accredited-professionals
206. ORBIT (no date). *Environmentally sustainable research*. https://orbit-rri.org/training-courses/environmentally-sustainable-research
207. Campbell CD, Birkett TC & Stewart MI (2024). *Applying a guided inquiry approach to a classic practical on chemoselective reduction*. Journal of Chemical Education **101(8)**, 3434-3444. https://pubs.acs.org/doi/10.1021/acs.jchemed.4c00331

- The inclusion of sustainability training in education programmes might crowd out other essential research skills development or overburden students in already time-limited curricula. This can be addressed by building training in sustainability into existing modules or core components, such as laboratory or field work. Such an approach would also provide a hands-on experience, which is more likely to have a lasting impact and be directly applicable in a research setting.
- The inclusion of sustainability teaching might become a 'tick-box' exercise and therefore suitable assessments need to be developed to ensure training is having the desired impact.

Solutions and recommendations

Recommendation 1: Expand institutional capacity to support training on environmentally sustainable research

a) **Leverage funders to drive capacity building:** Health research funders should offer targeted funding streams and incentives for the capacity building of researchers within research institutions, particularly for cross-institutional and cross-border collaborations.

b) **Share promising practices and build collective capacity:** Health research organisations should actively share resources, promising practices, and training materials to support smaller or less well resourced organisations in adopting sustainability practices.

c) **Support sustainability in international partnerships:** Health research organisations and health research funders involved in global collaborations should ensure that host country researchers and institutions receive appropriate training, tools and resources to implement sustainable research practices.

d) **Develop a standardised framework and best practice guidance for training and capacity building:** National research bodies, in partnership with health research organisations, should co-create and publish a set of best practices or standardised recommendations to guide the integration of training in environmentally sustainable practice across research disciplines. These should be flexible and adaptable to meet needs in different contexts.

Recommendation 2: Develop and scale sustainability training and capacity building across research career pathways

a) **Fund sustainability training at all research career levels:** Health research funders and health research organisations should provide dedicated funding for sustainability training across undergraduate, postgraduate and professional research career stages to build long-term capacity.

b) **Embed sustainability into mandatory training programmes:** Health research organisations and training providers should integrate sustainability content into existing Good Research Practice (GRP), Good Clinical Practice (GCP), safety, and research ethics training.

c) **Create technical training and upskilling opportunities:** Health research organisations should offer technical training in sustainable research practices tailored to a wide range of research environments, not limited to laboratory settings.

d) **Establish central technical assistance services:** Health research organisations and health research funders should co-create technical assistance resources or consultative services to review research proposals and operations, offering tailored recommendations for reducing environmental impact.

	e) **Develop and scale structured curricula on sustainable research:** Health research organisations and higher education institutions should co-develop formal curricula on sustainable research practice and make them accessible to both public and private researchers.
Recommendation 3: Promote transparency and collaboration in sustainability training and capacity building efforts	
	a) **Share sustainability training materials across institutions:** Higher education and health research organisations should openly share training curricula, methods and tools used to build sustainability capacity to support sector-wide improvement.
	b) **Conduct coordinated reviews of current practice:** National research bodies, higher education, and health research organisations should lead reviews across organisations to identify effective training models, barriers to adoption, and opportunities for scaling sustainability capacity.

Conclusion

Improving the environmental sustainability of health research in the United Kingdom and the United States is both an ethical imperative and a practical necessity. The sector's sizeable carbon footprint – from energy-intensive laboratories to complex international clinical trials – risks eroding the very health outcomes it strives to advance. Our analysis points to three overarching insights.

First, progress hinges on having *standardised, comprehensive metrics and data methodologies.* Consistently tracking GHG emissions (including elusive scope 3 sources, such as supply chains and cloud computing) enables benchmarking, guides investment and exposes 'carbon hotspots' where change delivers the greatest return. Without common yardsticks, comparisons across disciplines, institutions and borders remain impossible, stalling collective action.

Second, *system-level coordination* must match the growing grassroots momentum. Funders, regulators, research organisations and industry each wield unique levers – grant criteria, ethical approvals, procurement policies, infrastructure investments – for embedding sustainability. Aligning these levers, rather than relying on isolated initiatives, will accelerate uptake while minimising administrative burden and duplication. Recent UK commitments and emerging US efforts offer a template, but global alignment and collective responsibility are essential to hold the health research sector to account, avoid fragmented standards and to ensure researchers in resource-limited settings are not left behind.

Third, *capacity building and equitable support* are critical. Training researchers to quantify and mitigate environmental impacts, incentivising the sharing of best practice, and investing in sustainable infrastructure will normalise climate-conscious research without compromising scientific rigour. Such investments ultimately reduce costs through energy savings, waste reduction and streamlined processes, reinforcing the economic case for sustainability.

Collectively, these insights lead to a clear call to action:

1. **Adopt and refine shared metrics, tools and methodologies** for all research activities –including digital and AI-driven methods – to ensure transparent, comparable reporting.
2. **Embed sustainability requirements incrementally** in funding, regulatory and publication processes, pairing them with accessible guidance and financial support.
3. **Invest in people and infrastructure,** prioritising training, accreditation schemes and green facilities that can be scaled up across diverse research settings.
4. **Foster international collaboration and data sharing,** recognising that climate change knows no borders and that solutions developed in one context can benefit many.

The health research community excels at solving complex problems through collaboration and evidence. Addressing its own environmental impact is no different. By harnessing the momentum already visible in laboratories, funding agencies, regulatory bodies and industry, the sector can lead by example – advancing knowledge while safeguarding the planet on which human health depends.

Annexe 1: Acronyms and abbreviations

AHRQ	Agency for Healthcare Research and Quality
AI	Artificial intelligence
CDC	Centers for Disease Control
DDCT	Decentralised digital clinical trial
DHSC	Department of Health and Social Care
ECI	Environmental Change Institute
EIA	Environmental impact assessment
ESG	Environmental, social, and governance
FDA	Food and Drug Administration
GCLP	Good Clinical Laboratory Practice
GHG	Greenhouse gas
GPU	Graphics processing unit
HHS	Department of Health and Human Services
HPC	High-performance computing
HRA	Health Research Authority
HTA	Health technology assessment
IRB	Institutional review board
LEAF	Laboratory Efficiency Assessment Framework
LEAN	Laboratory Efficiency Action Network
LEED	Leadership in Energy and Environmental Design
MHRA	Medicine and Healthcare products Regulatory Agency
MIT	Massachusetts Institute of Technology
MRC	Medical Research Council
MRCT	Multi-Regional Clinical Trial
NHS	National Health Service
NICE	National Institute for Health and Care Excellence
NIH	National Institutes of Health
NIHR	National Institute for Health and Care Research
NSF	National Science Foundation
OHRP	Office for Human Research Protections
SMEs	Small and medium-sized enterprises
TMRP	Trials Methodology Research Partnership
UKHSA	UK Health and Security Agency
UKRI	UK Research and Innovation
UNFCCC	UN Framework Convention on Climate Change
WHO	World Health Organization

Annexe 2: Definitions

Key definitions

Defining health research
In this report we use the WHO's definition of 'health research', which refers to *'the systematic collection or analysis of data with the intent to develop generalizable knowledge to understand health and health challenges and mount an improved response to them'*.[208]

Based upon the above definition, we would broadly categorise 'health research' as encompassing, but not limited to, the following list of areas:

- Biochemical or physiological research occurring in laboratory settings
- Animal-based research
- Clinical trials involving human subjects, not yet in the 'real world'
- Applied research (moving trials to the 'real world')
- Medical device/technology testing and development
- Behavioral research with human subjects
- Computational research (including simulation and large dataset-driven research using words, numbers or graphics)
- Health services, systems, and workforce research
- Public health research (e.g. on epidemiological, macro-level health challenges)

Whilst the list above is quite extensive, the majority of the findings and evidence in this report are based largely upon research conducted in laboratory, clinical and computational research settings. Further research is needed to provide evidence on the sustainability of health research in wider health research settings.

Stakeholder definitions

A number of stakeholders are identified in this report. A description of each stakeholder can be found in the table below.

Stakeholder	Description	Icon
Health research organisations	Unless otherwise specified, research organisations refers to public, public and academic research organisations.	
Health research funders	Organisations, agencies or institutions that provide financial resources to support health research.	
Health research regulators	Authorities or bodies responsible for overseeing how research is designed, conducted and reported to ensure it meets legal, ethical and safety standards.	
Health researchers	Individuals who systematically investigate questions, problems or phenomena to generate new knowledge, develop solutions or improve existing knowledge/practices.	

208. WHO (no date). *Research* [web page]. https://www.who.int/health-topics/research/#tab=tab_2

Stakeholder	Description	Icon
Health research groups/teams and leads	Groups who work together on the same health project/topic to systematically investigate questions, problems or phenomena to generate new knowledge, develop solutions or improve existing knowledge/practices. Health research group leads are the leads of these groups.	
Sustainability and environmental impact information providers	Organisations, groups or individuals who provide information to others on how to improve the environmental and sustainability impacts of health research.	
National health research bodies	Government/federal funding bodies which focus on advancing health and research. They play a crucial role in funding, coordinating and overseeing research initiatives.	
Government departments	Health research-related departments within government that influence or set direction on policy.	
Institution review boards	Committees responsible for overseeing and reviewing research involving human subjects within an institution.	
Health research educators	Groups/individuals/organisations who provide health research or related education.	
Health research publishers	Organisations who facilitate the publishing of research and scholarship.	
Umbrella organisations	Associations of related institutions who work together to coordinate activities or pool resources.	
Relevant state/local environmental agencies	Government bodies responsible for protecting the environment at a local level. They work to ensure sustainable development, manage natural resources and address environmental issues such as pollution and habitat conservation.	
Higher education institutions	A higher education institution is defined as a university or non-university entity that provides education beyond secondary school, often engaging in research and following a framework established by relevant legislation. These institutions can be public or private and may offer various programs of study.	
Health research training providers	An individual or organisation that provides training on health research to individual researchers or to health research organisations.	
Industry	Private companies that conduct medical research and manufacture drugs and medical equipment	
Suppliers	Individuals or organisations providing the products or services needed to conduct health research	

Annexe 3

The structure of the US and UK health research sectors

The health research sectors in the UK and the US are made up of a wide range of stakeholders and actors, from researchers at individual levels to suppliers, procurement specialists, research organisations, funding bodies and regulators. These cover governments, health service providers, and private and philanthropic bodies.

Basic structure of UK health research sector

In the UK, publicly financed basic health research is largely funded by UKRI's MRC, through funding from the UK government's Department for Science, Innovation and Technology. The Department of Health and Social Care (DHSC) funds applied health research through NIHR. DHSC additionally funds the UK Health and Security Agency (UKHSA), which provides scientific and operational leadership on security against public health hazards. Both private biopharmaceutical companies and non-governmental funders support a large proportion of basic and applied health research in the UK. The HRA regulates applied health research, while the MHRA, a government-independent body, regulates and reviews the safety of all medicines and therapeutics for use in the UK, including the regulation of clinical trials of those products. The National Institute of Health and Care Excellence (NICE) provides guidance, support and recommendations for both applied research and the use of medicines and therapeutics and carries out health technology assessments (HTAs) to determine whether a medicine is recommended for use within the NHS in England and Wales (NHS Wales is advised by Health Technology Wales). In Scotland, this function is carried out by the Scottish Medicines Consortium and Scottish Health Technologies Group, In Northern Ireland, Health and Social Care NI reviews guidance provided by NICE and the technology's suitability for use in Northern Ireland. Both NICE and the HRA are funded by the DHSC.

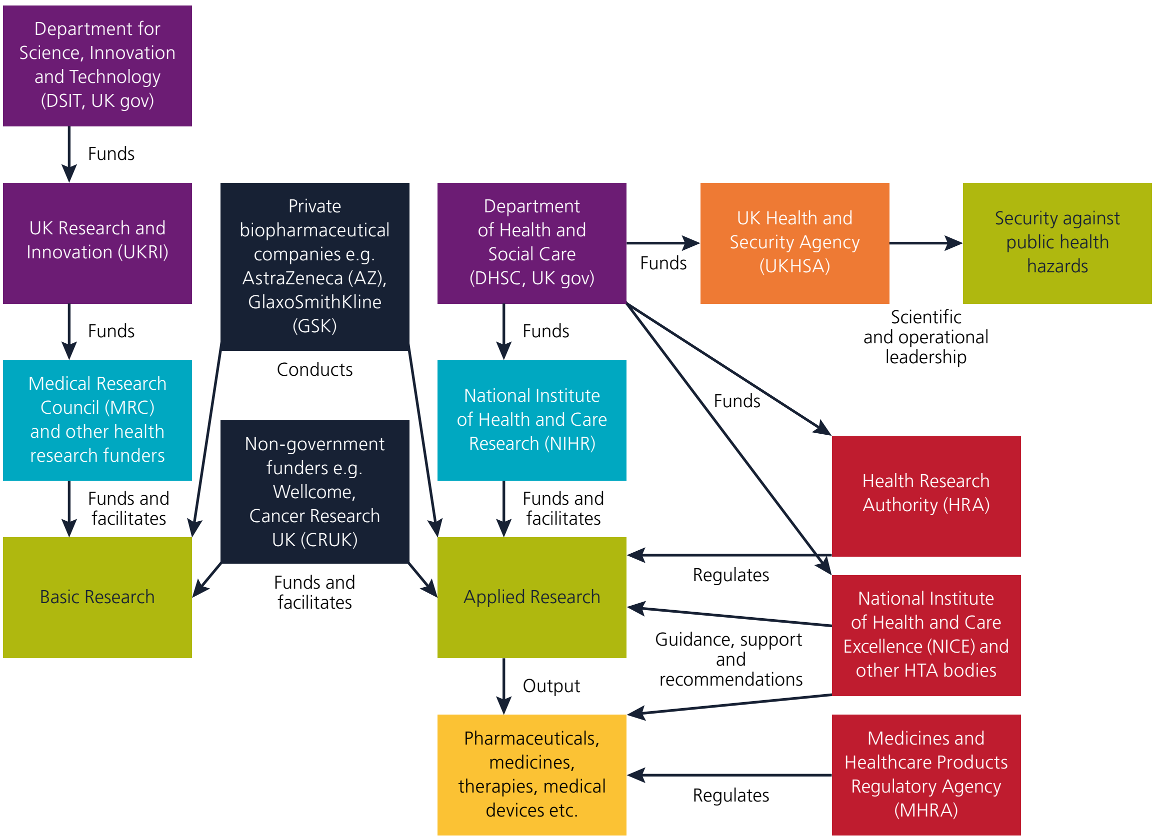

Figure 1: Schematic of the basic structure of the UK health research sector

Basic structure of US health research sector

In the US, the HHS houses many agencies, five of which (CDC, Agency for Healthcare Research and Quality (AHRQ), OHRP, FDA and NIH) are the major funders of US health research, though health-related research is funded through other agencies in HHS as well.

The NIH funds and facilitates both basic and applied research through either the Intramural Research Program, which takes place within the 27 NIH institutes, or the Extramural Research Program within non-NIH facilities. Funding may also be awarded to international researchers. The NSF is a HHS-independent government body which funds basic health research, as does the US Department of Defense. Similarly to the UK, both private biopharmaceutical companies and non-governmental funders support basic and applied health research. Two HHS departments are responsible for the regulation of applied health research, the FDA and OHRP. The FDA also regulates and approves all pharmaceuticals, medicines, therapies and medical devices for use in the US. The AHRQ supports health systems research, whilst the CDC provide security against public health hazards.

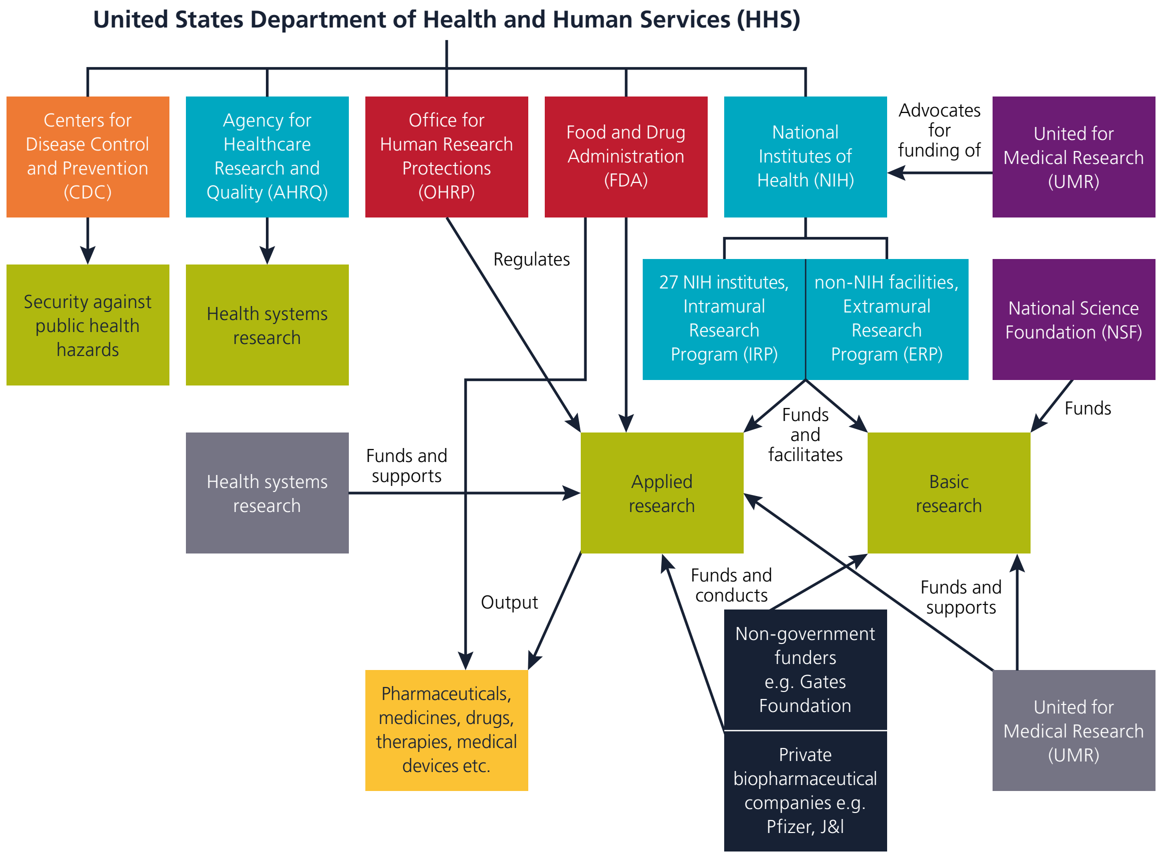

Figure 2: Schematic of the basic structure of the US health research sector

Key stakeholders in the UK and US health research sectors

	UK examples	US examples
Government/civil service	DHSC Department of Science, Innovation and Technology	HHS
	UKHSA	CDC
	UKRI	FDA
		NIH
		OHRP
		AHRQ
		NSF
Public funders	MRC, funded by UKRI	NIH
	NIHR	NSF
Non-government funders (examples)	Wellcome Trust	The Gates Foundation
	Cancer Research UK	Robert Wood Johnson Foundation
Membership bodies	Association of Medical Research Charities (AMRC) Association of the British Pharmaceutical Industry (ABPI)	
Health regulators	MHRA	FDA
	HRA	OHRP
Major health research-supporting organisations	The King's Fund	HRA
	NICE and Scottish Medicines Consortium	American Public Health Association (APHA)
		United for Medical Research (UMR)
Educational organisations	Medical Schools Council; UK medical schools Universities	US medical schools Colleges Universities
	UK universities providing courses on life sciences	
Trade unions (UK)/labour unions (US)	British Medical Association (BMA)	National Union of Healthcare Workers (NUHW)
	Academy of Medical Royal Colleges	National Nurses United (NNU)

	UK examples	US examples
Health service providers	NHS	Hospital systems, e.g. HCA Healthcare
	Independent Healthcare Provider Network (IHPN)	Home Health Agencies, e.g. BrightStar Care
Industry (examples)	AstraZeneca	Pfizer
	GSK	Johnson and Johnson
Academic research institutes	University College London	Harvard University
Academic basic health research institutions (university-independent)	Laboratory of Molecular Biology	Johns Hopkins University
	Francis Crick Institute Institute of Cancer Research	Van Andel Institute
Procurement and supply chain	Scientific Laboratory Supplies (SLS)	ThermoFisher Scientific
	GE HealthCare Life Sciences	New England Biolabs (NEB)
	Merck KGaA	VWR, Avantor
Health research-related professionals	Researchers and research-specific roles Laboratory managers Procurement specialists Laboratory technicians Clinical research associates Scientific operations, sites professionals	

Annexe 4

Examples of environmentally sustainable health research initiatives, networks, training and accreditation schemes and policy approaches in the UK and the US

Name	Description	Reference
Tools/initiatives		
My Green Lab (global initiative started in the US)	Non-profit organisations aiming to make research more sustainable; works with scientists and research organisations to improve environmental health and resource utilisation. The My Green Lab certification is considered the gold standard for laboratory practices around the world.	My Green Lab - My Green Lab
LEAF (UK)	The framework provides defined sustainability actions that lab users can take to reduce waste, energy, plastics and water in the lab.	LEAF – A new standard in Sustainable Science
International Institute for Sustainable Laboratories (I2SL) (US)	Focused on promoting sustainable design and operation of laboratories and other high-tech facilities. They also develop and disseminate guidelines and toolkits for sustainable lab practices.	Home | I2SL
Green Impact (UK)	An employee engagement programme providing a toolkit of effective actions that can be taken to support environmentally and socially sustainable practices in organisations.	Green Impact | Students Organising for Sustainability | Green Impact is SOS-UK's sustainability engagement program for teams
Life Cycle Assessment (LCA) (global)	A standardised methodology for measuring the environmental impact of a product through every phase of its life. The goal of LCA is to facilitate decision-making.	Life Cycle Assessment - an overview | ScienceDirect Topics
Green Algorithms (UK)	Aims to promote more environmentally sustainable computational science. Provides many resources, including an online calculator to estimate the carbon emissions of computing.	Green Algorithms | Green Algorithms
Greenhouse Gas Protocol (global)	Provides standards and guidance to provide a framework for businesses, governments and other entities seeking to measure and report their GHG emissions.	Homepage | GHG Protocol

Green Light Laboratories (UK)	Offer their customers the means to identify the most sustainable lab equipment for their needs and to use it in the most efficient, cost-saving manner.	Green Light Laboratories
Green Lab Associates (UK)	Guides labs toward sustainable practices, saving money, cutting pollution and unlocking research potential.	Green Lab Associates
The Planetary Health Report Card Initiative (US)	A metric-based tool for evaluating and improving planetary health in health professional schools.	Home - PHRC
RecycleLab (UK)	Works with labs to help them understand the environmental impact of their waste management systems. Helps them to implement change and offers services for plastic waste collection, decontamination and recycling.	Circular Economy Lab Plastics | RecycleLab Ltd
LabCycle (UK)	Safely recycles single-use plastic waste, including materials that are hazardous or contaminated from the laboratory setting. The first company on the market to create a circular economy for single-use plastics.	Home - LabCycle
The Freezer Challenge	An international initiative by My Green Labs and I2SL to enhance the energy efficiency of cold storage.	Freezer Challenge

Name	Description	Reference
Groups and networks		
Future Earth (global, UN)	A global network of scientists, researchers and innovators collaborating for a more sustainable planet.	Home | Future Earth
Sustainable Markets Initiative (SMI) Health Systems Taskforce (UK)	A public–private strategic partnership taking joint, scalable action to accelerate the delivery of net zero healthcare.	Health Systems taskforce | Sustainable Markets Initiative
Sustainable Developments Solutions Network (global, UN)	Operates under the auspices of the UN Secretary-General, mobilising the world's largest knowledge network to drive action on the Sustainable Development Goals and the Paris Agreement on Climate Change.	Home - Sustainable Development Solutions Network
Sustainable Healthcare Coalition (UK)	The coalition drives action on net zero healthcare, bridging public and private sectors to deliver sustainable solutions that prioritise human health alongside environmental stewardship. They have produced a Clinical Trials Carbon Calculator to help provide some indicative numbers on carbon emissions associated with trials.	Sustainable Healthcare Coalition | A healthcare sector-led group that looks for the greatest opportunities to inspire sustainable practices in healthcare through collaboration

Centre for Sustainable Healthcare (UK)	An independent non-profit leading sustainable transformation in health systems. Provides strategic input to healthcare organisations through a variety of bespoke services and initiatives and provides education and guidance for healthcare professionals. It also undertakes research projects that aim to improve the sustainability of the healthcare sector worldwide.	Sustainable Healthcare
Action Collaborative on Achieving a Climate Resilient and Sustainable Health Sector (US)	Provides a neutral platform for its participants to align around collective goals and actions for decarbonisation, based on evidence, shared solutions, and a commitment to improving health. The collaborative's work focuses on healthcare supply chain and infrastructure; healthcare delivery; health professional education and communication; and policy, financing and metrics.	Action Collaborative on Decarbonizing the U.S. Health Sector - NAM
Digital Humanities Climate Coalition (UK)	The coalition focuses on understanding and minimising the environmental impact of digital humanities research.	Home | DHCC
Green Your Lab (global initiative started in the US)	A non-profit organisation that leads scientists, vendors, designers and energy providers in improving the social and environmental responsibility of scientific research.	Green Lab Best Practices | Green Your Lab
Green Neuroscience Working Group (UK, British Neuroscience Association)	The group helps guide the British Neuroscience Association's activities, set targets on carbon reduction, and raises the profile of green neuroscience within the wider neuroscience community.	Green neuroscience | The British Neuroscience Association
MRC and NIHR TMRP – Greener Trials subgroup (UK)	The overall aim of the group is to facilitate networking and collaborative research in environmentally sustainable clinical trials.	Network Hubs: About TMRP
LEAN (UK)	An organisation of individuals who are passionate about sustainable science working in academia. Members meet regularly and share best practice through an online forum and resources.	Sustainable Science | Laboratory Efficiency Action Network (LEAN)
Sustainable European Laboratories (SELs) Network (Europe)	A network of local sustainability teams and independent 'green labs' networks that advocates for sustainable research practices in Europe.	SELs Network - SELs Network

Name	Description	Reference
Initiatives by academia		
Environmental Change Institute (ECI) (University of Oxford)	The ECI has eight research programmes, which focus on climate; energy; ecosystems; infrastructure; food systems; global finance and economy; environment and health; and land, society and governance.	Home | Environmental Change Institute
Dunn School Green Group (University of Oxford)	A community of students, postdocs, group leaders, facility and lab managers, and administrative staff at the Dunn School who are championing environmental sustainability within the institute through numerous initiatives.	Home | Dunnschoolgreengroup
Environmental Sustainability Strategy (University of Oxford)	The strategy aims to achieve net zero carbon and achieve biodiversity net gain by 2035.	Environmental Sustainability Strategy | Sustainability
Green Labs initiative (University of Bristol)	Works on making the University's labs more efficient, sustainable and compliant by focusing on four areas: design, equipment and operation, management and training, and encouraging behavioral changes.	Sustainable Science and Green Labs | Sustainability | University of Bristol
Greener Trials (University of Liverpool)	Aims to reduce the carbon footprint of clinical trials by digitising guidance for assessing the carbon footprint of publicly funded trials to more rapidly gather the data required to identify areas of concern, identify research gaps and issues with current decarbonising systems, share mitigation strategies and promote behaviour change.	New initiatives to advance move towards greener healthcare - News - University of Liverpool
Energy Interdisciplinary Research Centre (University of Cambridge)	Brings together Cambridge researchers to collaborate with global partners on creating solutions for a sustainable and resilient energy landscape for generations to come.	Energy | Interdisciplinary Research Center
Climate and Sustainability Action Plan (Kings College London)	Sets out 14 key impact areas to guide the university's approach to sustainability and climate change, informed by the UN Sustainable Development Goals.	Climate & Sustainability Action Plan | King's College London
University of California Center for Climate, Health and Equity	The Center aims to drive climate action to safeguard health through research, education, health system sustainability, and policy.	About Us | UCSF Center for Climate, Health, and Equity
Harvard Office for Sustainability (Sustainability Action Plan)	A framework outlining how Harvard will meet its sustainability goals, through an integrated, interconnected methodology.	Sustainability Action Plan - Harvard Office for Sustainability

Name	Description	Reference
Initiatives by the private sector		
The Carbon Neutral Laboratory (GSK)	The laboratory is built from natural materials and energy required to run the laboratory is met by renewable sources, such as solar power and sustainable biomass.	The Carbon Neutral Laboratory - The University of Nottingham
Green Chemistry Initiative (Pfizer)	Through the Green Chemistry Initiative, Pfizer are developing processes that are more sustainable, environmentally sound and cost-effective. They are prioritising the use of environmentally preferable chemicals, eliminating waste and conserving energy.	Greener Processes | Pfizer
Ambition Zero Carbon (AstraZeneca)	AstraZeneca are investing over $1 billion to decarbonise their business and value chain.	Ambition Zero Carbon
Green Chemistry Initiative (Takeda)	Takeda has a goal of achieving net zero GHG emissions by 2035. Focusing on energy efficiency projects and low-emission technologies, Takeda is increasing renewable energy sources at its sites and purchasing renewable energy on a regional basis. It is also reducing indirect emissions by engaging with suppliers.	Protecting our Planet - Sustainable Products | Takeda Pharmaceuticals
Amgen	Amgen strive to reduce their impact on the environment throughout their operations and value chain by reducing the natural resources used, the emissions produced, and waste generated.	Environmental Sustainability | Amgen
New England Bioscience (NEB)	NEB has a commitment to promoting environmental sustainability and ensuring the protection and preservation of natural resources. Its building is LEED certified and it strives to incorporate sustainability throughout the business pipeline.	Environmental Commitment | NEB
Merck	Merck plans to achieve climate neutrality and reduce resource consumption by 2040.	Sustainability at Merck: Creating enduring value | Merck

Name	Description	Reference
Initiatives by funders and governing bodies		
NIH Green Labs Program (US)	The NIH developed the Green Labs Program to increase awareness and participation of laboratory personnel in sustainable laboratory practices, with the goal of protecting the environment and human health.	Green Teams NIH Green Labs Program

Concordat for the Environmental Sustainability of Research and Innovation Practice	This cross-sector concordat for the environmental sustainability of research and innovation practice supports the UK government's ambition to achieve net zero by 2050. The signatories are committed to progressively embedding environmental sustainability into all aspects of research and innovation practices.	Concordat for the Environmental Sustainability of Research and Innovation Practice
UKRI Environmental Sustainability Strategy (UK)	A strategy setting out UKRI's ambition to be a leader in environmental sustainability for the sector.	UKRI environmental sustainability strategy – UKRI
NIHR commitments to climate, health and sustainability (US)	NIHR has a commitment to: reducing the environmental impact of central operations; funding research into climate, health and environmental sustainability; publishing and disseminating findings to share knowledge; and building capacity around environmental sustainability, and climate and health in the research community.	Our commitments to climate, health and sustainability 2024-2026 | NIHR
NIHR Carbon Reduction Guidelines (US)	The guidelines have been developed by researchers for researchers, demonstrating how the principles of good carbon management and sensible study design can reduce carbon footprints without increasing the administrative burden on researchers.	NIHR Carbon Reduction Guidelines | NIHR
NHS Net Zero (UK)	The NHS aims to be the world's first net zero national health service, reaching net zero by 2040.	Greener NHS » Delivering a net zero NHS
Wellcome Trust (UK)	Wellcome will only fund research that is conducted responsibly, in an environmentally sustainable way.	Environmental sustainability funding policy - Funding Guidance | Wellcome
Cancer Research UK	Cancer Research UK is committed to reducing direct and indirect emissions by 50% by 2030 and reaching net zero by 2050. To be eligible for funding from the organisation, applicants must hold LEAF or My Green Lab certification.	Environmental sustainability in research | Cancer Research UK

The Academy of Medical Sciences

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