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Health Tech Enterprise

TOWARDS A NET ZERO NHS: ROLE OF TECHNOLOGY & INNOVATION

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MedTech Navigator

The MedTech Navigator (www.medtechnavigator.co.uk), part-funded by the European Regional Development Fund (ERDF), is a three-year programme, delivered by Health Tech Enterprise, to facilitate knowledge exchange between the MedTech industry, many of whom are small and medium sized enterprises (SMEs), the NHS, and academia.

The programme seeks to enable companies to identify potential market opportunities in a variety of specific disease areas and apply for Innovation Grant funding through the programme, thereby engaging SMEs in new R&D projects that are both customer-focused and collaborative in nature. This will allow the creation of partnerships between clinicians, academics, and industry to develop novel medical technologies which will improve healthcare and quality of life for patients and the healthcare market of the future.

About Health Tech Enterprise

At Health Tech Enterprise, we believe in improving healthcare through technology and innovation. We work with the NHS, the medical technology industry and government organisations to help turn innovative ideas into products and services that will benefit patients.

Our experienced team offers clients a diverse range of business and innovation management services. Our strengths include IP management, technology commercialisation, health economics and strategic market access advice.

Based in Cambridge, we work with over 20 NHS organisations nationally and MedTech companies globally. Our aim is to help our clients address the challenges faced along the product development pathway, connecting them with relevant healthcare experts and funding opportunities.

1. Summary

Climate Change - A Global Crisis

According to the World Health Organisation, climate change is the "greatest threat to global health in the 21st century". Climate change affects the social and environmental determinants of health – clean air, safe drinking water, sufficient food, and secure shelter. Between 2030 and 2050, climate change is expected to cause approximately 250,000 additional deaths per year, from malnutrition, malaria, diarrhoea, and heat stress. Reducing greenhouse gas emissions through better transport, food and energy-use choices can result in improved health, mainly through reduced air pollution.[1]

The UK government is determined to achieve net zero carbon emissions by 2050, aligning with sustainability targets outlined in the Paris Climate Change Agreement.[2] This endeavour holds the potential to save over 140,000 lives annually, primarily through improved air quality, greater physical activity, and healthier diets.

Pollution in the UK is attributed to be the cause of between 28,000 and 36,000 premature deaths, annually, due to heart disease, stroke and lung cancer. The associated health impact incurs an estimated cost ranging from £8.5 billion to £18.6 billion annually. High air pollution can trigger asthma attacks and COPD exacerbations and worsen symptoms for people with lung conditions.[3]

As the UK's largest employer, the NHS is accountable for approximately 4% of the nation's carbon emissions.[4] Despite the obstacles posed by the coronavirus pandemic since 2020, the NHS remains resolute in contributing to the country's climate goals. The pandemic has underscored the interconnectedness of global public health, the environment, and communities worldwide. This commitment has driven the NHS to aim for net zero carbon emissions by 2045.[5] We explore the NHS's strategy to establish a Greener NHS, focusing on the pivotal roles of people, technology, and innovation in achieving this ambitious goal.

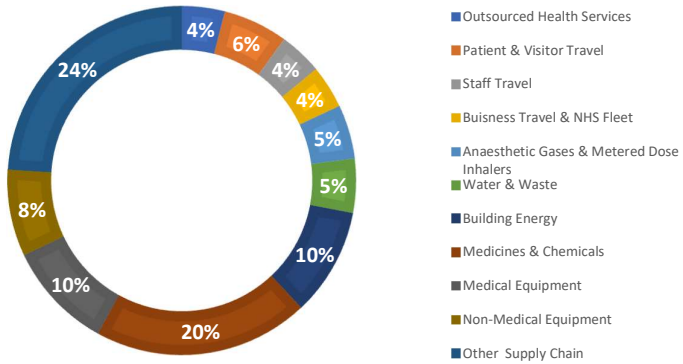
2. The Carbon Footprint of the NHS

The NHS has monitored its carbon footprint and made progress in reducing its carbon emissions since 2008. Using a sophisticated methodology to calculate the NHS Carbon Footprint, emissions covering both direct and indirect emissions from NHS facilities, energy supplies (mainly electricity), waste, supply chain production and manufacturing, medicines and travel have been tracked.

The latest report on carbon footprint, published in 2020, shows that the NHS in England is responsible for 24.9 million tonnes of carbon dioxide equivalents ($MtCO_2e$), annually. There has been some reduction in the NHS carbon footprint over the years - a 26% reduction since the 1990 baseline laid out in the 2008 Climate Change Act when national targets for reducing carbon emissions in England were set. [6] Significant progress is still required however if the NHS is to reach an 80% reduction by 2036 to 2039, with net zero by 2045.

Figure 1 shows that the greatest opportunities for change are in the supply chain, estates and facilities, pharmaceuticals and medical devices and travel.[5]

FIGURE 1: SOURCES OF NHS CARBON EMISSIONS



Medicines production accounts for 20% of NHS emissions with a further 5% attributed to anaesthetic gases and metered dose inhalers. Recycling of unused medicines where clinically safe could also be applied in accordance with NICE guidelines.[7] There is a

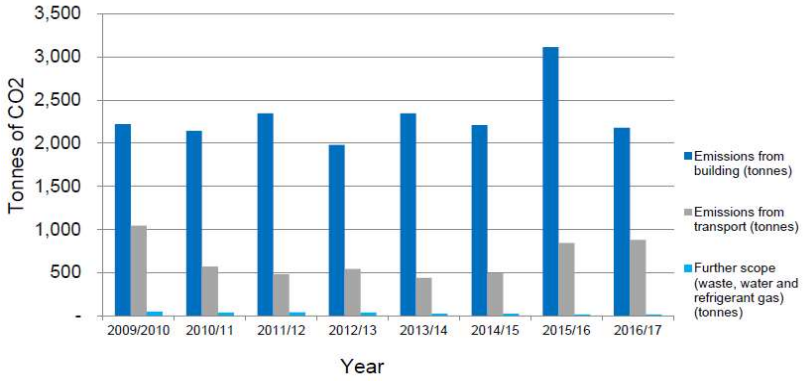
significant focus on two groups at the point of use, namely anaesthesia gases and inhalers, in addition to avoidable medicines-related hospital admissions.

The NHS estate and supporting facilities services account for 15% of the total NHS carbon footprint (2015 figures) while the NHS supply chain made up of more than 80,000 suppliers of medical equipment, food, business and office goods contributes 42% of the NHS carbon footprint.[5]

Travel and transport are another major contributor to the NHS carbon footprint, generating around 14% of the total emissions. There are approximately 1.3 million people employed by the NHS while in England there are over 1 million people in contact with the service every 36hrs.[8] Approximately one in every 20 journeys on UK roads is healthcare-related, entailing that the NHS accounts for approximately 3.5% of all road travel.[9] The NHS has set ambitious goals to achieve a 20% reduction in business mileage and lower its fleet's air pollutant emissions by 2028. This initiative involves transitioning at least 90% of its vehicles, including ambulances, to low-emissions engines.

The Centre for Sustainable Healthcare's green nephrology programme successfully implemented sustainable approaches, resulting in substantial benefits. They managed to save £7 million in kidney care costs and reduced 11,000 tonnes of CO_2 equivalent emissions. Additionally, through their efforts in waste reduction, they identified potential savings worth £2 billion.[10]

Examples of emissions from buildings, transport, waste, water, and refrigerant gases are shown in Graph 1.[11]



Graph 1. Emissions from buildings, transport, waste, water, and refrigerant gases. 'Sustainable development management plan, 2017[11]. [Note: The carbon cost of treatment at private providers paid for by the NHS is not captured].

The NHS has committed to reducing its core emissions that it controls directly to net zero by 2040, with an ambition to reach an 80% reduction (compared to a 1990 baseline) by 2028 to 2032.[5] For carbon emissions that the NHS can influence, the goal is net zero by 2045, with an interim target of an 80% reduction between 2036 and 2039.

To achieve these targets, substantial changes in clinical practice and established procedures are necessary. The focus should be on designing care pathways that prioritize desired outcomes while ensuring lean and efficient healthcare delivery.

3. Reduction and Elimination of Environmental Footprint

Potential approaches.

The NHS is making efforts to reduce its environmental impact, focusing on areas like remote clinical service delivery, energy consumption, and NHS estates utilization. For example, the Newcastle Upon Tyne Hospital Trust has been reducing emissions from anaesthetics by opting for less polluting gases.[12] Subsequently, a mother in Newcastle became the first person in the UK to use climate-friendly pain relief during labour. SageTech Medical supports the Trust with a circular economic solution, capturing and reusing 99.9% of volatile anaesthesia agents. The captured waste is recovered and recycled for future reuse.[13]

NICE developed a patient decision aid to help people with asthma. The tool is designed to aid individuals in selecting inhalers with significantly lower carbon footprints. The initiative is projected to benefit an estimated 5.4 million people in the UK, helping them to make an environmentally friendly inhaler choice.[14]

Moreover, sustainable care pathways are being developed to offer patients the right care, in the right place, and at the right time. For instance, shifting terminal care from hospitals to home settings is preferred by patients and helps reduce environmental impact.

The NHS is dedicated to reducing traffic-related appointments to reduce carbon emissions. The Long-Term Plan aims to make up to 30 million outpatient appointments redundant, saving approximately 6.7 billion road miles travelled annually by patients and visitors.[15]

Moreover, since the emergence of the COVID-19, the adoption of remote telehealth services has accelerated. Such services have brought environmental and productivity gains to the NHS. For instance, Barts Health NHS Trust estimated that a single virtual oncology consultation can save up to 5.8 kg of carbon dioxide.[16]

However, it is essential to acknowledge and manage risks associated with remote consultations, such as accuracy concerns and access barriers, is essential.[17]

To further reduce transport-related emissions, the NHS Long-Term plan sets a target that by 2024 9 out of 10 vehicles will be low emission. Moreover, various measures have been introduced to encourage sustainable transportation choices among staff. These include lift-share schemes, cycle-to-work programs, free shuttle buses facilitating convenient travel between sites, and the development of accommodation within walking distance of workplaces.[18]

For instance, the Sussex Community NHS Foundation has taken significant strides by implementing a car lease scheme with strict emissions caps, leading to a 37% reduction in emissions. Meanwhile, the Oxford University Hospitals NHS Foundation has promoted cycling by introducing a cycle-to-work scheme, in addition to providing free staff shuttle buses along with a lift-share scheme to further encourage sustainable commuting choices.[18]

To address energy consumption, measures like using electric ambulances and environmentally friendly gases in dialysis and anaesthesia, as well as waste reduction efforts, can positively impact the NHS's carbon footprint.[18] Several NHS Trusts have adopted sustainable practices, with Newcastle upon Tyne NHS Trust leading the way by installing combined heat and power plants and using 100% renewable electricity. They've achieved impressive sustainability milestones, such as zero waste to landfill since 2011 and recycling over 40% of non-clinical waste.[19]

Other Trusts have also shown commitment to sustainability, like University Hospitals of North Midlands, which installed solar panels, and Greater Manchester NHS, which declared a climate emergency. [21, 20,]

Recognizing the harmful impact of certain anaesthetic gases, Trusts like University Hospitals Bristol and Weston NHS Foundation Trust have committed to using lower carbon alternatives.[21]

Operating theatres are also a major source of carbon emissions, comprising around 25% of a hospital's total emissions. Solihull Hospital achieved a groundbreaking net zero operation in 2022 by making significant changes, such as using reusable gowns and drapes and recycling single-use equipment.[22]

Educating organizations, the NHS, suppliers, and the public about environmental impact is crucial for promoting sustainable practices. The "For a Greener NHS" campaign, supported by the UK Health Alliance on Climate Change, plays a crucial role in raising awareness and fostering a culture of environmental responsibility.[15]

By adopting and promoting sustainable practices, the NHS is leading the way to a greener and more environmentally conscious society, setting an example for the healthcare sector to follow.


CO_2

4. Tools and Resources Available for Greenhouse Emissions

There is a growing body of resources and tools available to support the adoption of sustainable healthcare practices.

A key resource underpinning the Greener NHS campaign is the 'Delivering a Net Zero National Health Service' report.[23] This comprehensive report highlights the NHS's progress in achieving Net Zero targets and outlines the interventions and modelling required to realize this ambition. It serves as a crucial guide for understanding and mitigating the NHS's carbon footprint, both directly and indirectly, while also offering insights into future plans.

The Centre for Sustainable Healthcare provides healthcare professionals with valuable educational resources.[8] These materials assist in comprehending the carbon footprint sources within clinical settings and developing strategies to decarbonise practices effectively.

For comprehensive guidance in planning sustainability efforts, the Green Plan is a national resource designed to aid both providers and commissioners.[24] Moreover, the NHS Forest initiative offers information and support on the environmental benefits of trees and how they can be optimally utilized within NHS estates.[25]

To gain a better understanding of emission changes over time, valuable guidance can be found in the Defra guidance and the HM Treasury Green Book supplementary guidance for greenhouse gas appraisal.[26] Additionally, the UK government's website provides essential carbon conversion factors and details on various activities, such as travel distance, fuel usage, and waste disposal, facilitating the production of comprehensive greenhouse emissions reports.[27]

MedTech companies can benefit from Life Cycle Assessment (LCA), a quantitative tool that evaluates the environmental impact of products throughout their entire life cycle. LCA enables the identification of key areas of carbon emissions, aiding companies in making informed decisions.

We have developed a qualitative Sustainability Impact Assessment Tool. This assessment tool is valuable for innovators to evaluate the sustainability of their practices across various domains, helping identify areas that require attention to minimise carbon footprint.

By leveraging these resources and tools, healthcare organizations can make significant strides in adopting sustainable practices, contributing to a greener and more environmentally responsible healthcare sector.

5. A Sustainable Impact Assessment Tool for MedTech Innovations

To support MedTech innovators, HTE has developed a sustainable impact self-assessment tool, empowering you to conduct qualitative evaluations of your innovations' sustainability and identify areas in need of improvement. You can read more about our approach to HealthTech NETZERO in section 7.

Domain	Questions	Answer	Comments • If yes – in what ways? • If no – what can be done to facilitate the positive change?
Travel	1. Is your technology projected to directly affect patient travel to hospital premises? 2. Is your technology projected to directly affect carer travel to hospital premises? 3. Is your technology projected to directly affect healthcare staff travel?		
Care Models	4. Is your innovation projected to affect the number of first and repeat consultations? 5. Is your innovation projected to affect the length of inpatient stays in hospitals? 6. Is your innovation projected to affect the setting of care delivery? 7. Does your innovation promote remote patient monitoring or telemedicine, reducing the need for physical visits to healthcare facilities?		

Logistics	8. Is your innovation expected to create environmental gains from logistical changes as compared to current practices? 9. Does your innovation use energy-efficient technologies?		
Materials & supply chain	10. Is your technology produced from sustainable materials? 11. Is the supply chain of your innovation sufficiently decarbonized? 12. Does your technology incorporate recyclable or reusable components? 13. Have you conducted a life cycle assessment (LCA) of your innovation to identify potential environmental impacts?		
Waste	14. Is your technology expected to reduce the use of single-use items? 15. Will your innovation help in reducing the waste of drugs and medical equipment? 16. Does your technology have the potential to reduce other types of waste in clinical settings? 17. How does your innovation handle the disposal or recycling of outdated devices?		
Sustainability Policy	18. Does your company or organization have a sustainability policy or plan in place? 19. Do you promote the sustainable use of your technology to healthcare providers and end-users? 20. Does your innovation comply with any relevant environmental certifications or standards?		

6. Innovation Grant Programme

Throughout the MedTech Navigator programme we have funded a programme of Innovation Grants to support SMEs to engage in new research collaborations with eligible knowledge providers. In all, we have granted a total of 16 awards under this programme.

The sustainability of the project was a crucial selection criterion for the grant funding panel. Below, we present some examples of the projects we have funded, showcasing their contributions to the sustainability agenda:

Kymira

Kymira is developing a smart garment with embedded sensors to support remote motor rehabilitation and self-management for stroke survivors and patients with chronic illnesses.

100,000 people have a stroke each year in the UK, and 1 in 53 is a stroke survivor, according to the Stroke Association which estimates there are currently 1.3 million stroke survivors in the UK. Current stroke rehabilitation practices involve both physical and cognitive exercises. There are no technologies currently available that monitor whether movements/exercises are being executed in a safe and effective manner.

Stroke rehabilitation is currently sub-optimal, with the pandemic worsening existing issues. Access to rehabilitation services has deteriorated, with 39% of survivors reportedly not receiving enough rehabilitation therapies. This puts them at risk of experiencing long-term complex disabilities and increases costs to the healthcare system.

Kymira collaborated with the University of Southampton to assess, validate, and improve its smart garment system following the award of an Innovation Grant in January 2022. Kymira's garment-embedded sensing technology could support remote motor rehabilitation and self-management, reducing the need for outpatient appointments and associated travel miles in addition to

preventing the risk of more severe disability or illness through a lack of appropriate monitoring and care.

To learn more about Kymira's smart textile innovations, visit their website [KYMIRA – Powered by progress].

TekiHealth Solutions

TekiHealth Solutions partnered with Connected Nottinghamshire (part of Sherwood Forest Hospital Trust) to design a telemedicine service that could directly help to tackle the consequences and effects of the Covid-19 pandemic on care home residents.

In January 2021, TekiHealth was awarded an Innovation Grant to leverage audio and video technology to remotely support the care of frail elderly patients. By doing so, TekiHealth significantly reduces the need for travel, promoting a sustainable and efficient model of care. The Teki-Hub technology empowers clinicians to conduct remote video consultations and gather vital signs data from medical devices, allowing for informed care plans tailored to each individual patient's needs.

The technology was ideally placed to support clinicians to deliver virtual remote consultations with elderly patients in retirement living complexes and care homes, whilst minimising direct patient contact and supporting infection prevention and control measures in place during the pandemic.

The Teki-Hub is currently operational in two care homes in Nottingham, where it facilitates a personalized triage model for clinical engagement between GPs and care home residents. Looking beyond the pandemic, the implementation of Teki-Hub in care homes holds the potential to significantly reduce inappropriate GP callouts, ambulance calls, and hospital admissions, thereby contributing to a more sustainable and efficient health service.

Visit TekiHealth Solutions to find out more.

7. Our Approach: HealthTech NETZERO

Health Tech Enterprise specialises in providing comprehensive carbon footprint evaluation services to effectively communicate the carbon impact of MedTech Innovations. Our rigorous methodology draws upon principles from Health Economic Evaluation, enabling us to quantify the incremental change in carbon emissions between the innovation and current care practices.

We begin by identifying specific sources of CO_2 emissions affected by the intervention, determining areas where the innovation leads to reduced CO_2 emissions compared to current care. Our assessment considers a wide range of CO_2 sources, including patient and visitor travel, reductions in unnecessary treatments, logistical changes, hardware manufacturing, server space usage, and consumable disposal.

We develop a robust model that quantifies CO_2 emissions associated with each stage of care, allowing us to assess your

intervention's incremental reductions compared to current emissions. This valuable insight demonstrates the technology's positive impact on the carbon footprint.

Presented through an interactive MS Excel model, our carbon impact analysis can be adjusted as new data becomes available, ensuring the most up-to-date and relevant information.

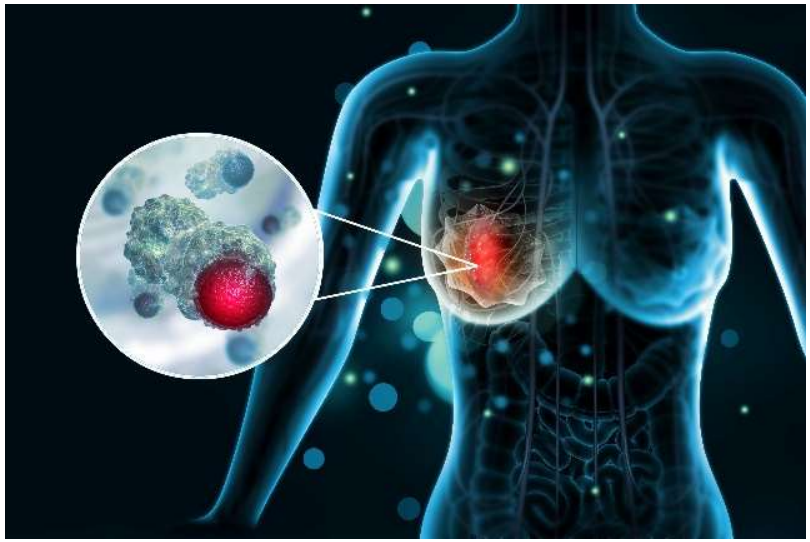
Additionally, we offer a qualitative analysis of potential greenhouse gas emissions savings from the intervention, enhancing the value proposition of your technology to key stakeholders. We provide expert advice on data collection during clinical trials and conduct post hoc primary data analysis to gather real-world evidence of the technology's impact on carbon emissions, building a robust case for its environmental benefits.

To find out more about how we can help you, visit the HealthTech NETZERO section of our website.

Case Study: Digistain

HTE conducted a Carbon Impact Assessment for a tumour profiling technology designed to stratify patients based on their risk of cancer recurrence, aiding in chemotherapy decision-making. Our analysis focused on quantitatively measuring the reduction in carbon footprint resulting from decreased patient travel and improved logistics compared to the current standard of care.

We developed a CO_2 Emission Saving model based on the original Budget Impact Analysis of the innovation. Assigning specific CO_2 emissions to each health state represented in the Markov Model, we considered the number of hospital appointments required for each state to estimate associated CO_2 emissions. Additionally, we assessed CO_2 emissions related to logistics, transportation, and sample storage for tumour profiling testing. This allowed us to quantify cumulative CO_2 emissions savings over a 5-year period.



"This modelling work completed by Health Tech Enterprise has helped us show the positive impact our innovation has in supporting the NHS Net Zero commitments." Hemmel Amrania, CEO of Digistain

At HTE, we are committed to providing MedTech innovators with valuable insights into the carbon impact of their technologies, enabling them to make sustainable choices and contribute to a greener healthcare ecosystem.

The CO_2 Emission Saving Analysis forecasted statistically significant potential CO_2 savings cumulatively over 5 years once the innovation is implemented as a substitute for the current care. Our fully interactive model allowed Digistain to explore results from different scenarios, while our recommendations for future studies ensure data collection and verification of current assumptions.

8. Useful Links

Additional references and links:

- Delivering a Net Zero NHS Health Service: Discover how the NHS is becoming greener.
- The Carbon Trust offers businesses a service to understand and evaluate their product carbon footprint.
- The Department of Health provides advice on integrating sustainable development and estates management advice. Health Technical Memoranda (HTMs) give comprehensive advice and guidance on the design, installation and operation of specialised building and engineering technology used in the delivery of healthcare available online.
- Defra has a number of guidance documents around Measuring and Reporting Environmental Impacts including guidance on building energy use, greenhouse gas (GHG) emissions and extending to travel and procurement emissions.
- Building Research Establishment's Environmental Assessment Method (BREEAM: Healthcare) provides standards for new build, refurbishment and buildings in use.

9. References

[1] WHO Health and Climate Change Survey Report. 2021

[2] United Nations Climate Change. The Paris Agreement. 2015

[3] Public Health England. Improving outdoor air quality and health review of interventions. 2019

[4] Owen A, Giesekam J, Barrett J.. Data release of material footprint and resource efficiency for the UK. 2019

[5] NHS England. Delivering a 'Net Zero' National Health Service. 2020

[6] The Climate Change Act 2008 (2050 Target Amendment) Order 2019. Statute Law Database. 2019.

[7] NICE Environmental impact report: Medicines optimisation. 2015

[8] The Centre for Sustainable Healthcare. We work in healthcare – of course we care about carbon!

[9] NHS. n.d. "Air Pollution." NHS Long Term Plan. Accessed July 31, 2023. https://www.longtermplan.nhs.uk/online-version/chapter-2-more-nhs-action-on-prevention-and-health-inequalities/air-pollution/.

[10] NHS could save £1bn by adopting green strategies used in kidney units. *BMJ* 2013

[11] NHS England. Sustainable Development Management Plan for NHS England 2018-2020. 2018

[12] The Newcastle upon Tyne Hospitals NHS Trust. Using climate-friendly gas and air during labour. 2021

[13] SageTech Medical. Internal Data.

[14] NICE. Asthma inhalers and climate change. 2019

[15] NHS England. Greener NHS campaign to tackle climate 'health emergency'. 2020

[16] The Health Foundation. Sustainable improvement: growing a greener NHS. 2021

[17] Sloan M et al. Telemedicine in rheumatology: a mixed method study exploring acceptability, preferences and experiences among patients and clinicians. *Rheumatology* 2021

[18] The Guardian. The NHS produces 5.4% of the UK's greenhouse gases. How can hospitals cut their emissions? 2019

[19]"Sustainable-Healthcare-in-Newcastle-Report-2019-2020" https://www.newcastle-hospitals.nhs.uk/wp-content/uploads/2020/09/Sustainable-Healthcare-in-Newcastle-Report-2019-2020.pdf.

[20] NHS makes good progress on sustainability. *BMJ* 2018

[21] The Health Foundation. 'For a greener NHS' campaign. 2020

[22] NHS. n.d. "University Hospitals Birmingham: A World First in Carbon Net Zero Surgery." Accessed July 31, 2023. https://www.england.nhs.uk/greenernhs/whats-already-happening/university-hospitals-birmingham-a-world-first-in-carbon-net-zero-surgery/.

[23] England, N. H. S. 2022. "Delivering a 'Net Zero' National Health Service." NHS, July. https://www.england.nhs.uk/greenernhs/wp-content/uploads/sites/51/2022/07/B1728-delivering-a-net-zero-nhs-july-2022.pdf.

[24] BEIS. 2017 Government GHG Conversion Factors for Company Reporting.

[25] "NHS Forest Initiative." 2021. NHS Forest. November 26, 2021. https://nhsforest.org/.

[26] "The Green Book (2022)." n.d. GOV.UK. Accessed July 31, 2023. https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-governent/the-green-book-2020.

[27] "Greenhouse Gas Reporting: Conversion Factors 2023." 2023. GOV.UK. June 7, 2023. https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2023.