NHS

Delivering a 'Net Zero' National Health Service

Contents

Foreword by Sir Simon Stevens

In late January we launched the campaign *For a Greener NHS* and I invited Dr Nick Watts and an expert panel to set out a practical, evidence-based and quantified path to a 'net zero' NHS.[1]

Less than a week later, WHO declared COVID-19 a global health emergency. Since then, 2020 has been dominated by this virus. Alongside tragedy and suffering, the pandemic has seen NHS staff recognised for their rapid, professional and selfless response – caring for COVID-19 patients and sustaining the wider work of the NHS.

The burden of coronavirus has been exacerbated and amplified by wider, deep-seated social, economic and health concerns. The right response is therefore not to duck or defer action on these longer-term challenges even as we continue to respond to immediate pressures. It is to confront them head on.

One of the most significant is the climate emergency, which is also a health emergency.[2] Unabated it will disrupt care, and affect patients and the public at every stage of our lives. With poor environmental health contributing to major diseases, including cardiac problems, asthma and cancer, our efforts must be accelerated.

We therefore make no apologies for pushing for progress in this area while still continuing to confront coronavirus.[3]

This report sets out the considerable advances that the NHS has already made in improving our carbon footprint and reducing the environmental impact of our services. But as the largest employer in Britain, responsible for around 4% of the nation's carbon emissions, if this country is to succeed in its overarching climate goals the NHS has to be a major part of the solution.

It is for this reason that we are committing to tackle climate change by reducing our emissions to 'net zero'. In doing so, our aim is to be the world's first 'net zero' national health service. This report provides a clear plan with credible milestones to get there. It covers both the care we provide (the NHS Carbon Footprint) and the entire scope of our emissions (the NHS Carbon Footprint Plus).

Our thanks go to the expert panel, to all those who responded to the international call for evidence and to the many staff across the NHS who have helped shape this plan. Everyone will need to continue to play their part – including our partners, our suppliers and our staff. Of course in a fast moving field where urgency is increasing, it represents an important milestone rather than the final word. Our commitment is therefore to continuing engagement and dialogue, further building support for both practical action and deepening ambition.

Simon Stevens
NHS Chief Executive

October 2020

Summary

The NHS aims to provide health and high quality care for all, now and for future generations. This requires a resilient NHS, currently responding to the health emergency that COVID-19 brings, protecting patients, our staff and the public. The NHS also needs to respond to the health emergency that climate change brings, which will need to be embedded into everything we do now and in the future.

More intense storms and floods, more frequent heatwaves and the spread of infectious disease from climate change threaten to undermine years of health gains. Action on climate change will affect this, and it will also bring direct improvements for public health and health equity. Reaching our country's ambitions under the Paris Climate Change Agreement[4] could see over 5,700 lives saved every year from improved air quality, 38,000 lives saved every year from a more physically active population and over 100,000 lives saved every year from healthier diets.

The NHS embarked on a process to identify the most credible, ambitious date that the health service could reach net zero emissions. This work comprised an international call for evidence, with nearly 600 submissions provided in support of further commitments on climate change; a robust analytical process described throughout this report; and the guidance of a newly formed NHS Net Zero Expert Panel.

This report provides a detailed account of the NHS' modelling and analytics underpinning the latest NHS carbon footprint, trajectories to net zero and the interventions required to achieve that ambition. It lays out the direction, scale and pace of change. It describes an iterative and adaptive approach, which will periodically review progress and aims to increase the level of ambition over time.

With the UK government hosting the UN climate change negotiations in 2021, we will launch an engagement process with patients, our staff and the public over the coming months, to identify further opportunities and resource to help decarbonise our health service.

Two clear and feasible targets emerge for the NHS net zero commitment, based on the scale of the challenge posed by climate change, current knowledge, and the interventions and assumptions that underpin this analysis:

- for the emissions we control directly (the NHS Carbon Footprint), net zero by 2040, with an ambition to reach an 80% reduction by 2028 to 2032
- for the emissions we can influence (our NHS Carbon Footprint Plus), net zero by 2045, with an ambition to reach an 80% reduction by 2036 to 2039.

An overview of the interventions required to meet these targets is provided in the sections below, accompanied by analysis of the expected carbon reductions and any risks, and opportunities for an accelerated timeline.

A number of early steps will be taken to decarbonise:

1. **Our care:** By developing a framework to evaluate carbon reduction associated with new models of care being considered and implemented as part of the NHS Long Term Plan.

2. **Our medicines and supply chain:** By working with our suppliers to ensure that all of them meet or exceed our commitment on net zero emissions before the end of the decade.

3. **Our transport and travel:** By working towards road-testing for what would be the world's first zero-emission ambulance by 2022, with a shift to zero-emission vehicles by 2032 feasible for the rest of the fleet.

4. **Our innovation:** By ensuring the digital transformation agenda aligns with our ambition to be a net zero health service, and implementing a net zero horizon scanning function to identify future pipeline innovations.

5. **Our hospitals:** By supporting the construction of 40 new 'net zero hospitals' as part of the government's Health Infrastructure Plan with a new Net Zero Carbon Hospital Standard.

6. **Our heating and lighting:** By completing a £50 million LED lighting replacement programme, which, expanded across the entire NHS, would improve patient comfort and save over £3 billion during the coming three decades.

7. **Our adaptation efforts:** By building resilience and adaptation into the heart of our net zero agenda, and vice versa, with the third Health and Social Care Sector Climate Change Adaptation Report in the coming months.

8. **Our values and our governance:** By supporting an update to the NHS Constitution to include the response to climate change, launching a new national programme For a greener NHS, and ensuring that every NHS organisation has a board-level net zero lead, making it clear that this is a key responsibility for all our staff.

Meeting this commitment will only be achievable if every part of the NHS – more than 1.3 million of us – are working together. Whether it is a physiotherapist keeping their patients active with sustainable mobility aids, a mental health nurse providing high quality care via telemedicine or a hospital chef sourcing their ingredients from the local community, we all have a role in delivering a net zero NHS, providing health and high quality care for all, now and for future generations.

1. Introduction

The climate emergency is a health emergency.[5] Climate change threatens the foundations of good health, with direct and immediate consequences for our patients, the public and the NHS.[6,7] The situation is getting worse, with nine out of the 10 hottest years on record occurring in the last decade and almost 900 people killed by heatwaves in England in 2019.[8] Without accelerated action there will be increases in the intensity of heatwaves, more frequent storms and flooding, and increased spread of infectious diseases such as tick-borne encephalitis and vibriosis.[9,10]

Over the last 10 years, the NHS has taken notable steps to reduce its impact on climate change.[11] As the biggest employer in this country,[12] there is more that the NHS can do. Action must not only cut NHS emissions, currently equivalent to 4% of England's total carbon footprint,[13–15] but also build adaptive capacity and resilience into the way care is provided. This action will lead to direct benefit for patients, with research suggesting that up to one-third of new asthma cases might be avoided as a result of efforts to cut emissions.[16] This is because the drivers of climate change are also the drivers of ill health and health inequalities. For example, the combustion of fossil fuels is the primary contributor to deaths in the UK from air pollution,[17] disproportionately affecting deprived and vulnerable communities.[18]

In January 2020, the campaign For a greener NHS was launched to mobilise our more than 1.3 million staff and set an ambitious, evidence-based route map and date for the NHS to reach net zero. This report sets out the initial results of this work, reaching net zero emissions for the care we provide (the NHS Carbon Footprint) by 2040, and zero emissions across the entire scope of our emissions (the NHS Carbon Footprint Plus) by 2045. These dates, and the activities that will help deliver them, have been informed by our staff, an international call for evidence and the NHS Net Zero Expert Panel (see **Annex 1**).

The current global COVID-19 pandemic has further reinforced the connection between global public health and healthcare systems and populations across the world, described in **Box 1**. The NHS' response to the pandemic has demonstrated an impressive capacity to adapt and respond in an emergency. It also highlights the importance of preparedness for future pandemics, and the wider health implications

of climate change.[19] The forthcoming third Health and Social Care Sector Climate Change Adaptation Report will cover these topics, and the alignment between adaptation and mitigation in greater detail.

Box 1: COVID-19 and the NHS

COVID-19 is having a profound impact on the world, every health sector including the NHS and, in turn, the work outlined in this report.

There is an interrelationship between the pandemic and the environment,[20,21] which reinforces the need to minimise our impact on the environment and be prepared for climate change. A host of infectious diseases, ranging from dengue fever to swine flu (H1N1), are in part affected by changes in land use as a result of environmental degradation.[22]

The NHS has introduced rapid changes to the way services are delivered to minimise risks of transmission and ensure continued access to timely treatment for those who need it. COVID-19 remains a priority for the NHS, and alongside this, the NHS is also continuing to provide non-COVID-19 services and preparing for winter demand pressures, in the context of minimising the risks of further outbreaks. It is clear therefore that COVID-19 will continue to impact on the way the NHS delivers care, and the emissions from that care.

Key learnings from this response may be evaluated and retained for the long-term, with future carbon reduction benefits. This includes the roll out of digitised care in primary and secondary care settings, which could represent a significant step forward in accelerating NHS Long Term Plan commitments.

Conversely, some elements of the response to COVID-19 have the potential to increase our impact on the environment, including increased need for personal protective equipment (PPE), cleaning products, ventilators and other associated equipment, single-use plastics and changes to patterns of prescribing and clinical interventions.

2. A net zero NHS

Since 2008, the NHS has tracked and reported its carbon footprint, regularly improving its methods and monitoring our progress in meeting the commitments of the Climate Change Act (2008)[23,24] This report provides an update on the progress the NHS has made in reducing carbon emissions as well as an overview of the targets and trajectories for reaching net zero. **Box 2** describes the analytical approach taken to inform these trajectories.

Box 2: A net zero NHS – the analytical approach

A number of inputs have been used to inform the targets and trajectories for net zero. An initial call for evidence received almost 650 responses from a wide variety of stakeholders across the system. Analysis was conducted by NHS England and NHS Improvement, with the NHS Net Zero Expert Panel meeting regularly in 2020 to provide guidance on the scale of ambition and the scope of change required.

A four-step analytical process, described in full in **Annex 2**, was followed to establish these trajectories:

1. **Baseline:** A complete update of the NHS carbon footprint was conducted to provide an estimate of present-day emissions against a 1990 baseline (see Section 2.1). This made use of a hybrid approach, combining 'top-down' modelling (drawing on financial activity data and an environmentally extended input–output model) with 'bottom-up' validation (drawing on a range of inputs from NHS organisations, including local travel, buildings and medicines data).

2. **Projections:** A number of scenarios were then modelled to understand the emissions from the NHS over the long-term, including a 'do nothing' scenario and a 'committed policies' scenario.

3. **Carbon reductions available across the system:** Available reductions for each of the key sources of carbon were then estimated, which informed the system-wide targets for net zero.

4. **Net zero interventions:** Drawing on the call for evidence and external technical input, an extended set of interventions and carbon reductions were modelled, to give confidence in the credibility and ambition of the trajectories.

A full summary of the responses from the call for evidence can be found in **Annex 3**, and the full methodology for the NHS' carbon footprint will be independently published to support other healthcare systems across the world.

2.1. The carbon footprint of the NHS

In 2008 the Climate Change Act set national targets for the reduction of carbon emissions in England, against a 1990 baseline. Since then, the NHS has been working to deliver on these targets, most closely approximated by the **NHS Carbon Footprint** (see **Table 1**).

These targets do not, however, cover the full scope of emissions from the NHS. The Greenhouse Gas Protocol (GHGP)[25] scopes cover a wider set emissions, and support international comparison and transparency:

- **GHGP scope 1:** Direct emissions from owned or directly controlled sources, on site
- **GHGP scope 2:** Indirect emissions from the generation of purchased energy, mostly electricity
- **GHGP scope 3:** All other indirect emissions that occur in producing and transporting goods and services, including the full supply chain.

However, there are still some emissions that fall outside these scopes. As agreed with the NHS Net Zero Expert Panel, the NHS will also work towards net zero for a **NHS Carbon Footprint Plus** that includes all three of the scopes above, as well as the emissions from patient and visitor travel to and from NHS services and medicines used within the home (see **Figure 1**).

An independent review by the Lancet Countdown has confirmed that the methods used to calculate the NHS Carbon Footprint and NHS Carbon Footprint Plus remain the most comprehensive, and sophisticated of any health system to-date.

Figure 1: GHGP scopes in the context of the NHS
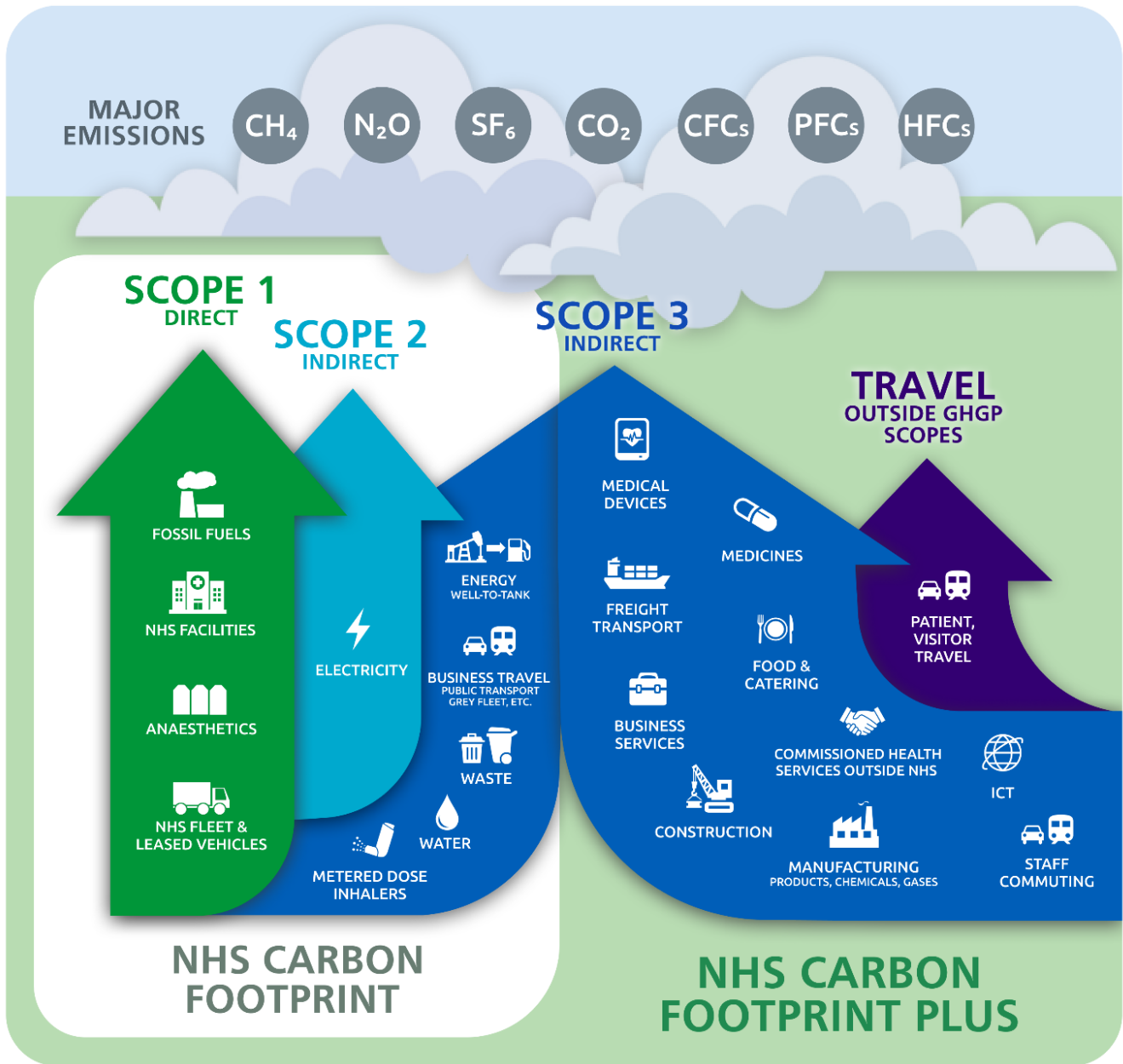
Considerable progress has been made in reducing the NHS Carbon Footprint. While only an approximation, the estimated 62% reduction in emissions significantly exceeds the 37% requirement for 2020 outlined in the Climate Change Act (see **Table 1**). The wider scope of the NHS Carbon Footprint Plus has also delivered a meaningful improvement on the 1990 baseline, with an estimated reduction of 26% by 2020.

Table 1: NHS emissions from 1990 to 2020

Carbon footprint scope	1990	2010	2015	2019	2020 (est)
Climate Change Act – carbon budget target		25%	31%		37%
NHS Carbon Footprint (MtCO$_2$e)	16.2	8.7	7.4	6.1	6.1
NHS Carbon Footprint as a % reduction on 1990		46%	54%	62%	62%
NHS Carbon Footprint Plus (MtCO$_2$e)	33.8	28.1	27.3	25.0	24.9
NHS Carbon Footprint Plus as a % reduction on 1990		17%	19%	26%	26%

Despite this progress, there is still a significant challenge ahead. To close the gap to net zero the NHS will need to remove 6.1 MtCO$_2$e from the NHS Carbon Footprint and 24.9 MtCO$_2$e from the NHS Carbon Footprint Plus, roughly equivalent to the emissions profile of Croatia.

Every area of the NHS will need to act if net zero is to be achieved. However, looking at the wider scope of the NHS Carbon Footprint Plus, **Figure 2** shows that the greatest areas of opportunity – or challenge – for change are in the supply chain, estates and facilities, pharmaceuticals and medical devices, and travel. Similarly, **Figure 3** draws the emissions from medicines and food and catering out, and shows that while the greatest gains can be made in hospitals, change will be needed across every setting of care.

Figure 2: Sources of carbon emissions by proportion of NHS Carbon Footprint Plus
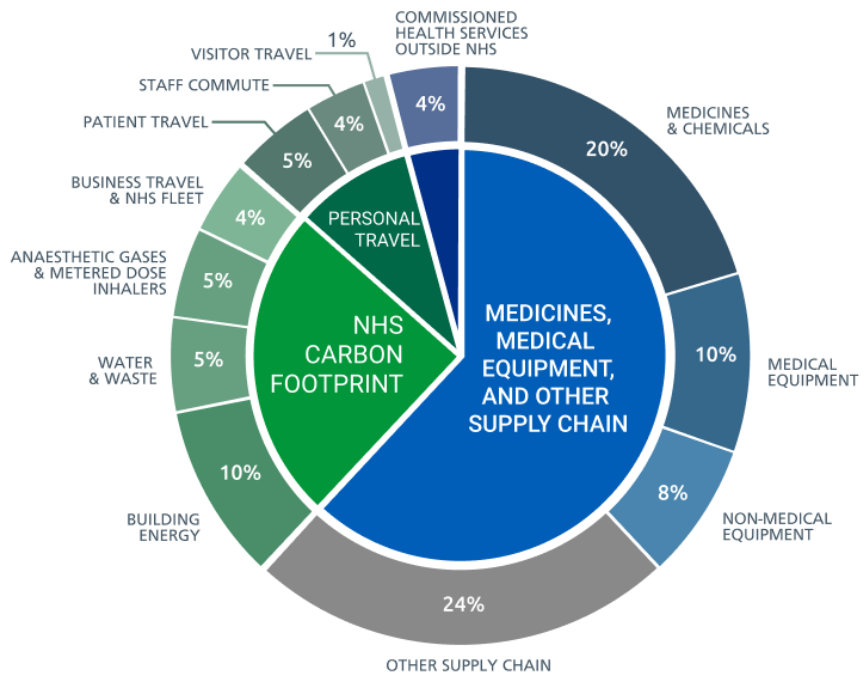
Figure 3: Sources of carbon emissions by activity type and setting of care
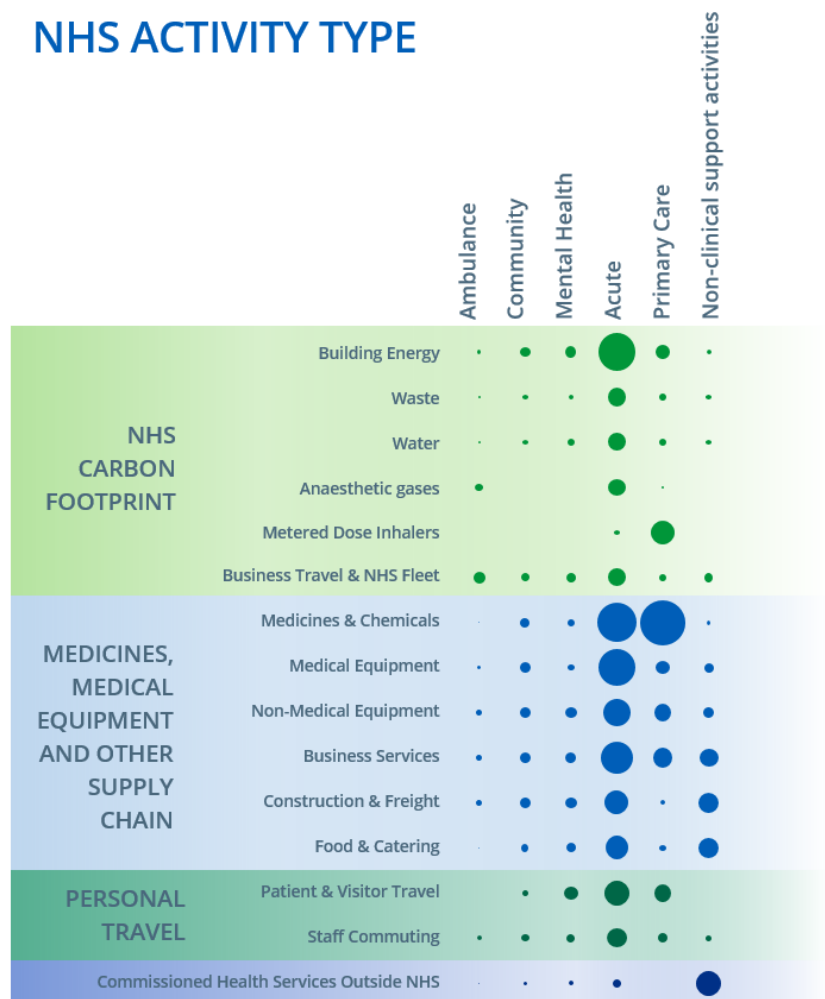
2.2. A pathway to net zero carbon emissions

Identifying a trajectory to net zero emissions for a complex, highly specialised system as large as the NHS is particularly challenging. The NHS Net Zero Expert Panel agreed that the targets set should be as ambitious as possible, while remaining realistic; and supported by immediate action and a commitment to continuous monitoring, evaluation and innovation.

Two net zero targets for the NHS have emerged from this process:

- by 2040 for the NHS Carbon Footprint, with an ambition for an 80% reduction (compared with a 1990 baseline) by 2028 to 2032 (**Figure 4**)
- by 2045 for the NHS Carbon Footprint Plus, with an ambition for an 80% reduction (compared with a 1990 baseline) by 2036 to 2039 (**Figure 5**).

These trajectories have been developed based on analysis of current and planned activities for the NHS, and by drawing on national and international best practice that can be scaled across the NHS in England. They also included assumptions about future innovations and the pace at which government, other sectors and the international community will drive change.

Our intention for these targets is to construct the most ambitious, credible declaration to reach net zero of any national healthcare system in the world. However, they can only be delivered if they are supported by collective action from all NHS staff and collaborative partnerships within and beyond the NHS, as well as appropriate investment.

Any analysis that looks forward 30 years will be subject to uncertainty. The pace of change is likely to increase over time and predicting future shifts and innovations that will help accelerate this ambition is particularly challenging. This uncertainty is, in part, reflected in the date ranges above, which will be refined through updated analysis every five years.

Delivering these trajectories will require action across every part of the NHS. However, the main areas of action for the NHS and its partners can be categorised into:

- direct interventions within estates and facilities, travel and transport, supply chain and medicines

- enabling actions, including sustainable models of care, workforce, networks and leadership, and funding and finance mechanisms.

National and international government action to decarbonise electricity, transport and supply chains will also contribute to the ambitions of the NHS and is included in the analysis, but not covered in this report.

While it is difficult to quantify the benefits that a net zero NHS alone can deliver in terms of lives saved, our current analysis makes clear that reaching our national commitments under the Paris Climate Change Agreement[2] and achieving a net zero UK economy would result in significant health benefits. Indeed, by the year 2040, this trajectory would see an estimated: 5,770 lives saved per year from reductions in air pollution; 38,400 lives saved per year from increased levels of physical activity. A peer review of this analysis is currently underway.

Figure 4: Pathway to net zero for the NHS Carbon Footprint Scope
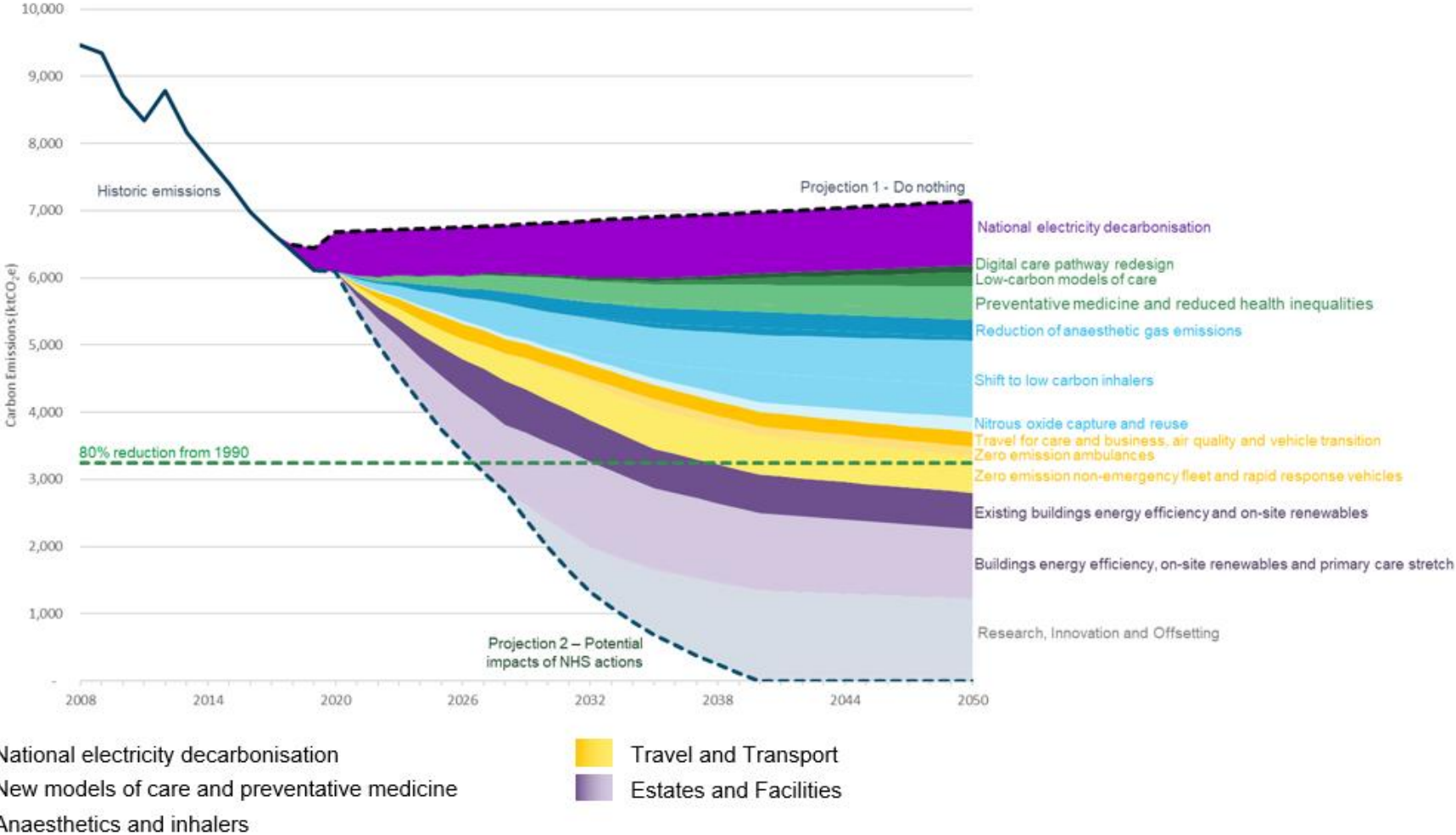
Figure 5: Pathway to net zero for the NHS Carbon Footprint Plus Scope
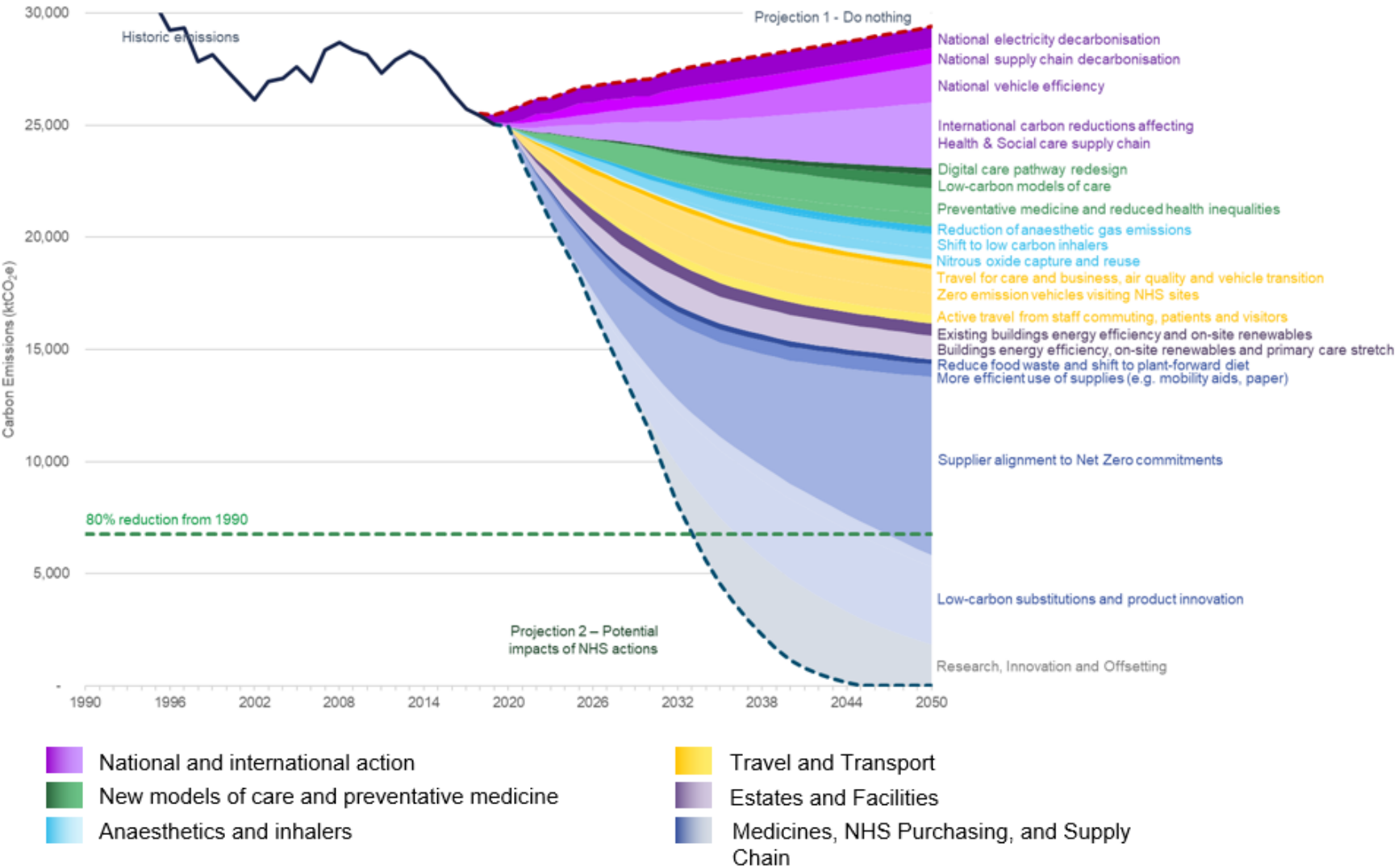
Box 3: Equality and health inequalities

Delivering a net zero NHS has the potential to secure significant benefits across the population, and particularly for vulnerable and marginalised populations, addressing existing health inequalities. These benefits will only be fully realised through public participation, involvement and engagement with those communities as this work goes forward, having regard to the need to reduce health inequalities and taking into account the public sector equality duty.

As a key priority, the NHS will work to reduce air pollution and improve local environments, thereby supporting the development of local economies in geographical areas of deprivation. Air pollution disproportionately affects people in these areas, many of whom are already at risk of poorer health outcomes. Examples of the links between climate change, sustainable development and health inequalities are seen across the country. For example:

- Access to green spaces has positive mental and physical health impacts, and these beneficial effects are greatest for those from socioeconomically disadvantaged groups. However, these groups also have the least access to green spaces.[26]

- Black, Asian and minority ethnic groups are disproportionately affected by high pollution levels,[27] and children[28] or women[29] exposed to air pollution experience elevated risk of developing health conditions.

- As climate change worsens the demand for energy will increase. This may increase the price of household fuel, which is likely to make it harder for poorer families to maintain good health, particularly in poorly insulated homes.[30]

As part of the development of this report, an equality and health inequalities assessment (EHIA) has been produced, drawing on EHIAs from each of the core analytical workstreams. The EHIA will be further developed based on feedback from further engagement with diverse audiences, and be required as a part of the implementation of future local initiatives.

3. Direct interventions to decarbonise the NHS

The NHS has over a decade of experience in sustainable healthcare, with recent commitments set out in the NHS Long Term Plan,[12], the 2020 NHS Operational Planning and Contracting Guidance[31] and the Standard Contract.[32] There is more work to do, and a range of opportunities to tackle climate change while delivering high quality care and improving public health.

This section sets out the immediate actions the NHS will take to reduce emissions and actions that could be delivered with additional investment and support. For each section, a waterfall chart is provided to give a high level overview of where emissions reductions can be achieved. Where practicable, all savings are expressed in kilotonnes of carbon dioxide equivalent ($ktCO_2e$).

3.1. Estate and facilities

The NHS estate and its supporting facilities services – including primary care, trust estates and private finance initiatives – comprises 15% of the total carbon emissions profile. **Figures 6 and 7** highlight the opportunities for emissions reductions in the secondary and primary care estates respectively, with significant opportunities seen in energy use in buildings, waste and water, and new sources of heating and power generation.

3.1.1. Reducing emissions from hospital estates and facilities

Delivering a net zero health service will require work to ensure new hospitals and buildings are net zero compatible, as well as improvements to the existing estate.

To support this, a new Net Zero Carbon Hospital Standard will be available from spring 2021, and applied across the 40 new hospitals to be built as part of the government's Health Infrastructure Plan.[15,31,32] This will involve both the use of innovative, low-carbon materials, as well as new design that allows for flexibility and shifts in how care will be delivered in the future.

While these new hospitals will need to meet the Net Zero Carbon Hospital Standard, they form less than a fifth of the secondary care estate and so significant interventions will also be required in the retained estate.

A summary of the range of interventions considered is presented in **Figure 6**.

Figure 6: Interventions to reduce emissions in the secondary care estate
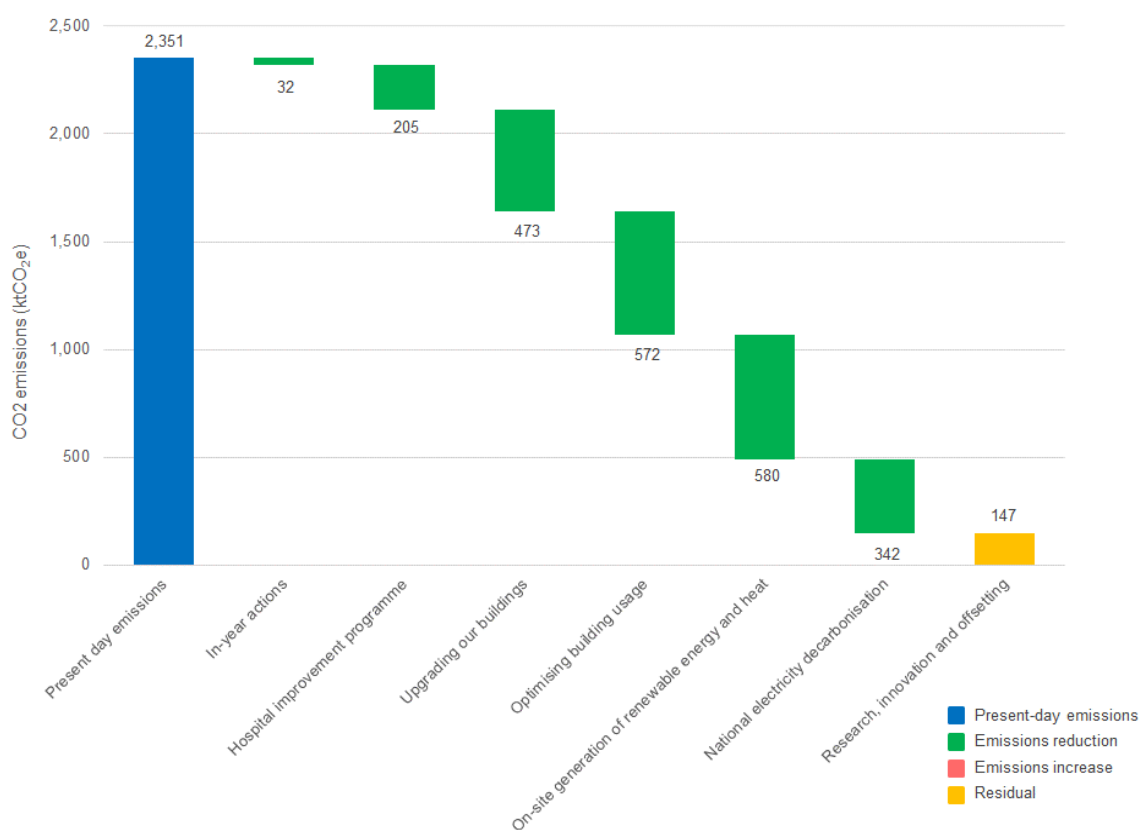
Engineering solutions to **upgrade our buildings** represents a total of 473 ktCO2e in potential emissions savings. Here, the £50 million NHS Energy Efficiency Fund (NEEF) will upgrade lighting across the NHS estate, acting as a pilot for future work and saving £14.3 million and 34 ktCO2e per year. Delivering 100% LED lighting could be achieved with an additional non-recurrent investment of £492 million, which would be paid back over a 3.7 year period, providing an estimated net saving of over £3.0 billion during the next three decades. A wide range of interventions focused on air conditioning and cooling, building fabric, space heating, ventilation and hot water could all be rolled out throughout the secondary care estate over the next 5 to 10 years, saving some £250 million per year (once all interventions are implemented by 2034). Crucially, a significant portion of the investment required to

deliver this will overlap with that for work underway as part of the regular maintenance and upkeep of the estate.

A range of socio-technical interventions will also be required to **optimise the way the NHS uses its buildings**. Intelligent, real-time energy monitoring and control, including the use of artificial intelligence, would contribute up to 2.3% of the total required reduction in carbon emissions, with an upfront investment of £259 million paid back within two years, and a net annual saving of £120 million once all interventions are implemented by 2034.

Finally, better use of roofs and adjacent ground space will support a shift to **on-site renewable energy and heat generation** across the estate, bringing a potential saving of 580 $ktCO_2e$ per year. Royal Manchester Children's Hospital has invested in an on-site renewable energy project and saved £80,000 in lifetime energy costs and 380 tonnes of carbon, and increased the resilience of its power supply. Installation of photovoltaics across the entire NHS estate would reduce the NHS Carbon Footprint by 1.6%. However, investment costs for this are high – £1.9 billion paid back over 15 years, with a net saving of £1.2 billion – and would need to be considered for early implementation to maximise benefits. In the first instance, the NHS will remove all coal and oil heating systems from its sites as soon as possible, with complete phase-out over the coming years. Finally, the NHS will purchase 100% renewable energy from April 2021. While we are aware this creates no additionality (and hence have not been built any reductions for this shift in purchasing into the existing modelling), it does demonstrate the system's commitment to net zero.

To help organisations understand what action they need to take, a net zero carbon capital planning tool for NHS trusts is being tested with 15 organisations, with the final version to be published later this year, alongside new clinical waste and energy management strategies.

3.1.2. Reducing emissions from the primary care estate

There are approximately 7,000 GP practices in England, spread over some 9,000 buildings. Total emissions for the primary care estate last year were 167 ktCO2e.

A summary of the range of interventions considered is presented in **Figure 7**.

Figure 7: Interventions to reduce emissions in the primary care estate
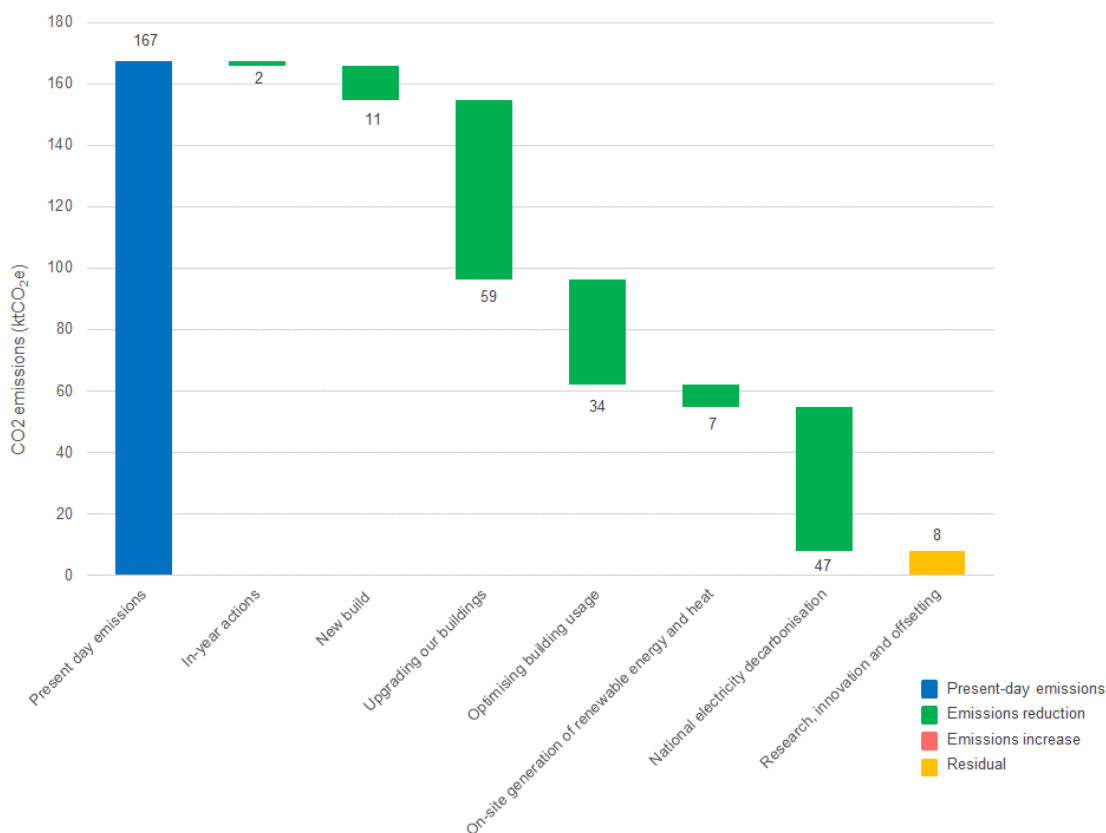
Additional resource will be required to support older primary care buildings across England to become more energy efficient: engineering interventions such as improved building insulation, lighting and heating could save 59 ktCO$_2$e annually; improvements to building instrumentation and energy management could save 34ktCO$_2$e annually; while the installation of photovoltaics and heat pumps could save 7ktCO$_2$e annually. Although further work is required here, one important resource is the Green Impact for Health toolkit, produced by the Royal College of General Practitioners and the educational charity SOS-UK. It was used by 754 GP practices in 2019/20, and provides accessible and comprehensive guidance on available emissions reductions interventions.

Box 4: COVID-19 and estates and facilities

The NHS' response to COVID-19 led to an increase in some types of activity and hospital capacity including in intensive care units and through the construction of the Nightingale hospitals across the country. Conversely, the number of virtual outpatient consultations has increased substantially over the last six months.

Other changes to practice will have an impact on emissions from NHS facilitates. As noted below (see **Box 6**), enhanced hygiene measures have increased use of single-use PPE to protect staff and patients while maintaining service delivery. This in turn will have generated more waste and increased use of in-house sterilisation and laundry services. Data is not yet available to quantify the net impact of these effects, and further work is needed to understand the overall impact these and other changes have had on emissions from the NHS estate and its facilities.

3.2. Travel and transport

Approximately 3.5% (9.5 billion miles) of all road travel in England relates to patients, visitors, staff and suppliers to the NHS, contributing around 14% of the system's total emissions.[14] This includes approximately 4% for business travel and fleet transport, 5% for patient travel, 4% for staff commutes and 1% for visitor travel.

A summary of the broad range of interventions considered is presented in **Figure 8**, from transitioning the fleet to zero-emission vehicles, to reducing unnecessary journeys and enabling healthier, active forms of travel such as cycling and walking. Forecasted increases in vehicle use are, in part, offset by rapidly evolving vehicle efficiency standards.

Figure 8: Interventions to reduce transport and travel emissions
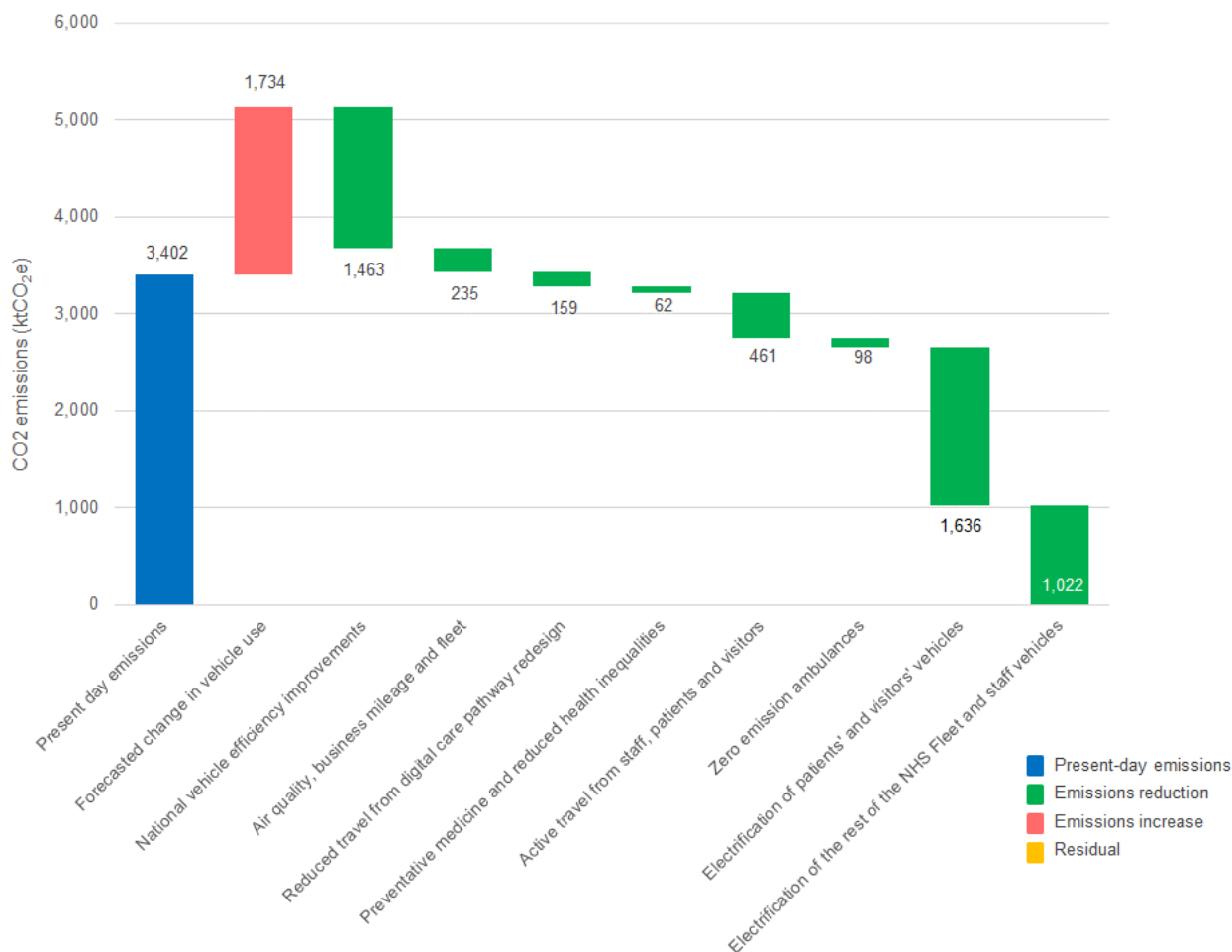
3.2.1. Electrification of the NHS transport fleet

To deliver high quality care, the NHS makes use of a large and varied fleet of vehicles. This analysis accounts for all vehicles used for NHS duties that are directly owned and leased by the NHS and its staff, with emissions totalling approximately 1,000 ktCO$_2$e per year. The analysis extends to vehicles from commissioned services, where our influence is less direct and less complete than for our own fleet.

To support this agenda, the NHS will:

- Ensure all vehicles purchased or leased are low and ultra-low emission (ULEV), in line with the existing NHS operating planning and contracting guidance deliverable for 2020/21.

- Meet the NHS Long Term Plan commitment for 90% of the NHS fleet to use low, ultra-low and zero-emission vehicles by 2028, and go beyond this with the entire owned fleet of the NHS eventually reaching net zero emissions.
- Undertake green fleet reviews[31] to identify immediate areas of action at the individual trust level.
- Incentivise staff to use electric vehicles, with increased access to these.
- Develop and test the world's first hydrogen–electric hybrid double-crewed ambulance through the London Ambulance Service as part of project ZERRO (Zero Emission Rapid Response Operations Ambulance), funded by Innovate UK. If approved this would have an important impact on NHS travel emissions, with the seven-year turnover in fleet, recommended by the Carter Review,[33] enabling adoption of this new vehicle within seven years.

The transition to low-emission vehicles will be supported by the UK government pledges to ban the sale of new petrol, diesel and hybrid vehicles from 2040 (and potentially earlier, pending consultation). Ambulances pose a particular challenge and require targeted interventions. However, for the rest of the fleet, rapidly exploring options for a complete transition to zero-emission vehicles by 2032 will be a key focus in engagement over the coming months.

Effective take up of zero-emission vehicles will require a comprehensive electric charging infrastructure across the NHS. This must happen in parallel with the adoption of electric vehicles, in partnership with the NHS estate and wider rollout in the community. More work is required to understand whether electricity capacity needs upgrading to meet new demand. However, there are examples of good practice across the system already. Northumbria Healthcare NHS Foundation Trust has been investing in electric vehicle charging since 2012. Seventy-nine chargers have been installed across nine sites, including 12 fast chargers and two rapid chargers, for essential vehicles.

3.2.2. Cycling, walking and shifting modes of transport

Shifting away from cars and towards cycling, walking and public transport decreases air pollution, improves physical activity and increases access to care for patients. This represents potential savings of some 461 $ktCO_2e$ per year.

To enable this, all NHS trusts will be required to have a green travel plan as part of their annual planning and reporting. This should include targeted interventions that

encourage staff and patients to reduce vehicle use. This might include promoting active travel (walking and cycling), the provision of electric bikes supported by digital platforms (apps), changes in infrastructure (eg improved cycle paths, storage and shower facilities) and policies (eg car parking priority for those car-pooling). Such plans are already implemented across several trusts, with Manchester University NHS Foundation Trust's sustainable travel plan providing personal travel advice for staff and updated travel information, over 200 additional cycle parking spaces, two cycle hubs for staff (including storage, lockers and showers) and a bicycle users group. It has subsidised travel and discount schemes, ensured two public bus route stops on the main sites and a shuttle service between sites and car clubs.

In line with the NHS People Plan, green travel plans should also set out how staff can be offered flexibility in their working patterns and supported to choose sustainable methods of transport for their commute.

Finally, emissions can be reduced through dedicated programmes to tackle air pollution, and prevent unnecessary journeys through improved preventative medicine and enhanced digital care. These interventions, with potential transport emission savings of 456 $ktCO_2e$ per year, are covered in the sections below.

Box 5: COVID-19 and travel

National measures introduced to reduce the transmission of COVID-19 have meant more people are staying at home, working from home and wherever possible accessing services online. While some of these national measures have changed, social distancing remains in place, meaning that workplaces may have lower occupancy and public transport is set up to carry fewer passengers. In the NHS, early estimates suggest that moving outpatient appointments online could have avoided 58,000,000 miles over three months.

A number of more sustainable travel options have also been made available such as Transport for London (TfL) providing free 24-hour access to Santander cycles for NHS workers in London; Uber offering NHS staff in London free use of their Jump electric bikes; BP Chargemaster (EV charging supplier) providing support to electric taxis transporting NHS workers during

the pandemic, allowing them to charge staff reduced fares; and MG Motor supplying up to 100 electric vehicles to the NHS.

Restrictions on travel are likely to have had a significant, but as yet unquantified, effect on reducing elements of current air pollution levels in the UK. However, whether these effects are retained in the long term will depend on a variety of factors.

3.3. Supply chain

The NHS Carbon Footprint Plus considers an expanded scope of emissions, covering the products procured from its 80,000 suppliers. While the NHS does not control these emissions directly, it can use its considerable purchasing power to influence change.

A summary of the broad range of interventions considered is presented in **Figure 9**, eg for reductions of emissions from medical and non-medical equipment (18%), food and catering (6%), other procurement (18%), commissioned healthcare services outside the NHS (4%) and medicines and pharmaceuticals (20%).

Figure 9: Interventions to reduce supply chain emissions
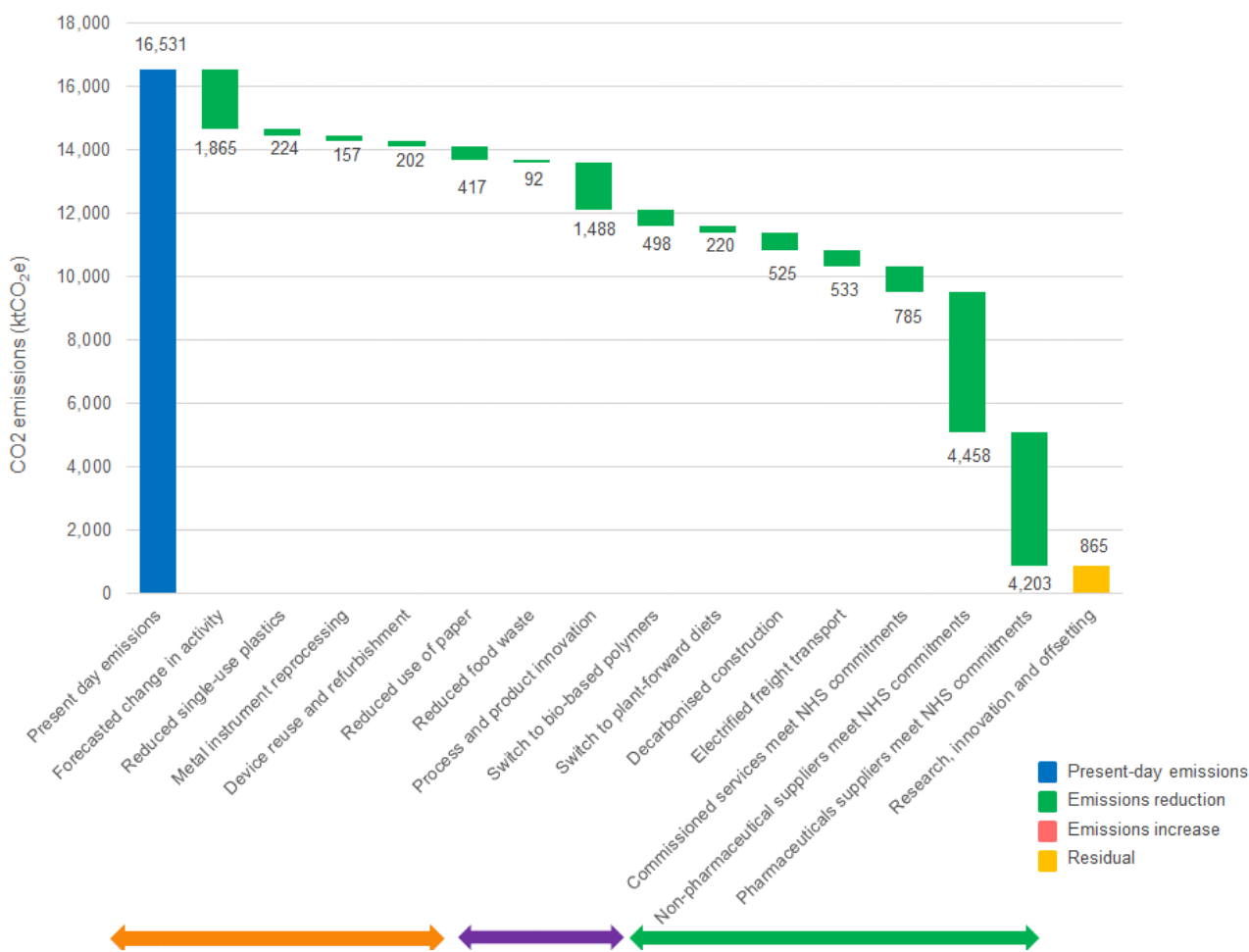
3.3.1. Decarbonising the supply chain

The NHS can reduce emission from its supply chain in three ways: more efficient use of supplies; low-carbon substitutions and product innovation; and by ensuring our suppliers are decarbonising their own processes. Ultimately though, delivering a net zero health service commits to having a net zero supply chain.

Good progress has already been made in **using resources more efficiently**. Over 1.4% of supply chain emissions are due to single-use devices, some of which could be refurbished and reused, saving the NHS both carbon and money. Action to reduce reliance on disposable products includes:

- Continued commitment to the NHS Plastics Reduction Pledge. To date over 145 trusts have signed up, with one trust, Yorkshire Ambulance Service

NHS Trust, removing 200,000 single-use plastic items from its waste stream in 2019/20; saving four tonnes of waste per year and over £12,000 a year in packaging, delivery and disposal costs.

- A 10% reduction in clinical single-use plastics in the short term, eventually saving a total of 224 $ktCO_2e$.
- Expanding existing walking aid refurbishment schemes, with 40% of all walking aids refurbished in the next five years.
- Reducing reliance on office paper by 50% across secondary care through increased digitisation, with a switch to 100% recycled content paper for all office-based functions.

The NHS will also work to **substitute for low-carbon alternatives** where they are available. New technologies and innovations are developing at an incredibly fast pace. Our role is to identify and encourage innovative approaches that will deliver improved patient outcomes with a reduced impact on the climate. For example, we anticipate that bio-based polymers will produce significant savings of 498 $ktCO_2e$ in the future. In response to COVID-19, the NHS has demonstrated an ability to respond to novel challenges at pace and scale, with the examples in **Box 6** describing the procurement of PPE and other single-use products, and how sustainability will be built into its work going forward.

Finally, the NHS will work to **ensure that suppliers are decarbonising their own processes** and provide clear and long-term signals about the direction of travel. This process has started through the NHS supplier engagement programme aimed at driving significant reductions in carbon emissions through carbon transparency reporting. An early pilot has seen 27 suppliers voluntarily share their plans on carbon reduction. In 2021, engagement will be expanded to 500 significant NHS suppliers. A compact with suppliers of clinical consumables and medical devices focused on reducing the emissions from product packaging will be developed. This process will recognise and support the needs of small and medium sized enterprises and the role the NHS has as an anchor institution in England.

Further work over the next 12 months is required to determine the precise dates, timelines and mechanisms to deliver these initiatives. However, the long-term target is clear: before the end of the decade, the NHS will no longer purchase from suppliers that do not meet or exceed our commitment to net zero. This will be an essential component of any net zero strategy, delivering reductions of 9,446 $ktCO_2e$ per year when fully realised.

Box 6: COVID-19 and personal protective equipment

During the first COVID-19 peak, demand for PPE globally rose to unprecedented levels, putting a strain on global supply chains. The NHS has rightly used exceptionally large volumes of PPE to maintain service delivery and sustain high quality care. However, there are growing concerns about the environmental impact this has had, and may continue to have, due to increases in production and disposal of single-use items, which are predominately made from plastics. The full impact of this on the NHS' emissions is not yet fully known.

Work is already underway seeking to reduce the NHS' PPE environmental impact, and understand how sustainability can be built into plans. As part of the UK Make initiative, we are increasingly looking to domestic PPE manufacturing, to develop a resilient, strategic supply chain, with high quality, innovative products for end users.

Working with our partners to encourage a greater focus towards sustainably sourced and innovative PPE, the NHS will over time focus on PPE that meets the criteria for an improved sustainability profile. Examples of this are the procuring of made-for-reuse PPE items, including masks and gowns.

3.3.2. Food, catering and nutrition

It is estimated that food and catering services in the NHS produces 1,543 ktCO$_2$e each year, equating to approximately 6% of total emissions. Healthier, locally sourced food can improve wellbeing while cutting emissions related to agriculture, transport, storage and waste across the supply chain and on NHS estate.

The Hospital Food Review, announced by the government in August 2019, is expected to consider sustainability and the impact of the whole supply chain, including sustainable procurement and waste. Alongside this review, new national standards for healthcare food for patients, staff and visitors will be developed by NHS England and NHS Improvement later this year. These standards will signal a more systematic approach to procuring and producing sustainable and healthy food for patients, visitors and staff. This may include, for instance, ensuring suppliers have sustainable production and transportation practices, sourcing local supplies of

food, the use of seasonal produce, increased use of sustainably sourced fish and efforts to limit food waste.

The government's EatWell plate[34] recommends a diet with reduced processed foods high in sugar, salt and fats as part of a healthy balance. Analysis makes clear that this diet is also a low-carbon diet, with seasonally and locally sourced fruits and vegetables greatly decreasing emissions, as well as one for which rates of colorectal cancer and heart disease are lower compared to average diets across the country.

3.4. Medicines

Medicines account for 25% of emissions within the NHS. A small number of medicines account for a large portion of the emissions, and there is already a significant focus on two such groups – anaesthetic gases (2% of emissions) and inhalers (3% of emissions) – where emissions occur at the 'point of use'. The remaining 20% of emissions are primarily found in the manufacturing and freight inherent in the supply chain.

Interventions to reduce the 20% of emissions found in the supply chain have been described in Section 3.3. **Figure 10** focuses on the scope of emissions reductions available from anaesthetic gases and inhalers, including commitments made in the NHS Long Term Plan that are already underway. Here, interventions considered include optimising prescribing, substituting high carbon products for low-carbon alternatives, and improvements in production and waste processes.

Figure 10: Reducing emissions from inhalers and anaesthetic gases
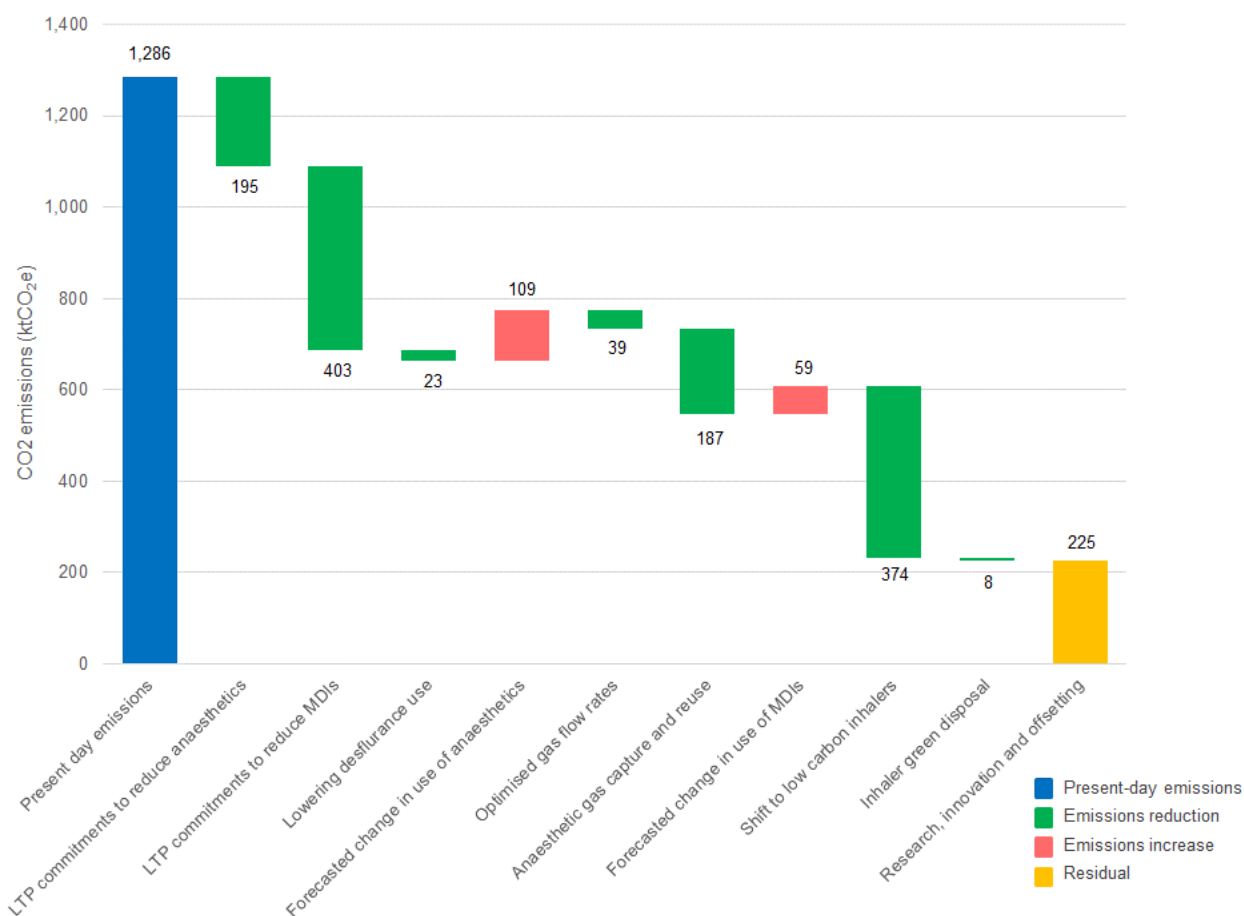
The NHS is working with patients, clinicians and industry to reduce emissions, and will continue to work with pharmaceutical companies to encourage carbon transparency reporting. Further work will include the active consideration of compulsory reporting from suppliers, and the inclusion of carbon accounting in the metric by which suppliers are assessed during procurement exercises.

3.4.1. Low carbon inhalers

Inhalers are used in a variety of respiratory conditions, ranging from asthma to chronic obstructive pulmonary disease. The majority of the emissions come from the propellant in metered-dose inhalers (MDIs) used to deliver the medicine, rather than the medicine itself. The NHS Long Term Plan set targets to deliver significant and accelerated reductions in the total emissions from the NHS by moving to lower carbon inhalers, such as dry powder inhalers (DPIs). Achieving the required reduction in emissions from inhalers will only be possible by:

- significantly increasing the use of DPIs, which may be clinically equivalent for many patients, and come with significantly lower carbon emissions
- increasing the frequency of the greener disposal of used inhalers
- supporting the innovation in and use of lower carbon propellants and alternatives.

The first of these will require shared decision-making between patients and clinicians: a 30% uptake would result in a reduction of 374 $ktCO_2e$ per year. Resources are available for specialists, prescribers and patients to support decision-making, including National Institute for Health and Care Excellence's (NICE's) Asthma Patient Decision Aid to support shared decision-making and a shift to low carbon inhalers.[35] Examples from healthcare systems across the world demonstrate that such a transition is possible while maintaining high standards of care. By learning from these initiatives, and those across the country, NHS England and NHS Improvement will continue to develop resources which aid patients in opting for low impact medicines where clinically appropriate.

Options to support and incentivise the uptake of low carbon inhalers were developed for 2020/21, with potential emissions reductions of 403 $ktCO_2e$ per year in the first instance, growing beyond this as ambition increases. While these are on hold due to COVID-19, further steps will be taken, including through an enhanced focus in the GP contract Investment and Impact Fund. Any measures going forward will need to support patients and ensure they are informed and empowered through the resources above, with inclusive and accessible messaging.

Beyond this, the International Pharmaceutical Aerosol Consortium (IPAC) is co-ordinating a consortium of large pharmaceutical companies to develop a programme encouraging patients to return inhaler devices to pharmacies for green disposal.

Looking to the longer term, two major pharmaceutical suppliers have committed to action on reducing the carbon impact of their MDIs and, from 2025, reformulating their inhalers so they can be used with low carbon propellants.

3.4.2. Anaesthetic gases

The NHS Long Term Plan committed to lowering the 2% of the NHS' carbon footprint from anaesthetic gases by 40%, by transforming anaesthetic practice. This requires efforts to shift from desflurane to lower carbon alternatives such as

sevoflurane; effective capture, destruction or reuse of these gases; and reduction in the atmospheric release from leftover nitrous gas canisters.

Anaesthetic gases used in surgery, such as desflurane, have a particularly high carbon footprint, with the emissions from one bottle equivalent to those from burning 440 kg of coal. However, low carbon alternatives exist, and are clinically appropriate in a wide variety of settings. Engagement with anaesthetists has seen a significant cut in some anaesthetic gas use since 2018, with monthly volumes of some volatiles falling by nearly 50%, saving 17 ktCO$_2$e per year. With further clinical engagement, it could be feasible to reduce the use of desflurane to as little as 5% by volume, saving a further 23 ktCO$_2$e per year.

The capture and destruction of nitrous oxide could cut over one-third of NHS anaesthetic emissions. This technology has been readily deployed in Sweden for some 16 years and could save an estimated 90 ktCO$_2$e emissions if implemented across 132 high impact trusts in the NHS. Scaled across the entire health service, this could deliver up to a 75% reduction in nitrous emissions. Similar technologies for anaesthetic gases went to market in 2020, following successful trials in UK hospitals, with funding from Innovate UK.

Finally, significant carbon savings are available by decreasing nitrous oxide wastage, with the College of Paramedics estimating that 30% of nitrous oxide is left in canisters after use. Recycling or reusing this is technically difficult, with new methods required to address the residual nitrous oxide.

3.5. Research, innovation and offsetting

The four sections above describe the suite of interventions available to reduce carbon emissions and deliver against the NHS' net zero ambition. These go as far as possible, with **Figure 11** describing the sources of the residual emissions.

Figure 11: Further work required from research, innovation and offsetting to reduce the residual
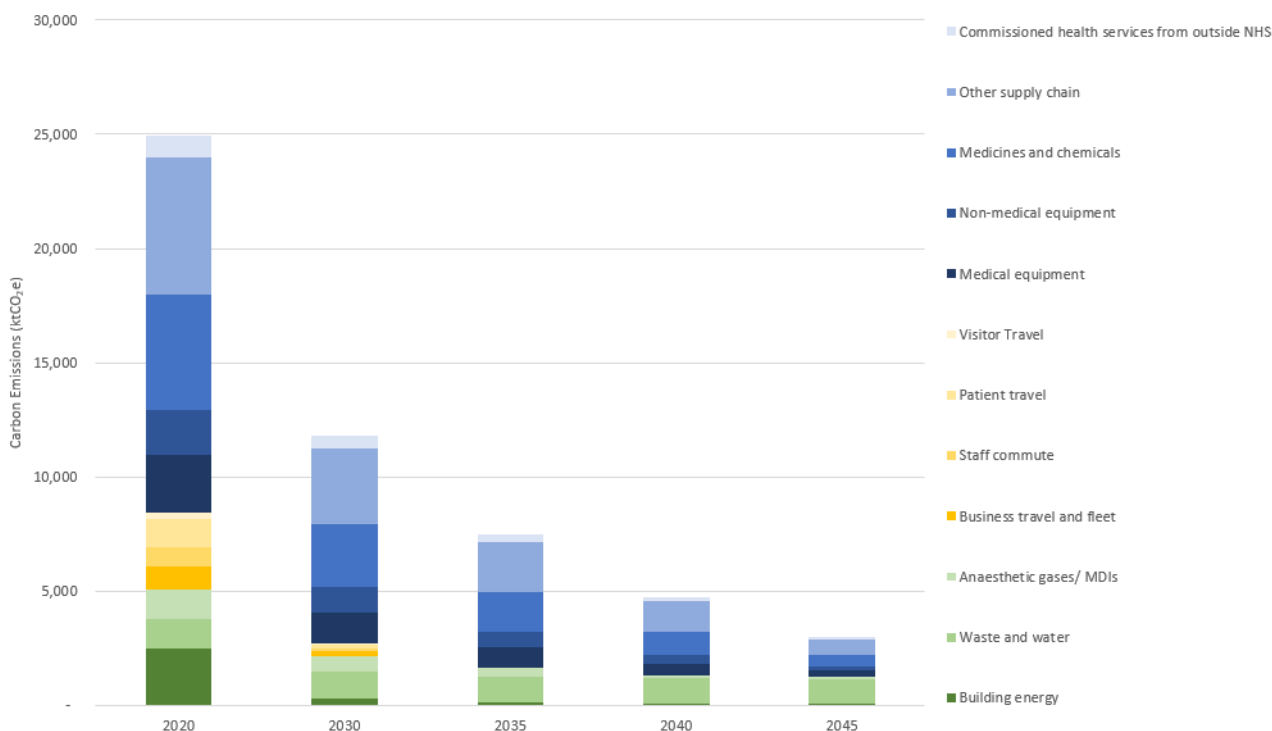
At every point, the NHS will look to reduce this residual through research and innovation. Net zero will be included in the NHS' research strategy, and will inform engagement with industry, research centres of excellence and other key partners. This will clarify areas of unmet need, signal areas in need of innovative solutions and help inform the Accelerated Access Collaborative (AAC).[36] Innovations could include switching from disposable to reusable equipment and use of technologies to avoid plastics in medicine supply, through to low-tech solutions such as the 11 $ktCO_2e$ saved from the reorganising of nephrology services as demonstrated by the Centre for Sustainable Healthcare.[37]

To support the future development and adoption of new technologies and innovations, the NHS will:

- require all applicants to national innovation support programmes to consider and articulate the environmental impact of the products and services for which they are seeking support
- embed sustainability in assessment criteria and decision-making processes for all innovation programmes by the end of 2020

- work with the Academic Health Science Networks (AHSNs) to embed net zero into the AHSNs' business as usual processes, working with them to develop a network-wide ambition and identify specific ways of working to promote the drive to reach net zero
- Use the AAC Horizon Scanning Function to identify the future pipeline of innovations which can support efforts to transition to net zero.

NHS England and NHS Improvement will also consider the feasibility of launching a dedicated sustainability challenge to support the development of technologies and innovations specifically designed to support our ambition of reaching net zero.

Having further reduced emissions as far as possible, the NHS will need to consider offsetting and mechanisms to secure negative emissions. Strategies to address this include direct energy generation from photovoltaics installation (some of which are outlined in Section 3.1), biosequestration and technology-based carbon capture and storage. While the carbon benefit is small, increasing green space and trees on NHS sites also provides opportunity for improving air quality, supporting mental health and social prescribing. Since 2009, the NHS Forest has planted over 65,000 trees across 180 NHS sites, increasing green space, improving air quality and mental health, and capturing carbon.

These mechanisms will need to link in with the government's existing plans in this domain. Technology-based carbon capture methods are in development in the UK, and the NHS will work with the Department of Business, Energy and Industrial Strategy (BEIS), academic institutions, and research and innovation partners nationally to understand what additional options may be available for the NHS to address the residual carbon footprint.

4. Delivering a net zero NHS

Having identified the interventions available to reduce carbon emissions, and the associated targets and trajectories, this section discusses how the NHS will deliver a net zero health service, covering: new models of care and alignment with the NHS Long Term Plan; workforce and leadership; and funding and financial mechanisms.

4.1. Sustainable models of care

The NHS Long Term Plan set out a commitment to deliver a new service model for the 21st century. If the NHS is to reach net zero emissions, that new service model must include a focus on sustainability and reduced emissions, with the section below describing the synergies here.

4.1.1. A new service model for the 21st century

As part of the new service model for the 21st century, multiple commitments are in progress, including boosting 'out-of-hospital' care; empowering people to have more control over their health; digitally enabling primary and outpatient care; and increasing the focus on population health. Optimising the location of care ensures that patients interact with the service in the most efficient place, which may be closer to, or even in, their home. Not only does this improve patient experience and often offer greater access to care, but it also reduces emissions by helping to avoid unnecessary hospital visits and admissions. The urgent and emergency care programme is working in partnership with the primary care and community care teams on this approach, with NHS 111 First helping to rapidly triage and connect patients to the most relevant, and often community-based, health professional. It is estimated that accelerating this approach will directly improve patient treatment, avoiding approximately 8.5 million km of unnecessary travel per year, to and from hospitals, with a carbon saving of 1.7 ktCO$_2$e per year in the first instance. Similarly, estimates suggest that up to 3 million people who visit A&E each year could have their needs addressed elsewhere, and perhaps by 24-hour urgent treatment centres.[38]

4.1.2. Further progress on care quality and outcomes

Health professionals have long worked to embed best clinical practice and there has been a commitment to further progress on care quality and outcomes. The Getting it Right First Time (GIRFT) approach exemplifies this. Its orthopaedics programme aims to identify and scale best clinical practice, resulting in significant efficiency savings and improvements for patient care.[39] Across the country, this has helped to avoid 49,026 less appropriate procedures, 385,493 bed days from reduced length of stay and 4,967 emergency readmissions, equating to an annual carbon reduction of approximately 26.5 $ktCO_2e$ from 2014/15 to 2018/19. GIRFT covers the full suite of surgical specialties – from cardiothoracic and vascular to urology and general surgery – and has been responsible for a combined reduction of 918,117 bed days, 91,538 admissions and 60.0 $ktCO_2e$ saved per year.

There is also a commitment to set out clear priorities for the diseases which contribute the most to ill health. Earlier and quicker testing, detection and intervention is a key target for the national cancer programme. Rapid diagnostic centres (RDCs) aim to improve outcomes for patients by delivering faster diagnosis and treatment, while also significantly increasing efficiency, and reducing carbon emissions.[40] Our analysis suggests that these RDCs could help avoid GP consultations and visits to the emergency department, by getting patients to the right place for treatment more quickly.

4.1.3. More NHS action on prevention and health inequalities

Preventing ill health not only benefits patients, but also increases efficiency and reduces emissions. The Alcohol Care Team in Nottingham University Hospitals NHS Trust provide one-such example. There, the team achieved a two-thirds reduction in hospital admissions due to detoxification and alcohol-related cirrhosis, saving 36 bed days per month.[41] Over a year, this would lead to estimated carbon savings of 0.27 $ktCO_2e$.

To support the embedding of sustainability and this net zero trajectory into the delivery of the NHS' national programmes, a net zero framework will be developed to help consider and evaluate carbon reductions associated with new models of care. This is currently being tested with NHS@Home and community diagnostic hubs and will soon be expanded to other parts of the system. Options to further incentivise emissions reductions will be considered through appropriate contractual

levers, eg the GP contract Investment and Impact Fund, as well as through partners such as NICE and the Care Quality Commission.

4.1.4. A digital, low-carbon transformation

The NHS Long Term Plan set a number of critical priorities to support digital transformation, seeking to mainstream digitally-enabled care across all areas of the NHS. **Box 7** describes the way these plans were rapidly accelerated in 2020 in response to COVID-19.

Going forward, changes will require significant infrastructure, and an associated increase in carbon emissions, with the supply chain currently estimated to emit 456 $ktCO_2e$ from information and communications technology (ICT). While energy efficiency is improving all the time, a rapid growth in data demand and digital equipment has the potential to add to these emissions unless we specify lower carbon digital products and services.

The NHS will ensure that a trajectory compatible with a net zero health service is embedded in the digital transformation agenda, and work to continuously drive down residual emissions from digital services via a number of actions which include:

- digitally enabled care models and channels for citizens that will significantly reduce travel and journeys to physical healthcare locations, with care closer to home being delivered through remote consultations and monitoring
- developing a blueprint for 'What Good Looks Like' for low carbon digital care, across the system
- building net zero into the digital maturity framework
- issuing policy advice to ensure NHS data centres and companies providing these services minimise their environmental impact and support the drive to reach net zero
- utilising levers, including local spend controls for technology, to incentivise a shift to net zero
- supporting front-line digitisation of clinical records, clinical and operational workflow and communications, aided by digital messaging and electronic health and care record systems.

Future opportunities for net zero identified as part of digital transformation include: digitising the estate and smart hospitals; ensuring large-scale migration of trust data centres into the hyper-scale cloud; and reducing the need for the storage of large volumes of data.

Box 7: COVID-19 and digital care

The response to COVID-19 rapidly accelerated the digitisation of outpatient and primary care appointments, with implementation of a five-year delivery plan being reduced to weeks. While still in the early stages of implementation, preliminary data suggests that during the initial seven weeks of the COVID-19 response in April and May 2020, there were 1.9 million remote outpatient appointments, representing 46% of the total.

Rapid procurement in primary care has enabled the implementation of digital first programmes in GP practices. This, as a part of the COVID-19 response, led to high levels of video consultation capabilities being put in place in GP practices by April 2020.

Adult mental health services have seen 95% of Improving Access to Psychological Therapies (IAPT) appointments being conducted remotely following a rapid movement away from face-to-face appointments. However, there is the expectation that some of these will return to face to face.

These examples indicate that much progress has been made to move care into a virtual setting, but data from a wider range of services and over a longer time horizon is required to more completely assess the full health, health equity and sustainability implications of these shifts, as well as how any beneficial changes can be maintained as part of the phased COVID-19 recovery.

4.2. Workforce, networks and system leadership

The staff who work in the NHS support further action on climate change, with a recent survey demonstrating that 98% of all staff believe the health and care system should be acting more sustainably.[42] This support is further demonstrated in the professional bodies across the country, with the UK Health Alliance on Climate

Change bringing together 21 of the country's major health organisations (including the Royal Medical and Nursing Colleges, the British Medical Association and two leading medical journals) to advocate for a stronger health response to climate change.

4.2.1. Building capability in all staff

An upskilled workforce will be needed to drive and implement the interventions outlined in this report. They will need to be supported to learn, innovate and embed sustainable development into everyday actions in the health service.

So that everyone understands that they have a role, a tailored induction module will be prepared for all NHS England and NHS Improvement staff to support staff understanding of the links between health and climate change, and interventions they can take to reduce emissions. This will draw on insights from the NHS England and NHS Improvement Behavioural Science Unit, setting out the most influential and impactful behaviours, including those in the 2020/21 NHS People Plan.[43] A dedicated net zero training package for staff working in estates and facilities will also be developed.

Meeting the growing demand for skills will require partnerships, which need to be further supported by the introduction of sustainable healthcare into the curricula for all health professionals. This is already being done by the General Medical Council outcomes for medicine graduates,[44] the Nursing and Midwifery Council Standards of Proficiency for Midwives[45] and the World Federation of Occupational Therapy Minimum Standards for the Education of Occupational Therapists.[46] Teaching on climate change, health and sustainable healthcare is also being introduced to a range of medicine and allied courses in the UK – including medicine at the University of Bristol and nursing and dietetics courses at Plymouth University. The Centre for Sustainable Healthcare has also developed a bespoke 'sustainable specialties' programme. Finally, the NHS Confederation is developing training to educate and upskill non-executive directors on the opportunities for sustainable healthcare in their trusts.

4.2.2. Spreading and scaling what works across our regions

Excellent local initiatives with tangible carbon reductions can be found across the system, with many able to be scaled to the national level. Operation TLC (Turning off equipment; Switching off lights; and Closing doors) at Barts Health NHS Trust

improved patient experience, while saving carbon and £500,000 from reduced energy consumption. Expanding this model across the NHS could save up to £45 million and 200 ktCO$_2$e per year.

Regional networks will be central here, and the sustainability and health networks will help maintain the focus on the net zero ambition and facilitate local learning and sharing of best practice. At a system level, Dame Jackie Daniel, Chief Executive of The Newcastle upon Tyne Hospitals NHS Foundation Trust and member of the Net Zero Expert Panel, is co-ordinating a group of NHS leaders to explore the enablers of accelerated collective action. A complementary group for primary care will be established to support further action.

4.2.3. Embedding sustainability across the NHS

To reflect the NHS' commitment to a net zero health service, we propose that the NHS Constitution is updated to include our net zero ambitions and sustainable development, making it clear that this is a key responsibility of all staff. All NHS organisations – including every region and integrated care system – will also be required to have a board-level lead, responsible for leading on net zero and the broader greener NHS agenda.

National and local levers and incentives will be used to support the delivery of the commitments set out in this report. These will build on the 2020/2021 Standard Contract requirement for providers to produce a green plan, approved by their governing body, along with an annual summary of progress towards net zero.

4.3. Funding and financial mechanisms

Investing in a net zero NHS aligns with investment in the long-term sustainability of the health service and with the health of the people in England. The net zero ambitions outlined in this report go further than the commitments set out in the NHS Long Term Plan. The actions identified will need to be appropriately resourced with the right capital investment and investment in skills and capacity in the right parts of the system to lead these actions. Delivery of this plan will therefore require ongoing, targeted investment and an aligned financial policy and decision-making process.

These net zero ambitions will be aligned with existing commitments as far as possible; for example, to ensure that the design of new hospitals and major refurbishments, including the government's 40 new hospitals, take into account the

need to reduce emissions, and that wherever possible maintenance or the replacement of equipment is done in a way that improves energy efficiency and reduces emissions. We will work to ensure that these factors are taken into account in investment decisions.

We will look to develop tools so that decisions across the NHS are informed by an understanding of environmental impacts, as well as financial ones. We will explore existing policy and decision-making processes to align with the ambition to get to net zero, including through procurement, business cases and reimbursement. As part of this we will review best practice from other sectors, including options such as introducing an internal carbon fee to incentivise consideration of carbon impacts of financial transactions between NHS organisations.

We also need to review how financial mechanisms influence and change behaviour. The role of incentive schemes and removal of disincentives in driving change is well understood. We will undertake a review of contractual mechanisms and levers to understand the opportunities to drive environmental change. We will look to explore opportunities created through the development of integrated care systems for more efficient joint working and to explore how best to enable systems to focus investment in a way that reduces emissions.

We will actively work with government to access funds directed towards the UK-wide ambition for net zero, and with trusts to explore alternative ways to fund this investment. The investment needed for a net zero health service clearly extends beyond its buildings alone. This also requires investment in our people, ensuring they understand what they can do to respond to climate change, and have the expertise needed to implement new ways of working and to embed behaviour changes.

4.4. Data and monitoring

Evidence-based targets and data underpin the analysis and commitments laid out in this report. However, more work is needed to improve the monitoring and data collection capacity of the system.

Sustainability indicators are already reported nationally through a range of systems, such as the Greener NHS Dashboard. This includes key indicators on anaesthetics, inhalers and building energy use, and process indicators to support action to deliver

on current commitments. Annual sustainability reporting is now mandated for clinical commissioning groups (CCGs) and trusts by the NHS Standard Contract (Service Condition 18). The optional Sustainability Reporting Portal tool supports providers and CCGs in demonstrating and reporting on progress in a consistent way as part of their annual report. These indicators will be reviewed in light of the new net zero commitments and used to monitor and understand the scale of the challenge and progress across the NHS. Trusts will be required to include these indicators in their annual report, which will be used to inform a regular update of the NHS emissions profile. This will be supported by efforts to mainstream sustainability into the common data pipeline for the system, and by making a wide range of tools available online to allow NHS organisations to measure their own progress.

5. Next steps – an iterative and adaptive process

The NHS' approach to achieving net zero emissions will be iterative and adaptive and aim to continuously improve with an increasing level of ambition. Its work will inherently be unfinished, and continually subject to change as technology evolves, the regulatory environment changes, resources materialise and more data becomes available.

The long-term targets and direction of travel are set. However, continual review will be required to ensure the system is on track, with regular planning and review. To this end, an expert panel will be re-convened periodically to provide expert input into a process of monitoring, review and planning for the coming years. In this way, the NHS will constantly aim to have certainty on targets and delivery plans in the near-term, while ensuring it is on track to meet its long-term commitments.

To support internal co-ordination, the NHS England and NHS Improvement Sustainability Board will be refreshed to ensure senior coverage across the system, and will report to the NHS Board. Outside the NHS, the national cross-system group will also be revitalised to help co-ordinate action from the full range of organisations involved in delivering against the net zero agenda. A new International Advisory Committee will be formed to support the delivery of the NHS Carbon Footprint Plus scope, in recognition that achieving net zero emissions will require partnerships with health professionals across the world. Finally, the new Greener NHS national programme will build on the work of the former Sustainable Development Unit, with an expanded, outward-facing remit, enhanced capacity, and a focus on net zero healthcare and the broader sustainability agenda.

Box 8: A resilient, net zero health service

A net zero NHS is an essential component of the response to climate change. However, the NHS must also adapt to the impacts of climate change that are already occurring today, and those that cannot be avoided. Heatwaves, storms and floods are already affecting the way that care is delivered across

community, primary and secondary care settings, and the evidence suggests that these events will only become more frequent over the next 30 years.

Mitigation and adaptation priorities are often mutually strengthening. However, without careful planning, they may undermine one another, making both objectives less achievable. The NHS will build resilience and adaptation into the heart of the net zero agenda, and will use the third Health and Social Care Sector Climate Change Adaptation report (due for publication in the coming months) to highlight this approach.

5.1. The next 12 months – an ongoing engagement process

The direction, scale and pace of change outlined in this report have been informed by the near 600 submissions to the call for evidence, national and international technical expertise, and the guidance of the NHS Net Zero Expert Panel. Ongoing engagement is required from a broad range of stakeholders within and beyond the NHS to provide further detail and advance this work. Over the coming months, this will include:

- continuing to finalise and then publish the analysis underpinning the dates presented here
- working with government and the full range of NHS organisations to explore the resources available to deliver a net zero health service
- publishing the third Health and Social Care Sector Climate Change Adaptation Report (**Box 8**)
- restarting the national campaign For a greener NHS to engage with our staff and patients, and to ensure that the health service's commitments on climate change and net zero are clear to the world.

Importantly, the publication of this report, and the commitments and discussion within it, will be used as a basis of an engagement process over the next six months. Engaging with key stakeholders and across government, this will be used to provide further clarity on what is possible, always with the aim of increasing ambition over time. Importantly, it will ask several targeted questions about the

medium-term direction of this work, and explore mechanisms further to support staff and the wider system to deliver against the NHS' net zero ambitions. For example, while the rapidly evolving technology and infrastructure needed to reduce road transport emissions presents an opportunity, there is a need to further understand the mechanisms available to deliver on this. The results of this process will be used to inform further commitments and will be published throughout 2021.

The evidence-based targets laid out in this report provide ambitious and credible targets for net zero emissions. With the UK government hosting the UN Climate Change negotiations (COP26) in Glasgow in 2021, the NHS is well-placed not only to meet, but to exceed its commitments under the Climate Change Act, and to become the world's first net zero national health service.

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7. Glossary

AAC   Accelerated Access Collaborative

AHSN   Academic Health Science Network

CFCs   chlorofluorocarbon gases

CO_2e   carbon dioxide equivalents

Defra   Department for Environment, Food and Rural Affairs

DPI   dry powder inhaler

GDP   gross domestic product

GHGP   Greenhouse Gas Protocol

GIRFT   Getting It Right First Time

GWP   Global Warming Potential

HEE   Health Education England

HES   Hospital Episode Statistics

HFCs   hydrofluorocarbons

ICT   information and communication technology

IPAC   International Pharmaceutical Aerosol Consortium

IPCC   Intergovernmental Panel on Climate Change

LED   light-emitting diode

MDI   metered-dose inhaler

NEEF   NHS Energy Efficiency Fund

NICE   National Institute for Health and Care Excellence

PPE   personal protective equipment

WHO   World Health Organization

Annex 1: The NHS Net Zero Expert Panel

Member	Affiliation
Dr Nick Watts (Chair)	Executive Director, The Lancet Countdown on Health and Climate Change
Preeya Bailie	Director of Procurement Transformation & Commercial Delivery, NHS England and NHS Improvement
Kay Boycott	Chief Executive, Asthma UK and British Lung Foundation Partnership
Dr Isobel Braithwaite	Public Health Registrar and Academic Clinical Fellow, University College London
Professor Paul Cosford	Emeritus Medical Director, Public Health England
Dame Jackie Daniel	Chief Executive, The Newcastle upon Tyne Hospitals NHS Foundation Trust
Professor Mike Davies	Professor of Buildings Physics and the Environment, Bartlett School of Environment, Energy & Resources, University College London
Ian Dodge	National Director, Primary Care, Community Services and Strategy, NHS England and NHS Improvement
Professor Piers Forster	Professor of Climate Physics, University of Leeds
Dr Fiona Godlee	Editor in Chief, *British Medical Journal*
Sara Gorton	Head of Health, UNISON
Professor Hilary Graham	Professor of Health Sciences at the University of York
Prerana Issar	Chief People Officer, NHS England and NHS Improvement
Richard Murray	CEO, The King's Fund
Professor Donal O'Donoghue	Registrar, Royal College of Physicians
Sonia Roschnik	International Climate Policy Director, Health Care Without Harm
Professor Harry Rutter	Professor of Global Public Health, University of Bath

Professor Emily Shuckburgh	Director of Cambridge Zero, University of Cambridge
Dr Richard Smith	Chair, UK Health Alliance on Climate Change
Professor Helen Stokes-Lampard	Chair, Academy of Royal Medical Colleges
Dr Madeleine Thomson	Interim Head, Our Planet, Our Health, the Wellcome Trust
Dr Matthew Tulley	Director of Built Environment, Imperial College Healthcare NHS Trust

Annex 2: The analytical approach to net zero

The net zero modelling and analytics approach provides the basis for setting out the pathway to net zero for the NHS. It combines the following: outputs of estimates of the NHS carbon footprint emissions from 1990 to date; a forecast of emissions to 2050; a model of the impact of the combined actions from agreed policy wedges that deliver expected emission savings and individual analysis; and modelling of specific interventions or set of interventions to demonstrate the scale of change required to reach net zero for the NHS.

The four main elements of the modelling and analytics approach that underpin the recommendations in this report are detailed below.

Figure 12: The four main elements of the modelling and analytics approach

1	Estimate NHS carbon footprint baseline emissions from 1990
2	Projection of NHS carbon footprint emissions to 2050
3	Model impact of proposed and agreed policy wedges on NHS carbon footprint
4	Model impact of specific interventions within policy wedges on NHS carbon footprint
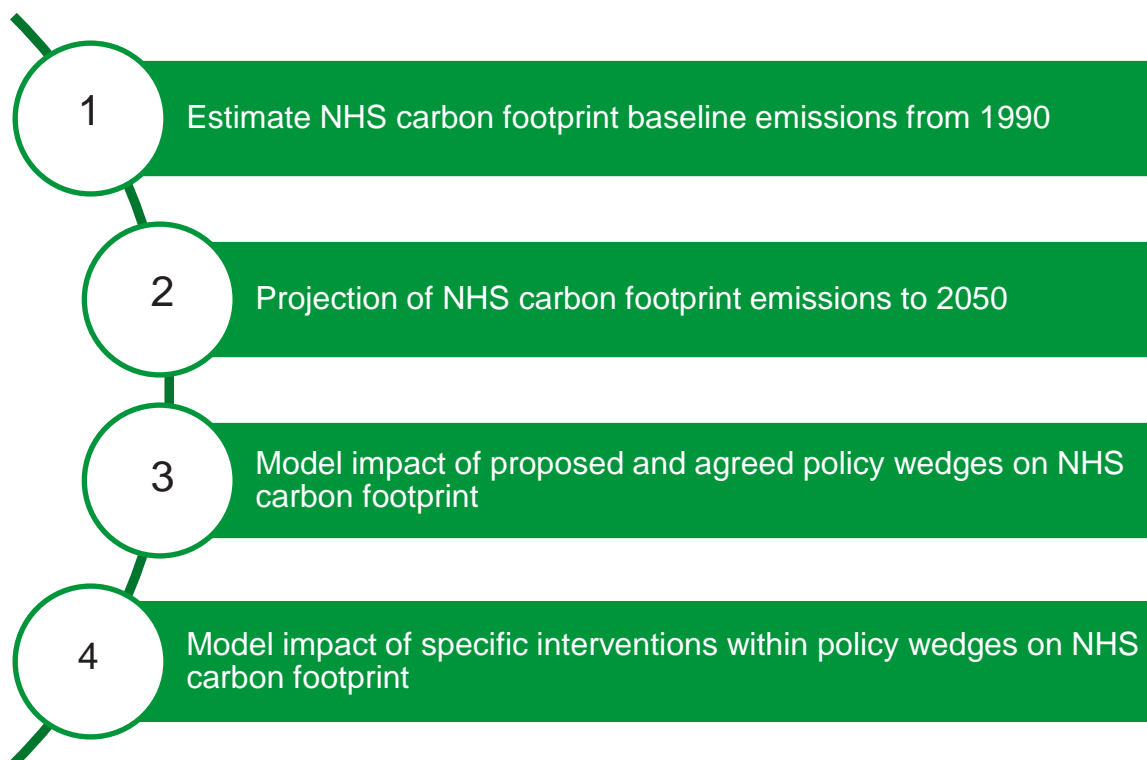
Estimating NHS carbon footprint emissions from 1990

The NHS carbon footprint model quantifies emissions within scopes 1, 2, and 3 of the Greenhouse Gas Protocol, as well as 'out of scope' patient and visitor travel emissions, from 1990 to 2019. This allows for benchmarking with the Climate Change Act. The estimates blend:

- Location-generic (top-down) results for categories that can only be measured in economic terms, or that are too complex to model physically. Financial information is combined with environmentally extended input output (EEIO) carbon intensities per unit spend ($kgCO_2e/£$) for 105 economic sectors.[47] The 2020 carbon footprint update uses the 2016 EEIO model.

- Product and location-specific (bottom-up) results for categories that can be measured and described physically. Organisational data collections of activity (units of energy, waste, travel miles, etc) are combined with carbon factors from BEIS.[48]

Environmental and economic datasets are collated internationally so the base dataset is four years older than the bottom-up information.

Location generic (top-down) modelling

NHS supply chain and commissioned health services emissions are calculated using the location generic (top-down) modelling approach. This relies on economic models of the interconnections between different sectors, and their associated satellite accounts on emissions or resource use data. Estimates of the emissions or resource use associated with expenditures on goods or services are made by calculating the share of economy-wide emissions due to those expenditures.

The analysis uses the UK Multi Region Input Output (MRIO) model developed by researchers at University of Leeds for Defra to estimate the impact that UK consumption has on CO_2 emissions. The worldwide production of goods consumed in the UK is considered, as well as goods produced in the UK and emissions directly generated by UK households. This version is adapted for use for the NHS.[47]

The MRIO model links the flows of goods and services described in monetary terms with the emissions generated in the process of production. Forecasting uses a static model of an economy, represented in economic input–output tables using

linear fixed assumptions on technology mixes and prices. This limits the capacity of the forecast to capture the effects of new technologies, price shifts or changes to the structure of economies. The model combines UK national input–output tables, taking advantage of their high sectoral resolution, and complements them with EXIOBASE's MRIO model (an MRIO table produced by a prominent consortium of EU research institutes), more accurately representing economic structures and emissions intensities of other countries and world regions.

The model uses UK government spend data on health from HM Treasury Public Expenditure Supply and Use (Final Demand) tables and from Statistical Analysis (Public Expenditure Statistical Analysis) apportioned to England based on population. Broadly, the process is as detailed in **Figure 13**.

Product and location-specific (bottom-up) modelling

Staff, visitor and patient travel

Business travel and freight and business-related transport are calculated using the top-down approach. National Travel Survey (NTS) results have been used to estimate the patient travel to and from NHS sites including primary care, such as pharmacy and GP practices, and patient transport services not paid for by the NHS.[49] This is also used to estimate visitor travel accompanying patients, visiting patients in hospital, escort and staff commute to and from NHS sites. No consistent surveys were available for travel to and from NHS sites, so this national dataset provides the only source information.

Carbon intensity factors from BEIS have been mapped to each mode of travel to calculate emissions[48] and a continuing trends model has been used to calculate the carbon intensities of travel in the future. This assumption will need re-visiting with scenarios for moving to electric vehicles and regulation already in place which reduces the carbon emissions from cars.

Figure 13: Process to develop UK MRIO model

UK Spend on Human Health

Sourced from HM Treasury Public Expenditure Supply and Use (Final Demand) tables and from Statistical Analysis (Public Expenditure Statistical Analysis Supply and Use tables from HM Treasury) both proportioned to England based on population.

Spend by economic sector

Total spend is proportioned using the transaction matrix in the UK MRIO model, mapping the total NHS expenditure to sectors for UK, China, EU and rest-of-world regions.

Expenditure by the NHS

Expenditure by the NHS by economic sector for the four world regions is created using UK spend on human health and spend by economic sector.

Carbon intensity multipliers

Emissions factors for each sector are calculated from the UK MRIO satellite accounts and emissions are then calculated from the disaggregated expenditure data and the sectoral emissions factors.

NHS green house gas results

Created by multiplying out expenditure by the NHS by carbon intensity multipliers for each of the 106 economic sectors for the four world regions.

Result concordance

Raw results are then aggregated using a concordance-based approach that maps emissions into 19 expenditure categories.

Nine of these relate to emissions and are removed as accounted for via bottom-up calculations.

Discontinuities corrected

Discontinuities resulting from sector reclassification or MRIO model updates are replaced with interpolated values to conform with long-term trends.

Results

Amalgamates bottom-up and top-down information to provide a single time series for the NHS. Outputs are green house gas emissions.

Building energy use and electricity intensity

Data from the Estates Return Information Collection (ERIC) system is used to estimate emissions from NHS buildings in NHS trusts and ambulance trusts within England.[50] The data includes the consumption of energy, water and limited other goods for all buildings and NHS-leased sites, covering 24 million m^2 of hospitals and other clinical facilities across the country. It does not include other healthcare buildings such as those for primary care, sites below 150 m^2 with fewer than 10 inpatient beds or office buildings of non-clinical organisations. ERIC reporting requirements and NHS structures have changed over time and an annual adjustment is included to account for this. Annual emissions factors for fuels and electricity, are taken from the UK Government Energy (BEIS) and Environment (Defra) ministry publications for 2002 to 2019, and from company reporting guidance for older calculations.[48] Future electricity factors are published in the HM Treasury Green Book supplementary guidance for the valuation of energy use and greenhouse gas emissions for appraisal.[51] These are modelled based on predicted grid mix of energy generation.

Anaesthetic gases (volatiles and N$_2$O)

Anaesthetic gases analysis uses four different categories of data sources for estimation purposes:

1. supplier data from distribution or manufacturing companies; voluntary health facility reporting
2. hospital data obtained at the facility, trust, or ambulance trust level
3. NHS pharmacy hospital-level electronic data (volatiles only)
4. dental clinic N$_2$O data from work commissioned by Public Health England.[52]

UK data is scaled to England by population, and all bottom-up data is extrapolated to England by occupied bed-days. The model assumes there are four activity drivers for the use of N$_2$O. These are in surgery as a carrier gas for volatiles, gas and air in maternity, ambulance and emergency room. Volatiles are assumed only to be used by anaesthetists during surgery. Surgical activity is modelled on bed days for surgical specialties using hospital admitted patient care activity from the Hospital Episode Statistics (HES). Maternity activity is based on the number of maternities. A&E activity is recorded by the number of A&E attendances.

Ambulance activity is used in terms of calls to the ambulance service that receive a face-to-face response from the ambulance service.

Global warming potential factors (GWP100) for the volatiles are taken from Sulbaek Anderson (2011) and for N_2O from the IPCC AR5.[51,53]

Metered dose inhalers

Metered dose inhalers analysis uses the internationally reported national atmospheric emission intensity (NAEI) data (including private prescriptions) for 2006 onward, and back dates to 1990 using population and assuming no change in inhaler use per capita prior to 2006.[54] For the years between 2006 and 2017, this data is scaled down from the UK to England, by proportion of population.

Projection of NHS carbon footprint emissions to 2050

The projections of NHS carbon emissions build on the carbon footprint baseline using assumptions to develop a conditional forecasting model to 2050. The outputs of this model are then used to set out a pathway to net zero for the NHS. This includes the short-term forecasts to extend from available time series data to present day (2020) and longer-term projections to 2050.

- For categories that can be measured and described physically (bottom-up), historical trends and known interventions have been used to create independent assumptions for each category of emissions. Both activity (changes in energy use, travel, spend, etc) and carbon intensities are combined to produce a forecast of emissions for each year to 2050.

- For categories that can only be measured in economic terms, expenditure has been modelled in line with Office for National Statistics (ONS) and Office for Budget Responsibility (OBR) published projections of health expenditure and the NHS proportion of this in England has been calculated using known expenditure figures.[55,56] Nominal gross domestic product (GDP) for 2018 and Consumer Price Index assumptions are taken from the OBR Economic Outlook supplementary (2019). These are combined with the GDP deflator index from the HM Treasury Green Book supplementary (2019) and growth forecasts from the OBR Fiscal Sustainability Report (FSR) (2018) to produce projections of future NHS spend.[57,58]

Where forecasts for carbon intensity or spend have been published, by BEIS or other government departments, this information was used, however many categories do not have this information available. Forecasts therefore use one of three options: continuing trend, continuing growth or known trajectory.

Table 2: Details of data used and projections modelled

Category	Bottom-up or top-down?	Source	Backcast years	Actual data	Projection years	Projection basis
Building energy use – hospitals	Bottom-up	ERIC	None	1990–2018	2019–2050	Gas, oil, coal – continuing trends Electricity – expenditure adjusted for inflation
Building energy use – other sites (GP, offices)	Estimate	Sample data source	1990–2013	2014–2015	2016–2050	Backcast based on hospital energy use Forecast based on expenditure adjusted for inflation
Electricity factors	Bottom-up	BEIS HMT Green Book	1990–2002	2002–2017 2018–2050		All BEIS factors have been used for grid composition year and HMT Green Book modelled factors have been used for subsequent years. For 2018 an average of 2019 BEIS (2017 grid composition) and 2020 Green Book factor has been used
Waste and water	Top-down	EEIO	1990–1996	1997–2016	2017–2050	Comparison with bottom-up data shows a large variance so top-down totals are being used
Travel – staff, visitor and patient	Top-down	NTS	1990–2001	2002–2018	2019–2050	Continuing trends model

Category	Bottom-up or top-down?	Source	Backcast years	Actual data	Projection years	Projection basis
Supply chain	Top-down	EEIO	1990–1996	1997–2016	2017–2050	Forecast based on OBR FSR 2018 growth projections
Anaesthetics – volatiles	Bottom-up	Supplier information	1990–2015	2016–2018	2019–2050	
Anaesthetics – nitrous oxide	Bottom-up	Supplier information	1990–2010	2011	2012–2050	
Meter dose inhalers hydrofluorocarbons (HFCs)	Bottom-up	NAEI	1990–2005	2006–2017	2018–2050	Backcast uses linear increase between introduction of HFC inhalers in 1997 to first recorded emissions data in 2006
Meter dose inhalers chlorofluorocarbon gases (CFCs)	Bottom up	NAEI		1990	1991–2050	Linear reduction 1990 to 2006

Model impact of proposed and agreed policy wedges on NHS carbon footprint

The wedges model combines the estimate of the NHS carbon footprint emissions from 1990 to the present day with projection of emissions to 2050 and the modelling of the impact of specific interventions to deliver carbon savings. Areas where policy action are needed to tackle the carbon emissions in the NHS carbon footprint have been identified as a 'wedge' and broken down into smaller 'sub-wedges'. Potential carbon savings are estimated to create a wedge trajectory and contribution towards the delivery of net zero. This is based on evidence, bottom-up analysis, modelling and data where available. The savings are applied to the NHS carbon footprint forecast from 2020 to 2050 to provide projections of emissions post policy actions and the potential path to achieve net zero under the different scopes.

The wedges assume an 'order' such that the carbon reduction is applied sequentially (that is, each reduction is being applied to the remaining footprint only). The order of the wedges is set so that national and international actions are applied
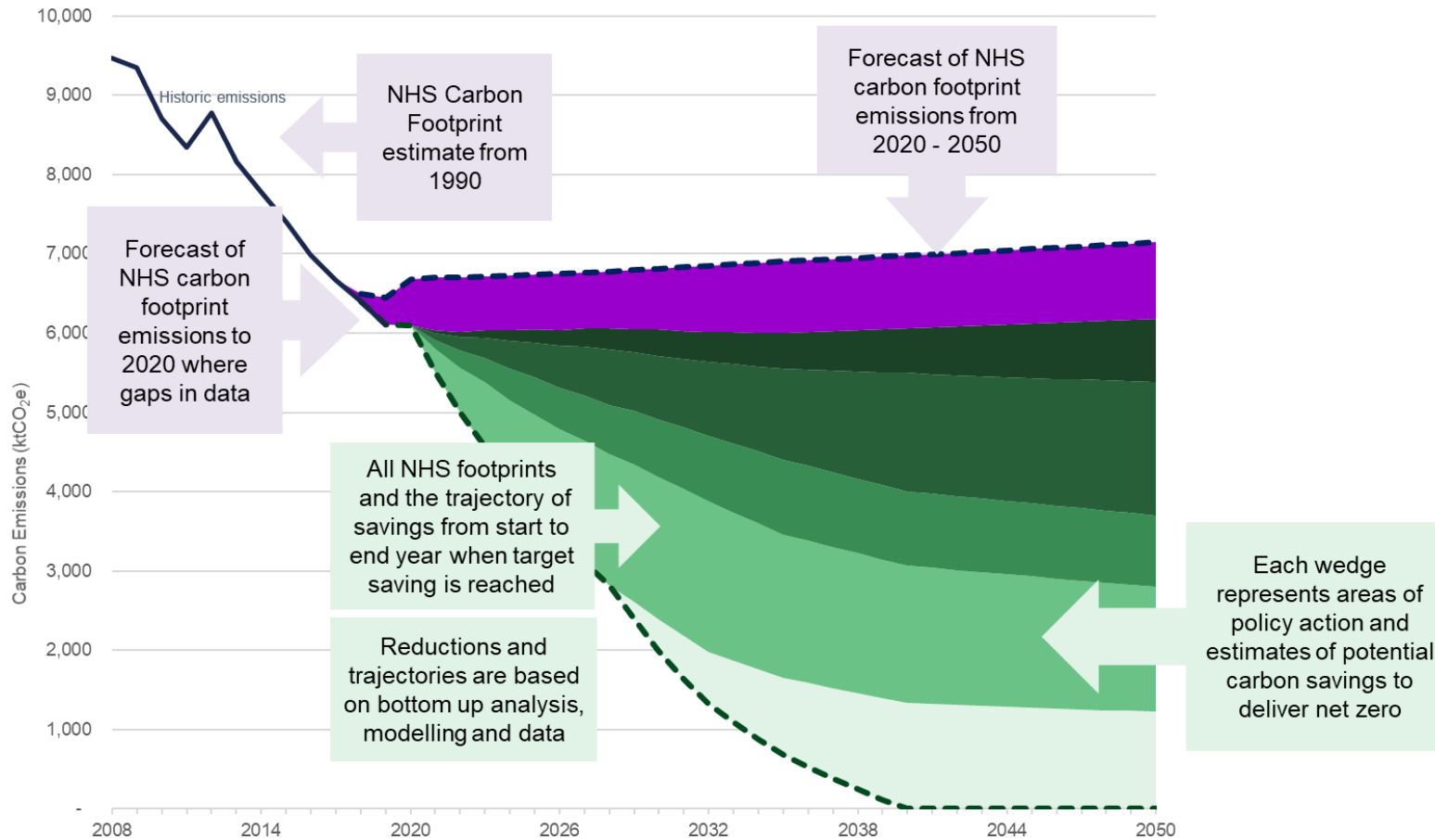
first, followed by any existing commitments (eg NHS Long Term Plan actions), followed by wedges with cross-sector impacts (eg new models of care), and any remaining emission would be addressed by the sector-specific wedges. This approach ensures that any duplication of emissions reductions is removed. However, the emissions reductions derived using this ordering process may slightly differ from the reductions identified in the bottom-up analysis.

Model impact of specific interventions within policy wedges on NHS carbon footprint

Each of the policy areas modelled by the wedges has conducted bottom-up modelling or analysis to understand the key interventions required to deliver net zero. This analysis sets the basis for the target carbon reduction (as a percentage of the footprint). The trajectory of savings used in the wedges model estimates the delivery savings each year from the start of implementation to the year when the target saving is reached.

Some of the wedges may have more impact than one carbon sector. For example, new models of care interventions (such as earlier intervention, rapid discharge, etc) aim to reduce the numbers of treatments and/or the carbon intensity of the treatment required. These interventions therefore can deliver savings across the NHS' footprint. The bottom-up analysis is not able to fully consider consequences of these cross-sector impacts; this is accounted for in the wedges model.

Figure 14: Detail of the carbon reduction wedges

NHS Carbon Footprint estimate from 1990

Historic emissions

Forecast of NHS carbon footprint emissions to 2020 where gaps in data

Forecast of NHS carbon footprint emissions from 2020 - 2050

All NHS footprints and the trajectory of savings from start to end year when target saving is reached

Reductions and trajectories are based on bottom up analysis, modelling and data

Each wedge represents areas of policy action and estimates of potential carbon savings to deliver net zero

Carbon Emissions (ktCO$_2$e)

Annex 3: Summary of the net zero call for evidence

The NHS net zero programme opened a call for evidence on 25 January 2020, inviting ideas on how the NHS could continue to reduce its carbon emissions and become greener.

The call for evidence formally closed on 22 March 2020, although to take account of the NHS response to COVID-19 we accepted a number of late submissions via e-mail. A total of 568 submissions were received and we are grateful to everyone who took the time to submit their ideas and evidence.

There was a diverse range of information from a broad range of contributors:

- **57% of submissions were provided by NHS staff**, with the remaining **43% coming from other sources** including industry, academia, the third sector and members of the public.

- Around **50% of the submissions represented ideas and expert opinions** and **30% included case studies or research**. The remainder comprised other resources, including links to sustainability blogs, outputs from projects, dissertations and innovative local policies.

- More than **40% of submissions contained a package of multiple ideas and resources**, applicable to a range of areas which we identified as discrete but interconnected workstreams. The remainder focused on specific individual ideas or innovations.

The main themes and ideas arising from our review of evidence is set out by workstream below.

Table 3: Percentage of submissions by area

Workstream	Percentage of submissions
Estates and facilities	21.4%
Travel and transport	12.7%
Supply chain	8.2%
Food, catering and nutrition	7.7%
Medicines	6.7%
Research, innovation and offsetting	4.6%
Sustainable models of care	11.8%
Workforce, networks and system leadership	9.9%
Funding and financial mechanisms	4.2%
Adaptation	1.8%
Strategic ambition	6.2%
Communications and engagement	4.8%

Estates and facilities

The submissions highlighted a range of tangible and visible ideas that can be implemented by both staff and patients; many of which are already being actioned across the estate.

- This includes a range of measures under energy generation and use, for instance: purchasing renewable energy, LED lighting, efficient infrastructure, and retrofit and installation of solar panels.
- Many suggestions noted the need for improved waste and recycling facilities at their local site, such as reduced use, improved waste management, sorting, reusing and recycling, with some suggestions relating to surgical theatres and food. The theme of the NHS going

paperless also emerged, with suggestions around a digital-first approach and stopping paper letters.

Submissions included a range of ideas that are not currently being implemented. These require further investigation to fully understand their impact:

- For energy generation, suggestions included the installation of fuel cells, biomass boilers and combined heat and power engines that run on hydrogen, developing heat networks and exploring heat generation. A suggestion to invest in batteries designed for storing photovoltaic power has been investigated further.

Under waste, ideas included switching to multi-use equipment where possible, such as reusable sharps bins, and reusing equipment that has been loaned to individuals (eg crutches, wheelchairs or supporting frames). Applying circular economy principles to waste management was also proposed, by fixing, rather than replacing, broken equipment (non-clinical) such as chairs, flooring and office equipment.

Travel and transport

Submissions related to avoiding travel and reducing the emissions from vehicles where travel is still required.

Some suggestions highlighted ideas that are already underway, including NHS employer initiatives to support sustainable travel for staff, patients and visitors such as:

- organisational or personal travel plans
- changes to business travel and expenses polices
- encouraging active travel (eg walking, cycling)
- car-pooling where appropriate.

Greening the NHS fleet, particularly ambulances, by transitioning to low, ultra-low and zero-emission vehicles was highlighted, along with the associated need for electric vehicle charging.

Some submissions related to action that has already been accelerated during the COVID-19 response. For example, avoiding staff travel by using video conferencing

and increased working from home reduced patient travel through digital GP and outpatient appointments or care provided at the patient's home.

Supply chain

Many submissions relating to supply chain highlighted projects already underway to increase the sustainable procurement of goods and services through, for example:

- embedding sustainability and carbon in decision-making
- setting whole-system and local-level targets for carbon reduction targets
- conducting life cycle assessments and evaluations of high volume products, most notably single-use products
- pooling NHS purchasing power to enable sustainable procurement of goods and services.

The wastefulness of paper usage and plastics was a frequently raised concern from respondents both within and outside the NHS. There was a particular focus on plastics, which fall into two broad groups:

- non-clinical plastics: catering plastics and excessive supply chain packaging, with proposals to switch from single-use to reusables (eg cups, plates, water bottles and food packaging)
- clinical plastics: proposals from staff to re-evaluate alternative options for many single-use items, disposable or expired equipment and unused pharmaceuticals, as well as calls for the NHS to consider reusable or refurbishable alternatives.

Food, catering and nutrition

The most frequently submitted proposal focused on increasing plant-based food and drink options available to patients, staff and visitors, notably for inpatient meals. Evidence submitted highlighted both the environmental and health benefits of an increased consumption of plants and a reduction in consumption of highly processed foods. Benefits include significant reductions in carbon emissions, water consumption, land-use needed for food production and a reduced risk of cardiovascular disease, stroke and obesity.

Other submissions included:

- offering healthier or more sustainable choices for concessions food
- carbon labelling of food to empower consumers to understand the environmental impact of products to make informed choices
- switching to local food suppliers to reduce food miles and utilise seasonal produce
- reducing food waste and reducing single-use plastics in canteens and food packaging.

Medicines

Most of the submissions related to one of four categories:

1. metered dose inhalers (MDIs)
2. anaesthetic gases
3. pharmaceuticals
4. logistics and storage of medicines.

Of the four categories, the majority of submissions related to inhalers and anaesthetics.

Several submissions related to work already underway, such as switching from meter dose inhalers to dry powder inhalers, reducing volatile anaesthetic gas use and more recycling. Others were new ideas, including: individually tailored medicine packaging, disposal of chemotherapy waste and looking at comparisons with veterinary anaesthesia.

Another significant category of responses related to the impact of single-use compared to reusable items, broadly split into plastics and metal items.

Research, innovation and offsetting

Research and innovation were reflected as important enablers to reduce NHS carbon emissions through finding new approaches to delivering healthcare, alongside the potential contribution of offsetting. Submissions in relation to research and innovation fell into two categories:

Innovations in or research into the delivery of a specific service or treatment, an aspect of its delivery or an aspect of its sustainability

In this category, there were significant overlaps with several other workstreams, including digital care, medicines and estate and facilities, since the innovation or research would relate to an operational aspect of healthcare. For example, ideas included switching from disposable to reusable equipment, application of technology to support care pathways, and research into improving the energy efficiency of buildings.

Strategy and policy interventions to support the spread and uptake of research and innovation, encouraging more sustainable healthcare

This included through:

- greater consideration of sustainability principles in decision-making across all areas of healthcare
- alternative procurement mechanisms to stimulate innovation in sustainable healthcare
- greater support to spread innovation and learning for innovators and policy-makers.

Offsetting

Tree-planting and greening of the NHS estate made up the overwhelming majority of submissions addressing how to offset residual carbon emissions. These ideas were mainly suggested for their health benefits, including impacts on staff and patient wellbeing, aiding recovery and social prescribing, rather than carbon capture.

Sustainable models of care

Generally, submissions regarding sustainable models of care related to three areas: principles underpinning models of care, prevention and health inequalities, and the role of digital in supporting low carbon transformation.

Principles

Submissions to the call for evidence highlighted four broad principles or approaches to reduce carbon emissions:

- optimising the location of care, eg care closer to home and in the community
- earlier and faster diagnosis, to allow for earlier and less intensive treatment
- reduced unnecessary treatments and interventions
- ensuring that all activity in the system represents best clinical practice.

The majority of these submissions supported an increase in use of digital technology to provide appointments and services virtually where possible. Several specifically suggested rolling out virtual appointments across primary and secondary care, replacing or supplementing face-to-face appointments. A few submissions also suggested streamlining the way that different forms of care are provided. For example, combining several treatments or diagnostic services in a single patient visit to save time and reduce the number of visits.

Prevention and health inequalities

The NHS Long Term Plan outlines specific activity to encourage prevention of ill health and to address health inequalities. This includes specific action primarily in secondary prevention, such as supporting changes in behaviours or lifestyle factors that are needed to improve a person's healthy life expectancy. Several submissions took a broader view of how the system could reduce carbon emissions, of which the majority focused on the need to tackle wider determinants of health (such as levels of education, income and types of employment) and health inequalities, to prevent people from becoming ill in the first place. This would require working across government, national and local public sector bodies and local authorities.

Many of the examples submitted included principles that align with personalised care approaches. There was a strong focus on patients taking responsibility for their own health, supported by continuity of carer, improved shared decision-making skills between clinicians and patients, and a move to reduce overdiagnosis.

A digital, low-carbon transformation

Many of the submissions related to ideas that are already in train under the NHS Long Term Plan ambitions. These included:

- Telehealth and web-based communication platform usage. Babylon was cited as a comprehensive and mature example of this type of activity already underway, which has subsequently been scaled up significantly due to COVID-19.
- Internet of Things and app-based health sensing and ill health prevention tools which represent a carbon reduction opportunity, building on examples underway. For example, smart inhalers, as cited in the NHS Long Term Plan, and arrhythmia devices.
- Moving away from paper, which is in line with the Digital First agenda.

Submissions also highlighted a range of new ideas and proposals, including:

- Smart hospitals which would link smart buildings to patient flow and experience.
- Data storage, resolution and retention, where submissions emphasised many opportunities such as reducing video or medical scan resolution to lower energy requirements to store and process data.
- Creating low impact ICT systems, including through a focus on circular economy (utilising re-manufactured kit and leasing over ownership). This would need to consider a wide dashboard of environmental and social sustainability factors, including consumption of energy, carbon, material, critical raw materials (rare earth metals) and consideration of ethical and social factors as well as modern slavery legislation.

The Fourth Industrial Revolution emerged as an important theme, which includes a focus on big data, artificial intelligence and machine learning. All these have high potential in terms of diagnostic tools and system efficiencies. This is an area which would need more investigation as there are concerns about what the energy sustainability impact will be. For example, machine learning is a hugely energy intensive process.

Workforce, networks and system leadership

The majority of submissions focused on how the workforce can be supported to operationalise and spread the greener NHS programme. Submissions fell into five broad themes:

Training and guidance

Suggestions made in the call for evidence ranged from national, mandated training for all NHS staff, to role-specific training as part of inductions, to including sustainable development in the curriculum. This would mean that all staff understand the challenges faced due to climate change, and how they can make a difference. It was noted that many trusts already undertake their own training programmes but may vary in the focus of the training. It was suggested that introducing a single narrative, aligned with the national greener NHS approach, would be beneficial.

Behaviour change

Many submissions highlighted the importance of knowing what can be changed to make the biggest difference. This included actions that anyone can take, clinical practice changes and specific changes based on topics (eg waste, travel).

Supporting staff resilience

Another theme emerging from submissions was that of resilience. This includes both managing the eco-anxiety that is being increasingly experienced as we understand the challenges posed by climate change, and ensuring that our workforce and health systems are able to manage those challenges in the future.

Influencing and enabling

Submissions highlighted the crucial role of commitment to the sustainability agenda from system and organisational leadership to enable staff to make changes. This would allow capacity and skills to be built in the right places in the workforce (eg sustainability managers, accountable board members) and would empower enthusiastic staff to have a more influential role. Additionally, submissions suggested that incentivising sustainable behaviours through policies and salary sacrifice schemes would demonstrate a level of commitment and leadership.

Wider system changes

It was noted that for any influential changes to be spread and shared across the system, early engagement with our workforce is essential. This includes engagement over changes to how care is delivered (eg increased use of digital and tech, social prescribing), changes to support services (eg digital-first approach to communication) and facilities management (eg recycling, use of green space).

Funding and financial mechanisms

A number of submissions explored the role of finance in delivering net zero. Some of these expressed support for ideas already underway, such as:

- specific funds or loans, including interest-free loans focused on energy efficiency.
- incentives like salary sacrifice schemes for sustainable travel
- improving information and data, including common measures of carbon to enable fair decision-making.

Others suggested new ideas or approaches, and broadly fell into three categories:

- targeted funding to support the move to more sustainable practices, such a specific greener NHS fund or a sustainable prevention fund to develop and implement green prevention strategies
- policy changes to deliver our net zero commitments, including calls for organisational divestment from fossil fuels, developing ringfenced funding to target sustainability and redesigning payment mechanisms to better incentivise more sustainable care models.
- changes to decision-making processes, including using a sustainability impact assessment for any new investments or financial decisions, adopting practices which consider sustainability in policy and practice from other parts of the public sector and industry (eg Wellbeing of Future Generations Act,[59] Accounting for Sustainability[60]).

Adaptation

Submissions relating to adaptation largely overlapped with at least one other workstream, mostly notably estates and facilities, in particular with a focus on

interventions for cooling and heating buildings. In this sense, and because adaptation interventions rarely have a direct carbon saving, and indeed can increase carbon emissions, proposed interventions have been reviewed and included as a cross-cutting theme within relevant workstreams.

Communications and engagement

Most submissions within this workstream focused on the enabling role of communications and engagement to support positive environmental actions. Campaigns, sharing resources, and use of digital tools and virtual events were recurring suggestions to support greater understanding of climate change and encourage positive activity.

There was a clear overlap here with themes arising under the workforce workstream, including the importance of engaging with staff and the need to increase carbon literacy.

A small number of submissions also provided ideas for the delivery mechanisms of a greener NHS, to make sure that the right decisions and activities happen at the right levels of the system. This will be relevant to planning delivery through local, regional and national teams.

Contact us:

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