HEALTHCARE ENGINEERING FOR A NET ZERO FUTURE

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A HEALTHCARE ENGINEERING ROADMAP FOR DELIVERING NET ZERO CARBON

A best practice guide for Healthcare Estates

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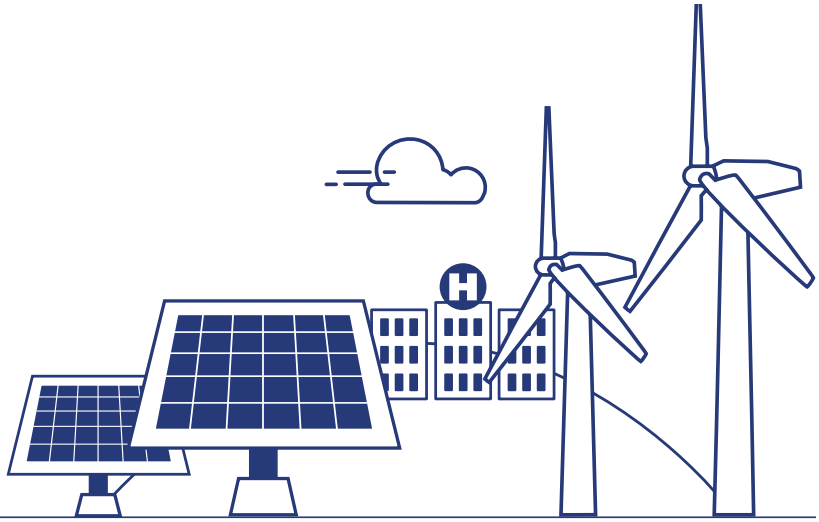

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Foreword

I am delighted to introduce this roadmap to net zero carbon outlining a recommended strategy to net zero carbon for the NHS and public sector estate. If we are to deal with the most pressing environmental challenge facing the world, then the NHS as the largest public sector carbon generator needs to take the lead and be a beacon to the whole public sector in the UK and beyond where NHS standards are widely applied.

In 2019, the UK Government and the devolved administrations committed to the net zero target as recommended by the Committee on Climate Change. Reaching net zero greenhouse gas (GHG) emissions requires extensive changes across the economy, but the foundations are in place. Major infrastructure decisions need to be made in the near future and quickly implemented. These changes are unprecedented in their overall scale, but large-scale transitions have been achieved successfully in the UK before, such as the natural gas switchover in the 1970s or the widespread harvesting of wind energy of the last decade.

The Committee on Climate change identified the following required changes

- *resource and energy efficiency, that reduce demand for energy across the economy*
- *societal choices that lead to a lower demand for carbon-intensive activities*
- *extensive electrification, particularly of transport and heating, supported by a major expansion of renewable and other low-carbon power generation*
- *development of a hydrogen economy to service demands for some industrial processes, for energy-dense applications in long-distance HGVs and ships, and for electricity and heating in peak periods*
- *carbon capture and storage (CCS) in industry, with bioenergy (for GHG removal from the atmosphere), and very likely for hydrogen and electricity production.*

Furthermore, the NHS has now also identified a commitment for the emissions controlled directly (the NHS Carbon Footprint), to net zero by 2040, with an ambition to reach an 80% reduction by 2028 to 2032.

It must be vital to the whole of government and to every level of government in the UK that the country moves swiftly to zero carbon. Overall, a well-managed transition can be achieved and lives can be improved. People can benefit from better physical and mental health, an improved environment and, crucially, a reduced exposure to climate risks.

The roadmap outlined in this document, if diligently applied, will form a significant part of the required changes as they apply to the NHS and public sector estate.

Baroness Brown of Cambridge DBE FREng FRS FInstP CEng FRAeS
Committee on Climate Change

View from Pete Sellars

IHEEM Chief Executive & President of IFHE-EU

The impact of the Covid-19 pandemic has brought together the worldwide scientific and public health community to lead the fight against this deadly virus. The global response across this community to develop a swathe of vaccines in such a short time is truly remarkable. Geographic, personal and political boundaries have been cast aside in the interests of a united global approach to the challenges faced through Coronavirus.

The pandemic has also resulted in engineers worldwide having to actively deal with a raft of new and complex healthcare engineering challenges. These challenges predominately centred around managing and maintaining critical engineering infrastructure services as demand increased and reached levels above and beyond their intended design. Up to this point core services such as medical gases, ventilation, water, electrical and decontamination services had, in most cases, been taken for granted by clinical and medical teams worldwide.

The "Delivering a Net Zero NHS" document recognises that COVID-19 will continue to impact how the hospitals plan to deliver their care models. The urgent requirement to ensure resilient healthcare infrastructure systems worldwide are available to meet these increased demands will almost certainly directly conflict with the ambitions to reduce the environmental impact of those services.

The scale of the task must not be under-estimated. The global impact of our healthcare sectors contribution to the deliver the Net Zero ambitions is significant. Healthcare engineers cannot forget the urgent need to address the increased clinical expectations and demands of these services. Our current engineering solutions to provide increased capacity and resilient healthcare infrastructures, in many instances, conflict with delivering the Net Zero Carbon aims.

The need for healthcare engineers and academics worldwide to collectively work together, share best practices and develop new innovative solutions has never been more needed than now. Our worldwide healthcare engineering profession needs to be informed of and have access to new technology and innovation and the latest thinking. New engineering solutions are likely to be extremely complex and highly specialised and require a strong network and platform for our healthcare engineering profession to engage and share new ideas and solutions.

I am delighted that IHEEM, in collaboration with our wider international partners of International Federation Healthcare Engineers (IFHE) & International Federation Healthcare Engineers Europe are creating a platform for the sharing of knowledge throughout our community. We are committed to working together in partnership with our engineering profession worldwide to promote the development of new engineering solutions that safely manage patients, protect staff and the public whilst responding to the climate change agenda.

Embracing the known and future advances in knowledge, innovation, and technology will be vital for healthcare engineers worldwide together with transferrable engineering science to help them meet whichever government policies or targets are required. This document will provide an excellent platform and reference point to work with.

The intention is to keep this document updated as new technologies and solutions come to light. Please help support this by contacting IHEEM, IFHE & IFHE-EU to enable us to continue to share worldwide with our healthcare engineering networks.

I do hope you find this engineering roadmap useful.

Pete Sellars
IHEEM Chief Executive, IFHE-EU President

Introduction

Since the publication of the original version of this guide there has been a lot of changes in the World. Efficiency in healthcare estates is still of vital importance as is minimising the environmental impact from its operations. The recent surge in interest in the environment, that emerged from the focus brought about by the Climate Emergency agenda has seen the NHS both at national, regional and Trust level set increasingly ambitious environmental targets.

As with its predecessor, this Guide has been developed to assist NHS Trusts in identifying, assessing and delivering commercially viable strategic energy solutions. It is intended to provide information for Directors of Estates, Directors of Finance and their teams, as well as other senior Investment decision makers with responsibility for wider Trust affairs. The content and technical detail of the document is a valuable source of information for designers, engineers and technical personnel directly involved in the development and delivery of energy solutions.

The development of this guidance document has been supported by The Institute of Healthcare Engineering and Estate Management (IHEEM) and Health Estates and Facilities Management Association (HEFMA). Both these organisations are committed to providing ongoing professional support and sharing of best practice guidance with their members as the NHS landscape continues to evolve. The content available within this guide is CPD accredited with CPD points available. More information is available at **www.carbonandenergyfund.net/CPD**

NHS target for net zero by 2040

In October 2020 the NHS published its ***"Delivering a 'Net Zero' National Health Service"*** report, which identifies proposed targets for decarbonising and establishes the objective to achieve a net zero emissions position by 2040, which is 10 years in advance of the UK Governments objectives set in June 2019. Net zero means any remaining emissions would be balanced by schemes to offset an equivalent amount of greenhouse gases from the atmosphere, such as planting trees or using technology like carbon capture and storage.

The NHS 2040 net zero target places it at the forefront of decarbonising healthcare, making it the world's first national health system to commit to become 'carbon net zero', backed by clear deliverables and milestones.

Crucially, the NHS ***"Delivering a 'Net Zero' National Health Service"*** report, has identified an 80% reduction in emissions that needs to be achieved within the next 8 to 12 years. The NHS ***"Delivering a 'Net Zero' National Health Service"*** report also cites that within the Secondary Care estate it anticipates 25% carbon reductions coming from on-site generation of renewable energy and heat, 20% carbon reductions coming from up grading existing buildings and 24% carbon reductions coming from optimising buildings.

This guidance document has been set out to show how a potential road map can be established that enables Trusts to plan a pathway starting from today, to lead towards the 2040 position through making planned and strategic investments in energy and building infrastructure helping to deliver against the objects defined within the NHS ***"Delivering a 'Net Zero' National Health Service"*** report.

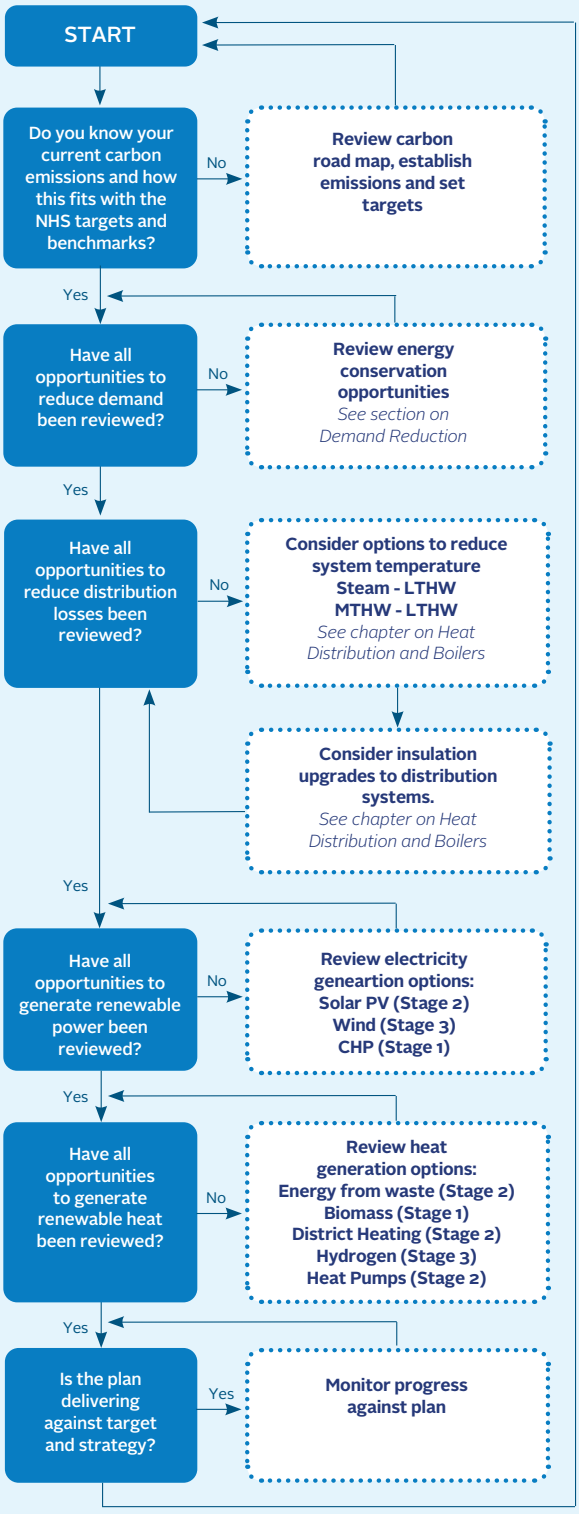
Looking beyond the now - a staged approach to energy projects

The 2040 NHS carbon reduction plan clearly places a sense of purpose and a need to deliver on significant carbon reduction milestones by the end of this decade and so well within the life of typical investments being made in energy projects today. So we need to look at energy projects not just in the here and now, but also in the 15 year life of a typical energy performance contract and to view projects as a continuum. There are technologies that are in development today that will eventually mature and be appropriate for hospital projects in the near future. However, action needs to be taken now to ensure investments are made in energy infrastructure to deliver savings today and meet the milestone carbon reduction targets that are just on the horizon; while at the same time not precluding the easy adaptation of these investments to accept the technology of tomorrow.

In this latest version of this guide we are introducing a staged approach to energy projects. There are technologies, such as gas CHP, that can generate large revenue savings today and in a carefully constructed project, can be recycled into preparing the estate for future technologies by including items such as upgrading the heat distribution systems to low-temperature-hot-water, that will in turn be ready for technologies such as heat pumps.

An obvious question is why not jump straight to stage 3 and avoid stage 1? This could be possible for some technologies; however many NHS Trusts do not have

A staged approach to energy projects



capital available to deploy such a rapid approach. The staged methodology will enable many healthcare estates to make a transition over several years without impacting their income and expenditure budget.

The changing NHS agenda

The NHS is a continually changing and evolving organisation. With a changing demographic and phenomenal advances in medical technology, the NHS is always on a programme of change. For some Trust's this can be more significant than others; however, almost all Trusts without exception will be involved in planning expansion or remodelling of their existing provision. The new NHS carbon reduction milestones; mean the ability to ignore the impact of carbon emissions and consequential impact to energy infrastructure as part of clinical facilities planning is not going to be possible. It is important that projects are progressed in parallel with other works. A well-developed energy project can complement a wider estates programme and help reduce cost burdens. The complexity of many major estates' capital programmes can mean they take many years to bring to completion. Energy projects on the other hand are a well-trodden path with established procurement methods and contracts. With focus, energy projects can be procured and in construction within a year. It is essential that energy projects, even major ones, are designed with inherent flexibility, ensuring that they work with wider and potentially changing strategic objectives of Trust boards and don't risk creating infrastructure that becomes useless due to an unforeseen future. This imperative toward strategic flexibility is now strengthened by the need to show progress towards the 80% carbon reduction needed by the end of this decade and eventual net zero position by 2040.

Decarbonising of the electricity grid

The UK Government has been successful in reducing the environmental impact of electricity production, with carbon emissions per kWh produced now around half of that ten years ago and a trajectory that will see that value halve again by 2030. This achievement is of enormous importance but challenges energy professionals when considering new projects. Within the current international carbon calculation methodology, new projects now appear to be delivering lower carbon savings than those delivered when carbon emissions per kWh were higher.

A technology of note is gas fired combined heat and power (CHP). Whilst CHP is a huge generator of revenue

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A 6.7MW solar array for New Cross Hospital (Wolverhampton) to be installed on an old landfill site that will be rented by the hospital from the local council.

savings for NHS Trusts; the overall carbon saving impact of gas CHP is reducing because the national grid electricity carbon factor is reducing much faster than that of natural gas. As UK electricity grid decarbonisation is realised, CHP starts to produce more carbon than simply using grid electricity and gas boilers. Legislation is likely to follow that will correct for the cash-carbon imbalance and ensure that overarching international and national environmental objectives are protected.

Meanwhile it is very unlikely that it will be possible to simply move all existing hospital heat infrastructure currently on natural gas over to low carbon electricity for large acute hospital sites.

So, there is not necessarily a single silver bullet available now, that delivers net zero at a practical and affordable level today. But the journey must be started now, with as far as possible, the right strategic choices being made. The right choices may differ from site to site, but it should be possible to invest today to deliver savings revenues today and into the future. Investments should also set the right foundations in place which can easily be evolved in the coming years, to progressively deliver the huge investment needed to transform large complex hospital infrastructure to a position that achieves the NHS and ultimately the country's net zero carbon position.

How to use this guide

As with the first edition of this guidance document, this guide has been ordered primarily to reflect the high-level sequence of planning activities you would carry out when developing a strategic energy programme. For example, undertaking a full technical review of the existing site infrastructure and services to identify and establish existing energy and water saving demand reductions first, will almost certainly reduce the level of capital required to deliver a complete strategic energy solution.

However, in this edition, we have added a section at the start called A Staged Approach to Net Zero. This section considers how different technologies can be combined in innovative ways to progress through a three-stage route to net zero carbon. This section provides some worked examples based on a series of different healthcare estates. It is not the intention of this section to mandate approaches to the different estates but rather introduces how one might use the guide to address issues on a particular site or sites. The remaining sections of the guide have all been updated as appropriate to account for changes in technology and technology application that have occurred since the first publication. For those familiar with the previous content, the authors would like to particularly highlight significant updates in: heat distribution (in particular de-steaming), heat pumps, and hydrogen energy systems.