IPEM Institute of Physics and Engineering in Medicine

# IPEM Advice Note

## Responding to Climate Change – Guidance for IPEM Members

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### Executive Summary

Climate change is a significant problem facing society, and this is acknowledged explicitly in IPEM's Science Leadership Strategy. Healthcare provision is both affected by climate change, and contributes to it. Both the UK Government and the NHS have put in place targets to ensure that the emissions from the healthcare system are limited.

In response, IPEM has set up the Environmental Sustainability SIG; details of how to make contact with this group are set out below. The second half of this document makes recommendations on how medical physics and clinical engineering (MPaCE) professionals can ensure that their work is likely to align with best practice for environmental sustainability, without compromising standards of healthcare and service provision. These are to be considered general guiding principles, and the list is not exhaustive.

### Introduction

Climate change is not the only environmental problem faced by society, but it is accepted to be among the largest and most urgent. It is addressed directly in the IPEM Science Leadership Strategy (SLS)[1] as one of its Grand Challenges. This is consistent with the climate emergency declared by the UK Government, NHS "net zero" carbon targets, and the UN Sustainable Development Goals.

In the SLS, IPEM acknowledges the need to reduce emissions across all sectors, and commits to support activity on this issue on behalf of the members and the professions.

This position statement outlines the response and position of IPEM relating specifically to climate change and assists the IPEM membership community to address the Grand Challenge in their place of work.

**Climate Change and Health**

We are currently in a period of unprecedented increase in global temperatures[2], and temperatures in Europe are warming at twice the rate of the global average. The increase in global temperature risks an increase in health-related effects, with higher risk of heat-related deaths, extreme weather events, climate-sensitive infectious diseases and food security concerns[3]. The UN[4] and World Health Organisation (WHO)[5] both consider climate change as the single biggest health threat facing humanity.

Climate change has been shown[6, 7, 8, 9] to affect health directly and indirectly in the following key areas:

- Extreme weather events[10]
- Excess mortality[11, 12]
- Patterns of disease[13, 14] and mental health issues[15, 16]
- Biodiversity[17]
- Food security and famine[18]
- Air pollution[19]
- Demographic changes[20]

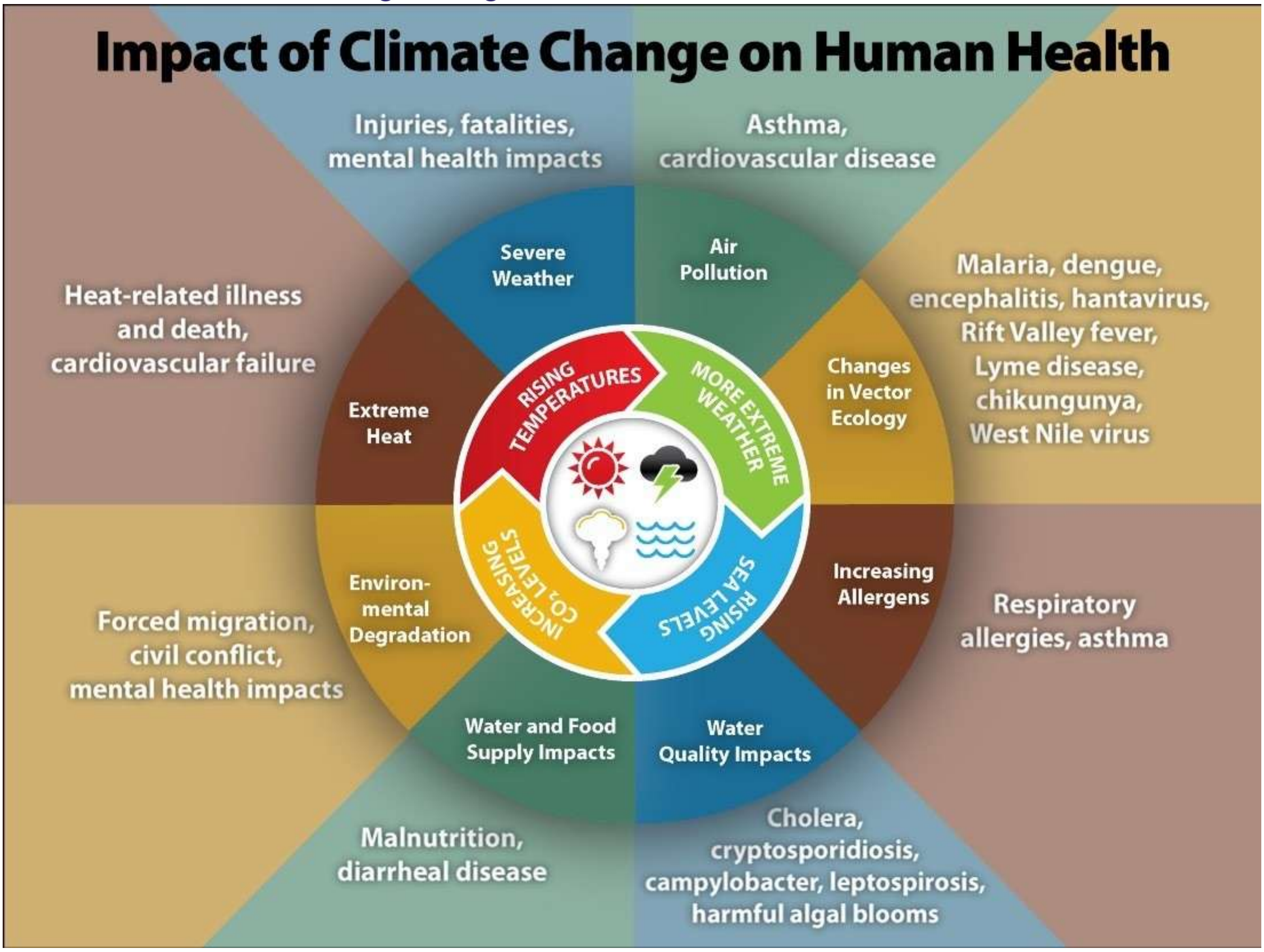
Without action, adverse climate-related health impacts are expected to worsen, with the WHO predicting that, between 2030 and 2050, climate change is likely to cause an additional 250,000 deaths per year from malnutrition, malaria, diarrhoea, and heat stress alone[10].

Biodiversity loss and climate change drive each other; WWF has measured approximately an average 70% reduction in sampled population size in the wild since 1970, with 28% of assessed species threatened with extinction[21]. This has the potential to modify systems of agriculture (already a major "greenhouse gas" emitter) and impair resilience to disease within the ecosphere. The resulting changes in food security and patterns of disease will directly impact human health.

Air pollution is exacerbated by the burning of fossil fuels and causes cardiovascular disease and lung problems. Asthma and respiratory issues contribute globally[22] to roughly 7M deaths per year and 40k premature UK deaths per year[23, 24, 25]. Particulate air pollution, and short-term exposure to ambient heat, have been associated with increased need for radiological intervention[26].

The healthcare sector is one of the largest individual sources of greenhouse gas (GHG) emissions globally, contributing about 4% of global emissions[27], exceeding aviation emissions[28]. Healthcare contributes to climate change, is affected by it, and must respond to its effects[29].

Environmental issues will also disproportionately affect the already disadvantaged, both globally and in the UK, as lower socioeconomic categories are less resilient to the effects of climate change. Globally, the high-income nations have historically contributed most to climate change, whereas the low-income parts of the world are already suffering most from its effects and will continue to do so[30, 31, 32].




*Source: Center for Disease Control and Prevention*

The United Nations Framework Convention on Climate Change (UNFCCC) and WHO consider that global heating should be minimised, and the 1.5°C figure is a benchmark, not a safe upper limit; with every additional tenth of a degree of warming taking a serious toll on peoples' lives and health. To limit global warming to 1.5°C, greenhouse gas emissions must peak as soon as possible, and decline 50% by 2030[33].

The UK government has committed to a target of net zero by 2050[34]. The NHS has a target vision "*to deliver the world's first net zero health service and respond to climate change, improving health now and for future generations*"[35] with the goal to reduce all direct carbon emissions to net zero by 2040, and indirect emissions, such as through the supply chain, by 2045. These targets are binding for the NHS, and referenced within the Health and Care Act 2022, with the "Delivering a net zero NHS" report as statutory guidance. In addition, "Greener NHS" has set ambitions for 80% emissions reduction; these ambitions however are not binding.

**Why does IPEM need a position statement?**

The SLS Grand Challenge states that "*it is essential that reduction of emissions does not negatively impact patient safety or care, nor compromise an already stretched workforce*". However, as a group of scientific professions within the relatively well-resourced high-income nations, the IPEM membership has the opportunity and moral duty to respond to the challenge of the "climate crisis"[36]. "*The health community can make a unique and powerful contribution,*

*applying its trusted voice to climate leadership and advocacy, providing evidence for action, taking responsibility for climate resilience and decarbonization of healthcare systems, and guiding other sectors whose actions impact substantially on health, carbon emissions and climate resilience.*"[37] Since environmental sustainability is outside the specialisms represented by the IPEM membership, this position statement is designed to assist IPEM members without specialist knowledge of sustainability.

Some degree of climate change is inevitable and will require adaptation from the healthcare system. IPEM will need to lead rapid & significant changes in technology, healthcare delivery and case mix requiring medical physics and engineering involvement. Environmental Sustainability should not be seen as antagonistic to the requirements of good clinical practice, future innovation, or development in healthcare. Good overall practice involves the convergence of clinical excellence, financial affordability, and environmental sustainability (the so-called "triple bottom line"). A recommended approach is to use the well-established work by the Centre for Sustainable Healthcare (CSH) on embedding sustainability into quality improvement initiatives ("SusQI"). Details and training materials are available through the CSH website[38].

**What can IPEM and its members do?**

IPEM will maintain the Environmental Sustainability SIG (ES-SIG) in line with the "Grand Challenges" identified in the Science and Leadership Strategy. The ES-SIG maintains a series of open meetings and resources, and it is recommended that this is used to allow the IPEM community to keep up to date with best practice. In the context of busy, resource-limited departments, it is recommended to work collaboratively across the UK healthcare sector to aid adoption of best practice. IPEM is well positioned to lead this collaboration within the UK Medical Physics and Clinical Engineering professions.

The ES-SIG will:

- Hold regular on-line "open meetings" to which any IPEM member, and others involved in MPaCE matters, are invited, to further this collaboration and discussion. Details of these meetings may be found by emailing the ES-SIG chairs as advertised on the IPEM website.
- Arrange periodic webinars on relevant topics.
- Maintain current advice on the IPEM website.
- Co-ordinate a teaching and outreach programme through IPEM aimed at education of the existing professional community and trainees entering the professions, and specific support for trainee members who wish to consider in depth the implications of the environmental crises faced by our society. This will include STP, "route 2" (through the IPEM scientist and technologist Guided Training Schemes), HSST candidates, and where possible, apprenticeship trainees.
- Research into the environmental implications of MPaCE activities and how these can be minimised, for example studies of the carbon footprinting of clinical pathways that involve MPaCE.
- Engage with manufacturers to assist in supporting their environmental sustainability programmes.

- Input into collaborative efforts with other groups, for example (but not limited to) RCR, SCoR and ESTRO, and connect with industry partners through AxREM.
- Advise on environmental sustainability for procurement of new equipment.

There is a unique role that IPEM members can play in the response of the healthcare system to the challenge of climate change. MPaCE professionals are skilled in data acquisition, processing, analysis, and interpretation, and are in a strong position to assist Trust-level sustainability groups with their abilities in these areas. MPaCE professionals should consider engaging with wider healthcare groups in a way which capitalises on their specific skill set.

IPEM members and other MPaCE professionals should give consideration to the following:

*Workforce up-skilling*

- MPaCE professionals should pro-actively explore and support existing sustainability initiatives within workplaces. For example, English NHS Trusts will all have “Green Plans” in place. Identifying existing initiatives will avoid unnecessary duplication of work and may accelerate board-level approval of MPaCE sustainability work.
- Trainee staff should be supported in learning about sustainable practices. Attention is drawn to the trainee group within the IPEM Environmental Sustainability community; it is recommended that trainees are made aware of the existence of this group and supported to connect as appropriate. The contact can be found via the IPEM Environmental Sustainability SIG.
- Institutions should maintain an induction package for new staff members, which should include material to present the organisation’s sustainability policy (for NHS institutions, this is the “Green Plan” mandated by Greener NHS). This material should be reviewed for appropriateness to MPaCE settings and supplemented if necessary.
- Staff are encouraged to maintain and protect available green spaces for their own benefit and that of health service users. There is a demonstrated link between access to green spaces at all levels and well-being[39].
- Staff groups who travel between sites (for example, to provide regional services) should consider how best to optimise the sustainability of travel. The mode of travel and fuel type are likely to make a significant difference. Scheduling work to minimise travel is likely to benefit staff efficiency as well as sustainability (combining visits where possible, and avoiding wasted journeys because of cancellations).
- Likewise, working from home may save significant travel emissions. Emissions from additional heating in the home can be significant and should be considered.

*Best practice*

- For NHS employees, Greener NHS and the Health & Care Act 2022 require environmental sustainability to be considered[40, 41]; many other healthcare organisations have similar policies. Include environmental considerations in the dialogue within each department. A significant contribution to the NHS carbon footprint comes from the accumulation of many small emissions, and therefore the regular practice of examination and reduction of the "footprint" of activities is worthwhile. Correct waste segregation, for example, will bring significant environmental (and financial) benefit when performed across the healthcare sector. An impact assessment should be considered to focus attention on the most important matters. In parallel with this, it is recommended that a baseline assessment is made; this will help with retrospective assessment of the effectiveness of a change in practice, and inform future choices.
- Sustainability should be considered in every service or protocol development, in the same way that cost and safety issues are considered. The CSH "SusQI" initiative[38] is recommended as a tool to achieve this. The inclusion of environmental sustainability on departmental meeting agendas, and in quality improvement considerations, is encouraged. It may help to implement the ALARA principle (from radiation protection) with sustainability considered[42].
- Correct use of resources should be considered during waste mitigation processes. For example, the "waste hierarchy"[43] encourages a reduction in the amount of equipment used first, then a consideration of re-use, and only finally a consideration of correct disposal and recycling.
- Healthcare practice should be science-based and sustainable[1]. MPaCE professionals foster a culture of constructive questioning of practice to achieve better clinical standards, and this should include sustainability. Clinical standards such as IPC rules, and good radiation protection practice, should never be compromised, but as in the example of "Gloves Off"[44], best clinical practice and best sustainability practice often align[2].
- The use of frameworks and accreditation schemes for particular disciplines is encouraged, for example:
  - the Radiotherapy Board's "Green Radiotherapy framework"[45]
  - the European Society of Radiology "Green Imaging Department" certificate[46]
  - the "Green Theatre Checklist"[47] for use in surgical settings
- Although only indirectly linked to climate change, resource use and pollution issues should be borne in mind. The disposal of contrast media (including contrast based on iodine[48] and gadolinium[49]) may be associated with a significant environmental burden, and should be controlled. Helium is a consumable with a finite supply; the use of low-helium MRI equipment should be considered where possible.

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[1] An example is the use of PPE: there are times when PPE is beneficial and should never be missed; there are also times when use of PPE, or changing of PPE, proceeds out of habit, where there is no clinical benefit, or even clinical detriment (see, for example, the "Gloves Off" initiative[44]).

[2] At the time of writing, there is insufficient evidence available concerning the sustainability aspects of PPE in
s a field for additional w

*MPaCE Improvements*

- Sustainability should be a consideration in the working life of IT equipment (along with performance criteria such as manufacturer's support and the availability of software updates). Consider giving older equipment back-end roles such as providing backup storage. Consider (a) the embedded carbon of the equipment for each option being considered; (b) the estimated power use for each option considered; (c) likely sustainability issues of equipment maintenance. Once no longer used, IT equipment should be disposed of appropriately.
- In some settings (for example, radiotherapy linear accelerators), energy taken during standby and preparation phases is greater than that taken during operation. Equipment should be checked for correct configuration of "sleeping" modes (the configuration for optimal power use is not always the factory default). Although not the expertise of MPaCE, consider also facility issues: air conditioning should be configured appropriately to minimise energy and in particular avoid temperature regulation of unoccupied areas when not required for equipment performance.
- Minimise the long-term online storage of data where this is not needed. Considerations should include:
    - For image reconstructions performed for experimental reasons that are not to be reported, and that do not need to be kept online, consider not sending these to PACS. Similar considerations should apply to other long-term online storage applications in other fields within MPaCE.
    - Minimise the unnecessary storage of data that can be derived again if needed (for example, MIP/MPR data that can be reconstructed again from slices).
    - For both GDPR and environmental reasons, in general, data should be removed when it no longer appropriate to retain them
- Of note is the environmental footprint of AI technologies, particularly in terms of power use for training, and consequences for data centre cooling. However, it is also possible that some AI systems may have a lower footprint than the possible alternatives. It is too early to be prescriptive in this rapidly evolving field; environmental considerations should however be taken into account when assessing these systems.
- Travel for physical attendance at conferences and meetings can be associated with a very high carbon footprint. This is a factor to bear in mind when choosing to attend physically or on-line. For conferences in the UK or EU, consider travelling by train rather than flying[50].
- MPaCE staff working in the environment of the operating theatre should be aware that anaesthetics and medication represent two major contributors to the NHS carbon footprint as a whole.
- Concrete has a large embedded carbon footprint. This should be borne in mind especially during bunker design to avoid over-specification of shielding which is financially and environmentally inappropriate. Alternative shielding materials may be available which may have a lower environmental footprint. This needs to be balanced with the principles of As Low As Reasonably Practicable (ALARP) and considerations of future requirements of the service. In considering shielding material choice, the weight-bearing capacity of the floor should also be considered.
- Environmental impact should be a factor in the consideration of the procedures and modality of radiopharmaceutical transport.

- Minimise packaging when transporting equipment, consistent with ensuring the safety of the equipment whilst in transit. Ensure that the packaging is designed in the most sustainable way that is reasonably possible.
- NHS staff engaged in procurement activities should be aware of the NHS "Suppliers' Roadmap"[51, 52, 53]. All NHS procurement evaluations should include at least a 10% weighting for net zero and social value.
- It may be beneficial to liaise with procurement and equipment manufacturers to ensure repair and maintenance procedures are addressed at the point of purchase.
- Consider "circularity" of equipment at procurement, and when no longer needed. Consideration should be given to re-use and recycling options, and best environmental practice in disposal. In some cases, re-use of equipment no longer needed can generate income.
- There is a growing literature on the carbon footprint of medical physics practice[54, 55, 56, 57, 58] but there are also areas of MPaCE which have yet to be studied from a sustainability standpoint. Engagement with relevant academic groups to address these gaps is to be encouraged. At the time of writing, NIHR funding to support such activities is available.

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