Written evidence submitted by the Environmental Investigation Agency

Heat Resilience and Sustainable Cooling – Call for Evidence

The Environmental Investigation Agency is a UK based environmental charity. We investigate and campaign against environmental crime and abuse. We campaign to eliminate powerful climate damaging refrigerant greenhouse gases and improve energy efficiency in the cooling sector as well as expose related illicit trade in refrigerant gases.

EIA is the leading civil society group engaging with both the UK and EU F-gas Regulations. With almost 30 years' experience investigating the illegal trade in chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs) and hydrofluorocarbons (HFCs) and engaging in policy at the Montreal Protocol, EIA's institutional knowledge on F-gas policy and availability of F-gas free cooling and heating options is unrivalled. EIA's 'Chilling Facts' campaign has been instrumental in persuading supermarket retailers in the UK, EU and other parts of the world to adopt climate-friendly refrigeration in place of HFCs in their cooling systems. EIA and Greenpeace host a website dedicated to sharing information on natural refrigerant based cooling and heating technologies www.cooltechnologies.org

HFCs are refrigerant gases used in cooling equipment and some heat pumps. However, they are also extremely potent short lived greenhouse gases, so their use and related emissions drive rapid climate change. In order to meet the climate crisis and provide heat resilience through sustainable cooling we must adopt HFC-free technologies.

What evidence exists on the relationship between heat and human health (mortality and morbidity), and which communities are worst affected?

By 2100, 75 per cent of the global population could be at risk of potentially deadly heat exposure for more than 20 days per year, up from 30 per cent today.[1] The link between extreme heat and human health and even death is documented but probably underrepresented as cause of illness/death is often attributed to other health effects that the extreme heat has exacerbated. Those most at risk are the elderly, infants, those with underlying health issues and those working outdoors. Poorer communities are also at elevated risk due to the lack of access to cooling and/or lack of green spaces in these communities which work to keep temperatures down in cities.

Poorer households often cannot afford to install cooling equipment in their homes and if they can they will often purchase the cheapest available technology which tends to be the least energy efficient with very high global warming potential (GWP) refrigerant gases meaning they have the highest climate impact. Many air conditioners on the market are 2-3 times less efficient than the best available units.[2]

There is also a connection between increased air conditioning use and lower air quality which impacts human health. For example, the use of fossil fuel generated electricity to power air conditioning units and diesel powered refrigerated trucks in cities contributes to air pollution, and is worsened by inefficient systems requiring even more energy. Furthermore, the heat rejected by the

[1] Camilo Mora et al, (2017). 'Global Risk of deadly heat', Nature Climate Change, Vol 7. Available here.
[2] International Energy Agency, (2022). 'Space Cooling'. Available here.

system exacerbates the heat island effect making dense urban areas significantly hotter than surrounding areas.

Extreme heat also impacts work productivity and the ability of children in schools to learn. Loughborough University determined that working at temperatures of 35°C results in an average 35% decrease in productivity, increasing to 76% reduction when temperatures are 40°C.[3]

How can sustainable cooling solutions and adaptation strategies be implemented in such a way as to minimise overheating, reduce energy consumption and prevent overloading of the electricity grid during peak demand?

Sustainable cooling for all requires a holistic rethink of how we meet our cooling needs. Sustainable cooling policy should follow the 'Avoid, Shift, Improve' methodology. This can be done by:

Avoiding (reducing) cooling demand through better city and building design to include passive cooling, ventilation, shading, insulation, building orientation and better building materials as well as better use of cool roofs and green spaces.

Shifting away from individual units to renewable run district cooling and heating, thermal storage and utilisation of waste heat/cold and shifting away from vapour compression cooling to not in kind technologies and passive cooling systems.

Improving mechanical cooling systems by increasing energy efficiency and avoiding the use of climate damaging fluorinated refrigerant gases, ensuring the use of ultra-low GWP natural refrigerants instead. Sustainable cooling must consider both the direct emissions from the refrigerant gases and the indirect emissions from the energy use. The energy used for cooling is predicted to skyrocket as global temperatures rise and more people can afford air conditioning units. The International Energy Association (IEA) predicts a tripling of global energy demand from air conditioners by 2050 and has labelled air conditioning as a key driver of electricity demand growth.[4] As the grid decarbonises and shifts towards renewable energy, the importance of the direct emissions will grow. F-gas free cooling solutions already exist in abundance on the market and shifting to natural refrigerants would make the direct emissions negligible.

Air conditioning units are normally turned on at the hottest times of the day which often coincides with peak load times for the electricity grid thus forcing standby powerplants to come online to meet demand. These plants are often the most climate damaging systems on the grid. Improving energy efficiency of cooling systems would reduce the burden on the electricity grid. However, a holistic transformational change is needed in how we meet cooling demand rather than just relying on incremental improvements in lowering GWP and raising energy efficiency.

Further examples of sustainable cooling solutions include:

Avoid

• Optimise building and city design to harness passive cooling by inter alia creating cross breezes, maximising shade and installing wind catchers on buildings.

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[3] Smallcombe, Foster et al, (2022). 'Quantifying the impact of heat on human physical work capacity; part IV: interactions between work duration and heat stress severity.' Int J Biometeorol. Available here.
[4] International Energy Agency, (2018). Air conditioning use emerges as one of the key drivers of global electricity-demand growth'. Available here.

• Cool Roofs are suitable for almost any building and can cool a building by 1-2°C and reduce annual cooling use from air-conditioning by 10-20 per cent on the floor directly below the roof.[5]

• Reduce demand for cooling by making the most of natural ventilation by opening windows at night if safe (and possible) to do so.

Shift

• Using fans instead of an air-conditioner where possible. Solar-powered fans are a more sustainable option.

• Research and development is accelerating on providing wearable cooling technology in the form of clothing or patches to provide personalised cooling and heating. These can use evaporative cooling or phase-change materials and be powered by battery packs, fans or by being soaked or filled with water or another fluid.[6] Patches made of thermoelectric alloys cool or heat the skin to a chosen temperature. These technologies could be particularly important for workers who spend long hours outdoors in high temperatures, including construction workers and farmers, but can also be worn in homes and offices.

• District cooling systems deliver chilled water to multiple users via a network of insulated pipes. District cooling can be run with natural refrigerants and renewable energy and/or waste heat and is up to 40 per cent more energy efficient than delivering cooling through individual domestic and commercial air-conditioning systems in cities.[7] District cooling systems in Dubai are reducing the amount of energy used for cooling by 50 per cent and are expected to meet 40 per cent of the city's needs by 2030.[8]

Improve

• Ensure air conditioners are HFC-free and energy-efficient. While more efficient air-conditioners can cost more, awareness of the longer-term savings due to reduced energy costs should be factored into purchasing decisions. This could be supported via government subsidies.

• Improve efficiency of cooling systems through better labelling programmes and standards, including Minimum Energy Performance Standards (MEPS). Additionally, these should couple energy performance with GWP limits to transform the market.

• Additionally, behavioural change can play a key role in reducing the emissions of air-conditioning equipment. Including setting the default temperature to between 24-27°C, using air-conditioners to only cool rooms in use and regular maintenance can also improve the energy efficiency of products over their lifetime.

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[5] Carbon Trust, (2020) 'Climate Action Pathway: Net-Zero Cooling – Executive Summary'. Available here.

[6] Sahngki Hong et al, (2019). 'Wearable thermoelectrics for personalized thermoregulation', Science Advances. Available here.

[7] 'District Cooling', Stellar Energy. Available here.

[8] Lily Riahi et al, (2015). 'District energy in cities: unlocking the potential of energy efficiency and renewable energy', United Nations Environment Programme. Available here.

What actions can be taken to protect those most vulnerable to the impacts of extreme heat?

Raising awareness about the dangers of extreme heat is the first step, especially changing the mindset adopted by many media outlets in the UK that heatwaves are cause for celebration with front page images of beach goers and ice creams. Some cities have appointed Chief Heat Officers who are working on heat action plans which include actions such as planting trees to increase shade cover, building fountains which lower surrounding temperatures and also naming heatwaves (akin to the naming of storms.)

Following the 2003 heatwave where 15,000 people died in France, the city of Paris established cooling centres where those without cooling in their homes could convene during extreme heat events.[9] There has also been efforts towards creating more accessible, shade providing parks and green spaces for residents during heatwaves. An app, Extrema, has also been created to alert to high heat days and provide information on local 'cool spots' including parks, churches, museums and bodies of water.

HFC refrigerant gases use in air-conditioning and cooling systems are very short-lived, thus the commonly used 100 year GWP metric underestimates their near term warming effects. In a recent paper, scientist from Oxford University demonstrated how an 85% reduction in HFC-134a emissions would significantly larger near-term cooling effects than a comparable reduction in CO2 emissions.[10] Thus, vulnerable communities can be protected from extreme heat via polices which recognise the near term warming effects of HFCs and prioritise them for phase-out.

What role might reversible heat pumps (which can act as both heating and cooling systems) and other emerging technological solutions, such as the development of smart materials, play in meeting future cooling demands?

Reversible heat pumps are the ideal solution for the UK which will experience both hot and cold weather throughout the year. However, it is imperative that we do not lock in unnecessary F-gas emissions in the roll out of reversible heat pumps and that those using natural refrigerants are prioritised.

Common HFCs used in heat pumps include HFC-410A and HFC-134a with 100 year global warming potentials (GWP) of 2,256 and 1,530 respectively (IPCC AR6 figures.) In contrast natural refrigerants such as propane (R-290) have a GWP of less than 1. Like the EU, the UK has committed to transitioning to renewable heating though a rapid heat pump roll-out. Equipment manufacturers have responded to the need to have HFC-free heat pumps with around 30 now having HFC-free air to water heat pumps on the market. Recognising the need for clear policy signals European policy makers are set to restrict the use of HFC in various types of heat pumps, including single split reversible heat pumps. The success of this policy will be driven by additional training and certification requirements for installation and servicing personal. With similar policy support, natural refrigerant based reversible heat pumps can play an integral role in meeting future cooling demand - where avoid and shift technologies are not available.

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[9] Sisson, Patrick, (2020). 'How Paris plans to protect its residents from rising heat', City Monitor. Available here.

[10] Miranda et al, (2023). 'Metrics for the emissions of F-gas refrigerants' Sustainable Energy Technologies and Assessments 58. Available here.

Air conditioning ownership in the UK is relatively low but is expected to grow as temperatures rise and heatwaves become more frequent and severe. However, many consumers will be opting for cheap, inefficient, high GWP units so clear incentives and policy signals are required to ensure against this and move the entire market to energy efficient natural refrigerant solutions.

How can cleaner refrigerants with low or zero global warming potentials support the UK's cooling needs while contributing to the national emission reduction targets?

Cooling products not only use huge amounts of electricity (the IEA estimates that air-conditioning and fans consume 20 per cent of total electricity used in buildings), they also rely on super climate pollutant refrigerant gases, such as HFCs.[11] HFCs are potent short-lived greenhouse gases, meaning they quickly exacerbate atmospheric warming when they leak from equipment or are released to the atmosphere when the equipment is disposed of.

As global grids decarbonise the relative impact of direct emissions from the refrigerant gas in cooling systems increases. In 2022 direct emissions from refrigerants represented 40% of total GHG emissions from cooling equipment. With electricity carbon factors set to drop by as much as 50% from today's level by 2040 the relative impact of direct emissions may double.[12] Direct emissions occur through leakage from equipment, during use and servicing as well as when the equipment is discarded at the end of life. Almost entirely eliminating direct emissions is possible when using ultra-low GWP refrigerants, such as natural refrigerants. A 2020 study by the Climate and Clean Air Coalition reveals it is technically feasible to achieve near complete global HFC mitigation by 2030, 20 years ahead of the Kigali phase-down.[13]

Single-split air conditioning systems dominate the domestic air-conditioning market, the majority of which run on high- and mid-GWP HFCs. HFC-410A (GWP 2,256) is the most commonly used, but the use of HFC-32 (GWP 771) in these systems is increasing; however, the GWP of HFC-32 means that it cannot be considered a sustainable alternative. Propane (R-290) is a natural refrigerant alternative used in small split systems. Its flammable nature means that design considerations and adequate training and certification of technicians is needed. A 2022 study found that switching all air conditioners globally to energy efficient propane could avoid 0.09°C increase in global temperatures by the end of the century.[14]

Energy efficient natural refrigerant solutions exist on the market today (many examples can be found on our online database cooltechnologies.org). There is no need to lock in climate and environmentally damaging refrigerants to meet the growing cooling demand in the UK.

Co-ordinated action on cooling, which focuses on both the GWP of refrigerants and the energy efficiency of products together must become an integral part of climate policy.

The F-Gas Regulation in the UK has been working well to reduce emissions from this sector however mid/high GWPs are still being used and the rise of fourth generation fluorinated gases is cause for environmental concern. Hydrofluoroolefins (HFOs) have low GWP however there are serious environmental impacts of their breakdown products, most notably trifluoroacetic acid (TFA). HFOs, and most HFCs are also classified as PFAS or forever chemicals, named such due to their persistent nature and environmental harm. F-gases, whether HFCs, HFOs or their blends are not sustainable or

[11] IEA (2018), The Future of Cooling, IEA, Paris https://www.iea.org/reports/the-future-of-cooling, License: CC BY 4.0
[12] Draft data generated by Ray Gluckman of Gluckman Consulting and shared by the Clean Cooling Coalition
[13] Climate & Clean Air Coalition, (2020). 'Opportunities for 1.5°C Consistent HFC Mitigation'. Available here.
[14] Purohit, Pallov et al, (2022). 'The key role of propane in a sustainable cooling sector'. PNAS. Available here.

futureproof solutions for the UK to meet cooling demand while pursuing national emission reductions targets.

How effectively is the Government working across departments and with local authorities to ensure a coordinated approach is taken to heat resilience?

One key area of policy concerning heat resilience is the revision of the GB F-Gas Regulation. As cooling demand increases, there is danger that the UK locks in a growing amount of fluorinated gas emissions inside this cooling equipment. The revision of the F-gas Regulation to phase down the use of HFCs must set an ambitious phase out schedule and include bans on equipment using these damaging gases. Eliminating the direct emissions from cooling units through the adoption of natural refrigerants is a simple and cost effective measure to ensure improved heat resilience does not have the adverse effect of increasing emissions and thus temperatures further. The departments of Defra (who own the file) and DESNZ (who have great industry knowledge on the sectors involved, especially on heat pumps) must coordinate to ensure an ambitious and feasible revision.

Coordination is also needed between Government work on refrigerant gases and work on efficiency for a more holistic approach to sustainable cooling. For instance, when setting energy standards for equipment, a GWP threshold should be included. Similarly, incentives (financial or otherwise) for the uptake of certain cooling or heating equipment should ensure this equipment meets both energy and GWP requirements e.g. a bonus scheme in the Clean Heat Market Mechanism for adopting natural refrigerants.

Does the UK need a dedicated Heat Resilience Strategy? What lessons can be learned from other nations when it comes to national strategies for heat resilience?

Yes, the UK needs a strategy on heat resilience and how cooling demand can be minimised and met with sustainable solutions that will not further exacerbate the global heating problem. Inspiration can be gleaned from national cooling action plans in countries such as India, China and Rwanda. A crucial element of these plans must be efforts to avoid fluorinated gas refrigerants and transition the cooling sector to natural refrigerants.

The work of Chief Heat Officers in Athens, Miami, Freetown and Melbourne should also be consulted.

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