Net Zero Beyond Refrigeration Policy Brief

"Strategies to support users of refrigeration, air conditioning and heat pump technologies to achieve carbon reduction through effective policy implementation, financial incentives, and emissions monitoring."

The IOR Environment Working Group has identified a number of key areas for supporting the path to net zero (www.ior.org.uk/beyondrefrigeration). The principle of moving t**oward a circular economy** is expanded upon here, together with proposed policy options to support the necessary changes across the Refrigeration, Air Conditioning and Heat Pump (RACHP) sector.

5 - Towards a Circular Economy

Introduction - what do we mean by the circular economy and why is it important?

In a traditional linear economy (LE) we take-make-use-dispose of resources. Virgin materials are extracted, utilised and dumped at end-of-life because components cannot be easily or economically separated because there is no consideration of design for disassembly, repair, or recycling.

Conversely a circular economy (CE) is an economy in which resources are circulated and used for as long as technically and economically feasible; in a CE waste and pollution are limited (and ideally 'designed out') and natural systems are regenerated. A whole systems approach is used to increase resource (materials and energy) efficiency – for example by reducing materials use via dematerialisation (without compromising performance), and extending product life (through reuse, repair and remanufacture). At end-of-life materials are recycled and reclaimed and where this is not possible they are incinerated with energy recovery, and final disposal to landfill is minimal.

In the RACHP sector an example of product life extension includes upgrading refrigerated display cabinets by repainting the shell and replacing older electrical and cooling components with more energy efficient components such as LED lighting and compressors. At end-of-life cabinets should be recycled via registered contractors to ensure that refrigerants and other hazardous substances are properly collected and treated and as many physical materials as possible are recycled, with those that cannot be reused incinerated with energy recovery.

The challenges of a circular economy for the RACHP sector

Currently there is a well-established infrastructure for recycling, reclamation and reuse of steel, aluminium and copper, which are all common to RACHP equipment and systems. However, electronics (which are used for management and control etc.) systems and component recycling is very limited. Only 17% WEEE (waste electrical and electronics equipment) are formally collected and recycled and the while some are informally sold and reused, much of this waste is shipped outside Europe where it is recycled in illegal and hazardous conditions or landfilled. The electronics recycling infrastructure is underdeveloped and would not be able to process all e-waste that is generated. In the current process, high value materials (gold and silver) and easy to reclaim materials (copper, aluminium steel) are reclaimed but many materials (including rare earth elements) are not and end up as waste in landfill. Plastics are widely used in RACHP equipment, and even though many can be recycled, the market for and use of recyclates is very limited. They could be incinerated with energy recovery but many are exported and end up as landfill.

Development of a circular economy presents many challenges because most products and equipment that are in use (and coming to end of life) were not designed for circularity - i.e. they embody linear design and thinking – which necessitates development of reactive strategies and processes to deal with electrical and electronic equipment waste (or e-waste). These processes are often uneconomic and inefficient. Designing for circularity and whole systems thinking is proactive and will reduce or eliminate many of the above challenges and encourage economic and efficient recycling at end-of-life and product life extension.

The drivers for change

There are number of drivers to encourage and support the various changes in practice including business models and case studies, which illustrate economic and environmental and social benefits of change. As the UK government seeks to reduce carbon emissions and become 'Net Zero' by 2050, it is encouraging industry to quantify greenhouse gas emissions and specifically carbon and equivalents. Initially responsibility for carbon related to direct emissions from sources that are owned and/or controlled (Termed Scope 1 emissions) was extended to include indirect emissions such as those from purchased electricity (Termed Scope 2 emissions). The scope has now been further extended to include all other emissions in the value chain (Termed Scope 3 emissions). Consequently, while Scope 1 and 2 emissions relate to operational energy and emissions,

Scope 3 also includes embodied energy and emissions. Assessment and reduction of Scope 3 emissions should encourage more circular practice because industry will seek to reduce emissions throughout the value chain. For example, although materials recycling requires energy and generates emissions, use of recycled materials eliminates the impacts of virgin materials mining and processing, which reduces overall emissions. Similarly, although replacement components may be required to extend product life, reuse, repair and remanufacture will increase resource efficiency and limit emissions by reducing the need for new products and equipment.

There is also potential to reduce emissions from transport if more local /UK-based refurbishment and recycling facilities are developed.

Our Policy Recommendations

1. *Understanding the Circular Economy*

	Policy proposals	Possible policy mechanisms
Our ambition is that policies will support businesses in their transition from Linear to Circular practices. Policy and regulation will incentivise and drive this change.	✓ Require understanding and knowledge of the principles that underpin the Circular Economy, and Whole Systems Thinking ✓ Fiscal incentives to drive change from linear to circular business practice ✓ Policies that lead the transition from linear to circular practice	✓ Policy and regulations to drive Circularity in UK including UK Government Circular Economy Package and EU Circular Economy Action Plan ✓ Capital allowances to increase use of second life products / components / component harvesting etc and /or recycling and materials reclamation as appropriate

2. *Increasing Resource Efficiency through Design*

	Policy proposals	Possible policy mechanisms
Up to 80% of a product's environmental impact is determined during the design phase. Therefore, our ambition is to increase resource efficiency across business by designing products that enable economically competitive circular practice.	✓ Requirement for design to ensure that all products, systems and services conform to latest UK and EU guidance, policies and regulations as and when these criteria are updated ✓ Incentivising efficient and durable design and ensure that designs enable best practice in line with the waste hierarchy to increase material efficiency, reuse / life extension, recycling; and decrease energy recovery through incineration and disposal in landfill ✓ Ensure designs embody mechanisms for circularity e.g. design for easy disassembly and separation of components, limit materials mixing, limit use of plastics ✓ Ensure design optimises opportunities for reuse of waste heat i.e. heat recovery ✓ Ensure that all designs limit use of hazardous substances and comply with RoHS directives	✓ Design Guidelines and Directives from professional bodies such as Design Council and Engineering Council ✓ UK Gov. Circular Economy Package ✓ EU Circular Economy Action Plan and policy ✓ WEEE (Waste Electrical and Electronic Equipment) Regulations and similar legislation

3. *Increasing Resource Efficiency by Extending Product Life*

	Policy proposals	Possible policy mechanisms
Our ambition is that policy will support the various strategies to extend product life in order to keep products in use and reduce waste.	✓ Requirement for design to facilitate repair and upgrade in line with e.g. EU Right to Repair directives ✓ Ensure manuals are readily available and updated to enable repair and upgrade ✓ Ensure spare / replacement components are available for 5 years after end of production runs ✓ Ensure that any control systems and/or IoT-related firmware / software and electronics are updated / open source for after end of production runs	✓ Transparency mandate for repair manuals, firmware etc. ✓ Fiscal incentives to support purchase of second life products ✓ Guarantees and warranties for second-life products ✓ Incentives to harvest and supply used / refurbished / remanufactured components ✓ Incentives to encourage regular maintenance and component

		upgrades to ensure efficient operation

4. Increasing Resource Efficiency through Materials Recycling and Reclamation

	Policy proposals	Possible policy mechanisms
Our ambition is that policy will increase recycling and reuse of materials in order to build resilient and robust supply chains and reduce waste.	✓ Requirement for design to facilitate recycling, reclamation and reuse of materials in either open or closed loops ✓ Ensure clear, simple and economical disassembly and separation of assemblies, components and subcomponents for recycling ✓ Reduce materials mixing to streamline separation and increase recycling	✓ Incentives to develop a UK-based comprehensive recycling infrastructure for all materials types ✓ Fiscal incentives to support purchase and use of recyclates in and outside the RACHP sector ✓ Incentives to purchase locally recycled materials to reduce impact of transport and build resilient supply chains

5. Whole System Thinking and Energy Efficiency

	Policy proposals	Possible policy mechanisms
Our ambition is that policy will support while system thinking that integrates operational and embodied criteria to create optimised products.	✓ Requirements to balance operational and embodied inputs, outputs and impacts in order to create optimised products that are fit for purpose ✓ Ensure operational (energy) efficiency and replace older components where beneficial to overall system; retire products if appropriate ✓ Ensure information is available to enable consumers to make informed decisions based on robust life cycle / circularity data ✓ Energy and resource efficiency - consideration should be given as to how systems can be better integrated to reduce waste and increase energy efficiency overall	✓ UK Gov. legislative proposal / legislation for substantiating green claims made by businesses ✓ Digital Passport scheme for all products ✓ ISO 4001 energy efficiency ✓ ISO14040 LCA series ✓ Climate Change Levy

6. Developing the Best People and Skills

	Policy proposals	Possible policy mechanisms
Our ambition is that everyone involved in cooling and heating systems purchasing, maintenance and operation has adequate understanding to champion Net Zero and whole system sustainability.	✓ Requirement to understand the principles of carbon assessment and footprints and the journey to Net Zero ✓ Requirement to understand the principles of Life Cycle Sustainability Assessment and environmental and social footprints and the journey to Net Zero+	✓ Specialist knowledge and skills requirement for LCSA ✓ ISO 14040 LCA series

Additional information about this topic

Ellen MacArthur Foundation Butterfly Diagram that identifies key processes and people - In the technical cycle, products are kept in circulation in the economy through reuse, repair, remanufacture and recycling. In this way, materials are kept in use and never become waste. https://ellenmacarthurfoundation.org/topics/circular-economy-introduction/overview

Carbon Trust Briefing: What are Scope 3 emissions? https://www.carbontrust.com/resources/briefing-what-are-scope-3-emissions

The RESOLVE framework (Regenerate, Share, Optimise, Loop, Virtualise, Exchange) applied to cooling processes and buildings by ARUP consulting. https://www.arup.com/perspectives/publications/research/section/circular-economy-in-the-built-environment

https://www.gov.uk/government/publications/green-claims-code-making-environmental-claims/environmental-claims-on-goods-and-services

https://www.gov.uk/government/publications/circular-economy-package-policy-statement

What is the purpose of this document?

Our objective is to provide to policy makers:

- expert advice from Institute of Refrigeration professionals on effective solutions to aid the move to net zero.
- the information needed to ensure that policy decisions take into account the interrelation of heating and cooling needs.
- realistic and achievable opportunities, solutions, targets and goals for users in this sector.
- the necessary depth of understanding of total life cycle and sustainable operation.
- advice for non-technical specialists responsible for high level net zero strategies within BEIS and DEFRA / DFE.

Background and Scope

- The Institute of Refrigeration (IOR) is the specialist professional engineering charity body for expert individuals working in this sector. It has a global reputation for independent technical advice and innovation. Its members provide services to users of cooling and heating services including manufacturing, supply, installation, service and maintenance, consultancy, and inspections.
- Refrigeration, Air Conditioning and Heat Pump (RACHP) technologies are used to provide essential services in food production, distribution, storage and retail, industrial cooling processes in manufacturing, the climate control in spaces, such as datacentres, IT rooms, offices, shops, leisure facilities and hospitality, as well as pharmaceutical and healthcare facilities, amongst others.
- Heating and cooling in the UK is estimated to account for 10Mt CO2e direct emissions from refrigerant use and 87Mt emissions from energy use to heat buildings.
- The sector is estimated to contribute to the UK economy through employment of around 70,000 people directly in manufacturing and service roles. It is estimated that the direct impact of cooling on the UK economy is £43Bn.

IOR Beyond Refrigeration Critical Issues and Ambitions

1. *Reducing the Need for Mechanical Cooling and Heating*

Our ambition is that policy should support businesses to consider mechanical refrigeration technology as a last resort instead of relying on "business as usual" purchasing and specification practices. This will mean the need to incentivise widespread adoption of net zero alternatives to mechanical cooling.

2. *Achieving Best System Performance*

Our ambition is that purchasers of new equipment and users of existing equipment should be supported to achieve the greatest possible reduction in energy demand and ongoing use, without compromising reliability.

3. *Balancing Heating and Cooling*

Our ambition is that policy will support the use of opportunities currently available to maximise heat recovery, sharing and storage across different business activities using heating and cooling.

4. *Making Use of Best Available Technology*

Our ambition is that the whole sector will rapidly adopt the best available, closest to net zero heating and cooling options as dominant technologies.

5. *Use Energy Intelligently*

Our ambition is for 100% renewable energy and zero carbon energy systems providing maximised efficiency, flexibility, and support grid stability.

6. *Developing the Best People and Skills*

Our ambition is that everyone involved in cooling and heating systems purchasing, maintenance or operation, has adequate technical understanding and responsibility for championing net zero.

7. *What else? Whole System Sustainability*

Our ambition is that everyone involved in cooling and heating systems purchasing, maintenance or operation has adequate technical understanding and responsibility for championing net zero.

With thanks to

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Further policy briefs are planned and this document will be updated as necessary. Check www.ior.org.uk/beyondrefrigeration for updates