Guidance for Owners and Operators of Commercial Refrigeration

TICR - Transport, Industrial and Commercial Refrigeration

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STAR TECHNICAL SOLUTIONS
CLT CARBON LIMITING TECHNOLOGIES
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This **Guidance for Owners and Operators** aims to provide sector specific advice on how to reduce emissions and support businesses in achieving net zero refrigeration.

The Transport Industrial Commercial Refrigeration Project (TICR) was launched in 2022 as part of the UK's national commitment to reach net zero emissions by 2050 and to gain a better understanding of all sources of emissions and tackle hard to abate areas. Refrigeration is increasingly being recognised as a significant, yet often overlooked, consumer of energy. The aim of this project, therefore, was to quantify the potential for emissions reductions and to answer some key questions:

- What are the current refrigeration energy demands and emissions across this sector?
- How is demand for cooling and subsequent emissions likely to increase?
- What are the market drivers and what environmental factors are having an impact?
- What are the most promising innovations to reduce energy use?
  What is the abatement potential of different types of technologies?
- What measures would help end users and practitioners to deliver net zero?
- How could policy and innovation be part of the solution to decarbonising refrigeration?

The recommendations in this publication form are drawn from Roadmaps and Technical Appendices published by the Department for Energy and Net Zero. Read together, these documents, not only support the intelligent use of cooling equipment by owners seeking to improve the efficiency of equipment they operate, but also policy makers in working together towards net zero emissions.

Policy context

The following national and international policies are relevant to the need to work together to achieve net zero refrigeration.

- Global Cooling Pledge
- UK National Cooling Outlook
- National Adaptation Programme and Climate Change Risk Assessment
- UNFCCC Global Cooling 5-year Stocktake as discussed at COP meetings
- BEIS Cooling in the UK 2021
- GB F-gas Regulations

Authors and acknowledgements

The TICR project was led by London South Bank University and includes the Institute of Refrigeration, Star Technical Solutions, Carbon Limiting Technologies, Carbon3IT and the University of Birmingham as partners in the consortium.The project acknowledges support from the UK Department for Energy Security and Net Zero, contract reference number FM21297.

We are grateful to all of the individuals, organisations, owners and others who contributed to this project and its outcomes including reviewers from the TICR Advisory Board and Institute of Refrigeration Technical Committees.

Content

1. Summary

This guide has been developed based on the findings of site surveys carried out on a range of refrigeration equipment by experts during 2023/4. It also takes into account work undertaken by the project to evaluate the sector emissions, technology options and industry best practices. Further details are published in the TICR Roadmap.

Emissions profile

The TICR Roadmap evaluated the carbon footprint of the UK transport, industrial and commercial refrigeration sectors based on the most up-to-date emissions data. Retail refrigeration produces GHG emissions both directly (Scope 1) due to refrigerant leakage and indirectly (Scope 2) due to its electricity consumption. A baseline figure for emissions from the sector has been calculated at 2.04MtCO_2e/yr. This calculation included a dataset of 6,395 convenience stores and 7,400 supermarket stores. It is assumed that the food retail sector would grow in line with the UK population, which is expected to increase by 14% from 2023 to 2050. Retail refrigeration accounts for at least 1% of electricity consumption (DESNZ, 2024) and 0.6% of GHG emissions in the UK (DESNZ, 2025) in 2023. Energy consumption for retail refrigeration is expected to grow 20% from 3.28 to 3.96 TWh from 2023 to 2050, with GHG emissions growing by 16% from 2.31 to 2.67 MtCO2e in the same period.

Reduction opportunities

There are significant opportunities for reducing energy use and emissions. If operation is optimised and the best available cabinets are used, energy consumption could be reduced by 67.5% compared to a business-as-usual scenario for 2050. A wider uptake of PV and waste heat recovery by supermarkets could also help to alleviate pressure on the grid and free up renewable energy capacity. Scope 1 emissions are still significant in retail refrigeration, corresponding to approximately 68% of total emissions for the sector in 2023. By transitioning to ultra-low GWP alternatives as retailers comply with updated F-Gas regulations, the retail sector could reduce Scope 1 emissions by more than 99%.

Recommendations

The following recommendations are detailed in this guide:

1. Prioritise Efficiency
2. Address the Information Gap
3. Get to Know your Assets
4. Take a Systems Approach
5. Start Thinking Long Term
6. Make Informed Investment Decisions
7. Work Together – People and Practices
8. Monitor Legislation, Regulation and Standards Frameworks

More detailed guidance is provided on emissions trends, sector best practice, technology options, benchmarking tools policy options and opportunities.

There is much that owners and operators can do to reduce current and future emissions. The steps recommended do not have to require significant financial investments or substantial legislative changes. The critical thread running through all of the findings is the importance of accessing and evaluating information that is often easily available about your refrigeration equipment. This is essential for owners and operators to understand how equipment is operating and measure its performance against how it should operate. If you do not have that knowledge, you need to work with a suitable expert to manage and plan accordingly.

2. Emissions and Sector Profile

Overall, retail refrigeration accounts for 1% of the UK electricity consumption. The sector is undergoing significant change due to several external factors related to climate adaptation and mitigation, as well as growth in demand and shifts in consumer preferences. Energy efficiency measures can help to decarbonise and strengthen the resilience of the retail sector in the UK, through improved operations and maintenance, the use of the best available cabinets and the transition to low-GWP refrigerants.

Scope and sector size

The retail refrigeration sector covered in this roadmap refers to the retail of food and drink products, either chilled or frozen, excluding catering and hospitality (e.g. restaurants, pubs, hotels). It covers applications where customers have visual contact with the products and normally have access to them directly (e.g. supermarket display cabinets, beverage coolers and ice cream freezers). However, many of the findings may also be applicable to other commercial refrigeration applications.

Although the sector is composed of many different retailers, including small, independent grocery stores, sale volumes are dominated by the larger retail chains.

The retail refrigeration sector is projected to undergo substantial transformation in the coming years, driven by a range of external pressures on the retail industry. This section examines emerging trends and influencing factors that are anticipated to impact the development and deployment of refrigeration technologies. These trends formed the basis for the modelling scenarios that were included in the decarbonisation pathways.

Trends

Climate change
Higher average temperatures will increase cooling demands and reduce operational efficiency. A higher frequency of severe weather events, such as heat waves, will impact system resilience as ambient temperatures will reach levels beyond operational boundaries more frequently.

Net Zero and energy security
Several UK retailers have set targets to achieve net-zero emissions from their own operations by 2030. Energy efficiency measures and a greater use of renewable energy by use of heat pumps to replace gas usage within stores will mitigate energy demand.

Market growth and consumer behaviour
The food retail market is projected to increase by 14% from 2023 to 2050 due to population growth. Consumer behaviour is difficult to predict and quantify, but it is likely, for example, that large supermarkets might give way to new cold stores or distribution centres targeted at online consumers if online shopping continues to grow.

Retail refrigeration produces GHG emissions both directly (Scope 1) due to refrigerant leakage and indirectly (Scope 2) due to its electricity consumption. As part of the TICR project, a baseline figure for emissions from the retail refrigeration sector has been calculated. This calculation included a dataset of 6,395 convenience stores (sales floor area threshold < 280 m2) and 7,400 supermarket stores (> 280 m2).

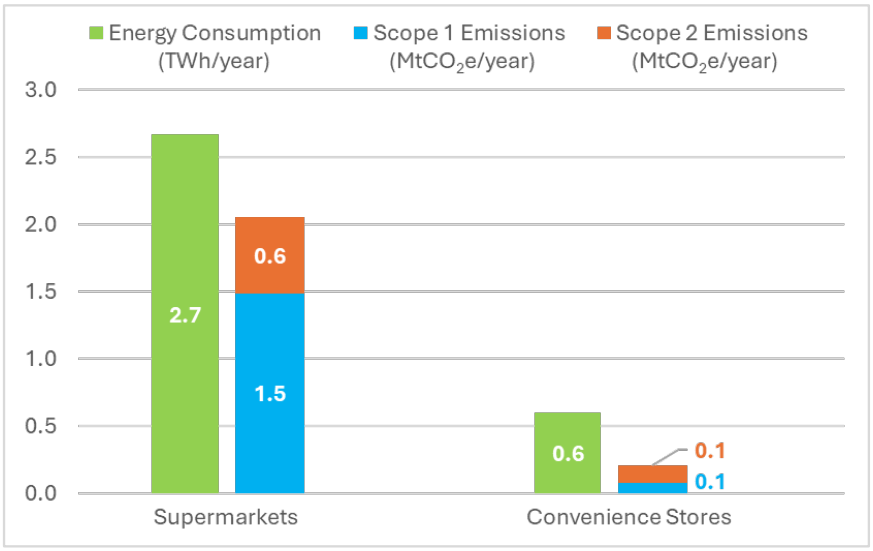

Figure 1: Annual energy consumption and GHG emissions (scope 1 and 2) values for retail refrigeration (source: TICR Roadmap Report)

Commercial refrigeration equipment

Small stand-alone (integral) units: small, hermetic, stand-alone refrigeration units including ice cream cabinets and drinking water coolers. These systems are commonly used in retail food stores but are also found in pubs, restaurants, and other hospitality and catering outlets such as hotels, hospitals, and schools.

Condensing units for commercial applications: composed of one (or two) compressor(s) and one condenser, assembled into a unit, which is located external to the sales area. The condensing unit is connected by refrigerant pipework to an evaporator located in the retail sales area (e.g. in a chilled retail display). These units are typically installed in small shops, beer cellars and small walk-in cold rooms and have refrigeration capacities ranging from 1 kW to 20 kW.

Centralised systems for commercial applications: comprised of racks of compressors installed in a machinery room. Commonly used in supermarkets with many refrigerated displays connected to a central system. A compressor pack is normally located in a plant room or on a roof as part of a bespoke condenser unit, with the evaporators located in the retail display cabinets. Each system typically has a cooling capacity in the 30 kW to 150 kW range and multiple refrigeration packs/ systems are sometimes used to provide diversity of cooling and also serve chilled and frozen food temperature cabinets. The refrigerants commonly used in a central system are HFC blends or CO_2.

3. Retail Refrigeration Best Practice

This section describes the outcomes from 10 site surveys that were carried out as part of the TICR project. The 10 retail sites visited were selected to represent typical equipment and operating conditions, being broadly divided based on their size (convenience stores or supermarkets) and dominant temperature level (chilled, frozen or mixed). Detailed results from the site surveys can be found in the TICR Technical appendix B. and this section provides a summary of key findings.

Operations and maintenance

Retail refrigeration systems are generally not maintained for efficiency, and maintenance regimes focus only on operational reliability. Several issues affecting energy efficiency are related to poor maintenance, lack of appropriate monitoring and controls, as well as the use of inefficient technologies. Common problems observed include operating with higher condensing temperatures than required, as well as signs of fouling at condensers/gas coolers (dirt build-up). Sub-metering was only observed in two sites, and no smart monitoring/ controls (e.g. weather-related head pressure control) were found in any of the sites. The display cabinets used were also sub-optimal from an efficiency perspective, with only five sites (50%) having doors installed in their chilled cabinets. Overall, the surveys highlight significant opportunities to reduce carbon emissions and energy consumption in retail refrigeration through improved cabinet design, maintenance, refrigerant choice, and system monitoring.

More efficient cabinets

The largest energy savings that could be obtained with new technology would be achieved by replacing existing cabinets with the best available in the market. By considering the current proportion of cabinets with doors and the shares of frozen/chilled (30/70) applications in food retail, a sector-wide energy saving potential of approximately 65% was calculated for the sector if best-practice cabinets were adopted.

Renewable energy integration

There is also a significant potential to invest in on-site solar PV panels for electricity generation and for recovering and reusing waste heat from refrigeration systems.

Low GWP refrigerants

The transition to ultra-low GWP refrigerants is an expected progression for the food retail sector, but there is still uncertainty at the pace of this transition, as the UK is yet to decide if they will follow the same level of ambition of the latest EU F-Gas regulations (EU 2024/573), which have established a target of phasing-out fluorinated gases completely. Despite this uncertainty, the HFC Outlook model projects a 99% reduction in Scope 1 emissions by 2050 for the retail sector. This is due to most retailers already having set climate neutrality targets as early as 2035 with a heavy reliance on natural refrigerants for retail applications, such as R744 (carbon dioxide) in remote systems and hydrocarbons in integral cabinets.

Opportunities

Manufacturers should be encouraged to design cabinets with higher evaporating temperatures (where feasible) and fit doors on chilled cabinets.

Improved condenser and gas cooler cleaning regimes should be adopted to reduce head pressures and smart controllers developed to monitor coil fouling.

Site sub-metering and digital twin-based optimisation systems for refrigeration systems should be implemented.

F-Gas logs should be maintained and kept on site, and systems should transition to ultra-low GWP refrigerants with support from regulation.

Training and skills

The UK is experiencing skills shortages in all technical and engineering fields however training and qualifications are available through apprenticeships, T-Levels and industry or manufacturer's training. Training is particularly valuable for those with technician, design and specification drafting responsibilities, as well as for owners and operators responsible for managing or purchasing refrigeration systems and equipment.

The UK market is regulated by the existing F-gas regulation that requires certification of personnel in the handling of fluorinated gases via a short course. There is currently no mandatory training required for any of the low GWP alternative refrigerants. There is no national database of trained persons, although there are databases of registered companies. Owners and operators must make sure that they use only registered certified companies and certified individuals to carry out work on their systems.

However the 2024 EU F-Gas regulation does include certification for low GWP alternatives and regular reassessment. This would be welcomed by the UK industry to drive up standards and ensure a sustainable transition to low GWP refrigeration.

Best Practice

1. **Reduce refrigerant leakage** during commissioning and operation
2. **Ensure F-Gas logs are maintained** and available on site
3. **Sub-meter energy use** of refrigeration system
4. **Pro-active refrigeration optimisation** (assess performance against a digital twin) sub-meter refrigeration components
5. **Fit doors on chilled cabinets** to reduce infiltration
6. **Regularly clean condenser** to avoid fouling
7. **Reduce condensing temperature**
8. **Use anti-fog glass and more thermal efficient glass doors on freezer cabinets or switch off freezer door frame heaters intermittently** to reduce power input and heat load in to cabinet

4. Evaluation Of Currently Available Technologies

The aim of the tables below is to compare different innovations and their potential benefits in terms of reducing the energy consumption for the entire refrigeration system, serving as an important tool for designers and manufacturers. More details of the full range of 65 technologies evaluated is available in the relevant TICR Technical appendix. below only the 10 ten technologies (in terms of emissions savings potential) are shown.

Technologies for minor retrofit

The table below shows technologies with potential for refrigerated retail display cabinets. These were considered to be technically ready or at an early stage of development. Payback periods for the installation of each technology were also noted, where information was available.

No.	Technology	Description	System energy saving	Payback period (years)
1	Doors on cabinets	Installing doors on open display cabinets	32%	3.7
2	Strip curtains	Clear, plastic strips hung over front of refrigerated cabinets, to prevent air infiltration	32%	1
3	Reducing/ floating head pressure	Condenser head pressures float down as ambient air temperatures decrease	28.4%	Depends on whether additional equipment installed
4	Night blinds and covers	Physical barrier reducing air entrainment and radiation heat transfer to products	17.2%	2 (new cabinet); 4 (retrofit)
5	Aerofoil air-guide	Use of guides or deflectors on open fronted cabinets to reduce air infiltration	16%	< 0.5
6	Shelf and well risers	Shelf risers- strips of (usually clear) plastic of ~50 mm height fitted to front of cabinet shelves. Well risers- (plastic or glass) up to 100 mm high	16.0%	1-1.5
7	Suction pressure control	Use of electronic EPR to vary pressure using a stepper motor to control temperature	11.4%	< 1
8	Motor efficiency controllers (MECs)	Reduce power supplied to induction motors as voltage waveform trimmed by MEC	10.5%	0.6 to 2.4 depends on system
9	Improved glazing (if doors fitted)	Installation of glass with a low emissivity (ε = 0.2) reflective coating for cabinets	10%	N/A
10	Adiabatic condensers	Operate by spraying water into the air supply of air-cooled condensers or supplying water to an evaporation media (pad) fitted to the front of the condense	8.2%	N/A

Technologies for major retrofit

This table lists technologies for major retrofit to refrigerated retail display cabinets (ie they require a more complex installation process and more significant adjustment to existing equipment, and some may only be suitable for complete replacement of equipment or new build locations).

No.	Technology	Description	System energy saving	Payback period (years)
1	Cabinet replacement with latest version	Replace with most energy efficient cabinets on the market	77 to 94%	< 1
2	Short air curtains	Short air curtains, with no back panel flow. Or air issuing from the front of each shelf, enclosing products below	21.4%	2
3	Ejectors	Enables kinetic energy to be recovered during the expansion process	14.2%	2
4	Boreholes and ground sink condensers	Exchanging heat from the refrigeration condensers to the ground in summer	14.1%	16
5	Refrigerant - Carbon dioxide (CO2, R744)	Use for remote refrigeration systems and heat pump chillers, but trans-critical systems require high pressures	12.3%	<1
6	Refrigerant – hydrocarbons (HC)	Propane, isobutane or propylene (GWP 3). Also blends containing ethane, propane and butane	10%	Similar cost to HFC systems but not suitable in all sites due to increased risk
7	Two stage compression	Two-stage cycle-based refrigeration, low and high stage compressors	9.5%	N/A
8	Water loop systems	Use water cooled condensers for each cabinet, with heat rejected to a water loop	7.8%	N/A
9	Liquid-suction heat exchangers	Internal heat exchangers, between suction line at exit of evaporator and liquid line at exit of condenser - increases refrigeration capacity	7.5%	N/A
10	Economisers	Use of sub-cooler for condenser outflow - expanding to an intermediate pressure	7%	N/A

Most promising innovation

By comparing the energy saving potentials of the minor and major retrofit technologies, listed in the two tables above, it is clear that the most promising innovation is the replacement of existing display cabinets with the best available in the market.

State-of-the-art cabinets combine several energy-efficient components e.g. doors, LED lighting, EC fans, variable speed drives, low emissivity glass and/or double glazing for cabinets, anti-sweat heater controls for doors.

5. Recommendations for Owners and Operators

About these recommendations

What follows below is a list of evidence-based recommendations for strategies that will help owners and operators achieve net zero refrigeration and to improve the efficiency and reliability of their refrigeration operations. It includes check lists for action. Each check list is not designed to be exhaustive because we recognise that each site is different. However, it provides a suggested starting point for the minimum action needed to develop individual refrigerant management strategies. This is backed up with relevant examples drawn from the findings of surveys that underpin the recommendations to illustrate why the recommendation is important.

1. Prioritise efficiency

Assign responsibility for refrigeration efficiency, proactively improve performance by maintenance, monitoring existing performance, evaluating it and implementing energy reduction opportunities. It is not enough just to keep your cooling systems operating you need a programme of management and monitoring of energy use supported by planned preventative maintenance to maintain and improve performance.

Recommended actions:

- ☐ Review and revise current maintenance policies.
- ☐ Record, monitor and report information about performance and changes in performance.
- ☐ Appoint a refrigeration expert with a remit to identify energy saving opportunities.
- ☐ A refrigeration optimisation system based on digital twin should be installed to ensure continued operating efficiencies.

Example: Maintenance was not focused on energy efficiency. The operator was not even aware that their refrigeration systems were not optimised.

2. Address the information gap

Start measuring and monitor the energy use of your cooling systems.

For most operators there is a substantial information gap. Owners and operators are not well informed about the best way to operate the system, when or how it should be updated or adjusted as their needs change. Energy is not sub-metered so they do not know how much the systems cost to run and what the impact are of these changes. Records such as F Gas must be made easily available as well as historical performance records to see the impact of changes over time and evaluate the operation and future life of systems.

Recommended actions:

- ☐ Install sub-metering and monitoring systems.
- ☐ Set data reporting and key performance indicators
- ☐ Ensure this activity is managed by a member of staff with both energy and refrigeration knowledge.

Example: Only 20% of the surveyed sites had functioning sub-metering. Even then, energy data on these sites were not accessible to refrigeration technician in a usable format.

3. Know your assets

Understand what refrigeration systems you have on sites, how they are designed to operate and what refrigerant they contain. Efficiency and reliability are interlinked, when you have access to good information you can make good business decisions to predict and prevent breakdown, identify which assets are coming to end of life, and plan effective refurbishment or replacement programme to fit with your business operations. Robust management and reporting systems are essential to this to review, reset and recommission.

Recommended actions

- ☐ Build and maintain an asset register.
- ☐ Collect system operating parameter data including energy and refrigerant leakage.
- ☐ Review and reevaluate current operation of systems against how they were planned/designed to ensure they are still fit for purpose.

Example: Setpoints on equipment were not set to the design documentation. It was great to see doors fitted on cabinets to reduce cooling losses but the compressor settings were not adjusted correctly and so even greater efficiencies could have been achieved

4. Take a systemic approach

Integrate your needs and the technologies available to minimise energy use. With an increasing range of different refrigerant and technology solutions available, owners and operators need to consider how these will impact whole system performance to achieve potential energy savings. The cooling needs of your business should not be considered in isolation. There are often opportunities to integrate heating and cooling in manufacturing processes, to reuse waste heat internally or with nearby businesses by connecting to heat networks, to use “free cooling” and reduced demand as well as employing alternative energy sources such as solar panels on cold store roofs, electric vehicles etc.

This systems approach also relates to how expert teams operate within your organisations. There needs to be a closer working relationship between customer, specifier consultant, designer and those responsible for installing, commissioning, maintaining and servicing. So that those maintaining or servicing equipment understand how it was designed to operate and what can be done if your refrigeration needs or design conditions have changed. Refrigeration equipment should be seen as part of the building or process system, not a separate unit.

Recommended actions

- ☐ Establish multi professional project teams.
- ☐ Work closely with all those involved in your system design and operation.
- ☐ Evaluate potential savings to be gained from retrofit technologies.
- ☐ Evaluate potential savings to be gained from new technologies and whether they are suitable for the applications.
- ☐ Consult reliable sources of information on performance eg Enhanced Capital Allowances (ECA), Energy Technology List (ETL), TICR Roadmap and Guidance.

Example: Rejecting heat outside was the norm whilst at the same time other parts of the store were being heated with gas and electricity. Sites were literally throwing useable waste heat away. Only one site had heat recovery.

5. Think long term

Make plans for end-of-life replacement of existing equipment. Businesses need to have plans in place for minor and major retrofits as well as end of life replacement or anticipated changes in your refrigeration needs in the future. A careful evaluation by experts is needed to ensure that when any change is undertaken there is also a review of opportunities to improve performance. In some cases making a change to an existing system may be the most environmentally friendly option, in others, for example if systems are using older type refrigerants, it may be necessary to completely replace with a new equipment. Replacing like for like is not usually an option – look for ways to optimise performance.

Recommended actions

- ☐ Consult the TICR Roadmaps for guidance on planning a long term strategy for moving towards net zero refrigeration.
- ☐ Evaluate options using the TICR Roadmap to help evaluate potential savings from new technologies, suitability of their application (eg new systems or retrofit) by sector.
- ☐ Maintain an asset log with planned replacement or retrofit strategy.

Example: The latest highest energy efficiency cabinets were not fitted in most sites. These stores will have a legacy of many years of energy hungry refrigeration systems.

6. Make informed decisions

The cooling systems installed today are going to have to meet the demands for the next 20 years. Purchasing must be made on an informed basis to achieve long term reduction in energy use if businesses are going to move towards net zero. Purchasing, whether for a new system, replacement of existing equipment or maintenance contracts need to prioritise not just first cost and payback period but, additional factors such as efficiency of operation, flexibility of assets, repairability, reliability, energy reduction, sustainability, circular economy.

Purchase of new equipment is an investment in the future of the business. It should be linked to overall net zero business plans by involving cooling expertise, that can identify refrigeration technology available to meet current and future needs, using resources such as the TICR Roadmap. The risk to businesses is sub optimally performing, costly and stranded assets that will not support business changing needs and growth – as well as compromising net zero objectives.

With an increasing range of different refrigerant solutions, new technology options need to be evaluated and effectively implemented or incentivised to achieve potential energy savings. This will necessitate a closer working relationship between customer, specifier consultant, designer and those responsible for installing, commissioning, maintaining and servicing.

Recommended actions:

- ☐ Include refrigeration experts in your purchasing team.
- ☐ Have purchasing policies that require best available practices and technologies such as using ETL listed products, highest EcoDesign category, ATP for refrigerated vehicles, proactive maintenance contract that report on energy use and identify energy saving opportunities.
- ☐ Consult the TICR Roadmaps for guidance on planning for NetZero.

Example: Whilst it is often the marketing department's responsibility to choose new cabinets they must be encouraged to select the highest efficiency rated equipment based on independent data, and not just focus on aesthetics.

7. Work together - people and processes

Collaborative practices between customer and everyone responsible for system design, installation, commissioning, maintenance and repair. People, consistency, responsibility, co-ordination with all parties involved whether external designer, commissioner, installer, service and planned preventative maintenance which are often different people. This also applies to non-technical roles and teams – those with responsibility for energy use, sustainability or financial policies need to have access to refrigeration expertise. Access free training or continued professional development activities for those responsible for managing refrigeration systems through trade associations, professional bodies and organisations supporting energy efficiency in the refrigeration industry.

Recommended actions;

- ☐ Specify that new refrigeration project teams must include refrigeration experts from the outset, including in developing specification for tender, monitoring installation and checking operation after commissioning.
- ☐ Even if you are using a different company to install or maintain, those responsible for the original specification should be included in reviewing operation data.
- ☐ Make use of TICR Training resources and webinars as well as its resources pages on the TICR website.

Example: Condenser and gas coolers were poorly located in several sites resulting in air recirculation. It was clear that the architects and the refrigeration design team have missed an opportunity to save energy by not working collaboratively.

8. Monitor legislation, regulation and standards frameworks

Ensuring compliance will help you to achieve efficiency.

There is an ever-growing range of obligations and requirements related to energy efficiency, environment and safety. These are often interlinked so ensuring that your business is complying with regulations and legislation is not only a legal requirement. It is good business practice to manage your refrigeration assets. Businesses can actively contribute to reviewing and improving legislation and standards through trade associations, professional bodies and other government forum. Trade magazines and online newsletters provide updates and summaries.

Recommended actions:

- ☐ Ensure you are a member of your relevant trade association to keep up to date with changes eg British Refrigeration Association, Cold Chain Federation, Chilled Food Association, British Frozen Food Federation, Food and Drink Federation, Datacentre Trade Association.
- ☐ Participate in external meetings to ensure you are up to date with latest legislative developments and standards.
- ☐ Employ individuals who are members of a relevant professional engineering bodies such as Institute of Refrigeration.
- ☐ These bodies can also make nominations to Standards Committees through the BSI so that you can contribute to future standards development.

Example: Maintenance contractors were working to the practices specified by the client (retailer) and this resulted in different maintenance approaches and plant operating efficiencies across the estate. Consistency could have easily been achieved by consulting industry best practice recommendations.

6. Benchmarking Tools

Food retail is an important sector to the UK economy that is currently undergoing significant change, which is being triggered by several trends that are expected to shape the market in the future. As part of the TICR project, modelling has been carried out to assess how these trends may impact refrigeration in the retail sector in terms of its energy consumption and carbon emissions (scope 1 and 2). The Figures below show the retail refrigeration emissions and energy reduction potential by 2050.

Using findings of the site surveys carried out and the sector emissions trends from the TICR roadmaps benchmarking of various emissions projections against the baseline for the sector have been calculated in the waterfall diagrams below. These have been developed by gathering and normalising energy use data from a variety of published sources, validated against data obtained from the site investigations carried out by the TICR project during 2023-2024.

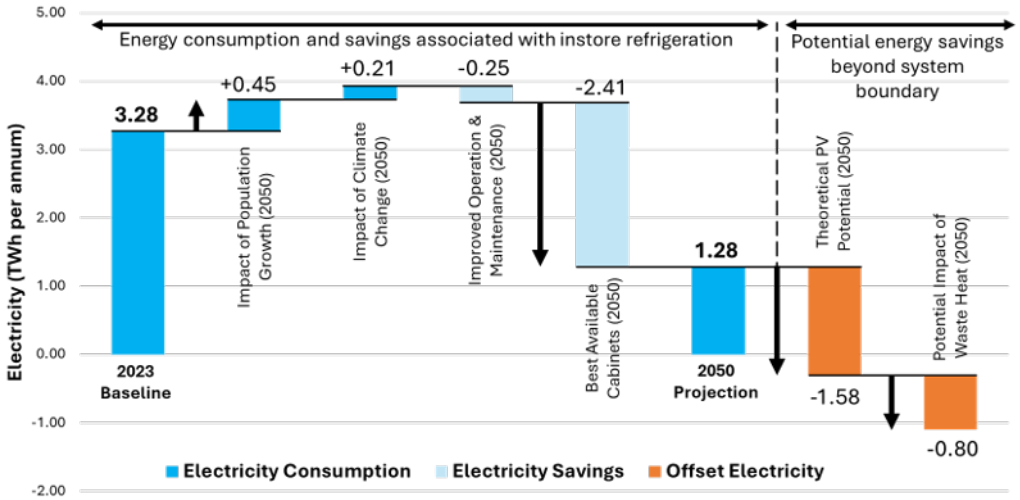

Figure 2: Projected refrigeration energy use in 2050 for retail refrigeration and estimated impact of different trends (source: TICR Roadmap)

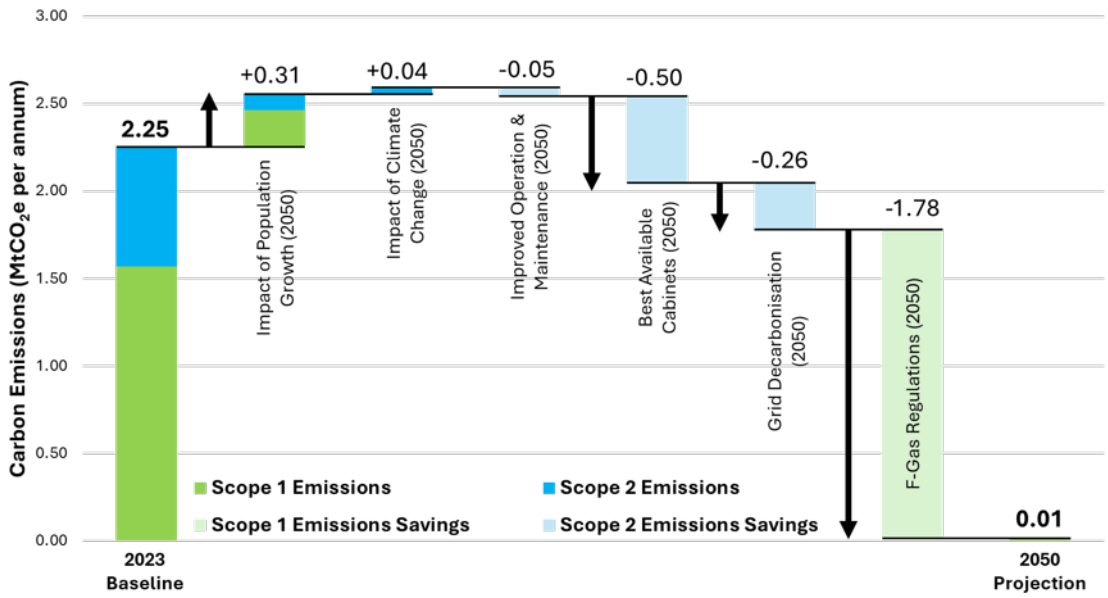

Figure 3: Projection of carbon emissions in 2050 for retail refrigeration, and estimated impacts of different trends (source: TICR Roadmap)

7. TICR Benchmarking Survey

The aim of benchmarking is to help identify poor, good, best and aspirational practice in the retail refrigeration sector. TICR has developed a self assessment approach to assist with this benchmarking.

Qualitative benchmarking

This approach allows you to benchmark your own practices and policies against sector specific recommendations detailed in this report. The questions cover best practice and opportunities for improving refrigeration system energy management, as identified through research and actual site surveys.

This provides a method for business owners, energy managers and in-house engineers to benchmark their business against the key recommendations of the project. You are encouraged to use the tool as many times as you need either for your complete estate or for individual systems to help you to improve your benchmark score.

As well as providing a final score based on your answers to the questions in the survey the tool will provide you with useful guidance and sources of further information that you can use to help reduce energy, reduce emissions and work towards your net zero refrigeration targets.

How to complete the survey

You will find a link below and on the www.netzerorefrigeration.uk website.

Before you start this survey, you should consult a copy of your most recent F Gas logs, site or system energy use data, if available, and energy audit inspection reports. If you do not have access to this information, you can still compete the survey, but this will affect your results. You can complete this survey for a single site or for your total overall estate - whichever data is more readily available to you.

Using the survey results

You will receive a score (Gold, Silver, Bronze or nil) at the end of the survey that you can use to benchmark the approach to refrigeration against best practices in the sector identified by the TICR project. This benchmark will also allow you to evaluate the impact of any changes in the future. Your results will include details of how you scored against each question which will help you identify areas for improvement and create an action plan.

8. Areas for Further Action

The TICR project has identified the following five key areas that support the decarbonisation of refrigeration systems. These areas that are outside of the direct control of the sector are interlinked and can accelerate industry transition to net zero emissions through the measures described below. For full details of these and supporting policy areas see the TICR Roadmaps.

1. Support for education and skills

Underpinning the decarbonisation of the sector is having the right people and skills to achieve the best cooling solution. This encompasses the shortage of people particularly in design roles, lack of availability of training and qualifications, and lack of awareness of operators. Intelligent users are needed to ensure that best available solutions are put in place. Improving the supply of qualified people requires national level support for training, minimum standards of competency to address shortage of provision and lack of qualifications.

2. Refrigerant policy

Legislation will affect the choice of refrigerant available in future and will have the greatest impact on which refrigerants are used on which equipment. Future legislation can be expected to further reduce direct emissions from leakage and restrict in which equipment higher GWP refrigerants can be used. There will be a cost and safety impact associated with moving to natural refrigerants due to the design/optimisation required as these refrigerants have higher flammability (hydrocarbons), higher pressure (CO_2) or toxicity (Ammonia). A shortage of skilled designers to ensure new refrigerants are used safely will be a barrier. Minimum standards for training and leak checking with mandatory registration are needed.

3. Data and benchmarking

Reliable data collection is a key missing factor in current legislation aimed at reducing GHG emissions, enhancing energy efficiency, and compliance with safety and environmental standards. Data plays a crucial role in enabling better decision-making, providing clarity on where focus and intervention are most needed and supporting the development of effective benchmarks. Without accurate data, owners, operators, and policymakers lack the ability to measure or monitor current emissions, estimate future trends or identify suitable benchmarks.

4. Technology incentives

Purchasers need to have reliable guidance to make intelligent investment decisions, and many sites extend or adapt existing equipment thus failing to capitalise on opportunities of new technologies. As UK ambient temperature change owners and operators need to be directed to technologies that will assist them in both adaptation and mitigation. This applies to schemes such as the Energy Technology List; Enhanced Capital Allowances Scheme; Energy Savings Opportunity Scheme; Streamlined Energy and Carbon Reporting Scheme; NABERS UK actual in-use energy performance.

5. Sector specific innovation

Targeted capital investment support schemes to provide subsidies for investment in specific innovation. Business innovation funds to encourage start-up innovators of low carbon technologies identified by TICR Roadmaps. There are key research gaps in areas such as the impact of climate change and extreme heat on refrigeration systems failure; impact of raising frozen food set point by 3 K throughout the whole UK cold chain; quantifying energy, emissions and decarbonisation pathways for UK convenience stores; predict changing consumer preferences.

9. Relevant Policies and Incentives

National regulatory frameworks play the most significant role in shaping owners and operators' choices regarding equipment selection, while also determining the approach and direction of future transitions.

Refrigeration is important to the UK. It cuts across many Government departments and functions (DESNZ, DEFRA, DfT, DSIT, DfE, Institute for Apprenticeships and Technical Education, Local Government planning, Environment Agency and CCC) and collaborative, multi-level whole-of-government approach is essential to ensure the right scale of action across infrastructure sectors. The importance of refrigeration is not just in terms of its essential contribution to various business functions, but also to critical national priorities including energy use, net zero, and climate change adaptation and mitigation.

The most relevant national policy areas that were identified by the project that can be used to support decarbonisation are shown opposite. It is critical that owners and operators contribute to Government consultations and monitor changes to these policies to ensure that they continue to support future decarbonisation strategies and activity for the sector.

Climate Change Agreement a voluntary agreement between the UK government and energy-intensive industries that incentivises energy efficiency improvements and reduce carbon emissions by offering reduced rates on the Climate Change Levy (CCL).

Energy Savings Opportunities Scheme (ESOS) energy audits in buildings, processes and transport.

Fluorinated Greenhouse Gases Regulation regulates the use of certain refrigerants, including leak checking, recording and rectifying and training for refrigerant handling.

Enhanced Capital Allowance scheme provides first year tax allowances on investment in qualifying plant and machinery.

Energy Technology List assists businesses in making more energy efficient choices through testing against robust criteria with an updated list of products.

Innovate UK and EPSRC provide funding for research to support industry and academic partnerships

10. References

This guide was produced for the Transport Industrial and Commercial Refrigeration (net zero) project by the Institute of Refrigeration.

For additional documents, guides and technical materials see www.netzerorefrigeration.uk/resources

TICR Roadmap and Technical Appendices are referenced throughout. These are published by the Department for Business Energy and Net Zero and available from: www.gov.uk/desnz