Guide to Net Zero.
How Heat Pumps Play a Role.

KTP_GTNZ_0425v2

www.kooltech.co.uk

CONTENTS

THE CHALLENGE

In 2019, the UK government announced the intention to bring all greenhouse gas (GHG) emissions to Net Zero[1] (against a benchmark of 1990 emissions) by 2050.

There are also interim targets of a 68% reduction by 2030 and a 78% reduction by 2035. Although some progress has been made towards the first milestone, there is still a long way to go, particularly in our commercial building stock.

The Climate Change Committee (CCC) which manages and oversees the UK's Net Zero journey, presented its most recent Seventh Carbon Budget Report on 26th February 2025. It clearly states that the generation of clean, green electricity will make up the largest share of emissions reductions – 60% by 2040.

The section on heat pumps from the carbon budget reads:
Heat pumps: by 2040, our Balanced Pathway sees around half of homes in the UK heated using a heat pump, compared to around 1% in 2023. This requires the annual rate of heat pump installations in existing residential properties to rise from 60,000 in 2023 to nearly 450,000 by 2030 and around 1.5 million by 2035, a rate of increase in line with that seen in other European countries such as Ireland and the Netherlands. But installation rates do not exceed natural replacement cycles; heating systems are only replaced at the end of their life. All new and replacement heating systems become low carbon after 2035 to ensure a fully decarbonised housing stock by 2050.

But what about the public sector?
It is fair to say the targets are equally ambitious; for example, the NHS[4] is aiming to achieve Net Zero by 2040, with an ambition to reach an 80% reduction by 2032. The Department for Education (DfE) aims for all new buildings to be Net Zero in operation. In addition, the DfE will transform existing schools in the next seven years as part of its Let's Go Zero 2030 scheme[5].

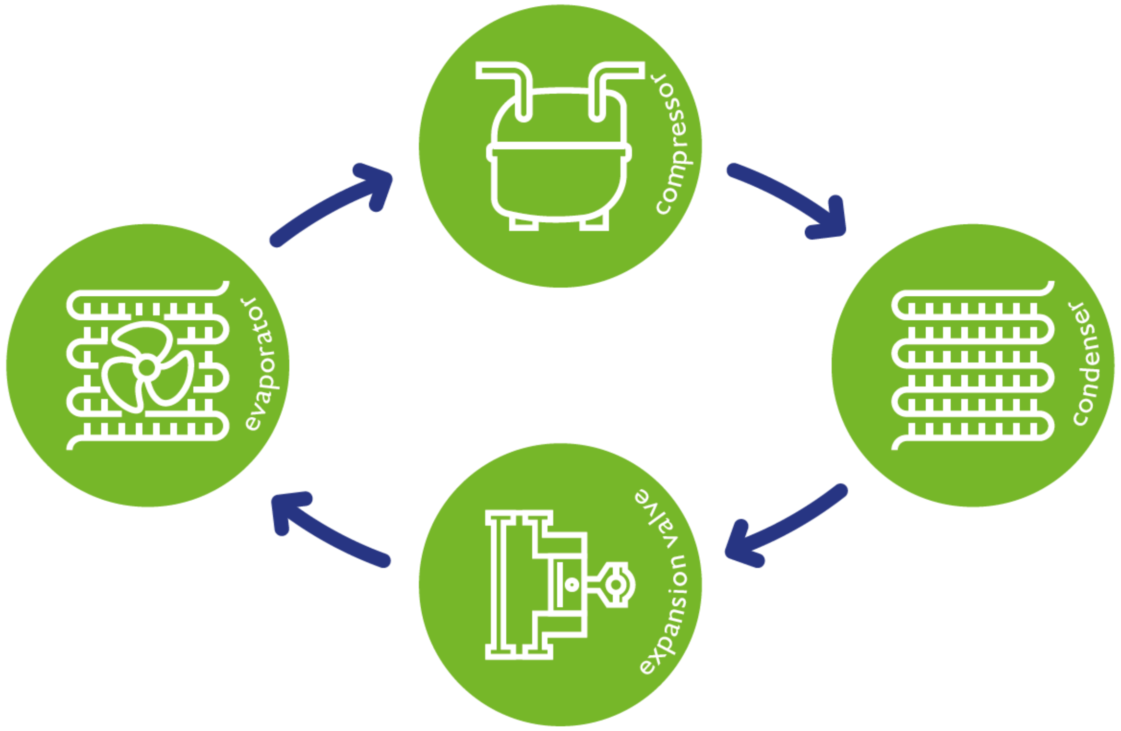
Commercial properties also face significant challenges. The Minimum Energy Efficiency Standards (MEES)[6] came into effect in 2018, requiring all non-domestic buildings to have a minimum EPC rating of E. Originally this rule only applied to new leases, however from April 2023 it has been applied to the continuation of existing commercial leases. The government is proposing to raise this requirement to a minimum of C by 2028 and B by 2030.

This change is driving building owners to upgrade the energy efficiency of their buildings. For example, property consultant Savills[7] has suggested 83% of retail stock would have to be improved to meet EPC rating B and 87% of the UK's office stock has an EPC rating of C or below. The impacts of the UK's Net Zero ambitions are therefore being felt across the whole built environment.

THE CHALLENGES AND OPPORTUNITIES IN IMPLEMENTING NET ZERO STRATEGIES IN UK COMMERCIAL BUILDINGS.

TAKE A LOOK AT HOW AIR SOURCE HEAT PUMPS OPERATE

Proven technology.
The vapour compression refrigeration cycle used in fridges and air conditioning consists of four primary components:



Above: The DX cycle.
Compressed refrigerant gas warms, this warmth is transferred via the heat exchanger to heat buildings and domestic hot water.

The technology has been used for over 100 years and is a proven and reliable method of removing heat from a space. By reversing this cycle, we can extract warmth from the outside air and use it to heat commercial buildings.

Air source heat pumps (ASHPs) can be placed into two main categories: air-to-air, commonly referred to as air conditioning; and air-to-water. This uses the same technology but delivers heat to water via a heat exchanger to a wet heating system like traditional radiators or underfloor heating (UFH).

There are 14.84 million heat pumps installed in Europe and that number has grown 26% in the past two years. Norway, one of the coldest European climates, now has one heat pump for every four people. The effectiveness of the technology is not in doubt, however, like all heating products, the selection and installation are the key drivers of success.

THE MEANING OF EFFIENCY

The more efficient the heat pump is, the less energy it consumes. The efficiency of a heat pump is measured by its coefficient of performance (COP). That is the ratio of heat produced per unit of electricity consumed when pumping the heat.

A COP value of 3 means that you achieve 3kWh of heat output for every 1kWh of electricity used to operate the heat pump. It can therefore be described as 300% efficient. For comparison a traditional gas boiler would be about 90% efficient, with a COP of 0.9.

Heat pump efficiency decreases in cold weather, typically to around COP 2.5, and increases in warmer weather to approximately around COP 4.0. These figures will vary depending on models and the type of heat pump. The fact that a heat pump's efficiency drops in cold weather has been highlighted in the media as evidence that they do not perform in colder climates; however, this is consistently proved incorrect by the success of heat pumps in Northern Europe with the Scandinavian nations having some of the greatest uptake in heat pump installations. To help the industry better apply heat pumps, we have seen a move towards SCOP which looks at the seasonal efficiency of the products. This gives us a measurement of the efficiency over a day and takes into account ambient temperature fluctuations over an entire year.

The new method of rating energy efficiency is driven by the EU's Energy Related Products (ErP) Directive (the Eco-design Directive) which specifies the minimum design requirements that manufacturers must integrate into their energy-using products. In addition to COP and SCOP for heating, we have the equivalent cooling efficiencies, the Energy Efficiency Ratio (EER) and the Seasonal Efficiency Ratio (SEER).

RUNNING COSTS

If we have established that heat pumps are significantly more efficient than gas boilers then logically, we would expect a financial saving, but unfortunately, this is not always the case.

Based on the new domestic energy price guarantee rates from 1st April 2025, with the average cost of gas at 6.99p per kWh, and electricity at 27.03p per kWh, we can establish the price ratio of electricity to gas is more than 3.

The ratio of a heat pump (with a COP 2.7) to a gas boiler (COP 0.9) is three.

Therefore, what we find in practice here in the UK is the financial saving from efficiency is effectively cancelled out by electricity prices. This highlights the importance of ensuring we select heat pumps with the greatest possible efficiencies for the application. However compared to direct electric, storage heaters or oil the savings can be significant.

We know the capital cost of large decarbonisation schemes is significant and clients look to offset upfront expenditure against long-term savings. The hope is that as the electricity grid becomes cleaner, the electricity unit cost can reduce and clients benefit financially from the efficiency savings heat pumps offer.

FLOW TEMPERATURES

Flow temperatures make a significant difference in the performance of heat pumps. Simply put, the lower the flow temperature, the higher the COP; and the higher the flow temperature, the lower the COP. Decisions made by project teams aim to balance the efficiency and the emitter sizing to achieve an optimised solution. However, there is still a lack of consistency in this area.

BS EN 14511 is a well-established standard[8] for testing of steady-state performance of heat pumps across a variety of rating conditions. BS EN 14825 is a related standard[9] and defines the conditions for measuring seasonal performance.

The test conditions for four heating modes are specified as: low temperature (35°C), medium temperature (45°C), high temperature (55°C) and very high temperature (65°C). As an industry, we need to be more knowledgeable on this so we can ensure project teams are comparing apples to apples on projects.

REFRIGERANTS

The role of the refrigerant is to travel to the different parts of the system, changing from a low-pressure gas to a high-pressure liquid.

As it does so, it absorbs heat and then releases it where required. All refrigerants have different properties and manufacturers look at their characteristics including boiling points, flammability and environmental impact in determining which ones to use.

The Global Warming Potential (GWP) of a refrigerant is its global warming impact relative to the impact of the same quantity of carbon dioxide over a 100-year period. The F Gas regulations developed by the EU and followed by the UK will see the phase-down of fluorinated gases.

These F gases trap heat in the earth's atmosphere, increasing global warming. In fact, one kilogram of the refrigerant R410a has the same greenhouse impact as two tonnes of carbon dioxide, which is the equivalent of running your car for six months.

The F Gas phase-down program was introduced in 2014 with the aim of achieving a 79% cut in emissions by 2030. It has driven manufacturers to adopt lower GWP refrigerants, but the steepening of the phase-down will continue to present challenges and it is vital that this does not slow the adoption of heat pumps in the UK or push manufacturers into using unsuitable refrigerants negatively affecting performance or safety.

The paradox of the refrigerant debate is that to decarbonise our heating we currently utilise significant quantities of refrigerants that can potentially harm our planet. The answer to this question going forward may be to adapt the products to utilise low global warming potential (GWP) refrigerants such as R744 (CO_2, GWP= 1) or R290 (Propane, GWP = 3).

It is an unchartered time in the refrigerant market, which is an opportunity for technological advancements, but with uncertainty also come cost pressures, shortages and the risk of rising black market supplies.

STANDARDS

ASSETS - LEGISLATION

As already noted, proposed changes to MEES requirements are already impacting property across the UK economy. The changes, and a potential penalty of up to £150,000 per breach, have gained the attention of many building owners and developers who now run the risk of their asset no longer complying with current standards and expectations.

In addition, changes to Part L (Conservation of fuel and power) of Building Regulations came into force on 15 June 2022 in the form of two new Approved Documents. They include higher performance targets – CO_2 emissions are reduced by 31% for dwellings and 27% for other buildings.

There is also a new emphasis on low-carbon heating systems. These are an interim step towards the Future Homes Standard and Future Buildings Standard that are due to arrive in 2025.

Whether it is legislation, standards or the drive of eco-conscious tenants or financial investors, the appetite for Net Zero buildings will continue to increase. The built environment needs to adapt and the construction industry needs to rise to this challenge to ensure buildings are lettable and do not become a stranded asset.

STANDARDS

For many years the main drivers for commercial building energy compliance have been Part L of the Building Regulations and the BREAAM assessment method, but in recent times there has been a significant increase in the range of voluntary carbon assessment schemes, for example:

SBEM (Simplified Building Energy Model): Is used to calculate how much energy a non-residential building will use and how many harmful gases (emissions) it will release into the air. It's used in the UK to figure out how much energy a building is likely to use and helps designers and builders make sure their buildings meet the energy rules, seeing how the building fabric like insulation and windows affect energy use.

NABERS: Administered by CIBSE in the UK, the star rating system proved very popular in Australia. NABERS checks how much energy an office building actually uses, by looking at the meters. Nabers UK, has two products – Design for Performance (DfP), which drives energy efficiency in new offices, and Nabers Energy for Offices, which measures the energy efficiency of existing offices.

UK Net Zero Carbon Buildings Standard: At the moment there is no single Net Zero building standard that the industry is working to. In an effort to change this, leading industry organisations such as BBP, BRE, the Carbon Trust, CIBSE, IStructE, LETI, RIBA, RICS, and UKGBC are working together and have launched a pilot scheme, launched in September 2024, called The UK Net Zero Carbon Buildings Standard. They are encouraging organisations to target and adopt the Pilot version of the Standard.
The Standard has been created using industry data on what is achievable, and cross-referencing this with 'top down' modelling of what is needed to decarbonise the built environment industry in line with 1.5°C aligned carbon and energy budgets. It covers all the major building sectors, as well as both new and existing buildings[11].

GOVERNMENT INCENTIVES

INCENTIVES

The Public Sector Decarbonisation Scheme[12]

Often referred to as the Salix program, provides funding to enable the delivery of capital energy efficiency and heat decarbonisation projects within public sector non-domestic buildings. Since its formation in 2004 up to 31 March 2022, the scheme has helped public sector organisations commit to more than 21,500 projects by administering £2.7 billion of funding, with projects saving 1.1 million tons of carbon dioxide annually.

The government also announced[13] in March 2023 that a further £409 million has been allocated to public sector bodies across England to help reduce their carbon emissions. As a result, 144 public sector organisations responsible for hospitals, schools, leisure centres,museums and universities will benefit from this support.

Speaking at the announcement, Lord Callanan, Minister for Energy Efficiency and Green Finance, said: "The UK is truly a world leader when it comes to reducing carbon emissions and the progress we've made over the last decade has been remarkable. But we can't rest on our laurels and must continue to drive forward progress, setting a standard for other countries to follow."

The Boiler Upgrade Scheme (BUS)[14]

Provides grants supporting low-carbon heating options for both home and small non-domestic property owners across England and Wales. The scheme covers systems with a maximum installation capacity of 45kWth.

To help drive this commitment the Boiler Upgrade Scheme came into force in May 2022 for England and Wales only, which offers an upfront grant of £7,500 towards the total cost of an air source or ground source heat pump and installation, or a £5,000 grant towards a biomass boiler.
And a zero rate of VAT for both the materials and installation.

The scheme is administered through Ofgem and has £1.5 billion of finding for eligible applicants.
The low-carbon heating product and the installer, both must be MCS certified to apply.

EMBODIED CARBON VS OPERATION CARBON

Embodied carbon refers to the greenhouse gas emissions arising from the manufacturing, transportation, installation, maintenance, and disposal of building materials. Operational carbon refers to the greenhouse gas emissions due to building energy consumption.

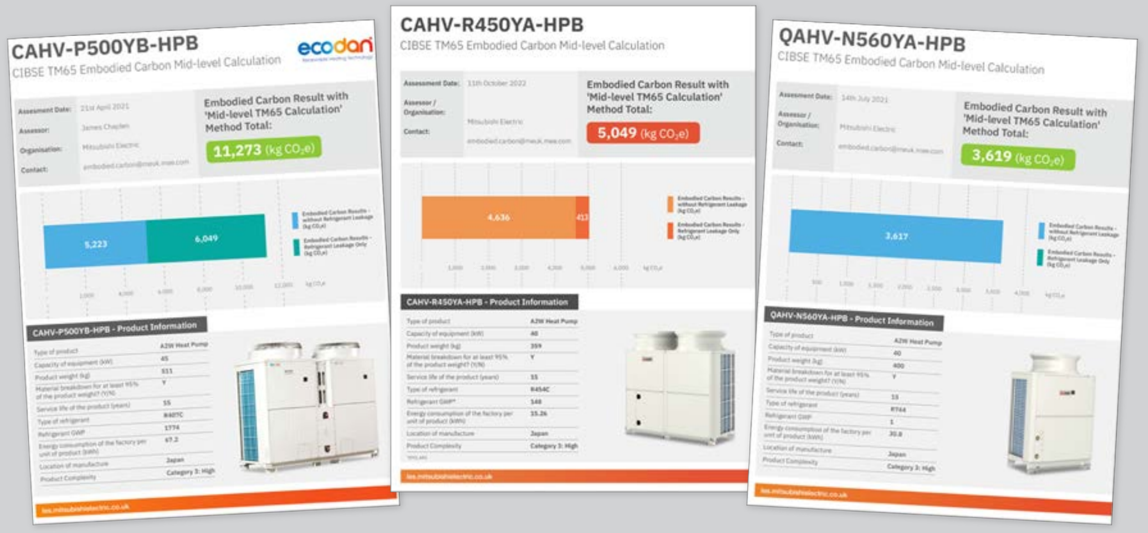
The heating, ventilation and air conditioning (HVAC) industry has primarily been focussed on operational carbon, constantly looking at the efficiency of our equipment, but the consideration of embodied carbon is coming into focus and manufacturers are increasingly being asked to provide embodied carbon data.

To provide a standard approach to calculating the embodied carbon of HVAC equipment, the Chartered Institution of Building Services Engineers (CIBSE) published TM65 Embodied Carbon in Building Services: A Calculation Methodology (2021). Understanding the embodied carbon impact of our buildings puts a new emphasis on retrofitting existing buildings and making the demolish-and-rebuild approach less attractive. It can be argued that the greenest buildings are the ones that already exist so we need to make the most out of the embodied carbon that has already gone into their construction.

The London Energy Transformation Initiative (LETI) is a network of over 1,000 built environment professionals which published Retrofit vs Rebuild: Unpicking the Carbon Argument in March 2023. The document compares the whole-life carbon impact of retrofit or rebuild.

As you would expect, demolishing and rebuilding a new purpose-made building would typically result in greater embodied carbon than retrofitting. However, if we consider operational carbon, a new-build project offers greater flexibility over the design, so it should in theory be possible to produce a new building with lower operational energy use.

The specific site and user requirements of any given project can flip the decision between rebuild or retrofit and there is not a simple answer to this question, it must be reviewed on a case-by-case basis. What is clear is that existing buildings can present a challenge for heat pumps, as plant spaces have been designed for the existing equipment. Because of this we need to be flexible in our approach to find solutions to these challenges.



TECHNOLOGY IN ACTION

INNOVATIONS AND SOLUTIONS

Exmouth Leisure Centre swimming pool is now being heated by a small data centre. The computer (the size of a washing machine) is surrounded by oil which captures the extracted heat and transfers it via a heat exchanger to the pool. Enough energy is transferred to heat the pool to 30°C for 60% of the time, saving the council thousands of pounds. This is the sort of heat recovery innovation we will have to see more of in the future as we make our journey to Net Zero.

Another interesting innovation in the built environment is the use of aerogel15, which is often described as the most effective insulating material known to man. It has insulated components on rovers sent to Mars, but it can be easily applied to existing building stock and is an excellent insulator. A 10mm layer of aerogel insulation fixed to the walls of a building could reduce heat loss through those walls by two-thirds.

The use of ambient heat loops is another approach. These are based on the principle of a heat-sharing water pipe network at low temperatures (typically 10 to 30°C), generated by a heat pump. This can be used to share heating and cooling across different areas of a building or development. For example, the waste heat generated in a gym or a data centre can be transferred to residential apartments. Each apartment is fitted with a water-to-water heat pump that can increase the water temperatures for domestic hot water and space heating.

District heating schemes (also called heat networks) offer heat recovery on a much larger scale. Through a network of hot water pipes, it is possible to share energy between multi-use buildings across a development. In the UK heat networks provide less than 2% of the heat demand and local planning frameworks are holding back the progress. However, we hope to see a push from the central government and larger developments looking at this solution.

High temperature water. We have seen schemes that require high-temperature water, so an existing building can move from fossil fuels to renewable energy without the need for stripping out the existing wet heating systems. For example, a listed building with existing radiators requiring a flow temperature of around 75°C to heat the building, it is now possible to use an ASHP with the introduction of natural refrigerants such as R290. For applications requiring a higher target temperature, a cascade set up could be used, where an ASHP to generate 55°C and then a second stage WSHP to raise the temperature further. This solution meets the challenges in existing buildings today and if a future retrofit takes place, the WSHP can be removed and use a lower, more efficient flow temperature once improvements have been made.

Hybrid VRF solutions with the removal of refrigerant from the indoor units (using water as the medium) also offer significant reductions in embodied carbon. If we take a typical 30kW VRF system on R410a with 8No. Ducted FCU, we calculate the system has 49,655 kg CO2e/using a hybrid VRF solution for the same application the figure would be 13,802 kg CO2e, a reduction of 72%. We anticipate further growth in this area as the simplicity and availability of VRF will continue to offer a highly efficient solution in retrofitting buildings.

Kooltech ASHP solution. At Canary Wharf, we have been involved in a project where ASHPs are to be sited in the exhaust air path of an air handling unit. This means that the ambient temperature around the ASHPs will remain higher than the surrounding conditions. The ASHP therefore benefits from heat recovery due to its location, allowing it to achieve more energy-efficient operation. The higher capacity output from the unit allows for the selection of a smaller ASHP, resulting in lower embodied carbon and cost to the client.

These practices, if adapted across the industry, would be hugely beneficial in our efforts to achieve our Net Zero goals.

CONCLUSION

As we to count down towards 2050, there is no doubt that the government's Net Zero targets provide a challenge and opportunity for the construction industry. Progress is being made on legislation and standards, designers are producing innovative ideas, manufacturers are advancing the technologies and building owners and end users are pushing for solutions.

By working together, we will see the built environment transformed in the coming years and there is no doubt that heat pumps and other innovative heating and cooling solutions will provide part of the decarbonisation required in our society.

Despite the challenges, it's an exciting time with abundant opportunity.

ABOUT KOOLTECH

At Kooltech, we specify, modify, engineer, design, support and supply heating, ventilation, air conditioning and refrigeration equipment, components, gas and tools. Built around our customers, we challenge the status quo in the HVAC+R industry, by thinking outside the box. We can do this, as we have the in-house expertise and facilities, with our K-con R&D division and factory and our Kooltech Applied department specialising in decarbonisation and sustainability heat pump projects, domestic, commercial and industrial.

We have a long-standing partnership with Mitsubishi Electric spanning over three decades, which provides us with unparalleled access to industry-leading products. As the UK's only exclusive Mitsubishi Electric distributor we bring exceptional technical expertise across their entire product range.

Beyond distribution

We enhance Mitsubishi Electric HVAC systems through our K-con modifications and bespoke solutions, ensuring seamless integration and optimised efficiency. All designed and manufactured to meet stringent CE certification and ISO standards, guaranteeing quality and compliance.

Claim your CPD certificate

Once you have read this paper, you can request your CPD certificate for 30 minuets by, emailing appliedmarketing@kooltech.co.uk, subject CPD Net Zero White paper, with your name, company name and the date that you read the paper. We will email your PDF certificate by return.

CPD CERTIFIED
The CPD Certification Service

References

1. https://www.gov.uk/government/news/uk-becomes-firstmajor-economy-to-pass-net-zero-emissions-law
2. https://www.theccc.org.uk/publication/2023-progressreport-to-parliament/
3. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1044598/6.7408_BEIS_Clean_Heat_Heat___Buildings_Strategy_Stage_2_v5_WEB.pdf
4. https://www.england.nhs.uk/greenernhs/a-net-zero-nhs/
5. https://letsgozero.org/
6. https://www.gov.uk/guidance/non-domestic-privaterented-property-minimum-energy-efficiency-standardlandlord-guidance
7. https://pdf.euro.savills.co.uk/uk/rural---other/spotlight---real-estate-and-the-carbon-challenge.pdf
8. https://landingpage.bsigroup.com/LandingPage/Series?UPI=BS%20EN%2014511
9.https://knowledge.bsigroup.com/products/air-conditioners-liquid-chilling-packages-and-heat-pumps-with-electrically-driven-compressors-for-space-heating-and-cooling-commercial-and-process-cooling-testing-and-rating-at-part-load-conditions-and-calculation-of-seasonal-performance
11. https://www.nzcbuildings.co.uk/pilotversion
12. https://www.gov.uk/government/publications/public-sector-decarbonisation-scheme-phase-4
13. https://www.gov.uk/government/news/18-billion-awarded-to-boost-energy-efficiency-and-cut-emissions-of-homes-and-public-buildings-across-england
14. https://www.gov.uk/apply-boiler-upgrade-scheme
15. https://www.bbc.co.uk/news/business-64636384

Est 1979

BESA AFFILIATE

QUALITY CERTIFIED iso 9001 isoassured

ENVIRONMENTAL CERTIFIED iso 14001 isoassured

SAFETY CERTIFIED iso OHSAS 18001 isoassured

Head Office: Strathaird, 12 Mossland Road, Hillington Park, Glasgow, G52 4XZ
Tel 0345 034 4180

appliedsupport@kooltech.co.uk

www.kooltech.co.uk

#KEEPITKOOLTECH