The Mitsubishi Electric guide to:

Energy Efficiency and Net Zero for University Estates

Guide

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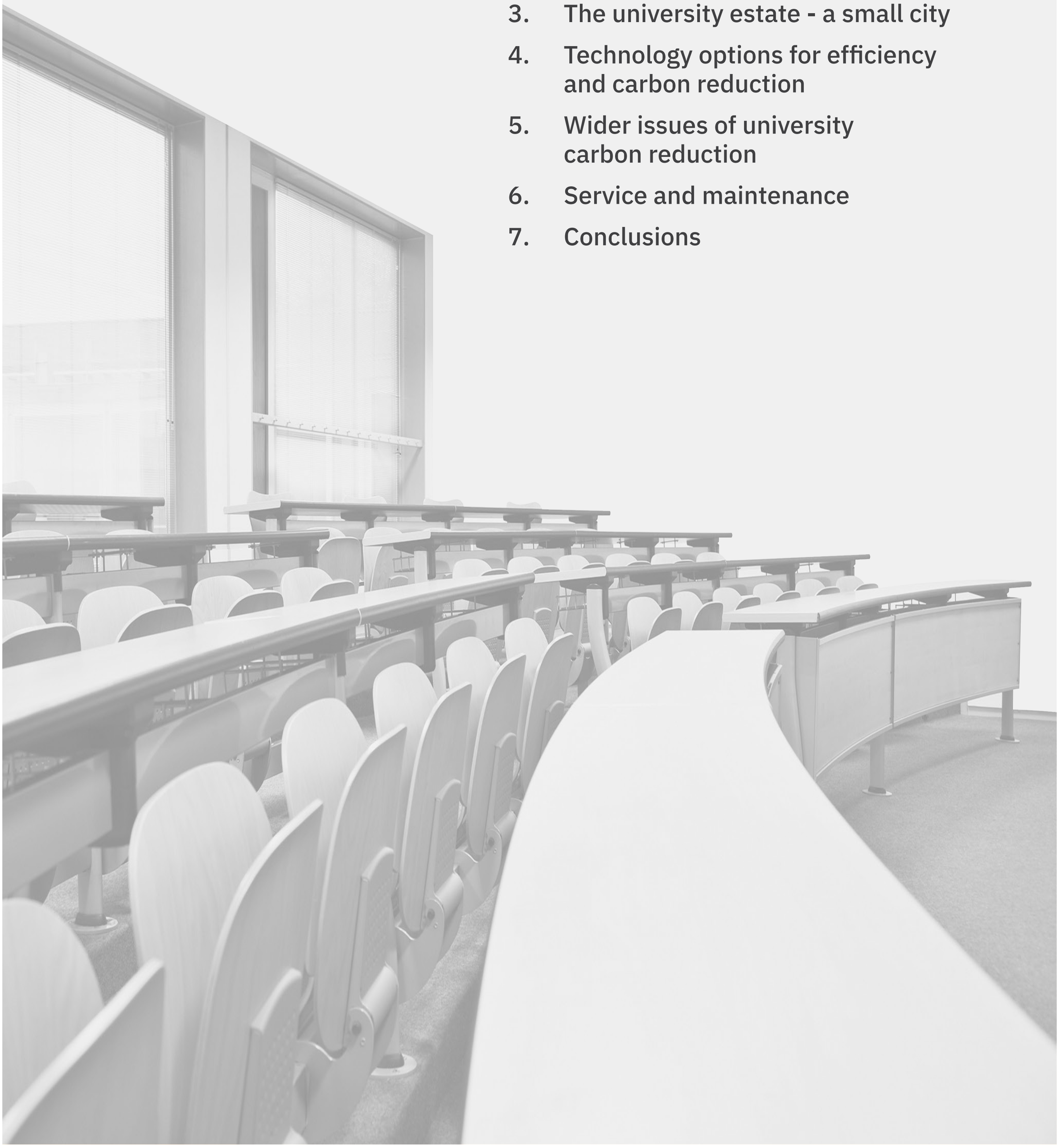

Introduction

There are approximately 150 universities in the UK, and the total university estate in the UK in 2023 amounts to approximately 21.4 million m^2, **an increase of around 2.5% from the previous year[1].**

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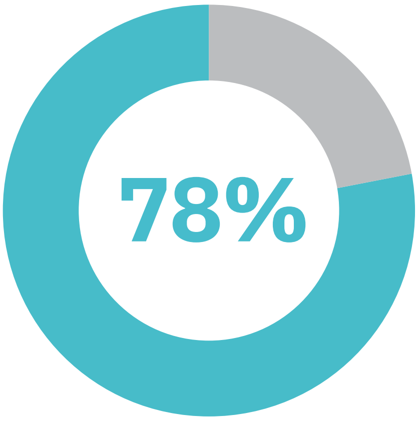


Universities have been taking the lead on setting Net Zero goals for some time. Universities UK[2], representing 140 UK universities, notes its members have committed to setting targets for scope 1 and 2 emissions reductions. These would align with the government targets of a 78% reduction by 2035 and Net Zero by 2050.

However, many universities have gone beyond those targets. For example, Reading University[3] and Cardiff Metropolitan University[4] have committed to achieving Net Zero by 2030 and are not alone among universities in setting challenging targets for themselves. The ambitions of the higher education sector are primarily driven by its main customers: young people. The organisation Students Organising for Sustainability (SOS) takes an annual survey of around 8,500 UK students. Its latest study (2021 - 2022) says[5] that since 2010, 80% of students want their university to do more on sustainable development. And 88% agreed: “Their place of study should actively incorporate and promote sustainable development.”

Scope 1, 2 and 3 emissions

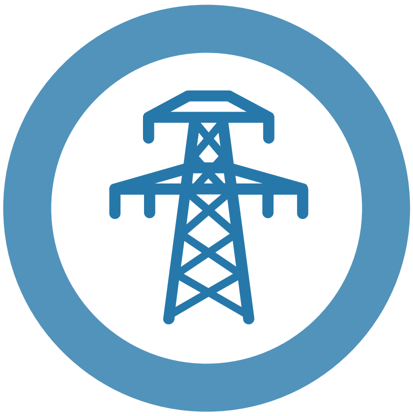
Under the International Greenhouse Gas Protocol, greenhouse gas emissions are placed into three groups (or ‘Scopes’).

Scope 1:

Direct emissions from owned or controlled sources (e.g. fuel combustion; company vehicles

Scope 2:

Indirect emissions from generation of purchased electricity, heat, cooling or steam consumed by the ‘reporting company’



Scope 3:

All other indirect emissions that occur along a company’s supply chain, e.g. purchased goods and services; employee commuting; business travel, investments.

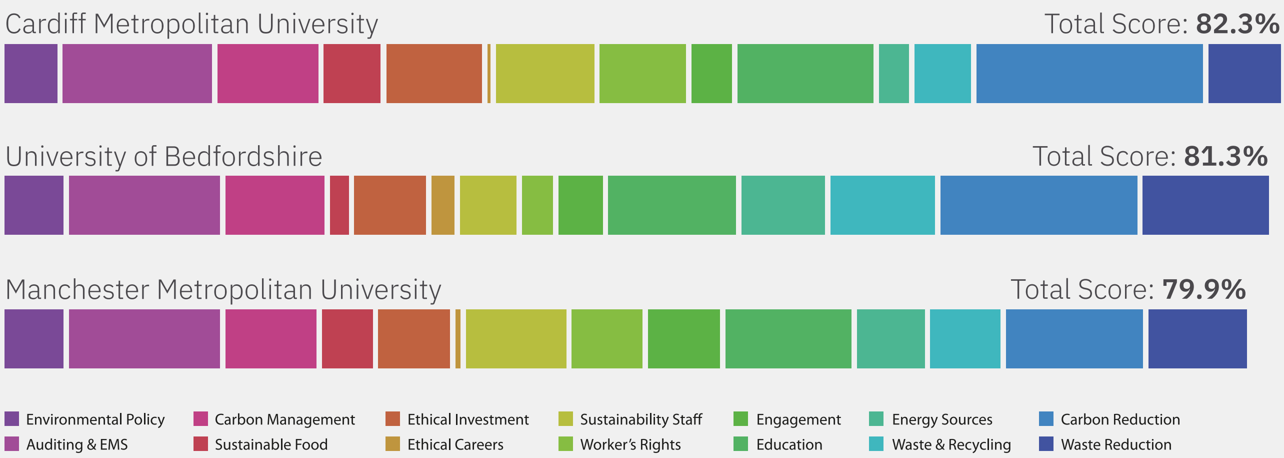
There is a growing trend among the younger generation to see sustainability as something which is not a separate pursuit but something which should run through all university courses - and be demonstrated through a sustainable campus.

The organisation People & Planet[6] provides a league table of 153 universities ranked by sustainability related issues such as environmental policy, energy sources used, carbon management, and environmental auditing and management systems. The top three in 2023 are Cardiff Metropolitan University, University of Bedfordshire, and Manchester Metropolitan University.

As universities focus closely on sustainability, energy efficiency and carbon reduction, buildings across UK campuses must be designed with these issues in mind - or refurbished to meet new standards. This guide looks at the scale of this challenge and highlights some technologies that can help deliver low-carbon campuses and indoor environments that support the health and wellbeing of students and staff.

With so many building types to consider on a university campus and with tight maintenance schedules, it may be tempting to update equipment with a like-for-like approach. However, by considering the technologies available and working with expert advisors, it is possible to deliver better building and system energy performance, lower carbon and improved indoor environments for occupants.

1st Class Universities



Source: **peopleandplanet.org/university-league**

Factors to consider on the journey to low-carbon university buildings

With low-carbon and energy efficient university buildings as the focus, there are several important considerations for estate engineering and facilities teams.

These will influence decisions about technology options which will provide the most effective solutions and help to **achieve carbon reduction targets for the university.**

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There are also external factors to bear in mind, such as government policies and funding which may be available to assist with the adoption of some types of low-carbon technology.

Building age and condition

University buildings differ widely in age across the country and often across campuses. Figures highlighted in a blog from Jane White, executive director of the Association of University Directors of Estates (AUDE)[7] show a mix of construction dates reflecting higher education's growth over the decades. Around 20% of the university estate was built before 1914, and this group includes some historical and listed buildings.

While older estate requires specialist care and maintenance, they may not necessarily be the most challenging in terms of maintaining performance. The largest portion of the estate (32%) was built during the university growth boom of the 1960s and 1970s. As noted by White: "When estates teams measure Quality (as a KPI indicator), it may well be buildings from this period that are most likely to give them indigestion."

Of course, the past two decades have also seen new university buildings spring up, representing around 25% of the UK's estate. Many of these new facilities have been designed for low embodied and operational carbon along with energy efficiency. Several are exemplars of best practice in this area. However, modern buildings can come with their own challenges, as White also highlighted: "New buildings tend to be more energy efficient than older ones, but that very efficiency means they also tend to be used for longer hours, leading to an overall increase in energy use."

When looking to adopt low-carbon technologies in existing university buildings, the issue of performance needs to be considered. For example, it is important to consider current insulation levels and even the practicalities of finding space for new equipment in existing plant rooms.

Decarbonising heating and hot water

One of the UK government's main goals is to move all UK buildings away from a reliance on fossil fuels such as natural gas for heating and hot water[8]. Decarbonising these systems is a critical requirement to meet the national target of Net Zero by 2050.

Many universities are also joining the campaign to divest all financial investments in fossil fuel-related industries. People & Planet notes that over 100 have already done this[9]. It makes sense therefore to remove fossil fuels from campuses too.

Many existing UK university buildings rely on gas boiler systems to provide heating and hot water across campus from main buildings to student accommodation. A key consideration for university engineering and FM teams is therefore shifting from gas boilers to alternative approaches (heat pumps, for example). A successful transition requires investment and expertise. Fortunately, government grants are available to higher education institutions to help them access consultancy advice and purchase equipment.

Occupant wellbeing and experience

The university sector is competitive, with domestic and international students facing a considerable choice of institutions. Attracting the best of them means providing attractive campuses and working and living spaces that support healthy and productive lifestyles.

A modern university campus is highly likely to include **leisure and sports facilities, student accommodation, advanced laboratories,** and **advanced IT facilities** - as well as the usual **lecture theatres, breakout rooms, libraries** and **meeting spaces.**

From a building services perspective, this mix of spaces challenges university engineering teams to deliver comfortable indoor environments, which often operate for long hours. Indoor air quality is essential in our post-Covid world, **so ventilation in domestic and teaching spaces must be balanced with energy efficiency.**

Funding availability

University facilities and engineering teams are often on tight budgets, which are allocated to ongoing maintenance work. So, finding funding sources for new projects and updates can make all the difference when it comes to achieving ambitious targets.

The list below is not exhaustive, and it is essential to bear in mind that schemes can open and close quickly if grant funds are allocated rapidly - Salix funding is a case in point. Therefore, if your university has an update in mind for which you would like to seek funding, it is a good idea to check out the requirements of these schemes and gather data for the application process as soon as possible.

Public Sector Decarbonisation Scheme (PSDS)

(operated by Salix and often referred to as the 'Salix scheme)

Provides grants for public sector bodies to fund heat decarbonisation and energy efficient projects.

Phase 3c of the PSDS should open in October 2023. However, it is a good idea to check on what information is required for an application as this is a very popular grant scheme which has historically had a short window for applications: Phase 3b of the scheme opened and closed in October 2022 because its grant threshold was reached so quickly.

Green Heat Network Fund (BEIS)

Opened in March 2022 with quarterly rounds of funding until 2025.
£288 million capital grants available for constructing new low- and zero-carbon heat networks.
This includes the expansion and retrofitting of existing heat networks.

Heat Network Efficiency Scheme (HNES)

HNES provides funding for improvements to poorly-performing heat networks.

Strategic Innovation Fund (Ofgem and Innovate UK)

Launched in 2021 with rounds of funding available to 2026 with the possibility for an extension. Currently has a fund of £450 million, which may increase. Supports network innovation that contributes to the achievement of Net Zero.

Research England Development (RED) **Fund**

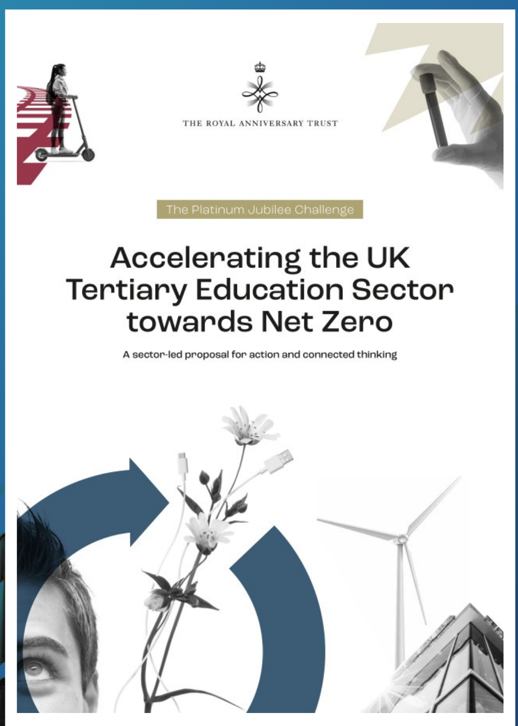
Launched in September 2020 and is ongoing. The fund has an annual budget of £27 million which supports the delivery of the UK's Industrial Strategy through knowledge exchange. The fund has backed energy related projects, including at universities, where sustainable technologies are being demonstrated.

The university estate - a small city

In 2023, the Royal Anniversary Trust[10] launched its report **Accelerating to Net Zero.**

The report comes from a year-long research project (The Platinum Jubilee Challenge) led by 21 higher and further education institutes from across the UK.

This document sets out a proposed pathway for universities to achieve carbon emissions reductions. The report highlights current figures on energy use and emissions from UK universities. Tertiary education sector (all education for over-18s) emissions across Scope 1, 2 and 3 are 18.1 million tonnes CO_2e (carbon dioxide equivalent).



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Universities account for 86% of that figure, of which 19% is produced by its built environment using fuel on-site (e.g., natural gas) and electricity. According to figures from the recent AUDE report[11] on UK universities, carbon emissions from the total estate in 2022 averaged 55.1 kg CO_2/m^2, up from 54.6 kg CO_2/m^2 in the previous year.

AUDE research also shows that the total energy expenditure for the sector is £379 million, which represents 18% of total property costs - just behind the £661 million (32%) for repairs and maintenance.

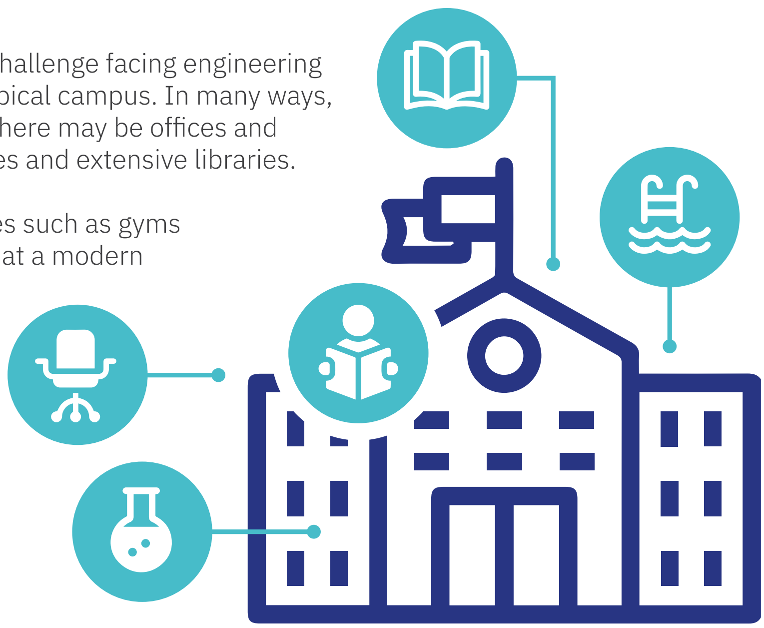
The Trust report highlights a new Standardised Carbon Emissions Framework (SCEF)[12] which provides a unified approach to measuring progress across the entire UK university estate. The SCEF was created by EAUC (The Alliance for Sustainability Leadership in Education) working alongside the Royal Anniversary Trust.

A further issue is that the rising energy costs facing the UK impact universities as much as every other sector. This concerns universities directly, adding to their total estate operation costs, and affects students who face rising living costs. Optimising the energy efficiency of all buildings on campus, including accommodation, is therefore a high priority.

This highlights another important point about the challenge facing engineering and facilities teams: the variety of buildings on a typical campus. In many ways, the modern university campus is like a small city. There may be offices and facilities for teaching, but also specialist laboratories and extensive libraries.

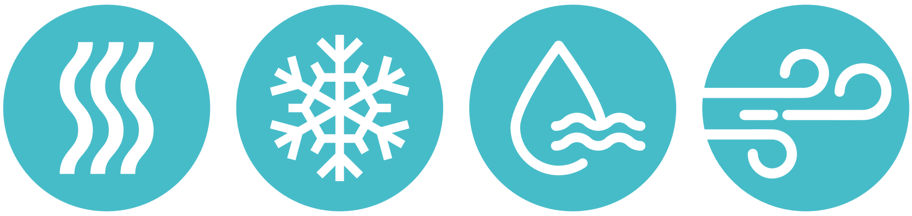
Student accommodation is found alongside facilities such as gyms and swimming pools. It is also increasingly likely that a modern university will have data centre facilities on-site.

> Each building type has its requirements for heating, hot water and cooling. They will have different occupation and usage patterns. And each must be considered against the backdrop of opportunities for optimising energy use and applying low-carbon solutions wherever possible.



The University Estate - a range of challenges

Building Type	Building Services Requirements	Energy and Carbon Impacts
Office buildings: for administrative and teaching staff	■ Heating and cooling requirements ■ Domestic hot water ■ Ventilation and IAQ considerations	■ Impact of simultaneous heating and cooling needs on energy use ■ Balancing occupant comfort with ventilation needs ■ Use of gas boilers for DHW needs - carbon emissions
Lecture theatres	■ Heating and cooling requirements ■ Ventilation and IAQ considerations (especially post-Covid)	■ Delivering heating and cooling to large spaces can be energy intensive ■ Ventilating large spaces for good IAQ can result in energy loss
Leisure centres - campus gymnasium, indoor sports facilities, swimming pools	■ High hot water requirements ■ Heating and cooling requirements ■ Ventilation and IAQ needs	■ Hot water may be provided by gas boilers - carbon emissions ■ High energy use due to large spaces
Data centres - storage of university data; serving all departments; possible IT specialists working at the campus	■ Cooling requirements for data centres	■ High energy use ■ Robust delivery of cooling to avoid hazards of overheating



Building Type	Building Services Requirements	Energy and Carbon Impacts
Student accommodation	■ Heating requirements - possibly also cooling ■ Domestic hot water provision ■ Management of comfort and efficiency	■ Delivery of hot water on demand 24-7 ■ Gas boilers - carbon emissions ■ Control of energy use challenging in multiple dwellings
Libraries / studios	■ Heating and cooling requirements ■ Ventilation and indoor air quality considerations (particularly post-Covid) ■ Noise issues from operation of HVAC equipment	■ Delivering heating and cooling to large open spaces can be energy intensive ■ Ventilating large spaces for good IAQ can also result in energy loss
Student communal areas e.g. bars, canteens, event spaces	■ Heating and cooling requirements ■ High hot water requirements ■ Ventilation and IAQ considerations (particularly post-Covid)	■ Delivering heating and cooling to large open spaces can be energy intensive ■ High energy use for DHW production in kitchens ■ Ventilating large spaces for good IAQ can result in energy loss
On-campus convenience stores	■ Heating and cooling requirements	■ High energy use

Technology options for efficiency and carbon reduction

Building services technology available today can help university engineering teams address these issues by **delivering energy efficient solutions and, in some cases, low-carbon options.**

Heat Pumps

The UK government has committed to installing **600,000 heat pumps in homes and other buildings each year by 2028**, because they are seen as an essential technology for the future of a fossil-fuel-free UK.

The benefit of heat pump technology is that it can be applied to a wide range of buildings, from leisure centres to offices and student accommodation. The Public Sector Decarbonisation Scheme has supported many heat pump installations, so it is a technology which may be within reach of university estates' budgets with support.

Modern heat pumps can provide a viable alternative to gas boilers, including the provision of high-temperature water at volume as well as heating at scale, from domestic requirements to offices and larger spaces. Air-to-air heat pumps can also provide energy efficient cooling.

Mitsubishi Electric has been developing its heat pump technologies for many years and offers a range of market-leading low-carbon solutions. For example, the **Ecodan CAHV air source heat pump (ASHP)** provides space heating and sanitary hot water, with flow temperatures from 24ºC to 70ºC. The CAHV uses low-GWP refrigerant (R454C) and can operate as a single system or in a multi-unit set-up. This makes it a scalable solution that can be applied across a range of buildings.

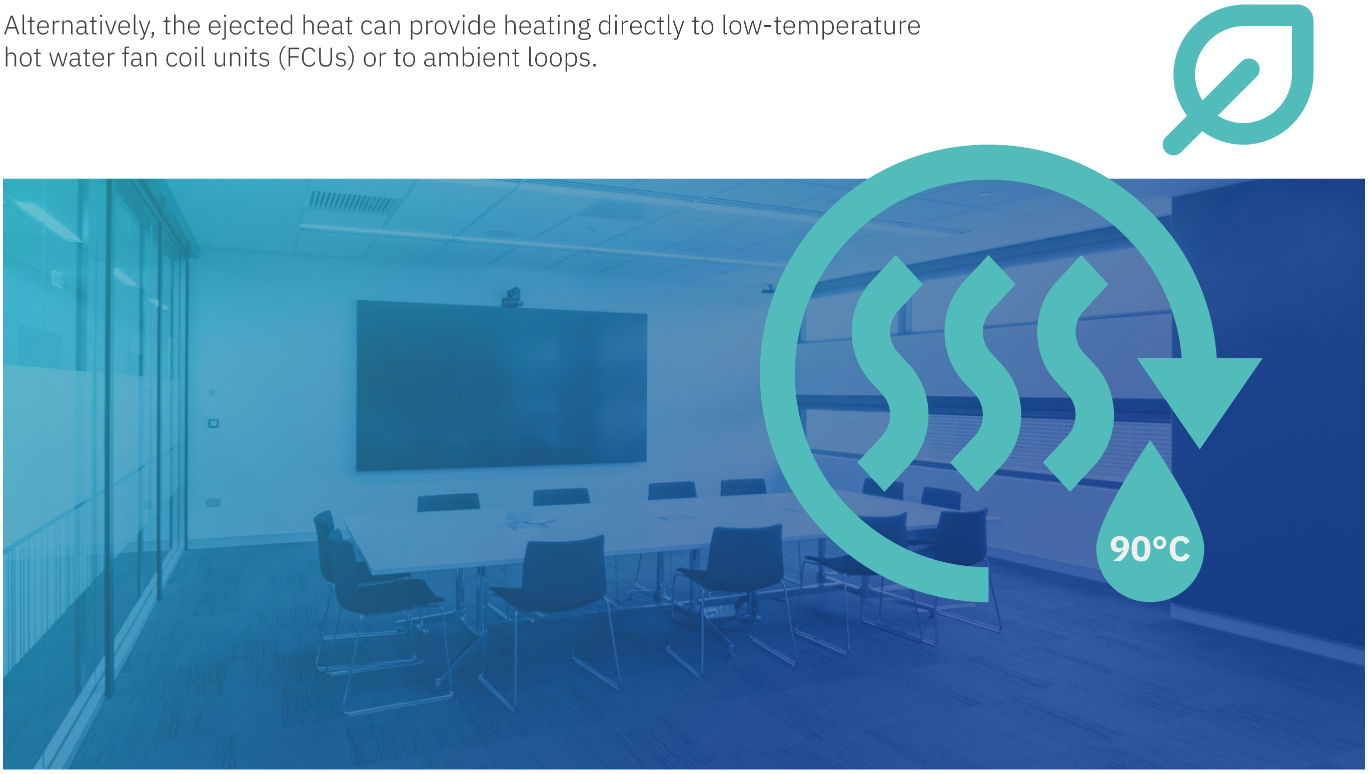
A further benefit of using multiple units is that they can operate rotationally, based on accumulated run hours, helping to extend product life. The CAHV is a monobloc design that is hermetically sealed, needing only water and electrical connections for easy installation and low maintenance.

Another Mitsubishi Electric heat pump is the **Ecodan QAHV Monobloc air source heat pump which can produce water up to 90ºC**. Not only does this heat pump system provide high efficiency at high flow temperatures, but it also uses CO_2 as a refrigerant - with a GWP of just 1. Moreover, with super-low noise levels, the Ecodan QAHV is also an excellent low-carbon hot water solution for buildings close to residential areas, which can be helpful for city-centre university campuses.

The ability of heat pumps to transform low-temperature heat into high-temperature outputs can be harnessed in other ways. For example, an air source heat pump can be used to produce low-temperature water (25ºC to 55ºC), which provides the energy for a water source heat pump (WSHP) that produces high-temperature hot water of 75ºC and above.

This concept is applied in Mitsubishi Electric's Integra range of 4-pipe heat recovery chillers. In this system, chillers can provide cooling to the building, while the rejected heat is used as an energy source, for example, to supply Mitsubishi Electric's EW-HT water-to-water heat pump and produce hot water up to 78ºC.

Alternatively, the ejected heat can provide heating directly to low-temperature hot water fan coil units (FCUs) or to ambient loops.



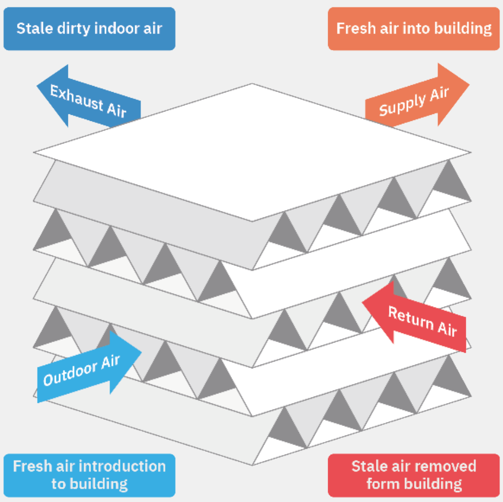
Mechanical Ventilation with Heat Recovery (MVHR)

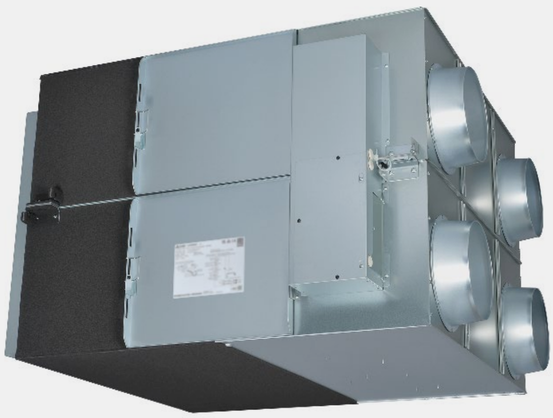
Commercial and domestic solutions are available to provide predictable, controllable ventilation in a range of spaces to deliver occupant comfort, and good IAQ with energy efficiency.

But in pursuing better indoor environments, higher ventilation rates per person and per square metre of floor area can mean greater energy use. **Mitsubishi Electric's Lossnay MVHR units can recover up to 90% of heat energy while delivering localised ventilation**. This is particularly important for universities, where extraction of indoor pollutants and viruses is critical for occupant wellbeing and reassurance. It is a technology that Mitsubishi Electric has offered for many years and has evolved to provide outstanding ventilation and filtration performance along with energy efficiency.

Lossnay Core

Mitsubishi Electric's Lossnay uses a hyper-efficient core made from specially processed paper, separating the inlet and exhaust air supplies entirely. The corrugated core is layered in alternating directions, creating a cross airflow to maximise heat recovery - without allowing the two air flows to mix. As stale air is extracted from a building, heat energy is recovered through the paper core and transferred to the incoming air. The core enables the exchange of both latent heat (humidity and moisture) and sensible heat (temperature) to maintain a comfortable internal environment with minimal energy consumption. The Lossnay range of units is available for domestic and commercial projects.



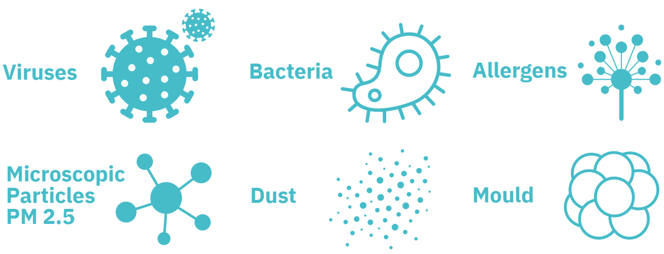


LGH RVX3-E
Commercial Lossnay

Plasma Quad Connect air purifier

Mitsubishi Electric's latest filtration technology is the Plasma Quad Connect which can be fitted to new and existing air conditioning units across the RAC (Room Air Conditioning), PAC (Packaged Air Conditioning) and VRF systems. This includes the M Series, Mr Slim and City Multi ranges.

Plasma Quad Connect works like an electrical curtain to catch and neutralise even microscopic particles in the air, significantly improving indoor air quality. The technology has also been independently tested and inhibits 99.8% of SARS-CoV-2, as well as being effective against microscopic particles down to PM2.5*.



*Derived from and subject to test results, for and on behalf of Mitsubishi Electric, conducted at the Microbial Testing Laboratory, Japan Textile Quality and Technology Centre, Kobe, Japan.

Energy Efficient Cooling

Some buildings on university campuses require cooling, which can be a significant energy user. Applying the latest Variable Refrigerant Flow (VRF) solutions can save energy and deliver better comfort levels for occupants. This is an excellent solution for buildings with cooling and heating requirements but less need for hot water, such as offices or classrooms.

The VRF solution can be a practical option for decarbonising heating in buildings where it may not be possible to use a heat pump to replace a gas boiler. VRF systems have a small footprint and offer a scalable solution that can be installed in phases (for example, floor-by-floor). This can be particularly useful when a building is undergoing a change of use. Adding energy-efficient cooling capability with VRF can also provide improved indoor environments for occupants.

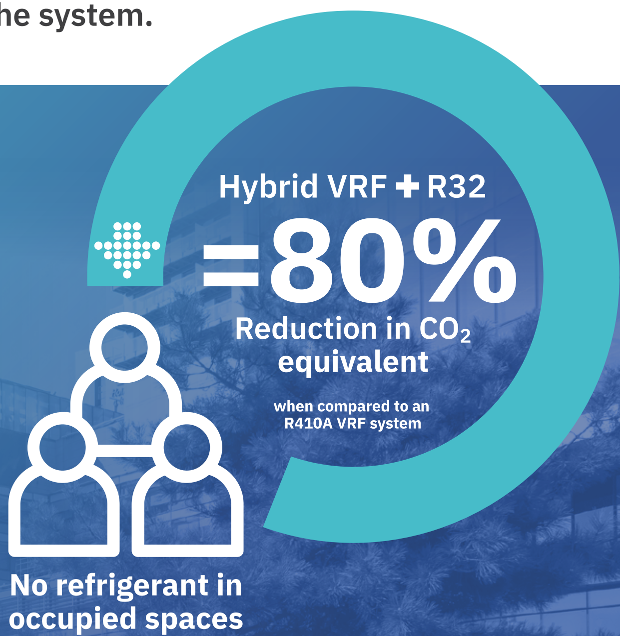
With a focus on building carbon emissions in mind, using low GWP (global warming potential) in cooling systems is a sensible option. Mitsubishi Electric has developed a Hybrid VRF (HVRF) system which uses lower GWP R32 refrigerant. HVRF also minimises the total amount of refrigerant because it uses water as the medium for transferring cooling (or heating) into the space. This removes the need for and cost of leak detection.

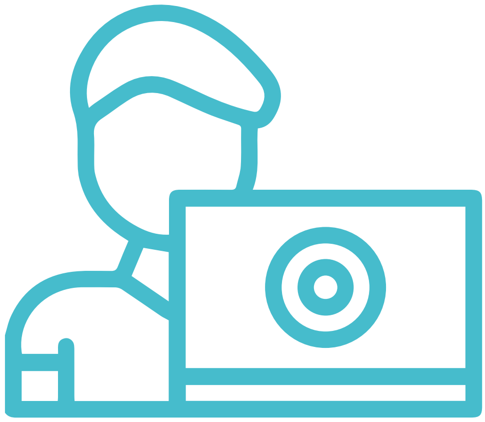
This reduces the overall carbon footprint of the system.

R32 Refrigerant

Using R32 in occupied spaces requires the installation of leakage detection systems since the refrigerant is ‘mildly flammable’.

However, because HVRF does not place refrigerant in occupied spaces, no capital expenditure is required for leak detectors and installation time is also reduced.



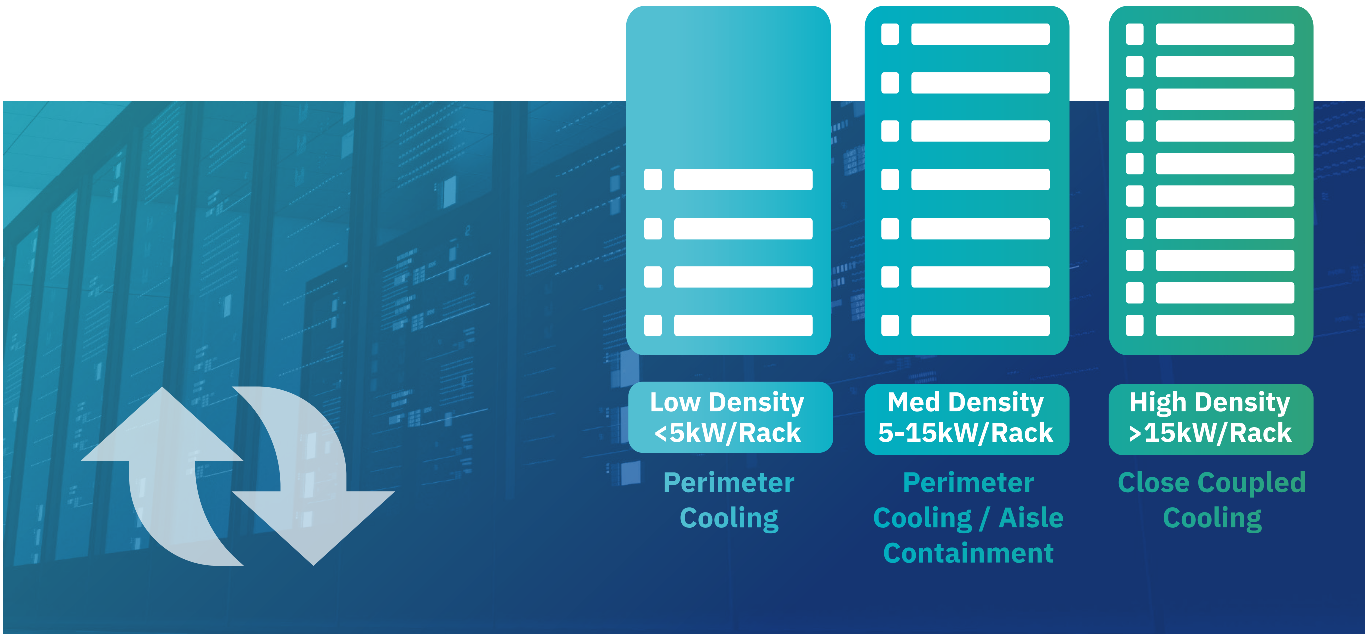


Specialist IT Cooling

Today's education system relies heavily on IT capabilities. Undergraduates and post-graduate researchers rely on 24-7 access to systems, increasingly so if they are working remotely.

As a result, university engineering teams may find themselves managing the cooling needs of on-site data centres. These may be small buildings, but they provide mission-critical services across the campus, where there is no room for failure. One of the main factors data centre managers must contend with is cooling. After the IT load, this is the most significant energy user in the building. Density is the factor to consider when looking at cooling options for data centres. This refers to the cooling power required to remove heat produced by the IT equipment. For IT cooling applications where the cooling power needed in a single rack is less than 5kW, this would be described as low density. Medium density indicates a required cooling power between 5kW and 15kW; high density refers to a cooling power of more than 15kW.

More IT equipment in a space makes cooling more challenging. For example, in low-density applications, it is possible to maintain temperatures in the rack by controlling the overall room temperature. The most common solution is perimeter cooling. However, as the density of racks increases, the risk of localised hot spots in a space grows. These can lead to failure if they get out of hand. Localised cooling is needed closer to the racks to lower this risk. In-row or rear-door coolers bring the conditioned air right up to the server inlet - commonly called close-coupled air conditioning.



Mitsubishi Electric has extensive experience working across the data centre sector, providing innovative solutions for a fast-moving industry. We have worked closely with data centre clients to develop solutions ranging from small to large capacity centres. For example, our in-row solution for high-density data centres is the Multi-Density with variable refrigerant flow (VRF). It combines the simplicity of a VRF solution with the high performance needed for a close-coupled cooling solution. It is also intended to be easy to install as a plug-and-play product.

In smaller-scale data centres, the Mitsubishi Electric high precision **s-MEXT** unit is the ideal solution where splits don't meet the project cooling requirements. The s-MEXT package consists of a high-precision air conditioner that provides 6kW to 42kW cooling capacity connected to Mitsubishi Electric's Mr Slim Power Inverter outdoor unit. The system is designed as a packaged solution for quick and efficient delivery with a small space-saving footprint.

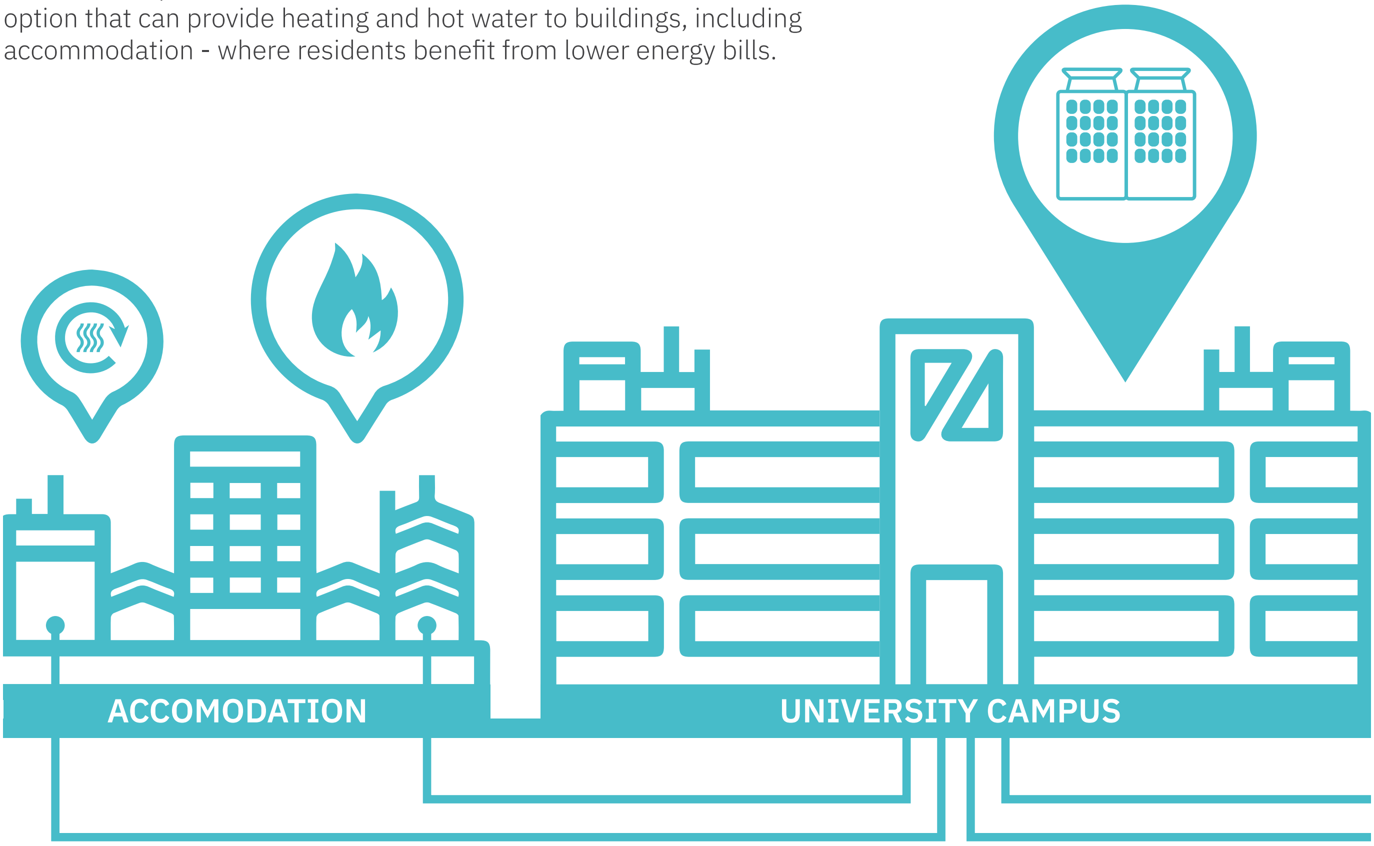
The **x-MEXT DX** provides a further range of cooling capabilities, from 30kW to 129kW; and the w-MEXT offers 5kW to 204kW. These systems make it possible to retain constant temperature and humidity, even with strong load variations.

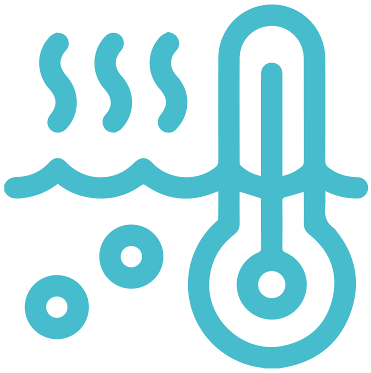
Low temperature heat networks - harnessing waste heat energy

The UK government regards heat networks as another critical technology to decarbonise the country's heating. As a result, several grant schemes exist to help set up new heat networks or to upgrade existing ones.

Heat networks can be particularly suitable for campus universities since they can deliver low-carbon heating to several buildings, including student accommodation. However, older heat networks may use gas boilers as the source of energy - making them unsuitable for universities looking to decarbonise their buildings.

But if the heat is produced using a low-carbon source, such as a heat pump, the option has even more benefits. Heat network technology has evolved and now low-temperature or 'ambient' heat networks are a more sustainable option that can provide heating and hot water to buildings, including accommodation - where residents benefit from lower energy bills.





Rather than using an energy centre that pushes out the heat, ambient heat networks (or heat loops, as they are also known) circulate low-temperature water around an ambient energy loop. Temperatures are between 10ºC and 30ºC. Each building or apartment on the loop has a heat pump which produces domestic hot water and space heating.

The benefit of this approach is that the loop can be a heat source or a heat sink. In mixed-use campuses, heat ejected from cooling systems in data centres, for example, can be absorbed back into the loop to provide heating elsewhere on the network. The loop is therefore a balancing system, with heat pumps ensuring that temperatures are always maintained. The low-temperature approach also eliminates distribution heat losses and overheating in buildings, often seen in traditional heat networks. And the ability to use heat recovery enhances energy efficiency and carbon savings further.

Mitsubishi Electric views ambient loops as a crucial low-carbon heating technology. Our range of heat pump technology includes Ecodan Hydrodan, a water-to-water heat pump specifically designed for ambient loops - built to fit into modern apartments, easy to install and maintain and very quiet in operation. And, as mentioned earlier in this Guide, the EW-HT from Mitsubishi Electric can also be linked to an air-to-air heat pump system to capture ‘waste’ heat which can be applied in an ambient loop system.

EW-HT
Water to Water
Heat Hump

Controls and Monitoring

An essential aspect of energy efficiency in any building is to control the building services equipment. For example, modern control systems offer practical solutions for small meeting rooms. On a larger scale, controls for building services can be linked to the university building energy management system (BEMS) to provide a campus-wide view of operation and energy use. Controls can also monitor energy use and provide useful data and reporting to the engineering team.

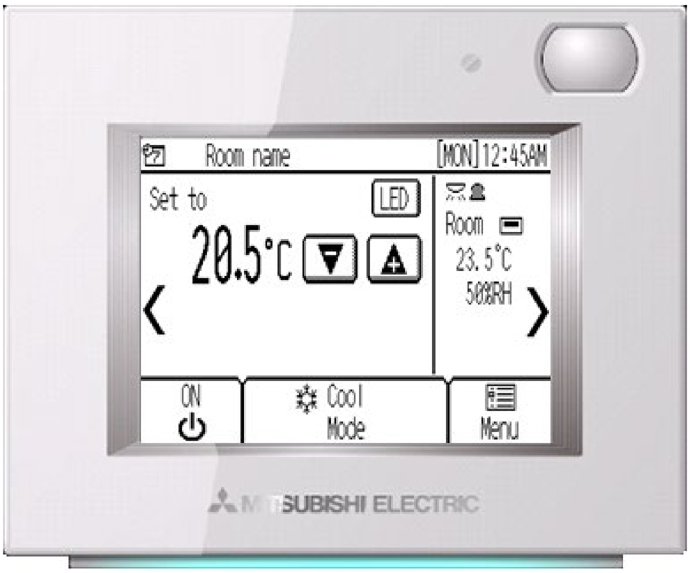
As hybrid working becomes more common across all sectors, occupancy patterns change. More universities are realising that heating or cooling in empty spaces is costly. Monitoring and control technology can help avoid this problem by providing a demand-based approach that ensures systems only run when needed. Technology such as PIR (passive infrared) room sensors can switch systems such as cooling on or off based on room occupancy sensor feedback. This reduces the need for occupants to touch control panels (helping to maintain hygiene) and save energy by switching off cooling in unoccupied spaces.

For example, **Mitsubishi Electric's PAR-UO2MEDA is a backlit touchscreen remote controller with a built-in PIR sensor** that allows the air conditioning to be switched automatically according to room occupancy.

Using an MNET adapter, the controller is compatible with City Multi as standard and the M Series or Mr Slim range.

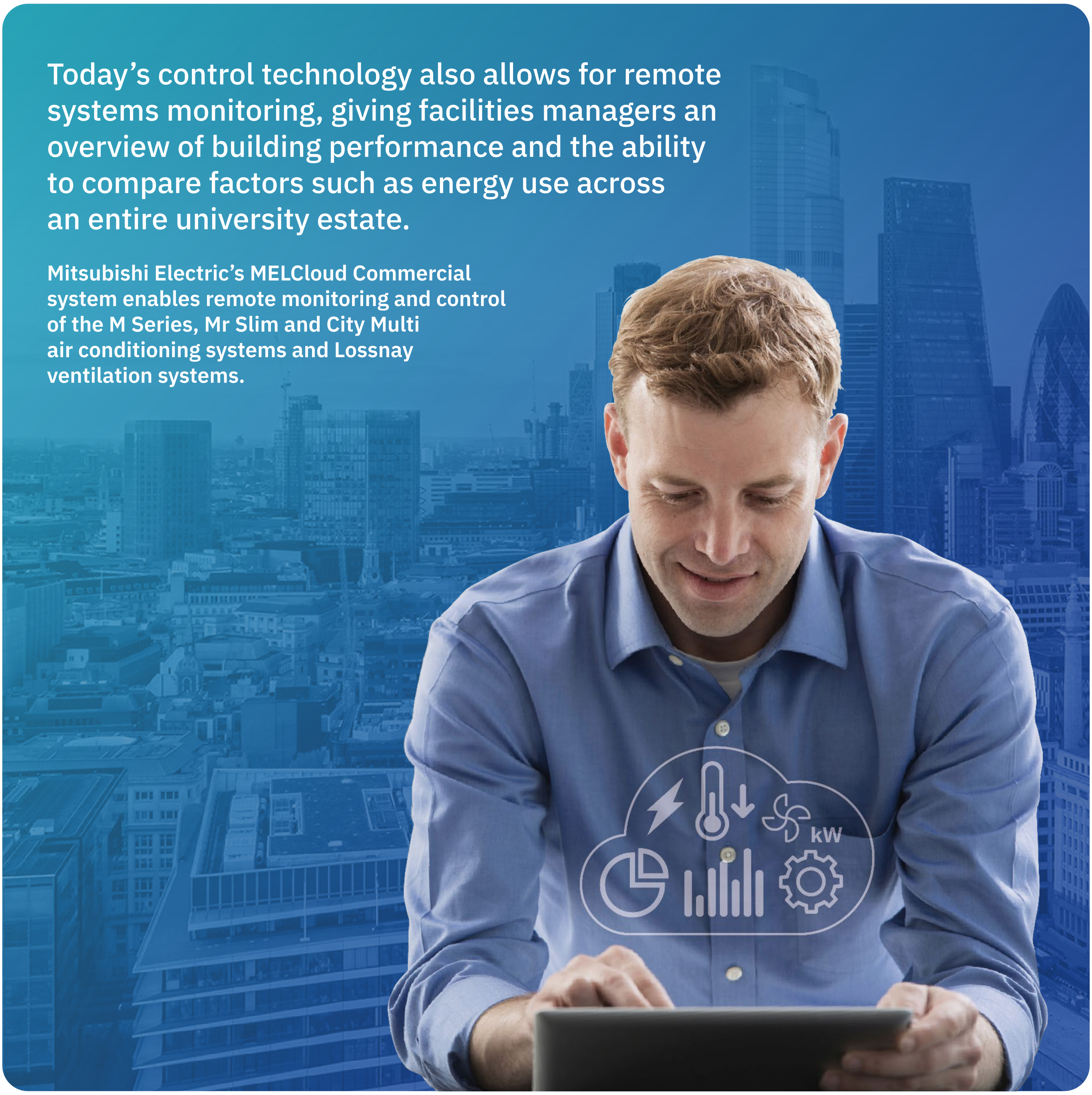
Mitsubishi Electric also offers the 3D i-see Sensor Grille. This is a 360°, highly accurate sensor, which detects human body temperature, provides monitoring of room occupancy as well as position detection.

In addition, the 3D i-See sensor allows for precise demand control of air conditioning in a space - automatically providing excellent comfort levels for occupants while ensuring that the equipment only operates when required. Again, this reduces the need for occupants to touch control panels.



Today’s control technology also allows for remote systems monitoring, giving facilities managers an overview of building performance and the ability to compare factors such as energy use across an entire university estate.

Mitsubishi Electric’s MELCloud Commercial system enables remote monitoring and control of the M Series, Mr Slim and City Multi air conditioning systems and Lossnay ventilation systems.



Wider issues of university carbon reduction

Building services such as heating, cooling and hot water are key considerations in reducing any building's carbon footprint, but there are other areas to consider.

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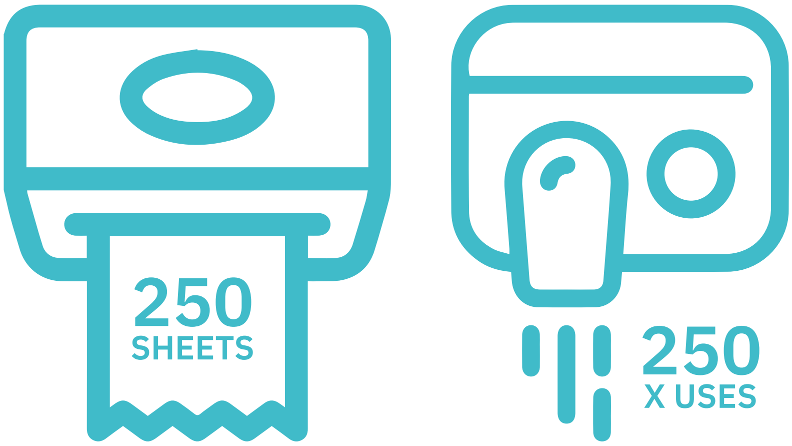
Universities are setting carbon reduction targets beyond their campuses and into their delivery and supply chains. As a result, it's crucial to look at all areas of facilities management for carbon savings. One example is hygiene, particularly in washrooms and toilets where paper towels are used.

Paper towel dispensers are increasingly recognised as having a large carbon footprint. For example, paper towel waste results in 254 million tonnes of landfill every year globally. And for every tonne of paper towels made, 17 trees are cut down.

The carbon impact of paper towel use on campus can be significant. For instance, a paper towel dispenser with 250 uses per day amounts to 1,561kg of CO_2 per year. In addition, paper towel use also includes continuous transportation of the towels to site and removal of waste, both adding to the financial and environmental cost.

By comparison, modern electric hand dryers can provide a hygienic solution with a much smaller carbon impact. For example, the Mitsubishi Electric Wave i01, if used 250 times per day, produces only 82kg of CO_2 annually. This equates to around 0.58kg of CO_2 per use and 5000 dries for £1.



Mitsubishi Electric Wave i01 (Jet Towel)
Once installed, the Wave requires minimal site visits except as part of regular maintenance scheduling. Models available are hands-in (Wave i01) or hands-under (u02). Both are designed for optimum hygiene, with a no-touch design and an antibacterial filter. In addition, Wave i01 has a built-in excess water pod in each dryer which catches water blown from hands so that it doesn't end up on the floor.

Moreover, Wave hand-drying technology is designed for quiet operation. It switches off immediately when not in use, which can be crucial in areas such as libraries and study rooms (see our University of London case study). Hand dryers may seem like the least high-profile, low-carbon technology, but given the extent of university hygiene and toilet facilities, the right choice can make a significant impact. What's more, well-designed hand dryers will contribute directly to the health and wellbeing of staff, students and visitors.

Service and maintenance

Service and maintenance are vital to deliver consistent energy efficient building performance and to enhance the lifetime performance of heating, cooling and hot water systems. **If your university is pursuing these objectives, working with service and maintenance partners who can support your goals is essential.**

6

One of the main reasons to take maintenance to the next level is that today's HVAC equipment is more complex than it was 20 years ago. For instance, a modern chiller or heat pump is a high-performance machine optimised to deliver energy-efficient chilled or heated water to centres or designed to ensure occupant comfort and wellbeing.

Maintenance on this type of equipment is more complex than checking refrigerant levels. Everything from the calibration of temperature and pressure sensors, to compressor operation and heat transfer from exchangers must be regularly checked. Operating conditions should also be logged to ensure correct optimum running efficiencies. Doing this will keep equipment operating within its target parameters for its entire life-cycle.

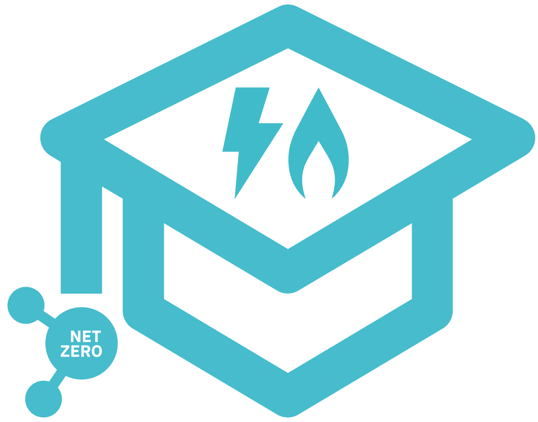
Service and maintenance also have vital roles in ensuring that HVAC equipment stays within its optimum operation, helping to avoid wasteful energy consumption. In addition, regular planned visits can help to maintain energy efficiency levels over time. Mitsubishi Electric's Service and Maintenance teams can support in-house engineering and facilities teams from commissioning to helping plan for equipment replacements.

Our expert engineers provide maintenance fundamentals, such as F Gas inspections and long-term servicing support. It pays dividends in terms of better system performance over its whole life and more value from the investment in HVAC equipment.

However, if the equipment does fail, as a maintenance customer of Mitsubishi Electric, **one of our highly trained engineers can be on-site 24/7, 365 to assist with a breakdown.**

Conclusions

The university sector has recognised the need to accelerate its transition to low-carbon energy sources while ensuring the entire estate is as energy efficient as possible. **The sector is undoubtedly leading the way, and many university engineering teams have set high standards in adopting sustainable technologies and approaches.**



Launching the Standardised Carbon Emissions Framework (SCEF) marks a point where more universities can begin tracking their progress towards net zero using a standardised approach - making comparison and information sharing easier. The Framework is voluntary, but the Anniversary Trust has said that it anticipates higher education and further education institutions will start to monitor existing emissions and adopt the SCEF as soon as possible.

But whatever tool universities want to adopt, their main customer base continues to be students who are highly motivated to drive environmental change. For example, the NUS survey noted that 77% of respondents to its annual survey would take a salary of £1000 less than average to work in a company with a good social and environmental record.

Building services are significant energy users in buildings across the campuses. But modern equipment can provide cost-effective solutions that deliver low-carbon systems and reduce energy waste while providing better indoor environments for staff and students alike. The time invested in working with experts in energy efficient and low-carbon solutions can pay long-term dividends. Mitsubishi Electric can help your in-house facilities and engineer teams spot potential areas for savings you may have yet to consider. And these don't have to be large-scale technologies.

For example, even hand dryers in public toilets across the campus can be significant energy users. Mitsubishi Electric's Wave hand dryers use compact digital motors to produce high-powered air jets to remove moisture quickly and effectively. As a result, hand dryers provide a more environmentally-friendly and hygienic solution than hand towels, which produce more than 250 million tonnes of landfill globally each year and do not always remove bacteria effectively.

77%

of respondents to NUS's annual survey would take a salary of £1000 less than average, to work in a company with a good social and environmental record

OFFICE BUILDINGS
Administrative & teaching staff

Building Services Requirements

- Heating and cooling requirements
- Domestic hot water
- Ventilation and IAQ considerations

Equipment Solutions

Heat pumps are suitable for offices - they can provide heating and cooling and DHW.

Removes requirement for gas boilers - decarbonisation.

MVHR is ideal for office space, and with filtration can provide excellent IAQ.

STUDENT COMMUNAL AREAS
Bars, canteens, event spaces

Building Services Requirements

- Heating and cooling requirements
- Hot water requirements
- Ventilation and IAQ considerations

Equipment Solutions

Heat pumps are suitable for student communal areas and can provide both heating and cooling across the year.

Removes requirement for on-site boilers, helping to decarbonise university buildings.

MVHR is ideal for communal areas and with filtration can provide excellent IAQ.

LEISURE CENTRES
Campus gymnasium, indoor sports facilities, swimming pools

Building Services Requirements

- High hot water requirements
- Heating and cooling requirements
- Ventilation and IAQ needs

Equipment Solutions

Heat pumps can deliver hot water up to 90ºC in buildings which have requirements for hot water at scale.

DATA CENTRES
Storage of university data; serving all departments; possible IT specialists working at the campus

Building Services Requirements

- Cooling requirements for data centres

Equipment Solutions

Specialist cooling to suit the density of the data centre is energy efficient and reduces the risk of overheating.

Waste heat can be re-used in other areas of the campus through ambient heat loops.

STUDENT ACCOMMODATION

Building Services Requirements

- Heating requirements - possibly also cooling
- Domestic hot water provision
- Management of comfort and efficiency

Equipment Solutions

Heat pumps can be provided for accommodation buildings.

Accommodation can use waste heat for heating and hot water needs in student accommodation.

MVHR for domestic spaces is ideal for improving IAQ in living space - and can even be applied in humid areas such as showers and kitchens.

LIBRARY/STUDIOS

Building Services Requirements

- Heating and cooling requirements
- Ventilation and IAQ
- Low breakout noise

Equipment Solutions

Heat pumps are suitable for libraries and can provide both heating and cooling across the year.

Removes requirement for on-site boilers, helping to decarbonise university buildings.

MVHR is ideal for library spaces and with filtration can provide excellent IAQ.

LECTURE THEATRES

Building Services Requirements

- Heating and cooling requirements
- Ventilation and IAQ considerations (especially post-Covid)

Equipment Solutions

Low GWP VRF systems can provide energy efficient cooling.

MVHR can provide ventilation and filtration can be used to deliver excellent IAQ in occupied spaces.

CAMPUS CONVENIENCE STORES

Building Services Requirements

- Heating and cooling requirements

Equipment Solutions

Direct expansion (DX) split systems are suitable to provide heating and cooling of shop areas.

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Green Heat Network Fund
https://www.gov.uk/government/publications/green-heat-network-fund-ghnf

Heat Network Efficiency Scheme
https://www.gov.uk/government/publications/heat-network-efficiency-scheme-hnes

Strategic Innovation Fund
https://www.ofgem.gov.uk/strategic-innovation-fund-sif

Research England Development Fund
https://www.ukri.org/what-we-offer/browse-our-areas-of-investment-and-support/research-england-development-fund/

Case Study

Cardiff University - a chiller upgrade delivering £4,000 annual savings and reduced carbon footprint

Cardiff University needed to replace the ageing chiller cooling on some of its third-floor laboratories. Specialists Cooltherm Wales reverse-engineered the solution. A Mitsubishi Electric e-series, inverter-driven chiller was installed. The result was a smaller carbon footprint for the system and operational savings for the university of £4,000 per year.

One of the challenges was that the original pump in the building had been undersized, which had caused past issues with cooling. The new inverter-driven chiller delivers the correct flow-rate through the system to ensure cooling is optimised for energy efficiency. Another feature that enhances the system's energy efficiency is the e-series soft start of just 8 Amps, compared to a conventional chiller which has an average start current of 180 Amps.

Case Study

University of Salford - its first all-electric building

The development is part of the Salford Crescent and University District's masterplan, which includes developing one million square feet of educational floorspace.

The four-storey, 15,550 square metre Science, Environment and Engineering Building provides space for students working in physics, electronics and other sciences. The building benefits from four Mitsubishi Electric air source heat pumps and one Mitsubishi Electric chiller. Working with Arup from the early design stage, Mitsubishi Electric and Morgan Sindall determined which equipment would best meet the university's energy goals and maintain the optimum temperature for students to work.

The innovative design allows the university to re-use 'waste' heat that would have been expelled to the outdoor air to 'heat' the plant room, where the heat pumps have been installed, to boost the system's overall efficiency. Artificially increasing the temperature of the plant room around the heat pumps adds to the overall efficiency of the system.

Case Study

Durham University - using waste heat with a low-GWP system

The Mathematical Sciences and Computer Science building at Durham University is using Mitsubishi Electric's Hybrid VRF (HVRF) system to provide energy-efficient heating and cooling. The system consists of 8 City Multi HVRF outdoor units and 52 indoor units in the new building, which is designed to BREEAM Excellent standards.

This approach required the need to use low GWP refrigerants. Mitsubishi Electric's HVRF requires smaller amounts of refrigerant than traditional VRF systems and uses lower GWP R32. The system also aligns with Durham University's sustainability goals by providing heat recovery to meet the need for simultaneous heating and cooling around the building. By redistributing waste heat from cooling operations in computer suites to areas in the building where heating is needed, it is possible to achieve energy savings of up to 30% over conventional systems.

Case Study

University College London (UCL) - low GWP air conditioning system with quiet operation

UCL's Division of Biosciences is housed in the Rockefeller Building, a seven-storey building on University Street in London. It houses a centre for leading bioscience research and teaching, with 500 staff and 300 PhD students working there.

A quick and efficient heating and cooling system was needed to meet UCL's environmental requirements. As a result, two M Series MSZ-LN air conditioning units were installed over three days by Artic Building Services and were the first R32 systems within UCL's estate. The short installation period was crucial to ensure minimum disruption to the building's occupants during work.

UCL opted for this system because of the pivotal role R32 refrigerant plays in meeting future legislation and reducing the environmental impact of air conditioning. Another feature that makes the M Series range suitable for UCL is its quiet operation, with noise levels as low as 19dBA, making it ideal for use in a quiet study environment.

Case Study

De Montfort University - optimised indoor environment with energy efficiency

To provide the best possible conditions for study, the University has installed ventilation and air conditioning in some of the rooms within one of its properties, Edith Murphy House.

Consultancy, Mott MacDonald, was tasked by the University to design a system to provide the optimum solution for Edith Murphy House. Engineers selected Mitsubishi Electric's Lossnay Mechanical Ventilation with Heat Recovery (MVHR) system. While basic ventilation systems allow all the energy spent in heating or cooling an interior to be lost as soon as fresh air is introduced to a room, Lossnay MVHR extracts stale pollutant air and introduces fresh, clean air without compromising on internal temperature and humidity.

The provision of good ventilation and air conditioning offers a healthier and more comfortable environment in which to live and work. It also improves people's ability to concentrate. Moreover, the Lossnay system saves energy and operational costs for the University.

Case Study

London University -
finding a quiet and low-carbon solution for library washrooms

Between 2018 and 2020, the University of London transformed the library's interiors at its Institute of Advanced Legal Studies. This major refurbishment included the washrooms, which had not been substantially updated since the building was first completed in the 1970s.

One of the first decisions was to switch from paper towels to electric hand dryers. However, the facilities team soon received complaints from library users that the hand dryers could be heard in the library's quiet reading room space. As a result, the University team replaced the original dryers with Mitsubishi Electric Jet Towel ultra-quiet models. Not only are they much quieter in operation, but they also shut off when the user removes their hands, so no noise enters the library space once the user leaves the washroom.

In addition, the refurbishment project was targeting an SKA Gold rating, a RICS carbon benchmark for sustainability good practice. Andrew Beach, project officer for the transformation project, notes: "In terms of procurement, we needed to find a hand dryer that met our need for quiet operation and the SKA rating requirements. The only one we found that met those two criteria was the Mitsubishi Electric Jet Towel".

MITSUBISHI ELECTRIC
Changes for the Better

Telephone: 01707 282880

Corporate Solutions
telephone 0870 3000070
email corporatesolutions@meuk.mee.com
website: les.mitsubishielectric.co.uk

@meuk_les @green_gateway | Mitsubishi Electric Living Environmental Systems UK | Mitsubishi Electric Cooling and Heating UK | mitsubishielectricuk_les | mitsubishielectric2 | BLOG thehub.mitsubishielectric.co.uk

UNITED KINGDOM Mitsubishi Electric Europe Living Environmental Systems Division
Travellers Lane, Hatfield, Hertfordshire, AL10 8XB, England. Telephone: 01707 282880 Fax: 01707 278881

IRELAND Mitsubishi Electric Europe
Westgate Business Park, Ballymount, Dublin 24, Ireland. Telephone: (01) 419 8800 Fax: (01) 419 8890 International code: (003531)

Note: Refer to 'Installation Manual' and 'Instruction Book' for further 'Technical Information'. The fuse rating is for guidance only and please refer to the relevant databook for detailed specification. It is the responsibility of a qualified electrician/electrical engineer to select the correct cable size and fuse rating based on current regulation and site specific conditions. Mitsubishi Electric's air conditioning equipment and heat pump systems contain a fluorinated greenhouse gas, R410A (GWP:2088), R32 (GWP:675), R407C (GWP:1774), R134a (GWP:1430), R513A (GWP:631), R454B (GWP:466), R1234ze (GWP:7) or R1234yf (GWP:4). *These GWP values are based on Regulation (EU) No 517/2014 from IPCC 4th edition. In case of Regulation (EU) No.626/2011 from IPCC 3rd edition, these are as follows. R410A (GWP:1975), R32 (GWP:550), R407C (GWP:1650) or R134a (GWP:1300).

Effective as of May 2023

Green Gateway
www.greengateway.mitsubishielectric.co.uk
Mitsubishi Electric UK's commitment to the environment

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