MITSUBISHI ELECTRIC

The Mitsubishi Electric guide to:

# Low Carbon Classrooms:

## Refurbishing Heating and Cooling in Schools and Colleges

Guide

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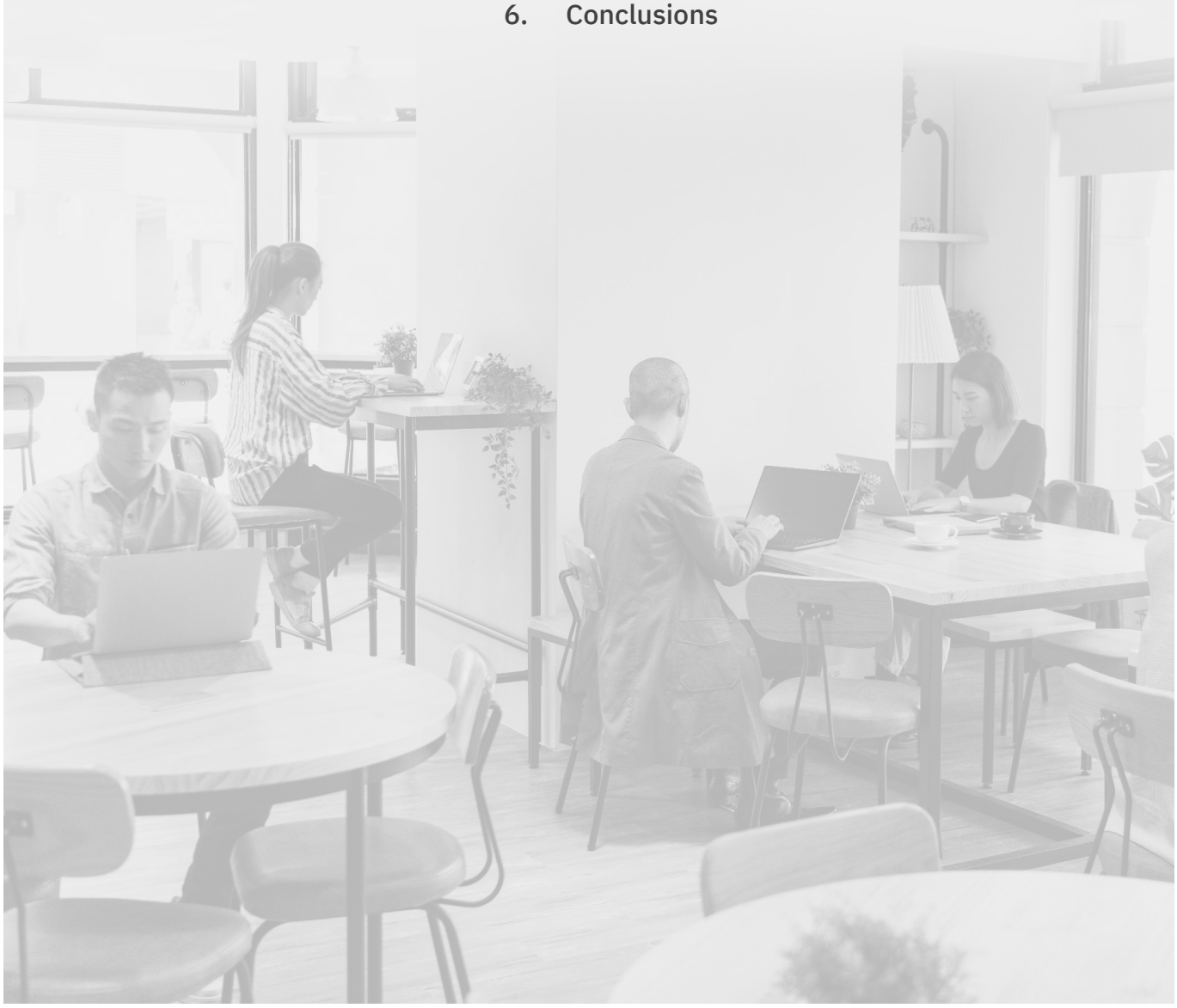
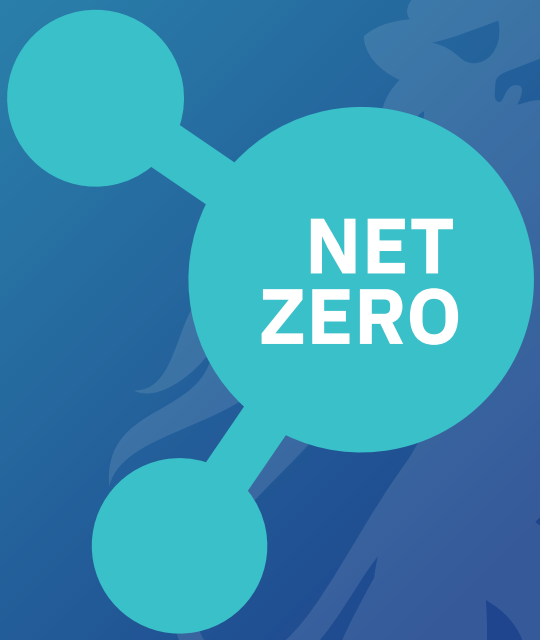


# Net Zero schools and colleges - meeting the environmental challenge

**In the UK's pursuit of Net Zero greenhouse gas emissions by 2050, all aspects of government and the public sector must take a role.** This includes the Department for Education (DfE), which aims to achieve Net Zero across the UK's educational estate (including devolved governments in Scotland, Wales and Northern Ireland).




The DfE views the buildings in its estate as an essential route for delivering carbon reductions while educating future generations about environmental and sustainability issues. **Figures show that schools and universities account for 36% of total UK public sector building emissions.**

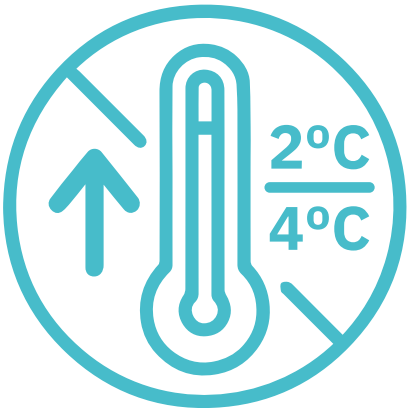
The DfE[1] has established two science-based milestone targets for reducing emissions against a 2017 baseline:

1. **50% reduction by the end of Carbon Budget 5 (2032)**
2. **75% reduction by the end of Carbon Budget 6 (2037)**

As part of these objectives, there are several measures to cut emissions from school and college buildings:

1. Reduce direct and indirect emissions from education buildings
2. Adapt these buildings to prepare for the effects of climate change in the UK
3. Create better environments for future generations, including improving air quality in and around these buildings

For schools and colleges, this means that new buildings or blocks delivered by the DfE, not already contracted as of April 2022, must be Net Zero in operation. **They must also be designed to cope with a 2°C rise in average global temperatures and future-proofed for a 4°C rise**. This includes delivering new school and college buildings adapted to risks such as flooding and higher indoor temperatures.




However, while new school buildings can be exemplars of energy and carbon performance, a large proportion of the education stock is already built and in daily use. These buildings pose a challenge for the DfE and those who manage, work and study in them.

**The Government has set aside grants and funding to improve the existing stock to meet new environmental requirements and improve overall performance.** Many school buildings need upgrades, and there is an opportunity to enhance educational facilities for users while also delivering on Net Zero goals.

One important area for consideration in these refurbishment projects is building services - providing heating, hot water, ventilation and cooling. These elements impact the energy use and carbon footprint of a building, as well as significantly influencing the health and comfort of teachers and students working and learning there.

This Guide is intended to help school and college management and facilities teams understand the impact of building services on their energy use and carbon footprint. In addition, it will highlight the benefits of modern heating, cooling and ventilation systems and explain how best to engage with contractors and installers when discussing the various options available for upgrading existing systems.

# School and college buildings - the upgrade challenge

**Schools and colleges in the UK deliver primary, secondary, and further education.** The figures opposite show the extent of the current (2022) educational estate at these levels.

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There are several different types of schools delivering education for different age groups. There are also specialist schools, independent schools, and academies, which may incorporate more than one school.

| Type of School | England | Wales | Scotland | Northern Ireland |
|---|---|---|---|---|
| All schools | 24,413 | 1,553 | 5,052 | 1,123 |
| Nurseries / Early Learning | 388 | 9 | 2,630 | 94 |
| Primary | 16,791 | 1,219 | 2,001 | 784 |
| Secondary / Middle | 3,458 | 205 | 357 | 192 |
| Independent | 2,366 | 80 | 91 | 14 |
| Specialist | 1,410 | 40 | 111 | 39 |

(Figures from British Education Suppliers Association[2] sourced from DoE, Welsh Government, Scottish Government and NI DoE.)

Further education is delivered after school to over-16s, but not at higher education level (i.e. undergraduate degree courses and beyond). The courses provided in college buildings include A levels, apprenticeships, and adult education. Further education is delivered through sixth-form, tertiary and specialist colleges.

| Type of School | England | Wales | Scotland | Northern Ireland |
|---|---|---|---|---|
| Colleges & further education | 227 | 13 | 26 | 6 |

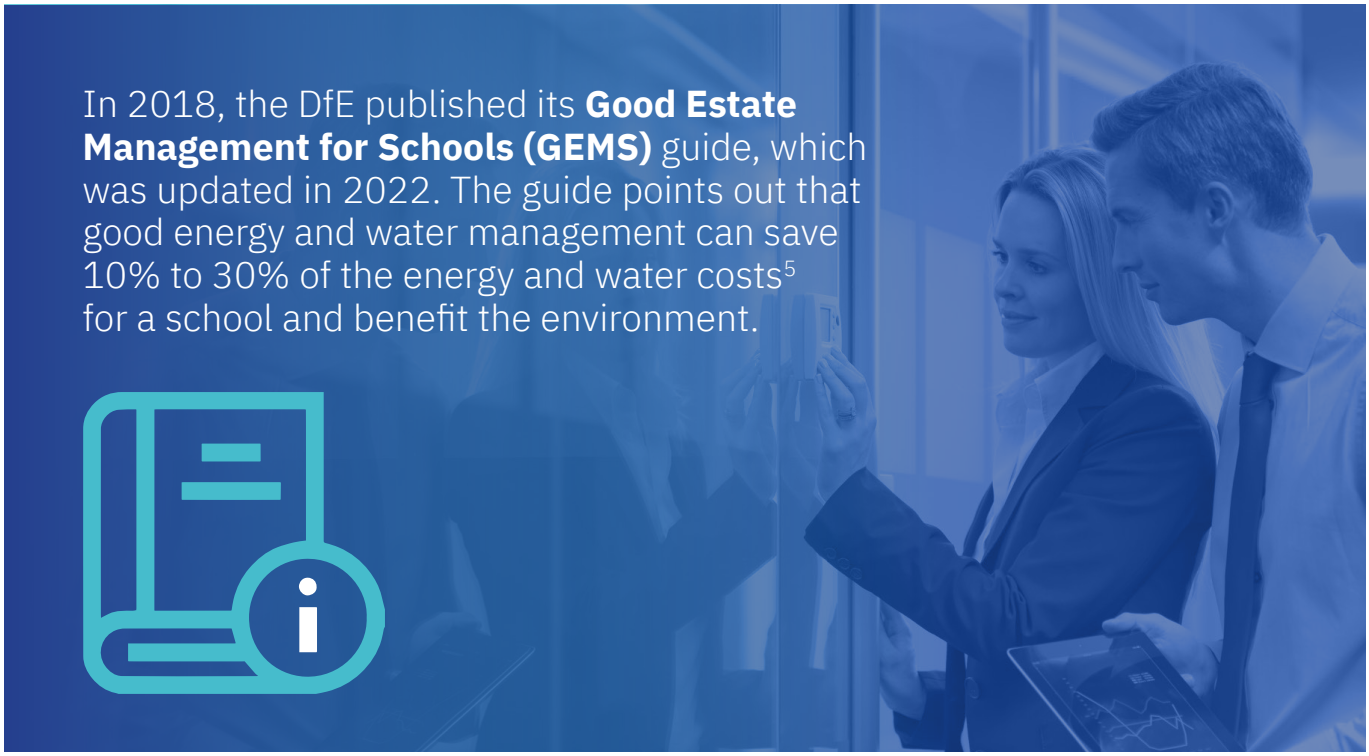
(Figures from the Association of Colleges[3])

**Unfortunately, many of the UK's school buildings need urgent repair work.** The DfE's most recent Condition of Schools Building Survey[4], published in May 2021, states that the cost to repair or replace "all defective elements in the school estate" is £11.4 billion.

In the survey, mechanical services such as boilers, air conditioning and pipework were the second-largest proportion of repairs or updates required amounting to just over £2 billion. This is second only to electrical services such as mains switch panels, lighting and IT infrastructure at £2.5 billion.

The Department for Education notes that poorly-maintained school and college buildings increase the risk of accidents and potential liabilities. But the state of a facility goes beyond physical risk. For example, the DfE points to a RIBA survey that found that 20% of teachers have considered leaving their jobs because of the condition of the building they're in.

However, upgrading schools is about more than just improving their current state of repair. It is also about managing the long-term costs of school operations. In recent years, energy cost has been high on the agenda for all schools as prices have risen. But reducing energy waste has been a long-term issue.



In addition to saving energy, there is a growing impetus from the government to reduce the use of fossil fuels across the public sector estate, which includes school and college buildings. For example, many educational establishments rely on gas boilers for heating and hot water, but government programmes such as the Public Sector Decarbonisation Scheme (PSDS) provide grants for schools and colleges to switch to alternatives such as heat pumps, as well as for energy efficiency improvements (See Section 4 for more details).

Carbon reduction is also crucial for certain Academy Trusts under the Streamlined Energy and Carbon Reporting (SECR) requirements for public sector organisations that meet specific size criteria. Around 600 Trusts and 5,800 Academies must include information on electricity and gas consumption and associated greenhouse gas emissions within their audited accounts.[6] Figures are collected annually so that reporting organisations can demonstrate reductions in their carbon footprints.

With these growing pressures on schools to update buildings and reduce their carbon footprints, finding the right approach can be challenging. Equipment must not only be energy efficient and have a small carbon footprint, but it must also be relatively easy to maintain. Unlike universities, most schools and colleges do not have on-site facilities and engineering teams. Refurbishment of equipment for heating, hot water and cooling must take this into account and be easy to operate, with robust performance and low maintenance requirements. There are also other essential factors to consider in the modern education environment that will impact the choice of equipment and system approach.

# Modern school & college buildings - understanding the needs of building users

When looking at school and college refurbishment options, particularly around heating, hot water and cooling, it's vital to think about the school's particular requirements and facilities.

**No two establishments are alike, so decisions on the most suitable type of equipment must be tailored to suit building uses and users.**

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Today's schools and colleges offer an array of courses and are increasingly adding to their facilities to extend this range and keep up with the changing needs of modern education.

However, this impacts the performance of the buildings, both in terms of energy use and issues such as internal temperatures. For example, using ICT equipment for teaching can raise classroom temperatures. This applies to specialist ICT labs and classrooms with electronic whiteboards.

Specialist colleges offering courses in catering may have extensive kitchen facilities that use significant amounts of energy but may also be at greater risk of overheating in the summer months. And if a school has extensive sports facilities, such as a swimming pool, this will add to energy costs. In addition, a gymnasium with showering facilities will increase the hot water requirements.

Another issue is that the local community often uses modern school buildings outside regular school hours. For example, adult education courses may run in the evenings, and schools may hire out their gymnasiums for local sports clubs. Extended operation times use more energy, so it is vital to ensure that equipment is switched off once the building is empty - something which can easily be overlooked.

**One factor that affects all schools and colleges is the changing UK climate, with extreme summer and winter temperatures becoming more common.**

There are currently no legally enforced minimum or maximum temperatures for UK schools in the School Premises (England and Wales) Regulations (2012)[7]. Scotland sets a minimum temperature of 16°C in classrooms, although 18°C is recommended as the lowest temperature and rules in Northern Ireland are similar. Other temperatures are recommended for different areas of a school or college building, for example, corridors which are usually unoccupied, can be 11°C and spaces for physical exercise can also have lower temperatures.

It is widely understood that extremes of temperature should be avoided in any workspace and that a good learning environment is one in which teachers and students can be relaxed but alert and productive. The National Education Union (NEU)[8] advises that 18°C should be considered a safe minimum for classrooms.

Summer is an increasingly problematic time of year for classroom temperatures. With higher summer temperatures happening more frequently, classrooms can quickly soar to 30°C and above. The NEU has been campaigning for a maximum indoor working temperature of 26°C, stating: "Even at lower temperatures likely to be experienced in classrooms, heat still leads to a loss of concentration and increased tiredness which means that teachers are more likely to put themselves and others at risk."

# Finding the right technical solutions for heating, hot water and cooling

Looking at the overall challenges and aims for the UK school and college estate, we can summarise **the main objectives when refurbishing heating, hot water and cooling systems:**

**1. Source funding for refurbishment**
This is a critical point for school and college upgrades which can only be achieved with financial support. There are several government grants and schemes to make projects more achievable.

**2. Decarbonise the building**
Remove fossil fuel systems wherever feasible and switch to electric options.

**3. Improve indoor conditions**
Support the health and wellbeing of teachers and students now, but also have a view to future-proofing buildings against the effects of climate change.

**4. Deal with requirements for 'specialist' areas**
This includes ICT suites, gymnasiums, as well as facilities such as toilets and showers.

**5. Plan for long-term management and maintenance for efficiency and cost-effectiveness.**

## Find funding - grants and schemes

The UK government has set aside a significant sum of money to help schools and colleges refurbish buildings. Some of this is focused on dealing with condition needs and addressing buildings in poor condition. In addition, monies are set aside to assist with improving heating and other systems.

### School Condition Allocations (SCA)[9]

Funds are paid to eligible bodies responsible for maintaining school buildings. The fund is focused on improving poor building conditions and addressing health and safety issues. But energy efficiency improvements are also included in this fund's list of allowable projects.

### Condition Improvement Fund (CIF)[10]

This is a bidding round with funds paid directly to single academy trusts, small academy trusts (MATs), small voluntary aided (VA) bodies and sixth-form colleges.

Local authorities, larger multi-academy trusts (MATs) and larger VA school bodies receive direct SCA funds to invest in priorities across the schools they are responsible for. However, smaller academy trusts, smaller VA bodies and sixth-form colleges can bid into the CIF instead. Academies and sixth-form colleges can also take out a loan for all or part of the project in their application at favourable rates.

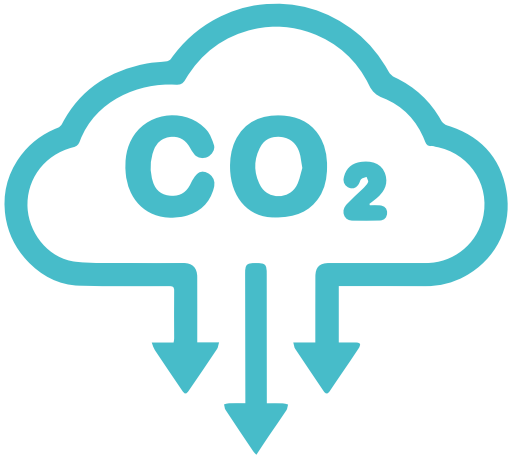
There is a strong sustainability element in the CIF requirements, which state: "We expect applicants to consider energy efficiency and environmentally sustainable options when replacing components in and around buildings in the move towards reducing carbon emissions and future-proofing estates."

In the most recent round of the CIF allocations for 2023 to 2023, the DfE has introduced a new priority project type: the replacement of coal and oil boilers. Successful applicants to this programme can use their potential CIF funding as the mandatory contribution towards an application to the Public Sector Decarbonisation Scheme.

### Public Sector Decarbonisation Scheme (PSDS)[11]

Provides grants for public sector bodies to fund heat decarbonisation and energy efficient projects. The scheme includes a broad range of energy efficiency and low-carbon technologies such as heat pumps, solar panels and energy efficient ventilation.

Phase 3c of the PSDC is scheduled to 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.



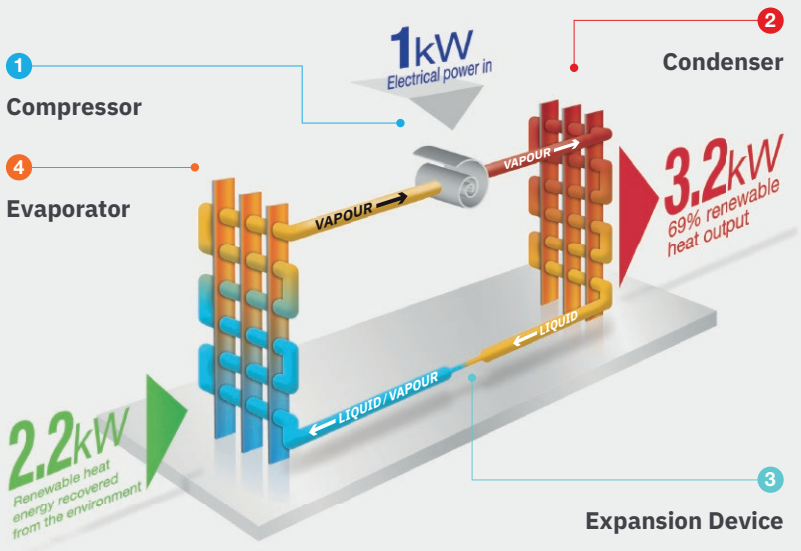

## Decarbonisation - saying goodbye to gas

With the government providing grants through the Public Sector Decarbonisation Scheme for equipment and technical advice on switching away from fossil fuels, this is an excellent time to consider replacing older gas boilers. A good option for schools is the heat pump. Modern heat pumps can provide an alternative to oil and gas boilers or ageing biomass systems. Heat pumps can provide energy efficient heating, hot water, and in some cases cooling.

### How a heat pump works

Gaining early popularity in the 1970s, early heat pumps were mainly considered for milder climates. But modern heat pumps can provide high-performance heating and air conditioning to buildings anywhere, even in extremely cold climates. To provide heat, the outdoor heat pump absorbs heat energy from the outside air and transfers it to the inside unit via the refrigerant. The refrigerant is compressed, increasing its temperature significantly when it reaches the indoor coil. Then, a fan blows air over the heated coil to deliver warm air to the room. This heating process is much cleaner and better for the planet than burning fossil fuels, providing zero emissions. Heat pumps can provide heating-only or heating-and-cooling by operating in reverse.

### The Vapour Compression Cycle




**1 Compression**
Refrigerant vapour is raised in pressure and therefore temperature.

**2 Condensing**
This hot pressurised refrigerant vapour is then passed through a condenser, where it liquefies and gives off usable heat that can be delivered to a building by either air or water.

**3 Expansion**
Liquid refrigerant is then allowed to expand, which lowers its pressure.

**4 Evaporation**
The low pressure liquid then expands and absorbs naturally occurring heat from the environment (this can be from the air, water or ground) and in doing so changes back to a vapour, which is then passed to the compressor for the cycle to start again.

**The UK government has committed to installing 600,000 heat pumps in homes and other buildings each year by 2028. The benefit of heat pump technology is that it can be applied to various building types, including main school buildings, offices, and gymnasiums. In addition, financial support from the PSDS has supported many heat pump installations, so it is a technology which may be within reach of a school or college budget.**

Mitsubishi Electric has been developing its heat pump technologies for many years and offers 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. In addition, the CAHV uses low-GWP refrigerant (R454C), which means that it has a small carbon footprint.

Another benefit is that it 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. This might also prove helpful if a school or college wants to take a phased approach to swapping out its fossil-fuel boilers. Then, depending on timing and budget, one boiler can be replaced with a heat pump at each phase.

A further benefit of using multiple heat pump 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.

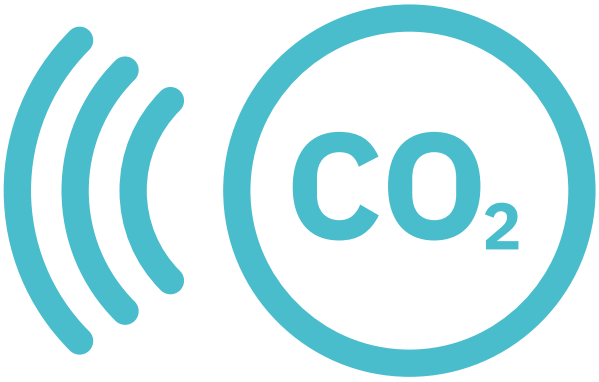
## Improving indoor conditions - ventilation and cooling

Good ventilation is essential for classrooms, ensuring a healthy environment and helping students focus and concentrate. However, good indoor air quality (IAQ) must be balanced with energy efficiency. For example, increased ventilation in cooler weather introduces cold air into classrooms, which means that heating systems operate longer.

Another important point about ventilation is that certain efficiency improvements can impact it. For example, improving building insulation will reduce heat loss and lower energy use, but the adverse effect can be sealing classrooms and reducing ventilation.

So, even in projects where ventilation may not be the focus, it is vital to consider indoor air quality. The Condition Improvement Fund notes this in its requirements: “Applicants will be required to consider the adverse impact on broader ventilation in relation to your CIF project”.

Mechanical ventilation with heat recovery (MVHR) can help to address these issues by capturing heat energy from the air as it’s extracted from the classroom and applying it to incoming air. For example, Mitsubishi Electric’s Lossnay MVHR units can recover up to 90% of heat energy while delivering localised ventilation. As a result, very little heat energy is lost, supporting efficiency, but occupants still benefit from controlled ventilation and good IAQ.

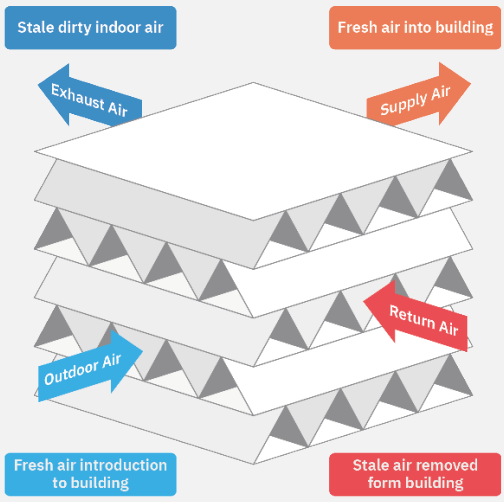


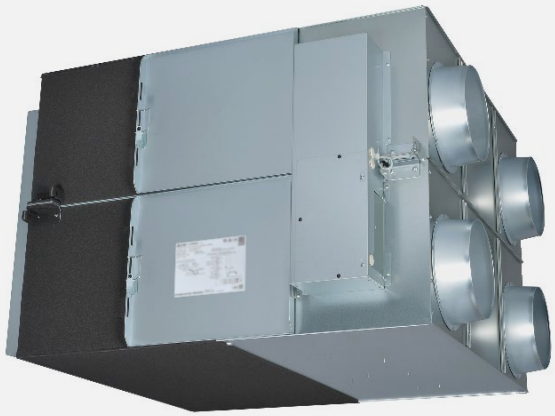

MVHR is particularly important for teaching environments, where removing indoor pollutants and viruses is essential for occupant wellbeing and reassurance. It is a technology that **Mitsubishi Electric has offered for many years and has evolved to provide outstanding ventilation, filtration performance, and energy efficiency.**

Lossnay can also be used with Mitsubishi Electric's $CO_2$ sensors which gradually increase the unit's operation as carbon dioxide levels rise in the occupied space. This is ideal for busy classroom environments, as the MVHR will work to maintain good indoor air quality without any need for teachers to make manual adjustments.

## Lossnay: Energy efficient ventilation

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.



**LGH RVX3-E**
Commercial Lossnay


**Optimising indoor conditions also requires consideration of indoor temperatures. Some areas of modern school and college buildings, such as ICT suites or kitchen areas, are particularly susceptible to higher temperatures. However, the entire building, particularly classrooms, must be considered when mitigating the effects of the UK's hotter summers.**

While there is no official maximum temperature for classrooms, 26ºC is recommended for the health and safety of teachers and students. However, maintaining this level indoors while outdoor temperatures rise can be challenging if the only available cooling method is opening windows or using desk fans.

While air conditioning may not have been considered in the past for schools and college buildings, it is an increasingly affordable and low-carbon option. Variable refrigerant flow (VRF) air conditioning systems are an excellent choice for today's classrooms and staff rooms. Moreover, VRF can provide heating as well as cooling, so it can be a practical option for decarbonising buildings where it may not be possible to use a heat pump to replace a gas boiler. With a focus on building carbon emissions in mind, using low GWP in cooling systems is a sensible option. Mitsubishi Electric has developed a hybrid VRF (HVRF) system which uses low 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 reduces the overall carbon footprint of the system.

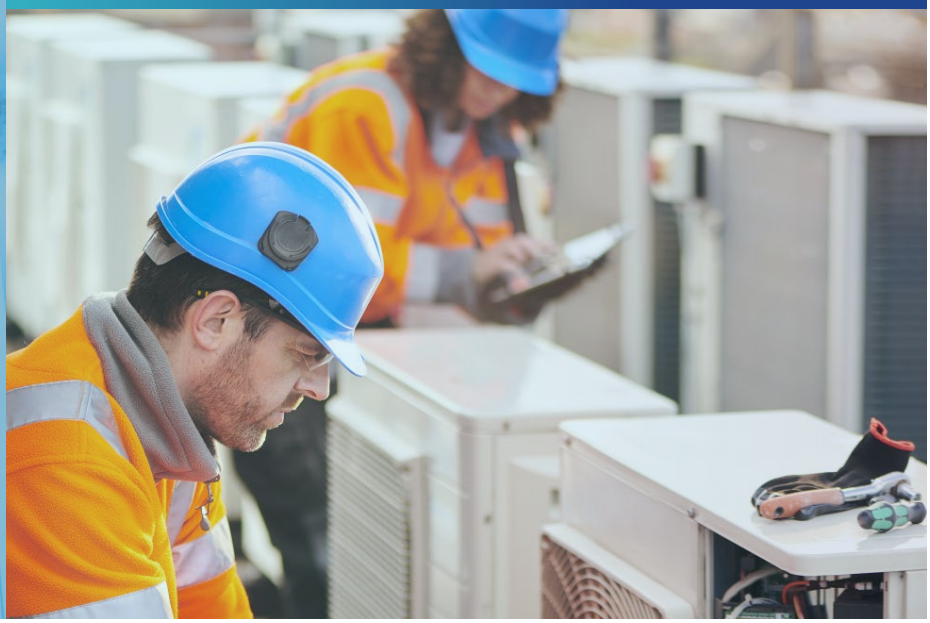
Using R32 in occupied spaces also requires the installation of leakage detection systems since the refrigerant is 'mildly flammable'. However, because HVRF does not place refrigerant in occupied spaces, no capital expenditure is required for leak detectors and installation time is also reduced.


## What is Global Warming Potential?

Air conditioning and heat pump systems use chemicals known as refrigerants to deliver heating and cooling. Each refrigerant has a GWP number which denotes its Global Warming Potential. It is a factor of how much heat a refrigerant can potentially trap in the atmosphere over a specific time relative to carbon dioxide.

The higher the GWP of a refrigerant, the more it can increase global warming. $CO_2$ has a GWP of 1, for example.

It's important to note that GWP is about the potential of refrigerants to cause warming if they leak into the atmosphere. In air conditioning systems and heat pumps, refrigerants are sealed into the equipment. This is why these systems should only be installed and maintained by registered professionals qualified to handle refrigerants safely to minimise the likelihood of leaks.



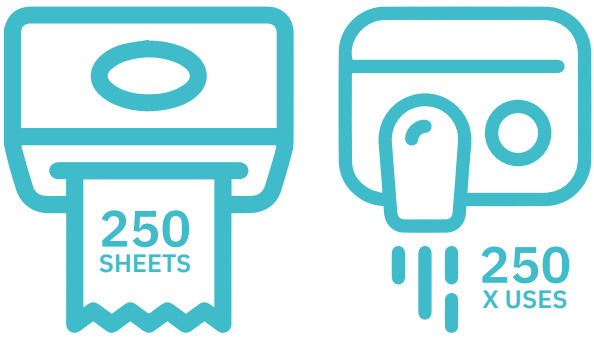
## Specialist areas - ICT suites and other areas

Many schools have teaching areas set aside for computers and other digital equipment. Specialist colleges may also provide TV production suites with large screens, cameras and lighting. Unfortunately, all of these create heat in the space, which will quickly become uncomfortable without adequate cooling.

VRF air conditioning is an excellent solution for these areas, providing an energy efficient and robust solution that keeps the space cool for occupants and the equipment. In addition, the heat extracted from these high-temperature areas can be used in other parts of the building if the system is correctly engineered. Some colleges may have on-site server rooms if they have more advanced digital requirements, in which case more specialist cooling may be more suitable. 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.

The Mitsubishi Electric high precision s-MEXT unit, is an ideal solution in smaller-scale data centres that might be found in colleges. The s-MEXT package comprises a high-precision air conditioner with 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.

Kitchen and catering zones can also benefit from cooling. Mitsubishi Electric's Stainless Steel Suspended System has been designed for these environments. Its stainless-steel casing is resistant to oil and smoke and the fan casing can be separated into sections for easy cleaning. It's a highly energy efficient system that uses low-GWP R32.




## High efficiency hand dryers

When looking for ways to shrink the carbon footprint of a building, it's important to consider every area. For instance, paper towel dispensers are increasingly recognised as having a large carbon footprint. **Globally, paper towel waste results in 254 million tonnes of landfill every year. And for every tonne of paper towels made, 17 trees are cut down.**

The carbon impact of paper towel use in a busy school or college can be significant. For instance, a paper towel dispenser with 250 uses per day amounts to 1,561kg of $CO_2$ annually. 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.

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 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.

**Hand dryers may seem like the least high-profile, low-carbon technology, but the right choice can make a significant impact given the extent of school and college hygiene and toilet facilities.** Moreover, well-designed hand dryers will contribute directly to the health and wellbeing of staff, students and visitors.

**Mitsubishi Electric Wave i01** (Hands In)

**Mitsubishi Electric Wave u02** (Hands Under)


## Management and Maintenance

**One of the main challenges for many schools and some colleges is the lack of on-site facilities management or engineering expertise.** Therefore, ensuring that heating, hot water and other services are operating correctly and efficiently must be as straightforward as possible.

Controls can help to ensure that, at the simplest level, systems don't operate when they're not required. For example, this means that 'off' is the standard position for all switches on heating and cooling systems, so if people leave a classroom and forget that the air conditioning is running, it will switch off in a few minutes. This can be achieved using sensors included in the equipment for easy installation.

Remote monitoring may be a useful option for larger buildings or multi-site academies with more than one school building in their estate. Mitsubishi Electric can provide this service, ensuring that equipment is operating effectively and efficiently - while collecting and collating energy data that can be used as part of SECR requirements, for example.

## Management and Maintenance

| School / College Area | Requirements | Equipment Solutions |
|---|---|---|
| **Classrooms** | ■ Ventilation and IAQ<br>■ Heating<br>■ Summer cooling | ■ Heat pumps for heating remove the need for gas boilers - decarbonisation<br>■ MVHR - ideal for classrooms to provide IAQ; filters can protect from outside pollution<br>■ Heat pumps can provide cooling; alternative is VRF system which can provide both cooling and decarbonised heating |
| **Staff and Admin Offices** | ■ Ventilation and IAQ<br>■ Heating<br>■ Summer cooling | ■ Heat pumps can provide low-carbon heating<br>■ VRF is an ideal solution for office cooling |
| **Assembly Halls / Gymnasiums** | ■ Ventilation and IAQ<br>■ Cooling | ■ MVHR systems are available for larger spaces<br>■ Cooling from VRF when gym is in use |
| **Hydrotherapy areas for specialist treatment** | ■ Ventilation and IAQ | ■ MVHR systems for larger spaces are also suitable for high humidity areas |
| **Showers** | ■ Hot water | ■ Heat pump systems can provide hot water up to 90°C |
| **Kitchens** | ■ Ventilation and IAQ<br>■ Cooling<br>■ Easy to clean | ■ VRF or heat pump cooling can help to keep kitchen areas cool year-round<br>■ Mitsubishi Electric Stainless Steel Suspended System for kitchens which is ideal for kitchen environments and which can easily be cleaned and maintained. |

| School / College Area | Requirements | Equipment Solutions |
|---|---|---|
| **Canteens/refectory** | ■ Ventilation and IAQ<br>■ Heating<br>■ Cooling | ■ Heat pumps can provide heating and cooling to these areas<br>■ MVHR can also be applied to remove odours and support IAQ in shared spaces |
| **ICT / digital learning suites** | ■ Cooling | ■ VRF is the ideal solution for areas where equipment such as screens, laptops and desktops produce heat<br>■ Heat recovery can also be used with VRF if the system is designed for this approach |
| **Server rooms or data centres** | ■ Cooling | ■ Specialist cooling for data centres is recommended for these areas |
| **Library areas** | ■ Ventilation and IAQ<br>■ Heating<br>■ Cooling | ■ Heat pumps provide quiet operation and can provide heating and cooling<br>■ MVHR can work as a continuous extract system which is very quiet and effective at maintaining good air quality |
| **Toilets** | ■ Hot water<br>■ Hand drying facilities | ■ Heat pumps can provide hot water as well as heating<br>■ High-efficiency hand dryers can replace paper towels to reduce carbon footprint |
| **Building management and maintenance** | ■ Schools often do not have engineering experts in their on-site facilities team<br>■ Easy control of heating and cooling systems needed for busy teachers<br>■ Energy waste must be reduced even as school/college buildings are used for longer hours by more people | ■ Simple in-room controls on all equipment make it easy for teachers to control the classroom temperature.<br>■ Heating and cooling systems set to 'auto off' as the standard.<br>■ PIR sensors - detect when a room is occupied; switch off when no movement detected<br>■ Remote monitoring by experts can help multi-site academies/trusts check energy use and spot potential performance issues in heating/ cooling/hot water systems |

# Taking action - Next steps for your school or college on the road to Net Zero

Schools and colleges vary widely in size and age - as do their heating, cooling and hot water systems.

**But whether you're managing a Trust with multiple buildings, or a single primary school, there are steps you can take to get off on the right foot on the road to Net Zero.**

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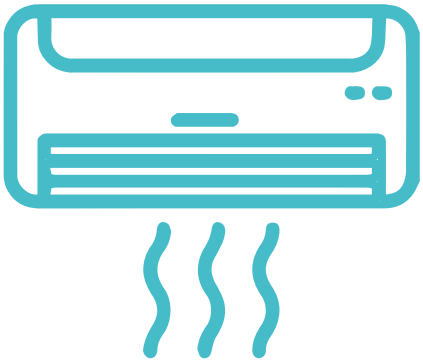


## 1. Build your Net Zero team

Getting engagement across your staff (and students) is critical for achieving energy efficient and low-carbon buildings. A cross-department team can help to set objectives, communicate them and drive action. It can be useful to involve relevant outside suppliers such as facilities teams and maintenance contractors as they can help build energy saving and carbon reduction into their programme in the long-term.

## 2. Establish your baseline - where are you now?

Understanding how your building, heating and cooling systems perform now provides the framework for the next steps and helps to prioritise grant applications and future financial investments. Information to gather includes metered energy use for electricity and gas across all buildings. Ideally, this will be data from the past twelve months.

**There are three important data points to note:**

- **The amount of energy consumed**
- **Time of consumption** - time of day, month and year, to establish patterns
- **Where energy is consumed** - sub-metering can identify which part of a building or which equipment uses the most energy.

Energy use data will also provide a baseline to demonstrate improvements in efficiency and carbon emissions in the future and is often required when applying for grants.

## 3. Review your equipment

Work with contractors to undertake a review of the heating, hot water, ventilation and cooling equipment in your building. It may seem obvious, but these records can easily go astray. It's important to understand what is in your building now, along with the age and maintenance records.

**There are some key indicators that equipment is ageing and due for an upgrade:**

- **Decreasing reliability** - For example, increased heating system breakdowns, or paying for emergency repairs more often. This not only impacts occupant comfort, it also costs money.
- **Increased energy use** – If you find that ventilation and cooling systems are using more electricity, it can be a sign that the equipment is in need of a maintenance overhaul or even replacement.
- **Unstable indoor temperatures** - Varying temperatures around a building are normal, but hot-spots and cold areas can indicate that equipment is not functioning effectively. This can be the result of changes in a building (such as moving partition walls or increased occupancy). However, it is also a possible sign that the equipment is under strain.

## 4. Prioritise your refurbishment and retrofit programme

Your equipment review may identify urgent requirements for example, you may have an older boiler that's becoming less reliable; or one property that consistently suffers hot water failures. Less urgent projects are no less important. For example, is one building using more energy than others? Are teachers and students experiencing summer overheating in the IT room?

The review of energy use and equipment should point to some clear early objectives to solve immediate problems but also highlight areas for successful carbon reduction and efficiencies. For example, if boilers are older and failing, it could be an ideal opportunity to replace them with low carbon heat pumps to provide heating and hot water.

You may also want to include improvements to the indoor environment in your programme. For instance, an upgrade of ventilation systems or the addition of cooling to areas where high temperatures are impacting staff and students.

Although not directly related to schools or colleges, the Better Buildings Partnership[12] highlights four useful factors to consider when prioritising energy efficiency improvements, and they apply equally to carbon reduction measures:

- **Ease of implementation**
- **Cost** - which should include consideration of any grants available
- **Payback period**
- **Anticipated savings in energy and carbon**

## 5. Measure and manage

If you are making investments in new equipment and setting out your school or college's Net Zero goals, then it's vital to plan for long-term management and maintenance for efficiency and cost-effectiveness.

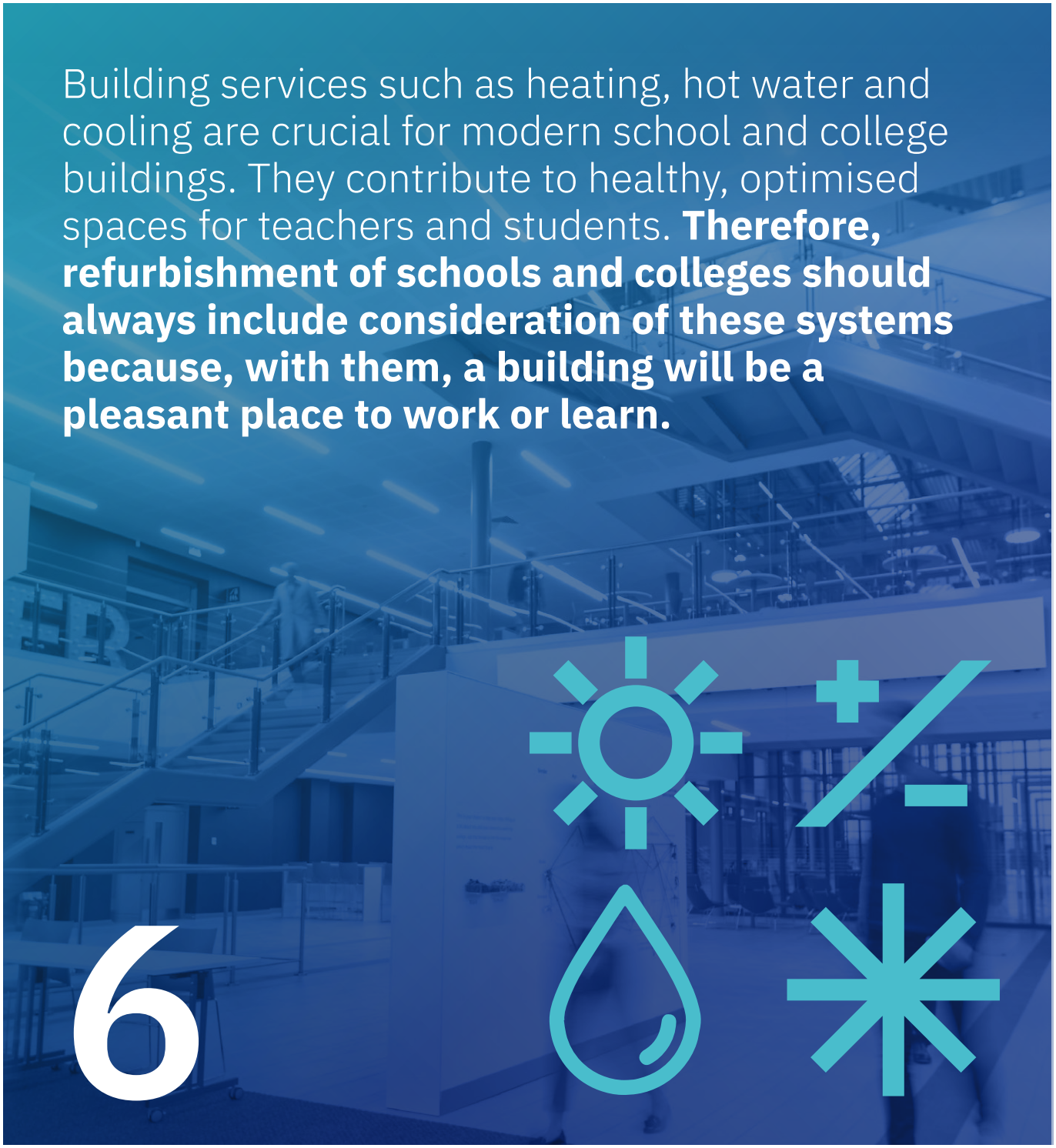
Working closely with service providers who maintain or manage your heating, ventilation and cooling systems will be key to making the most of investments. It is important to let them know your priorities for energy efficiency and carbon reduction so they can offer appropriate advice and take action that supports your objectives.

Keeping track of energy use will help to identify the savings made from new equipment while highlighting further opportunities for improvements. The ability to provide data-backed evidence can also be the basis for future investments in your buildings.

# Low Carbon Classrooms: Refurbishing Heating and Cooling in Schools and Colleges

# Conclusions

Building services such as heating, hot water and cooling are crucial for modern school and college buildings. They contribute to healthy, optimised spaces for teachers and students. **Therefore, refurbishment of schools and colleges should always include consideration of these systems because, with them, a building will be a pleasant place to work or learn.**



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## Modern equipment can provide cost-effective solutions that deliver low-carbon systems and reduce energy waste while providing better indoor environments.

The time invested in working with experts in energy-efficient and low-carbon solutions can pay long-term dividends. Mitsubishi Electric can help you spot potential areas for savings you may have yet to consider. And these don't have to be large-scale technologies installed in a single project - a phased approach is entirely feasible.

Mitsubishi Electric has extensive experience in providing advice to the public sector and having worked with many schools and colleges, we understand the challenges clients face. Our national network of approved installers can help with school and college refurbishment projects from the earliest stages, providing advice on the most effective approaches and products. Their work is also backed by industry warranty, giving clients peace of mind.

**Together, we aim to help you achieve a refurbishment which makes your building better today and for many years to come.**

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Case Study

# St Andrew’s School
## Renewable heating upgrade with government grant

St Andrew’s School in Chedworth was one of the first schools to obtain a grant under the Public Sector Decarbonisation Scheme (PSDS).

The school wanted to move away from its old oil-fired boiler to a low carbon and energy efficient approach. By switching to a Mitsubishi Electric Ecodan air source heat pump, the school was able to use its existing radiators and underfloor heating. This saved on capital expenditure and also reduced disruption inside the building.

The school also used its PSDS funding to install solar PVs that help power the heat pumps and improved its insulation to support energy efficiency.

Case Study

# Ysgol T Llew Jones School
## A school with a new approach to heating

A new school was needed to replace four smaller schools, struggling with old premises and falling pupil numbers. The result was the Ysgol T Llew Jones Primary School in Brynhoffnant in mid-Wales.

The school opted for ground-source heat pumps, which use underground pipes to collect heat energy and supply heating and hot water. A series of boreholes drilled into the earth hold a network of pipes that pump water underground and transfer heat energy. Using a small amount of electricity, the heat pump collects low-grade heat from below the ground's surface and upgrades it to produce a higher grade of heat which is then used to heat the underfloor heating and hot water within the building.

Low maintenance, a small footprint and easy installation combine with the scalability of units to make the ground source system cost-effective for larger projects.

Case Study

# Arley Primary School

## Modern heat pumps free up space for teaching

The new-build Arley Primary School is designed on the Sunesis model from Scape and Willmott Dixon. It provides a fixed-cost approach to construction and includes several sustainable and energy efficient features.

Included in this was the application of three Mitsubishi Electric Ecodan CAHV air source heat pumps. These provide heating and hot water year-round. In addition, using the Ecodan means that the plant room could be half the size required by a gas boiler - freeing up valuable space for education provision.

Case Study

# Chapelford Primary School
## Energy efficient heating with cooling and efficient ventilation

The innovative Chapelford Primary School was designed to be ultra-modern and innovative to demonstrate Warrington Borough Council's commitment to sustainable living.

Key to the project was a low-impact design which used advanced, renewable, energy efficient equipment to keep the school environment fresh and comfortable for staff and pupils. The school uses four Ecodan CAHV air source heat pumps to deliver heating. In addition, Mitsubishi Electric's Mr Slim air conditioning units were chosen to deliver energy efficient heating and cooling to the general offices, the staff room, head office and server room to provide a constant, comfortable temperature with low running costs and minimal maintenance. And cooling was also installed to address certain 'hot spots' throughout the school building.

As a highly energy efficient design, Chapelford Primary faced the challenge of ensuring good ventilation in a sealed building. To address this, 18 Lossnay MVHR units were installed to ensure good IAQ in classrooms while ensuring minimal heat energy is lost from the building.

Case Study

# Woolly Wood School
## State-of-the-art heating for a school building

Sheffield City Council required this school to meet at least 10% of its energy needs from renewable sources and a 20% reduction in predicted carbon emissions.

Six Mitsubishi Electric Ecodan air source heat pumps were installed to serve an underfloor heating system. This has eliminated the need for wall-mounted radiators and saved valuable space. The units also provide heating and hot water for the school's hydrotherapy pool.

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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).

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Green Gateway
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