

Information Guide: Commercial Heating

Issue 30

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Commercial Heating

This is an independent guide produced by Mitsubishi Electric to enhance the knowledge of its customers and provide a view of the key issues facing our industry today. The guide accompanies a series of seminars, all of which are CPD accredited.

The changing face of construction in the 21st Century demands that designers, specifiers and suppliers work as teams to create better buildings - or occupants and the environment.

Mitsubishi Electric aims to be a part of this by encouraging employees and customers to work together to increase their knowledge of the latest technology, legislation and markets.

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Commercial heating - finding a new approach

In the commercial sector, 55% of energy used in buildings is for heating, according to the Department for Energy and Climate Change (DECC). Many legislative drivers are forcing building operators and owners to find new ways to reduce their energy consumption, so finding energy efficient heating technologies is an important issue. There are also strong arguments for reducing our use of primary fuels by switching to more energy efficient and renewable sources of heat for commercial buildings.

More than 5,000 UK organisations are involved in the Carbon Reduction Commitment Energy Efficiency Scheme (CRC), and between them these public and private sector bodies account for about 10% of the UK's carbon emissions. The scheme is a mixture of 'carrot-and-stick' with financial incentives for those organisations that cut their carbon and penalties, including fines, for those that don't.

Even organisations not taking part in the CRC scheme are already affected by Energy Performance Certificates and Display Energy Certificates. In the new-build sector, requirements to demonstrate energy efficiency are now legally enforced through Part L of the Building Regulations and the Energy Performance of Buildings Directive (EPBD).

While this legislation is driving the requirements for energy efficiency in commercial buildings, other considerations are making renewable technologies an increasingly important consideration. For new buildings, many local authorities are enforcing the use of on-site renewables technologies through the planning system. The amount of renewables required varies from anywhere between 10% and 20%. There are also strong incentives for private and public sector organisations to be seen to be taking a responsible approach to their energy use. Many organisations are therefore adopting renewable and low-carbon solutions as part of their Corporate Social Responsibility programmes.

There are no easy solutions to reducing carbon emissions in the commercial sector. A combination of approaches is required. One of the most important steps is to find technologies that enable us to maintain comfortable working environments while reducing our energy use. By using energy in buildings more efficiently, we reduce our use of primary fuels such as gas or coal which are currently the main fuels used in UK power stations.

Use of energy efficient technologies has the potential to have a massive impact on our fossil fuel consumption. **Diagram 1** opposite shows the results of shifting commercial heating away from gas fired boilers to heating-only heat pumps. It shows that the heat pump can produce the same amount of usable heat, but uses around half the units of primary fuel. According to industry figures, in gas fired power stations only 30% to 50% of the energy consumed is converted to electricity. And in the UK network losses average 6.5%.

By using less energy, technologies such as heating-only pumps also assist in the move towards renewable energy sources such as wind. **Diagram 2** shows that with less energy demand, we can reduce the pressure on renewable energy sources, for example cutting the number of wind turbines we would need to meet current energy demands and therefore reducing the costs of developing this type of technology for the UK.

Diagram 1: Fuel use chain - heating

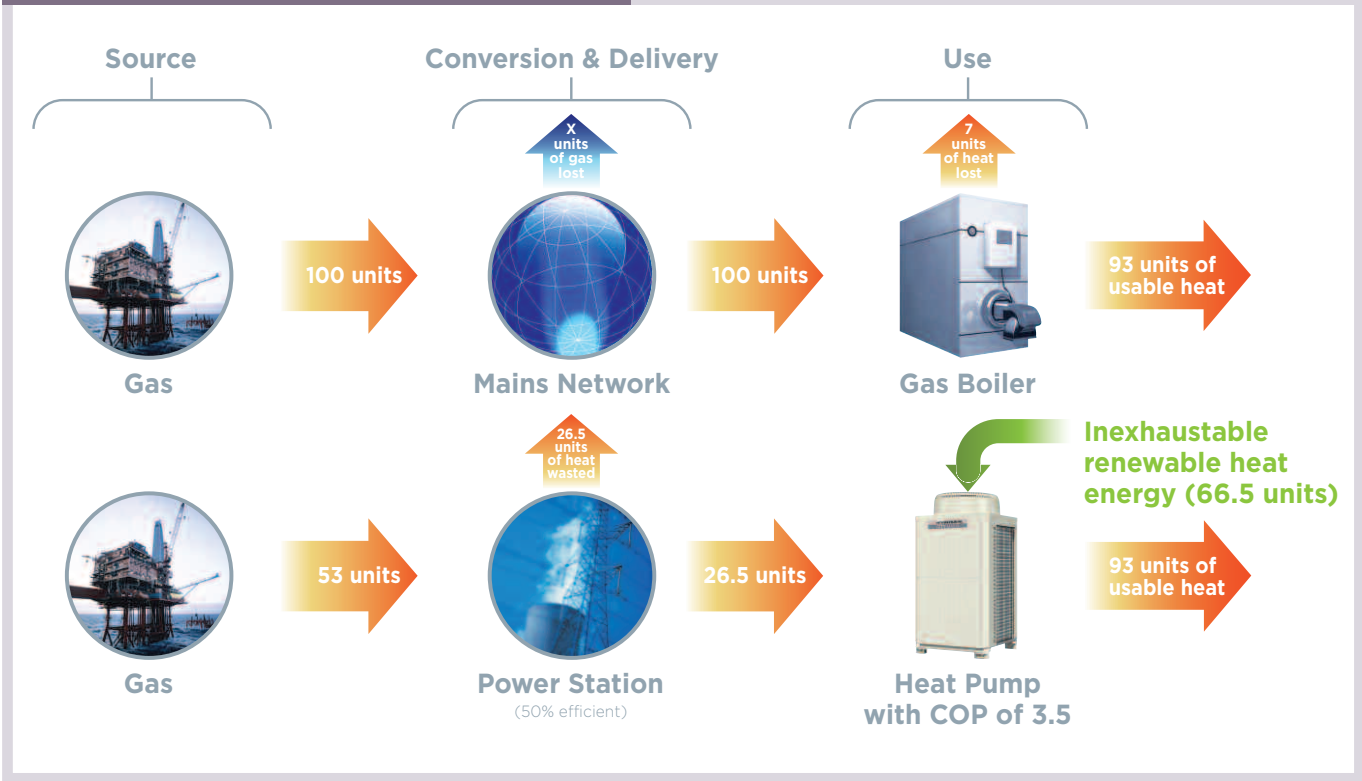
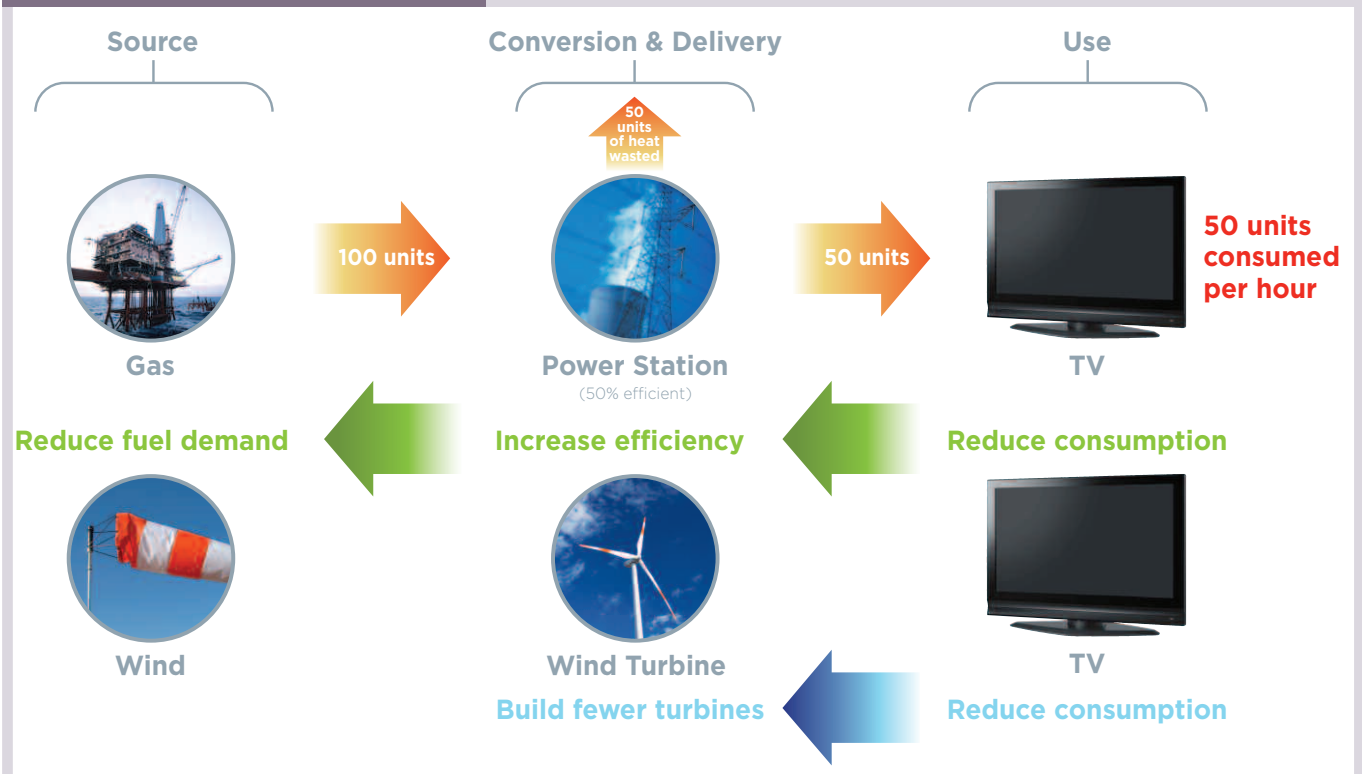


Diagram 2: Fuel use chain



A new approach for today's commercial buildings - heat pumps

Finding energy efficient and renewable solutions for heating commercial buildings can be a challenge. Heat pumps offer a new approach to heating commercial buildings, based on well established and reliable technology which offers the added benefit of being officially recognised as 'renewable'.

New developments in heat pump technology and Government incentive schemes are making heat pumps a more financially and technologically attractive option compared to gas or direct electric heating systems. The capital cost of heat pumps is likely to be considerably lowered by the introduction of the Renewable Heat Incentive (RHI) early next year. Since heat pumps are now classified by both the UK Government and the European Union as a renewable technology, they will be eligible under this new scheme.

The RHI is set to be introduced in April 2011. The proposed scheme will move the UK towards more efficient and renewable heating, and supports a range of renewable technologies including air and ground source heat pumps. It also includes heat at all scales, from households to businesses and industrial applications. The aim of the RHI is to boost the use of renewable technologies in the UK by helping to bridge the financial gap between the cost of conventional and renewable heat systems.



There is additional compensation for some technologies for an element of the non-financial costs, for example borehole digging for placement of a ground source heat pump. There is also a rate of return of 12% on the additional cost of renewables, making it a brilliant financial investment. Leading manufacturers estimate that the RHI will effectively halve the price of a heat pump compared to a gas boiler; there by incentivising the use of renewable heating.

In the new-build market, use of renewable energy sources is now often required as part of achieving planning approval. By using heat pumps, projects can take significant steps towards meeting these targets (which can vary between 10% and 20% on-site renewables targets). Furthermore, for some buildings it can be appropriate to use heat pumps and gas boilers in tandem - meeting renewable energy requirements and client needs for hot water.

Heat pumps have already proved their worth as energy efficient cooling and heating systems for today's buildings. With the latest development of **heating-only** heat pumps designed to take the place of the (heating-only) gas boiler, clients now have an extra renewable option, based on well-established and understood technology. The RHI will reduce the capital cost of heat pumps, making them a more viable option for many clients. The lower running costs of heat pumps, compared to technologies such as gas boilers, have already been demonstrated in a range of projects. With rising fuel costs, this consideration will become increasingly important in the commercial sector.

The proposed Renewable Heat Incentive

The target launch date for the RHI is April 2011. The proposals for how the scheme will operate were put out for market consultation in early 2010. The key elements of the Government's proposals for the RHI include the following points:

- The scheme will support a range of technologies including air and ground source heat pumps, solar thermal, and biomass/biogas.
- RHI payments will be claimed by and paid to the owner of the equipment.
- In small and possibly medium sized installations, installers and equipment will have to be certified under the Microgeneration Certification Scheme (MCS) or 'equivalent standard'.
- The proposal is that payments are made over a number of years: annually for installations below 45kW and quarterly for larger installations. Payments will be subject to conditions such as continued operation and maintenance of the equipment.

- Payments will be calculated on the amount of heat output expressed in kilowatt hours (kWh). The amount of heat generated will be estimated when installed.
- RHI will remain open to new projects until 2020. Tariffs will be reviewed occasionally to take new technologies and changes in costs into account. Eligible installations completed after 15th July 2009 will benefit from the scheme as if they had been installed when the RHI was in force.

Heating-only heat pumps: how do they work

When considering renewable technologies for heating, the heat pump option compares very favourably with biomass technologies. Although biomass is useful for projects where large amounts of very hot water are required, for example large hospitals, heating-only heat pumps offer a number of key advantages:

- Ease of design and installation: leading manufacturers are offering heating-only heat pumps in modular systems, ranging from 50kW to 200kW. This makes plant room or roof installation a much easier option. By contrast, with installation of biomass boilers consideration must be given to storage of fuel, which can take up large amounts of space on-site. Cost, availability and delivery of fuel also has to be considered with biomass technology.
- Ease of maintenance and operation: biomass boilers must be cleaned regularly, and consideration must be given to the disposal of ash, which varies depending on the type of fuel used. Fuel deliveries must also be planned for. By contrast, heating-only heat pumps require very little maintenance and produce no by-products.
- Flexibility: heating-only heat pumps can source their energy from the ground or the air; they can also deliver heat via water (radiators or underfloor heating) or air. This gives clients a number of options which they can use according to the particular needs of a project.
- EC Directive 2008/50/EC Ambient Air Quality and Cleaner Air for Europe must be transposed into national legislation by June 2010. The Directive is significant for biomass users because it reduces the size of particulates that must be controlled from 10 microns or above down to 2.5 microns or above. Although the majority of these particulates come from vehicle emissions, biomass boilers will be affected. Further filtration will be required on new biomass boilers, and also need to be retrofitted on existing biomass boilers.

Heating-only heat pumps in action

Heating-only heat pumps offer a flexible option for designers and clients alike. They can be ground or air source, and leading manufacturers are now offering heating-only heat pumps in modular systems, for easier installation.

The main delivery mechanisms for the heat in these systems are air or water. A water system delivers heat into the space via radiators or underfloor heating. Alternatively, heat can be brought into the space via a fan coil system through ducts and grilles. In the systems that use water as the medium for delivering heat, modular configurations are now available. The heating-only heat pumps are available in multiples of 25kW, with 50kW and 75kW available as pre-plumbed modules. Maximum single module capacity is up to 200kW, after which 200kW units can be plumbed together on site. Water can either be delivered at 70°C to the sanitary hot water tank; or at 45°C for radiators or underfloor heating.

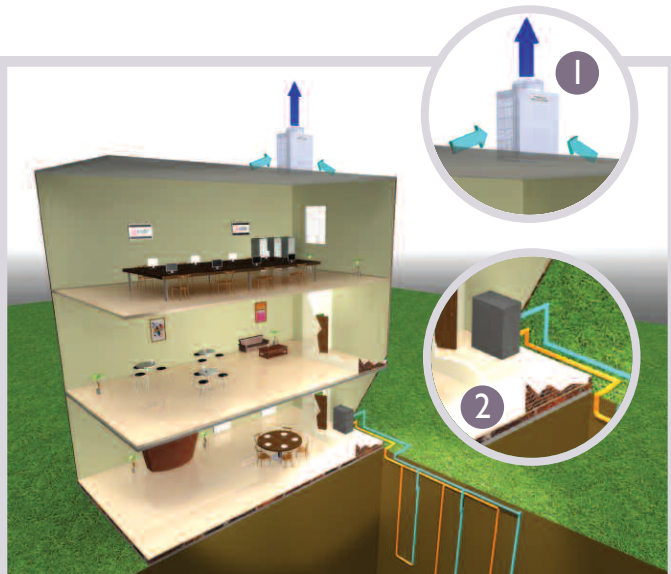
Method of Extraction

1 Air source heat pump

Uses outdoor units, sited either on the roof or on the ground, to extract heat from the ambient air to deliver heat to the building.

2 Ground source heat pump

Extracts heat from the ground via a circulating water loop buried in the ground to then deliver heat to the building. The ducted fan coil delivers warm air through ducting and a series of grilles (2nd Floor).



Method of Delivery

1 The heat pump boiler

Supplies water between 35°C and 45°C to the radiators (Ground Floor)

2 The heat pump boiler

Supplies water between 30°C and 45°C to the under floor heat (1st Floor)

3 The ducted fan coil

Delivers warm air through ducting and a series of grilles (2nd Floor)



The range of building types where heating-only heat pumps can be usefully applied is very varied. The table below shows how much energy is used for heating different types of building, demonstrating how much energy could be saved by the application of this technology:

Key opportunity property types	Catering	Computing	Cooling & Ventilation	Hot Water	Heating	Lighting	Other
Commercial Offices	3%	7%	10%	6%	57%	15%	3%
Communication & Transport	7%	2%	6%	5%	24%	40%	17%
Education	8%	3%	0%	11%	59%	14%	4%
Government	8%	5%	1%	8%	64%	7%	6%
Health	4%	1%	0%	11%	66%	15%	2%
Hotel & Catering	26%	0%	4%	18%	36%	12%	4%
Retail	13%	3%	8%	5%	32%	32%	8%
Sport & Leisure	8%	1%	7%	16%	38%	15%	16%
Warehouses	8%	1%	2%	4%	55%	18%	11%
Other	4%	1%	2%	9%	62%	14%	7%

Case study 1: University accommodation block

This new block was designed to house 230 overseas students. The building is in London, and therefore subject to planning rules on use of on-site renewables. Heating-only heat pumps are proposed to meet this requirement. The energy-demand breakdown of the building is shown below:

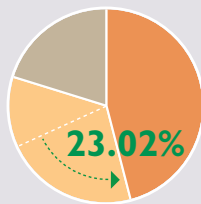
Space heating: 46.2% (877,207kWh/year)

Water heating: 33.5% (636,371kWh/year)

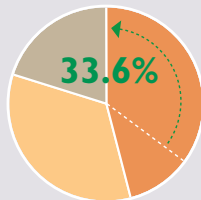
Other electricity: 20.3% (386,332kWh/year)

The application of heating-only heat pumps to this project can be achieved in a number of ways, each offering varying levels of renewable heat:

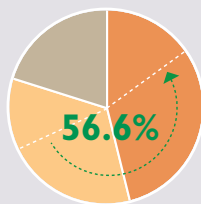
Meeting the **sanitary hot water heating demand** with a heat pump COP of 3.2 provides 23.02% renewable heat.



Meeting the **space heating demand** with a heat pump COP of 3.63 provides 33.6% renewable heat.



Meeting both the **sanitary hot water and space heating demand** with a heat pumps COP of 3.63 and 3.68 respectively provides 56.6% renewable heat.



Case study 2: Commercial office

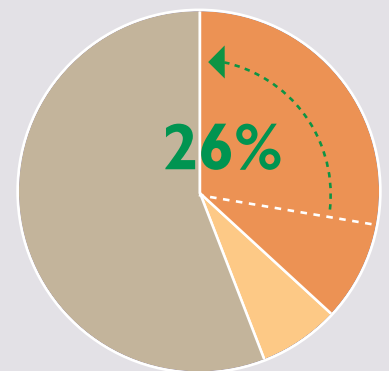
This is another London-based project, requiring use of on-site renewables to meet planning regulations. In this project, the office electrical loads exceeded the space heating requirements.

Space heating: 36.8% (537,380kWh/year)

Water heating: 7.5% (109,200kWh/year)

Other electricity: 55.7% (813,210kWh/year)

However, by fulfilling all of the **space heating needs** with a heating-only heat pump, the building achieves more than 26% of on-site renewables.



Heating-only heat pumps offer a realistic solution that meet the many challenges faced by building designers and operators today, from planning regulations to rising energy costs. Heating-only heat pumps offer a realistic alternative to combustion-based heating systems: as well as being renewable, they are also easy to install, maintain and operate. With the added benefit of the forthcoming Renewable Heat Incentive which will drastically lower capital costs, heating-only heat pumps are set to become an increasingly popular choice in the commercial sector.

Further information

You can find more information on the topic of **commercial heating** and related issues at the following websites:

Mitsubishi Electric has produced a wide range of guides, and several of these address the use of heat pumps for energy efficient heating in homes and commercial buildings. There is also information on the latest legislation on low carbon and energy efficient buildings:

www.mitsubishielectric.co.uk/aircon and

www.mitsubishielectric.co.uk/commercialheating

The Department for Energy and Climate Change website contains the latest information on the Renewable Heat Incentive, and will offer updates on progress towards its introduction in April 2011: www.decc.gov.uk

If you missed the CPD seminar on **commercial heating** you can call your Mitsubishi Electric Regional sales office to arrange an in-house presentation of this information.

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Issue 30 Version 1 (April 2010)



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