Achieve Low Carbon in Schools, Hospitals & Commercial Applications

SUSTAINABLE ENERGY EFFICIENCY THROUGH THE USE OF HEAT PUMPS AND RADIANT HEATING AND COOLING

SPC

www.spcoils.co.uk

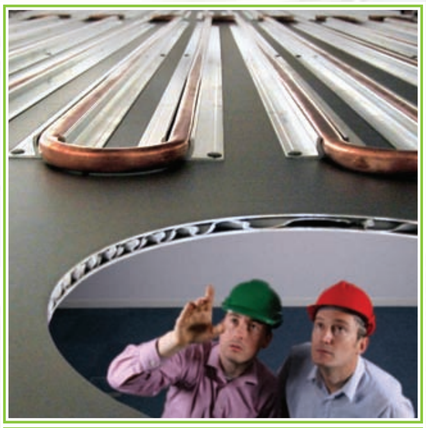
Carbon reduction
– the facts

The United Kingdom's commitment to reduce carbon and other greenhouse gas emissions is now a matter of legal obligation.

Research published by the Carbon Trust demonstrates that non-domestic buildings present a significant opportunity to reduce the UK's carbon footprint economically.

THEY ESTIMATE THAT:

- 35% CO_2 reduction can be achieved by 2020 (from 2005 levels) with a net benefit to the UK of at least £4 billion.
- A reduction of 70-75% can be achieved by 2050 at no cost, using options which exist today.



"CIBSE believes that changing our buildings and communities is the first and fastest step to a less carbon intensive world. Engineers, architects, facilities managers and all those involved need to be united in their vision and in their approach to delivering that vision, while building users must demand change, and show their desire for more energy efficient workplaces. We must speed up the process and make real headway now in order to have a fighting chance of reaching future targets".

Mike Simpson FCIBSE president,
Chartered Institution of Building Services Engineers

How can we help achieve this...

S & P Coil Products Limited have over 30 years of experience as specialist suppliers of heating and cooling equipment.

We have now combined market leading technologies to offer the most energy efficient heating and cooling solution available by seamlessly uniting the proven energy efficiency of radiant heating and cooling, with low carbon, optimised heat pumps.

Heat pumps have long been considered only in conjunction with underfloor heating systems due to the low water temperatures that they generated. While satisfying the needs of low carbon heat generation, the underfloor emitters suffer from high inertia that offset many of the benefits of the heat pump.

The latest generation of heat pumps provide the option for high temperature water generation up to 65°C along with reversibility for summer cooling and the possibility of building wide heat recovery in mid season.

The ideal partner to the heat pump is an SPC Radiant Conditioning Sail. Sails provide year round space conditioning and require only a relatively high summer chilled water temperature and relatively low winter hot water temperature thus allowing the heat pump to operate at its most efficient level. The heat pump system will operate at the same low water temperatures that are common for underfloor systems but with none of their disadvantages, only the added advantage of summer cooling.

Indeed, the new generation of heat pumps now allow them to be matched to the full range of SPC heat emitters; fan convectors, air curtains, trench heaters and heating/cooling coils. Heat pump solutions are now available for almost all heating and air conditioning requirements.

Gain BREEAM points with SPC...

BREEAM requires that new buildings be designed, built and operated in such a way as to minimise their carbon footprint. SPC radiant/heat pump solutions offer a number of key opportunities to raise the BREEAM rating of your building.

While BREEAM examines the overall energy efficiency of a building, particular features of an SPC radiant/heat pump system can be used to score particular credits under the system.

- Our radiant conditioning sails and panels can be used to create thermal zones by being part of a sophisticated building management system, or be individually controlled by the occupants. This allows BREEAM credits to be claimed.
- Heat pumps containing less than the threshold mass of refrigerant gain credit for maintaining the occupied space refrigerant free. SPC heat pumps, air or water source, only circulate water through the buildings that they serve.

The Perfect Combination

Radiant Conditioning with Heat pumps
– the perfect combination

The benefits of a coupled radiant/heat pump system result from the synergy that is obtained by matching the energy efficient principles of radiant conditioning to the set of water conditions which allow the heat pumps to operate at their most efficient.

THE FEATURES OF THE SYSTEM ARE OUTLINED BELOW:

- In cooling mode the radiant sails need their surfaces to be above the room air dewpoint. This means that the chilled water from the heat pump need only be delivered at around 15°C allowing it to operate at its most efficient.
- In heating mode the large surface area of sails need only a low temperature delivery of hot water i.e. 40°C to offset heat losses and hence provide perfect conditions to optimise the COP of the heat pump.
- Radiant conditioning warms/cools the surfaces and bodies within a space giving rise to higher resultant temperatures in heating mode and lower resultant temperatures in cooling mode. This allows the space air temperature to be lower in winter and higher in summer effectively reducing the heating/cooling loads.
- Radiant systems have very low inertia compared to underfloor systems and simple changeover between heating and cooling modes.
- Modern air source heat pumps can approach the efficiencies associated with ground source heat pumps and provide a very cost-effective option.
- As fossil fuel costs increase and the electricity grid becomes ‘cleaner’ running costs and carbon costs of heat pumps will be increasingly favourable.
- While heat pumps are at their most efficient with radiant systems, other emitters can be incorporated into the design where required; fan convectors, trench heating and air curtains have all been successfully employed.

When designing radiant conditioning/heat pump systems the number of sails and their size is determined by the cooling load on the space. Once the required surface area is determined the designer has free rein to design shape, colour and any other features required such as in-built lighting. While sails default to a rectangular shape with a white finish the alternatives are only limited by your imagination.

As the sails operate dry, a chilled water delivery temperature of 14°C to 18°C is ideal for optimising the efficiency of the heat pump in cooling mode. The large surface area of the sails is available for absorbing the radiant heat emitted from the bodies and surfaces in the room and also direct radiant gains through fenestration.

The area of sails available for heating means that the hot water temperatures can be low and at least on a par with those used for underfloor heating. These low temperatures allow the heat pump to deliver hot water at a temperature which matches that at which it operates most efficiently. It also optimises occupant comfort through a consistent but low overhead temperature and constant floor to ceiling space temperatures.

Sails can easily be zoned to achieve energy efficient control while heat pumps have the ability to incorporate weather compensation to match their water flow temperatures precisely to the heating or cooling load. This compensation can by characterised to match the parameters associated with radiant systems giving a fine degree of control with minimal energy wastage.

The combination of radiant conditioning sails and heat pumps can arguably provide the most energy efficient heating/cooling system currently available.

Thermatile Plus Radiant Panels
– efficient heating from above

Thermatile Plus Radiant Panels are primarily designed to be incorporated into false ceiling grids and intended for heating only systems where they are not required to provide summer cooling. They are available in a standard width to fit a standard 600mm grid but in a range of lengths and configurations to suit the output required.

The radiant portion of the output from a Thermatile Plus Radiant Panel is much higher than conventional radiators, convection heaters and underfloor heating systems giving rise to higher resultant temperatures (the apparent temperature sensed by occupants). This is a result of the radiant effect warming surfaces rather than air and is responsible for the space air temperature being able to be maintained at up to 3°C lower than other convective systems.

The result of the 3°C depression in air temperature is a typical energy saving of 15% and corresponding carbon saving. As radiant systems heat primarily at low level there is little of the stratification associated with convective systems and occupants are bathed in a constant temperature of air head to foot.

Thermatile Plus Radiant Panels work well with low water temperatures but require the number and size of panels to be sufficient to provide the necessary output. A favoured solution is to use a high temperature heat pump which minimises the number of panels required but has weather compensation features to maximise its efficiency when the heating load reduces.

Thermasail Radiant Conditioning Sails
– heating and cooling with style and efficiency

In the summertime Thermasail Radiant Conditioning Sails combine the high efficiency of a radiant cooling system with low velocity convective cooling; cooled air convects along the back of the panel and down into the room.

Thermasail Radiant Conditioning Sails are hung freely from the false ceiling or soffit with a minimum gap of only 60mm - so no problems with low ceiling applications. A Thermasail consists of a sandwich panel with no sidewalls or insulation to encourage convection of air across the upper face of the panel, maximising its cooling capacity.

While convective cooling adds to the available capacity and results in a typical output of 110W/m^2, the major portion of the room cooling is provided radiantly. The large exposed lower surface area of the Thermasails is available to absorb energy radiantly from all walls, floors, bodies and other surfaces that are at a higher surface temperature than the panel itself. As heat is absorbed from the surfaces their temperatures are reduced allowing comfort conditions to be maintained at space temperatures of around 2°C higher than conventional convective cooling systems.

As the space temperature is allowed to increase by 2°C the cooling load is reduced resulting in energy and carbon savings of up to 20%.

Thermasail Radiant Conditioning Sails provide a most attractive ceiling finish and are available in an almost endless range of sizes. Non-standard panel shapes can also be accommodated – think outside the rectangular box, and colours can be to your whim.

In areas where noise suppression is beneficial the Thermasail Radiant Conditioning Sail can be perforated and an acoustic lining fitted so as to absorb noise within the room. Holes can be cut within the panels in order to fit lighting modules or other features.

In winter the Thermasail Radiant Conditioning Sails are equally as effective in offsetting the heating load, providing comfort heating when supplied with low temperature hot water. The surface area of panel available for heating will be so high as to only require temperatures of 30°C to 40°C making them ideal for coupled with heat pumps.

Heat Pumps
– low carbon future proofing

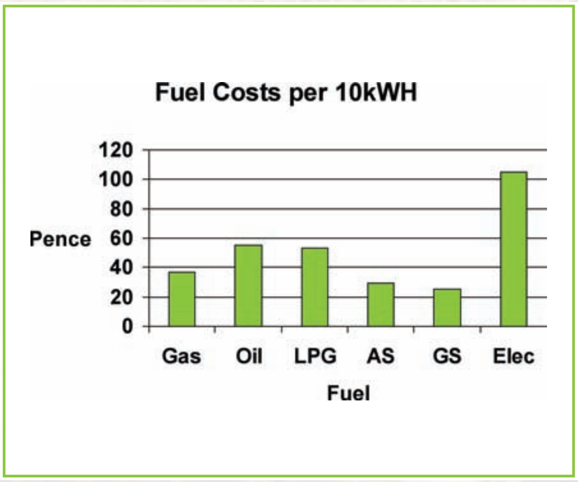
Heat pumps have been available for many years and their popularity has waxed and waned. Traditional shortcomings, however, have now been transcended and combined with the urgent need to reduce the carbon footprint of heating (and cooling) sources the heat pump is not only a common feature now but will become ever increasingly so.

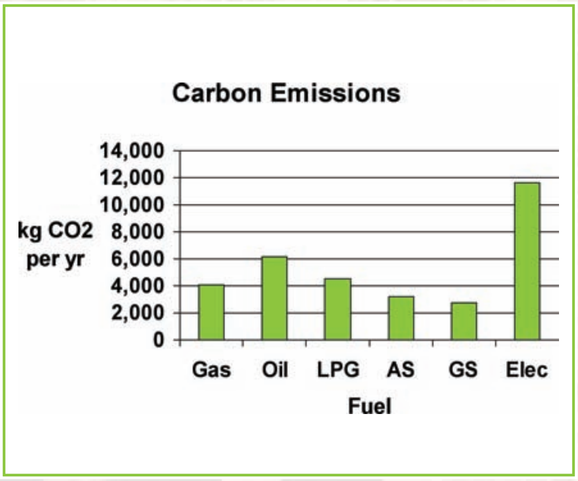
A heat pump transfers solar energy stored in the ground, water or air at a low temperature and converts it to high temperature water which can be used in heating systems and for generating domestic hot water.

While ground or water source heat pumps have the ability to operate most efficiently due to their higher storage temperatures, air source heat pumps are rapidly approaching the efficiency of these systems and combined with much lower installation costs will fast become the system of choice for many applications.
Air source heat pumps now provide COP values of over 4.0, i.e. four times as much heating energy is made available as energy is consumed in operating the heat pump.

Conventional heat sources burn fossil fuels and release carbon dioxide to the environment, the only carbon emissions associated with heat pipes are those that are linked to the generation of electricity fed to the national grid. A heat pump system, of whatever sort, will have a carbon footprint up to 40% less than that of a conventional natural gas boiler.

The charts below show indicative values of the cost of running heating systems with a variety of heat sources and the carbon usage of a typically sized installation. AS refers to an air source heat pump and GS a ground source heat pump.





Adoption of heat pumps into building designs will also provide a key to unlock the requirements of sustainable legislature; particularly part L building regulations and the credit worthiness of designs measured against the BREEAM rating system. Accredited heat pumps are also the key to qualification for subsidies based on the sustainability of the equipment.

THE ADOPTION OF HEAT PUMPS IS GROWING AND THE RANGE OF APPLICATIONS IS COVERED BUT NOT EXHAUSTED BY THE FOLLOWING:

- Schools and educational facilities
- Hospitals and healthcare facilities
- Leisure facilities and swimming pools
- Social housing projects
- Community projects
- Domestic dwellings

SPC offer a wide range of air source heat pumps and backs this up with a corresponding ground or water source offering. We also provide system ancillaries such as buffer tanks and hot water tanks and are available to advise through every stage of your heat pump and associated system design.

OUR RANGE IS CHARACTERISED BY THE FOLLOWING KEY FEATURES:

- Hot water delivery at up to 65°C with air as low as -12°C
- Heat pumps for heating and hot water plus the possibility of simultaneous cooling
- Heat pumps with dual heat exchangers capable of energy recovery and simultaneous heating and cooling
- Units operating down to -20°C
- Weather compensation to maximise the year round COP of the unit
- Reversible units for heating or cooling
- Up to 100kW in a single unit, up to 500kW in cascade systems
- Optimised defrost cycles for energy efficiency
- Advanced microprocessor controls with simple user interfaces

Carbon Saving

Carbon Saving

– a case study of radiant conditioning using heat pumps

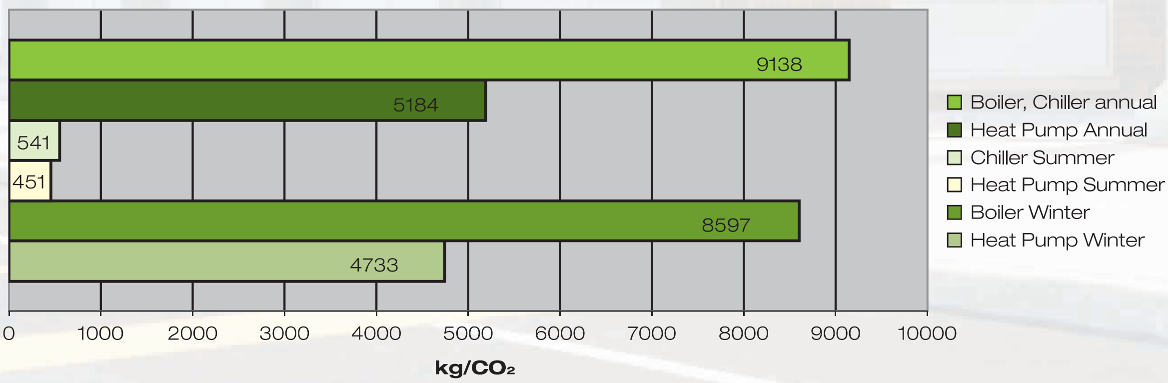
This study is based upon the actual installation of a reversible heat pump in a small/medium sized office space. The heat pump installation was combined with the fitting of an array of radiant sails to provide winter heating and summer cooling. The system replaced an old conventional boiler and wall mounted radiators plus an air cooled chiller and fan coil units used for summer cooling.

Winter heat loss is estimated as a maximum of 30kW when taking 99% worst case external winter temperatures and summer cooling load at 15kW. The adoption of radiant sails immediately reduces the winter heating load by 8% due to the radiant effect and reduced space air temperatures while the radiant cooling effect reduces the summer cooling load by some 20%.

The data shown below is based on the heat pump operating only during working hours with automatic switch over between summer and winter operation at 15°C. In winter the heat pump will deliver hot water to the sails at a flow temperature of 45°C and compensated down to 35°C as the ambient temperature rises. In summer the flow temperature will be 15°C to ensure no condensation on the sails. The tables below identify the outside air temperature against the number of working hours that the temperature is experienced and allow ready calculation of the total energy usage of the heat pump system compared to the previous boiler/chiller arrangements.

The figures for carbon emissions are based upon grid emissions of 0.562 $kgCO_2/kWh$ and natural gas at 0.206 $kgCO_2/kWh$. The chart shows that the heat pump system retro-fitted to the installation achieves a carbon reduction of 43% compared to the previous system of boiler and chiller. While this is a single example it is typical of the savings that would be expected.

Carbon Emissions Compared to Previous System



Conditions for heating season		Heat pump/sail system			Boiler/radiator system		
Outside air (°C)	Annual running hours	HP COP	Heat load (kW)	Total energy used (kWh)	Boiler efficiency (%)	Heat load (kW)	Total energy used (kWh)
-5.3	5	2.4	30.0	63	75	32.4	216
-2.5	6	2.6	26.7	62	75	28.8	230
0.3	128	2.8	23.4	1068	75	25.3	4318
3.1	239	3.1	20.0	1545	75	21.6	6883
5.8	405	3.4	16.8	2006	75	17.1	9234
8.6	531	3.7	13.5	1940	75	14.6	10337
11.3	433	4.1	10.3	1089	75	11.1	6408
14.2	416	4.4	6.9	650	75	7.4	4105
			Annual energy (kWh)	8422		Annual energy (kWh)	41731
			Annual carbon (kg CO2)	4733		Annual carbon (kg CO2)	8597

Conditions for cooling season		Heat pump/sail system			Chiller/fan coil system		
Outside air (°C)	Annual running hours	HP EER	Cooling load (kW)	Total energy used (kWh)	Chiller EER	Cooling load (kW)	Total energy used (kWh)
19.7	223	4.2	7.0	372	4.2	8.4	446
22.5	109	3.9	10.0	279	3.9	12.0	335
25.3	34	3.6	13.0	123	3.6	15.6	147
28.1	6	3.2	15.0	28	3.2	18.0	34
			Annual energy (kWh)	802		Annual energy (kWh)	962
			Annual carbon (kg CO2)	451		Annual carbon (kg CO2)	541

Scematic of a typical installation

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