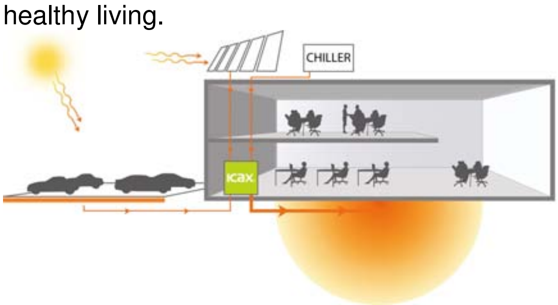
Renewable Energy Synergy

Going with the flow

The move toward zero carbon buildings is gathering momentum. Everyone would like to see zero carbon buildings, but it is not always easy to see how this can be achieved. There are now a number of different approaches that can be taken to reduce carbon consumption in new buildings.

The main energy demands from most buildings come from winter heating, summer cooling and electricity for lighting and computing. Part of these demands can be reduced by constructing well insulated buildings, sensitive use of natural lighting and careful control of lighting, heating and ventilation. These techniques can also be used to provide a sense of space and contribute to a comfortable internal environment conducive to healthy living.



Heat collection in summer

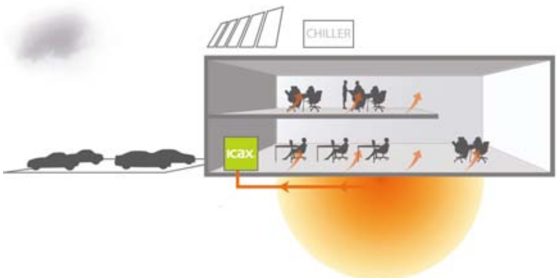
On-site generation of electricity is currently difficult because of the cost of photovoltaic panels, the large size of wind turbines needed for economic generation and the problems of storing electricity from the time it is generated to the time it is needed. Obtaining planning permission is also a big issue for big turbines.

Solar thermal panels for providing hot water offer a well developed technology with a low capital cost and a low running costs, but this is appropriate only for buildings with a need for large volumes of hot water.

Biomass boilers are often considered for heating because of their low initial capital cost. However, such systems require management and regular maintenance. They need a good local supply of biomass fuel and can raise health, safely and congestion issues in the regular delivery of fuel to the site. Because biomass boilers take time to heat up and cool down they are best suited to continuous operation: this is will not be a perfect match for buildings which are not occupied at weekends or in the evenings. A number of sustainability issues have also been raised recently in relation to using biofuels, so you will want to check that your source of fuel is local, reliable and not diverting resources from other sustainable objectives.

Ground source energy is increasingly being favoured as a good low carbon route to space heating. This option has strong merits where it can be designed into new buildings. There will be higher initial capital costs than the standard carbon emitting solution of providing heat from a gas boiler – or an oil boiler where no piped gas is available – but a Ground Source Heat Pump can deliver the ongoing benefits of lower running costs and lower maintenance costs, provided the GSHP is matched to a well insulated building designed to use underfloor heating. This derives from the ability of a heat pump to extract more heat from the ground than the electrical energy spent in powering it.

There is, however, a potential difficulty inherent in providing a well insulated new building: a good design for retaining heat in winter can also lead to excessively high internal temperatures in summer. Anything above 28°C is likely to feel uncomfortably high and the general view is that internal temperatures should be held to no more than 5°C above the external temperature. This forces architects to consider air conditioning in spite of capital budget constraints and all the adverse implications for running costs and further carbon emissions. The extra space that needs to be provided in new buildings to accommodate air conditioning equipment and ducts is so large that it is often hidden within more general building costs.



Heating from ThermalBank in winter

There is, luckily, an alternative approach which can help both with heating in winter and cooling in summer. This involves using ThermalBanks™ to store heat from the time it is plentiful (in summer) to the time when heat is needed (in winter). Equally a ThermalBank can store cold when it is in abundant supply (in winter) to the time when it is needed (for summer cooling).

Solar collector construction

Interseasonal Heat Transfer™ system from ICAX Ltd that can solve both winter heating needs and summer cooling needs – and do both with a low carbon footprint. Instead of solving each problem separately at a high carbon cost, Interseasonal Heat Transfer can solve both problems together. IHT balances the excess temperatures of each season with the extreme differences collected and stored from six months earlier. At the new Howe Dell School in Hatfield, the playground performs a second role as a solar heat collector in summer. Heat is collected from water pumped through a series of pipes embedded just beneath the sun baked surface and channelled down to heat the Thermal Banks found beneath the insulated foundation of the building.

ThermalBank installation at Howe Dell

In winter IHT takes advantage of the merits of Ground Source Heat Pumps to meet the heating needs of buildings by extracting the warmth from the Thermal Banks and delivering it to the building. Unlike a normal GSHP which starts with a cold temperature of around 10℃ from the ground, an IHT system starts with a warm temperature of around 25℃ from the Thermal Bank and, for this reason, it has less work to do and can extract the stored heat with a Coefficient of Performance (“CoP”) double that of a normal GSHP.

Interseasonal Heat Transfer can perform the same exercise in reverse to provide cooling in summer. IHT can collect cold from the playground on freezing winter nights and store this in a separate Thermal Bank for use in cooling a building in summer. This is radically less expensive than using air conditioning and chiller packs to try to “waste” the internal heat to the hot atmosphere outside in summer.

So IHT can “go with the flow” and perform a delicate temperature balancing act over the year, instead of fighting each need separately. This lateral approach saves money and saves carbon emissions. IHT can save over 50% of carbon emissions compared to using a gas boiler for heating. IHT can save over 80% of carbon emissions compared to using standard air conditioning and chillers for cooling.

Howe Dell School

The key factor here is the use of the ground to store energy. A standard GSHP extracts heat from the ground in the winter and creates a “thermal heat overdraft” in the ground. It relies on much of the heat gradually migrating back to replenish the “overdraft” over the course of the following summer. Unfortunately this only happens gradually as heat only moves very slowly through the ground and, as everyone knows, it can be unwise to live on a permanent overdraft. Interseasonal Heat Transfer takes advantage of the heat storing properties of the ground to deposit heat in the ThermalBank *in advance* of the heating season, when surplus solar heat is readily available over the summer. This makes it much easier (and cheaper) to extract heat from the ground when it is needed in winter.

Playground collecting solar energy

Although a ThermalBank can normally be constructed near the surface this will not always be possible or practical. Just as with a larger scale GSHP installation there times when a deeper thermal store is called for to achieve greater storage capacity and, in these cases, boreholes can be used to store heat in larger volumes of ground or ground water.

Interseasonal Heat Transfer represents a complementary fusion of two successful technologies: solar thermal collection and ground source energy. Sometimes the value of the whole can be greater than the sum of the parts.

Edward Thompson is a director of ICAX Ltd.
Interseasonal Heat Transfer™ has been invented, developed and patented by ICAX Ltd.
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