Interseasonal heat transfer

Generating renewable heat is easy in the summer, so why not store this for extraction in the winter when it's needed? Edward Thompson *reports on a technology which does just that.*

Of the various renewable energy technologies available it is noticeable that none of them, by themselves, add up to economic renewable energy. Wind turbines and photovoltaic cells provide electricity, but at a high cost (before subsidy) and only on an intermittent basis. If you can't use the electricity when it is generated you will not reap much benefit. And it is notoriously difficult to store electricity from the time it is generated until the time you need it.

With the renewable heat technologies there is a similar pattern: solar thermal panels can provide a lot of heat in summer – when you can't use much of it. Heat pumps are very good at transferring heat out of the ground in winter – until the ground is frozen and it yields less heat. What is urgently needed in this field is a mechanism for storing heat energy from the time it is freely available – in summer – to the time it is really needed – in winter.

ICAX has developed 'interseasonal' heat transfer to provide thermal energy storage and bridge this gap. It provides a solid heat bridge between summer and winter to transfer solar energy from the time of heat feast in summer, to the time of heat famine in winter.

The critical link is the 'ThermalBank.' Having observed that heat moves only very slowly in the ground, ICAX charges up a large body of earth with heat in summer as a heat store. The technology captures solar energy in summer (from solar thermal collectors, asphalt solar collectors or buildings) and transfers this heat to the ground using water channelled through an array of pipes in a borehole field.

Over the summer months the temperature over a large volume of ground can be built up from its natural level of around 10°C (in England) up to 30°C.

When space heating is needed for buildings in winter, the technology uses ground source heat pumps linked into the warm thermal bank to transfer heat back to the building. Recycling heat is much cheaper than burning fossil fuels to heat your building in winter, and it releases no carbon emissions into the atmosphere.

Hybrid renewable technology

Interseasonal heat transfer is therefore a hybrid form of renewable energy integrating the capture of heat energy with solar thermal panels in summer, storage of heat using thermal banks over the autumn and delivery of heat in winter using ground source heat pumps. The thermal bank is the vital link that finds a good use for solar thermal panels in summer and recycles that heat to double the performance of ground source heat pumps in winter.

The principles are simple but the management of heat transfer is critical and depends on a careful thermal modelling approach for each installation, which takes into account the local geology as well as the annual heating loads and cooling loads of each building.

Heating pipework and connections are insulated to a high level

Heat transfers are managed by the ICAX Skid which arrives on-site having been assembled and tested off-site. The skid incorporates heat exchangers, heat pumps, circulation pumps and an electronic controller which is connected to the building's heat distribution system and the thermal bank in the ground, as well as heat sensors at all critical points. The skid is also linked back to ICAX's head office by remote telemetry to enable the system to be monitored and fine tuned, as well as recording all heat transfers necessary for the owner to be in a position to claim the Renewable Heat Incentive.

The benefits of recycling thermal energy through a thermal bank are that you can cool buildings in summer without facing the horrendous cost of running roof-mounted chillers – because it is cheaper to allow heat to escape down to cold ground in summer instead of trying to 'waste' it into hot air. The by-product of this process is a block of warmer ground by the time winter arrives. This higher temperature in the ground can be exploited by a ground source heat pump which has less work to do to heat a building than an unassisted ground source heat pump starting with cold ground.

Case study – Wellington Civic Centre

A recent example is the redevelopment of the Wellington Civic Centre by the Telford & Wrekin Borough Council, which was opened in June. Interseasonal heat transfer has been installed to manage the heating and cooling of the buildings which incorporate a library, registry office, café, swimming pool and gym, as well as council offices. Heating demands are balanced within the building as well as between the seasons. A south-facing pitched roof acts as a solar thermal collector and supplies much of the heat needed by the swimming pool directly. Surplus heat is stored in the thermal bank installed beneath the car park. The skid is programmed to transfer heat from the source where it is most freely available (which may be the solar roof, the thermal bank or the atmosphere, depending on the season, the time of day and the weather) to the places where it is needed (to, or from, the swimming pool, changing rooms, gym, library or offices). ●

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