Scottish Government supports copper-intensive heat batteries for clean energy in buildings

The integration of solar PV and thermal energy storage is helping to decarbonize heating, particularly in the EU where there is an emphasis on upgrading the energy performance of existing buildings.

Renewable energy from solar PV and wind turbines is variable and unpredictable. Without any form of storage, it would be impossible to instantaneously meet the energy requirements of homes. Considering two-thirds of the final energy consumption in buildings is for heating/cooling and hot water, using thermal storage instead of electrical batteries makes sense. Heat storage traditionally occurs in insulated water tanks that take up a great deal of space. A new technology using a nontoxic material and copper tubes to store heat in a compact modular system is ideal for installation in old and new buildings.

Sunamp, based in Edinburgh, Scotland, has developed and commercialized super-compact, high-power heat batteries that achieve high-energy densities and, therefore, high compactness by using phase change materials (PCM). PCMs remain solid below a certain temperature and turn to liquid above that temperature. By changing phase, PCMs can store large quantities of heat around the melting/freezing temperature. To store heat, Sunamp uses a proprietary formulation of a nonflammable, nontoxic hydrated salt (based on sodium acetate trihydrate) with a phase change temperature of 58ºC (136ºF). Working with researchers at the University of Edinburgh, Sunamp determined how to make this low-cost salt operate consistently over the tens of thousands of cycles needed for decades of trouble-free operation in home heating systems.

If this PCM is heated to a temperature below the phase change temperature, its storage capacity is slightly lower than the same volume of water. If heated above 58ºC (ca. 136ºF), its thermal storage density skyrockets to four times that of the same volume of water. A heat battery charged with electricity from solar PV or the grid can deliver hot water at a cost comparable to a water tank but will take up one third the volume.

Copper heat exchangers embedded in the PCM are a key element of Sunamp's technology. In fact, copper pipes are in contact with the PCM to maximize the heat transfer between it and the circulating heat transfer fluid, e.g., water. Copper has a few properties that make it ideal for this application, including high thermal conductivity, lack of corrosion when in contact with the PCM, and the ability to satisfy potable water regulations required to fully certify Sunamp's products.

In homes with solar PV panels, any additional renewable electricity is usually exported to the grid. While this has been incentivized to facilitate adoption of solar PV panels, its success can cause issues to the electrical grid originally engineered to deliver electricity to our homes from large, centralized power plants, not the other way around. Storage is paramount importance to maximize the self-consumption of solar electricity in homes.

To tackle space heating with solar PV, Sunamp heat batteries can be integrated with very efficient air-source heat pumps. Heat pumps are a green way to heat homes, producing up to four units of heat for each unit of electricity; they act as solar amplifiers, displacing fossil fuels normally used for home heating. Compact heat batteries are the ideal addition to such system, allowing heat pumps to work better by reducing start/stop cycling and permitting the use of a smaller, less expensive unit.

The use of PCMs for thermal storage also applies for space cooling, and Sunamp will soon release cold PCM batteries for residential space-cooling applications. An example of such a system can be found in the project Heat4Cool, developed with the support of the European Community in the H2020 framework. This system is expected to deliver significant savings in CO_2 emissions related to heating and cooling and is expected to be used in retrofitting and new construction.

The smallest Sunamp heat battery cell stores up to 2.5 kWh of heat, equivalent to around 50 liters of hot water. Larger units provide up to 80 kWh of storage (equivalent to over 1500 liters of hot water) to meet the needs of a house, office or farm.

The Scottish Government is the first to include heat batteries into an interest free loan scheme to make energy-saving improvements. Heat batteries can last 10 times longer than battery systems and have a lower installed cost.

Sunamp founder and chief executive Andrew Bissell is pleased with the support they have received from the Scottish Government and notes, “Hopefully, other governments will follow Scotland’s lead so consumers everywhere can benefit from heat batteries to cut energy consumption.”

Sunamp founder and CEO Andrew Bissell with the copper inside the company’s heat battery.

A heat battery cell is one third the size of a comparable water storage tank. The cells come in multiple sizes and can be connected to reach the desired level of energy storage