MONASH University

MONASH INNOVATION

RENEWABLE ENERGY STORAGE SYSTEM

A cost effective and efficient energy storage system based on thermal energy. The system closes the gap in operating temperatures, using novel Phase Change Materials to link an Organic Rankine Engine with renewable energy sources.

- **Renewable energy storage using novel Phase Change Materials**
- **A system - storage linked Organic Rankine Engine and thermal energy sources**
- **Residential or modular for industry**
- **Cheap and efficient energy conversion**

THE CHALLENGE

The current challenge to move away from carbon-based energy generation has shifted to renewable, sustainable energy sources. The problem with these solar, wind, wave and other technologies, is the need for reliable, cheap storage of the energy for later use.

Domestic Individual or Community: Batteries have limited life spans and are costly; there are also potential AC versus DC issues as well as the possibility of power surges. For community use, there also presents the issue of physical space required for the large number of batteries needed.

Industry: For many industries a large amount of low grade thermal energy is wasted in the form of heat. This heat cannot be utilized by many existing thermal storage solutions, as they are geared to high temperature applications (>400°C). In addition, a standalone Organic Rankine Engine (ORE) is not effective in many industries, where the heat is generated in batch processes.

THE TECHNOLOGY

Phase change materials for energy storage are well known for high temperature operations (>300°C) and ambient temperatures (-20 to 100°C), but have not been developed for the 100 - 250°C range. This temperature range has been recognised as critical for storage of solar thermal energy, waste or low grade heat from industry, or excess wind energy. The stored energy can be used to power an ORE to generate electricity on demand, along with hot water heating and space heating or cooling.

Such an energy storage system can be implemented alongside a vacuum tube solar thermal collector as a stand-alone solar generator and storage system.

In a complete modular system for remote areas, the system could be connected to a downsized diesel generator, where it could also utilise the waste heat from the diesel engine and provide supplementary peak power and back-up power to the system.

Our combined system (Fig.1) using novel Phase Change Materials (PCMs) offers a cheaper, more reliable alternative to current options:

- Lowering of CO_2 emissions and maximised green energy
- Reduction in peak load demand
- Improvement in the overall efficiency of the energy system by balancing the fluctuating demand for energy
- Minimised usage of expensive 'peak high cost' energy

We will be developing a proof of concept system:

- that contains 30kWh of stored energy
- has a 2 kW ORE
- is coupled to a heat energy source

Intellectual property: Two Australian provisional patents filed in 2016.

THE OPPORTUNITY

The global thermal energy storage market has been valued at over US$0.6 bn and is expected to reach US$1.8 bn by 2020.

Monash seeks a partner to license and/or to carry out scale-up demonstration of the technology (50+ kW ORE for industry) and develop the large scale manufacture of the residential combined system.

The Monash research team is led by Prof Doug MacFarlane (Australian Research Council Laurate Fellow; ARC Centre for Electromaterials Science – Energy Program Leader). Prof MacFarlane and his team are experts in the development of new chemical entities for energy and other uses.

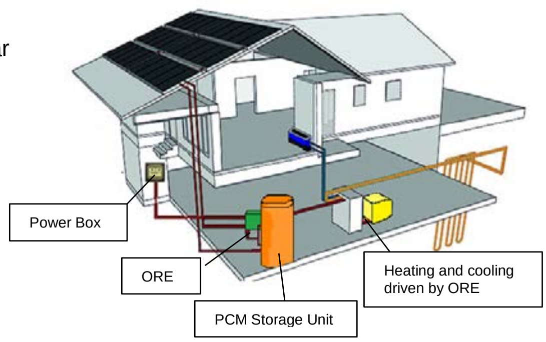

Figure 1: Schematic showing our proposed thermal energy storage system.

Table 1 : Thermal properties of promising Phase Change Materials (PCMs)			
PCM	**Tm (°C)**	**ΔH_f (J/g)**	**ΔH_f^v (J/cm^3)**
PCM 1	164	145	204
PCM 2	109	134	186
PCM 3	138	135	171
PCM 4	123	112	168
PCM 5	125	107	137
PCM 6	102	93	130
PCM 7	207	76	117

Reference

R. Vijayraghavan et al, Protic Ionic Solids and Liquids Based on the Guanidinium Cation as Phase-Change Energy-Storage Materials, *Energy Technol*. 2013, 1, 609 – 612.

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