



Energy Expertise

// Thermal Energy Storage

Main expertise areas

- Low grade heat utilisation
- Thermochemical thermal energy storage solutions
- Novel thermodynamic cycle development for heating and cooling
- Solid-liquid two phase flow and heat transfer
- Passive PCM thermal management
- Compressed Air Energy Storage
- Geological Thermal Storage
- Seasonal solar thermal energy storage
- Liquid Desiccant Waste Heat Recovery
- Combined heat and power systems incorporating thermal energy storage

Background

Space heating and hot water account for about 33% of the total energy consumption of the UK economy, and natural gas is the main energy source for space and hot water heating in the UK. To reduce CO₂ emissions and improve energy efficiency and security, low carbon technologies for both active heating and thermal energy storage are needed.

Thermal Energy Storage (TES) utilises the properties of different materials to store and release heat, which can provide a wide range of benefits, such as supporting the efficient use of renewable energy, enabling surplus heat recovery to reduce industrial energy use and decoupling energy supply and demand. Thermal energy storage is cheaper than electrical energy storage, and so is an important part of the solutions that will be needed to enable the net zero transition.

There are various categories of methods for thermal energy storage: Sensible TES, in which heat is stored through changing the temperature of a material, Latent TES, where heat is stored through a phase change of a storage material, Sorption TES, where heat is stored through a reversible reaction where a gas is adsorbed by another material, Thermochemical TES, where heat is stored through a reversible chemical reaction, and Geological storage, where heat is stored in a underground. DEI is undergoing internationally leading research in all of these technologies.

Research team

Huashan Bao, Assistant Professor Engineering, researcher with expertise in thermochemical sorption, seasonal solar thermal storage and low grade heat use

Jon Gluyas, Ørsted/Ikon Chair in Geoenergy, Carbon, Capture and Storage, geoscientist with expertise in geological thermal energy storage

Dr Janie Ling-Chin, Assistant Professor in Engineering, researcher with expertise in thermal management including liquid desiccant technology

Dr Zhiwei Ma, Assistant Professor (Research) in Engineering, expert on low grade heat use, thermodynamic cycle development, and solid-liquid two phase flow for TES

Dr Julien Mouli Castillo, Postdoctoral Research Associate in Earth Sciences, with expertise in compressed air energy storage

Professor Tony Roskilly, Chair in Energy Systems, research expert of industrial decarbonisation and thermal energy storage

Dr Sumit Roy, Assistant Professor (Research) in Engineering, researcher with expertise in integrated smart thermochemical energy systems

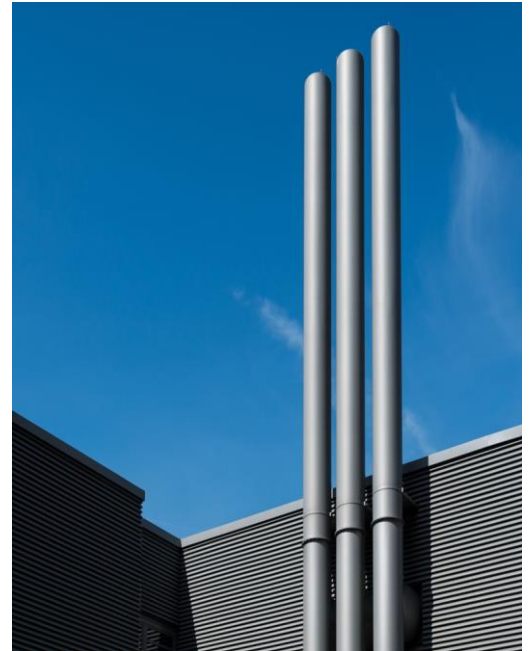
Dr Andrew Smallbone, Associate Professor and Director of EPSRC Network+ on the Decarbonisation of Heating and Cooling, expert in industrial decarbonisation

Dr Yaodong Wang, Associate Professor in Engineering, research in chemisorption TES



Examples of current research

- DEI are participating in the EPSRC funded project **Decarbonisation of Low Temperature Process Heat Industry** (Delta PHI), which includes a programme of research on routes to decarbonisation of heating in low temperature industrial process, including research into costs of heat storage and economic options for heat reutilisation, and the development of modelling to predict how technologies can be integrated to use heat across a multi vector energy systems
- DEI are leading the £1.01M EPSRC funded **Advanced hybrid thermochemical-compression seasonal solar energy storage and heat pump system** (Solar S&HP) project, which aims to develop a seasonal solar energy storage system that can effectively store abundant but relatively low temperature solar heat in summer and utilise this at the desired temperature for space and hot water heating in winter, using an advanced hybrid thermochemical sorption and vapour compression process to achieve sustainable and 'zero carbon' heating
- Collaborative project **UK-India Foundation Industries Sustainable Thermal Energy Management Collaboration** (UK-India FI-SusTEM Collaboration), between DEI and Amrita Vishwa Vidyapeetham, bringing together research at these two universities to explore possible innovative thermal energy management and waste heat utilisation solutions to transform foundation industries, which are significant drivers in both the UK and Indian job market
- DEI are leading the **Thermal Energy Challenge Network**, which brings together engineers, physical scientists, and social scientists working in a multi-disciplinary manner to improve thermal energy conversion and utilisation, supporting synergistic approaches which offer opportunities for improved sustainable use of thermal energy, taking account of the current and future economic, social, environmental and legislative barriers and incentives
- Tony Roskilly and Zhiwei Ma have recently given significant contributions to the 2022 **EERA Industrial Thermal Energy Storage – Supporting the transition to decarbonise industry** White Paper



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