

WARWICK
THE UNIVERSITY OF WARWICK

Sustainable Thermal Energy Technologies Laboratory

School of Engineering

Warwick's Sustainable Thermal Energy Technologies Laboratory connects both academia and industry with cutting-edge thermal energy research facilities and expertise. With an 80% reduction in greenhouse gas emissions by 2050 a priority for the UK, we're collaborating with industry to develop innovative, efficient low carbon heating and cooling technologies to help meet this target.

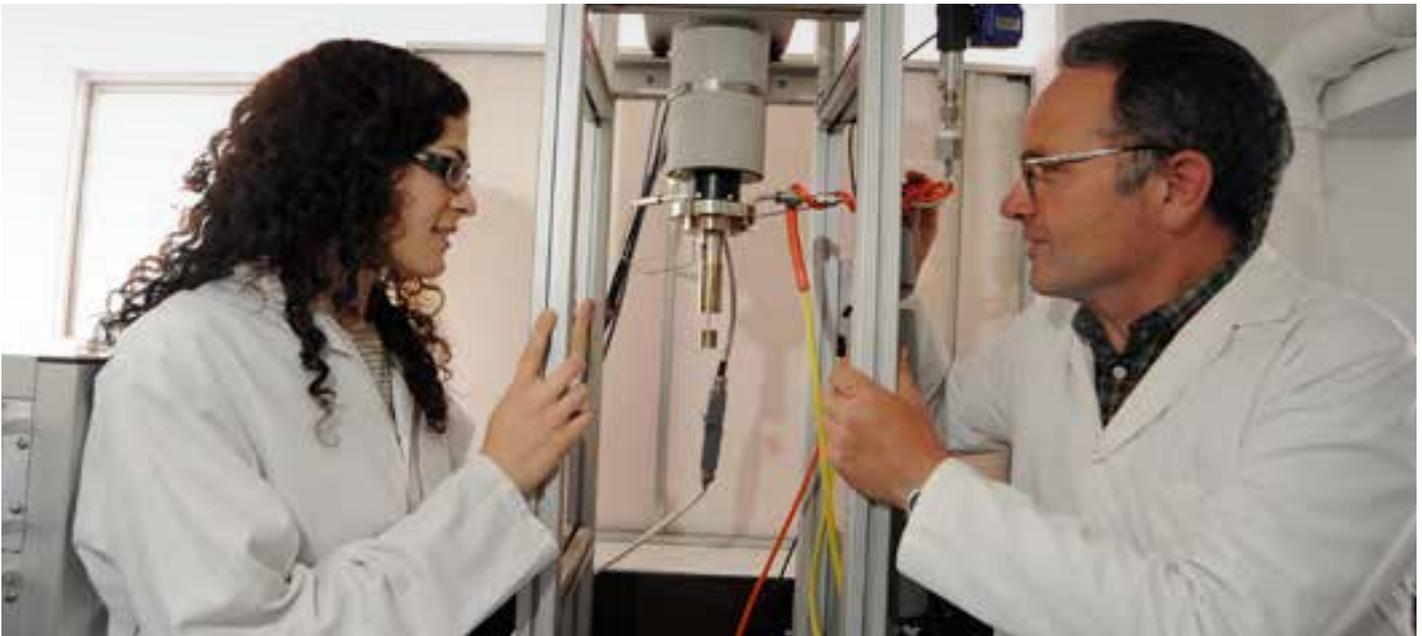
These include heat driven refrigeration, air conditioning and heat pumping systems, solar heating systems, thermochemical energy storage technology and materials with enhanced properties for use in these technologies.

The Laboratory's facilities are available for industry use to support innovation, and the research and development of products and services. Our team of experts can support your business with projects large or small, whether you need product testing on an individual basis or a pilot-plant facility to investigate scale-up of new system technology.

The Laboratory's research and development facilities include:

- ▶ A **Thermal Properties Lab** to evaluate the conductivity and thermal storage characteristics of materials
- ▶ A **Thermal Technologies Lab** to develop novel thermal stores and thermal compressor designs
- ▶ **ThermExS Lab** to test heating and cooling technology on a pilot-plant scale
- ▶ **Environmental Chambers** to provide a temperature and humidity controlled environment to test heating/cooling devices
- ▶ A **Solar Development Lab** including solar simulators for PV cell and small thermal collector testing
- ▶ A **Solar Systems Lab** including a large area continuous solar simulator to evaluate the performance of solar thermal and photovoltaic systems.

To find out how your business can access our outstanding facilities, contact Dr Stan Shire on **024 7652 3118** or stan.shire@warwick.ac.uk.



Thermal Properties Lab

The Thermal Properties Lab is designed for material testing, including conductivity and adsorption measurement. The Lab is set to receive funding from T-ERA, which will extend the Lab into five newly-refurbished test cells to accommodate additional equipment for analysing thermal properties of materials.

Equipment:

- Anter steady state guarded hot plate thermal conductivity meter
- Hot Disk transient plane source thermal conductivity (specific heat and thermal diffusivity) meter
- Differential scanning calorimeter
- Rubotherm magnetic suspension balance (for weighing material samples in a temperature and pressure controlled gas environment)

In action:

- Conductivity of diamond-like carbon coated surfaces
- Conductivity of floor screeds
- Thermal capacity of phase change materials
- Adsorption coefficient for materials used in heat pumping and energy storage systems
- Thermal conductivity of steel crucibles for metal casting
- Phase change material testing
- Calorimetry of cement during setting to measure the effect of accelerants

New T-ERA funded equipment:

- Xenon flash thermal conductivity measurement
- High temperature guarded hot plate thermal conductivity meter
- High pressure simultaneous thermal analysis (STA) - Differential scanning calorimeter (for corrosive gases) with thermo-gravimetric analysis and evolved gas analysis
- Calorimeter
- Dilatometer

Thermal Technologies Lab

The Thermal Technologies Lab works to develop novel thermal stores and thermal compressor designs. This Lab is also set to be extended with funding from T-ERA, providing further test equipment and control/data logging facilities. The Lab will also be able to investigate how real world conditions and system dynamics can influence the performance of new technologies, and vice versa.

Equipment:

- Bench scale (1-2kW) heating and cooling
- Flow rate, temperature and pressure measurement

In action:

- Developing compact ammonia storage technology for vehicle applications
- New thermal compressor designs for solar refrigeration
- Design and testing of novel thermal stores

New T-ERA funded equipment:

- Heating and cooling baths, flow meters, temperature and pressure sensors with new data acquisition equipment
- Prototyping equipment (micro-TIG welder, laser cutter)

Thermal Energy Research Accelerator (T-ERA) Funding

Warwick is part of the Energy Research Accelerator (ERA), a multimillion pound research hub building on the expertise of six leading Midlands universities, the British Geological Survey and the surrounding industrial base, and supported by £60m of government funding for energy research.

Part of the Thermal Energy Research Accelerator (T-ERA) research theme, the Sustainable Thermal Energy Technologies Laboratory has recently received funding of £1.95m through InnovateUK to develop the facilities available within its labs. The funding will be used to enhance and extend the range of equipment and laboratory space that is already in place, thanks to recent funding of £310k from EPSRC and around £2m from ERDF/AWM.

ThermExS Lab

The ThermExS Lab is designed for testing and evaluating a range of medium-sized thermal energy storage systems.

Equipment

- Pilot-plant scale heating and cooling (up to 10kW and 250°C) for testing performance and behaviour of thermal storage and transformer technology

In action:

- Thermal compressors for gas fired domestic heat pumps
- Thermochemical heat stores



Environmental Chambers

The Environmental Chambers facility enables development and testing of new heating technologies.

Equipment:

- Temperature and humidity controlled environment for testing heating/cooling devices and building fabric

In action:

- Phase change material wall boards (heat flux, storage and temperature regulation)
- Advanced radiator designs (heat transfer mechanisms on each face under varied connection and operation)
- Gas fired heat pump (evaluating COP and performance characteristics)

Solar Development Lab

The Solar Development Lab enables research and evaluation of heat transfer and optical efficiency in solar thermal panels.

Equipment:

- Solar simulator for photovoltaic (PV) cell testing
- Solar simulator for small thermal collectors (0.5*0.5m)
- Spectrometer and pyranometers for evaluating solar radiation
- Optical characterisation equipment for evaluating visible light transmittance of cover materials
- Emisometer for characterising selective surfaces

In action:

- Solar snow-melter design and development for the British Antarctic Survey
- Solar air heater development
- Solar thermal (water) collector development (CK Solar, Sertec)



Solar Systems Lab

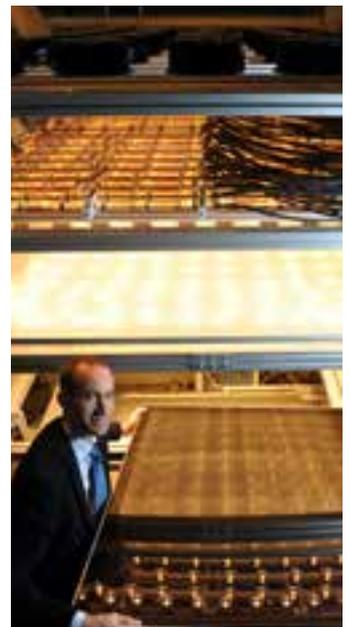
The Solar Systems Lab enables testing of both photovoltaic (PV) and solar thermal systems, and evaluation of solar collector performance.

Equipment:

- Large area continuous solar simulator
- Outdoor test site
- Weather station and radiation monitoring

In action:

- PV panel testing for many companies
- PV system testing and comparison for New World Solar
- Solar thermal collector testing and development for Sertec and CK Solar
- Combined photovoltaic and thermal (PV/T) collector testing (Abacus solar)
- Long-term ageing test of commercial panels



Thermal Performance of Metal Melting Technology

An independent, privately-owned steel foundry company in the West Midlands came to Warwick's Sustainable Thermal Energy Technology Laboratory for support to measure the conductivity of metal crucibles used for melting materials.

The company had developed a new metal melting crucible design utilising an alternative metal alloy to improve waste reduction and reduce environmental impact, and they needed to convince a major customer that the material would meet their requirements for thermal performance.

Our team measured the thermal conductivity of the samples using two independent techniques, a steady state guarded hot plate thermal conductivity meter and a hot disk transient plane source thermal conductivity meter, to ensure accuracy of results.

Our work enabled the company to demonstrate their high technical competence and understanding of the thermal performance of metal melting to their customer, and was invaluable in steering their future product development.

Design and Testing of Advanced Thermal Storage

British Gas, South Tyneside Homes and Spirax Sarco were interested in developing new storage technology that could be retro-fitted to heat pump installations to make use of off-peak electricity and generate savings, and approached Warwick for assistance with developing different thermal storage designs.

Modular stores were developed that were constructed from polypropylene sheets containing narrow channels carrying water, with thin walled sheets forming an effective plate heat exchanger. However, although polypropylene is lightweight and chemically resistant, it is difficult to bond.

We investigated different thermal energy storage materials and exchanger designs to overcome the issue of providing a low cost modular storage system that could be retro-fitted in unused spaces.

We identified and tested suitable storage materials and demonstrated the efficacy of the heat exchanger design. We used experimental results to develop a validated system performance model that was used to predict potential economic savings.



To see how we can help your business, contact Dr Stan Shire on 024 7652 3118 or email: stan.shire@warwick.ac.uk.