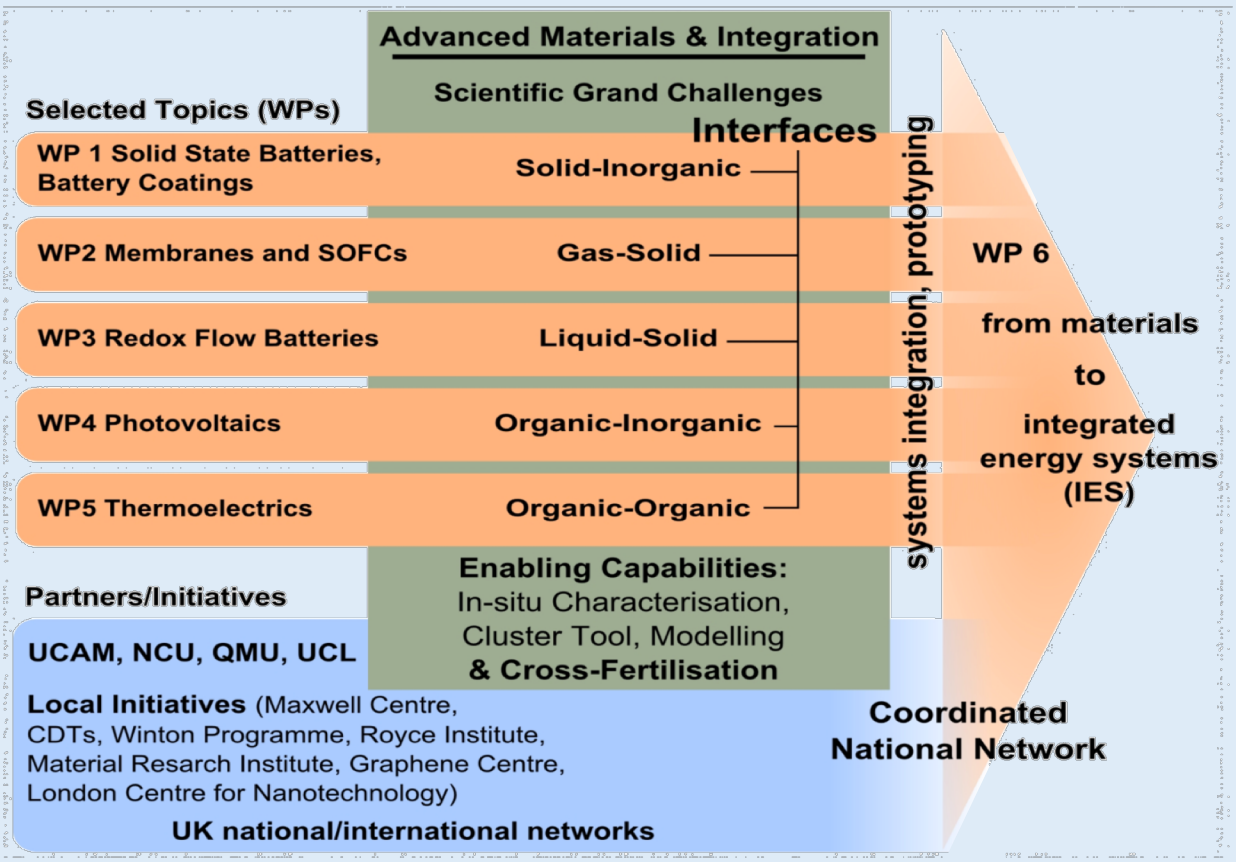
# CAM-IES

Centre of Advanced Materials for Integrated Energy Systems

- Partnership between UCL, Newcastle University, Queen Mary University, and University of Cambridge, with ten industry partners
- CAM-IES is one of six national networking Centres established by EPSRC in 2016
- £2.1 M grant with matching funding from industry
- Four year grant from 1 Dec 2016 until 30 Nov 2020
- Focus on development of advanced materials for energy generation, conversion, storage, and efficient energy use



## CAM-IES Co-Investigators

**Prof Clare Grey** (Director and Principal Investigator, University of Cambridge)
**Prof Ian Metcalfe** (Co-Director, Newcastle University)
**Prof Henning Sirringhaus** (Co-Director, University of Cambridge)
Prof Judith Driscoll (University of Cambridge)
Prof Stephan Hofmann (University of Cambridge)
Prof Sir Richard Friend (University of Cambridge)
Dr Sian Dutton (University of Cambridge)
Dr Sohini Kar-Narayan (University of Cambridge)
Dr Hugo Bronstein (University of Cambridge)
Prof William Gillin (Queen Mary University of London)
Dr Christian Nielsen (Queen Mary University of London)
Prof Franco Cacialli (University College London)
Dr Tracey Clarke (University College London)
Dr Bob Schroeder (University College London

**Henry Royce Institute facilities, University of Cambridge**

## CAM-IES Industry Partners include:

American Institute of Physics
Applied Materials Inc.
Arm
Cambridge Display Technology
Deregallera
Dyson
Eight19
Johnson Matthey
National Physical Laboratory
Siemens
Shell
Tata Steel

## CAM-IES Achievements

- Developed strong modes of collaborative working and networking, via identifying synergies between research topics within the energy materials space, resulting in new cross-cutting projects

- Created a thriving UK community of researchers, focused on materials for integrated energy systems, industry collaboration and knowledge exchange, and development of new research directions for energy technologies and ideas

- Provided access to state-of-the-art equipment for the wider community, for energy materials characterization and deposition, that in particular benefitted early career researchers to gain further funding to accelerate research into new concepts and technologies


**Posters at the CAM-IES Industry Workshop, May 2019, University of Cambridge**

## Scientific Advances within Energy Materials field

Over the past three years, the broader energy materials community (including some CAM-IES collaborations), have made breakthroughs in three key areas in energy materials research:

1. Rapid developments in atomistic characterisation and growth of disordered/dynamic interfaces to understand and control the structure of materials for energy applications.

2. Improvements in the design of materials that can withstand non-equilibrium operational environments, through bottom-up control of how each atom/ion moves under different conditions, such as electrochemical potential, illumination, temperature or gas pressure change.

3. Recent discoveries of defect-tolerant materials/interfaces to enable disruptive and transformative impact on energy materials device performance.

# Cross-Cutting Research and Networking Activities

## 1. Funding Calls

- 2018: Redox Flow Battery projects of £100,000 each awarded to University of Glasgow, University of Nottingham, QMUL and Imperial College London, in collaboration with Superstore: The Energy Storage Supergen Hub

- 2018: Hydrogen Fuel Cell project of £50,000 awarded to Manchester Metropolitan University, in collaboration with H2FC Supergen

- 2019: Two Projects of £100,000 each awarded to University of Cambridge and QMUL for synergy projects for new energy applications

## 2. Synergy Webinars and Workshops

- Monthly webinars through 2018 for early career researchers to present initial results or ideas for new cross-cutting topics

- The more popular topics in this series were developed into UK-wide workshops throughout 2018 and 2019, to bring together early career researchers to network and find new collaborations with industry, and forge new links with other research centres e.g. Diamond Light Source.

## 3. CAM-IES Equipment Access Awards

CAM-IES has awarded access funding of up to £5000 to dozens of early career researchers to conduct projects using the Henry Royce Institute's equipment throughout 2018 and 2019. These awards have been vital to enable many postdoctoral researchers to be progress on to receiving advanced fellowships and lectureships. Examples include:

- *"Investigation of Jc of REBCO tapes for Fusion Applications",* Thomas Bedford, University of Cambridge

- *"PLD of Battery electrodes",* Nina Meddings, Imperial College London

- *"Doping, charge transport and thermoelectric performance of $CsSnI_3$",* Oliver Fenwick, QMUL

- *"Investigations of "Stressed" Guanidinium Substituted Mixed-Cation Perovskite Solar Cells",* Tom Macdonald, Imperial College London

# Industrial collaborations

- CAM-IES has numerous ongoing projects with its ten industry partners
- SINTEF has collaborated with CAM-iES researchers on developing supported molten-salt membranes
- Shell funds one PhD student on the synthesis of new molecules for redox flow batteries, under a CAM-IES Work Package.
- Shell funds one postdoctoral researcher under a CAM-IES Work Package, for research into investigating interfacial phenomena in redox flow batteries

**Patents and Spin-Outs**

- Spin-out company founded 2019: *Cambridge Photon Technology* (co-founders: Hugo Bronstein, Akshay Rao, Richard Friend, Neil Greenham)

- Patent application GB1905395.8 filed on 16 April entitled *"Thermoelectric Nanocomposites for Thermal Energy Harvesting".* Inventors: S. Kar-Narayan, C. Ou


**Cluster Tool Facility Meeting, University of Cambridge**

# Next Steps: CAM-IES “Big Idea”

In September 2019, CAM-IES members and affiliates used the Committee on Climate Change’s 2019 Report as the basis for proposing an EPSRC “Big Idea”, with the goal of bringing together the energy materials community to work towards developing commercial alternative renewable and sustainable energy technologies and associated energy distribution infrastructure. By developing such technologies, the zero-carbon 2050 target may even be achieved earlier than 2050, and may even put the UK on the pathway to net negative greenhouse gas emissions.

- Climate Change Report: based on current commercially-available sustainable energy technologies, the UK is capable of achieving net-zero greenhouse gas emissions by 2050
- The report states that it only explored technologies that are currently deployed, but anticipates that new commercial technologies are necessary, given the urgency to meet targets
- It is therefore vital to gain a better understanding of technological systems that are currently under development in order to bring them to commercial readiness, as well as to harness as-yet undiscovered materials systems and technologies, to reach Net Zero targets. Many of these technological systems and new materials are being investigated by CAM-IES and wider materials communities.

CAM-IES has been invited to further develop the Big Idea, and will submit a more detailed report to the Big Idea Panel in January 2020. CAM-IES plans to hold numerous workshops in 2020, as well as a larger conference to bring together different energy materials communities to work towards the common goal of understanding and controlling energy materials systems, in order to design viable energy technologies to contribute to net zero greenhouse gas emissions by 2050.

**CAM-IES has forged links with Diamond Light Source**