ANNUAL COLLOQUIUM 2019

THE BUILDING CENTRE, LONDON

About the Centre

The energy system is undergoing a major transition. Low carbon energy sources have an increasing role to play and accommodating them requires a new flexible and resilient energy system. The EPSRC and SFI Centre for Doctoral Training in Energy Resilience and the Built Environment will train the people who will lead this revolution.

The interactions between buildings, people and the energy they need will transform the relationship between supply and demand. Our domestic and non-domestic buildings will no longer be passive consumers of heat and power; instead, our homes and businesses will participate actively in an integrated, low-carbon supply and demand system. New technologies, smart controls and innovative business models will emerge that enable consumers to manage their energy use and support the buying, selling and storing of heat and power.

Energy security and the future zero-carbon economy may require an absolute reduction in demand. Our built environment will be transformed by the construction of new, ultra-low energy buildings and new ways of working, together with clean affordable energy will power our homes and transport systems.

Improving the health, well-being and comfort of our citizens, whilst achieving the energy transformation is essential. Productive workspaces and affordable, clean, safe homes ensure social equality and a vibrant economy.

The ERBE CDT will help realise this vision. It brings together world-leading academics from physics, engineering, the social sciences and economics to train our future leaders. It will provide them with a deep understanding of buildings, low and zero carbon technologies and the socio-technical context. ERBE graduates will lead, and drive change in government, industry, NGOs and academia.

The Centre builds on a decade of high-quality doctoral training to provide a new, bespoke PhD programme, which includes opportunities to work with leading researchers, projects integrated with industry, and a comprehensive skills and development programme.

Join ERBE as a student, partner, supervisor or supporter, and help us make a difference!

Prof Robert Lowe
(Director UCL)

Prof Kevin Lomas
(Director Loughborough)

Prof Brian Ó Gallachóir
(Director MaREI)

PhD students

Jalal Ahmed – PhD, UCL

After completing his undergraduate degree in Natural Sciences, Jalal completed an MSc in Sustainable Building: Performance and Design from Oxford Brookes University. He then worked as a sustainability engineer focusing on environmental modelling, renewable energy feasibility studies and building performance evaluation. Being interested in the environmental degradation of historic buildings, he is also a Conservation Volunteer with the National Trust. Jalal joined the ERBE CDT in 2019 with research interests in moisture and ventilation.

Scalable method to assess ventilation rates in dwellings

Knowledge of air exchange rates in existing buildings is increasingly important, especially in the context of retrofit. Retrofit interventions to improve the energy efficiency of a dwelling will most likely lead to a reduction in air exchange through infiltration, and it is important to ensure that this does not negatively impact the overall background ventilation rate in the building.

There are many established techniques for measuring and characterising air exchange rates in buildings. Despite this, there is currently very little data available regarding ventilation rates of existing dwellings in the UK. This is partly due to the complexity and cost of deploying established techniques, e.g. tracer gases, at scale.

However, through the increasing uptake of smart thermostats it is likely that temperature and humidity data will be available for large numbers of dwellings in the future. This project aims to explore how this data can be used to estimate ventilation rate. Provided both internal and external hygrothermal conditions are recorded, the resulting vapour pressure excess, i.e. moisture content rise above external levels, can be derived. Since vapour pressure excess is effectively a function of internal moisture generation and ventilation effectiveness, estimates of ventilation rate can theoretically be made using vapour pressure excess.

Hani Alkhatib – PhD, MaREI – TU Dublin

Mechanical engineer with Master of Science in Energy (Distinction grade) from Heriot Watt university worked in the buildings field at a construction and consulting company in UAE. Done Various project in the building energy field such as: Protecting FPC from overheating using coating; Cleaning PV using Innovative Technology System (Funded by USAID); Case study: Design a CPV to provide cooling in UAE; Case study: Validity of using Different heating systems in JU building in Jordan; Design a 4 cylinder sterling engine. Took external courses related to presentation qualifications, time management, and in entrepreneurship and innovation, Interested in researches related to building efficiency applications and innovations.

Adaptive Building Fabric as a Cyber-physical System for Energy Efficient Buildings

New materials have enabled building facades to collect, store and re-direct energy to achieve zero-carbon emissions. This PhD research project will examine data requirements, control strategies, specific adaptive building fabric elements, the building's heat and electricity distribution systems, energy use devices and sensors using (i) building simulation models, (ii) experimental work on a room-scale test cell to provide measured data on the control parameters of adaptive fabric elements and (iii) validation data sets for comparison with simulation outputs of real building case studies. The objective is to contribute to optimization of cyber-physical facade - ICT systems in buildings.

Shyam Amrith – PhD, UCL

Shyam graduated from UCL in 2018 with a Physics MSci. Throughout his degree, he had a strong interest in both thermodynamics and the need to tackle climate change. The ERBE CDT was a perfect opportunity to combine these two interests. With experience in programming, he will be working on simulating and optimising the performance of the building stock.

Simulating and Optimising the Performance of the Building Stock

This project proposes a further development of 3DStock and SimStock in association with Bentley Systems, a leading global provider of software solutions for the design, construction, and operations of buildings and infrastructure. The aim is to develop automatic processes that allow the future evolution of the UK building stock to be forecast, emulated and the resulting energy and environmental performance to be predicted. These processes will allow future scenarios in which new buildings are constructed to every increasing standards of performance and existing buildings are retrofitted to reduce carbon emissions and improve indoor environmental quality. Modules will be developed to evaluate the costs and benefits of these scenarios, considering direct costs and other social costs and benefits. Emerging techniques such as genetic algorithms will be employed to identify optimal approaches to reducing carbon emissions whilst maintaining, in many cases improving, indoor environmental standards at least overall cost. The resulting models will be used to explore policies and regulations options aimed at achieving net zero carbon emissions by 2050.

Benjamin W. Atack – PhD, Loughborough University

Over the past five years has worked as the Technical Director for a SME developer and assisted with the design and construction of 17 low energy residential dwellings – with more to follow.

Has a passion for low carbon construction and the application of innovative technology to the built environment. A focus on the energy demand in the design of dwellings and an understanding of the building regulation requirements / technical standards required for integration of innovative technology to the built environment.

Currently enjoying the expanding of his horizons through the Energy Resilience and the Built Environment CDT programme while considering potential PhD topics.

Yusuf Oladipupo Bilesanmi – PhD, Loughborough University

Yusuf has a BSc in Information and Communications Technology and an MSc in Information Systems (Smart Grid) from Ritsumeikan Asia Pacific University (Oita, Japan) and Waseda University (Tokyo, Japan) respectively. He worked with Panasonic Corporation as a Market and Life Research Analyst and with Mitsubishi Corporation as a Business Lead for Power and Infrastructure developing projects across OECD and Non-OECD Markets. He later did a post-graduate at Cambridge University (CISL) on Corporate Sustainability and ran a startup supporting power generation in the UK energy market. Presently, he is taking up a PhD under the ERBE program.

Eleni Davidson – PhD, UCL

Eleni obtained a MEng in Biochemical Engineering from UCL in 2018. She has since gained experience working in communications, helping to manage public engagement for high-profile clients in the biopharmaceutical sector. She also worked as a technology consultant for a UCL tissue engineering start-up at the Royal Free Hospital, building a technological solution to complex tissue donation pathways. Eleni decided to pursue her ongoing interest in Architecture and Sustainable Design and recently started a PhD with an innovative architecture company holding a deep interest in sustainability. She hopes to draw on her broad range of experiences, both communicative and technical, in this well-balanced project.

Healthier Higher Education Buildings and Campuses in the Context of Climate Change

Higher education buildings are complex, dynamic, socio-technical systems seeking to provide solutions to a multitude of conflicting design and operational issues. At a basic level, the built environment is fundamental to the occupants' sense of wellbeing. The aim of this research is to investigate physical factors that may influence mental stress levels and other disturbances to the health, comfort and wellbeing of occupants in higher education systems. Experimental measures will be used in conjunction with thermal dynamic simulation to investigate the potential future impact that climate change may have on the health of occupants in these environments.

Shimon Shai Hassid – PhD, UCL

Shai is a electricity sector economist with five years of experience in GB and EU energy policy and regulation. He is currently working as an electricity market modeller at BEIS alongside his PhD studies at UCL. Prior to that Shai worked at Ofgem and PA Consulting on topics ranging from electricity markets design and regulation, to electricity markets modelling and transaction advice. In 2015 Shai completed an MSc in Economics and Policy of Energy and the Environment at UCL with Distinction, looking at the relationship between electricity markets openness and their ability to balance the electricity trilemma.

Understanding the sources of value in emerging and future energy systems

Decarbonisation of energy supply is leading to significant changes in energy systems around the world. One important change is the increase in variable renewable generation which affects the availability and price of electricity at different times. Demand side flexibility services are needed including demand management and storage, in order to utilise this renewable energy. To ensure these services flourish, providers of demand-side flexibility must be rewarded in a way that recognises their value to the energy system as a whole.

To provide an effective energy system, it is important to understand how prices could change in the future and provide incentives for new services for customers. A key step is to distinguish clearly between market value and the value of new flexibility services to the system. Market value depends on current tariff and contractual structures, and may not fully reflect value to the system. Value to the system is in principle dependent on technology costs (on the demand and supply side), changes in network infrastructure, and regulations and policies. This value may be obscured by existing contractual and regulatory arrangements, and therefore be unrealisable to consumers, innovators and other market actors. Value to the system is also path dependent, because infrastructures and policy frameworks are difficult to change quickly

Adria Martin Vilaseca – PhD, UCL

Adria is an architect graduated from Universitat Politecnica de Catalunya and holds an MSc in Environmental technology from Imperial College London. Adria has working experience in the building and energy sectors. Through his career, he got involved in energy efficiency planning for local and national governments. He has also collaborated in two European projects analyzing barriers and triggers to energy efficiency uptake in residential buildings and measuring fuel poverty. He is currently studying at UCL as a member of ERBE CDT.

Human-centered control of low carbon heating

To help meet our commitments to radically reducing our greenhouse gas emissions, the UK is committed to decarbonising heating. However, this is likely to increase strains on the energy network. To reduce these strains, heating needs to be more flexibly provided, including shifting or reducing heating demand. However, humans driving technology drive heating demand. Consequently, this is a socio-technical challenge and requires interdisciplinary insights.

Most Home Heating Controls are designed for technology; they require humans to communicate with them in technological terms - temperature, time and occasionally space. Although the purpose of this technology is to provide comfort to the occupants, we know very little about what thermal comfort means to householders, what sensations and preferences matter to them, the scope for gauging these subjectively and objectively, whether these can be communicated to heating controls, and whether they can be translated into heating system actions and/or communications with householders. This PhD will establish the groundwork for Human-centred Comfort Controls, designed for householders in relevant terms that are meaningful to them.

Orlaith McGinley – PhD, MaREI - National University of Ireland, Galway

Graduated with First-Class Honours Bachelor's degree in Project and Construction Management.

Completion of research projects over my undergraduate studies, including my Thesis entitled 'Retrofitting of Existing Buildings to Improve Comfort and Reduce Energy Consumption' and the 'Galway City Council Retrofit Project', have driven my passion for research within the area of energy in the built environment.

Research interests include the maximisation of building energy efficiency benefits, within an economic, social and environmental context, and in particular, the role of the occupant in such.

PhD project will focus on the maximization of building energy efficiency benefits, within an economic, social and environmental context, and study the influence of occupant behaviour, perceptions and interactions within buildings on such.

Charlotte Shields – PhD, Loughborough University

Charlotte is an Anthropologist with an interest in the interface between technical solutions and the socio-cultural landscape, which was sparked during the final year of her undergraduate degree at Durham University. She holds a Masters in Urban Design and Planning and is interested in the ways in which human behaviour can be shaped by interventions, and the need to understand the subjectivities of the human experience in developing solutions for sustainable energy use

S M Shahnewaz Siddiquee – PhD, MaREI - University College Cork (UCC)

S M Shahnewaz Siddiquee has received his MSc and BSc degree from Kyungpook National University, South Korea and International Islamic University, Chittagong respectively. Prior to joining UCC as a Ph.D. student, He was with Power System and Smart Energy Network Lab at KNU as a research assistant, working on projects primarily focused on Energy Management in Buildings and Machine Learning Applications in Smart Grid. His research interest includes Building Energy Management, Machine Learning applications in Smart Grid, Energy Economics, V2G technology and Prognostics in Smart Grid.

Optimizing Demand Side Response in Smart Grid Applications

Environmental issues related to global climate change as well as carbon emission have driven us to adopt policies to increase the share and utilization of renewable energy sources in electricity generations. As a result, a steady increase of renewable energy integration with the smart grid has been observed in which renewable energy sources are pre-dominantly Solar and wind energy. In this research, an in-depth study of grid integration of renewable energy sources with energy storage sources and different controllable loads will be considered under a virtual power plant (VPP) scenario. The associated challenges and benefits of VPP will be evaluated under different case studies. The uncertainties in renewable energy generation bring new challenges in grid balancing and stable operations. Demand-side management is an essential feature that enables intelligent control of electric loads in order to maximize the utilization of DERs by matching the electric load with generated power. Different DSM approaches will be studied considering different optimization criteria such as minimizing emission, maximizing profit for DER owner

Kumar Raushan – PhD, MaREI – TU Dublin

I am an Architect with 5 years of field experience; I have been involved in various projects ranging from designing of public buildings to building performance analysis of corporate & institutional buildings. I have an M. Arch. Degree in Sustainable Architecture from CEPT University. Earlier I was employed by the Government of India. As a government, Architect I have been involved in policy-level interventions. I am primarily interested in research area related to the performance of built environment in terms of energy efficiency. I am also interested in research areas related to shading and daylighting of buildings

Making Building stock energy analysis robust

The absence of robust detailed multivariate building stock model for Ireland has inhibited the effectiveness of policy frameworks. Dwelling stocks enable energy analyses of the stock thereby enabling insight-driven decisions and informed policy.

This research proposes to use artificial intelligence combined with machine learning algorithms to automate data mining of information from the national BER database to inform a live-dwelling-stock-model leading to a national residential energy consumption model.

Instead of manual data analysis, the database engine will be combined with machine learning to:

1. Detect and prevent input of erroneous data through identifying and ranking information that positively correlates with defined attributes of unscrupulous activities.
2. Analyze raw data to impartially cluster dwellings objectively.
3. Monitor changes in patterns in the data so indicating renovation activity and trends over time.
4. Ascertain statistically derived (rather than arbitrary) default values that change as the stock changes to narrow the energy performance gap while increasing the credibility of the information produced.

EPSRC Centre for Doctoral Training in Energy Resilience and the Built Environment (ERBE): Industry partnerships

What is ERBE?

The doctoral training centre in Energy Resilience and the Built Environment, short ERBE, will train five cohorts of PhD graduates in world-leading research environments at UCL, Loughborough University and the Centre for Marine and Renewable Energy in Ireland. They will work with partners in industry, government and NGOs to deliver insights that are directly relevant to the challenges the energy sector faces. At ERBE, we tackle systemic, radical and interdisciplinary challenges, and equip our graduates with the leadership skills to effect change.

Research focus

ERBE addresses a national priority research area focusing on the interactions between energy supply systems and buildings, and the need to create healthy and productive home and work environments. Our students will attain a depth of understanding only possible as cohorts work and learn together. An integrated, 4-year programme will provide the knowledge, research and transferable skills to enable outstanding graduates from physics to social sciences to pursue research in one of three themes:

- Flexibility and resilience: the interaction between buildings and the whole supply system, through new generation and storage technology, enabled by smart control systems and new business models.
- Technology and system performance: demand reduction and decarbonisation of the built environment through design, construction methods, technological innovation, monitoring and regulation.
- Comfort, health and well-being: buildings and energy systems that create productive work environments and affordable, clean, safe homes.

Why become an industry partner?

- Your own bespoke research: this is a unique opportunity for you to co-develop research projects of real technical and commercial significance. We will set the research question together, and the PhD student will work closely with your business to deliver their research outputs to you, including a 3-months work placement.
- Affiliation and access to UCL: you will have access to our academics who provide world-leading expertise in energy demand in buildings research within and beyond the scope of the PhD projects.
- Shape your future workforce: being part of ERBE will provide you with access to graduates with skills to meet your needs. Our graduates possess excellent academic and professional track records and have been trained in solving real world research problems;
- Reduce your Corporation Tax: through the gov.uk tax relief scheme, a range of companies that seek to research or develop an advance in their field can claim a corporation tax relief. https://www.gov.uk/guidance/corporation-tax-research-and-development-rd-relief

Flexibility and resilience	Technology and systems performance	Comfort and wellbeing
Using behavioural science to increase consumer adoption of time-of-use electricity tariffs: evidence from survey and field experiments	The impacts of project scale, scope and risk allocation on financial returns for clients and contractors in Energy Performance Contracts - a stochastic modelling analysis	A socio-technical perspective of ventilation practices in UK social housing with whole house ventilation systems; design, everyday life and change.

Taking Charge: How does perceived personal control affect consumers' acceptance of residential energy demand side management programmes?

Modelling of integrated community energy systems

Aggregated load profiles of domestic buildings: the implications of an all-electric future

People, Energy and Zonal Control Applications

Blockchain enabled peer-to-peer energy flexibility trading

Error & Uncertainty in whole house heat loss (Co-Heating) measurements

Comparisons of the next generation of domestic heating solutions to identify the most appropriate solutions for real world conditions

Design and control of mixed-mode cooling and ventilation in low-energy residential buildings

Design and Performance of Naturally Ventilation in Non-Domestic Passivhaus Buildings

Mapping thermal discomfort responses in residential environments

A holistic approach to building design optimization for whole year thermal comfort and indoor air quality in UK dwellings under multiple constraints and stochastic occupant behaviour.

Ventilation and thermal comfort in UK homes: can we maintain indoor air quality and reduce the threat of future air-conditioning of UK homes?

Quantifying the benefits of measures to reduce exposure of deprived communities to indoor and outdoor sources of air pollutants

Cost

£30,000 per student over the four-year programme, or £25,000 per student for two or multiple students.

What to do next?

If you are interested in finding out more about the opportunities presented by the Centre for Doctoral Training in Energy Resilience and the Built Environment, please contact

At UCL:

Elinor Kruse, Partnerships Manager Bartlett School of Environment, Energy & Resources (elinor.kruse@ucl.ac.uk, 020 3108 9044)

Prof Bob Lowe, Centre Director (robert.lowe@ucl.ac.uk, 07776 164 066),

Dr Cliff Elwell, Deputy Director (clifford.elwell@ucl.ac.uk, 020 3108 5975),

At Loughborough:

Prof Kevin Lomas, Centre Director (k.j.lomas@lboro.ac.uk, 01509 222615)

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