The transition to a secure, affordable, low carbon energy system is the challenge of the 21st Century, and one that is historically unprecedented in scale and complexity. The UCL Energy Institute seeks to be a key UK and global player in this endeavour, illuminating strategic choices from multiple disciplinary perspectives.

The historic Paris Agreement for a global architecture to limit climate change to well below 2°C, negotiated by the largest gathering in history of global leaders, was a triumph of diplomacy.

The Agreement has been echoed in the UK by the confirmation of the 5th carbon budget, committing the country to a 57% reduction in emissions by the year 2030. At the global level, grounds for optimism can also be found in the continued exponential growth in renewable energy and corresponding fall in prices. (Read more about UCL-Energy's reaction to COP21 on page 27).

But more remains to be done. In the UK, while decarbonisation of electricity supply remains more-or-less on target, there is no clarity around decarbonisation of heat, little detail on how the 2030 target will be delivered and less on the transitions from 2030 to the much more demanding 2050 target. With the abandonment of the flagship Green Deal and the zero carbon target, the buildings sector is adrift.

Given an unwillingness to regulate or to enforce regulations, to develop an energy pricing policy, to introduce sector-wide reporting systems, or to guide innovation, it is difficult to see how an effective strategy will be developed for this sector. Perhaps the merger of DECC with BIS in the new Department of Business, Energy and Industrial Strategy (BEIS) holds the key.

Highlights of our own year are set out in the rest of this Review. We have underpinned the UK government’s long-term energy pathway analysis via a joint academic-government process with our UK TIMES model (pg 22). We have published a real-time map of CO2 emissions from global shipping (pg 10). We have run landmark events, including, in partnership with the French Embassy, the implications of the Paris Agreement for Africa. We have worked with the International Energy Agency to promote the new discipline of energy epidemiology internationally (pg 15). Lastly, we have published a series of position papers on how to transition the UK’s heat and gas networks (pg 28).

We are also committed to developing the thought leaders of tomorrow, and are delighted to see 10 successful PhD completions, with our graduates taking up exciting new positions, for example in International Energy Agency (IEA), University of Oxford and KPMG (pg 18).

Finally, we must mention Brexit. With 1/3 of our students and faculty, and 1/10 of our research funding coming from the EU, this impacts us directly. We are working hard to ensure continuity in funding and stability for our most important resource – our staff and students.

Remaining positive, the wake of Brexit has also led to opportunities – e.g. through the resumption of national control over aspects of energy policy previously decided by the EU. The coming year will present great challenges and great opportunities. We intend to rise to both.
UCL-Energy 2015/16 Highlights

UCL-Energy reacts to COP21, Paris 2015 In the lead up to and aftermath of the historic Paris Agreement in December 2015, UCL-Energy promoted topical work from staff and students. This included a number of blogs and media appearances by UCL-Energy researchers, as well as several public facing events that focused on the lead-up and after-effects of COP21. Read more about UCL-Energy’s involvement in COP21 on page 27.

UCL-Energy’s co-authored Deep Decarbonization Pathways Project (DDPP) synthesis report details the deep emission reductions required by 2050 to put the world on course to meet the 2°C climate objective. The report, published in September 2015, details the analysis by the 16 largest emitting countries, accounting for approximately 75% of global emissions. The report’s lead author Steve Pye, UCL-Energy Senior Research Associate, stated: “Analysis suggests that the incremental costs of delivering these pathways is manageable, with strong economic opportunities in low carbon technology sectors”. Read more about UCL-Energy’s DDPP public lecture on page 27.

Nationwide Building Society led a research group on Green Mortgage lending with UCL-Energy as academic partner. Formed in December 2015, the group is researching how to build a stronger link between energy and mortgage borrowing. Supported and part-funded by Innovate UK, the research draws on the expertise of diverse groups with green credentials, and part-funded by Innovate UK, the research draws on the expertise of diverse groups with green credentials, including UCL-Energy, Principality Building Society, UK Green Building Council, Zero Carbon Hub, Constructing Excellence in Wales, BRE, Energy Saving Trust and Arup. Read more about UCL-Energy’s partnerships on page 22.

UCL-Energy named in Lloyd’s List top 10 regulators of 2015 In January 2015 UCL-Energy was included in Lloyd’s List top 10 regulators of the shipping industry, alongside the European Union, the International Chamber of Shipping and the Federal Maritime Commission. Lloyd’s List provides information, analysis and knowledge for business decision-makers in the global shipping community. Read more about UCL-Energy’s shipping and transportation research on page 10.

UCL-Energy Deputy Director Professor Neil Strachan appointed to Catapult Energy Systems Board Professor Strachan was appointed to the board in February 2016. When asked about his appointment Prof Strachan said: “I am really excited to be joining the Board at such an early stage in its development. I am looking forward to working across the sector to support and enhance the UK’s energy networks.” Read more about UCL-Energy’s energy systems research on page 12.

The Energy & Resource Economic Policy Group launches as a joint initiative between UCL-Energy and UCL ISR The group, launched in May 2016, promotes the integration of economic studies with disciplines related to resources and energy, involving junior and senior researchers in a prestigious research environment and network, as well as as an active forum for advice, discussion and collaboration. Find more information about the group’s aims and how to join the group online.

wholeSEM’s UK TIMES model (UKTM) used by DECC to set ambitious new fifth carbon budget with a target to reduce emissions by 57% by early 2030 UKTM is a state-of-the-art energy systems model that facilitates analysis of long-term energy pathways. Coordinated by UCL researcher Peihao Li, a multi-year collaborative venture has made UKTM a key long-term energy model for DECC. Read more about wholeSEM on page 14.

UCL Energy’s co-authored Deep Decarbonization Pathways Project (DDPP) synthesis report details the deep emission reductions required by 2050 to put the world on course to meet the 2°C climate objective.

UCL exhibition ‘Women at UCL: Presence and Absence’ featured UCL-Energy staff This exhibition, which opened in March 2016, was created to celebrate women at UCL who are inspiring women with whom they work. The exhibition profiled women from across the UCL community and featured three UCL-Energy staff members: Dr Lai Fong Chiu, Dr Michelle Shipworth and Dr Catalina Spataru. The exhibition features were based on UCL nominations and the planning committee received over 200 submissions, which shows the real impact UCL women have on their colleagues and students. The full exhibition booklet with all UCL staff featured in the exhibition can be viewed at bit.ly/2awqjI3. Read more about UCL-Energy’s activities and outreach on page 24.

UCL-Energy’s DDPP public lecture on page 27.

The 2015/16 academic year saw success with 10 PhD graduates The 2015/16 academic year saw a record number of PhD students successfully pass their viva. The graduates were: Peter Warren, Faye Wade, Samuel Stamp, Ed Sharp, Carrie Behar, Tia Kanisara, Sofie Pelsmakers, Mike Fell, Will Usher and Paula Morgenstern. Read a full list of all UCL-Energy PhD students and thesis titles on page 20 and on the UCL-Energy website.

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Research at UCL-Energy

Research is the bedrock of UCL-Energy. The Institute has its own core activity but also acts as an umbrella for energy-related research at UCL, bringing together leading researchers on different topics. The multidisciplinary approach of UCL-Energy is at the heart of its success.

Most energy problems are multidisciplinary in nature; spanning science, engineering and the social sciences. Therefore different approaches are needed to understand and tackle these issues. UCL-Energy research works to develop a range of tools, models and methods that are required to address the energy challenges facing the world over the next two decades.

Most energy problems are complex, and addressing them requires a range of disciplinary perspectives and methods. UCL-Energy aims to develop a working environment in which colleagues can work across disciplinary boundaries to address such problems.

During the 2015/2016 academic year, including consultancy based projects (pg 23), there were 33 active research projects at UCL-Energy across four interacting themes: Energy Space Time (pg 7); Buildings (pg 8); Transport (pg 10); and Energy Systems (pg 12).

During the 2015/16 academic year UCL-Energy submitted a further 40 research proposals, and while over 20 of these projects are still awaiting decisions, 7 were approved.

UCL-Energy also hosts two research centres, the Whole Systems Energy Modelling Consortium (wholeSEM) (pg 14) and the Research Councils UK (RCUK) Centre for Energy Epidemiology (CEE) (pg 15).

“During the 2015/2016 academic year, UCL-Energy continued to combine cutting-edge techniques and interdisciplinary focus, to generate new insights into key energy challenges.”

Professor Andreas Schäffer, Director of Research, UCL-Energy

Net Zero Research project to inform UK response to the ambition set out in the Paris Agreement

Researchers from UCL-Energy have been exploring the implications of more ambitious carbon targets for the UK, in which the energy system becomes a ‘net zero’ emitter. The research suggests important implications for the ambition of UK climate targets, both before and after 2050, and the need for specific action across a range of low-carbon technologies.

The work is informing how the UK responds to the ambition set out in the Paris Agreement, in particular in relation to achieving a net-zero system in the post-2050 period. During the past year, the work has been discussed with both DECC, the Committee on Climate Change, and with UK Parliament members.

Research Theme: Energy Space Time

The Energy Space Time group at UCL-Energy researches the interplay of energy demands and supply, costs and emissions over space and time, under the influence of social, economic and meteorological factors. Activities range from theoretical investigations to implementation research, carrying out research into the design and application of sustainable energy systems, whole system integration in space and time.

The group, set up by Prof Mark Barrett and De Catalina Spataru in April 2015, works closely with industry, government and the third sector. In addition to the two academic staff members, the group currently consists of one research associate and nine PhD students.

Selected 2015/16 projects:

- UCL-Energy’s Energy Space Time group works to support the development of secure, environmentally sound city and national energy systems.

SiCEDS Stakeholder Interactive City Energy Demand Simulator: This project funded by Innovative/TSB is a joint venture between the group and the Energy Saving Trust. The project aims to aid the development of energy and environment policy in cities and nationally using data and models. The initial focus of this project is the UK, in particular the stakeholder cities of Birmingham and Exeter.

City Energy Demand Simulation (CEDS): Funded by Innovative UK this project aims to engage with stakeholders and create scenario plans for energy projects, so that approved schemes best meet each city’s unique visions and objectives.

The vulnerability of refrigerated food to unstable power supplies for UK, Brazil, Thailand and India: This project investigates how the proliferation of refrigeration might affect the vulnerability of refrigerated food, as countries develop chilled food chains and electricity grids.

National Grid EDAM2: Electricity System Modelling at DNO/Grid Supply Level in collaboration with EST and National Grid: Development of a scalable dynamic energy agents model (DEAM) which predicts the change in scale and shape of current demand profile and forecasts potential changes until 2050, given a mixture of efficiency and supply technologies that might be installed over the coming decades.

Energy Solutions for Ukraine and partnership solutions with EU and Russia: An international collaboration project funded by British Council in Ukraine to design and create a roadmap of solutions for reliability and energy security within Europe with a main focus on the Russia-Ukraine-EU route.

Energy Modelling and Data Analysis at Distribution Network Operators: This project is in collaboration with EST and Western Power Distribution Network part of Low Carbon Network Fund (LCNF) FALCON project.

Blackouts prevention through multi-disciplinary techniques (B-PAS): A multi-disciplinary consortium to review research methods from medicine, biology, economics and power engineering.

Common Road to 2050: Energy Networks and Policy design (ENP2050): Analyses the main barriers to planning and implementing a long-term strategy for the use of different resources, so that to achieve environmental commitments as well as energy security.

Selected 2015/16 publications:

The UCL-Energy’s Buildings research theme covers domestic and non-domestic buildings at scales from individual components through to the national and international stock. The UCL-Energy team is the largest in the UK and has a global reputation in the field. It works with policy makers, research communities, industry, NGOs and the public to develop effective policy, stimulate reductions in carbon emissions and fuel poverty, and promote a wider understanding of energy and buildings research. Coordinated by Prof David Shipworth and Dr Cliff Elwell, the Buildings theme is the largest in the Institute, with eight academic staff, five visiting/honorary staff, 17 research staff and 20 PhD students.

### Selected 2015/16 highlights:

- **3D Stock model**
  - A team at UCL-Energy has been developing a new kind of 3D model of the UK non-domestic building stock. The model aims to assess energy use in buildings and study conservation options. The model has been trialled successfully in Camden London, as well as Leicester and Tamworth. The team is now working on extending the model to large parts of England and Wales. Inclusion of the domestic stock is envisaged.
  - The 3D Stock model generates geometrical descriptions of self-contained units (SCUs) and their material properties, and these are passed to a specially customised version of the EnergyPlus simulation tool, called SimStock. This tool then builds energy models, covering heating and cooling uses, as well as appliances, for large numbers of SCUs testing out scenarios for future conservation options and new supply and servicing technologies. Further development is planned through the UK RCUK Centre for Energy Epidemiology and a proposal to EPSRC regarding schools. In the Building Energy Efficiency Survey (BEES) Shadow Modelling project, SimStock has been used to peer review empirically based modelling of the non-domestic building stock for DECC (read more on page 23).

- **Theory development**
  - Another focus of theory development as been work on the physical characterisation of buildings. This work particularly focuses on the application of isostatic methods to assess the thermophysical and hygrothermal performance of buildings.
  - Through the application of Bayesian analysis combined with physically informed models, researchers are currently undertaking projects to reduce the error and required times to estimate the U-values of building components, characterise whole house heat loss, and investigate moisture transfer through walls. They have also applied these methods to assess the impact of energy policy on demand, through the analysis of national data on energy use and boiler uptake.

- **Data-driven methods**
  - The year has been characterised by model and theory development for many of the research groups within the Buildings theme. There has been exciting progress in the automated construction of stock models from data through the 3D Stock and SimStock models.

### The OPTIHOUSE project

- **Honeywell Control Systems and EPSRC, aims to increase**
  - Determine the impact of regulatory policy on UK gas use by Bayesian analysis on publicly available data.

- **Energy Policy, 86, 770-783.**

- **Garcia Kerdan, I; Raalan, RM; Ryusseveit, P;**


- **Huebner, G. M., I. Hamilton, Z. Chalabi, D. Shipworth and T. Oreszczyn 2015.**


### Selected 2015/16 publications:

- **Elwet, CA; Biddulph, P; Lowe, R; Oreszczyn, T (2015)**
  - Determining the impact of regulatory policy on UK gas use by Bayesian analysis on publicly available data.

- **Energy Policy, 86, 770-783.**

- **Garcia Kerdan, I; Raalan, RM; Ryusseveit, P;**


- **Huebner, G. M., I. Hamilton, Z. Chalabi, D. Shipworth and T. Oreszczyn 2015.**

Research Theme: Transport

Led by Prof Andreas Schäfer and Dr Tristan Smith, UCL-Energy’s Transport research theme covers all major modes of transport, spanning all geographic scales, from local scale urban transport to global networks of marine transportation and aviation. This interdisciplinary team consists of two academic staff and seven research staff.

Selected 2015/16 highlights:

- **UCL-Energy Shipping Group launches interactive map that shows CO2 emissions for every ship for every hour** Using the methodology the group developed for the Third International Maritime Organisation Green House Gas (IMO GHG) Study 2014 and AIS data to estimate emissions from five different ship types, Shipmap.org is a new interactive map that plots 250 million data points to show the movements of the world’s commercial shipping fleet over the course of a year. Read more about Shipmap.org in the media on page 30.

- **UCL-Energy Shipping Group and partners win new media on page 30.**

- **Nature Climate Change publishes paper by UCL-Energy academics identifying the cost-effectiveness of CO2 emission reductions from passenger aircraft** “Costs of mitigating CO2 emissions from passenger aircraft,” published in January 2016, identifies the cost-effectiveness of CO2 emission reductions from narrow-body aircraft, the workhorse of passenger air transportation. This paper by lead author Dr Andreas Schäfer has received international attention and has been cited in numerous media outlets including PBS Newshour, the Pacific Standard, Wired Magazine and Vox.com.

- **UCL-Energy Urban Transport and Energy Group launch interactive map of the Pacific Standard, Wired Magazine and Vox.com.**

- **Rethinking mobility: the successful completion of the FS-MaaS project by the Urban Transport and Energy Group at UCL-Energy** The group received funding from the T-TRIG scheme of the Department for Transport to explore the feasibility of a new mobility solution that could offer seamless mobility, the “Mobility-as-a-Service” (MaaS). The feasibility study was delivered successfully in June 2015.

- **UCL-Energy Urban Transport and Energy Group launch London Mobility Survey: Innovation in mobility and travel surveying** In June 2016 this survey invited Londoners to participate in a new survey to analyse London’s travel habits and preferences for new mobility services. Through a state-of-the-art smartphone based application, respondents had the opportunity to learn about their travel and contribute to innovative research.

- **Selected 2015/16 projects:**

  - **Airport Capacity Consequences Leveraging Aviation Integrated Modelling (ACCLAIM):** This project explores simulating local and global impacts of airport capacity expansion policies. While the tool to be developed is applicable to any airport worldwide, it will be applied initially to the London airport system, where the UK Government plans to add capacity in the near future.
  - **CO2 emission targets for shipping:** Commissioned by the Sustainable Shipping Initiative, this study provides the SSI with an understanding of what a 2°C target would mean for shipping and what would be the implications or consequences for SSI members and the industry at large to committing to such a target. IMO 0.5% sulphur fuel oil study: As part of a consortium led by CE Delft, the demand and supply of compliant fuel oil in 2020 is studied. The project deploys GloTraM (Global Transport Model) to model the fuel supply side, such as refineries.
  - **Investigation into a INTERTANKO member’s fleets’ energy efficiency:** Follow-on project to monitor performance of a member of INTERTANKO and a similarity analysis of sister ships.
  - **ISO 19030 – Hull and propeller performance measurement:** This project is the first deployment of uncertainty analysis to assist ship owners and operators in understanding trends in hull and propeller performance.
  - **Newton Fund: Working in collaboration with Universidade Federal do Rio de Janeiro to develop an international trade and shipping database and to study port and shipping efficiency.**
  - **Future Opportunities.**

- **Selected 2015/16 publications:**

Research Theme: Energy Systems

The Energy Systems theme at UCL-Energy, led by Professor Neil Strachan, is the UK’s largest academic energy systems research group and is a globally leading centre of excellence in E4 (energy–economic–engineering–environment) modelling. The highly interdisciplinary team consists of four academics and 13 research staff members. The team’s modelling underpins the UK government’s analysis on energy transition pathways and contributes to the international debate through the EU Commission, International Energy Agency and a range of international energy networks (IPCC, EERA, IAMC).

Selected 2015/16 highlights:

Exciting new tools have been developed, documented, published and applied by the Energy Systems team. This includes a High Spatial and Temporal Resolution Electricity System Model (highRES), developed by Marianne Zeyringer and James Price which investigates the feasibility of very high shares of renewable energy in the energy systems. This requires looking at how variable renewable energy technologies (VRE) and demand vary in time and space. Transitioning to an energy future with high shares of VRE needs long-term planning and technically feasible solutions, hence the development of highRES.

HighRES complements the long running energy system model UK Times Model (UKTM) to find electricity pathways which are cost-effective, flexible and robust to the variability of the weather. The objective of highRES is to minimise power system costs to meet hourly demand subject to a number of constraints on the operation of power plants and storage, as well as transmission constraints allowing the balancing of demand and supply across the country.

The advantage of highRES is its good representation of VRE (photovoltaic, onshore and offshore wind energy). Hourly data for 10 years with a spatial resolution of 50km x 30km is useable. This allows for the ability to capture the scope of variability of weather conditions both temporally and spatially. HighRES determines the optimal locations for VRE and the optimal capacities and location of different renewable integration options. The models currently include electricity network expansion, interconnection to neighbouring countries, electricity storage and flexible generation.

Another key part of energy systems research at UCL-Energy is the Behaviour, Lifestyles and Uncertainty Energy model (BLUE), by Dr Francis Li, that investigates the competing roles of different actors in energy transition pathways.

BLUE is a system dynamic model of the UK energy system that simulates technological change, energy use and emissions. A defining feature of the model is the ability to simulate the individual behaviours of multiple energy system actors, which interact dynamically through time as changes to technologies, demands, and prices unfold.

BLUE enhances the policy relevance of energy modelling by explicitly addressing deviations from strict economic rationality found in behavioural economics literature and by enabling technological diffusion to be directly related to decisions made in specific sectors or by specific institutions. Finally, the model employs a stochastic Monte Carlo formulation that makes it particularly well-suited for exploring energy transitions under conditions of deep uncertainty.

Details of these models and others can be found at: www.ucl.ac.uk.energy-models

Nature Energy publishes paper by UCL-Energy academics: ‘Reinventing the energy modelling-policy interface’ This paper by senior UCL-Energy academics Neil Strachan, Birgit Fais and Hannah Daly stresses that energy modelling has a crucial underpinning role for policy making, proposing four key improvements to ensure that the modelling-policy interface delivers the insights that decision makers need.

Selected 2015/16 projects:

wholeSEM: The UK Research Council’s flagship research initiative to develop, integrate and apply state-of-the-art energy models. Read more about wholeSEM on page 14.

ADVANCE: An international consortium to develop a new generation of Integrated Assessment Models (IAMs) for the analysis of climate change mitigation policies.

UERG Phase III: The UK’s largest energy policy and research consortium. The UCL team focuses on the current and future roles of different resources and energy vectors in the UK energy system.

INSIGHT: E: A Think Tank for the European Commission that provides unbiased policy advice and insights into policy options and assessing potential impact.

Realizing Transition Pathways: A novel project to undertake historically-informed, forward-looking analysis of energy system transitions, bringing together quantitative and qualitative research methods.

HYVE: The HYVE (Hydrogen’s Value in the Energy System) project aims to find out how hydrogen might contribute to a transition to a low carbon economy.

Role of technologies in an energy efficient economy (REEM): A major new EU Horizon 2020 project to improve understanding of the diffusion and use at scale of technologies in an energy efficient economy.

Bio-value Energy Chains: Whole systems analysis and optimisation to understand the potential and risks of different biomass technologies and supply chains.

Energy Pathway Uncertainties: A new project for the Energy Technologies Institute to investigate and extending the uncertainty capabilities of their Energy Systems Modelling Environment (ESME) model in long terms decarbonisation pathways.

Selected 2015/16 publications:


The wholeSEM’s innovative bi-directional Fellowship Programme enables UK and international professionals in academic, policy and industrial positions to work with the wholeSEM consortium, sharing and building expertise. This programme has proven to be a great success with our fellows demonstrating huge topical and geographical diversity and creating strong links with the wholeSEM team.

wholeSEM 2015/16 fellows included:

- Sandy Skelton (University of Cambridge - E3 Modelling, Athens, Greece) Sandy looked to develop a complete methodology for incorporating material efficiency into dynamic CGE models.
- Zenaida Sobrat-Mourao (University of Cambridge - UC Berkeley, USA) Zenaida examined ‘Impacts of energy system pathways on Air Quality and human health within the wider context of Integrated Earth System Models’.
- Behnam Zakeri (Aalto University, Finland – UCL, London) Behnam investigated energy transitions towards high-level integration of variable renewable energy (VRE), and flexibility of energy systems in this respect.

The Research Councils UK (RCUK) Centre for Energy Epidemiology (CEE) studies energy demand from transport and the built environment, and develops a new path for energy-demand research. UCL-Energy was awarded one of six Centres of Excellence in End-Use Energy Demand (www.eueduk.com) by the RCUK in 2013.

The CEE provides an evidence base for government and industry to support end-use energy reduction across buildings and transport. CEE uses an epidemiological approach derived from the study of health and disease since the 19th Century, to provide data-driven insights into the drivers of end-use energy demand, and the impacts of measures to reduce it.

Highlights from wholeSEM’s 2015/16 activity include:

- July 2016 - wholeSEM ran a technical workshop - ‘Iterative Decision Making’. More than 100 academics, industry experts and doctoral students from across the world came to Cambridge to attend this innovative two day conference.
- June 2016 - it was announced that the UK TIMES energy system model, developed by UCL-Energy’s wholeSEM team, was one of the principal tools used by the government in setting the fifth carbon budget.
- May 2016 - wholeSEM ran a technical workshop - ‘Integrated energy system models incorporating spatial and temporal detail’ - to consider the current state-of-the-art in integrated energy network models that include both spatial and temporal details.
- March 2016 - wholeSEM sponsored a UKERC residential conference: ‘Energy Modelling Insights for Iterative Decision Making’. More than 100 academicians, industry experts and doctoral students from across the world came to Cambridge to attend this innovative two day conference.
Graduates in energy related subjects are currently in high demand. UCL-Energy is a leading centre for research into energy demand and the built environment, a sector of increasing importance due to the challenges of climate change, energy affordability and energy security.

Students undertaking the Master of Research in Energy Demand Studies (MRes EDS) have the opportunity to learn from experienced and respected researchers and to undertake original research in energy demand reduction in the built environment in at a leading institution. The aim of the MRes EDS is to provide a grounding in the required skills and knowledge to pursue a career in industry or academia.

In addition to being offered as a full time or part-time stand-alone masters course, the MRes EDS can form the first year of a four year PhD programme offered by UCL-Energy, via the London-Loughborough EPSRC Centre for Doctoral Training in Energy Demand (LoLo).

In the 2015/16 academic year 83 students were enrolled on the Masters in Economics and Policy of Energy and the Environment (MSc in EPEE). Launched in September 2013, the MSc in EPEE aims to give its students the essential skills and knowledge they need to understand, analyse and manage environment-resource-economy interactions. This is now a global agenda, and one of increasing importance to business, policy makers and civil society in all countries.

The MSc in EPEE equips its graduates to become leaders and entrepreneurs in their chosen area of specialisation, whether in terms of policy making, the business management of sustainability issues, energy system modelling or their understanding and application of the innovation system.

"The MSc is an exciting and interdisciplinary course that provides students with the fundamentals necessary for careers as energy and environmental policy professionals. During the 2015/2016 academic year, the third year of the course, we built on the success of the first two years by offering a new module (Planetary Economics and the Political Economy of Energy and Climate Change, led by Professor Michael Grubb). The MSc continues to grow and go from strength to strength, and it's hugely satisfying to see our alumni from our first years go off into careers in business, government and NGOs, with many also pursuing PhDs in the field."

Will McDowall, Course Director MSC EPEE

"MRes EDS is a programme where students can learn the fundamentals of energy research in the built environment from an economic, scientific and social perspective. This knowledge will combine with the different analysis tools to provide the technical background required to undertake research in this challenging multidisciplinary area.

Becoming a good researcher is about much more than learning techniques and facts. The transferable skills courses teach key aspects of research; the fundamentals of being a researcher and research communication."

Catalina Spataru, Course Director, MRes EDS

Postgraduate Study at UCL-Energy
Doctoral Research at UCL-Energy

UCL-Energy’s MPhil/PhD Energy programme was established in 2009 as UCL’s response to the global challenges of mitigating climate change and providing energy security in the 21st century.

UCL-Energy doctoral students work alongside experienced researchers in a dynamic, multi-disciplinary environment and are core to the institute’s research activities, contributing to a wide range of ongoing research and consultancy projects, including being named authors in a number of national and international papers and reports (pg 28).

During the 2015/16 academic year 60 doctoral researchers were registered with UCL-Energy and 10 students successfully passed their vivas. The London-Loughborough EPSRC Centre for Doctoral Training in Energy Demand (LoLo) experienced success with six students joining the LoLo PhD programme and eight LoLo Energy Demand (LoLo) experienced researchers in a dynamic, multi-disciplinary environment. Students join active research groups contribute to an expanding community of alumni from the MPhil/PhD programme with over 30 PhD students graduating since 2009 and over 20 affiliate students. UCL-Energy alumni have gone on to obtain competitive positions as lecturers and postdoctoral researchers within UCL and other academic institutions as well as entering professional positions at organisations such as the International Energy Agency in Paris, University of Oxford and KPMG. UCL-Energy is eager to keep in touch with alumni and will be launching a new UCL-Energy Alumni and Friends LinkedIn presence in early 2017.

“I very much enjoyed doing the PhD, particularly as I had great support in a truly multi-disciplinary environment, and had the freedom to design and develop my own topic. The knowledge and skills that I gained during the PhD were an important part of helping me to put theory into practice through my current position in the Department for Business, Energy & Industrial Strategy.”

Peter Warren, LoLo, CDT PhD Graduate 2016

UCL-Energy now has a rapidly expanding community of alumni from the MPhil/PhD programme with over 30 PhD students graduating since 2009 and over 20 affiliate students. UCL-Energy alumni have gone on to obtain competitive positions as lecturers and postdoctoral researchers within UCL and other academic institutions as well as entering professional positions at organisations such as the International Energy Agency in Paris, University of Oxford and KPMG. UCL-Energy is eager to keep in touch with alumni and will be launching a new UCL-Energy Alumni and Friends LinkedIn presence in early 2017.

LoLo actively engages with a wide network of external organisations, co-developing high impact, cutting-edge research topics with partners and establishing four-year PhD research programmes in which 70% of the costs are met by the CDT. UCL partners have included Bouygues UK, CIBSE, Crest Nicholson, EDF, Skanska, Willmott Dixon, and British Board of Agrément (BBA).

LoLo research themes:
- Technology and systems
- Energy epidemiology
- Urban scale energy demand
- Building performance and process
- Unintended consequences

These themes are investigated using a wide range of methods and disciplinary perspectives, including social sciences, economics, socio-technical studies, statistical analysis, simulation and physical measurements.

The London-Loughborough EPSRC Centre for Doctoral Training in Energy Demand (LoLo) is the premier UK centre for energy demand in the built environment doctoral training. Its aim is to help deliver deep reductions in CO₂ emissions by 2050 through an innovative, multi-disciplinary, high impact research and training programme.

LoLo brings together two leading energy research organisations: the London Energy Partnership (LoLP) and the Energy, Environment and Industrial Strategy (Energy) branch of LoLo is based at the UCL-Energy. The Centre’s core focus is the energy performance of buildings, their technologies and multiple interactions with people and the wider energy system.

LoLo was set up as a Centre for Doctoral Training (CDT) in 2009 with funding from EPSRC for 50 studentships, with a renewal of funding in 2014 of 60 additional studentships over the next eight years.

LoLo aims to create a unique student-focused environment. Students join active research groups supporting a wide range of projects, undertake a robust programme of skills training, engage in range of events throughout the year including our Annual Colloquium, Student Led conference and site visits and have ample opportunities to engage with leading researchers, industry and policy makers.

Since 2009, LoLo has funded a total of 60 students with a growing community of 20 alumni who have gone on to attain research positions and lecturerships within UCL-Energy and other academic institutions along with technical and professional roles in external organisations such as the Department for Business, Energy & Industrial Strategy, Willmott Dixon Energy Services Limited, Useful Simple Projects and Investec Asset Management.

LoLo actively engages with a wide network of external organisations, co-developing high impact, cutting-edge research topics with partners and establishing four-year PhD research programmes in which 70% of the costs are met by the CDT. UCL partners have included Bouygues UK, CIBSE, Crest Nicholson, EDF, Skanska, Willmott Dixon, and British Board of Agrément (BBA).

LoLo research themes:
- Technology and systems
- Energy epidemiology
- Urban scale energy demand
- Building performance and process
- Unintended consequences

These themes are investigated using a wide range of methods and disciplinary perspectives, including social sciences, economics, socio-technical studies, statistical analysis, simulation and physical measurements.

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UCL-Energy Partnerships

The benefits of working with UCL-Energy include access to leading academics and forthcoming research, and the chance to incorporate the Institute’s research findings into strategic direction, policy, products, services and processes.

Partners are able to plug into a unique, multidisciplinary institution in which physicists, economists, social scientists, engineers, architects and data modellers work side-by-side on the same questions and challenges.

Current partnerships include:

Consultancy projects – Providing consultancy support to government and industry clients on specific questions, issues and projects, in the form of access to expertise, knowledge and data. UCL-Energy often collaborates with clients when its reputation for expertise in energy demand can be a decisive factor in project proposals (pg 23).

Support for major initiatives – Securing support from external partners for major projects, such as the RCUK Centre for Energy Epidemiology (pg 15), either as research funding or in-kind support in the form of advice, guidance, or through the provision of data.

PhD research projects – Through the LoLo CDT (pg 19), co-developing high impact, cutting-edge research topics with partners and establishing four-year PhD research programmes in which 70% of the costs are met by the external partners when its reputation for expertise in energy demand can be a decisive factor in project proposals (pg 23).

Coordinated by UCL researcher Dr Peihao Li, this multi-year collaborative venture has become the key long-term energy model for DECC. Most recently, in June 2016 UKTM was the underpinning model in the decision from (DECC), in agreement with the Committee on Climate Change, of the ambitious new carbon budget proposing that the fifth budgetary period covering 2028 to 2032 should be set at 1,725 MtCO2e, broadly a 57% reduction from 1990 by early 2030.

Alec Waterhouse, Head of DECC’s Central Modelling Team, said: “DECC and UCL have been co-developing the UK TIMES model for some time. We have used the model as one of three sections of analysis used in developing the HMIG response to the Committee on Climate Change’s recommendation on the level of the fifth carbon budget. We intend to use the model heavily this year to develop our long term strategy.”

Read more about the UK TIMES model: www.ucl.ac.uk/energy-models/models/uktm-ucl

Consultancy at UCL-Energy

UCL-Energy makes a direct, real-world impact in the advisory role it has with government and industry, bringing its knowledge and expertise in energy demand to bear on the policy and decision-making process.

The Institute contributes a focus on data quality and rigorous, robust models of energy use at regional, national and international level, taking into account factors such as economic growth, carbon emissions and climate change, and societal trends.

Over the past academic year, UCL-Energy signed 18 new consultancy contracts with a total value of over £0.5 million, including the winning of repeat business. The story for the year has been one of delivery of significant projects, with a number of major DECC projects completed.

UCL-Energy has been actively involved in several European and DECC Framework contracts for delivery of specialist advice and research in technical, economic and social-sciences areas, relevant to energy and environmental policy. UCL-Energy was also involved in two Collaborative Research projects sponsored by Innovate-UK.

Clients for the year included:

- Department of Energy and Climate Change
- DNV GL
- EDF Energy
- Energy Savings Trust (i-UK project SiCEDS)
- Energy Technologies Institute

The European Commission (DG Energy, DG Environment)
- Ricardo-AEA
- Nationwide Building Society (i-UK project LENDERS)
- Akzo-Nobel

UCL-Energy undertakes peer review of the Building Energy Efficiency Survey Hypothesis Model Methodology for DECC

The UK Department of Energy and Climate Change (DECC) undertook the Building Energy Efficiency Survey (BEES) in 2015/16 to provide an updated, disaggregated evidence base around energy end uses and abatement potential in non-domestic buildings in England & Wales. As part of the BEES project a comparison was undertaken by UCL-Energy between the building stock ‘hypothesis’ model employed in BEES and a tailored simulation model.

The exercise by UCL-Energy, which was conducted for health centres and offices, built confidence in the BEES hypothesis model and revealed the potential of a simulation model to represent and investigate the highly complex nature of the non-domestic building stock. The simulation model, known as SimStock, is now undergoing further development with the aim of providing a scenario analysis tool for the non-domestic building stock.
Activities and Outreach

During the 2015/16 academic year, UCL-Energy continued to expand its communication and outreach activities to engage UCL staff, students, industry and the public. The academic year saw an incredibly successful public seminar series, with over 946 attendees across the events, and continued to expand its online presence.

The Institute seminar series included a fantastic programme of invited speakers from industry, academia and elsewhere, who spoke on a wide range of topics (pg 25). The series also incorporated a number of joint events with other UCL institutes, including the UCL Institute of Sustainable Resources, UCL Global Governance Institute and UCL Department of Science, Technology, Engineering and Public Policy (UCL STEaPP).

This series was in addition to UCL-Energy hosting the 5th Cycle for the UCL and French Embassy event collaboration under the auspices of the long-established relationship between the French Embassy’s Science and Technology Department and UCL’s Grand Challenges programme (pg 27).

The first two events of the three-part series focused on the lead up and the effect of the COP21 Paris agreement (pg 27). The third and final event is scheduled to take place in September 2016 and will focus on energy and climate collaboration in Europe.

The UCL-Energy YouTube channel hosts the seminar recordings, alumni videos and videos about ongoing projects. In 2015/16 academic year subscribers increased by 32% with over 30,000 video views and viewers watching from 29 different countries including India, Australia, the United States, Singapore, Brazil and the United Arab Emirates.

The UCL-Energy blog also experienced continued success during the 2015/16 academic year. There were 23 posts contributed by UCL-Energy academics, researchers and students with topics ranging from the impact of COP21, the 2016 London Mayoral Election, and International Women’s Day.

UCL-Energy staff appeared in over 50 national and international publications during the year. Staff members wrote guest articles and blogs for major publications as well as being featured commentators on current events relating to energy (pg 30).

With over 3,000 subscribers to the UCL-Energy newsletter and 5,486 unique users following @UCL_Energy on twitter, UCL-Energy looks forward to continuing to expand its engagement and outreach in 2016/2017.

UCL-Energy 2015/16 Events

06 October 2015 seminar: Dr Henri Waisman, Coordinator, Deep Decarbonization Pathways Project, Institute for Sustainable Development and International Relations (IDDRI) ‘The Deep Decarbonization Pathways Project (DDPP): Can country-led decarbonisation efforts help achieve a 2°C pathway?’

20 October 2015 UCL, UKERC & the French Embassy present: ‘Global Energy, Global Climate’

01 December 2015 seminar: John Cunneen, founding Executive Director and Member of the Authority for Electricity Regulation, Oman ‘Where are we now? Reflections on UK Energy Regulation from 1920 to 2015’

02 February 2016 seminar: Dr Laura Diaz Anadon, Visiting Senior Lecturer, UCL STEaPP ‘Energy technology innovation and the role of governments: state of the art, new developments, and key questions’

01 March 2016 joint UCL-Energy, UCL Institute of Sustainable Resources and UCL Global Governance Institute Seminar: Dr Tom Pegram, Lecturer in Global Governance ‘Wanted: a third generation of global governance research’


05 April 2016 seminar: Julie Hirigoyen, Chief Executive of UK-Green Building Council ‘Energy efficiency in non-domestic buildings: Are we on target for 2050?’

03 May 2016 seminar: Dr Mark Barrett, lecturer UCL-Energy and Dr Ed Sharp, research associate UCL-Energy ‘Developing secure, environmentally sound city and national energy systems’

24 May 2016 seminar: Dr Tristan Smith, Reader in Energy and Transport, UCL-Energy and David Balston, Director Safety & Environment, Chamber of Shipping ‘International shipping GHG policy post-Paris Agreement, recent developments at IMO MEPC and their implications for the sector’

02 June 2016 joint UCL-Energy and UCL STEaPP seminar: Joe Aldy, Associate Professor of Public Policy, Harvard Kennedy School ‘Evaluating the Paris Agreement’s Mitigation Pledges’

09 June 2016 UCL-Energy and The Edge Expert Panel Discussion: ‘EU Referendum: Environmental & climate change consequences for the built environment’
UCL-Energy Global Presence

UCL-Energy’s global presence continued to expand in 2015/16. With over a dozen nationalities making up UCL-Energy staff and students, the Institute cultivates an international perspective both within itself and with its global outreach, through research and online engagement.

According to Google analytics, during the past academic year the UCL-Energy website had nearly 40,000 visitors from 200 countries. Over 60% of website traffic came from international locations with the top ten countries outside the UK being the United States, India, Germany, France, Indonesia, China, Italy, Greece and Nigeria.

UCL-Energy research has a significant impact on international policy and strategy. Some of the Institute’s internationally focused active grants include: Supporting Sub-Saharan Africa’s Municipalities with Sustainable Energy Transitions (SAMSET) and INSIGHT: the European Sub-Saharan Africa’s Municipalities with Sustainable Energy Transitions (SAMSET) and INSIGHT: the European Scientific multidisciplinary ‘think tank’.

In June 2016, UCL-Energy’s shipping group was awarded a new project to advise the Danish Shipowners Association (DSA) on CO2 strategy and targets. The DSA included not only the world’s biggest shipping company (AP Møaerks), but several world leading ship-owners including Norden, Torm, and DFDS. It is a great validation of the group’s global reputation and credibility.

Throughout the academic year a number of UCL-Energy staff were heavily involved with work on the International Energy Agency’s Energy in Buildings and Communities Programme (IEA-EBC) annexes. In March 2016, UCL-Energy hosted the IEA-EBC Annex 69 international meeting. This was the first meeting for the working phase of IEA Annex 69 on ‘Strategy and Practice of Adaptive Thermal Comfort in Low Energy Buildings’. UCL-Energy’s Buildings group are playing a leading role in this Annex in the development of new thermal comfort models. The meeting was attended by working groups from all over the world, including China, the United States, Europe, Japan and Korea.

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UCL-Energy director Professor Bob Lowe speaks at UK-Japan event: The Past and Future Earth

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UCL-Energy and COP 21

In December, the 2015 Paris Climate Conference, also known as COP21, was held to address the serious issue of global warming. At the end of this conference an agreement was reached by 195 nations to drive actions and investment towards a low carbon, resilient and sustainable future and to focus efforts to limit the temperature increase to 1.5°C.

In the lead up to this conference UCL-Energy organised a series of high profile public events, focusing on issues relating to COP21 and promoting topical work from staff and students in the form of blogs, academic articles, media appearances, policy briefs and ongoing projects. A full round up of all these items and reaction pieces to the final Paris Agreement are available on the UCL-Energy website.

In October 2015, UCL-Energy hosted a seminar on The Deep Decarbonization Pathways Project (DDPP). In this seminar Dr Henri Waisman, Coordinator of the DDPP, presented key findings from the ground breaking DDPP initiative and what this meant for the COP21 process.

Also in October 2015, UCL-Energy made global climate the focus of its first event in the three part series organised jointly by UCL-Energy and the French Embassy, under the auspices of the long-established relationship between the French Embassy’s Science and Technology Department and UCL’s Grand Challenges. This event, titled ‘Global Energy, Global Climate’ launched the book Global Energy, Global Climate. Internationally recognised speakers from UCL-Energy, UCL Institute for Sustainable Resources, UKERC, Imperial College and CIERED discussed energy and climate solutions, in the context of the evidence laid out in the book.

In March 2016, UCL-Energy hosted the second event of the French Embassy series focusing on the repercussions of the Paris Agreement: ‘The Paris Agreement - What does it mean for Africa?’. The event addressed questions such as: Does the Paris Agreement satisfy the African negotiations position? And, how can we move from political agreement to concrete action? There was a special focus on the African Renewable Energy Initiative (AREI), nationally determined contributions and adaptation communications.

The event recordings are available at: bit.ly/1maxM4u

Shipping under scrutiny at COP21, UCL-Energy Reader Dr Tristan Smith participated in COP21 side event.

The Path for Low Carbon Shipping event considered what options are available to put shipping on a sustainable path, and how a successful COP agreement can contribute to this objective. This was the only COP21 side-event that focused on shipping.

Read about Tristan’s article in The Conversation discussing the omission of shipping and aviation from the Paris Agreement on page 30.
Selected UCL-Energy Publications 2015/16


Juan Gomez, Anestis Papanikolaou, Jose Manuel Vassallo ‘Measuring regional differences in users’ perceptions towards road user charges Transport Geography, Volume 54, 1 June 2016, Pages 22-33.


UCL-Energy in the Media 2015/16

'Estimated cost of Hinkley Point C nuclear plant rises to £37bn', The Guardian
Dr Paul Dorfman, Honorary Senior Research Associate, comments on the increase on the EDF plan for Hinkley Point C nuclear power plant and it’s reflections on possible uncertainty of the project, particularly in light of Brexit. Article published on 7 July 2016.

'Ride-sharing: The solution to our transport woes?', InMotion
Maria Kamargianni, head of the UCL-Energy Urban Transport and Energy Group, discusses the availability of smartphone apps to make ride-sharing more accessible. Article published 4 July 2016.

'Non-domestic energy efficiency – policy design principles', Association for the Conservation of Energy
Peter Mallaburn, Senior Research Associate for ACE, outlines the policy principles around which a new energy efficiency programme could develop. Published on 24 May 2016.

'Three crucial omissions that could jeopardise Paris climate hopes', The Conversation
Dr Tristan Smith, UCL-Energy Reader in Energy and Shipping, wrote an article following the November Paris COP21, discussing that the omission of shipping and aviation represents the gaps between the reality of the climate situation and the text of the Paris Agreement. Published on 15 December 2015.

'How green is your skyscraper? Why the most sustainable rise buildings are more energy-intensive than equivalent low-rise buildings', The Conversation
Christopher Grainger, UCL-Energy doctoral candidate, authored an article discussing how the economic model of the historic electricity sector may be an economic necessity. Published 4 December 2015.

'Kite Power', BBC's The One Show
Andrew Smith, UCL-Energy Research Associate, appeared on The One Show, where he discussed some of the opportunities and the challenges of kite power and how kite power may benefit other countries that don’t have the same optimum off-shore environments of Britain. Aired 8 February 2016.

'New report states wind technology can yield up to 60% fuel savings for ships', Carbon War Room
UCL-Energy shipping group and the Carbon War Room published a paper reviewing the opportunities and barriers to the adoption of wind technology in the international shipping industry. This article reviewing the report was published on 19 February 2016.

'Shipmap.org went live in April 2016, it has made over 500k twitter impressions and has been tweeted about all over the world, including a direct tweet from Bill Gates. This interactive visualisation was picked up by a number of international media sources including The Guardian, Daily Mail, China Dialogue, Motherboard and VOX.'

Management and Administration

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Catalina Spatharu
Phil Steadman
Alex Summerfeld
Will Usher
Fade Wade
Matthew Winning
Jez Wingfield
Marianne Zeyringer

The UCL-Energy Team 2015/16

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