

**UCL INSTITUTE FOR
SUSTAINABLE RESOURCES**



ANNUAL REVIEW 2016/17

Discover world-leading research,
teaching and enterprise in the
sustainable use of global resources.



ABOUT

UCL ISR is a world-leading research, teaching and enterprise institute in the sustainable use of global resources.

Our approach blends expertise from across UCL to make a truly cross-disciplinary institute.

For any queries regarding ISR, please visit ucl.ac.uk/bartlett/sustainable or contact sustainable-resources@ucl.ac.uk

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INTRODUCTION

The vision of the UCL Institute for Sustainable Resource (ISR) is a world that makes globally sustainable use of its natural resources and the environment. All our research and teaching is oriented towards this goal.

From a handful of staff at its foundation in 2011, ISR now has around 30 researchers and 20 PhD students.

It runs two successful Masters programmes. It has been successful in winning research funds from the UK Research Councils, the European Union, and a wide variety of other private and public sources.

It contributes to global environment and resource policy processes, through UN Environment and the International Resource Panel, and engages in collaborative research and dissemination programmes in Africa, China and Latin America. It is a core member of the UK Energy Research Centre and the Supergen Hydrogen and Fuel Cells Hub.

Each term it organises seminars and lectures open to the public, and attended by a wide range of interested organisations, as well as by the UCL community.

In short, in our six-year life we have developed a global reach and had impact at home and abroad.

In 2016/17 we grouped our research activities into a number of distinct streams, with an over-arching focus on the green and circular economy, eco-innovation and resource and environmental policies and indicators.

The themes are climate policy, energy pathways, and the water and food resource nexus. Our major research methods are econometric evaluation, macro-economic modelling and innovation analysis. We are developing further research groups on social research, especially on land use in the global south, resource futures, urban transitions and sustainable finance.

In these pages you will read about a selection of our activities over 2016-17, with most space devoted to descriptions of our research. We hope that you will find the information both interesting and inspiring. For further details please visit our website or contact any of our staff, listed at the back of this Review.



Professor Paul Ekings OBE
UCL Institute for Sustainable Resources

KEY HIGHLIGHTS

Global misuse of non-renewable groundwater reserves

In March 2017, ISR Senior Research Fellow Carole Dalin published findings showing the rising use of unsustainable water supplies by international food producers is putting global food and water supplies at risk and could cause basic food prices to skyrocket.

The research, published in *Nature*, found that the use of non-renewable groundwater for irrigation increased by a quarter from 2000 to 2010, doubling in China alone. The analysis suggests that unless action is taken by both producers and consumers, this trend could eventually lead to depleted water reserves, limited access to imported food and increased food prices.

The paper was covered by more than 40 media outlets, including BBC News, and its online reach was ranked in the 99th percentile (ranked 169th) of the 256,353 tracked articles of a similar age in all journals.

ISR launches three new Hydrogen and Fuel Cell White Papers at City Hall

In March 2017, The Hydrogen and Fuel Cell Research Hub launched three new White Papers to inform key stakeholders, especially policy makers, of the roles and potential benefits of hydrogen and fuel cell technologies in addressing these issues. See more detail on page 17.

Paul Ekins appointed Co-Chair of UN's Global Environment Outlook report (GEO-6)

In October 2016, Professor Paul Ekins was appointed Co-Chair of UNEP's 'Global Environment Outlook' report (GEO-6), the world's most comprehensive assessment of the state of the global environment.

The assessment provides policy makers with trends and projections for air, climate, water, land and biodiversity and an outlook for the future.

UCL ISR hosts Summer Challenge programme

In June and July 2017, ISR and UCL-Energy jointly-hosted a Widening Participation Summer Challenge for talented Year 12 A level students from backgrounds less likely to apply to university.

The programme aimed to support and develop the potential of these students, to encourage them to have the confidence to make an application to a top university such as UCL, to give them experience in techniques and other transferable skills, and to inspire their interest in environmental issues and solutions.



Science & Environment

Food trade drains global water sources at 'alarming' rates

By Matt McGrath
BBC

© 30 March 2017



BBC News coverage of ISR paper

KEY HIGHLIGHTS

UCL ISR at UNLEASH

In August 2016, Professor Paul Ekins spent a week as an invited expert on energy in Denmark at the first year of UNLEASH, a new global initiative that brings together young leaders, experts, and entrepreneurs annually.

Each year they will be tasked with developing innovative and practical solutions to the 17 Sustainable Development Goals (SDGs).

1,000 hand-picked young people from 129 countries (including 12 from UCL) were brought to Denmark, starting in Copenhagen with team building, company visits, real life case challenges and key notes from top speakers from around the world, and then dispersing for the co-creation of SDG solutions took place at 10 different Folk High Schools.

UNLEASH ended with a Final Awards Show, which included key notes from HRH Crown Princess Mary, Danish PM Rasmussen, actor and investor Ashton Kutcher, the founder of Khan Academy, Salman Khan and many others.

Paul Ekins is now engaged to see whether UNLEASH can visit London in the future.

Hinkley Point to be obsolete within a decade

In September 2016, ISR's Professor Michael Grubb jointly-authored a note outlining that the planned Hinkley Point C nuclear plant will be outpaced by cheaper, lower-carbon energy sources that will render it largely obsolete within a decade of opening. The analysis, based on National Grid's own energy scenarios, shows that by 2030 wind and solar energy sources will, for increasing periods of the year, be meeting all the UK's electricity needs.

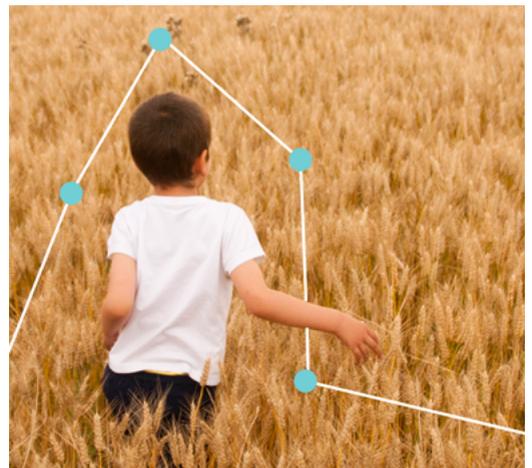
The Lancet Countdown: Tracking Progress on Health and Climate Change

In 2017 UCL ISR researchers contributed to a report showing that climate change is already a significant public health issue and a looming global health emergency.

The Lancet Countdown: Tracking Progress on Health and Climate Change is an international research collaboration, dedicated to tracking the world's response to climate change, and the health benefits that emerge from the transition to a low-carbon world.

The first report is scheduled for publication in October 2017 (following an initial publication in The Lancet in November 2016 to introduce the Countdown, and propose the set of indicators to be tracked).

Paul Drummond and Paul Ekins from UCL ISR lead the 'Economics and Finance' indicator set – one of five indicator sets that comprise the Countdown.



Credit: The Lancet Countdown

RESEARCH

UCL ISR runs multidisciplinary teams, providing critical mass and capacity for large projects on topics of resource efficiency, circular economy, eco-innovation, and low carbon societies. It does this by employing its own staff and by acting as a forum and coordination mechanism for UCL staff in different departments.

It collaborates in particular with the UCL Energy Institute as part of the Bartlett School for Environment, Energy and Resources (BSEER) and with the UCL Circular Economy Lab (CircEL).

The ISR research strategy revolves around seven interconnected areas, which aim to structure and strengthen our expertise.

Research themes

1. Green Economy, Eco-Innovation, Resource Policies and Indicators (p8)
2. Climate Policy (p10)
3. Energy Pathways (p12)
4. Water and Food Resource Nexus (p12)
5. Econometric Assessments (p14)
6. Maco-Economic Modelling (p16)
7. Innovation Analysis (p17)



The Lancet Countdown, contributed to by UCL ISR researchers in 2017

RESEARCH (CONT.)

In addition to its research themes, ISR also explores:

- **Urban transitions**, especially towards a circular economy (led by Teresa Domenech)
- **Social research**, especially on land use in the global South (led by Julia Tomei)
- **Resource futures**, especially on transition scenarios and foresight methodologies (led by Michal Miedzinski)
- **Sustainable finance**, led by Nadia Ameli

Urban transitions

With most of the world's people expected to live in cities by 2050, urban areas hold the key of a sustainable future.

ISR is a pioneer in the application of Circular Economy (CE) principles to urban areas and identification of integrated policy frameworks to boost circularity and placemaking in cities.

ISR is involved in one European project 'Cities of Making', which investigates sustainable urban manufacturing, its connection to the makers' movement, and the role that manufacturing plays in closing resource loops in cities.

ISR is also involved at the local level with a number of London Boroughs to help identify opportunities to identify business opportunities derived from a better use of resources. ISR has developed a number of research proposals around capacity building with third countries to investigate adaptation of CE principles to urban areas in the Global South in the framework of the SDGs.

Social research

Understanding how resource use and governance affects people and communities, particularly in Low and Middle Income Countries, is an important research theme for UCL ISR.

The UN's Sustainable Development Goals (SDGs) provide a framework for analysing the interlinkages between different types of resources – from land to water, and energy to infrastructure – and the impacts on people, planet and prosperity.

Under this theme, researchers at UCL ISR have recently been awarded funding from the Global Challenges Research Fund (GCRF) to investigate decentralised energy networks in Myanmar, and to co-design an anaerobic digester for remote fishing communities in Colombia.

Resource futures

This research area covers foresight and prospective studies in the area of innovation and sustainability. The main focus is on developing and critically appraising long-term visions, scenarios and road mapping conducted by public sector and business related to the challenges of sustainable development.

ISR researchers apply foresight and futures perspectives in research and teaching. In research the focus on prospective studies features in policy studies, impact assessments and modelling. Examples of projects involving research on futures include INNOPTHS and Inno4SD. In teaching, MSc in Sustainable Resources includes a lecture and seminar on foresight and scenario planning applied to challenges of eco-innovation and sustainable development.

RESEARCH: GREEN ECONOMY, ECO-INNOVATION, RESOURCE POLICIES AND INDICATORS

ISR has a major over-arching research focus on Green Economy, Eco-Innovation, Resource Policies and Indicators.

These topics run through the other research themes, as will be seen, so that they act as strategic underpinning for ISR research generally.

This research includes decoupling analysis based on a number of indicators (MFA, LCA, footprints, etc.), and the computation of an environmental full 'sustainability gap' (SGAP) indicator for the UK and other EU countries.

Over time, ISR seeks to develop a new perspective on the economics and policies of resources and materials, with resources being appropriately valued and accounted for, more equally shared, and maintaining their value for longer, as will be required for the attainment of the Sustainable Development Goals.

Key highlights

ISR contributes to UN Environment reports

Paul Ekins, member of UN Environment's International Resource Panel, contributes to their reports across a range of environmental and resource topics, including resource efficiency, resource governance, and scenarios of future resource use.

Paul Ekins announced as Co-Chair of UN's GEO-6 report

Paul Ekins is also Co-Chair of the UN Environment's flagship publication Global Environment Outlook (GEO)-6, which is being prepared for publication at the UN Environment Assembly in 2019.

High Level Expert Panel on the European Decarbonisation Pathways

Paul Ekins is a member of the European Commission's High Level Expert Panel on

the European Decarbonisation Pathways Initiative, which in the summer will report to the European Commissioner for Research and Innovation on recommendations for future EU research.

ISR co-edits a special issue on the Circular Economy

In July 2017, Raimund Bleischwitz co-edited a special issue on 'Resource efficiency, circular economy and sustainability dynamics in China and OECD countries' in *International Economics and Economic Policy*.

Selected projects

INNOPATHS

A four-year EU funded research project, led by UCL ISR, that aims to work with key economic and societal actors to generate new, state-of-the-art low-carbon pathways for the European Union.

UK Energy Research Centre Phase III

UCL ISR leads the Resources and Vectors Theme of the UK Energy Research Centre's (UKERC) third phase.

RECREATE

RECREATE (Raw Materials and Innovation Policy) seeks to improve the understanding of how policy interventions impact research and innovation developments in the fields of climate action, resource efficiency and raw materials, and how these are interrelated.

SINCERE

The SINCERE project, led by ISR, develops new macro-economic modelling tools to understand the resource use patterns of China and the EU. It addresses indicators and policies, and examines patterns between trade and macro-economic performance.

Routledge Handbook of the Resource Nexus

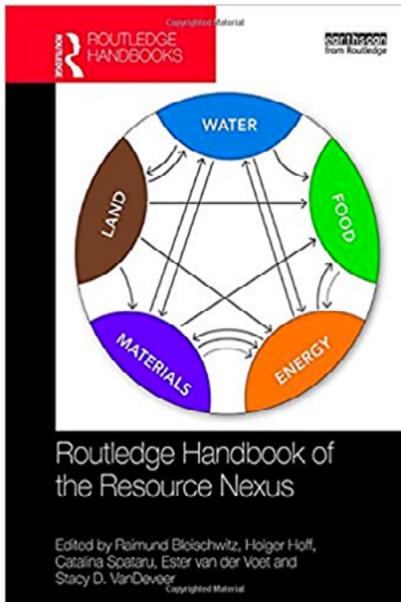
The 'Routledge Handbook of the Resource

Nexus' has been published.

The book, edited by Raimund Bleischwitz and four co-editors, focuses on rigorous research, including tools, methods and modelling approaches to analyse resource use patterns across societies and scales from a “nexus perspective”.

It also provides numerous examples from political economy to demonstrate how resource nexus frameworks can illuminate issues such as land grabs, mining, renewable energy, the growing importance of economies such as China in the supply and demand of resources.

It will also propose lessons and outlooks for sound governance.



The 'Routledge Handbook of the Resource Nexus', published in late 2017

Selected publications

Barrett, J., Ekins, P., Eyre, N., Gross, R., Watson, J. and Wright, L. 2017 'Building our Industrial Strategy: Response to the Green Paper from the UK Energy Research Centre', April 18, UKERC, London

Bleischwitz, R., & Perincek, R. (2017). Raw Materials and International Relations. *Security and Peace - Sicherheit und Frieden*, 35 (3), 129-133. doi:10.5771/0175-274X-2017-3-129

Ekins, P. 2017 'Resource efficiency will improve UK competitiveness', in Industrial strategy fit for the future: Perspectives on building a competitive UK economy, Green Alliance, London, pp.8-9, http://www.green-alliance.org.uk/industrial_strategy_fit_for_the_future.php

Flachenecker, F., Bleischwitz, R., & Rentschler, J. E. (2017). Investments in material efficiency: the introduction and application of a comprehensive cost-benefit framework. *Journal of Environmental Economics and Policy*, 6 (2), 107-120. doi:10.1080/21606544.2016.1211557

Bleischwitz, R., Nechifor, V., Winning, M., Beijia, H., & Yong, G. (2018). Extrapolation or saturation – an exploration into growth patterns, development stages and decoupling. *Global Environmental Change* 48C (2018) pp. 86-96

Pedro, A., Ayuk, E., Bodouroglou, C., Milligan, B., Ekins, P. and Oberle, B. 2017 'Towards a sustainable development licence to operate for the extractive sector', *Mineral Economics*, May, DOI 10.1007/s13563-017-0108-9

Watts, N, Drummond, P., Ekins, P. et al. 2017 'The Lancet Countdown: tracking progress on health and climate change', *The Lancet*, Vol. 389, Issue 10074, 18–24 March, pp.1151–1164

RESEARCH: CLIMATE POLICY

The Climate Policy theme focuses mainly on the economic and policy dimensions of emissions mitigation, both internationally (including the UN / Paris Agreement) and with regional foci for UK, Europe, and China.

Cross-cutting EU-funded research projects include exploration of the potential for 'win-win' outcomes, particularly in relation to financial architectures and related risks ('GREEN-WIN' project); and economic and governance dimensions of implementation of the Paris Agreement ('RIPPLES' project).

Other research focuses on energy system costs in low carbon transition, the role of international trade including 'embodied emission transfers' (CO₂ production vs consumption / footprint), and related policy issues for tackling emissions from consumer end.

This theme is led by Michael Grubb, Professor of Energy and Climate Change

Key highlights

ISR continues extensive research on carbon pricing and 'carbon clubs'

This year, extensive work continued on carbon pricing and 'carbon clubs' in the aftermath of the Paris Agreement, including a workshop on the topic hosted with the French embassy and numerous presentations in UK, US and China.

Brexit and the impact on UK climate and energy policy

In 2016, UCL ISR and the UCL European Institute released a paper that analyses the implications of Brexit for the UK's energy sector.

The research finds that in the short term, the impact would be limited because EU rules (the *acquis communautaire*) would remain in place.

Post-2020 effects would depend on

the extent to which Brexit slowed down the construction of new electricity interconnectors (cables carrying electricity to and from Britain), and on the arrangements the UK negotiated with the rest of the EU.

This paper considers the three main scenarios for Brexit: joining the European Economic Area (EEA, like Norway), entering into a Customs Union (like Turkey), or negotiating a Free Trade Agreement (FTA, like Canada).

Prof Grubb submits evidence for House of Lords enquiry

Prof Grubb was invited to submit evidence on the possible impact of Brexit on EU and UK energy and climate change policy. He discussed the short and long term impact of Brexit. In July 2016 Prof Grubb appeared at a Select Committee hearing on the topic.

Lecture tour on 'Delivering the energy transition'

In August 2017, Prof Grubb presented a lecture tour on 'Delivering the energy transition' in Australia & China. He also presented at the World Bank and in Canada.

Limiting global warming to 1.5 °C may still be possible, according to new study

In September 2017, Prof Grubb co-authored a new study suggesting that the 1.5°C Paris climate target is still possible if emission reductions begin immediately.

The paper finds that the goal of the Paris Agreement on Climate Change, limiting the increase in global average temperatures above pre-industrial levels to 1.5°C, is not yet geophysically impossible, however it will require more ambitious emission reductions than those pledged so far.

Selected projects

Carbon-CAP (Consumption Accounting and Policies)

Framework 7 project was completed in December 2016. Several presentations around both the accounting and analysis of policy instruments were delivered. In addition to delivered reports, journal papers are in review and a Special Issue confirmed.

An exploration of energy cost constants, affordability limits and adjustment processes

This project was supported by the Institute of New Economic Thinking (INET) and was completed in June 2017.

GREEN-WIN

A EC H2020 programme exploring potential for 'win-win' approaches, running from October 2015 to September 2018). UCL's main input is on finance structures and financial risk appraisals.

COP21 RIPPLES

COP21: Results, Implications, Pathways and Policies for Low-Emissions European Societies is a EC H2020 programme that analyses the implications of the Paris Agreement, running from October 2017 to December 2019. UCL is overseeing the main modeling work package and engaged across the consortium, including in relation to competitiveness analysis.

Carbon Pricing

A part-time Research Associate has been appointed to focus on carbon pricing, in support of Prof Grubb's role as co-chair of the Evidence-base group on the Carbon Pricing Leadership Coalition.

Selected publications

S. Bisaro, Ameli N., F. Schuetze, M. Grubb, P. Drummond 'Public investors leveraging private institutional finance: potential and limits' (under review in *Climate Policy* special issue)

M. Grubb (2017). Energy: Scanning the energy horizon. *Nature*, 543: 37–38

M.Grubb et al (2017), Empirics, theory and implications of the 'Bashmakov-Newbery Range of Energy Expenditure', Final report to INET

R.J. Millar et al (Sept 2017). Emission budgets and pathways consistent with limiting warming to 1.5 C, *Nature Geoscience* DOI:10.1038/NGEO3031

'Carbon decoupling? Carbon emissions and economic growth — production vs consumption-based evidence' <https://www.ineteconomics.org/perspectives/blog/carbon-decoupling>

Energizing European Recovery (2017) – the European Energy Union <http://www.euractiv.com/section/energy/opinion/energising-european-recovery/>

RESEARCH: ENERGY PATHWAYS

The energy pathways theme examines long-term scenarios for the energy system and explores the implications of these scenarios for people and policymakers. It spans economics, engineering, social and environmental issues, and policy. It works with other themes on cross-cutting issues such as climate policy and the water-food-energy nexus.

One strand of current research focuses on the implications of new energy systems and technologies for people, particularly in the global South. Fossil and biomass resources have been an area of interest for several years, and there is increasing interest in modelling waste management and the circular economy. Low-carbon energy vectors are the third major research area, with a hydrogen energy programme and projects on bioenergy, greenhouse gas removal technologies and renewable electricity generation.

Both quantitative and qualitative methods are used. The most prominent is the development and use of UK, EU and global economy-wide energy system models.

This theme is led by Dr Paul Dodds.

Key highlights

ISR launches three White Papers at City Hall

ISR contributed to three White Papers on hydrogen systems, hydrogen security and economic opportunities from adopting hydrogen technologies, and these were launched at City Hall, with subsequent seminars at All-Energy, the World Hydrogen Technical Conference 2017 and the FCH2 Technical Conference.

Paul Dodds was appointed BEIS's alternate delegate for IEA Hydrogen

Paul will represent the UK at IEA Hydrogen meetings, starting at Naples in December 2017. He organised a UK workshop with

BEIS in October 2017 and is working on several new IEA Hydrogen projects that the UK might lead.

Hydrogen and Fuel Cells Hub Extension

The Hub was extended by 2 years to 2019, with Paul Dodds taking over from Paul Ekins as the UCL lead on socioeconomics, and with a project on hydrogen for heating.

Policy note on energy storage

The RESTLESS project published a policy note on energy storage in markets and followed this up with meetings at BEIS and OFGEM, and a response to a government consultation with UKERC. The UK Government has recently announced that several of the recommendations are being pursued.

Energy development in South America

ISR researchers published several papers in the energy and development space, and have undertaken fieldwork in Colombia and, shortly, in Brazil. ISR is also involved in several proposals funded by the GCRF and Newton Fund.

Carbon Capture and Storage (CCS) research

CCS has become a major research area in the last year. UCL has joined the UK CCS Research Centre to undertake energy system modelling, and major new projects have commenced on bioenergy with CCS and greenhouse gas removal technologies.

Selected projects

Hydrogen's value in the energy system (HYVE)

Assessing the potential value of hydrogen to the UK as part of a transition to a low carbon economy, including power-to-gas and supply chain infrastructure analyses.

Definition of a UK green hydrogen standard

Examining working definitions for “green” hydrogen for policy purposes, and the implications for UK policy of introducing a green hydrogen standard.

Hydrogen and Fuel Cells Hub

The UCL team is the lead institution on a socio-economic package of work under the hub.

Off grid electrification in Chocó, Colombia

Interviews and questionnaires with off-grid fishing communities, supported by the development of an energy system model.

Sustainable Gas Pathways for Brazil; from Microcosm to Macrocsm

Assessing socio-economic implications of potential biomethane pathways in the Brazilian energy system.

Bioenergy value chains: Whole systems analysis and optimisation

Understanding the potential role of biomass in the UK energy system by integrating models of different aspects of international and UK bioenergy supply chains across multiple scales.

UK Carbon Capture and Storage Research Centre 2017 (UKCCSRC 2017)

Contributing UK energy system modelling of the potential role of CCS in electricity, hydrogen and industry.

Realising Energy Storage Technologies in Low-carbon Energy Systems (RESTLESS)

Integrating energy storage across the UK energy system to reduce the costs of introducing renewable electricity generation in the future.

UK Energy Research Centre

Examining EU gas security using GNOME, a new gas network investment optimisation model developed by ISR. Exploring potential interactions between energy vectors at distribution scale to underpin decarbonisation of heat provision.

Selected publications

Castagneto Gisse, G., Dodds, P. E., Radcliffe, J. (2018) Market and regulatory barriers to electrical energy storage innovation. *Renewable and Sustainable Energy Reviews* 82(Part 1): 781–790

Castan-Broto, V., et al. (in press). Universal access to sustainable energy in urban areas. *Nature Energy*, forthcoming.

Lott, M. C., Pye, S., Dodds, P. E. (2016). Quantifying the co-impacts of energy sector decarbonisation on outdoor air pollution in the United Kingdom. *Energy Policy* 101:42–51.

Staffell, I. and Dodds, P. E. (Eds.) (2017) The role of hydrogen and fuel cells in future energy systems. H2FC Supergen Hub, London, UK.

Steinberger-Wilckens, R., Dodds, P. E., Kurban, Z., Velazquez Abad, A., and Radcliffe, J. (Eds.) (2017) The role of hydrogen and fuel cells in delivering energy security for the UK. H2FC Supergen Hub, London, UK.

RESEARCH: WATER AND FOOD RESOURCE NEXUS

Human use of all natural and synthetic resources is increasingly recognised as being interlinked, as conceptualized through the water-energy-food 'nexus' concept.

Under this research theme, UCL-ISR researchers are assessing the environmental sustainability of global food production and trade (NERC fellowship project), focusing on agriculture's interactions with land, climate and water. Further nexus analysis at UCL-ISR targets the interlinkages of energy and water.

The Institute pushes the boundaries of the resource nexus debate through integrating minerals and land; it has produced a handbook published by Routledge on the resource nexus, that will be published in 2017. ISR will make efforts towards nexus coefficients, a global database and liaising with research on environment and security.

This theme is led by Dr Carole Dalin.

Key highlights

Groundwater depletion and international food trade

UCL ISR research published in leading journal *Nature* in March 2017 found that the use of non-renewable groundwater for irrigation increased by a quarter from 2000 to 2010, doubling in China alone.

The analysis suggests that unless action is taken by both producers and consumers, this trend could eventually lead to depleted water reserves, limited access to imported food and increased food prices.

Groundwater – water abstracted from underground, as opposed to water found on the surface in rivers or lakes – supplies global agriculture with 43% of the water used for irrigating crops. Some sources of groundwater are considered non-renewable, as their rate of recharge is slower than the rate at which they are used.

The depletion of local water reserves also risks putting large populations at serious danger during emergencies such as droughts, earthquakes or fires, when immediate access to water is required.

Using trade data from the United Nations and estimates of non-renewable groundwater abstraction, researchers traced the sources of water used to produce agricultural crops.

The country exporting the most crops produced using non-renewable groundwater is Pakistan, with 29% of global non-renewable sources embedded in trade – closely followed by the United States (27%) and India (12%).

The publication received wide spread media coverage and is in *Nature's* top 5% of all research outputs.

UCL awarded 'Our Planet, Our Health' research grant

A new partnership between UCL, LHSTM, Aberdeen and international partners (UKZN in Durban and PFHI Delhi) won a £5 million Wellcome Trust grant about Sustainable and Healthy Food Systems. UCL ISR's Carole Dalin is a collaborator and will co-supervise a postdoctoral researcher for this project.

Scale of global water crisis is unclear due to inadequate metrics

In March 2017 UCL ISR and UCL Geography released a report suggesting the scale of the global water crisis could not be properly known due to inadequacies with the current metrics used to measure it.

The report, authored by Simon Damkjaer and Richard Taylor, finds that the misrepresentation of freshwater resources and demand is particularly severe in low-income countries of the tropics where the consequences of water scarcity are projected to be most severe and where most of the global population now live.

Annual Symposium on Water SDGs and Future Water Management

In November 2016, UCL ISR hosted an annual symposium series focusing on the Sustainable Development Goal (SDG) 6 to 'ensure availability and sustainable management of water and sanitation for all'.

Experts from across the world joined us to discuss possible water supply scarcities, analyse current water markets and policies, as well as modelling approaches interlinking those issues, and concluded with a discussion on future water management systems.

Selected projects

FOODIES

Developing Integrated Environmental indicators for Sustainable global Food production and trade (FOODIES) [Natural Environment Research Council], led by Dr Carole Dalin.

ADVENT

ADVENT assesses the environmental, social and economic implications of delivering the decarbonisation pathways to radically cut GHG emissions by 2050

GRANTHAM project

'The Impact of Climate Change on Global Food Production' aims to provide insights into the possible future impact of the cumulative effects of climate change and land degradation on agricultural production in the major crop-producing regions. The project evaluates the economy-wide impacts of different climate change, land degradation and adaptation scenarios.

Selected publications

Dalin et al. (2017). Groundwater depletion embedded in international food trade, *Nature* 543, 700–704

Marsden, T et al. (2018) Handbook of Nature, SAGE. Sage Publications Ltd

Usubiaga, A., Butnar, I. and Schepelmann, P. (2018). Wasting Food, Wasting Resources: Potential Environmental Savings Through Food Waste Reductions. *Journal of Industrial Ecology*

Vivanco D. et al (2017): Nexus Strength. A Novel Metric for Assessing the Global Resource Nexus. *Journal of Industrial Ecology*, DOI: 10.1111/jiec.12704

RESEARCH: ECONOMETRIC ASSESSMENTS

The econometric modelling and evaluation of energy and economic policies has been a long-standing research area at ISR.

Our research focuses on the impact of future low carbon pathways on natural capital and ecosystem services, the impact of economic and climate shocks on the price of traded commodities and the drivers of variability in the yield of agricultural crops.

Our team has also an extensive track record in assessing the impact of energy efficiency measures, such as those introduced by the Department for Business, Energy & Industrial Strategy.

Our research is based on different branches of econometrics such as structural VARs, Kalman filtering, gravity models and programme evaluation econometrics.

This theme is led by Dr Paolo Agnolucci.

Key highlights

ISR develops energy projection module for government

ISR's estimation of the industrial module of the Energy Demand Model was used by the Department for Business, Energy & Industrial Strategy to produce updated Energy and Emissions Projections.

Indicators for Energy Poverty

ISR advised the European Commission on different approaches to select indicators for energy poverty.

Renewable Heat Premium Payment Scheme

ISR analysed data from heat pumps installed as part of the Renewable Heat Premium Payment Scheme introduced by the Department for Business, Energy & Industrial Strategy.

Selected projects

UKERC Phase III (Theme 2.4)

Theme 2.4 assesses the existence of synergies and trade-offs between a number of Sustainable Development Goals (SDGs) arising from global demand for biomass included in decarbonisation pathways due to the amount of land and water required to meet that demand and other competing needs such as food production.

ADVENT

ADVENT assesses the environmental, social and economic implications of meeting delivering the decarbonisation pathways to radically cut GHG emissions by 2050.

GRANTHAM

In the Grantham project ISR assesses the impact of climate change on the yield of agricultural crop in a number of European countries as well as the impact of climate change on food price.

SINCERE

The SINCERE project develops new economic modelling tools to understand the resource use patterns of China and the EU.

Selected publications

Agnolucci, P. A., De Lipsis, V., & Arvanitopoulos, T. A. (2018). Modelling uk sub-sector industrial energy demand. *Energy Economics*.

Moreno-Benito, M., Agnolucci, P., & Papageorgiou, L. G. (2017). Towards a sustainable hydrogen economy: Optimisation-based framework for hydrogen infrastructure development. *Computers & Chemical Engineering*, 102, 110-127.

Rademaekers, K., Yearwood, J., Ferreira, A., Pye, S. T., Hamilton, I., Agnolucci, P., . . . Anisimova, N. (2016). Selecting Indicators to Measure Energy Poverty. Brussels: European Commission.

RESEARCH: INNOVATION ANALYSIS

Innovation is fundamentally important in enabling more sustainable use of natural resources. The innovation theme at ISR is taken forward through teaching, research and policy engagement.

Key highlights

Launch of INNOPATHS project

A four-year EU funded research project, led by UCL ISR, that aims to work with key economic and societal actors to generate new, state-of-the-art low-carbon pathways for the European Union.

ISR welcomes a Marie Curie fellow

ISR welcomed a Marie Curie fellow, Maria Rosa de Giacomo, to work on eco-innovation and business models.

New research proposals

ISR is submitting project proposals on finance for low-carbon innovation, low-carbon innovation and comparative advantage and responsible research and innovation.

Institute for Innovation and Public Purpose

ISR is joined at UCL by a new institute, the Institute for Innovation and Public Purpose, led by Professor Mariana Mazzucato. The new institute creates new opportunities for innovation-related research at ISR.

Selected projects

INNOPATHS

Funded by the European Commission, this multi-institution project is addressing the role that innovation can play in achieving a decarbonised European energy system.

SINCERE

Funded by the ESRC and funders in China, Germany, France and the Netherlands, this collaborative project includes a stream of work on innovation.

Inno4SD

This project is building an international network of researchers on eco-innovation. UCL ISR leads the work package on policies.

We also have a number of PhD students working on innovation-related topics, including Tobias Reinauer (technology transfer in biogas), Benoit Decourt (valuation of early-stage technologies for power-to-gas) and Domagoj Baresic (emerging innovations for low-carbon shipping).

Selected publications

Grubb, McDowall & Drummond (in press) On order and complexity in innovations systems: Conceptual frameworks for policy mixes in sustainability transitions. *Energy Research and Social Science*.

McDowall et al (2017): Circular Economy Policies in China and Europe. *Journal of Industrial Ecology*, DOI: 10.1111/jiec.12597

McDowall, W. and F. W. Geels (2017). "Ten challenges for computer models in transitions research: Commentary on Holtz et al." *Environmental Innovation and Societal Transitions* 22: 41-49.

Miedzinski, McDowall & Bleischwitz (2018) Eco-innovation and resource nexus challenges. Chapter 29 in Bleischwitz, Hoff, Spataru, van der Voet, VanDeveer (eds) *Routledge Handbook of the Resource Nexus*.

RESEARCH: MACRO-ECONOMIC MODELLING

The Macro-Economic Modelling area explores resource interlinkages and transition pathways at the global, regional and country level.

Our research is mainly based on the UCL-ISR Environmental Global Applied General Equilibrium (ENGAGE) model, which has been recently developed as a tool for the analysis of energy, environmental, resource and economic policies. ENGAGE is a powerful tool to evaluate policies across sectors and across regions, quantifying the economic costs and benefits of the policies in question.

Detailed versions of the ENGAGE model have been developed to assess the economic impact of food, mineral and energy policies. Over time we will extend the modelling to measure and monitor countries' economic, social and environmental performance towards the SDGs and various footprints.

A dynamic input-output model and a dynamic CGE model for the UK are expected to be developed in the short term. These models will allow an economy-wide analysis of UK policies considering distributional aspects of different energy, climate and environmental policies.

This theme is led by Dr Alvaro Calzadilla.

Key highlights

ISR presents at 20th Annual Conference on Global Economic Analysis

Two articles were presented at the 20th Annual Conference on Global Economic Analysis, held in June 2017: 'A GTAP-based model for analysing resource efficiency and the circular economy' and 'Higher CO₂ concentrations impacts over global crop production and irrigation water requirements'.

ISR awarded new GCRF funded research project

A new four-year GCRF funded project 'Resilient and Sustainable Interventions in Water-Energy-Food-Environment Mega-Systems' will begin from October 2017. UCL-ISR is part of this unique multi-disciplinary team.

Selected projects

The Grantham project

'The Impact of Climate Change on Global Food Production' aims to provide insights into the possible future impact of the cumulative effects of climate change and land degradation on agricultural production in the major crop-producing regions. The project evaluates the economy-wide impacts of different climate change, land degradation and adaptation scenarios

COP21 RIPPLES

'COP21: Results and Implications for Pathways and Policies for Low Emissions European Societies' aims to analyse the transformations in the energy systems, and in the wider economy, that are required in order to implement the Paris Agreement (NDCs), and investigate what steps are needed to attain deeper, more ambitious decarbonisation targets, as well as the socio-economic consequences that this transition will trigger.

SINCERE

'Sino-European Circular Economy and Resource Efficiency' aims to understand the resource use patterns of China and the EU. The project addresses indicators and metrics, institutions and policies, and historical patterns between resource indicators, trade and macro-economic performance.

MICA

'The Mineral Intelligence Capacity Analysis' project aims to provide a stakeholder

tailored product, namely the ‘European Union Raw Materials Intelligence Capacity Platform’ (EU-RMICP). To do so, the project conducts a careful analysis of stakeholder needs and undertakes a review of existing data, methods and tools that provide intelligence on raw materials.

UKERC

‘Theme 2.2 of UKERC phase 3’ aims to research the relationship between energy and the economy. So far the project has concentrated on the global implications of the Paris Agreement and the timing of NDC commitments. New research will focus on distributional concerns of energy policy in the UK.

DAMS 2.0

‘Resilient and Sustainable Interventions in Water-Energy-Food-Environment Mega-Systems’ aims to improve the thinking around the construction of dams by considering them as disturbances of an interacting system of water, energy, food and the environment. The main outcome should be a software system which can be used for dam design, training and operation management.

Selected publications

Calzadilla, A., K. Rehdanz, R. Roson, M. Sartori and R.S.J. Tol (2016) Review of CGE models of water issues. In: Bryant, Tony (ed.) Computable general equilibrium models. The WSPC Reference on Natural Resources and Environmental Policy in the Era of Global Change, 3. *World Scientific*, Singapore, pp. 101-124.

Calzadilla, A., R. Delzeit and G. Klepper (2016) Assessing the Effects of Biofuel Quotas on Agricultural Markets. The WSPC Reference on Natural Resources and Environmental Policy in the Era of Global Change, 3. *World Scientific*, Singapore, pp. 399-442.

DeCarolus, J., H. Daly, P. Dodds, I. Keppo, F. Li, W. McDowall, S. Pye, N. Strachan, E. Trutnevvyte, W. Usher, M. Winning, S. Yeh, M. Zeyringer (2017) Formalizing best practice for energy system optimization modelling, *Applied Energy*, 194, 184-198.

Winning, M., A. Calzadilla, R. Bleischwitz and V. Nechifor (2017) Towards a circular economy: insights based on the development of the global ENGAGE-materials model and evidence for the iron and steel industry, *Int Econ Econ Policy*, DOI 10.1007/s10368- 017-0385-3.

MSc SUSTAINABLE RESOURCES: ECONOMICS, POLICY & TRANSITIONS

The MSc in Sustainable Resources: Economics, Policy and Transitions offers students a unique opportunity to understand and learn how to analyse and manage the sustainable exploitation of mineral and natural resources, throughout the economy.

This multi-disciplinary programme includes contributions from economics, political science, development planning, engineering and the natural sciences, as is appropriate for understanding planetary boundaries, people and the resource nexus.

“It has been an exciting academic year for the new MSc Sustainable Resources. In September 2016 we welcomed our first cohort of students.

“We had an extremely smart and interdisciplinary group that were up for the challenge and show commitment and eagerness to learn. All our brand new modules have proven very popular and discussions and field trips have complemented more formal lectures. We have tried to present our students with cutting edge research in the area of sustainable resources with a very applied perspective.

“External lecturers, including representatives from businesses, policy-makers and NGOs, have added different perspectives on the complex issue of sustainable resources. Having seen the steep learning curve of our students in the course, we are now keen to follow the next steps in their professional careers.”

Teresa Domenech
MSc Sustainable Resources Course Director

Student testimonials

“I very much enjoyed this masters programme. I found the topics extremely interesting and progressive and particularly loved the interdisciplinary nature of the classes. Most importantly, I thought the programme allowed for extensive critical analysis and discussion. I’ve emerged ready and excited to embark on the next chapter of my career.”

Christina, former MSc SR: EPT student

“This course has provided me with an insight into the challenge of resource management on a global scale, from an economic, political and practical perspective. The lectures are engaging and the module content is challenging. The skills I have developed have enabled me to pursue a career in the sustainability sector, as well as many other industries.

Christopher, former MSc SR: EPT student



MSc Sustainable Resources field trip, 2017

MSc ECONOMICS & POLICY OF ENERGY & THE ENVIRONMENT

The MSc in Economics and Policy of Energy and Environment equips students to address climate change, resource exhaustion, energy poverty and energy security, and become sustainability leaders and entrepreneurs in business, policy-making and research.

In an interdisciplinary, collaborative learning environment students are introduced to environmental law, the economics of the environment and natural resources, the issues and challenges of global energy use and the field of energy modelling.

Highlights 2016/17

Professor Paul Ekins, teacher on the MSc EPEE course, was nominated for Students' Union UCL 'Outstanding Teaching Award' as part of their Student Choice Teaching Awards Roll of Honour 2017.

The Annual Alumni event was held at the UCL Energy institute in June. The event included a lecture from Professor Paul Ekins and panel discussion with alumni. Discussed were hot-topics of the year; Brexit, Trump, and EURATOM, as well as alumni reflecting on their experiences working in the energy sector.

"The course is now coming to the end of its fourth year, and it continues to grow. It is a real pleasure to see our alumni from previous years establish themselves in such a wide range of careers – in governments, in NGOs, in specialist energy consultancies and in large energy and financial corporations. We clearly provide skills and knowledge that help our graduates into fascinating careers in the energy and environmental policy field, and that evidence of the value of the course is hugely rewarding for the course teaching team."

Will McDowall
MSc EPEE Course Director

"Studying at UCL has given me broad and solid background knowledge on energy economics and policies, which I found to be essential for my current job. After graduation, I started working as project manager for the German Energy Agency in Berlin in the department of Renewable Energy and Energy-Efficient Mobility."

Laura Prawatky, former MSc EPEE student



MSc EPEE students, 2017

DOCTORAL RESEARCH

In 2016/17, UCL ISR's PhD cohort continued to grow with a large proportion working on collaborative projects measuring regional progress towards or away from environmental sustainability.

PhD alumni

ISR would like to congratulate our first cohort of PhD graduates:

Jun Rentschler

In August 2017 Jun completed his PhD, which focused on environmental and energy economics in developing countries.

He joined the Young Leaders Program at World Bank and now works as an Economist at the World Bank's Climate Change Division, where he contributes to the applied research agenda on climate change, and supports project teams in developing strategies for resilient and sustainable development. Jun's PhD thesis on energy pricing reform will be published as a book by Routledge in 2018.

Louise Guibrunet

Louise's PhD research was about the role of the informal economy in domestic solid waste management in Mexico City. She explored the different waste handling activities informal workers engage in, their relationship with the formal sector, the impacts of their work in terms of urban sustainability, and finally the political implications of their informal status.

As of March 2018, Louise will be working as a post-doctoral fellow in the Research Institute for Ecosystems and Sustainability, National Autonomous University of Mexico, in Morelia, Mexico.

Melissa Lott

Melissa's PhD focused on the nexus of Energy Systems and Public Health.

"My PhD at UCL ISR focused on the intersection of energy systems and public health. In this research, I investigated the co-impacts of energy technology transitions in the United Kingdom and London on greenhouse gas emissions, air pollution, and premature deaths. I am now applying this type of interdisciplinary energy modeling at a multi-national scale in my new position in Japan.

"After completing my PhD, I took up post as the Assistant Vice President of the Asia Pacific Energy Research Centre. Here in Tokyo, I coordinate and oversee the development of the APEC Energy Demand and Supply Outlook, leading a talented and diverse group of 18 researchers from across the APEC region."

Melissa Lott

Florian Flachenecker

Florian was a Doctoral Researcher at the UCL Institute for Sustainable Resources, researching the effects of material productivity on competitiveness and climate change mitigation in Europe.

Florian joined the Organisation for Economic Co-operation and Development (OECD) as a Junior Policy Analyst (Young Professionals Programme) in September 2017. He is working on Green Growth Indicators, supporting the OECD's work streams on resource efficiency, the OECD Green Growth Strategy, and the monitoring of progress towards the UN Sustainable Development Goals.

PhD projects

Jabraan Ahmed: Towards Sustainable and Risk Free Gas Production from an Unconventional Source

Abdulaziz Ahmad Al-Shalabi: Provision of Sustainable Water and Electricity in the State of Kuwait

Theodoros Arvanitopoulos: Econometric modelling of energy consumption, natural resources, and economic growth in industrial sectors

Tony Carr: The impact of climate change and land degradation on global food production

Simon Damkjaer: An investigation into the role of storage in water scarcity indicators: Evidence from the Great Ruaha River Catchment, Tanzania

Lindsay Duncan: The study of archaeological deposits to examine local soil formation at Marco Gonzalez, Ambergris Caye, Belize: investigating the potential for Life-Cycle Assessment in archaeology

Nino Jordan: Rescaling Climate Politics: policy evolution towards consumption-based approaches

Thuy Duong Khuu: Reconciling marine conservation with sustainable fisheries: A case study of Marine Protected Areas in Vietnam

Marie Longnecker: Balancing biodiversity conservation and ecosystem service delivery: An investigation of the design, implementation and management of NIAs and their potential impact on England's ecological network

Seyed Mehdi Mohaghegh: Materials and Energy pathways: A whole system approach to investigate possible impacts of materials on future low carbon transitions

Victor Nechifor-Vostinaru: Modelling freshwater resource use and the economy-wide impacts of water scarcity — A global-level CGE analysis framework

Donyang Pan: Green Financial Policy and Sustainable Development in China

Ruya Perincek: Resource Efficiency, Environmental Sustainability, and Industrial

Diversification Through Green Economic Linkages in Resource Based Economies

Niranjana Ramesh: Techno-Politics of Urban Water: the Case of Desalination in London, UK & Chennai, India

Darshini Ravindranath: Confronting Land Degradation and Climate Risks: Examining Dryland Degradation through the Lens of Vulnerability in Jodhpur, India

Adam Roer: Uncertainty and Sensitivity Analysis of Climate Change Integrated Assessment Models

Theodoros Semertzidis: The water-energy nexus in Brazil

Bernard Tembo: Strategic investment decisions in Zambia's mining sector under a constrained energy system

Arkaitz Usubiaga: Measuring progress towards environmental sustainability: A SGAP-based assessment

Stijn van Ewijk: Sustainable use of materials in the global paper life cycle

Daniel Welsby: Modelling Global Natural Gas Resources

Michael Benedict Yamoah: Managing the environment in the era of sustainable development: Options for convergent and coherent national implementation of the post-2015 agreements

EXTERNAL OUTREACH

Matt Winning performs at Edinburgh Fringe



UCL ISR Research Associate Dr Matt Winning, a member of UCL ISR's macro-economic modelling team, performed a show inspired by his research at the Edinburgh Fringe festival in 2017.

He discussed how global warming is 'destroying the planet and his life'.

In a recent Interview with The Guardian Matt discussed his work and the show, saying "I spend all of my other time thinking about serious things. Standup has always been an escape, so I've tended to do obscure, silly stuff."

Media engagement

ISR continues to be a leading voice in the media on sustainability issues, with 2016/17 seeing the Institute's experts commenting on a range of issues from the arrival of Donald Trump, Hinkley Point C, Brexit and fossil fuels.

Raimund Bleischwitz published an article on 'greening the miners', which has appeared in 18 publications in 18 countries and in seven languages.

International media engagement continued to grow, including Professor Paul Ekins commenting on air pollution for China Central Television (see opposite).

ISR hosts Summer Challenge programme



In June and July 2017 ISR hosted a Widening Participation Summer Challenge for A level students from backgrounds less likely to apply to university.

The event was designed by Dr Nick Hughes to support and develop the potential of these students, to give them the confidence to make an application to a top university.

The event was also designed to give students experience in the kind of study techniques and other transferable skills that they will need at university, and to inspire their interest in environmental issues.

Every Tuesday evening for five weeks, after finishing their normal school day, the students travelled to UCL to take part in the course.



Partnership work

Working with partners in industry, academia and government is at the heart of ISR's work.

By engaging with external partners, the Institute is more likely to create a real-world impact with its research.

Case study: ISR develops energy projection module for government

In autumn 2016, the UK government asked a team from ISR to lead the development of an improved industrial module of the BEIS Energy Demand Model. The model is an important component in UK energy policy-making as it is used to produce the Energy and Emissions Projections, an annual report which analyses and projects future UK energy use and greenhouse gas emissions.

The UCL team partially funded by UKERC (Dr Paolo Agnolucci, Dr Vincenzo De Lipsis and Theodoros Arvanitopoulos) developed new approaches for projecting GVA, energy consumption and fuel consumption (coal, electricity, gas and oil) for each of the 10 industrial subsectors included in the model.

The work produced a new module that improves the theoretical underpinnings and statistical validity, therefore increasing the confidence in its projections.

“It was a great experience of working with civil servants on a modelling project with clear policy relevance. We had considerable exposure to several BEIS internal stakeholders approaching the model and the Energy and Emissions Projections from a number of different angles. It was fascinating to see the diversity of BEIS teams which use the output from our model in their analyses.”

Paolo Agnolucci
Senior Lecturer in Environmental and Resource Economics at UCL ISR

Public events

ISR has a busy calendar of public events running throughout the year, enabling engagement with academics, students, industry, policymakers and the wider public.

2016

7-25th November

Disruptive Innovation Festival, featuring ISR sessions on the circular economy

8-9th November

UCL ISR Annual Symposium: Water SDGs and Future Water Management

29th November

UCL Energy & Resource Economics Group seminar by Prof. Michael Grubb

30th November

Public Lecture by Achim Steiner on 'Lost in the Green Economy Transition: Environmental Imperatives vs. Economic'

2017

7th February

UCL ISR & Energy seminar: World Energy Outlook 2016, Dr Christophe McGlade

26th April

UCL ISR Seminar: The politics of carbon inequality, Prof. Ian Gough

17th May

UCL ISR Seminar: Who is eating up the world's aquifers? Groundwater depletion in international food, Dr Carole Dalin

2nd June

2017 Alumni Event: MSc Economics and Policy of Energy and the Environment

14th June

UCL ISR Seminar: Homeward bound: Antarctic reflections on a female quest for a more sustainable planet, Prof. Lindsay Stringer

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