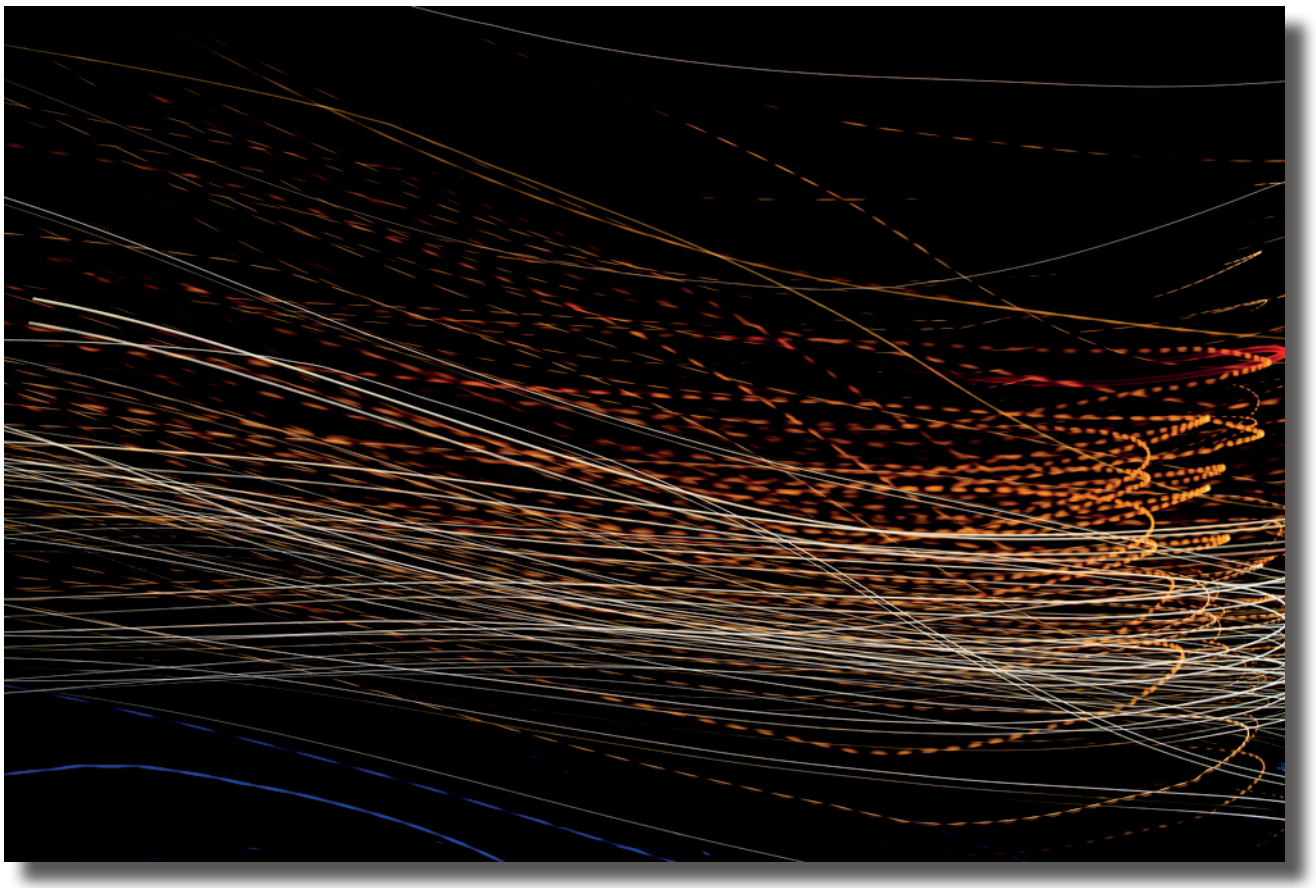
wholeSEM Annual Conference 2016

4 & 5 July 2016

Energy Modelling Insights for Iterative Decision Making Conference Report



Overview

The 3rd Annual Conference of the wholeSEM consortium (Whole Systems Energy Modelling) was held at The Moller Centre, University of Cambridge on the 4th & 5th of July 2016. It was attended by an invited audience of over 100 leading energy modellers from all over the world. This diverse mix of experts was drawn not just from academia but also from government, think-tanks, consulting and firm's in-house expertise. These technical experts were joined in a set of discussion sessions by government and industrial model users and consumers of model outputs, to discuss how to better link and iterate model insights into real world decision making. This conference thus combined attempts to model the future energy pathways under uncertainty, while recognising the muddling-through, multi-faceted and imperfect nature of energy policy and industrial decision making.

PhD Student Participation

An innovative and highly popular feature of the conference was the invite to 15 UK and international PhD students to participate in a poster competition, with a 2-minute elevator pitch in plenary sessions to deliver insights of their work in an extremely high pressure environment. We congratulate all the PhD participants for their efforts. The chair of the wholeSEM advisory board **Jo Coleman**, Strategy Director at the ETI, awarded prizes for the top 3 PhD Posters to:

1st Place: Hossein Ameli, Imperial College London, 'Value of Gas Network Infrastructure Flexibility for Supporting Future Low Carbon Power Systems'

2nd Place: Aisha Al-Sarihi, Imperial College London, 'Assessment of environmental and macroeconomic impacts of renewable energy uptake using a system dynamics approach: The case of Oman'

3rd Place: Hannah Bloomfield, University of Reading, 'The importance of climate variability for a weather-d pendent power system in Great Britain.'

wholeSEM Annual Conference 2016, Moller Center Cambride, Opening Session

Conference Outreach and Further Information

The conference communicated in real time with wider stakeholders via the Twitter feed at @wholeSEM using the event hashtag #wholeSEM16.

Full details of the conference including PDF versions of presentations are available at:

www.wholesem.ac.uk/events/annual-conference/annual-conf-16

Presentation Themes and Insights

The conference presentations were grouped within three main themes:

1. Integrating society within energy systems modelling

Capturing societal preferences and iterative actions within energy modelling frameworks is a key challenge to understand the evolving energy transition.

2. Wider drivers, impacts and unintended consequences

Broadening the scope of energy modelling to include wider geographical drivers, to link to other technical, economic and physical systems, and to introduce new disciplinary viewpoints is a key challenge.

3. Strategic vs. incremental investment under policy uncertainty

Assessing the trade-offs between long-term, (likely) high upfront cost, (possibly) irreversible investments with short term priorities and constraints, is a key challenge in an energy transition with incomplete and inconsistent policy framing.

Key insights emerging from the discussions at the conference included:

- The advantages of considering wider impacts (e.g., on air pollution, social indicators, employment) and iterating these metrics – that are key for decision makers – back into the modelling process

- A clear focus on uncertainty in model inputs and outputs, even if these uncertainty ranges can be very large

- The usefulness of exploratory modelling to understand possible tipping points, feedbacks and new futures

- A continuous consideration of model engagement, information, interpretation and influence

- The avoidance of modelling silos – interdisciplinarity is difficult to do, but can enable the insights that decision makers need.

- The recognition that decision makers often exist in a silo (e.g., a government department, a sector of industry) and a broder set of interdisciplinary model insights is key for broadening their viewpoint.

wholeSEM Annual Conference 2016
Moller Center Cambridge

CONFERENCE SESSIONS Key Points
DAY 1

Plenary: **Julian Allwood**, University of Cambridge
Welcome to Cambridge, to the wholeSEM consortium, and to our 3rd Annual conference
Keynote speaker: **Laura Cozzi**, Head of Demand Outlook Division, International Energy Agency

Models and forecasts: we have many good examples of bad forecasts made by models in the past, and need to be very careful that scenario analyses are introduced so that they do not imply any forecast. Laura's point that the role of scenarios is to anticipate and identify cross-roads - where key decision points are coming, and to attempt to give guidance on the consequences of main choices.
Multiple metrics and effects: single metrics are often insufficient (e.g. air quality), and outcomes may have more than one benefit (energy efficiency being driven by comfort as much as GHG reduction). But there is a danger that more complex models may give less valuable outputs. What is the right scope of a useful model?
Policies not targets are what makes a difference, and there are significant challenges in implementation- particularly within homes - that are not captured in models.
Silos and short termism: no structure of govt. departments can be designed to avoid issues falling between departments, and many of the issues of concern to energy modellers are in this space. The solution is probably to gain sufficiently high level support in the civil service to convene a cross-departmental task force. A parallel problem exists with short-termism – many government departments at present are ill-configured to examine medium or long term strategy, and many energy policies appear to survive the live of just a single parliament

INTEGRATING SOCIETY WITHIN ENERGY SYSTEMS MODELLING

Session 1a: Integrating society within energy systems modelling

Speakers: **Georg Holtz**, Wuppertal Institute, **Kalai Ramea,** University of California, **Kavin Narasimhan,** University of Surrey
Organiser and Rapporteur: **Tom Roberts**, University of Surrey
Modelling approaches are being developed that attempt to capture broader drivers of energy systems change (from technology and social niches through to evolution in the cultural landscape)
Capturing agent based decision making – whether in social practices in buildings or in discrete vehicle choices is a highly promising avenue to capture energy systems changes

Session 1b: Wider drivers, impacts and unintended consequences

Speakers: **David McCollum**, IIASA
Sean Beevers, Kings College London, **Zenaida Sobral-Mourao**, University of Cambridge
Organiser and Rapporteur: **Sandy Skelton**, University of Cambridge

Sustained low or high oil prices could have a major impact on the global energy mix. The implications

for global CO2 emissions depend on how the substitution dynamics play out, in particular whether oil and gas prices decouple. High oil prices cause substitution towards cheap coal and biomass-based synfuels to replace oil-based products in transport, buildings, and industrial applications. Poor air quality adversely effects health mainly due to fine particulates but also due to other pollutants such as nitrogen dioxide. Meeting the commitment set out in UK government's Climate Change Act could negatively affect air quality through deployment of biomass, diesel and biofuels. Alternatively, strategies such as energy efficiency, demand management, nuclear, and renewable energy options (wind, social and tidal) offer both GHG emissions savings and improvements in air quality.

The configuration of the energy systems has implications for land-use (for example through the deployment of bioenergy) and water use (for cooling and CCS). A study – soft-linking UKTM and Foreseer – finds that including national scale sustainable water and land use constraints on the UK energy system adds only a small additional welfare cost (+0.2%).

Session 1c: Strategic vs. incremental investment under policy uncertainty

Speakers: **Keigo Akimoto,** RITE, **Chris Bataille**, Simon Fraser University', **Peihao Li,** UCL.

Organiser and Rapporteur: **Francesco Fuso Nerini,** UCL

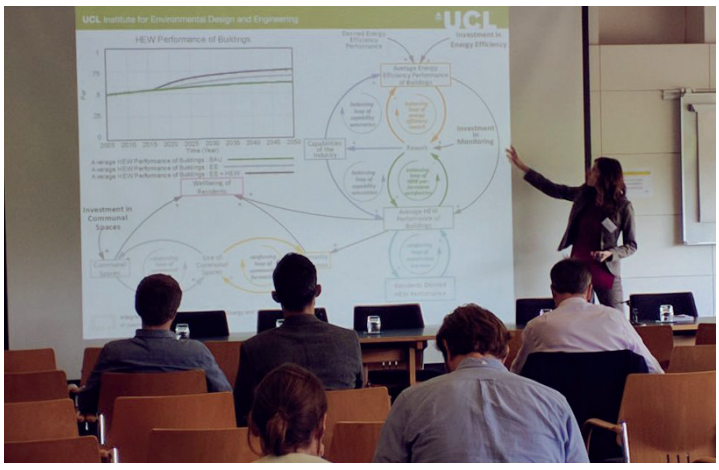
Submitted NDCs (national defined contributed) with the temperature rise target emission pathways were modelling using the Energy Assessment Model DNE21+ was used. Model results showed how the projected 2030 global emissions in line with the submitted NDCs have large gaps from the emission pathways for the 2 ºC target (with a high probability).

There are several ways to present models and model results in a common language for communicating with informal and formal policymaking. There a particular trade-off between technical detail and impact to policy formulation, with mechanisms to bridge this such as dashboards as a translation device to quantify stories told by models in a common format.

In modelling the potential of demand response options in the UK with insights gained from the UK Times Model (UKTM), results showed how demand response could avoid considerable investments in new power generation capacity in the UK by reducing the peak-load and better distributing demand across the model time-slices.

Day 1 was concluded with a discussion session: encouraging modellers and model users to combine insights from real world markets, societal process and technology policies. Chaired by Nilay Shah, discussants were Jim Watson UKERC; Evelina Trutnevyte, ETH; Phil Taylor, University of Newcastle.

Following the conference dinner at Trinity College Cambridge the after dinner speaker **Nick Winser**, Chair of the Energy Systems Catapult, speaking from a business perspective, gave a very well received talk on insights on future energy pathways and their contribution to understand and respond to the overlapping and complex challenges the energy industry is facing.



Nici Zimmerman, UCL, 'participary system dynamics modelling for integrated decision making about housing energy and wellbeing'

DAY 2
INTERDISCIPLINARY MODELLING

Session 2a: Integrating society within energy systems modelling

Speakers: **Jonathan Kohler,** Fraunhofer ISI, **Dimitrios Papadaskalopoulos**, Imperial College London', **Nici Zimmerman;** UCL, **Zia Wadud**, University of Leeds.

Organiser and Rapporteur: **Nawfal Saadi**, UCL

A comparative study of mobility in the Netherlands and the UK modelling the Multi-Level Perspective (MLP) framework, had a key takeaway that was the difficulty of linking such stylized theoretical approaches to whole energy systems models.

An integration project from wholeSEM linking a power systems dispatch model (WeSIM) to a social practices agent based model (HOPES), looks at how can we integrate electricity price (from an economic rationality model) into the social modelling framework.

An interesting modelling exercise based on stakeholder participatory workshops looking at the overall impact of housing policies on energy and wellbeing. One of the key takeaways was that stakeholders found the exercise as a good communication tool.

A study into the impacts of an automated private transport future using an energy decomposition framework, had the objective to understand the drivers for a smoother transition in the technology hype cycle to reach a plateau and to bind the potential of energy and carbon impacts of automation.

Session 2b: Wider drivers, impacts and unintended consequences

Speakers: **Kathrin Volkart,** PSI Switzerland, **Leonidas Paroussos**, NNTU, **Pete Smith,** University of Aberdeen

Sandy Skelton, University of Cambridge.

Organiser and Rapporteur: **Dennis Konadu,** Cambridge

A study that applied multi-objective optimization of energy models (without adverse effects of normalization and the analysis of side-effects), showed trade-offs between GHG emissions, non-renewable energy use, oil in surface transport and particulate matter emission decreases under mitigation scenarios.

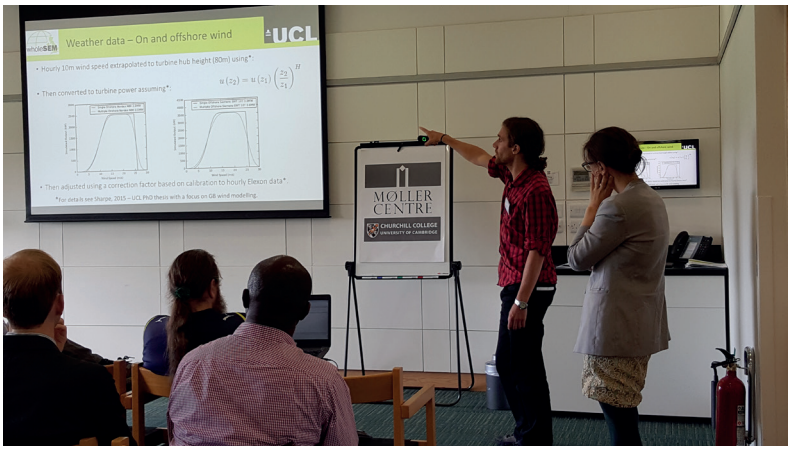
With an extended general equilibrium framework, the important role of revenue recycling from fuel subsidies phase out in cost effective and politically feasible mitigation pathways was investigated.

The need for radical deployment of low-carbon/negative emissions technologies (NETs) to meet stringent climate change objectives to meet <2oC UNFCC targets, showed however that these technologies have varying impacts/trade-offs on land, water, nutrients, albedo and energy, as well as cost.

Catherine Bale, University of Leeds, 'Decision theatres, heat networks and the modelling process; engaging local decision makers'

An on-going study uses a marginal abatement cost (MAC) curve to analyse the cost of GHG emissions abatement through greater material efficiency in the use of steel. The a MAC is used here to compare costs across different options, anticipate the direct response to a carbon

James Price and Marianne Zeyringer, UCL, 'Modelling long- term energy pathways with high shares of variable renewable energy sources'



price, inform prioritisation of other policy and as input into GEM-E3 macroeconomic models to analyse system wide effects.

Session 2c: Strategic vs. incremental investment under policy uncertainty

Speakers: **Laurent Drouet**, FEEM, **Stefan Pfenninger**, ETH, **Chris Dent,** University of Durham, **Sheila Samsatli**, University of Bath.

Organiser and Rapporteur: **James Price**

Using a multi-model dataset from the Intergovernmental Panel on Climate Change Assessment Report 5 Working Group 3, it was demonstrated that model choice is the most important factor in driving uncertainty when assessing the cost of global climate change mitigation policy.

When modelling variable renewable energy, one year's worth of input meteorological data only just begins to capture the temporal and spatial variability of weather across the British Isles and its impact on optimal renewable energy mixes.

Model emulators can be used to quantify uncertainty in large and complex energy models.

Infrastructure and energy model such as STeMES can address the important topic of multi vector energy systems analysis at high spatial and temporal resolution.

Session 3a: Integrating society within energy systems modelling

Speakers: **Evelina Trutnevyte**, ETH, **Catherine Bale**, University of Leeds, **Tom Roberts**, University of Surrey.

Organiser and Rapporteur: **Kavin Narasimhan,** University of Surrey

Three talks centered around the theme of integrating society within energy systems modelling. The talks focused on methods and approaches that enable modellers to engage with stakeholders, such as consumers, policy makers and service providers, throughout the different stages of model development.

A new approach was presented to enable interactive use of energy system models. The approach allows users to categorize large energy scenario ensembles into various categories based on multiple criteria, such as technology choices, risks to human health, safety, and environment, etc.

A participatory approach was presented to the development of agent-based models, using a collaborative decision-making concept called decision theatre. This helps researchers and stakeholders, in terms of helping to think about systemic changes, rather than specific interventions, while considering heat networks within particular cultural, historical, and environmental contexts.

Findings presented from qualitative walking interviews and a large-scale survey of self-reported regretted consumption, showed that post-purchase regret presents an opportunity to encourage reduced demand for goods, and thereby to reduce the associated GHG emissions, with minimal loss of consumer welfare.

Session 3b: Wider drivers, impacts and unintended consequences

Speakers: **David Brayshaw**, University of Reading; **Paul Brockway,** University of Leeds; **Marianne Zeyringer** & **James Price**, UCL,

Organiser and Rapporteur: **Zenaida Sobral-Mourao,** University of Cambridge

Weather and climate risk impacts short and long term energy system decisions at the level of operational, trading, strategic and long term planning decisions. Weather & climate data used to develop risk management strategies using information in two dimensions: understanding the range of the possible through reanalysis and climate model projections, and anticipating outcomes through ensemble prediction at different temporal resolutions – forecasting risk, helping design future energy systems

Presentation on use of exergy as an additional tool to design energy system policies. Whole chain of providing services starts at primary resources, through transformation of these into final fuels and lastly the use of final fuels to provide useful services. Economic analysis stops at the conversion of primary to final energy, but rebound works at the level of the useful service – can useful exergy be a better metric? Useful exergy defined as the minimum exergy input to achieve the task of work transfer (to useful services).

Energy system planning with high shares of variable renewable energy technologies – application to GB, via a high spatial and temporal resolution electricity system model - highRES - used to complement long term energy system models such as UKTM that works on more resolved time and spatial scales.

Session 3c: Strategic vs. incremental investment under policy uncertainty

Speakers: **Jan Imhof**, Aurora Consulting; **Michael Kenefick**, E4Tech; **Marko Aunedi,** Imperial College London.

Organiser and Rapporteur: **Sheila Samsatli,** University of Bath

Consider intertemporal sources of uncertainty: ageing power generation capacity that needs replacing soon, some technologies may no longer desirable, changing policy goals and instruments for carbon mitigation, high and rapid penetration of renewables, delay in investments, changing return on investments

The Scottish TIMES model – a tool for the Scottish government policy makers to help develop strategies for meeting energy and carbon targets is being soft-linked with other models, such as the Electricity Dispatch Model (EDM), Housing Model (NHM), Heat Model and Transport Model to exploit the strengths of the different models but harmonising the input data and models and making sure they are all consistent are challenging

Ambitious decarbonisation targets (e.g. rapid penetration of renewables, electrification, reduction of coal and gas capacity) have the potential to impact negatively on the utilisation of assets, hence there is a need for additional flexibility. Demand-side response, flexible generation, interconnectors and energy storage can all improve asset utilisation and increase the efficiency of system balancing. A “Balanced” deployment of flexible options leads to a least-worst regret pathway

The conference concluded with a final discussion session: How to develop, apply and communicate models when policy objectives are often not explicit? Chaired by Goran Strbac, Imperial College London, discussants were: Steven Becker, Ofgem; Andy Boston, ERP; Jon Saltmarsh, DECC.

wholeSEM

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About the Whole Systems Energy Modelling Consortium (wholeSEM)

The whole systems energy modelling consortium (wholeSEM) is a ground breaking, multi-institution initiative to develop, integrate and apply state-of-the-art energy models.
Our aim is to employ extensive integration mechanisms to link and apply interdisciplinary models to key energy policy problems, with substantive bilateral engagement with stakeholders in academia, government and industry. Funded by EPSRC, the consortium is led by University College London and consists of Imperial College London, the University of Cambridge and the University of Surrey. The corsortium is led by Professor Neil Strachan and administered by Kate Rice, both based at UCL Energy Institute.

Energy models provide essential quantitative insights into the 21st Century challenges of decarbonisation, energy security, energy equity, and cost-effectiveness. Models provide the integrating language and framework that assists energy policy makers – focusing at different scales and time periods – to make improved decisions and trade-offs in conditions of pervasive uncertainty. Whole systems energy modelling also has a central role in helping energy supply companies to make technical and economic decisions with regard to future energy technologies and infrastructure, as well as in the assessment of the potential role of societal and behavioural change.

Follow us on Twitter at @wholeSEM. We welcome you to tweet and share your thoughts about our event using the hashtag #wholeSEM16

Engineering and Physical Sciences
Research Council

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EPSRC is the main UK government agency for funding research and training in engineering and the physical sciences, investing more than £800 million a year in a broad range of subjects - from mathematics to materials science, and from information technology to structural engineering.

"It was my great pleasure for participating in the conference in Cambridge last week. The conference was really fruitful for me. I am looking forward to seeing you at future opportunities in Japan or other places."
Prof Keigo Akimoto, RITE, Japan

"First of all, I would like to thank you for allowing me to present my work in the Conference. I only have words of appreciation to congratulate you for the organization of the WholeSEM Conference. It was a rich and interesting experience to discuss about energy modelling around these two days and I am back in Paris with tons of ideas to continue my research" Juan Fernando, PhD Student International Research Center on Environment and Development, Paris