

Introduction to Panel 1

Foundations of future energy policy

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Introduction

The transition towards a low carbon society requires substantial energy efficiency improvements and greater flexibility. But how do we get there and what are the implications of decarbonisation or 100 % renewables for energy efficiency? Energy systems are evolving and future systems will provide new challenges and opportunities. We need to understand the dynamics of change and implement policies that address these changes and aim to reach low carbon systems. Such policies need to take into account technical efficiency improvements but also the potential that can be reached through behavioral change and reducing energy service demand. The way we talk about future systems and challenges influences the way we perceive them and vice versa. Thus, clear-cut communication that involves actors and is adapted to the situation is high on the agenda. Panel 1 successfully challenged authors to come up with papers addressing these issues, i.e., ones that constitute foundations for future policy. The results are summarized below.

The system of the future

What will be the role of energy efficiency in the system of the future where energy supplies may be 100 % renewables based? The arguments for climate mitigation and energy security will be different. Drysdale et al. (1-315-17) provide an original analysis based on the Danish case. A 100 % renewable energy system has implications for building energy efficiency where buildings can go from being a burden on the system to providing system benefits through energy storage options. They find that aiming for near Zero Energy in new buildings may not be the first priority from a broader system perspective. To answer

the same question Lechtenböhmer et al (1-318-17) provide a careful analysis of energy efficiency in a scenario for Germany with 100 % renewables. Substantial improvements in energy efficiency as well as electrification are critical to such a new system, not least from a renewable resource perspective but also to avoid energy losses in power-to-gas and other energy conversions.

Policies remain a challenge

To achieve a future low-carbon system based on renewables and energy efficiency, policies will remain a crucial instigator, providing opportunities for change, for overcoming barriers, for investment in low carbon technology, for changing behavior and routines. Current policies are not sufficient to achieve long term mitigation goals. At the same time, implementing ambitious policies remains a challenge. Schäfer-Sparenberg et al. (1-186-17) provide a comprehensive gap analysis of current EU energy efficiency policies and point out shortcomings in achieving their full potentials. In a next step, the authors elaborate remedies and provide comprehensive policy recommendations to increase the effectiveness of existing policies as well as to bridge some gaps with new policies. International cooperation is important to set binding legislation on efficiency and technology standards. However, political settings are changing and the implementation and content of international agreements, such as the TTIP, are uncertain as is the effect of BREXIT. Several options are discussed in the paper by Hartikainen et al. (1-070-17), with the aim to consider how to keep minimum energy performance standards (MEPS) in step with technological development and even pursue im-

provements if there is less ambition for international cooperation in the 2020s.

Policy recommendations warrant evidence. The paper by Warren (1-208-17) recommends the use of evidence reviews to inform energy policy based on applications of such reviews in the UK and internationally. Evidence reviews are a crucial method to collate and synthesize the evidence base on a certain topic, to determine the quality of previous evidence and to extract the greatest value from previous studies. Taking us to the U.S., Neumann et al. (1-415-17) compare energy efficiency program performance in 20 U.S. States. Moreover, they provide a summary of State-by-State legislative and regulatory energy efficiency goals, cost recovery provisions and incentives, and analyse the range of positive and negative outcomes that follow from the various types of regulatory approaches.

Low carbon buildings

Low carbon buildings are a prerequisite to meeting ambitious emission mitigation targets. Therefore, the reduction of fossil based energy in homes is important. To improve energy efficiency of old building stocks, buildings need to be retrofitted. Sheikh (1-329-17) looks specifically at California and builds the case for why energy efficiency with electrification of heating is the most promising path in California to achieve the large carbon emission reduction needed from this sector. Morgan and Killip (1-294-17) explore the major employment issues around retrofitting the UK housing stock, the likely broader economic impacts, and the policy requirements of performing large scale retrofit. Using emerging findings from modelling of the UK's housing stock, the key employment challenges for successfully achieving retrofit targets are highlighted, and possible solutions are discussed. Wilhite and Diamond (1-085-17) take us into the world of policy dilemmas, here for buildings policies that aim to achieve low carbon buildings based on technology-driven performance while discounting occupants' know-how and needs with respect to comfortable home environments. They argue for a new focus that engages with people's know-how and accommodates differences, and point out policy implications.

Sufficiency as a way forward

Three papers focus on sufficiency as a way forward to achieve substantial reductions in energy use. They call for sufficiency policies to be integrated in policy packages. Toulouse et al. (1-114-17) provide an overview on the topic, building on recent projects and research on sufficiency in the French context. They look into ways to stimulate sufficiency and call for establishing networks and exchange among researchers and experts to raise the topic on the political agenda. Thomas et al. (1-230-17) look more specifically into potentials and barriers for energy sufficiency, how household members perceive sufficiency practices, and how policymakers could support and encourage these. Bertoldi (1-362-17) reviews the concept of energy saving compared to energy efficiency. He identifies existing energy efficiency policies that may induce higher energy consumption and gives recommendations on how to promote "new", innovative energy efficiency policies, which may encourage sufficiency and behavioural change.

Communication in a different way

There are many important aspects to communication. In the context of energy efficiency and foundations of future energy policy, three papers shed light on this. For dealing with complex societal problems there is an increasing interest in participatory processes and stakeholder dialogues as a way of building support for and shaping policy. Schlomann et al. (1-385-17) report on the case of the German Climate Action Plan 2050 where a dialogue process took place in 2015 and 2016. Nilsson (1-003-17) discusses the fact that facts are often not enough to motivate and mobilise actors and suggests that our story and message on energy efficiency must be better tailored to the receiver. Problem oriented research often benefits from multi- and interdisciplinary collaboration but this may be complicated by terminology differences across disciplines. Robison and Foulds (1-267-17) unpack this challenge and report on a process to create an interdisciplinary energy lexicon and the result.

Addressing the dynamics of change

Long term scenarios are important to get a feeling for potential pathways into a sustainable future and how the dynamic is shaping. They provide information to policy makers on what strategies and paths into a low-carbon future could look like. Price et al. (1-242-17) develop a bottom-up model of China's energy demand and supply sectors. They analyse two scenarios to contrast a reference pathway of current development and a "Reinventing Fire" alternative path of meeting national needs by deploying the maximum feasible share of cost-effective energy efficiency and renewable supply through to 2050. The results show that China's CO₂ emissions could peak 11 years earlier than the reference pathway if the more aggressive Reinventing Fire pathway is pursued. Khanna et al. (1-142-17) also look at China and reveal trajectories beyond efficiency. They focus on the implications of maximizing electrification and renewable resources through to 2050. Herbst et al. (1-316-17) analyse future energy demand trends in Europe with a bottom-up modelling approach on country, sector, sub-sector and process levels and benchmark the outcomes with those of the European Commission's EU Reference Scenario 2016. The comparison leads to the impression that the EU efficiency targets could possibly be set more ambitiously than they have been until now by using a more detailed demand analysis approach. The paper by Khodamoradi and Sojdei (1-053-17) focuses on Iran and shows large energy efficiency potentials with a special focus on the building sector which is partially uncoupled from economic growth. Ituze et al. (1-049-17) review Rwanda's energy landscape by exploring potentials of energy resources, installed capacities and available technologies and aiming to reach a 70 % access rate to energy by 2017/18.

Mind your business

Business matters and solutions are critical to the delivery of energy efficiency. The roles and results of energy efficiency services and energy management systems are to some extent elusive and difficult to determine. Cooremans and Schönerberger (1-410-17) report on a carefully designed quantitative and qualitative study that provides evidence concerning the role of

energy management systems and skilled energy managers. In another empirical analysis Mourik and Bouwknecht (1-067-17) explore business models and strategies for energy services, as well as policy implications, based on their work under IEA DSM Task 25. Hampton and Fawcett (1-353-17) analyse the difficulty of reaching SME's with energy efficiency policy, how

current support policies are skewed towards economic growth, and possible ways forward. The broader challenge of capacity for the delivery of energy efficiency is well captured by Lebot et al. (1-297-17) who argue for the need to build institutions that provide a robust governance system rather than attempt to deliver project based energy efficiency improvements.