Introduction to Panel 2
What is next in energy policy?

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Introduction

EU and the rest of the developed world have to achieve net zero greenhouse gas emissions by 2050 and negative emissions thereafter if the temperature increase shall be limited to 1.5 °C. This will require an evolving and new energy system environment. Reduction of energy consumption by improving energy efficiency is an essential component in the transition to a low-carbon society, with a strong focus on competitiveness and security of supply. The transition will require significant investments in energy efficiency, renewable energy, new low-carbon technologies and grid infrastructure. Policies must take into account that investment decisions taken today will reshape the systems and affect them for the next 20 to 60 years. The transition requires new energy efficiency policy concepts, with new, innovative policies and measures to secure the full uptake of the energy technologies and solutions.

The role of energy efficiency in energy transition

Energy efficiency is a key element in the transition, but how long shall we go with energy efficiency in a future carbon neutral, flexible and integrated energy systems? The answer to this question is very much linked to the cost for the different options, but also to other benefits, including security of supply. Brugger et al. (2-356-19) analyse quantitatively how new societal trends, such as digitalization, the sharing economy or changing consumer awareness might interact with energy efficiency gains. The paper explicates that solely relying on unregulated energy efficiency gains to reduce energy demand underestimates the complexity of the interplay of energy demand with changing behaviour through societal trends, while they may also bring about large reduction potentials. Eyre (2-041-19) sets out a scenario for the UK where energy is provided solely by solar and wind energy, and final energy is delivered either as electricity or electrolytic hydrogen. The scenario shows that reductions of final energy demand by 50 % and primary energy demand by 60 % from current levels are possible. The main driver is the improvement in conversion efficiencies at the point of energy use. These types of changes to energy demand are not fully captured by many global energy models and may therefore significantly over-estimate future energy demand. Nilsson (2-025-19) argues that a fundamental rethinking is needed to make use of the energy efficiency to its full value. This must go beyond the traditional policies, i.e., it is not enough to only make it an issue about informing customers or providing financial means but understanding the way customers think and providing new and innovative means to facilitate action. Repenning et al. (2-068-19) compare a pathway mainly focused on energy efficiency, electric mobility and demand reduction and a pathway which is less efficiency oriented but primarily targets renewable energy and alternative fuels. They are compared against the emission targets for the different sectors in 2030 set in the Germany's Climate Action Plan. The study shows that both pathways have positive economic effects, but the efficiency partway represents a more robust pathway with regard to reduction targets for 2050. Steinbach & Kranzl (2-343-19) study the role of different energy infrastructure in ambitious energy efficiency scenarios for the building sector, and in particular the role of gas networks and heating grids to achieve a complete decarbonized heat supply. It compares a scenario where new gas boilers are prohibited from 2030 and a scenario with power-to-gas. Mellwig et al. (2-032-19) have a focus on buildings and assess how the German climate targets can be achieved at the lowest possible cost and what role build-

ing efficiency plays in the energy system. The study compares one scenario with a strong focus on building efficiency with alternative scenarios, which compensate less efficiency by more renewable energy, heat pumps or synthetic fuels. All five scenarios meet the German climate targets for the years 2030 and 2050, but the higher efficiency scenario is the more cost-effective, and it increases multiple benefits of energy efficiency. Cornelis et al. (2-001-19) present a desktop research on energy efficiency policy making in developing countries based on National Energy Efficiency Action Plans. Nilsson (2-026-19) shows that standard economic thinking is not enough to mobilize actors for energy efficiency. Instead, the telling of a good story is necessary to convince the market actors. Thomas et al. (2-236-19) describe the findings and recommendations of the German–Japanese Energy Transition Council (GJETC) established in 2016. On this basis, they assess if and how the GJETC can serve as a role model of bilateral cooperation on the energy transition. Grant et al. (2-305-19) present an energy access cost model that compares grid extension to off-grid solar approaches in Kenya. The modelling shows that greater appliance efficiency reduces the cost difference between distributed energy solutions and grid expansion but does not significantly impact which approach is least cost.

Energy efficiency and sufficiency

Energy efficiency policy alone is not enough to turn around the rising demand for environmentally costly energy services. Instead, there is the need for an additional policy paradigm of "energy sufficiency" which also takes into account the need for reducing energy uses beyond technical efficiency. Toulouse et al. (2-190-19) show where sufficiency research stands, especially in the perspective of policy-making. Based on a literature review on energy sufficiency and a survey among more than 40 experts from various disciplines, the authors draw some key recommendations on how sufficiency research could increase its impact, notably in relation to policy-making. Fawcett & Darby (2-226-19) address one key question connected with energy sufficiency on what is 'enough' by exploring the possibility of distinguishing between "needs" and "wants". They consider whether and how such distinctions may be embodied in current energy efficiency policies such as energy labels or standards. Based on ideas from the literature, a model for reaching a national consensus on basic needs is offered in the paper. Bergman (2-213-19) analyses the impact of a technological view on energy efficiency on the issue of reducing demand for energy services. His analysis is based on two concrete examples from the transport and household sectors (electric cars and smart-meter rollout) which show that the technical energy efficiency narrative might lock us in to high energy lifestyles through seeking ways to maintain, rather than disrupt, business as usual behaviours.

Energy efficiency first

The principle of "Efficiency First" has been adopted by the European Union (EU) in the various parts of the Clean Energy for All Europeans package as well as in some European countries. What is unclear so far is how the principle should be made workable. Siderius (2-051-19) provides a framework to explore relations between energy efficiency and renewable energies in the electric power system. All elements of the system – generation, connection, storage, control and efficiency – are combined in three different models to show the consequences for energy efficiency. Rosenow & Cowart (2-207-19) identify key policy areas where the Efficiency First principle could be applied. Using the United Kingdom as a case study, the potential for Efficiency First is assessed in the context of policy decisions that will be made over the next years, including the design of a new able-to-pay energy efficiency programme, energy network regulation (RIIO), infrastructure spending, revisions of the capacity mechanism, and the levy control framework. Wiese et al. (2-168-19) assess the use of auctioning revenues to accelerate decarbonisation efforts. They argue that strategic investments in energy efficiency programmes provide opportunities for realising multiple dividends and conclude that the strategic use of revenues needs to be accelerated in all Member States. Dunlop (2-206-19) traces the different interpretations and political struggles on the "Efficiency First" principle through the example of the European Union. Sojdei & Khodamoradi (2-123-19) show the barriers to implement the "Efficiency First" principle in an oil and gas producing country as Iran.

Multiple/non-energy benefits

Energy efficiency will not only reduce energy consumption and by this the energy cost. It has also other benefits – normally called multiple benefits or non-energy benefits. Therma et al. (2-241-19) present key findings and policy recommendations of the COMBI project "Calculating and Operationalising the Multiple Benefits of Energy Efficiency in Europe". Quantified impacts in 2030 in the project include reduced air pollution (and its effects on human health and eco-systems), improved social welfare (health, productivity), saved biotic and abiotic resources, effects on the energy system and energy security, and the economy (employment, GDP, public budgets and energy/EU-ETS prices). The paper shows that a more ambitious energy efficiency policy in Europe would lead to in 2030 alone, monetized multiple impacts would amount to approx. 50 % of energy cost savings.

Killip et al. (2-159-19) present the results of a literature review of multiple benefits of energy efficiency for individual businesses. They find that relatively little has been published on the topic, but there is evidence that strategic non-energy benefits do exist, e.g., reduced production down-time, increased product quality or improved productivity. These benefits can positively and significantly influence the financial assessment of energy efficiency projects. However, such benefits are generally not reported, quantified or included in project assessments. Ordonez et al. (2-277-19) compare the multiple benefits at different scenarios for energy efficiency and renewable energy in the ASEAN countries. It shows that EE and RES are more than reduction of energy consumption and greenhouse emissions. It also has a positive impact on public budgets, political security, industrial profitability/productivity, environment and health. Skumatz et al. (2-406-19) reviews the status of quantitative NEBs work (with a focus on the residential side) primarily based on studies from the US and shows typical values for some of the NEBs. The paper examines gaps, assembles recent work and provides new research that works to address the val-

ues for NEBs for some key health and other benefits, and demonstrates practical approaches for attributing program-wide benefits to measures. The paper offers suggestions for further research in the area. Johansson & Thollander (2-036-19) identifies and compares non-energy benefits (NEBs) from two key energy efficiency policies – energy audit and energy efficiency network programs – targeting Swedish SMEs. Commonly mentioned NEBs for both groups of companies were related to production, increased lifetime of equipment and more reliable production. One notable general finding in this limited study is that an energy audit policy program seems to generate perceived NEBs particularly related to the regarded energy efficiency measures while energy efficiency networks, which could be seen as a second generation of energy efficiency policy programs, also generated perceived NEBs related to the policy (e.g. improved company image and new customer relations). Hu et al. (2-155-19) give an overview of energy efficiency policies in China's building sector and discuss reasons for the limitation of energy efficiency policy in an energy consuming sector. Volt et al. (2-253-19) present a systematic review of existing literature (>250 studies) based on the key indoor environmental indicators in schools, hospitals and offices, and monetisation of the quantified benefits.

Energy efficiency and flexibility

In the future energy system primarily based on renewable energy, it is important to combine energy efficiency with more flexible energy consumption. Wohlfarth & Worrell (2-313-19) look at energy efficiency (EE) and flexibility (EF) as the dynamic duo. The presentation is based on the results from a survey of more than 1,500 German companies in the service sector. The survey shows that influencing factors on implementing EE and EF measures are comparable, but EE is much more established. EF is more sensitive to sectors and sizes. Liu et al. (2-256-19) look at demand response as a tool of power system flexibility in Singapore. Demand side management blurs the distinction between supply and demand, and enables the interaction with consumers to balance supply and demand in real time. The study find that by using an electricity dispatch and investment model to Singapore's long-term electricity technologies portfolio demand response and power storage can reduce the system cost in 2035 by 1 %. Leutgöb el al. (2-040-19) give a brief summary on the most current technological developments of demand response (DR) that will lead to a continuous expansion of DR potentials over the next decade. They present an overview of DR relevant regulatory framework in EU countries, describe business models that are currently applied to the market and analyse the limitations of these business models, and derive from there new business models that enable increasing flexibility on energy markets, including a clarification of roles and responsibilities of future DR service providers and their position as a market facilitators.

Innovative approaches and new business models for energy efficiency

Innovative approaches and new business models play a key role to strengthen the role of energy efficiency in a changing energy system, market and policy landscape. Sotiriou et al. (2-148-19) look at the optimal timing and the social benefits of energy efficiency measures for designing an effective climate policy. Their study shows that deep decarbonization in 2050 can only be achieved with designing a long-term strategy in 2020, and it is necessary to implement measures, which seems to be expensive in the short-term. Lösch (2-133-19) analyses a very innovative approach to reduce GHG emissions in the steel industry, the direct reduction of iron ore with hydrogen. They discuss how such a new and expensive technology could at least reach the status of a demonstration plant by creating a market niche for "green steel". Albert-Seifried et al. (2-164-19) present an integrated energy analysis tool, which enables calculations of the economic performance and carbon balance of PV installations in conjunction with battery storage, energy-efficiency measures and electric car charging. They demonstrate that an investment into a small PV system is profitable and that adoption of energy-saving measures at the time of PV installation can considerably reduce the overall costs and increase the internal rate of return. Kushler (2-258-19) shows what the leading states in the U.S. are currently envisioning regarding the role of utility companies in pursuing energy efficiency objectives, and the extent to which (if at all) those objectives are linked to climate goals. The results are based on an analysis of the most current materials and interviews with key personnel involved in these state discussions. Werle et al. (2-072-19) present new insights from an innovative funding scheme to promote energy efficiency in Germany, the "Energy Savings Meter". The scheme is designed to tap the benefits of digitization for energy savings. Businge et al. (2-294-19) investigate the correlation between energy efficiency investments and the competitiveness of firms through the example of medium energy-intensive sectors in Italian manufacturing. The paper reveals an overall statistically significant and positive correlation between energy efficiency investments and the competitiveness of firms, which also confirms the existence of important co-benefits of energy efficiency. Finally, Poskanzer et al. (2-178-19) present a future scenario in which the energy saving potential of cooler clothing is realized. The transformation occurs on two fronts, both a change of materials and a change of fashions, in terms of less formal clothing, or less clothing altogether.