SYCE 1: Climate and Energy: challenges and options from a physics perspective

Time: Wednesday 9:30–12:15 Location: HSZ 02

Invited Talk SYCE 1.1 Wed 9:30 HSZ 02

Towards a carbon-free energy system: Expectations from R&D in renewable energy technologies — •Bernd Rech[1,2] and Rutger Schlatmann[3,4] — [1]Helmholtz-Zentrum Berlin für Materialien und Energie GmbH, Albert-Einstein-Str. 15, 12489 Berlin, Germany — [2]Technische Universität Berlin, Marchstr. 23, 10587 Berlin, Germany — [3]Helmholtz-Zentrum Berlin für Materialien und Energie GmbH, PVcomB Schwarzschildstraße 3 12489 Berlin, Germany — [4]HTW - Hochschule für Technik und Wirtschaft Berlin, Renewable Energies, Wilhelminenhofstraße 75A, 12459 Berlin, Germany

The future global society needs a sustainable, climate-friendly energy supply largely based on a massive expansion of renewable energy sources. Photovoltaics (PV) and wind energy will become key technological pillars according to most scenarios and already today provide very low levelized cost of electricity (LCOE) in many regions and for several applications. It is important to note that for the long term the development of a system capable of trading, distributing and storing renewable energy will become necessary. This needs to be facilitated by the conversion of primary renewable energy into transportable and storable energy carriers.

Recent progress, opportunities and challenges in R&D will be highlighted for wind energy, solar thermal power plants and artificial photosynthesis on different technology readiness levels. In more detail we will discuss the development of new PV devices surpassing today*s efficiency limits as a case study how new renewable energy technologies may speed up the transition towards a sustainable energy system.

Invited Talk SYCE 1.2 Wed 10:00 HSZ 02

Decarbonizing the Heating Sector - Challenges and Solutions — •Florian Weiser — MVV Energie AG, Mannheim, Germany

The German climate targets cannot be reached without decarbonizing the heating sector that currently accounts for approximately one third of Germany's yearly CO2 emissions. Green heating technologies are already technically available for decentralized applications as well as for district heating systems, e.g. electrical heat pumps and biomass-fired systems. However, despite technical progress, green heating technologies will continue to be significantly more expensive than fossil-fired heating systems. Closing the CO2 gap between a "businesses as usual" path with current policies and a path consistent with the climate targets in the building heating sector will cost approximately 9 billion euros in the year 2030. The MVV study "Take-Off Wärmewende" proposes a mixture of instruments in order to accelerate the decarbonization of the building heating sector consisting of a CO2 tax on fossil fuels, CO2 limits for the building stock, municipal heat plans as well as funding schemes for green heat and energy efficiency. Furthermore, decarbonization policies for the building heating sector in Switzerland, Denmark, UK and France are analyzed.

Invited Talk SYCE 1.3 Wed 10:30 HSZ 02

The challenge of anthropogenic climate change - Earth system analysis can guide climate mitigation policy — •Matthias Hofmann — Potsdam Institute for Climate Impact Research, Germany

Since the industrial revolution humanity exerts a steadily growing pressure on the Earth's climate system. Unbridled anthropogenic emissions of greenhouse gases, notably of carbon dioxide, have already caused an increase in global mean surface temperature of about 1 °C since the beginning of instrumental temperature records. Earth system analysis is regarded as a powerful method to gain new insights into geophysical and biogeochemical fundamentals of the climate system.

Mitigating future climate change to avoid the transgression of dangerous thresholds and tipping points of crucial elements in the Earth system is currently one of the biggest challenges of humanity. Therefore, Earth system analysis is an indispensable tool in assessing planetary boundaries and guiding decision processes by political stakeholders.

15 min. break

Invited Talk SYCE 1.4 Wed 11:15 HSZ 02

A carbon-free Energy System in 2050: Modelling the Energy Transition — •Christoph Kost, Philip Sterchele, and Hans-Martin Henning — Fraunhofer-Institut für Solare Energiesysteme ISE, Freiburg, Germany

By 2050, Germany has committed to aim a carbon-free energy system under the Paris Agreement. This transition of the energy system from the 2020-system still based on high shares of fossil fuels to a system with zero carbon emissions from fossil fuels will completely change the energy world in Germany, in the power sector, building and industry sector, as well as in the transport sector. Modeling and analyzing this transition with the powerful tool for the German energy sector REMod creates insights how this challenging transformation can be carried out in the short-, medium and long-term by 2050. The model results show huge degradants for exchanges of technologies and applications in all four sectors.

Invited Talk SYCE 1.5 Wed 11:45 HSZ 02

The transition of the electricity system to 100% renewable energy: agent-based modeling of investment decisions under climate policies — •Kristian Lindgren — Department of Space, Earth and Environment, Chalmers University of Technology, Gothenburg, Sweden

A future energy system that to a large extent depends on variable renewable energy sources, like wind and solar power, involves new challenges for securing a reliable supply of electricity. The economic basis for such an electricity system differs significantly from the one we have today, and one can expect that prices will be more volatile and risk for shortages in supply increases.

We explore the transition towards a 100% renewable electricity system, driven by climate policies. These policies affect the investment decisions taken by companies, and we consider these to constitute the driving mechanism for the transition. This results in an agent-based (or mechanistic) model, in which companies are agents with possibly different bases for decisions as well as limitations in knowledge about the future. This is in contrast with the standard optimisation approach that identifies the cost-optimal allocation of investments generally assuming perfectly informed agents.

Several characteristics of the transition, like electricity prices, volatility, and roles of different technologies are discussed, and the dependence on different agent features is illustrated.