

Symposium Energy Meets Economy: Dynamics and Statistics of Future Energy Systems (SYEE)

jointly organized by
the Physics of Socio-economic Systems Division (SOE),
the Dynamics and Statistical Physics Division (DY), and
the Working Group "Young DPG" (AGjDPG)

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Current and future changes to our energy system (the Energiewende) imply hard conceptual questions about generation of energy, its fair and economic distribution - and not last our everyday behavior. For instance, the ongoing transition of power grids from containing essentially few large power plants to grids with smaller, more decentralized and less reliable sources based on renewable energy yield a trade-off between economic efficiency, grid stability and risk to failures. In addition, short and longer term trading of energy on both supply and demand sides further increase the complexity of the resulting dynamical system comprised of the energy grid and accompanying economic rules and total energy usage is globally limited. This symposium provides a perspective of different aspects of a modern energy system as a whole, on the physical and technical sides, but also on its economy and our behavior. Suggestions for solutions for coping with fluctuation and decentralization, control, and risk are complemented with a discussion on fields where physics and quantitative mechanistic insights may contribute to shape the future of our energy system.

Overview of Invited Talks and Sessions

(Lecture room: HSZ 02)

Invited Talks

SYEE 1.1	Wed	15:00–15:30	HSZ 02	Smart Grids - From incentives to coupled markets — ●RUDOLF SOL-LACHER
SYEE 1.2	Wed	15:30–16:00	HSZ 02	Energy and the economy — ●REINER KÜMMEL
SYEE 1.3	Wed	16:00–16:30	HSZ 02	Planetary constraints to energy supply and the economy — ●OLIVER RICHTERS
SYEE 1.4	Wed	16:45–17:15	HSZ 02	Identifying critical infrastructures in complex supply networks — ●DIRK WITTHAUT
SYEE 1.5	Wed	17:15–17:45	HSZ 02	Short time fluctuations of renewable energies — ●JOACHIM PEINKE, M. REZA RAHIMI TABAR, PATRICK MILAN, MATTHIAS WÄCHTER

Sessions

SYEE 1.1–1.5	Wed	15:00–17:45	HSZ 02	Symposium Energy Meets Economy: Dynamics and Statistics of Future Energy Systems
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SYEE 1: Symposium Energy Meets Economy: Dynamics and Statistics of Future Energy Systems

Time: Wednesday 15:00–17:45

Location: HSZ 02

Invited Talk SYEE 1.1 Wed 15:00 HSZ 02

Smart Grids - From incentives to coupled markets — ●RUDOLF SOLLACHER — Siemens AG, Corporate Technology, Munich, Germany
Future energy systems must meet the challenges introduced by an increasing portion of distributed renewable power generation. This talk describes the main challenges and presents current and future solutions. A special focus will be on market based approaches.

Invited Talk SYEE 1.2 Wed 15:30 HSZ 02

Energy and the economy — ●REINER KÜMMEL — Institut für Theoretische Physik und Astrophysik, Universität Würzburg, Am Hubland, D-97074 Würzburg

Energy conversion and entropy production determine the growth of wealth in industrialized economies. Novel econometric analyses have revealed energy as a production factor whose output elasticity, which measures its economic weight, is much larger than its share in total factor cost, while for labor just the opposite is true. Although this result is at variance with neoclassical economic theory, it is compatible with the standard maximization of profit or time-integrated utility, if one takes technological constraints on capital, labor, and energy into account.

Invited Talk SYEE 1.3 Wed 16:00 HSZ 02

Planetary constraints to energy supply and the economy — ●OLIVER RICHTERS — Universität Oldenburg, Institut für Chemie und Biologie des Meeres, Theoretische Physik / Komplexe Systeme — Vereinigung für Ökologische Ökonomie

The “great transformation” towards a future proof economy depends on the provision of a sustainable energy supply. Different planetary boundaries restrict the phase space of possible technical and societal solutions. Solar energy or nuclear fusion appear to be the solution for the radical reduction of greenhouse gas emissions, disregarding that other problem areas persist: First, the excessive installation of photovoltaics enters into competition with other kind of landuse and therefore may lead to land system change and accelerate biodiversity loss. Second, the low entropy of solar radiation is the basis for life on earth and its harvesting for human activity reduces the energy available for biological and meteorological processes. Jointly, though renewables can’t run out of stock, the energy throughput is constrained by the speed of regeneration. Third, even nuclear fusion or other sun-independent energy supply cause global warming simply by thermal pollution, as every human activity finally ends up as heat. On the whole, this poses relevant limitations to world energy consumption and possible future energy systems. The realisation of a sustainable

energy supply will stop the excessive growth of energy throughput, putting relevant constraints to economic growth, so that it will probably come to an end. An insight is given into the significance this development has for finance, economics, social security and the people on earth.

- 15 minutes break -

Invited Talk SYEE 1.4 Wed 16:45 HSZ 02

Identifying critical infrastructures in complex supply networks — ●DIRK WITTHAUT — Institut für Energie- und Klimaforschung, Forschungszentrum Jülich — Institut für theoretische Physik, Universität zu Köln — Max-Planck-Institut für Dynamik und Selbstorganisation

Transmission line failures can induce large-scale outages in power grids and other complex supply networks, causing potentially huge economic losses. Yet, how to determine which lines are particularly sensitive to inducing larger-scale outages is currently not well understood. In this talk I will discuss how the topological redundancy of a transmission line limits dynamical network robustness and allows to reliably identify critical infrastructures. I derive criteria to predict the dynamic stability of power grids based on the networks topology and the static loads prior to line failure. As both criteria are available before any outage from the state of normal operation, they may support network planning and real-time monitoring of grid operation.

Invited Talk SYEE 1.5 Wed 17:15 HSZ 02

Short time fluctuations of renewable energies — ●JOACHIM PEINKE, M. REZA RAHIMI TABAR, PATRICK MILAN, and MATTHIAS WÄCHTER — Institut für Physik und ForWind, Universität Oldenburg, Germany

Wind and solar energy, the main renewable energies on which the modern sustainable electrical power supply will be based, are characterized by a high volatility. News report frequently on a new challenge for the energy management to handle these new sources. For a better understanding of their impact on the electrical power system it is essential to know in more details the nature of the power fluctuations of wind and solar energy.

In our contribution we present results from an analysis of wind and solar power. We show that the turbulent features of the weather can be seen in the power output of such systems. We will mainly focus on the characterization and modeling of these power systems with advanced stochastic tools. Concerning the extreme event statistics, we show evidence that solar power is more volatile than wind power.