

# Data-driven energy system research – recent advances and future directions

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The global energy system is undergoing massive transformative changes that originate from far-reaching changes in societal, business and technical paradigms: the need to provide access to safe and clean energy services for all, the transition from fossil-fuel based energy systems to electricity-dominated ones, and advancements in ICT. These transformations go together with a change from top-down layouts of the energy system—that rest on centralized control—to a multi-national, multi-player system based on a mix of interconnected centralized and decentralized energy networks.

Data-driven energy system analysis is a key tool to monitor, assess and support necessary transformative changes. The research objective is to minimize transformative costs, to optimize technical applications and last but not least to account for social needs and environmental limits. The growing degree of complexity and uncertainty in the global energy system requires the development of models that are as close as possible to the real system; achieved through the integration of different types of data streams and interlinkages with other systems as well as the account for relevant time and geo-spatial scales. The availability of new data collection and analysis techniques is boosting data-driven energy system research. For example, it allows us to advance our understanding of the demand-side of the energy system and how social phenomena shape it. This talk will discuss recent advances and future directions in data-driven energy system research, drawing from examples in integrated assessment modeling, decision modeling and scenario analysis.

