

AKE 5: Renewable Energy - Wind Energy

Time: Monday 16:45–17:15

Location: DÜL

Invited Talk

AKE 5.1 Mon 16:45 DÜL

Limits to wind energy: From the physical basis to practical implications — ●AXEL KLEIDON — Max-Planck-Institut für Biogeochemie, Jena

Wind energy plays an increasing role in the transition to a carbon-free sustainable energy system. In this talk, I first use thermodynamics to describe how and how much wind energy is generated by the atmosphere from differences in radiative heating. I then show that only a fraction of the kinetic energy can at best be used as renewable energy

because the more wind turbines draw energy from the atmosphere at the regional scale, the lower the wind speeds, thus lowering power output and efficiencies of wind turbines. This results in much lower wind power potentials of about 0.5 Watt per square meter of surface area at the regional scale than estimates that are based on observed wind fields and that neglect the effects that wind turbines have on the atmosphere. I demonstrate the practical implications of this Earth system approach to wind energy by re-evaluating German energy scenarios for the year 2050, which rely on a substantial fraction of offshore wind energy.