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Decision support for renewables deployment through spatially explicit energy system alternatives

Bryn Pickering[1], Francesco Lombardi[2], and Stefan Pfenninger[2,1]
[1]ETH Zürich, Institute for Environmental Decisions, Department of Environmental Systems Science, Switzerland
(bryn.pickering@usys.ethz.ch)
[2]TU Delft, Department of Engineering Systems and Services (ESS), The Netherlands

A decarbonised European energy system will require a number of potentially contested decisions on where best to locate renewable generation capacity. Typically, modellers determine the "best" system based on the least cost to society, focussing on a cost-minimising energy system model result to inform planning and policy. This approach neglects potentially more desirable alternative results which might, for example, avoid problematic concentrations of onshore wind power deployment, increase national supply security, or lower the risk of system failure in adverse weather conditions.

In response, we have developed a method to generate spatially explicit, practically optimal results (SPORES) in the context of energy system optimisation. SPORES can be used to explore energy systems which may offer more socially, politically, or environmentally acceptable alternatives. Furthermore, we have developed metrics to aid identification of interesting alternatives, like those which maximise the spatial distribution of wind generation capacity or minimise exposure to multi-year demand and weather uncertainty.

In this presentation, we will detail the application of the SPORES method in two cases of energy system decarbonisation: the Italian power system and the European energy system. We will present technology deployment strategies which are prevalent across SPORES, such as solar photovoltaics coupled with battery storage, as well as those which offer flexibility of choice in location and extent of deployment. To help with the urgent task of planning socially and politically acceptable energy system decarbonisation strategies, our implementation of SPORES in the open-source energy systems modelling framework Calliope makes it accessible to a wide range of potential users; we will also discuss how other research groups can further build on this to accelerate the energy transition.