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# Designing renewable focused and weather resilient low carbon energy systems for Europe

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In order to reach the Paris Agreement and mitigate climate change, countries are moving to energy systems with high shares of renewable energy sources. In most European Union (EU) countries the potential for hydropower has been exhausted and variable renewables (i.e. solar and wind) are becoming a cost- effective decarbonisation option.

However, with increasing shares of variable renewables the variance in output can cause high integration costs. Two important methods to manage renewable intermittency are to integrate different renewable technologies into the system (technological diversity) and to take advantage of the fact that contemporaneous weather conditions can differ from one location to the next by spreading VRE deployment over a large geographical area (spatial diversity). The European Union provides a political framework and large geographical area with varying resource potential and timing of production for technological and spatial diversification. Weather does not only change from hour to hour but also from year to year. By averaging multiple years or using a single weather-year most of the previous European studies neglect the inter-annual variability of weather.

Here, we soft-link a long-term energy system model, which provides the electricity system boundaries for 2050 with the high spatial and temporal resolution power system model “highRES” for the EU and run it with up to 30 weather years. This allows us to design a highly renewable energy system for the European Union which is resilient to the spatio-temporal but also inter-annual variability of the weather.