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## CESM2energy: a modular climate-to-energy pipeline

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Transitioning to renewable energy will be instrumental in mitigating the devastating effects of climate change. Because of the many unknowns in the design and dispatch of future energy systems, quantifying climate risk in the energy sector is challenging: in particular, renewable energy production and heating demand is highly reliant on meteorological conditions, which are variable in nature and shifting due to climate change.

It is therefore important to use large samples of renewable generation and demand, for current and future climates, in energy system modeling. However, lacking standardized ways to translate between the climate and energy model world, most existing studies rely on different assumptions and draw from a limited sample of available climate variables.

To this end, we created a modular climate-to-energy pipeline: starting with hourly output from the climate model CESM2, it bias corrects, translates, and scales to the various inputs of energy system models. We base the conversion on open-source tools: GSEE for solar power generation, windpowerlib for wind from climate model levels and demand.ninja for heating and cooling demand. The resulting pipeline ensures consistency of variables, with inputs and outputs tailorable to specific needs.

We use the pipeline to analyze seasonal cycles of energy generation and demand under different weather conditions, for current and future climates deploying the AnyMOD.jl framework for energy system modeling. Because of the modular approach, the pipeline could easily be adapted for other climate models and time-series, providing better evidence for climate-informed energy system planning.