

### ENERGY MODELLING

## Staying within planetary boundaries

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To avoid catastrophic damage to the natural and human spheres, we must stay within planetary boundaries of parameters such as the amount of freshwater we can sustainably consume and the quantity of carbon or other types of pollution we can emit.

Energy systems models have yet to take these boundaries into account. In a recently published paper, Ibrahim Algunaibet and colleagues at Imperial College London, Radboud University and ETH Zurich posit that transforming energy systems to meet Paris Agreement targets would still leave us exceeding five planetary boundaries, including those for carbon emissions and ocean acidification.

The researchers use an energy systems model for the United States to project the energy mix in 2030. Under a business-as-usual (BAU) scenario where no climate or energy targets are pursued, they find that by 2030 the US power sector would exceed its share of planetary boundaries for climate change, freshwater use, nitrogen flow and ocean acidification. If active steps are taken to meet the 2 °C target set out in the Paris Agreement while minimizing cost, five boundaries including climate boundaries are still transgressed, albeit much less than in the BAU case. At an additional cost of 40% compared with the BAU scenario and relying on wind, hydropower and negative emission technologies, the energy system can be transformed to stay within seven out of eight planetary boundaries, which appears to be the best option unless energy use is significantly reduced. For future energy systems planning, their holistic impact on natural systems would have to be taken into account.

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