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Saptio-temporal complementarity of wind and solar power in India

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Wind and solar power are likely to be a part of the solution to the climate change problem. That is why they feature prominently in the energy policies of all industrial economies including India. One of the major hindrances that is preventing an explosive growth of wind and solar energy is the issue of intermittency. This is a major problem because in a rapidly moving economy, energy production must match the patterns of energy demand. Moreover, sudden increase and decrease in energy supply may destabilize the power grids leading to disruptions in power supply. In this work we explore if the patterns of variability in wind and solar energy availability can offset each other so that a constant supply can be guaranteed. As a first step, this work focuses on seasonal-scale variability for each of the 5 regional power transmission grids in India. Communication within each grid is better than communication between grids. Hence, it is assumed that the grids can switch sources relatively easily. Wind and solar resources are estimated using the MERRA Reanalysis data for the 1979-2013 period. Solar resources are calculated with a 20% conversion efficiency. Wind resources are estimated using a 2 MW turbine power curve. Total resources are obtained by optimizing location and number of wind/solar energy farms. Preliminary results show that the southern and western grids are more appropriate for cogeneration than the other grids. Many studies on wind-solar cogeneration have focused on temporal complementarity at local scale. However, this is one of the first studies to explore spatial complementarity over regional scales. This project may help accelerate renewable energy penetration in India by identifying regional grid(s) where the renewable energy intermittency problem can be minimized.