

How energy strategies are shaped by the correlation of uncertainties

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Abstract-

In the face of the global climate crisis, countries worldwide are striving for a shift in their energy systems from fossil fuels to renewable energy sources. This complex energy transition faces significant uncertainties, which must be addressed correctly to produce resilient and reliable investment strategies. This study systematically incorporates, for the first time, the correlation between uncertainties into a strategic energy planning model, in order to determine robust and consistent decarbonization strategies. Using the Spanish energy system as a real-size case study, we assess the impact of accounting for the correlations between primary energy prices and energy technology investment costs on strategic energy decisions. Our results reveal that decarbonization strategies significantly vary with the degree of correlation, and hence not accounting correctly for it may result in significant errors. When compared to the uncorrelated baseline scenario, a positive correlation results in increased fossil fuel use and reduced renewable deployment, whereas a negative correlation leads to higher renewable deployment and electrification.

Index Terms- Correlation, Uncertainty, Long-term energy planning, Spain, Energy model

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