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Spatial dimension of renewable electricity growth in Switzerland: Modelling the cost-equity trade-offs

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Abstract: After the Fukushima accident, Switzerland has decided to fundamentally transform its electricity sector to phase out nuclear power and rapidly increase renewable generation. So far, the growth of decentralized renewable generation has been very spatially uneven: some regions became hotspots with a high density of new renewable plants and others lagged behind. Using past statistics and prospective spatial modeling to 2035, we investigated the causes and implications of these emerging regional disparities in terms of electricity generation costs, investment needs, and new renewable capacity requirements. In particular, we quantified the trade-offs between cost-efficient (least-cost) and regionally equitable allocation of new renewable generation. A significant trade-off exists in Switzerland by 2035: 50% increase in a regional equity when allocating renewable generation so that various Swiss regions benefit leads to 18% higher total electricity generation costs. Least-cost allocation implies concentrating renewable generation and associated investments to few most productive locations only. The current diffusion of renewable generation deviates both from the least-cost as well as the highest-equity paths. In our analysis, solar PV emerges as the key technology for increasing regional equity at reasonable generation costs. We conclude with policy implications on managing this costs-equity trade-off.

***Keywords**:* Renewable Energy; Spatial modelling; Spatial energy projections; Socio-economic analysis; Energy transition