

Method for Evaluating Energy Community Viability Through Multivariable Territorial Analysis

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Abstract:

Energy communities represent a promising mechanism for accelerating a fair, decarbonised energy transition, yet their national scale deployment remains restricted by technological uncertainties, socio economic asymmetries and territorial heterogeneity, particularly in off grid or hard to reach regions where conventional planning instruments prove insufficient. This paper introduces an integrated, five stage methodology designed to systematically gauge the feasibility of community energy models collective distributed generation, micro grids and shared self consumption across an entire country. First, a conceptual framework clarifies definitions, success criteria and spatial scope. Second, renewable resource maps, electricity grid assets, demographic indicators and regulatory data are harmonised within a unified geographic information system. Third, multivariate statistics principal component analysis followed by hierarchical clustering delineate homogeneous territorial typologies and rank implementation priorities. Fourth, each zone is subjected to a comprehensive technical, economic, social and environmental appraisal under alternative policy and incentive scenarios generated by a prospective modelling module. Finally, the method formulates governance guidelines, blended financing schemes and phased implementation roadmaps that respect territorial diversity while ensuring scalability and community participation. The approach offers decision makers a replicable toolbox for designing resilient, inclusive and context sensitive energy community programmes at national and sub national scales.

Keywords:

Energy communities; Feasibility assessment; Multivariable territorial analysis; Geographic information systems; Just energy transition; National energy planning.