Risk-sharing in energy communities.

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Context

Energy communities (ECs) are emerging as a promising approach to addressing issues of climate change and energy security. These initiatives empower individuals and local groups to generate and manage renewable energy collectively, promoting sustainability and citizen involvement. Despite ambitious political support, their adoption remains quite limited. This paper explores the role of risk and risk aversion in influencing the formation and stability of ECs, addressing a so far overlooked factor in the literature.

Research Focus

The study investigates how risk and risk aversion affects ECs, particularly in two ways:

1. Risk aversion tends to reduce overall investment and benefits of community projects.
2. Heterogeneity in risk preferences among members complicates the allocation of project gains, threatening EC stability.

Using a model inspired by small solar projects, the present research studies stable sharing of costs, benefits, and risk among EC members. We incorporate cooperative game theory to assess stability under risk, focusing on members' decisions to remain or leave based on their received share of value and risk of the project.

Methodology

The proposed model simulates short-term and long-term EC dynamics. It accounts for:

- Variability in consumer load profiles and risk preferences.
- Shared investments in photovoltaic panels, with benefits like self-consumption and feed-in tariffs for surplus energy.
- The possibility of members exiting the EC if dissatisfied with how risk and value are shared.

This approach integrates stochastic cooperative game theory to analyze risk-sharing challenges and proposes strategies for overcoming them.

Key Findings

1. **Impact of Risk Aversion**: Risk aversion significantly hinders EC investments and development, even without considering the complexities of risk and gain-sharing.

2. **Risk aversion:** An overall level of risk aversion of members makes the EC instable because risk can never be shared in a satisfying way.
3. **Heterogeneity of Risk Preferences**: Differences in risk aversion among members can empede the formation of ECs, as less risk-averse individuals may prefer independent investments over collective limitations.
4. **Risk-Sharing Mechanisms**: Implementing insurance-like sharing rules can mitigate risk perception, fostering thereby member participation. These mechanisms, while complex, could be managed by a community coordinator or supported through state intervention.