From Dilemma to Synergy: Solving the Landlord-Tenant Challenge with Low-Carbon Retrofits in Multi-Family Housing

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Around half of the European Union's population lives in multi-family buildings (MFBs), which offer a large opportunity to reduce carbon emissions. However, improving the energy efficiency of these buildings is often difficult due to the landlord-tenant dilemma. This problem occurs because landlords are usually responsible for the costs of retrofitting, while tenants benefit through lower energy bills. As a result, MFBs are often less energy-efficient than owner-occupied homes, leaving tenants more vulnerable to high energy costs and energy poverty.

This study looks at how collective self-consumption (CSC) can help solve this issue. A techno-economic analysis was conducted using a mixed-integer linear programming model, incorporating climatic, regulatory, and economic variations across Western, Central, and Southern Europe. Four CSC regulatory frameworks were assessed, representing combinations of surplus remuneration levels, grid tariff exemptions, and internal CSC pricing mechanisms. The model optimizes retrofitting strategies—including photovoltaics (PV), heat pumps (HP), and thermal energy storage (TES)—to maximize building owner benefits while guaranteeing tenant savings under varying energy costs, climate zones, and building envelope efficiencies.

The results reveal that CSC initiatives offer mutual economic benefits for landlords and tenants across much of Europe, particularly in low-efficiency buildings and regions with higher energy costs. Positive net present values (NPVs) were achieved for owners and tenants in 97% of scenarios. A key finding is the consistent economic return provided by solar PV systems. Regardless of climatic or regulatory conditions, PV emerged as the cornerstone of successful CSC models, making it a foundational component of retrofitting strategies. The adoption of heat pumps, however, proved more regionally sensitive. Southern Europe showed the greatest potential for heat pump integration due to its mild climate and high electricity prices, which amplified the cost-effectiveness of decarbonized heating solutions. In contrast, the viability of heat pumps in Central and Western Europe was constrained by lower natural gas prices and the challenges of upgrading medium-to-high-efficiency buildings. However, decarbonizing heat remains challenging in Western and Central Europe for buildings with medium-to-high efficiency and low gas prices, requiring additional policy support.

The study highlights the role of tailored CSC regulations in incentivizing investment, with frameworks combining surplus remuneration and reduced internal electricity pricing maximizing benefits for stakeholders. By addressing the landlord-tenant dilemma through CSC, this research shows how both landlords and tenants can benefit, while also supporting climate goals. However, a combination of better regulations, financial incentives, and new technologies is still needed to fully decarbonize MFBs across Europe.