EQUITABLE DECARBONIZATION OF HEAT SUPPLY IN RESIDENTIAL MULTI-APARTMENT RENTAL BUILDINGS: OPTIMAL SUBSIDY ALLOCATION BETWEEN THE PROPERTY OWNER AND TENANTS

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Overview

The recently published *Fit for 55* package [1] by the European Commission outlines the pathway until 2030 to reduce greenhouse gas emissions by 55% compared with that in 1990 in the European Union (EU). With an eye on the therein described energy policy recommendations, undisputedly, massive efforts across sectors are necessary to enable a sustainable transformation of the energy system. At the same time, there is a need for energy justice complying with the manner of "no one left behind" [2]. Against this background, the residential building sector calls for particular attention. There are at least three reasons for this: (i) high shares of fossil fuels in the provision of heating service needs (and increasingly cold services as well), (ii) inefficient ways of delivering the heat demand caused by low standards of both building stock and heating devices, and (iii) complex building ownership structures and the property owner/tenant nexus in rented apartments or dwellings.

The scope of this paper aims at exploring how to deal with one of the "hot potatoes" on the road to a sustainable society: to trigger investments for deep decarbonization of the rented residential building sector in terms of heating system change and passive retrofitting. The focus is put on multi-apartment buildings in urban areas that are often heated by natural gas-based heating systems. Moreover, the frequently occurring ownership structure within the building with a single property owner (building or at least apartment owner) and numerous tenants plays a key role in the analysis as this is a generally crucial relationship. Typically, a property owner is the investment decision-maker in terms of potential (active and passive) renovation measures but is not affected in its decision process by an increasing CO_2 price as the most significant parameter determining deep decarbonization. On the contrary, the tenants are at the mercy of the future CO_2 development and have no decision-making power to counteract it, e.g., by changing the heating system.

Against this background, the core objective of this work is to set up a cost-optimal and socially balanced subsidization strategy for a multi-apartment building to trigger investments in a sustainable heat supply. A public authority (governance) incentivizes the replacement of the initial natural gas-based heating system toward a sustainable alternative along with building renovation measures (accompanied by reduced heat demand) by monetary support to the property owner and the tenants. Monetary support can be direct payments in the form of an investment grant for the property owner or a subsidy payment for the tenant. Besides, the property owner can also be indirectly financially supported by allowing a rent adjustment as the building is retrofitted. Social balance is defined at the building level from a monetary perspective using the net present value of the governance's total payments for the building's owner (or apartment's owner) and the tenants.

Methods

The method applied is the development of a linear optimization model. Thereby, the objective function is to minimize the governance's net present value of monetary support over time. The property owner's and tenants' strategy to minimize individual total costs is considered by tailor-made constraints in the modeling framework. The generalized formulation of the model allows to investigate different building types and categorization (size and number of tenants, building efficiency, initial rent price, etc.). This can be helpful to analyze different building stocks. Figure 1 shows a sketch of the model approach illustrating the interrelations between the governance, property owner, and tenants. Financial support from the governance is socially balanced at the partly renovated multi-apartment rental building.

The numerical example examined is an old multi-apartment building with a single property owner and 30 units (tenants). The partially renovated building is located in an urban area (Vienna, Austria) and initially heated by individual gas heating systems at the unit's level. The decarbonization of the heat supply can be achieved by two different investment options, namely, a connection to the district heating network or an implementation of an air-sourced heat pump system on the building level.

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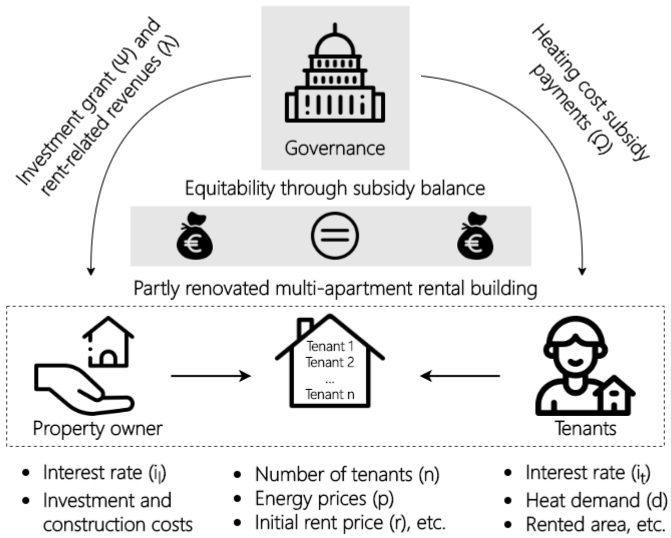

Figure 1 Sketch of the model illustrating the interrelations between the governance, property owner, and tenants. Financial support from the governance is socially balanced at the partly renovated multi-apartment rental building.

Results

The results of different decarbonization scenarios of a partly renovated old building switching from gas-fired heat supply to either the district heating network or being equipped with a heat pump system show that an equitable heating system change is possible, but with massive public subsidy payments. Particularly, the investment grant to the property owner and additional rent-related revenues due to building renovation are decisive for the profitability of the investment. Simultaneously, subsidy payments to the tenants are required at the beginning of the investment period to limit their energy and rent-related spendings. Results also show that the heat pump alternative is not competitive compared with district heating, even in case of extensive retrofitting of the building. Allocating the costs of inaction (opportunity costs associated with rising CO_2 prices) between the governance, property owner, and tenants turns out as an important lever, as required subsidy payments can be reduced significantly.

Conclusions

We find that a fair and equitable switch to a sustainable heat system is possible but with massive public subsidy payments. In particular, the property's owner investment grant and additional rent-related revenues derived from the building renovation measures are crucial to trigger the profitability of the investment. At the same time, subsidy payments to the tenants are required at the beginning of the investment period to limit the energy- and rent-related spendings. Furthermore, the results impressively show that the heat pump alternative is not competitive in supplying heat service needs in partly renovated old buildings. Either the subsidy payments are significantly higher than in the district heating case, or the equitability constraints of the model cannot be satisfied. Deep building renovation and associated reduction of heat demand enable feasible solutions but with high total costs. In this case, passive retrofitting measures need to be incentivized, too.

Furthermore, the results demonstrate that allocating the costs of inaction between the governance, the property owner, and the tenants is an important lever and can reduce the required subsidy payments. First and foremost, the biggest drop of the total subsidies (to nearly half) takes place when the costs of inaction are completely borne by the property owner. Also, a decrease in the property owner's interest rate reduces the total costs but limits the maximum share of the costs of inaction allocated to the property owner and implies a lower bound of the cost-minimized solution.

References

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