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A survey of private landlords in Karlsruhe and their perception of deep energy retrofit

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Abstract. Energy use related to buildings accounts for 35.3% of Germany's final energy consumption and nearly a third of greenhouse gas emissions. Thus, deep energy retrofit (DER) has a substantial role in the German energy efficiency strategy. Although many DER measures are economically viable, the pace of DER is below expectations and target value. A few studies investigated this phenomenon and conducted surveys mostly among owner-occupiers. However, 54% of the 40.5 million apartments in Germany are rented and a total of 15 million are let by private (not professional) landlords. Therefore, this investigation focuses on private landlords to find out what drives or constrains them to do deep energy retrofitting. A survey was conducted in a quarter of Karlsruhe, a large city in Germany with an above-average demand-driven real estate market. In this quarter, 83.2% or 8464 apartments are rented. 85 private landlords who own 10% of the rented residential buildings in the quarter responded and gave insight into their perception of DER. The results show that the buildings of the respondents originate from a construction period with large saving potential. Main strategies for investments in DERs are conservation of economic value of the property and the compliance with legal requirements. The main trigger is required maintenance. Despite an eco-friendly attitude, ecological criteria have a minor part in the DER decision. Finally, policy recommendations are made.

1. Introduction

In the strategic plans of the German government, the national building stock has a major role in achieving the goals of the German energy transition [1, 2]. These plans include several national milestones until 2050. Main goal for the national building stock is to reach nearly climate neutrality in 2050, which means a reduction of its primary energy demand by at least 80% compared to 2008 [2]. Currently, the energy use in the building stock is responsible for 35.3% of Germany's final energy consumption and most of the consumption originates from residential buildings (22.1% of Germany's final energy consumption) [3]. The latest monitoring report of the German energy transition, published mid-2018, states that the weather-adjusted final energy consumption in buildings increased by 4.3% from 2015 to 2016 [4]. However, since 2008 it has decreased by an average of 0.8% p.a. In order to meet the reduction targets, it needs to decrease much faster in the remaining years. Hence, further efforts are required in order to achieve the energy transition targets as quickly as possible [4]. The main challenge is the transformation of the existing building stock, as most of the residential buildings were constructed before first thermal requirements came into force in 1977/1978. Moreover, the pace of deep

energy retrofit (DER) is below expectations and target value. Latter can be explained, as private owners have decision-making sovereignty over the majority of the building stock and many of them do not invest into deep energy retrofitting, despite many retrofit measures are technically feasible, increase comfort, can be economically profitable, contribute to other tangible and intangible factors positively [5, 6]. In order to tackle the challenge, generating knowledge about the perceptions, preferences and the respective decision-making processes is of high importance. These findings support policy makers in determining strategies to increase the DER rate. However, owners can have multiple roles at the same time (see section 2). For owner-occupiers many studies about the perception of DER exist (see section 3). Therefore, this study aims to relate the perception of DER to a given role. The focus group of this investigation of the perception of DER are private ("amateur") landlords. This focus distinguishes this study from others and forms the original contribution of this paper.

Furthermore, in the *Urban transition lab 131* research project (*www.iip.kit.edu/english/1064_2827.php*) the citizens of the Oststadt quarter of the German city Karlsruhe demanded an investigation of their building stock, its owners and tenants. Subsequently, several surveys and field studies were carried out in this quarter. A survey of private landlords forms the basis of this paper.

2. Brief overview of ownership structure and deep energy retrofit in Germany

Owners pursue multiple aims concerning their properties and have different capabilities. Furthermore, they can be owner-occupier and/or landlords of a property. Then, landlords can be subdivided into professionals and "amateurs" [7]. The importance of considering roles is illustrated for Germany in the following. According to census data from 2011, the ownership structure and the type of use of apartments in Germany is shown in figure 1 [8]. A closer look into the statistics discloses that about 54% of a total of 40.55 million apartments in the German residential building stock are rented. Thereof, 15 million are let by private ("amateur") landlords (for comparison in the EU about 30% of the apartments are rented [9]). Furthermore, the results of EU-SILC survey [10] indicate that the household ownership rate has a slightly decreasing trend or seems to remain static in Germany (e.g. the EU household ownership rate was at about 70% in 2017 [10]). Another investigation predicts an increase of ownership rate from about 45% to 50% by 2030 for Germany [11]. However, on a granular level the German statistics show considerable regional differences. Besides ownership structure, the apartment age or building construction period is of high interest for the analysis of DER [12, 13]. A comparison of the frequency distribution of construction periods of residential buildings and apartments shows little discrepancies [14, 15]. In the period 1949-1978 the average number of apartments per building is higher than in other periods [14, 15]. Which indicates that more and bigger multifamily houses were built in that period. The micro census of 2014 reveals that rented apartments are on average older than owner-occupied apartments [16], e.g. in Baden-Württemberg (the state of the investigation area) rented apartments are on average 4.5 years older than owner-occupied apartments and about 74% of the rented residential building stock was built before thermal and heating system regulations came into force (1978). That is about 10% more than owner-occupied apartments. These figures show the significance of considering the roles and for the case of Germany the importance to conduct private landlord focused research.
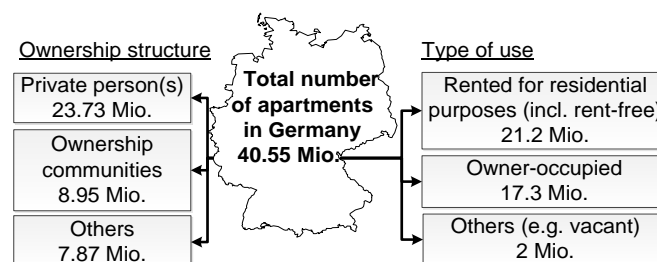
Figure 1 Ownership structure and the type of use of apartments in Germany (according to [8])

For assessing the progress in deep energy retrofitting, the respective annual rate is determined. The determination of this rate is complex, and approaches differ from each other. For Germany, the most cited studies compute insulation rate between 0.99% and 1.43% p.a. for the past 15 years for the building cohort built until 1978 and replacement rate of heating systems between 3.1% and 3.27% p.a. for the past 15 years for the same cohort [14, 15]. Nevertheless, the retrofit activity is limping behind the target values, which are twice as high. Besides favorable circumstances such as low interest rates and current real estate market conditions, other stimuli are set by the government to promote DER in the entire building stock. For new buildings, high requirements towards thermal insulation and heating systems are in force. For existing buildings, DER of certain building parts are mandatory and financial incentives are offered, as well as legal frameworks to mitigate burdens and drawbacks. Additionally, the replacement of heating systems with renewable heating sources is promoted via subsidies and requirements. Furthermore, informational instruments such as energy performance certificates (EPC) are used to raise awareness.

3. Brief literature review of decision-making of deep energy retrofit

The decision-making process and perception of DER has been investigated in several studies. Among others Friege & Chappin [17], Stengel [7] and Steinbach [18] present comprehensive reviews on modeling decisions of retrofit of buildings in the context of energy efficiency. Friege & Chappin [17] conducted a review using bibliometrics. Stengel [7] and Steinbach [18] reviewed relevant literature as part of their dissertation. These authors show that the parent topics are: technical options, modeling/simulation, policy/incentive instruments and understanding decisions. The following subsections briefly summarize three areas of interest, which partly complement the mentioned reviews.

3.1. Survey based studies of deep energy retrofit

More than 50 scientific survey-based publications can be found, which are related to energy efficiency measures in residential buildings and were published after the year 2000 (found via analyzing the Scopus query which yielded more than 620 results: TITLE-ABS-KEY(("Homeowner*" OR "Landlord* "OR "House Owner*" OR "Building Owner*" OR "Dwelling Owner*" OR "Apartment Owner*") AND ("Renovation*" OR "Retrofit*" OR "Refurbishment*" OR "Renovating" OR "Retrofitting*" OR "Refurbishing"))). The surveys have diverse approaches to study the subject matter. Some use official panel and survey data. However, due to limited consideration of items and attributes concerning retrofit, renovation or refurbishment of homes, many conducted own surveys. Most of them focus on owner-occupiers. Many of the reviewed surveys use convenience or random samples, which show a high heterogeneity of socio-demographic characteristics among the owner-occupiers and private landlords. For more insight please refer to [7, 17, 18] and to the query. As communality, most studies conclude that economic aspects are very important but not sole driver of DER decisions. The observed depth of DER activity is mainly based on economic trade-offs. For Germany, Albrecht et al. [19] created persona types of owner occupiers which are well established, often used and modified. More recent studies aim at combining survey results with agent-based models [20, 21].

3.2. Deep energy retrofit and landlords

Landlords are much less addressed than owner-occupiers. A reason could lay in the assumption of economic rational behavior, which seems likely. Another reason related to this void could be the challenge of surveying them. Official data about landlords is rare. Then, reaching them is not trivial and neither framing the survey. Many landlords do not reside in the rented building or in the vicinity of it. Therefore, questionnaires can fail to reach them. Additionally, the surveys need to isolate the behavior towards the building used by a third party. Otherwise, they can end up merging the general attitude with the specific attitude towards the rented object. Hence, generic surveys have pitfalls when considering multiple roles. Schätz et al. [22] conducted a survey among 1,354 landlords in Germany (2005-2006). According to them, the level of professionality can be determined by the quantity of owned apartments. They assume that landlords with more than 15 apartments are professional, who then act more rationally

and economically effective (a similar differentiation is made by [23] for so called "micro"-landlords who own up to 20 apartments). Interestingly, 73% of their sample manage their apartments themselves or with the help of family members [22]. The most prominent motive for apartment acquisition is retirement provision and asset formation. In a subsample with landlords of buildings older than 1990, more than half of them rate their assets as in excellent condition (without any renovation needs). However, only half of the respondents are aware of energy efficiency requirements and nearly 70% will only make investments if absolutely necessary. In 2015 Renz & Hacke [24] interviewed 18 private landlords in order to verify several hypotheses and combinations of motives. Among others, a significant barrier to implement DER is the principal-agent dilemma. Concerning this dilemma, the legally permitted modernization allocation is regarded as a not realizable option. Another interview of 18 private landlords in Germany [25] provides insight in the investment behavior in DER in the context of low demand housing markets. The interviewees show a lack of knowledge concerning energy efficiency of buildings and have limited access to good-practice examples. In contrast they were well acquainted with negative reporting of DER. Investments are made to fix small problems/maintenance and can be triggered, if an increase of finding new tenants or keeping long-standing tenants happy can be expected. Accordingly, the interviewees stated that investments are driven by social responsibility and by an emotional relationship with the building or the neighborhood, rather than due to increasing profit. However, energy efficiency is not regarded are an essential asset or benefit [25]. A survey of >2,000 private landlords and members of a German homeowner association conducted by the association itself in 2017 states that the top four barriers for investments in their assets are: rent cap, tax burden, lack of subsidies and bureaucracy [26]. In contrast to the other surveys, this survey was not analyzed scientifically by its authors. However, it is the only one which covers private landlords which are part of an organized network. The variety of surveys show some commonalties, especially the lack of knowledge about DER and the principal-agent dilemma seems to be a main issue for landlords both in low demand housing markets or in well-organized landlord associations.

3.3. Principal-agent dilemma and deep energy retrofit

The principal-agent dilemma is a problem, which occurs when agents make decisions and take actions based on their interests, which impacts principals with contrary interests. For the real estate rental market this dilemma is called landlord-tenant dilemma. It can occur in several situations. Only the DER triggered problem will be presented. This problem forms a major difference between owner-occupiers and landlords and forms a main economic barrier for the latter. Alike other countries, in Germany tenants pay for their energy consumption. The energy consumption for space heating and cooling is dependent on the composition and quality of the building. Therefore, landlords have little incentive to invest into DER as they do not profit from lower energy bills, unless they raise the rent level which is not in the interest of the tenant. This makes it plausible that investments are mainly dedicated for value conservation or maintenance. In theory, there are many possibilities to overcome this problem [27, 28]. In practice, landlords in Germany profit from financial subsidies such as low interest loans and grants to mitigate the financial burden and the landlord-tenant dilemma. Then, rental laws allow for modernization allocations, which enable landlords to increase rents after DER. An important influence on the dilemma are the real estate market conditions. The profitability of an investment depends on the enforceable rent increase and low rent levels represent an obstacle. However despite currently expectable profitability, retrofit activities appear to be stagnating and only a moderate increase is expected [29]. Survey results show that private landlords are not familiar in solving this problem. For example, they do not bail out the legal possibilities of rent increase as professionals do and are not acquainted with DER [24, 30, 31]. Testorf et al. [31] conducted a survey (2009-2010) among owners who received support from subsidy programs and had a total of 5,797 respondents. 251 of them were enterprises and about 13.2% of the remaining private owners were landlords. In their study, they compared landlords' rent level increase after DER. Professional landlords increased the rent on average by 27% whereas private landlords increased it by 10%. With respect to the specific investment per m², the increase is again considerably different between professionals (median is 18%) and amateurs

(median is 2.5%). As causes for the discrepancies Testorf et al. identified legal uncertainties and market conditions [31].

4. Survey design and data

A series of paper-based, online questionnaires and experiments was conducted in the quarter of the "urban transition lab 131". The investigation area has a population of about 21,000 who live in 10,173 apartments (83.2% or 8,464 apartments are rented). The quarter features an above-average demand-driven real estate market, mixed use areas and mixed construction periods, but most buildings are built before 1978 (85%). For this paper, the main questionnaire of private ("amateur") landlords is presented. This questionnaire had two forms: paper-based and online. Depending on the number of assets in the quarter the questionnaire was designed to be completed in 30-60 minutes. For the purpose of this study, the share of private landlords in the sample is maximized. Hence, a variant of snowball and convenience sampling as nonprobability sampling strategy was chosen in order to acquire an adequate sample. Requirement for participants was being a landlord with at least one asset in the investigation area rented by a third party. Therefore, the largest local homeowner association was approached in order to ask for referrals to private landlords in their network. Finally, the questionnaire was distributed by mail to 655 private landlords who met the criteria and were members of the association. The questionnaire was scheduled from 20th May 2016 to 25th July 2016. 20 questionnaires were undeliverable. Additionally, 34 responded in order to inform that they did not match the criteria. A reconsideration of the sample by the association assumed that about 120-230 of the 655 private landlords would not match the criteria as they suspect an error in address pre-processing. Therefore, population size is assumed to be 450.

5. Results

The analyzed sample contains 85 fully complete responses of landlords. The online survey yielded 11 complete and 34 uncomplete questionnaires which can be interpreted as a quit rate of about 77%. The number of uncompleted paper-based questionnaires which were handed in is 11. Two of them commented on the uncomplete questionnaire (rough translation): "…that local agencies and politics are to blame for the unattractiveness of DER…" and "…that landlords are discriminated by the legal framework... ". 20 landlords have assets which they partly occupy themselves and rent out the rest. The remaining 65 completely rent out their apartments/buildings. The 85 landlords own 419 apartments in 93 buildings in the investigation area. 54 of the buildings are solely owned by the respective landlords. The remaining belong to an ownership community. The residence of about one third of respondents lays in the investigation area, about one third in the city Karlsruhe and about one third elsewhere.

5.1. Age, asset management and identification of basic environmental perception

70% of the sample are older than 55 and 37% are at least 66 years old. Gender is mixed. Concerning the responsibility for asset management, 63% manage their apartments themselves, 32% hand the management over to third parties and 5% hand it over to friends or extended relatives. A cluster of Likert scale questions concerning attitudes and other questions about ecologic commitments (such as donations and other ecology related activities) aimed at identifying the basic environmental perception. In a comparative analysis, milieus and lifestyles are assigned according to the range of observations in the sample. This analysis is based on the official environmental awareness survey of 2010 [32]. On the social scale of Sinus-Milieus the landlords in the sample range between mid and upper class. On the fundamental orientation scale the landlords range across all three classes (traditional, modern/individualized and reoriented)[32]. A more granular analysis shows a good degree of conformity to several items in three Sinus-Milieus/lifestyles (Traditional, Social Ecological, Intellectual Milieu)[32].

### 5.2. Funding and investment planning

For maintenance and repairs, 54% of the landlords allocate funds in sinking funds or other similar dedicated reserves. The others fund maintenance and repairs from their general savings or with loans. 60% of the respondents do not dedicate any funds for DER related investments. The remainder dedicate

savings in some extent, but only 11 consult experts for determining the amount. A hierarchical cluster analysis of the responses reveals a group of 25 landlords who do not use any particular financial performance indicator for evaluating investments in their property. The remaining 60 landlords form 16 clusters which can be assigned to two main groups. The first group focuses on tax-based evaluation of investments and the other on amortization assessment/recapitalization.
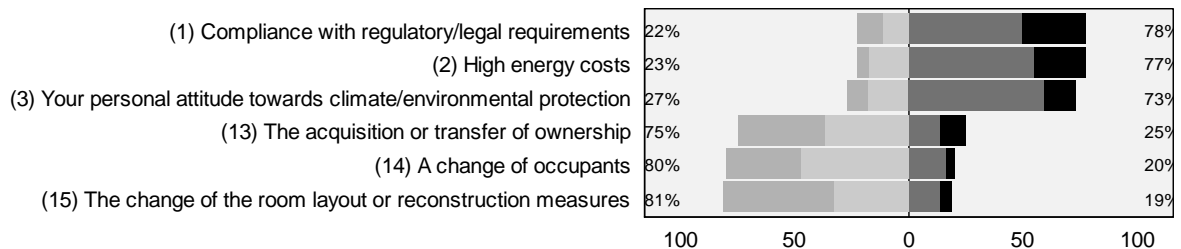
5.3. Motives, occasions, barriers

A total of 19 motives gathered from literature and interviews of landlords were tested in a Likert scale. Similarly, 14 occasions and causes for DER and 20 barriers were tested. Figure 2 summarizes the results of the three areas. For each area, results with the three highest and three lowest approvals are presented. For challenging the perception, some items were compared to objective data, e.g. energy performance certificate (EPC) values were compared to the perception of the energy performance of their building. In this case, the landlords highly overestimated the performance of their property.
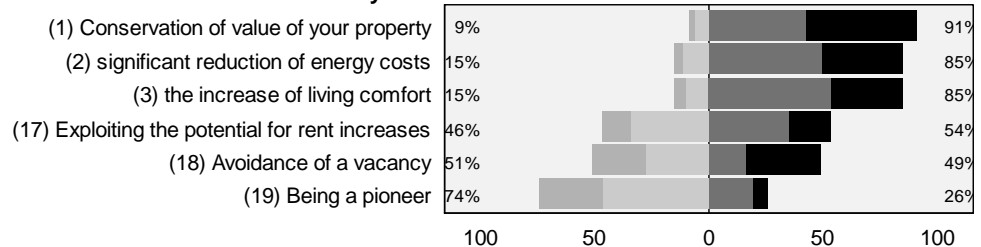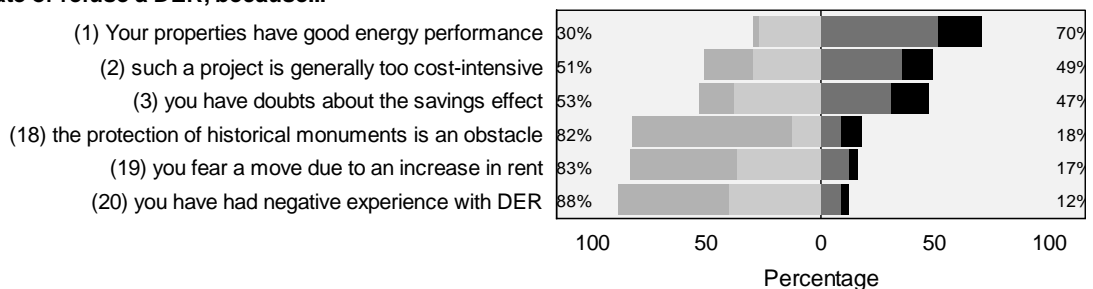

Figure 2 Approval of motives, occasions, barriers. Respectively, the items with the three highest and three lowest approvals are presented. N=85; top: motives; middle: occasions; bottom: barriers.

5.4. Experience with previous deep energy retrofit

More than half of the landlords made some experiences in the context of DER. The experience was assessed with four values: no experience, positive, negative and neutral. Figure 3 summarizes the results.

What were your experiences?

Figure 3 Experience with DER. N=85; no exp.= number of respondents without experience.

5.5. Channels of advice and information

The participants were asked who they seek advice from concerning their property on legal, financial issues and DER. They could choose multiple sources from a total of 25 predefined options. Figure 4 shows the sources with 30 and more mentions. Concerning legal advice, most of the respondents consult their homeowner association (who are professional lawyers). For financial advice, most landlords approach banks. For DER, no clear main information channel is used. The most frequently chosen channel is technical press. Internet sources and DER consultants are second. Real estate agents, neighbors and consumer advice centers belong to the least considered sources for advice.
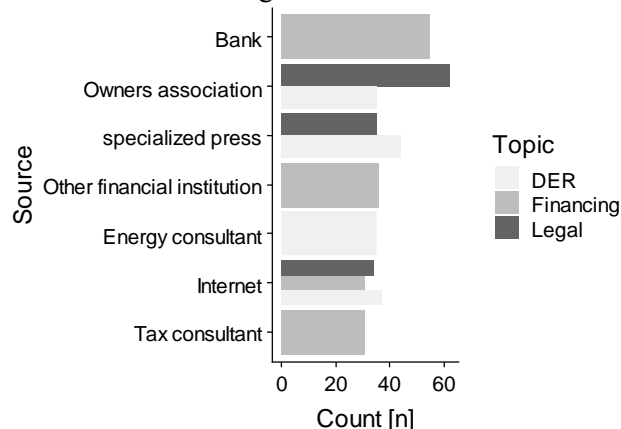

Figure 4 Sources of advice and information for the three topics of DER, financing and legal. The bars present and groupe different topics if a source has 30 and more mentions of the respective topic.

6. Discussion of the results

Despite the bias created by the sampling method, the interpretation of the results has some generic elements. Additionally, the design yields some specific findings about organized private landlords in demand-driven rental markets. A cluster-based analysis of presented and other results yielded six profiles. The communalities are aggregated to form a generic profile (cf. section 7). Concerning the demographics of the sample, the age spread and distribution is in accordance with other studies (e.g. [22]). Acceptable correlation between age and DER was not found, which is in accordance to Kastner

& Stern [33], who did not discover a clear pattern of correlation across several studies. In general, the sample has a positive attitude towards environment and climate protection. However, the identified milieus/lifestyles (personal attitudes) seem to have limited transferability to decision making behavior of DER of not self-occupied buildings, as ecological criteria have a minor part in the decision (cf. 5.1.-5.3.). The share of self-managed properties is comparable to the share determined in other surveys [22]. Those who transfer the management to professionals have a clear link between finance planning and maintenance-dedicated funds. This can be explained by the condominium act, which regulates administration and forming funds. In comparison to the survey on low demand rental markets [30], the motives and barriers shift as expected (figure 2), which emphasize the importance of considering the market conditions. The barriers for DER are mainly related to doubts about DER effectivity and to overestimation of the buildings' energy performance (figure 3). However, landlords should be sufficiently informed due to the mandatory generation of EPC. This indicates that EPC fail to achieve the informative purpose. The motive to exploit rent level increase potential by DER has one of the lowest approvals, which is in accordance with the observations of rent level increase after DER made by Testorf et al. [31]. This can be coupled to the legal framework, e.g. rent caps and uncertainty of enforceability, or to social responsibility or low familiarity and utilization of financial indicators (cf. 5.2-5.3). Noteworthy are the mainly positive and non-economic experiences after DER (figure 3 items 1, 3, 4, 6). The experiences made in preparation phase of DER (figure 3 items 2, 7, 8) show a split field. Landlord specific experiences which relate to the relationship to the tenants and the economic aspects show a considerably less positive experience. Overall, the experiences are mainly neutral or positive, which promises a potential to invalidate some barriers related to DER. The survey revealed a considerable deficit related to the information sources/access. For legal and financial issues, the information channels have a distinct expertise and the majority uses these as main sources. Specialists on DER are much less approached and most information on DER are compiled from technical press and the internet. This causes considerable issues concerning the perception of DER and energy performance, as two of the three most utilized channels for DER can be characterized as passive and not individualized.

7. Conclusion and policy implications

For reaching climate neutrality in the building stock, the importance of considering private landlords is evident. Despite good circumstances, DER implementation is behind expectations. The conducted survey revealed insights into private landlords in an above average demand rental market. In general, private landlords are characterized by their interest in climate and environment topics. They are motivated to save energy and convinced of the ecological advantages of DER. However, they doubt the promised energy savings. The main strategy for investments is conservation of property value and compliance with legal requirements. The main trigger for DER is maintenance. The building performance is often overestimated. Despite an ecofriendly attitude, ecological criteria have a minor part in the DER decision. Financial subsidies are the preferred type of financial incentives. In summary, four areas of policy improvement can be identified: economic incentives, markets, enforcement, lack of knowledge and awareness. For economic incentives, private landlords prefer grants more than subsidized loans. A large part of them focuses on tax-based economic evaluation. Even though tax deductibility of DER is possible, a combination with other economic incentives is not. Then, real estate markets are not reflecting the energy performance sufficiently. EPC fail their informative purpose and DER has no strong association with property value conservation. Adequate access to data about prices, rent levels and energy performance could improve this. Some DER measures are mandatory. However, these requirements are merely enforced. A stricter enforcement would raise awareness, responsibility and place DER higher on the agenda of legal and financial advice. In parts, simplifying bureaucracy could solve some issues of applying for subsidies or receiving professional advice. Concerning the lack of knowledge and awareness, better access to good-practice and DER roadmaps/EPC information could yield significant improvements, as well as the enhancement of public contact points and sources of information with dedicated DER experts. Finally, a higher focus of campaigns on landlords' and tenants' perspectives could raise awareness and mitigate the landlord-tenant dilemma.

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