Energy Policy 119 (2018) 327–338

Contents lists available at ScienceDirect

Energy Policy

journal homepage: www.elsevier.com/locate/enpol

Intersection of the global climate agenda with regional development: Unequal distribution of energy efficiency-based renovation subsidies for apartment buildings

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ARTICLE INFO

Keywords:
Energy policy
Energy efficiency
Equity
Housing
Renovation
Regional development

ABSTRACT

The residential sector is an important target area for achieving Europe's 2020 energy saving aims. There is virtually no evidence, however, of how incentives for attaining energy efficiency interact with countries' regional development aims. This article presents recent experiences from Estonia, where an energy renovation subsidy programme financed with carbon emission trading funds was carried out between 2010 and 2014. We show that despite equal access to subsidies for residents living in various places, a regionally unequal distribution of subsidies occurred. Empirical analyses confirm that low-performing regions acquire less public subsidy, thus adding another layer of regional inequality to existing socio-economic differences. Findings suggest that renovation subsidy distribution is related to regional socio-economic indicators and that real estate value explains 40% of subsidy distribution variations between regions. Although the energy policy goal of carbon conservation is important, ignoring the location and organisational capacity of local communities results in missed opportunities to mitigate growing regional disparities.

1. Introduction

"Success to the successful" is a systems' trap that Meadows (2008) has vividly described in a study of systems. The phrase suggests that social groups that already enjoy higher "capital" accumulation—due to their greater education, wealth, and social networks—tend to also be far better equipped to seize additional benefits. We argue that this phenomenon can be prevalent in societies, especially when access to certain publicly-available incentives requires more human, social, organisational or other types of capital and distribution of such benefits is competitive.

In Europe, it is important that the ongoing energy transition (Bridge et al., 2013) and cohesion policies support each other. Regional policy is a classical cross-sectoral policy field that can only reach its aims when parallel sectoral policies, including energy policy, embeds regional development in its agenda. In the context of a multi-level governance system, it is also important that the impact of policies at various governmental levels are consistent. For example, EU energy policy aims should be consistent with the policy targets of the EU's economic, social, and regional policies, however each member state also has the responsibility to apply EU targets in a way that ensures balanced development within national borders. The tools and impacts of energy policies are already by nature more global; the strategies at the national level could potentially consider how energy policy measures could alleviate rather than deepen socioeconomic stratification and regional inequalities within countries.

Many attempts have been made to measure and to understand the mechanisms of energy poverty (Bouzarovski et al., 2012; Braubach and Ferrand, 2013; Healy and Clinch, 2004). At the household level, energy poverty is understood as "the inability to secure a socially and materially necessitated level of energy services in the home" (Bouzarovski and Tirado Herrero, 2017, 69). Low-income groups living in energy-inefficient dwellings often pay disproportionately high energy cost; therefore, specific social protection measures or energy policy instruments are needed to alleviate this component of their poverty. Links between spatial inequalities and energy policies are less studied, but due to segregation in cities and disparities in regional development, vulnerable groups inevitably also tend to concentrate in space.

Bouzarovski and Tirado Herrero (2017) emphasise a clear divide between countries according to the core-periphery boundaries in Europe: in Southern European and (formerly socialist) Central and Eastern European (CEE) countries, energy poverty is generally higher,

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https://doi.org/10.1016/j.enpol.2018.04.013
Received 16 December 2017; Received in revised form 31 March 2018; Accepted 6 April 2018
Available online 10 May 2018
0301-4215/

and even the middle class is affected by high energy prices. In Northern and Western European countries, energy poverty threatens weaker social groups, who often live in less energy-efficient dwellings. Furthermore, CEE countries typically struggle with the legacy of an inefficient energy sector and low quality housing. A large share of the housing stock in CEE countries originates from the socialist years when energy prices were low and housing construction and maintenance was heavily subsidised. Energy poverty in CEE can be explained by interrelated conditions: privatisation of energy infrastructure; a transition from public to almost fully private ownership of housing; large investment needs in both sectors; in some countries dependence on energy imports; related sharp increases in energy tariffs and other housing costs for households; and, slow progress in social welfare programmes. As such, the housing sector in CEE countries urgently needs investments; consequently, energy poverty is a critical issue in both larger cities as well as in peripheral regions of these countries.

In this study, we explore an energy efficiency housing renovation subsidy programme applied at the national level in Estonia that possesses a built-in component of competition between communities applying for public subsidies. More specifically, we study the first comprehensive public subsidy programme occurring between 2010 and 2014 in Estonia (during the post-socialist period) intended to support energy efficient housing renovation. Our empirical contribution—-which demonstrates **how energy efficient housing renovation grants were distributed in Estonia at the core-periphery scale**—fills a gap in scholarly research in explaining how globally-oriented climate change aims interact with country-level regional development aspirations. This study therefore contributes to discussions about how to avoid the "success to the successful" trap in connecting energy policy with other cohesion aims.

This article first introduces the relations between energy policy and social inequality generally while focusing on regional polarisation. Next, we analyse to what extent the notion of equality is addressed in EU energy directives and member states' energy efficiency action plans. This is followed by the identification of relevant policy goals in Estonia, providing context for energy subsidy programmes introduced in the subsequent section. We then describe the data employed and techniques used. After presenting the data and results from our empirical analysis, we offer conclusions and identify policy interventions that could improve the coherence between global/European energy and country-level regional policies.

2. Role of equity in energy policy

2.1. The context of regional polarisation

The term 'regional polarisation' suggests that successful regions, compared to lagging regions, provide richer opportunities for economic growth, a more diverse social life, better housing opportunities, and greater possibilities for individual fulfilment. While regional disparities between EU member states are decreasing, the inequalities within member states are increasing (Heidenreich and Wunder, 2008). The reasons for growing disparities are complex. According to Lang (2015), the formation of peripheral regions is a social and economic but also a discursive and political process. Also, sometimes weak regions are not getting weaker per se but stronger regions are developing faster (Nordregio et al., 2007).

Formerly prosperous industrial and agricultural regions are often faced with double deprivation. In former socialist countries, such regions received abundant state infrastructural and housing investments. The volume of housing construction was large in fast-growing major CEE cities; at the same time, many people were attracted to smaller industrial towns (Tammaru, 2001) and to collective agricultural enterprises which dominated rural centres (Marksoo, 1990), where state-regulated salaries were competitive and apartments were generously distributed to arriving specialists. By the beginning of the post-socialist transition, peripheral regions in CEE countries were characterised by relatively good infrastructure and housing stock. Today, investment needs in these places are large and the out-migration of an economically productive population undermines the financial stability of small municipalities even further. The problem is also low return on housing investment. Real estate prices tend to rise only in major urban regions that attract enterprises and new residents. For these reasons, investments in energy efficiency are most likely to offer a return in prosperous regions where the value of improved real estate remains stable or appreciates. This makes co-financing attractive for residents, whereas in peripheral regions such motivation develops more modestly.

The complexity of regional polarisation emergence renders coherent policy intervention difficult to apply and its outcomes challenging to evaluate. It is argued that EU regional policy interventions are a waste of resources as they do not alleviate regional disparities (Boldrin and Canova, 2001). This is only partly true, because interventions for addressing polarisation may not work as intended due to the lack institutional capacity at the level of nation-state (Charron, 2016), or because of differences in social capital within and between communities (Ojamäe and Paadam, 2015; Raiser et al., 2002; Taylor, 2000). This means that intervention policy per se is not useless, but some communities are more capable of utilising EU subsidies while others are not.

Within EU member states, "peripheralisation" and "metropolisation" appears to be a structurally embedded and path-dependent processes (Lang, 2015; Martin and Sunley, 2006). For many peripheral regions in CEE with agricultural or industrial backgrounds, the most prosperous times are in the past. New and competitive economic activities have disproportionately developed in capital cities and other larger centres with diverse economic structures and healthy connections to global economies. This is also reflected in national internal migration patterns: larger metropolitan areas are attractive destinations for those leaving regions with growing unemployment (Leetmaa and Väiko, 2015). While regional polarisation is a Europe-wide trend (Boldrin and Canova, 2001; Gardiner et al., 2004), in CEE countries polarisation together with slow development in social protection and regional policy capacity have produced a severe loss in human capital (Raagmaa, 2001) in lagging regions. Most public subsidy programmes, however, presume local initiative, and in peripheral regions such local partnerships tend to be weaker.

In the 1990s, the housing privatisation process was considerably faster in core regions. The approach of housing privatisation in most CEE countries was to diminish public ownership of housing units (Kährik, 2000) so that residents would assume housing costs. But this approach did not work smoothly even in major cities, because investment needs were beyond households' capacities to pay, especially during the early post-socialist years. Little by little, (non-governmental) apartment associations in larger apartment buildings assumed various administrative and financial responsibilities, but the capacity of associations varied: in some residential buildings, effective leaders organised gradual improvements while in others, the apartment association staff was only able to accomplish the bare minimum with low communal costs. Even in large cities, it took time to establish the organisational capacity of apartment associations. In peripheral districts, maintenance and renovation of apartment houses is now often overseen by municipal officials rather than by owner communities. At the same time, some energy efficiency renovation strategies presume that a targeted community is able to mobilise its members to acquire available subsidies: an optimal renovation programme for each particular building must be identified considering technical, economical, financial, and procedural aspects. Given these conditions, we argue that disparities in energy poverty—similar to disparities in other regional development concerns—are deeply and institutionally rooted, and communities in peripheral regions may lack organisational capacity (e.g. social and financial capital) to compete for public subsidies.

We stress the importance of the polarisation phenomenon on a regional level because we assume that energy policy applications (e.g.

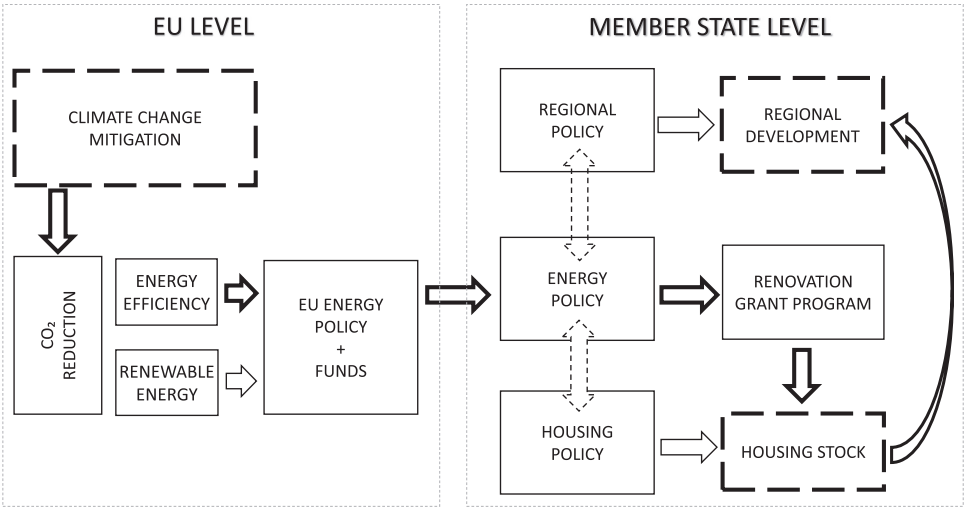

Fig. 1. Influence of global climate change agenda on local regional development.

housing renovation programmes) may unintentionally foster the growth of regional disparities (Bouzarovski and Tirado Herrero, 2017). Fig. 1 illustrates how the global climate agenda could shape regional development by implicitly influencing housing conditions through the requirement to conserve energy use in buildings. As the literature suggests, subsidised residential renovation projects may not distribute equally in space (Turcu, 2017).

2.2. Equity aspects of EU directives and member states' renovation strategies

The current climate agenda for buildings is operationalised through Energy Efficiency Directive (EED) (Council Directive 2012/27/EU, 2012). The main aim of the EED is to establish a set of binding measures to meet climate change mitigation targets in EU. Although EED is oriented to solve energy problems, we expect it to address social aspects for two reasons: (1) the application of any regulation can produce social and territorial impacts which might result in unexpected externalities and should therefore be mitigated in advance (this is the main rationale for the introduction of impact assessment procedures); and (2) disparate outcomes and uneven development cannot be addressed in separate specific regulations because of the complex nature and national variations in underlying conditions. Instead, these issues should be integrated with other sectoral regulations to achieve the aims of social and regional policy.

We observe that EED refers briefly to social aspects only in its introduction. In article 7/7 (a) there is a more concrete suggestion that member states may include funding scheme requirements with a social aim, but only in the "Saving Obligation Scheme", which is not relevant to housing renovation. Consequently, there are no direct requirements that energy efficiency measures at the national level (including renovation programmes) should directly address member states' social or regional policy challenges.

Although there are official impact assessment procedures available and in use (European Commission, 2015a) for European initiatives (e.g. directives), no significant contribution for social and regional equality was suggested to EED using this tool (European Commission, 2011). Furthermore, energy poverty is mentioned only once in the impact assessment report of the EED, when it is pointed out that EED supports a social agenda by reducing energy poverty. This is a general and normative statement which is not elaborated further in the assessment report. Therefore we argue that impact assessment of EED failed in impact assessment's core principle to answer the essential question of what are the economic, social and environmental impacts and who will be affected (European Commission, 2009). Moreover, this shortcoming was not recognised by the EU Impact Assessment Board whose explicit task is to analyse and submit opinions on the draft of impact assessment report. This is probably because impact assessments of EU initiatives do not anticipate territorial impacts that are also commonly absent from other initiatives (Fischer et al., 2015, 2011).

The Building Performance Institute Europe (BPIE) has made an important contribution in delivering EED article 4 by introducing guidelines for long-term housing renovation strategy (BPIE, 2013). However, this document does not address social equity, energy poverty or regional aspects related to building renovations. BPIE's subsequent document (BPIE, 2014) focuses on fuel poverty. This is an important emphasis, but unfortunately this report is too recent to have substantial impacts on the EU energy policy that has shaped current discourse. Furthermore, such single reports have generally little influence at the national level because of information overload and time stress on decisions by the government officials.

Indeed, it is quite surprising that despite various impact assessment procedures and a vast amount of literature on energy poverty, there is still no explicit emphasis of inequality in EU directives and guidelines. But this situation is likely about to change. A recent report prepared by the European Commission (2015b) for the European Parliament and Council states explicitly—for the first time—the need to address fuel poverty in building renovation strategies. The commission also emphasises a new preference for European Structural and Investment Funds to be used in grant programmes to fill the financing gap (for low income groups, social housing, and energy-poor households). To achieve these aims, the national government effort should certainly effect a mediating role. Next, we shall examine to what extent this opportunity has been utilised by European countries so far.

Under the EED, member states must prepare a National Energy Efficiency Action Plan (NEEAP); in addition, national governments must publish annual reports that quantify the national energy efficiency target and outline in detail how various programmes have been (or will be) implemented to meet the goals. In 2014, when each country was required to submit its third NEEAP report, a national building renovation strategy—designed to be evaluated on an ongoing basis—was required. Since the recent Science for Policy report by the Joint Research Centre on the assessment of the renovation strategies has not addressed social nor spatial aspects in its evaluation (Castellazzi et al., 2016), we present a brief overview of NEEAP reports in Table 1.

There are 12 member states that have not implemented nor planned any equality measures in their energy efficiency action plan. Although EED does not explicitly state the importance of equality aspects, there are 16 member states that have considered or will apply equality in their energy programmes in the future. The forerunner is the Czech Republic; although it has the lowest risk of poverty compared to other

Table 1
Risk of poverty and equality statements in National Energy Efficiency Action Plans.
Source: Eurostat; Member states' NEEAP reports 2014.

EU member state	Risk of poverty rate 2014	Equality statements in NEEAP reports
Czech Republic	14.8	JESSICA programme can be used by non-profit association specialized in social housing. Future measure in social housing
Netherlands	16.5	Special fund for social housing
Sweden	16.9	None
Finland	17.3	None
Denmark	17.9	None
Slovakia	18.4	Objective of decreasing energy poverty will be designed
France	18.5	Zero-interests loan for social housing Property tax reduction Future initiatives reducing fuel poverty
Luxembourg	19.0	Free interest loan has been considered
Austria	19.2	Styria region: renovation finances for social housing
Slovenia	20.4	Special scheme for low income household
Germany	20.6	None
Belgium	21.2	National level: tax credit for low-rent dwellings Wallonia: advice and grants for low-income households Brussels: free advice and differenced grants for low income households Flemish: incentives to social housing companies
Malta	23.8	None
UK	24.1	Special funding for low income households
Poland	24.7	None
Estonia	26.0	None
Lithuania	27.3	Programme that includes social housing
Cyprus	27.4	Programme focused on low income households
Portugal	27.5	None
Ireland	27.6	Programme for low income households
Italy	28.3	None
Spain	29.2	None
Croatia	29.3	Special financing will be established for low and mid income households in the future
Hungary	31.8	None
Latvia	32.7	Special measure for social housing Strategy for 2030: establishment of measure against energy poverty
Greece	36.0	Grants depending on the income
Romania	39.5	Special initiative for low income households
Bulgaria	40.1	None

countries, certain equality measures have been implemented there. Furthermore, the Czech Republic has a high quality building renovation strategy (Castellazzi et al., 2016). We stress that half of CEE countries that have higher-than-average risk of poverty have not implemented equality measures. The worst case is Bulgaria, with 40% of risk of poverty, no quality measures, and a renovation strategy is failing EED requirements. The same applies to Portugal and Poland, however, their risks of poverty are lower than that of Bulgaria (27.5% and 24.7% respectively).

National energy initiatives for addressing social and spatial aspects are rather scattered, and there is no evidence of a systemic approach on the subject within the EU and its member states. The concept of equality is explicitly missing in reports, even when general phrases like "energy poverty" can be found in the documents. Clearly more research is needed to understand how and to what extent equality is addressed in specific energy programmes of the member states, especially in CEE with its large share of deteriorating housing estates. Lastly, we emphasise that some attempts to assess the possible impacts of national energy policy using alternative tools of impact assessment have failed to anticipate social impacts because of a lack of consideration of social objectives by policy makers (Golobic and Marot, 2011). This suggests that the impact assessment tools per se are not a panacea for addressing social equality and that human factors must be emphasised to better define socially significant goals in impact assessment tools.

3. National policy goals and energy renovation in Estonia

3.1. Policy goals in Estonia

Every intervention programme is designed within the framework of relevant strategies. Several strategic policy documents guide regional, housing and energy policy in Estonia and, in theory, shape intervention proposals. We review documents most relevant to our empirical data and observed time period (2010–2014). The major spatial development principles of the country are reflected in the National Spatial Plan (Spatial Plan 2030) (Estonian Ministry of the Interior, 2013). One of the aims is to preserve the country's existing settlement system and maintain permanent settlement in peripheral regions (empty territories are not expected to emerge). Spatial Plan 2030 proposes to achieve this by maintaining physical and social infrastructure. There is no reference, however, to how and to what extent deteriorating housing should be addressed within this broad goal. Still, because housing stock can be addressed as part of physical infrastructure, it is clear that quality housing is needed and renovation subsidy programmes can help to achieve goals of the Spatial Plan 2030.

The Estonian Regional Development Strategy (Regional Strategy) (Estonian Ministry of the Interior, 2005) states broad goals for 2005–2015. Equality is emphasised by framing the vision of equal opportunities irrespective of spatial location. In respect to energy efficiency subsidy programmes, this means that communities on the periphery should have equal possibilities to apply for renovation grants. It also follows that if subsidies are limited, we should expect equal distributions of such finances between and within regions. Furthermore, in order to achieve equal opportunities, weaker regions like peripheries should have better starting points and advantages compared to more advanced regions that could finance energy renovations without major subsidies (Grösche and Vance, 2009). Another goal of Regional Strategy that supports our previous argument is that of limiting the disparities between capital region and other regions. This goal suggests that a concentration of housing renovation subsidy in the capital region is unwanted. In other words, energy programmes should not construct another layer of poverty in the already existing core-periphery spatial order.

So far, all Estonian governments throughout the post-socialist period have maintained a neo-liberal position and have avoided interventions in the housing sector (Liepa-Zemeša and Hess, 2016). This is somewhat justified in consideration of the generous contribution of the former Soviet state to the housing sector, but current welfare regimes in post-socialist countries do not support taking comparable responsibility. The Housing Management Strategy 2008–2013 (Housing Strategy) (Ministry of Economic Affairs and Communication, 2008) that was relevant at the time of the observed subsidy programme does not explicitly address regional or energy aspects. However, there are some support mechanism designed to aid large families. Energy poverty as a challenge is not mentioned.

Energy policy that should regard the housing–regional development nexus is addressed in the National Energy Management Strategy through 2020 (Energy Strategy) (Ministry of Economic Affairs and Communication, 2009). Although we could presume that in this more specific national strategy links between energy and other policies are more clearly expressed, there are unfortunately no connections built into this document between national energy, housingpolicy, regional policy, nor social equity.

The updated version of the Regional Strategy for 2015–2020 (Estonian Ministry of the Interior, 2014) is more conservative about

Table 2
Grant application criteria.
Source: Prepared by authors using information from Fund KredEx.

Requested grant amount	Energy conservation rate	Energy performance class	Threshold
15%	20–30%	E	No criteria
25%	40%	D	Façade and roof insulation, new windows, renovated heating system
35%	50%	C	All previous criteria, plus heat recovery ventilation system

spatial notions of balanced development and has softened the strict comprehensive goal of ubiquitous equal opportunities. Instead, regional differences should be connected to varying opportunities. This, however, should not legitimise grant applications only for the regions and social groups that are more capable or have higher financial capacity. While all versions of Regional Strategy have direct policies about energy sector development, there are no references to housing development strategy. This is a lost opportunity, as housing quality affects the quality of life in all regions, which is strongly emphasised throughout all versions of Regional Strategy. Moreover, it is evident that housing has not been considered to be a part of EU regional policy (Tosics, 2008).

In the early 2010s, the central government attempted to reduce the number of sectoral strategies in order to have a better general overview of goals and the means of achieving them; this aim, however, has mostly been renounced but the impact still remains. For example, after the evaluation of the Housing Strategy's progress and despite the fact that a new version was already prepared, the central government decided to abandon the new Housing Strategy for the following period. Instead, it was suggested that the Housing Strategy should be part of a broader effort. Interestingly, this wider view was the new version of the Energy Strategy.

The main reason to abandon the Housing Strategy and to integrate it with energy policy was not related to the aim to reduce sectoral strategies, although it was a significant argument at the time, but the very idea that housing policy was mostly regarded as a panacea for inefficient energy use in the residential sector. We suggest that the EU2020 energy goals, along with the strong involvement of energy specialists in policy design, reduced the importance of energy efficiency to the level that a comprehensive Housing Strategy was regarded as irrelevant.

The new version of the Energy Strategy, which has recently been officially adopted (10.2017), is a significant improvement of the previous version and considers the existence of all related sectoral strategies including the Spatial Plan 2030 and the Regional Strategy. However, it is still a techno-economic view that constricts housing policy into a narrow energy-efficiency framework and addresses broad regional policy goals like energy supply, energy transmission, and energy security. The fundamental failure of the new strategy is that housing and energy renovation is addressed regardless of location.

It has been declared that the strength and extent of state-level regional policy have decreased since Estonia joined the EU (Raagmaa et al., 2014); we argue that this is also the reason why connections between regional, energy and housing policies are weak (Fig. 1). No region of Estonia is declared to be hopeless, and energy-efficient housing renovation is consequently expected to happen everywhere.

3.2. Renovation subsidy programme in Estonia

In order to foster renovation activities and meet EU carbon goals, member states have designed incentive programmes. Next, against the policy backdrop in the previous section, we introduce the energy efficiency subsidy programme and the applications criteria which is the basis of our empirical study.

Prior to 2009 (almost 20 years after socialist housing construction programmes were terminated), only a small number of residential buildings in Estonia were renovated using contemporary techniques. Mostly urgent repairs like roof replacement were undertaken; sometimes the buildings walls (usually windowless sides) were insulated or windows were replaced. Energy efficiency developed as an important agenda in Estonia in 2009 after ambitious CO_2 emissions reduction goals were established in a renewable energy directive (Council Directive 2009/28/EC, 2009) and elaborated in a recast of energy performance buildings directive (Council Directive 2010/31/EU, 2010).

A more comprehensive housing renovation subsidy programme (known as KredEx scheme) was established in 2010 with a budget of 37.7 million euros for grants. This programme was financed with CO_2 emissions trading funds (a mechanism of the Green Investment Scheme that allows sale of Assigned Amount Units (AAU) to Kyoto protocol parties possessing a deficit in carbon emissions allowances), while the funds raised may be spent only on projects that further reduce carbon emissions

Apartment buildings with more than two apartments were eligible for grants. A grant could be used for all energy conservation work and applied to the total cost of the project. The grant amount depended on three criteria: 1) the estimated energy reduction (which was required to be calculated by certified energy auditors); 2) the class of energy performance certificate (EPC); 3) threshold criteria was required to achieve in order to apply for a larger grant amount (Table 2).

The subsidy was handled centrally by Fund KredEx. Although apartment associations were encouraged to apply for subsidy, the complexity of technical, financial and economic burden of renovations was left to community members to address. Local authorities had no influence over the subsidy handling. The first subsidy period concluded in September 2014 with the end of the subsidy budget. During that time, the programme granted renovation subsidies for 661 unique apartment buildings. While the grants covered on average of 25% of the overall expenses (total investment for energy renovation was 151 million euros), apartment associations had to acquire the remaining finances from commercial banks. Even at the beginning of the subsidy programme, when Fund KredEx also provided soft loans (before commercial interest rates lowered), the large role of commercial banks made this subsidy scheme competitive.

The subsidy programme had no specific objectives intended to aid low-income and energy-poor families or regions where the proportion of these families is high. The programme was considered an equal access opportunity, suggesting that everyone has an equal starting position to apply for a grant. The programme was considered a success mainly due to certain techno-economical dimensions which provided high-quality design and construction and follow-up monitoring based on scientific (technological) knowledge (Kurnitski et al., 2014; Kuusk and Kalamees, 2016a, 2016b).

4. Empirical study

4.1. Estonia's regional development and housing context

Estonia provides a compelling case for investigating renovation distributions for two key reasons. First, the form of ownership and occupation of apartment dwellings is remarkably homogenous: the private home ownership rate is 96%, the owner occupied rate is 82%, and

rental market is small (7.3% market and 1.7% social (Pittini et al., 2017). Second, the energy renovation programme establishes equal conditions for applicants, and the sole responsibility for the renovation initiative belongs to the apartment owner associations. These conditions exclude many uncertainties that must be otherwise carefully addressed, making our analysis framework rather robust.

In 2014, Estonia's 15 counties were divided into 215 municipalities including 30 cities. There were 21,401 apartment buildings containing more than two flats built before 1990 (90% of all apartment buildings) (2011 Census). Over half of those buildings (64%) are in cities and 36% are in rural municipalities. The first large socialist residential estate projects were launched in the 1950s and the final projects were terminated in the early 1990s. Due to the technologies applied during their construction, all these apartment buildings are now targets for energy efficiency renovation programmes; urgent renovation is necessary regardless of energy improvements. Every community of residents or owners in an apartment building can form a non-profit apartment association to collectively manage the building. There were 10,181 registered apartment associations in 2014. In fact, the potential for applying public subsidies and applying commercial loans could not have been comparable in different regions because the frequency of apartment association formation has varied. In lagging regions in particular, where people have lower incomes and fewer resources, the motivation of community members for cooperating in housing maintenance and renovation has been more limited. In many peripheral settlements, viable apartment associations were missing until recently (the formation of an apartment association was made compulsory in Estonia by law in January 2018).

4.2. Data and analysis methods

Our analysis unit is an apartment building that includes more than two apartments and was built before 1993 (N = 21,401). We used the same criteria that Kredex has established in its eligibility rules. The main problem with this analysis unit is the uncertainty of abandoned or soon-to-be abandoned buildings. As the renovation grants distribution is compared against the total housing stock in apartment buildings, it is critical to use the actual number of occupied buildings, otherwise we might overestimate the potential capacity of renovations. Unfortunately, there are only estimates of abandoned buildings (DTZ, 2013). To overcome this uncertainty we use 2011 census data and exclude all buildings which were classified empty or more than half vacant. This step in our research reduces the analysis units by about 10%, resulting in 19,720 apartment buildings in the dataset. The number of municipalities we use is 208; we exclude seven municipalities (mostly small islands) from our analysis because there are no such apartment buildings that can be renovated.

Our data originates from a renovation grants database and the national statistical database. Renovation subsidy data is extracted from the Fund KredEx database. There were 661 unique buildings in the KredEx database which were subsidised during the 2010–2014 grant period for energy renovations. Using the buildings registry, we estimate approximately 10% of all major renovations of apartment buildings were carried out outside of the subsidy programme within that time.

We first estimate the grants distribution as the share of renovation grants [*SH_REN*] in a region in this way:

$$SH\_REN = \frac{Number\ of\ Renovations\ in\ Region}{Number\ of\ Total\ Renovations} \times 100$$

However, the apartment housing stock in Estonia is not distributed equally in regions. There are more apartment buildings in cities and in rural areas where industrial labour was required. Therefore, we next analyse the distribution of renovation grants considering the number of apartment buildings in a region. Doing so allows us to compare the potential for renovation with renovation in practice. We estimate the relative share of renovations [*REL_SH_REN*] in a region as follows:

$$REL\_SH\_REN = \frac{Number\ of\ Renovated\ Apartment\ Buildings\ in\ Region}{Number\ of\ Apartment\ Buildings\ in\ Region} \times 100$$

The relative share of renovations in some regions can be small and therefore difficult to interpret. Furthermore, it is not a practical measure for showing the distribution and illustrate possible inequalities between regions. To overcome this limitation, we devise a renovation proportionality index [PRI] which can be employed on a regional (county or municipality) level:

$$PRI = \frac{Share\ of\ Renovated\ Apartment\ Buildings\ in\ Region}{Share\ of\ Apartment\ Buildings\ in\ Region}$$

The [*PRI*] is mathematically the same construct as [*REL_SH_REN*] but it has no unit. Values of [*PRI*] higher than 1.0 suggest that there are proportionally more renovated apartment buildings considering the total stock of apartment buildings in a corresponding region.

We first test our assumption of inequality at the county level using the proportionality index. Our main analysis in explaining renovation inequalities is based at the level of municipalities. The data for this originates mostly from the Estonian Statistical Bureau. We select variables that can illustrate the level of regional development of the municipalities. Absolute values of the variables are adjusted to reflect the relation to the municipality size using population size to obtain per capita values. Descriptive statistics of the variables are presented in Table 3. Variables 1–5 illustrate the number of renovations in different ways. Variables 6–32 are socio-economic indicators of the municipalities. The Demographic Workforce Dynamics Index [*DEM_WDI*] expresses the ratio between two population groups: 5–14 year olds and 55–65 years old. If the ratio is greater than 1.0 there will be more workers in the next decade than workers who are potentially leaving the job market because of their age. The variable [*RE_VALUE*] represents the median price per square meter of real estate transactions (only for apartment buildings) between 2010 and 2014 and it is acquired from the public database of the Estonian Land Board. Dummy variables are used to distinguish between municipality types (urban = 1; rural = 0, variable [*CITY*]) and to identify the three largest towns [*BIG_CITY*]. Data for apartment associations [*SH_APARTASS*] is obtained from the Estonian Business Registry.

Next, we investigate relationships—between the proportionality index and socio-economic variables of the municipalities—using canonical correlation analysis (CCA), which determines correlations between two sets of data (Hotelling, 1936). For both datasets, CCA is used to identify linear combinations of variables that have maximal correlation with another dataset. The number of such linear combinations depends on the smallest number of variables in either dataset. We use CCA unconventionally as we have only one variable [*PRI*] in the first dataset. The second dataset consists of socio-economic variables for municipalities. Therefore, we can obtain only one linear combination. CCA is useful because it provides more insights about the relationships between dependent and independent variables than conventional bivariate correlation could extract. CCA can calculate the correlation and its importance in the canonical model, allowing us to exclude insignificant variables in further analysis. Furthermore, we can calculate the canonical variable—a 'super-variable'—that captures the essence of all variables in set two. CCA is applied using IBM SPSS v23 built-in function.

As an extension of CCA, we specify a multiple linear regression model to understand how and to what extent socio-economic variables can explain the distribution of renovation subsides in municipalities. We use CCA to determine the significance of variables applied in the regression analysis. To conduct the analysis, we use IBM SPSS Statistics v23 and MS Excel 2013. Geographical analysis and illustrations are created with ArcGIS 10.2.2.

Table 3
Descriptive statistics (N = 208).
Source: Prepared by authors using information from Fund KredEx, Building registry, Business registry, National census database, and Estonian Land-Board.

Variable	No	Coding	Min	Max	Mean	SD
Share of multiapartment buildings form building stock	1	SH_MAB	0%	27.4%	0.5%	2.0%
Any number of renovations = 1; no renovations = 0	2	REN_binary	0	1		
Share of renovated buildings from all renovations	3	SH_REN	0.00	0.47	0.00	0.03
Relative share of renovated buildings	4	REL_SH_REN	0.00	0.22	0.02	0.04
Renovation proportionality index	5	PRI	0.00	6.53	0.58	1.13
Share of apartment associations	6	SH_APARTASS	0.00	2.00	0.40	0.29
Percentage of Estonian speakers	7	LANG_EST	2.18	99.66	87.54	20.78
Percentage of Russian speakers	8	LANG_RUS	0	96	11	20
Real-estate transaction price (EUR/m2, median, 2010–14)	9	RE_VALUE	0	1133	195	236
Relative poverty	10	REL_POVERTY	5.90	40.40	21.38	6.42
Gini coefficient of income inequalities	11	GINI	0.23	0.27	0.24	0.01
Share of unemployed	12	UNEMPLYMNT	1.60	9.20	3.93	1.45
No. of active companies per capita by annual report	13	COMPANYS_Pcap	9.51	119.13	41.68	16.10
Companies' sale income per capita (EUR)	14	COMP_SALES_Pcap	0.78	389.50	16.32	29.59
Demographic workforce dynamics index	15	DEM_WDI	0.23	2.07	0.75	0.28
Population size, 2015	16	POPUL	277	413,782	6275	29,785
Population change percentage (2011–2015)	17	POP_CH_11_15	− 48.76	156.80	− 3.15	16.96
Dummy variable - municipality type (city = 1; rural = 0)	18	CITY	0	1		
Dummy variable - three biggest cities (big city = 1; other = 0	19	BIG_CITY	0	1		
No. of real-estate transactions per capita	20	RE_TRANS_Pcap	0.00	163.72	32.04	24.82
No. of workplaces per capita of 15–65 year olds	21	WORKPLACES	0.21	1.87	0.55	0.24
Economic diversity: No. of business areas	22	ECON_DIV	12	265	71	41
Percentage of voters in local elections	23	VOTERS	0.48	0.82	0.60	0.06
Municipality's capital assets per capita (EUR)	24	CAPIT_ASSETS_Pcap	300	6435	1859	861
Costs for education per capita (up to 19 year olds) (EUR)	25	COST_EDU_Pcap	968	6407	2582	689
Costs for social security per capita (EUR)	26	COST_SOCI_Pcap	22.03	618.96	85.15	70.48
Costs for leisure activities per capita (EUR)	27	COST_LEISUR_Pcap	43	752	132	78
Costs for economy and environment per capita (EUR)	28	COST_ECON_Pcap	47	1090	208	144
Salaries and pensions (EUR per capita)	29	SALARIES	2899	7658	4658	727
Income support (EUR per capita)	30	INCOME_SUP_Pcap	0.53	72.33	16.66	13.22
Municipality budget income per capita (EUR)	31	BUDG_INC_Pcap	0.78	3.99	1.21	0.38
No. of pupils per capita	32	PUPIL_Pcap	0	330	91	37

4.3. Research limitations

Since our aim is to provide a regional-level overview of grant distribution and explain renovation activities on a macro-level, we focus on general socio-economic indicators. We acknowledge that there are several community-dependent factors (internal barriers for renovation) which contribute to the speed and success of renovations. For example, poor organisational capacity, general scepticism, a lack of trust, and divergent values are barriers which describe a community. We assume that internal barriers, such as investment resistance, are present in every building. Although we have no clear evidence how such barriers are geographically distributed, our field experience suggests that internal barriers are more prominent in peripheral regions where residents predominate from lower socio-economic groups. Furthermore, the rate of apartment association formation is lower in peripheral regions compared to core regions. Therefore, we assume that overall resistance and willingness to renovate has little significant impact on our results.

5. Results and discussion

5.1. Distribution of renovation grants

Our first empirical task is to analyse the distribution of renovation grants regionally and test our inequality assumption. Table 4 shows the distribution of renovations and number of apartment buildings that are eligible for the subsidy programme. The largest number of apartment buildings (38%) and renovations (60%) are in Harjumaa County (HAR) which includes the capital city of Tallinn. Tartu County (TAR) and Ida-Viru County (IVIR) both have about 10% of the apartment building stock, however there is a large gap between the distributions of grants in those counties: 16% and 1.5%, respectively. Hiiu County (HII) is an island that has a small number of apartment buildings and only one was renovated using the subsidy programme.

We also observe that the grant distribution during the period of our study does not follow a normal mathematical curve as might be expected (cf. Rogers, 2003). The renovation applications submission rate was relatively high within the first 12 months of the start of the grant scheme (32% of the total number of applications were received during this time period). The number of applications peaked in 2012, two years after the grant scheme announcement. By that time, 82% of subsidy applications were already submitted. There was no significant difference between regions and the grants' distribution dynamics—it followed a comparable pattern in every region.

Table 4 is ordered by renovation proportionality index (PRI), the ratio of renovation distribution of apartment housing stock in each county. A value of 1.0 suggests that the subsidy distribution and the number of apartment buildings in that county are proportional. There are two counties that have acquired more grants relative to the apartment building stock, Harju County (HAR, *PRI* = 1.72) and Tartu County (TAR, *PRI* = 1.25), where the country's two largest cities are located. Rapla County (RAP) has a [*PRI*] slightly less than 1.0 (*PRI* = 0.91) but all the others have acquired renovation subsidies significantly less than the potential of apartment building stock would suggest. Fig. 2 illustrates renovation subsidy distribution geographically.

It is clear that renovation subsidies are not distributed equally among counties. Between municipalities the contrast is even higher. The [*PRI*] value varies between 0 and 6.53 (mean = 0.582; SD = 1.12; n = 208). There are 127 municipalities which have not acquired any grants and 42 municipalities have [*PRI*] value over 1.0. Therefore, our assumption of unequal distribution of grants is confirmed.

5.2. Explaining the distribution of renovation grants

Our second aim is to identify characteristics that explain the distribution of grants. Our data includes geographical locations of

Table 4
Regional distribution of renovation grants.
Source: Prepared by authors.

County	Code	Number of apartment buildings	Share of apartment buildings (SH_AB)	Number of renovations	Share of renovations (SH_REN)	Renovation proportionality index (PRI)
Harju	HAR	6950	35.2%	400	60.5%	1.72
Tartu	TAR	2560	13.0%	107	16.2%	1.25
Rapla	RAP	621	3.1%	19	2.9%	0.91
Pärnu	PÄR	1580	8.0%	41	6.2%	0.77
Lääne-Viru	LVIR	1158	5.9%	27	4.1%	0.70
Valga	VAL	557	2.8%	9	1.4%	0.48
Lääne	LÄÄ	449	2.3%	7	1.1%	0.47
Põlva	PÕL	432	2.2%	6	0.9%	0.41
Jõgeva	JÕG	578	2.9%	8	1.2%	0.41
Viljandi	VIL	1110	5.6%	14	2.1%	0.38
Saare	SAA	403	2.0%	5	0.8%	0.37
Hiiu	HIIU	153	0.8%	1	0.2%	0.19
Järva	JÄR	641	3.3%	4	0.6%	0.19
Võru	VÕR	546	2.8%	3	0.5%	0.16
Ida-Viru	IVIR	1982	10.1%	10	1.5%	0.15
	TOTAL	19,720	100.0%	661	100.0%	

renovated buildings and descriptive data for the municipalities, permitting us to extend and elaborate the investigation. Using national statistical data, we gathered 27 socio-economic indicators that describe the municipalities' regional differences (variables 6–32 in Table 3). Our dependent variable is the value of the proportionality index [*PRI*].

We define two datasets for CCA. The first dataset consists of one dependent variable [*PRI*] and the second dataset includes 27 independent variables (socio-economic indicators and share of apartment buildings [*SH_AB*]). The canonical correlation between the two datasets is 0.694 ($p < 0.01$). The square of canonical correlation value is 0.482, suggesting that 48.2% of the variation in the first dataset is explained by the variables in the second dataset. Standardised correlation coefficients (weights for linear combination) for the second dataset express the contribution of each variable to the canonical variable (Table 5). There is no standard test for the significance of canonical correlation coefficients. However, the canonical loadings can be used to determine such significance manually. If the value of the canonical loading is greater than 0.3, the canonical correlation coefficient for each variable can be regarded as significant. CCA extracts four significant variables that explain the variation of renovation proportionality index [*PRI*]. The most influential is [*RE_VALUE*] which shows positive correlation (0.664) and the second is [*UNEMPLYMENT*] which is negatively correlated (−0.329). The third and fourth influential variables, [*SH_APARTASS*] and [*DMI_WDI*] are both positively correlated [(0.231) and (0.681), respectively] against the first dataset (dependent variable). For testing purposes, we performed CCA a second time for these four

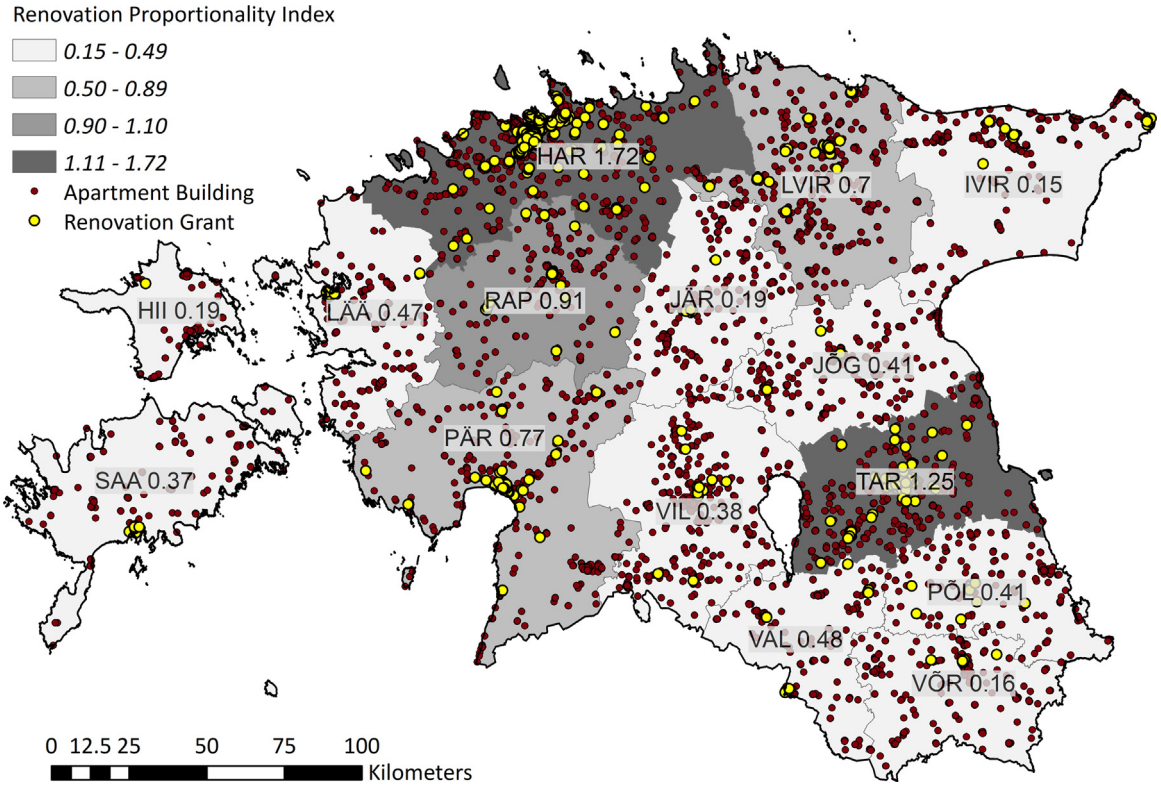

Fig. 2. Renovation grant distribution within regions of Estonia, Source: Prepared by the authors using information from Fund Kredex, Estonian Land-Board, and Buildings Registry.

Table 5
Canonical correlation coefficients and canonical loadings.
Source: Prepared by authors.

No.	Variable	Standardized coefficient	Canonical loadings
1	SH_AB	− 0.608	0.128
6	SH_HOUSASS	0.231**	0.532*
7	LANG_EST	− 0.980	0.063
8	LANG_RUS	− 1.159	− 0.065
9	RE_VALUE	0.664**	0.892*
10	REL_POVERTY	0.098	− 0.663*
11	GINI	0.022	0.238
12	UNEMPLYMNT	− 0.329**	− 0.543*
13	COMPANYS_Pcap	0.019	0.632*
14	COMP_SALES_Pcap	0.138	0.262
15	DEM_WDI	0.168**	0.795*
16	POPUL	0.557	0.166
17	POP_CH_11_15	− 0.007	0.195
18	CITY	0.049	0.103
19	BIG_CITY	− 0.120	0.092
20	RE_TRANS_Pcap	− 0.052	0.222
21	WORKPLACES	− 0.063	0.496*
22	ECON_DIV	0.093	0.622*
23	VOTERS	− 0.021	0.053
24	CAPIT_ASSETS_Pcap	− 0.002	− 0.070
25	COST_EDU_Pcap	0.227	− 0.145
26	COST_SOCI_Pcap	0.040	− 0.161
27	COST_LESUIR_Pcap	− 0.028	− 0.067
28	COST_ECON_Pcap	− 0.025	− 0.100
29	SALARIES	0.051	0.701*
30	INCOME_SUP_Pcap	0.184	− 0.281
31	BUDG_INC_Pcap	− 0.098	− 0.176
32	PUPIL_Pcap	− 0.093	0.198

* Significant loadings (value over 0.3).

** Important variables in linear combination based on absolute value over 0.1 and on loadings significance.

influential variables in the second dataset. The resulting explanation of canonical correlation dropped only 4 percentage points compared to the first CCA attempt ($r = 0.668$; $r^2 = 0.447$, $p < 0.01$), suggesting that these four variables capture the essence of variations in our dependent variable and it is rational to include these variables in further multiple variable analyses.

Next, we specify a multiple linear regression to predict dependent variable [*PRI*] using four socioeconomic variables [*RE_VALUE*], [*UNEMPLYMENT*], [*SH_APARTASS*] and [*DMI_WDI*] that were selected using our CCA process. A statistically significant regression relationship is found ($p < 0.01$), with R^2 of 0.441. Regression coefficients are presented in Table 6. As in CCA, the most influential variable is [*RE_VALUE*] and the only negative effect occurs from [*UNEMPLYMENT*].

Additionally, we specify a second regression model with the same conditions as the first but removing nine outliers that had standardised residual value higher than 2.0. Doing so, the regression model improved significantly with an R^2 value of 0.601 ($p < 0.01$). Nine outliners included municipalities which scored low in regional development but still had acquired renovation grants. This means that in reality there can be exceptions to the general rule that low socio-economic variables indicate no renovations. This phenomenon calls for further elaborated investigations to understand the capacity and motivation of those associations that managed to acquire renovation grant despite unfavourable conditions.

Table 6
Regression results.
Source: Prepared by authors.

	Unstandardized coefficients		Standardized coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	− 0.087	0.302		− 0.287	0.774
SH_HOUSASS	0.557	0.236	0.142	2.362	0.019
RE_VALUE	0.002	0.000	0.355	4.392	0.000
UNEMPLYMNT	− 0.124	0.046	− 0.160	− 2.717	0.007
DEM_WDI	0.803	0.305	0.197	2.630	0.009

5.3. Discussion

Results show that competition-based renovation subsidies are distributed unequally within Estonian regions. This finding is significant, as there are regions that differ in acquiring subsidies by a factor of 10 while their housing stock is approximately the same size. This result is consistent with a recent study in which unequal subsidy distributions were identified within the capital region of Bucharest (Turcu, 2017). However, the subsidy distribution mechanism is different in Romania compared to Estonia. Estonia has established a central distribution system using Fund KredEx as a distributor and subsidies upon request of apartment associations. In Bucharest, state subsidy funds are distributed by municipalities that decide which buildings will be renovated, and apartment associations have little influence over the renovation process. Interestingly, both subsidy distribution mechanisms result in unequal distributions of grants.

Subsidy distribution differences in Estonia are strongly related to regional development indicators, such as real estate value and unemployment rate. Higher real estate value and lower unemployment rates increase the probability of acquiring renovation grants. In other words, successful regions are more capable of acquiring public finances, thus exacerbating existing differences. This trend works against regional aims to decrease regional and societal polarisation. Interestingly, the post-impact assessment report of the 2010-2014 KredEx housing renovation programme acknowledges the regional differences of grant distributions, however it fails to identify and address this phenomenon as a regional development concern (Lauri, 2014).

The empirical analysis shows that most influential indicator that relates to unequal subsidy distribution is the value of local real estate, which alone explains about 40% of total variation in renovation distribution between regions. We interpret the influence of real estate value on renovation likelihood in three ways: (1) low real estate values reflect a depressed local economy (poverty) which prevents investments in housing; (2) low real estate values reduce the likelihood of loan acquisition for renovations in depressed places; (3) low real estate values suggest a feeling of hopelessness, and shrinking peripheral regions may engender a lack of motivation for change among community members.

Unemployment rates indicate the overall economic climate of a region. A lack of adequate income prevents investment in housing renovation. Our results confirm this through negative correlations between renovation likelihood and unemployment.

We observe that the existence of apartment associations is positively correlated with housing renovation. Although associations were not mandatory in Estonia during the subsidy programme, there were associations established in about half of the apartment building stock in 2014. As a rule, only apartment associations could apply for grant funds for renovation. Therefore, some communities were in a better starting position if they had an active association already established at the time of subsidy programme announcement. Experienced associations reflect the social co-operational capacity of community members of an apartment building. An experienced association can work more efficiently regarding decision-making about a potential apartment building renovation because of accumulated social capital that is considered a significant factor in collective action generally (Putnam, 1995) and in renovation action specifically (Cirman et al., 2013). This in turn may have a positive neighbourhood effect: comprehensively renovated apartment buildings in a neighbourhood serve as visual advertisement for renovation programmes and can demonstrate to community members that capacity is present locally for success in the application

process.

The demographic workforce dynamics index is a future-oriented indicator and reflects potential prosperity of a region by forecasting growth or shrinkage of the labour market. Its positive correlation with renovation activity is not surprising. However, this indicator is the least influential among statistically significant variables in our analysis.

The grant distribution rate within the four-year subsidy period demonstrates two important insights. Firstly, the early adopters, who in theory should reflect a slow start (Rogers, 2003) were quick in their decisions and thus conquered a surprising two thirds of the total amount of applications within the first year. However, to reduce the complexity of the decision-making process, early adopters were not very ambitious about their energy conservation goals. Secondly, majority of grant applications (82%) were submitted within the first 24 months. This fact emphasises the competition effect of the renovation programme and indicates that more competitive communities (i.e. apartment associations with greater administrative capacity and being in favourable location) can take immediate advantage of subsidised investment opportunities. Interestingly, the speed of renovation decision by apartment associations' is not correlated with the factors that indicate socio-economic status of the community and technical properties of a building (Lihtmaa, 2014). The spatial correlation between adoption speed and building locations is yet to be determined.

6. Conclusions and policy implications

The distribution of grants in an energy programme can produce important social consequences and critical effects on regional development. In examining outcomes from a state-funded energy programme in Estonia dictated by market mechanisms and lacking social criteria and regional balancing in the disbursement of subsidies, we find clear evidence that the distribution of grants for energy-efficient housing renovation subsidies is unequal both within counties and within municipalities. The relative share of renovations relying on KredEx subsidies in a region is related to the socio-economic indicators of the region. Real-estate transaction prices explain approximately 44% of the variation in relative share of renovations. Thus, real estate value is a reasonable basis for further research for example on the role of commercial banks in financing renovation projects.

Clearly, residents in economically stronger and diverse regions are better equipped to acquire subsidies and improve the quality of housing, leaving residents in weaker regions behind in unrenovated dwellings with lesser potential for enhancing their property value. This systems' trap amplifies urbanisation, energy poverty, segregation and, most importantly, societal polarisation.

An important task of the climate change agenda is to reduce carbon emissions, which can be achieved by emphasising energy efficiency and introducing renewable energy. Both of these practices are consistent with core objectives of the EU energy policy. This goal is important, measurable and even financed by the EU, rendering it a strong driving force of member states' individual energy policies. However, while shaping this policy there are additional aspects besides carbon targets that should be addressed. For example, energy efficiency incentive programmes can shape regional development by affecting the quality of housing stock in certain locations. Our analysis demonstrates that in Estonia, despite formally equal opportunities to access the programme, renovation grants are unequally distributed between regions. A confirmed relation between the relative volume of grants distributed and economic prosperity suggests that, without social considerations and lacking a regional strategy in grant distribution, the outcomes deepen pre-existing regional inequality. This energy programme outcome is in direct opposition to regional development policy. Consequently, we argue that it is a missed opportunity to address regional disparities with policy instruments made available in energy efficiency measures.

We might ask why Estonia—along with Bulgaria, Hungary, Spain, and Italy, four countries possessing higher poverty risks than the EU average—failed to integrate social goals or criteria, which could mitigate regional inequalities, into building renovation policy. We suggest that a lack of cross-policy co-operation limited the emergence of such problems and challenges in the first place, since energy-efficient apartment building renovation is usually considered a strictly technical and financial practice. Furthermore, the EU Energy Efficiency Directive does not explicitly state that member states must address inequality and social asymmetries while shaping energy incentive programmes. A failure to perform ex-ante assessment for renovation grants programme in Estonia—although there are readily-available tools such as Strategic Environmental Assessment, Policy Impact Assessment and Social Impact Assessment—ensured that the failure of national energy policy to address regional disparities remained masked.

In addition to incompatible aims between energy policy and regional policy, we can also argue that the climate change agenda could have an effect on other sectoral policies too. Findings from our analysis of various Estonian strategic policy documents suggests how national housing policy has been marginalised within the context of carbon conservation aims. Addressing energy efficiency simply as a techno-economic exercise, the already powerless neoliberal housing policy was reduced to the extent that a distinct strategy was considered irrelevant and housing policy was integrated with the energy strategy. The final formulation of the housing policy, as it is presented in the energy strategy, provides a clear indication that energy policy (with the effective influence of energy specialists) has overpowered the social aims of housing policy. This insight presents us with a lesson about the strength and influence of the climate change agenda (and its generous financial support system).

We acknowledge that the main goal of EED is to mitigate climate change while regional and social disparities are generally addressed in other sectoral policies (e.g. cohesion policy) which are not regulative like directives but rather disseminate awareness and provide financial motivation to foster mitigation of disparities in member states. However, as it is evident form our case study, such indicative polices have not influenced the development of the renovation programme in Estonia.

To improve equity in disbursement of subsidies for housing renovation, we might suggest several broad policy recommendations—including cross-policy co-operation and ex-ante assessments of intervention programmes—however, we recognise that it is not straightforward to universally introduce this practice for all member states of the EU directly. It takes time for policy-making practice to adapt to the energy transition concept and to consider the subtle externalities of the intervention programmes. We therefore focus on two key recommendations at the EU level which in turn could foster the change in member states' practice.

First, the EU Commission should articulate an aim to address social equality and balanced regional development in EU energy-related polices. Our analysis confirms a lack of explicit equality statements in EU energy policy. This could be why some member states have not introduced territorial nor social aims in renovation strategies. We suggest that it is necessary for the Commission to build awareness within its own organisation for articulating relationships between energy and regional policy. Next, the EU legislation should convincingly convey the importance of equality in energy policy of member states. And finally, the Commission should take full advantage of specific spatially-driven ex-ante evaluation tools to design more inclusive regulation and effective communication. We note a recent advance in impact assessment, known as Territorial Impact Assessment (Fischer et al., 2015), which is designed specifically to evaluate policy initiatives on a higher governmental level (such as EU directives) to improve the territorial considerations of those initiatives. We believe that as the Commission's rhetoric changes and the emphasis shifts towards social and regional aspects in energy policy, member states will comply.

Second, there is an urgent need to raise awareness about the territorial impacts of national policy-making generally and in

energy policy specifically. As EU-level legislation development, and especially the recast of directives, is a time-consuming process, more effective immediate actions are required to influence national policy making. Our empirical study suggests that overlooked spatial factors and the current general atmosphere of techno-economic discourse in Estonia has rendered carbon reduction aims one-sided. As local energy policy experts and programme developers are becoming more aware of the consequences of disparities and how inequality affects general development, they might also be able to design effective measures. As a broad approach to build awareness of territorial impacts, we therefore suggest the Commission include explicit equality statements in communications with member states. More specifically, we propose to focus direct communications toward such member possessing higher poverty risk rates, undeveloped renovation strategies, or growing regional disparities.

Additionally, we suggest that the EU Commission require member states to address equality and spatial aspects within the reports of mandatory energy efficiency action plans and also provide targeted guidelines to fulfil this task. We recognise that additional requirements from the Commission are generally not welcomed by member states, however, this could be one of the most effective measures for creating awareness of social and territorial impacts that are not obvious in current policy development discourse. In turn, this requirement could foster co-operation between various governmental bodies and motivate the application of novel ex-ante assessment tools to anticipate the externalities of intervention programmes. Finally, it could be useful to introduce additional assessment criteria to evaluate the quality of equality measures in energy efficiency action plans in order to establish a useful feedback loop.

Regarding the approach taken by individual countries, we suggest that policy makers consider abandoning market-based competition-driven renovation programmes and establish demand-based approaches instead. For more equal distribution of public finances, regional priorities should be articulated and vulnerable groups should be prioritised. Several strategies can help mitigate disparities, including establishing regional quotas, differential subsidy rates for growing and shrinking regions, additional finances for vulnerable groups, and inclusion of local authorities in grant distribution decisions. We recommend providing free professional advice and consultation for apartment associations, especially for those who are developing their capabilities. Also, dissemination of information about best practices can reduce investment resistance and prepare community members for meaningful discussion.

We conclude that, on the one hand, regional socio-demographic characteristics and economic performance explain a regionally unequal distribution of renovation grants. On the other hand, the availability of subsidies can affect the trajectory of a community and its housing stock (reflected in socio-demographic and economic measures). We observe a reinforcing feedback loop of deprivation of human capital in certain regions, an outcome which is contrary to regional development strategy. As Energy Efficiency Directives force compliance with EU carbon targets, there will be greater pressure to increase the pace of housing renovation, regardless of the beneficiaries and location. For Estonia and other similar countries, it is not too late to improve regulations to better address inequality in housing renovation policy, because a majority of apartment buildings await renovation.

Acknowledgements

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Marie Skłodowska-Curie grant agreement No. 655601 and Institutional Research Grant no. IUT2-17 of the Ministry of Education and Science Estonia. The authors acknowledge helpful contributions to the research from Coline Dalimier, Tiit Tammaru, Annika Väiko, Tanel Kaart, Targo Kalamees and Märt Möls. Fund KredEx and the Estonian Land Board provided data.

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