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Policy instruments for energy-efficient renovations at district level

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Abstract. IEA EBC Annex 75 aims to investigate, amongst other policy for reducing carbon emissions and energy use in buildings at district level, combining both energy efficiency measures and renewable energy measures. Particularly policy instruments deployed at the local level targeting owners and investors could increase residential building renovation and renewable energy systems to a district scale. A desk and empirical research using 38 expert interviews from 8 European countries was used to investigate the use and development of various types of policy instruments, including regulations, incentives, communication and facilitating instruments. The research confirms interest of frontrunners to use or develop specific policy instruments further, such as enforcement of energy standards and inspections, financial incentives for district stakeholders and for groups of homeowners, renovation services and energy desks, digital communication and network meetings in districts. It also finds that low relative advantage for some stakeholders, lack of good examples, an incompatible legal or national framework and high complexity are serious risks that can further hinder adoption of energy efficiency and renewable energy systems in districts. Renovations at district scale including energy efficiency and renewable energy can benefit from adapted or improved regulations, incentives, communication and facilitation to better support renovations at district scale including energy efficiency and renewable energy systems.

1. Introduction

To meet the objectives of the European Green Deal, Europe will need to boost the environmental performance of buildings in its Member States. Roughly 85% of buildings in the EU were built before 2001 - and thus before the introduction of significant energy efficiency standards -, and it is expected that 85-95% of them will still be in use in 2050 [1]. Renovations are happening but as observed from the analysis results the rate is still too low in all countries. New reforms of the Energy Performance of Buildings Directive (EPBD) [2], as well as the Energy Efficiency Directive (EED) [3] are on the way and are expected to reshape and influence national decarbonisation strategies again in many ways. For instance, with the Minimum Energy Performance Standards (MEPS), a de facto energy renovation

obligation for the 15 percent worst performing buildings per country until 2030 as well as including the building sector in the European Union Emissions Trading System are being discussed.

The renovation of the existing building stock is to a high degree influenced by overarching legislature or strategies – be it on the national, regional or European level, for example through EU funding schemes, concrete legislation like in the EPBD [2] or EED [3], long-term national renovation strategies of Member States [4,5] and overarching strategic policy documents like the New Leipzig Charter [6]. The Charter promotes the district as an important action level for integrated urban transformation and emphasizes the local authorities' need for legal framework conditions, investment capacities, adequately skilled employees and a steering and shaping role. It also point to the need of national and regional urban policies to enable stakeholder dialogue, platform action, development or reallocation of national or regional funding and incentives for innovation [6].

District approaches supported by local authorities might help to upscale the number of renovations including energy efficiency measures and a switch to renewable energy systems (RES), and foster an integrated approach. In this framework, IEA EBC Annex 75 aimed to investigate cost-effective strategies for reducing carbon emissions and energy use in residential buildings at district level, combining both energy efficiency and renewable energy measures [7,8,9]. The methodology of the IEA EBC Annex 75 [8] addresses the cost-effectiveness of the renovation measures at district scale in the sense that main factors from district demo cases are presented to identify, for instance, the influence of the degree of decentralization of the energy systems and the balance between energy efficiency and RES. Calculated life-cycle-cost for 30 years, including investments, maintenance, and energy use help understanding, for example, if the implementation of RES in urban areas can be technically and economically significantly more appealing and reach a deeper decarbonisation in districts. The outcomes can contribute building up the vision.

On the other hand, the European Renovation Wave calls for "Placing an integrated participatory and neighbourhood based approach at the heart of renovation" [1]. Renovations at district level involve multiple stakeholders and additional complexity: they require various types of stakeholders to engage in a coordinated and interdependent way, not only in terms of financial investment but also regarding the development of knowledge, adapted processes and business models, particularly if energy efficiency measures on building envelopes and renewable energy grids are combined.

Within this framework it is important to understand how policies – and particularly policy instruments deployed at the local level - can increase renovation of residential building envelopes and renewable energy systems at district level. A specific subtask of IEA EBC Annex 75 dealt with this issue, and here present some key findings that were also elaborated in a final report on policy instruments. See [10] for more details.

2. Research approach

To approach this issue a desk research was first done to investigate what policy options local authorities in multiple European countries have to support residential building renovation at district level including energy efficiency and renewable energy systems, and what strengths and weaknesses are observed regarding the use of various types of policy instruments that can target owner-occupants. This resulted in an overview and first assessment of policy options at district level - such as enforcement of minimum energy standards, inspections and energy audits, financial incentives created by local authorities, planning and tendering for districts, organizing services for districts - such as renovation services and energy advice services for citizens -, communication support for districts and supporting emerging private and civic initiatives.

Additionally, workshops were held with local policy actors and other stakeholders to check the applicability of policy instruments in various countries:

- Spain: Workshop on renovation at district level towards nZEB, 27 March 2019, Laboratory for the Quality Control of buildings, Basque Government, Vittoria-Gasteiz. This workshop attracted regional and national stakeholders and IEA EBC Annex 75 experts to discuss general ideas.

- The Netherlands: Workshop on upscaling energy renovation to the district level, 25 September 2019, Faculty of Architecture and the Built Environment, TU Delft, Delft. This international workshop mainly targeted interaction between Annex experts and local policy actors which were sourced through collaboration with the Interreg 2 Seas project 'Triple-A' [11] and had the specific objective to identify promising policy instruments and business models for district level energy renovation.
- Switzerland: webinar on combining the heating and cooling potential of lakes, rivers and the sea with energy efficiency measures in buildings at district level, 23 September 2020, online. This workshop attracted regional and national stakeholders and IEA EBC Annex 75 experts to discuss a particular topic.

Next, empirical research investigated how eight selected promising policy instruments are assessed by stakeholders, also taking into account differences in perception by policy and non-policy actors. Frontrunners and actors experienced with or responsible for district action were interviewed to assess the current or planned use of policy instruments and the perceived importance and difficulty for implementation. 38 in-depth interviews from 8 countries (Austria, Belgium, Germany, The Netherlands, Portugal, Spain, Sweden and Switzerland) were carried out for this purpose. Results were also used to qualitatively analyse the possible role of national or regional authorities to support local authorities and district action, with the aim of providing recommendations to improve policies for combining energy efficiency and renewable energy systems at district scale.

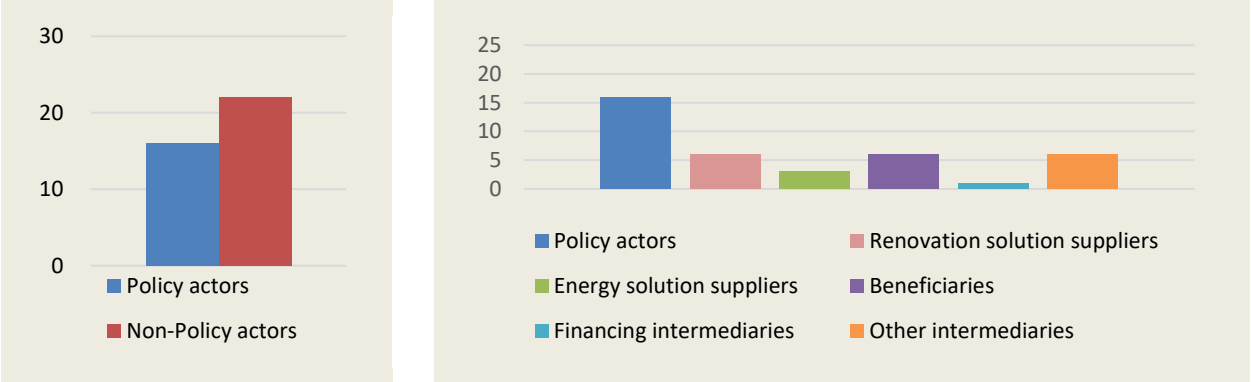

Figure 1. Number of interviewees per stakeholder category [10].

The empirical research is limited by the opinions of the interviewees. These interviewees were selected by Annex members assuming they have in-depth knowledge of the country framework and give a clear view of previous application, usefulness and feasibility of policy instruments from their perspectives. It has to be kept in mind that such perspectives give a comprehensive, yet not necessarily a complete picture of the situation in a country. The correctness of their statements was checked by Annex members; nevertheless, differences between perceptions and reality may persist, or statements may only apply to specific circumstances.

3. Research results

3.1. Policy options at district level

The desk research found that there are multiple ways in which (also local) authorities can strengthen the exploitation of energy efficiency and renewable energies in districts and inspire stakeholders to engage in residential building renovation at district level.

First, regulations and contractual arrangements might be needed to produce change in worst performing segments or to ensure change at a sufficient speed. If they are allowed to go beyond national standards, local authorities can for example enforce minimum building performance standards for the worst performing buildings, make a switch to renewable energy based heating systems mandatory, oblige building owners to connect to renewable energy based district heating systems, or use inspections and audits in districts to ensure the compliance with energy standards. However, such regulatory

competencies are not found in many countries on local level. Even if such competencies exist, policy actors often hesitate to resort to this instrument. Local authorities often wish to obtain additional support through funding to make sure additional costs for building owners are feasible for them and accepted by the implementing actors. Thus, policy actors usually hesitate to apply regulations and tend to either prefer incentives, communication and facilitation, or implement them as a part of a mix of policy instruments. Based on the expert interviews. local authorities in some countries prefer to support promising bottom-up district initiatives and emerging energy cooperatives that already benefit from stakeholder engagement instead of organizing top-down district planning, whereas others consider top-down energy planning as a driver.

Financial incentives supporting district planning, connections to district systems or groups of homeowners can have an impact and are considered to be useful in some countries. Furthermore, funds might be needed for stakeholder collaboration and cooperatives and for covering innovation and process risks. Local authorities emphasize their possible role for facilitating renovation at district scale. Interviewees point out the unique role local authorities may have for launching and coordinating renovation projects at district level, due to their complex nature, and for relieving the risks that private and/or civic actors take for building up such projects. However, renovation services for owners of multi-family buildings and for supporting stakeholders in districts are only still emerging. In this framework there might be a role for local energy desks to raise awareness and provide easy access of solutions to districts and building assemblies instead of individual buildings. Authority communication channels can support awareness raising for district campaigns, but also a better follow-up of data is needed to assess collaborative action and to verify targets.

3.2. Stakeholder viewpoints on policy instruments

Interviewees were asked to score in a 5-point Likert scale the current use, importance, and ease of use of (interest for developing) 8 specific policy instruments (see figure 2).

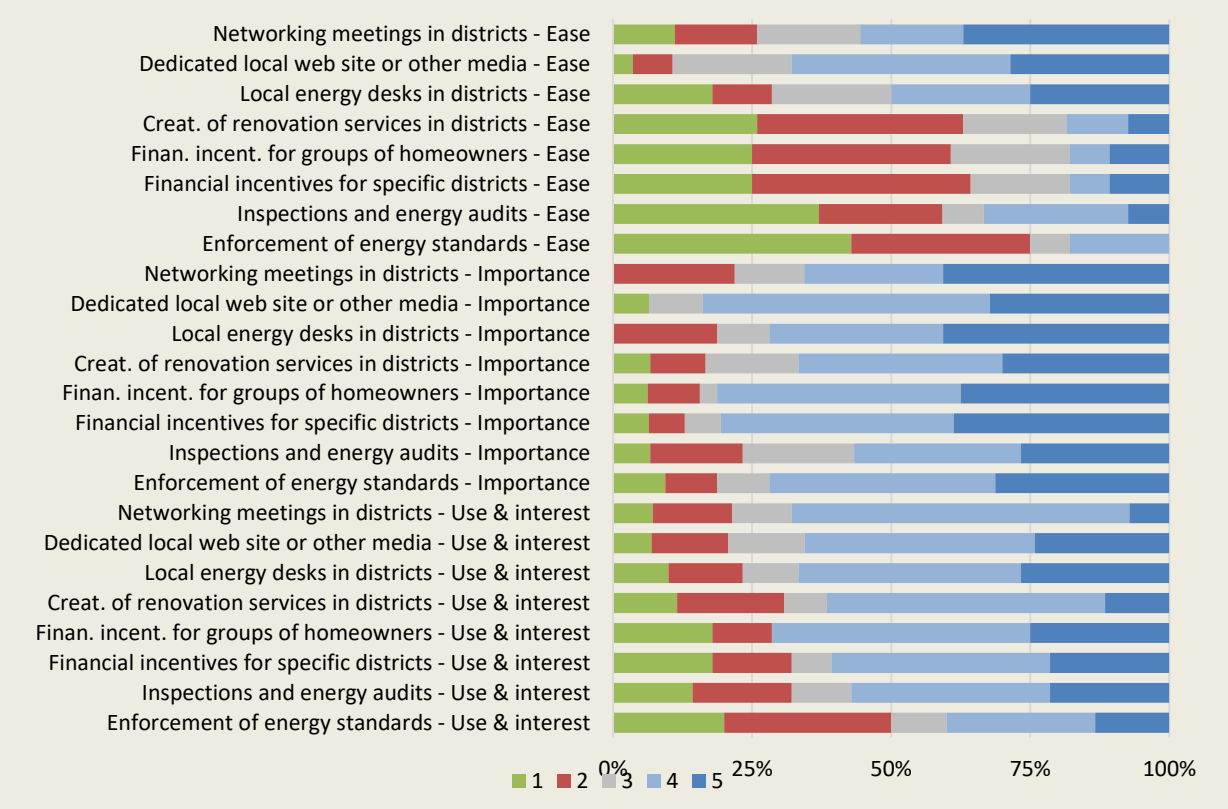

Figure 2. Relative frequency of stakeholder scores attached to specific policy instruments [10].

Expert workshops and interviews – which included local authority officials - confirmed interest of stakeholders to use or develop regulations - such as mandatory energy standards and inspections -, financial incentives for district stakeholders and for groups of homeowners, renovation services and energy desks, digital communication and network meetings in districts. Regulations are relatively less valued compared to other instruments, but all instruments are generally considered important. The ease of implementation of the instruments in the current context is questioned by a majority of the interviewees. Communication instruments are considered the easiest to implement and enforcement strategies the most difficult. Findings from the comparison between policy and non-policy actors' perspectives show that policy actors tend to declare more experience and interest with policy instruments than non-policy actors. Non-policy actors find it more interesting to use and develop financial incentives and inspections for specific districts, which policy actors find harder to develop than non-policy actors.

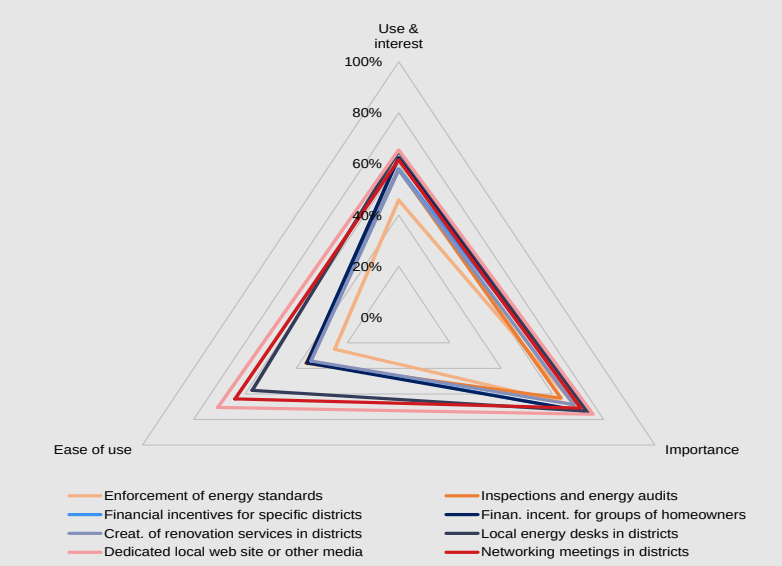

Figure 3. Stakeholder scores on importance, ease of use and current use (or interest to develop) for the proposed policy instruments. Example figure from [10].

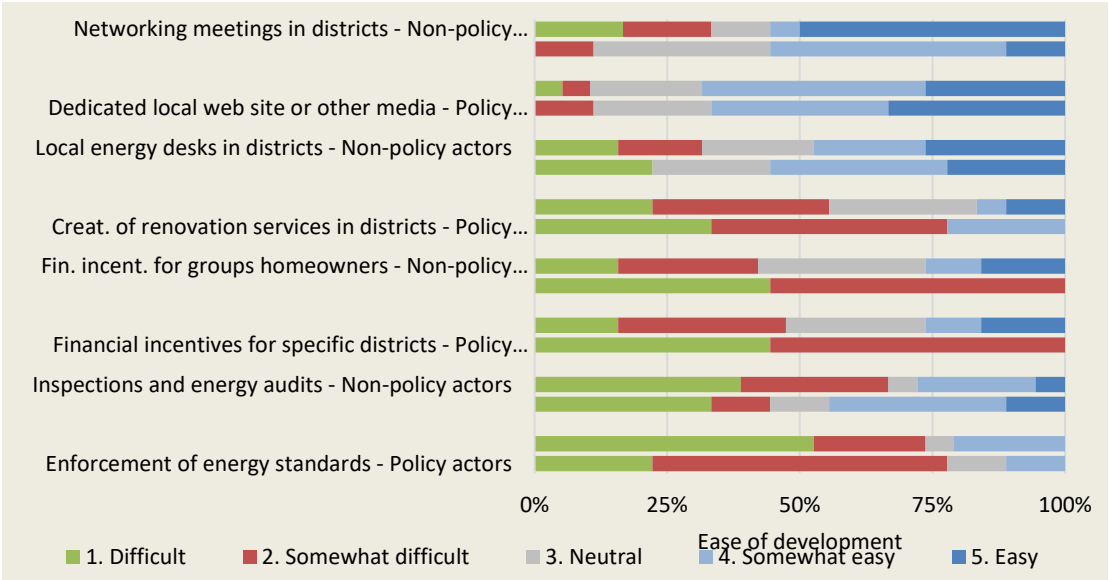

Figure 4. Relative frequency of stakeholder scores on the ease of developing the proposed policy instruments, distinguishing policy and non-policy actors viewpoints. Example figure from [10].

The qualitative findings from the interviews confirm that renovations at district level including energy efficiency and renewable energy can benefit from adapted or improved regulations, although these might be somewhat difficult to introduce. A few even consider regulations as the only approach that can ensure a sufficiently swift energy transition to comply with policy targets. Incentives, communication and facilitation of organisational processes also need to be adapted to support renovations at district level including energy efficiency and renewable energy systems.

Interviewees confirm that local compliance of (national) regulations can be strengthened and that local and regional plans and infrastructure might help the development of renovations including energy efficiency and renewable energy at district level. However, the local action can also be hindered by lack of collaboration between policy levels and lack of supporting national legislation. Concessions provided by local authorities to operators of district heating systems are an additional opportunity for ensuring the use of synergies with energy efficiency measures.

Furthermore, the need for specific energy and innovation grants, subsidies, loans, financial guarantees and tax benefits for district energy renovation came forward, especially to address current market failures. Interviewees also emphasize the need for financial solutions for specific target groups such as vulnerable households and assemblies of homeowners.

Regarding communication and facilitation, interviewees emphasized the need to organize structured stakeholder dialogues and transparent negotiations that engage citizens, possibly also in co-creation activities and by emphasizing cross-cutting issues for district development instead of a pure energy focus. Authorities were recommended to make better use of demo districts and to create homeowner awareness in target areas. An important tool in this context was considered to make available online maps to building owners which make them aware of opportunities to connect to current or future renewable energy grids. Overall good quality-oriented project management of renovations at district level were considered important to be assured as well as the engagement of specific process coaches, specialized staff and consultancy desks.

4. Discussion

Policy instruments that support renovation at district level might support upscaling renovation of building envelopes and renewable energy grids. There are many country and district differences when it comes to existing and future action for energy renovation at district level including energy efficiency and renewable energy, both regarding national and local ambitions as well as available policy instruments. There are also vast differences between district types, building characteristics within districts, ownership structure (various customer segments to be targeted at the same time) and available energy sources and grids in different districts. Our results include viewpoints from local authority officials and show that next to urban planning approaches [12,13,6] and existing policy instruments on the building level [2,3] it might be promising to develop policy instruments that specifically focus on (activating) groups of people such as co-owners of buildings and vulnerable target groups.

At this point, countries and districts can learn from each other's' successes and failures regarding the development of policy instruments to support energy grid changes and building renovations at district level. For example, Austrian policy shows that district management offices can take care of energy-related renovation (e.g. Vienna). Belgium showed that incentives targeting groups of homeowners have to be carefully designed as they do not necessarily target districts. The German KfW 432 programme (especially in combination with the Urban Development Funding (Städtebauförderung) and regional and local add-ons) already incentivizes and stimulates integrated energy renovation management in districts while mobilizing homeowners and stakeholders. Dutch innovation policy facilitates private actors to come up with integrated renovation concepts. Spanish policy tries to stimulate deep renovations and rehabilitation of rural areas, which is challenging regarding the past and current climate of recession. Swiss cantonal subsidy programs show that a switch to renewable energy based heating systems and also more advanced voluntary energy performance labels, such as Minergie for buildings or 2000-Watt areas for districts, can be used.

Local authorities can be drivers of district projects, but they also largely depend on available national and regional structures, initiatives, support and resources, while they need to deal with a possibly inconsistent national framework for renovation at district level. For example, the Swiss constitution grants local authorities the right to set autonomous goals and adopt related measures to the extent that this is granted or at least not restricted by superior law, and Swiss communes and cities have far-reaching competences for example to make a switch to renewable energy mandatory when a heating system is replaced, which is often not the case in other countries.

5. Conclusion

We found that building renovations at district level including energy efficiency and renewable energy systems are considered to be useful by many types of stakeholders for accelerating the energy transition, although efforts still need to be made to make them locally, socially and economically attractive. As the renovation scale can affect the cost-effectiveness of the solutions, a district approach also comes with many new social challenges – compared to single building renovations - that can even hinder adoption of energy efficiency and renewable energy systems, particularly when a national policy framework for district action is not yet present or fully developed. Furthermore, encouraging the development of energy grids is already on its own a complex task, and combination with energy efficiency measures on building envelopes is not straightforward in this context.

Ineffective multi-level governance, low relative advantage for some stakeholders, lack of good examples, an incompatible legal or national framework, a single focus on individual buildings, and high complexity are risks that can hinder adoption of energy efficiency and renewable energy systems at district level. However, renovations at district level could motivate large groups of citizens and new policy, management and business opportunities arise for an integrated approach mastering different components of current urban transformation challenges. All these findings reinforce the need for neighbourhood and district renovation scopes, as sustained by the European Renovation wave.

We hereby presented and evaluated a set of policy instruments that can be considered promising, suitable and important to support achieving renovations at district level combining energy efficiency and renewable energy systems. Their respective most promising combination and integration in existing structures (also beyond energy renovation) is a challenge that must be tackled place by place and to a proper extent. Countries, as well as cities, can learn from each other and accelerate building renovations, as there are already many frontrunners and good practices.

Acknowledgements

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References

[1] European Commission 2020 A Renovation Wave for Europe – greening our buildings, creating jobs, improving lives, Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, SWD(2020) 550 final, COM(2020) 662 final https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1603122220757&uri=CELEX:52020DC0662, accessed 20/04/2022

[2] EU Directive EU 2018/844 of the European Parliament and of the Council of 30 May 2018 amending Directive 2010/31/EU on the energy performance of buildings and Directive 2012/27/EU on energy efficiency (Text with EEA relevance) PE/4/2018/REV/1 http://data.europa.eu/eli/dir/2018/844/oj accessed 03/03/2021

[3] EU Directive 2018/2002 of the European Parliament and of the Council of 11 December 2018 amending Directive 2012/27/EU on energy efficiency (Text with EEA relevance) PE/54/2018/REV/1, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2018.328.01.0210.01.ENG accessed 20/04/2022
[4] European Commission 2021 Preliminary analysis of the long-term renovation strategies of 13 Member States https://ec.europa.eu/energy/sites/default/files/swd_commission_preliminary_analysis_of_member_state_ltrss.pdf, accessed 01/04/2022
[5] BPIE 2020 A Review of EU Member States' Long-term Renovation Strategies (Brussels: Buildings Performance Institute Europe) https://www.bpie.eu/wp-content/uploads/2020/10/LTRS-Assessment_Final.pdf accessed 01/04/2022
[6] European Commission 2020 The new Leipzig Charter The transformative power of cities for the common good https://ec.europa.eu/regional_policy/en/newsroom/news/2020/12/12-08-2020-new-leipzig-charter-the-transformative-power-of-cities-for-the-common-good accessed 14/04/2022
[7] Almeida M 2019 Cost-effective Building Renovation at District Level Combining Energy Efficiency and Renewables Annex 75 Factsheet https://annex75.iea-ebc.org/ accessed 20/04/2022
[8] Terés-Zubiaga J, Bolliger R, Almeida MG, Barbosa R, Rose J, Thomsen K E, Montero E and Briones-Llorente R 2020 Cost-effective building renovation at district level combining energy efficiency & renewables – Methodology assessment proposed in IEA EBC Annex 75 and a demonstration case study *Energy & Buildings* **224** 110280 https://doi.org/10.1016/j.enbuild.2020.110280
[9] Rose J, Thomsen KE, Domingo-Irigoyen S, Bolliger R, Venus D, Konstantinou T, Mlecnik E, Almeida M, Barbosa R, Terés-Zubiaga J, Johansson E, Davidsson H, Conci M, Dalla Mora T, Ferrari S, Zagarella F, Sanchez Ostiz A, San Miguel-Bellod J, Monge-Barrio A and Hidalgo-Betanzos J M 2021 Building renovation at district level – Lessons learned from international case studies *Sustainable Cities and Society* **72** 103037 https://doi.org/10.1016/j.scs.2021.103037
[10] Mlecnik E, Hidalgo-Betanzos J M, Meyer H, Lynar U S G zu, Konstantinou T, Meijer F, Haase M, Bolliger R, Johansson E, Davidsson H, Peters-Anders J, Gugg B, Almeida M and Domenico A (2022) Policy instruments for cost-effective building renovation at district level combining energy efficiency and renewables (Annex 75, D.1.), International Energy Agency, Energy in Buildings and Communities Technology Collaboration Programme, submitted for publication
[11] Triple-A 2021 Encouraging energy-efficient home renovations (Interreg 2 Seas project) http://www.triple-a-interreg.eu/ accessed 30/05/2022
[12] Reinhard J 2014 Energy Efficient Communities: Case Studies and Strategic Guidance for Urban Decision Makers (Annex 51) Report produced within the IEA's Energy in Buildings and Communities Programme Annex 51
[13] Strasser H 2018 Annex 63 Implementation of energy strategies in communities – putting energy in urban planning processes (IEA EBC Annex 63) International Energy Agency/ SIR – Salzburg Institute for Reginal Planning and Housing Austria http://annex63.iea-ebc.org/www.annex63.org/index.html